

BENTOMAT[®] DIRECT SHEAR TESTING SUMMARY

The following table summarizes the direct shear testing on Bentomat that has been performed by CETCO and other laboratories on a project-specific basis for the past several years. This data will give the designer some general information about the shear strength of commonly used GCL interfaces and should be the first step in evaluating a proposed liner system where slope stability is a concern.

The variables in any direct shear test are numerous, including specimen preparation; hydration pressures, liquids, and sequencing, and rate of shear, and others. Test results will vary accordingly, which is partially accountable for the wide range of data reported even for similar interfaces.

This data is for informational purposes only and is not intended to replace project-specific interface testing, which CETCO emphatically recommends. CETCO makes no warranty as to the usefulness of the data. Individual test reports for most of the summarized data can be provided upon request.

BENTOMAT GCL DIRECT SHEAR DATABASE

TR-114BM

Lab ¹	Report Date	GCL Tested	Interface Tested ²		Testing Conditions					Mohr-Coulomb Failure Envelopes ⁶				Comments ⁸	
										Peak		Large Displacement ⁷			
			GCL	Other	Normal Stresses (psi)	Hydration. ³		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)		
psf	hrs														
Internal Shear Results															
SGL	Oct-08	200R	Internal		75		200	24	48 hrs @ load	0.04	23 °	0	7 °	0	
SGL	Apr-09	ST	Internal		1.4		200	24	48 hrs @ load	0.004	73 °	0	--	--	sliding at gripping surface
PGL	Feb-08	ST	Internal		1.4		48 hrs @ load			0.004	77 °	0	--	--	sliding at gripping surface
SGL	Jun-06	ST	Internal		34.7		200	24	24 hrs	0.04	27 °	0	7 °	0	
SGL	Jun-06	ST	Internal		34.7		200	24	24 hrs	0.04	31 °	0	8 °	0	
SGL	Jun-06	ST	Internal		34.7		200	24	24 hrs	0.04	38 °	0	9 °	0	
SGL	Jun-06	ST	Internal		34.7		200	24	24 hrs	0.04	31 °	0	7 °	0	
SGL	Jun-06	ST	Internal		34.7		200	24	24 hrs	0.04	42 °	0	9 °	0	
SGL	Jun-06	ST	Internal		34.7		200	24	24 hrs	0.04	34 °	0	7 °	0	
SGL	Jun-06	ST	Internal		34.7		200	24	24 hrs	0.04	26 °	0	7 °	0	
SGL	Oct-06	ST	Internal		34.7		200	24	24 hrs	0.04	37 °	0	8 °	0	
PGL	Feb-03	ST	Internal		5 20 45	432	7 days	48 hrs @ load	0.004	22.7 °	1146	19.3 °	676		
SGL	Aug-01	ST	Internal		10 30 50	24 hrs @ load			0.001	32 °	1645	13 °	160		
SGL	Aug-01	ST	Internal		10 30 50	24 hrs @ load			0.001	39 °	1050	15 °	220		
SGL	Aug-01	ST	Internal		10 30 50	24 hrs @ load			0.001	38 °	1105	17 °	190		
SGL	Apr-09	ST	Internal		75		200	24	48 hrs @ load	0.004	32 °	0	8 °	0	

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										Peak		Large Displacement ⁷		
			GCL	Other	Normal Stresses (psi)	Hydration: ³ psf hrs		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)	
SGI	Jan-09	ST	Internal		75	200	24	48 hrs @ load	0.04	32 °	0	7 °	0	
SGI	Feb-08	ST	Internal		75	200	24	48 hrs @ load	0.04	38 °	0	8 °	0	
SGI	Jan-07	ST	Internal		75	200	24	48 hrs @ load	0.004	33 °	0	11 °	0	
SGI	Oct-98	ST	Internal		36 75 145	167	6 days	step-load	0.00006	22 °	1545	6 °	731	
SGI	Jan-09	ST	Internal		150	200	24	48 hrs @ load	0.04	24 °	0	6 °	0	
SGI	Feb-01	ST	Internal		50 100 150	48 hrs @ load			0.04	15 °	1195	8 °	-310	
SGI	Feb-01	ST	Internal		150 250 400	48 hrs @ load			0.04	11 °	2875	5 °	1080	
SGI	Feb-01	ST	Internal		50 to 400 psi	48 hrs @ load			0.04	12 °	2095	6 °	275	
SGI	Apr-09	DN	Internal		1.4	200	24	48 hrs @ load	0.004	75 °	0	--	--	sliding at gripping surface
SGI	Feb-08	DN	Internal		1.4	24 hrs @ load			0.004	77 °	0	--	--	sliding at gripping surface
TRI	Apr-03	DN	Internal		0.7 1.7 3.5	24 hrs @ load			0.04	47.3 °	2813	26.6 °	392	
SGI	Jun-01	DN	Internal		1.0 2.6 6.5	72	120	step-load	0.004	46 °	215	42 °	120	
PGL	Jul-06	DN	Internal		7 21	200	48	24 hrs @ load	0.04	14.5 °	2326	0.5 °	1436	
SGI	Sep-08	DN	Internal		5 25 50	200	24	24 hrs	0.04	34 °	1155	7 °	425	
SGI	Sep-08	DN	Internal		5 25 50	200	24	24 hrs	0.04	33 °	1260	8 °	425	
SGI	Sep-08	DN	Internal		5 25 50	200	24	24 hrs	0.04	35 °	990	8 °	430	

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											Peak		Large Displacement ⁷			
			GCL	Other	Normal Stresses (psi)			Hydration. ³ psf hrs		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)		adhesion (psf)
SGI	Sep-08	DN	Internal		5	25	50	200	24	24 hrs	0.04	32 °	1185	8 °	380	
SGI	Sep-08	DN	Internal		5	25	50	200	24	24 hrs	0.04	35 °	1120	7 °	385	
SGI	Sep-08	DN	Internal		5	25	50	200	24	24 hrs	0.04	33 °	1190	8 °	380	
SGI	Sep-08	DN	Internal		5	25	50	200	24	24 hrs	0.04	34 °	1150	7 °	410	
SGI	Sep-00	DN	Internal		10	25	50	24 hrs @ load			0.001	31 °	1000	12 °	770	GCL peel = 45 lbs
SGI	Sep-00	DN	Internal		10	25	50	24 hrs @ load			0.001	30 °	1155	10 °	170	GCL peel = 27 lbs
SGI	Mar-01	DN	Internal		15	30	60	48 hrs @ load			0.04	24 °	1655	7 °	180	
SGI	Apr-09	DN	Internal		75			200	24	48 hrs @ load	0.004	33 °	0	8 °	0	
SGI	Feb-08	DN	Internal		75			200	24	48 hrs @ load	0.04	40 °	0	8 °	0	
SGI	Jan-07	DN	Internal		75			200	24	48 hrs @ load	0.004	36 °	0	12 °	0	
SGI	Jun-08	DN	Internal		150			200	24	48 hrs @ load	0.04	28 °	0	7 °	0	
SGI	Sep-02	DN	Internal		34.7	150		As-received (21.6%)			0.04	23 °	1715	13 °	1100	
SGI	Apr-09	SDN	Internal		1.4			200	24	48 hrs @ load	0.004	76 °	0	--	--	sliding at gripping surface
GT	Nov-08	SDN	Internal		1.4			200	24	48 hrs @ load	0.004	74 °	0	--	--	
SGI	Aug-09	SDN	Internal		10	30	70	144	48	24 hrs @ load	0.004	34 °	1248	6 °	1020	
SGI	Apr-09	SDN	Internal		75			200	24	48 hrs @ load	0.004	37 °	0	8 °	0	

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Lab ¹	Report Date	GCL Tested	Interface Tested ²		Testing Conditions					Mohr-Coulomb Failure Envelopes ⁶				Comments ⁸
										Peak		Large Displacement ⁷		
			GCL	Other	Normal Stresses (psi)	Hydration. ³ psf hrs		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)	
SGI	Feb-08	SDN	Internal		75	200	24	48 hrs @ load	0.04	34 °	0	7 °	0	
SGI	Jan-07	SDN	Internal		75	200	24	48 hrs @ load	0.004	36 °	0	12 °	0	
TRI	Apr-08	SDN	Internal		90	24 hrs @ load			0.04	39.1 °	0	15.5 °	0	
SGI	Oct-06	SDN	Internal		5 20 90	115	24	step-load	0.004	22 °	755	5 °	435	
TRI	Oct-07	SDN	Internal		41.7 83.3 125	200	24	step-load	0.04	27.2 °	680	17.1 °	0	
SGI	Jun-03	SDN	Internal		150 250 400	48 hrs @ load			0.04	12 °	1390	5 °	1715	
SGI	Aug-08	STM	Internal		1.4	48 hrs @ load			0.004	73 °	0	--	--	sliding at gripping surface
SGI	Feb-01	CL	Internal		139	144	21 days	168 hrs @ load	0.04	25 °	0	7 °	0	
Interface Shear Results (with geomembranes)														
TRI	May-09	200R		40-mil smooth LLDPE	1 2 4	24 hrs @ load			0.04	11.2 °	4	10 °	4	
SGI	Mar-05	ST	W	60-mil text. HDPE	0.7	48 hrs @ load			0.04	34 °	0	25 °	0	co-extruded textured geomembrane
PGL	Feb-01	ST	white NW	40-mil text. LLDPE	0.35 0.69 1.39	50	24	24 hrs @ load	0.04	29 °	196	16 °	176	co-extruded textured geomembrane
SGI	Dec-08	ST	W	60-mil text. HDPE	2.8	200	24	48 hrs @ load	0.04	40 °	0	26 °	0	co-extruded textured geomembrane
SGI	Apr-07	ST	W	30-mil PVC	1 2 3	100	24	24 hrs @ load	0.04	16 °	5	15 °	5	smooth side
SGI	Apr-07	ST	NW	30-mil PVC	1 2 3	100	24	24 hrs @ load	0.04	14 °	0	14 °	0	smooth side
SGI	Jan-06	ST	W	30-mil PVC	1 2 3	200	48	--	0.04	15 °	5	15 °	0	faillie side
SGI	Jan-96	ST	W	30-mil PVC	2 4 6	24 hrs @ load			0.04	17 °	24	17 °	24	

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												Peak		Large Displacement ⁷		
			GCL	Other	Normal Stresses (psi)			Hydration. ³ psf hrs		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)	
PGL	Jun-01	ST	NW	40-mil text. LLDPE	1.3	2.6	6.3	72	72	step-load	0.001	24.8 °	230	18.9 °	203	embossed textured geomembrane
TRI	Apr-08	ST		60-mil text. HDPE	0.7	3.5	6.9	100	24	step-load	0.04	23.9 °	107	16.4 °	62	co-extruded textured geomembrane
TRI	Feb-06	ST	NW	60-mil text. HDPE	1.7	3.5	6.9	200	48	24 hrs @ load	0.04	26.7 °	0	23.9 °	0	co-extruded textured geomembrane
TRI	Sep-05	ST	NW	60-mil text. HDPE	2	5	10	24 hrs @ load			0.04	33.8 °	223	20.2 °	181	embossed textured geomembrane
TRI	Aug-06	ST	W	60-mil text. HDPE	3.5	6.9	13.9	48 hrs @ load			0.04	28 °	50	23.6 °	9	embossed textured geomembrane
TRI	Aug-09	ST	W	60-mil text. HDPE	6.9	13.9	20.8	24 hrs @ load			0.04	21.5 °	291	15.1 °	129	embossed textured geomembrane
PGL	Feb-03	ST	W	80-mil text. HDPE	5	20	45	432	7 days	48 hrs @ load	0.004	22.5 °	83	13.6 °	130	embossed textured geomembrane
PGL	Mar-06	ST	W	80-mil text. HDPE	5	20	45	432	7 days	48 hrs @ load	0.004	20 °	379	13.3 °	413	embossed textured geomembrane
PGL	Mar-07	ST	NW	60-mil text. HDPE	13.9	27.8	55.6	500	6 days	24 hrs @ load	0.04	18.1 °	70.5	12.2 °	222.5	
EMCON	Jun-05	ST	NW	60-mil text. HDPE	13.9	34.7	69.4	300	48	24 hrs @ load	0.04	20.6 °	426	8.1 °	738	embossed textured geomembrane
SGI	Jun-09	ST	W	60-mil text. HDPE	75			200	24	48 hrs @ load	0.04	24 °	0	10 °	0	co-extruded textured geomembrane
SGI	Jun-09	ST	W	60-mil text. HDPE	75			200	24	48 hrs @ load	0.04	23 °	0	11 °	0	co-extruded textured geomembrane
SGI	Dec-08	ST	W	60-mil text. HDPE	75			200	24	48 hrs @ load	0.04	22 °	0	11 °	0	co-extruded textured geomembrane
EMCON	Jul-05	ST	NW	60-mil text. HDPE	13.9	55.6	83.3	300	48	24 hrs @ load	0.04	17.8 °	404.9	6.4 °	463.6	
JLT	Oct-04	ST		60-mil text. HDPE	20	45	90	108	3 days	step-load	0.001	24.3 °	323	15.3 °	243	co-extruded textured geomembrane
TRI	Apr-08	ST		60-mil text. HDPE	6.9	69.4	139	100	24	step-load	0.04	18.9 °	0	7.6 °	192	co-extruded textured geomembrane

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											Peak		Large Displacement ⁷			
			Normal Stresses (psi)	Hydration. ³ psf hrs		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)					
SGI	2003	ST	W	60-mil text. HDPE	139			Hydrated		0.04	14.5 °	0	10.1 °	0	Encapsulated design	
SGI	Sep-09	ST	NW	60-mil text. HDPE	13.9	139	200	24	step-load	0.04	21 °	550	8 °	590	co-extruded textured geomembrane	
SGI	Sep-09	ST	W	60-mil text. HDPE	13.9	139	200	24	step-load	0.04	18 °	575	8 °	385	co-extruded textured geomembrane	
VE	Jun-09	ST		60-mil text. LLDPE	39	78	156	96 hrs @ load		0.04	18 °	990	4 °	1600	embossed textured geomembrane	
SGI	2003	ST	W	60-mil text. HDPE	208		Hydrated		0.04	13.7 °	0	9.8 °	0	Encapsulated design		
GA	Oct-08	ST		60-mil smooth LLDPE	75	150	300	24 hrs @ load		0.04	15 °	662	4.2 °	3355	GCL internal failure @ 300 psi	
SGI	Mar-09	DN	white NW	60-mil text. HDPE	1	2	3	240	48	24 hrs @ load	0.04	33 °	65	27 °	30	embossed textured geomembrane
SGI	Mar-09	DN	white NW	60-mil text. HDPE	1	2	3	240	48	24 hrs @ load	0.04	36 °	50	26 °	45	embossed textured geomembrane
SGI	Mar-09	DN	white NW	60-mil text. HDPE	1	2	3	240	48	24 hrs @ load	0.04	35 °	60	27 °	40	embossed textured geomembrane
SGI	Jan-06	DN	black NW	30-mil PVC	1	2	3	200	48	--	0.04	15 °	0	15 °	0	faillie side
PGL	Jun-01	DN	black NW	Textured HDPE	1.3	2.6	6.3	216	72	step-load	0.001	21.4 °	225	18.5 °	184	2-inch displacement
PGL	Jun-01	DN	black NW	Textured HDPE	1.3	2.6	6.3	72	72	step-load	0.001	24.8 °	230	18.9 °	203	2-inch displacement
SGI	May-01	DN	black NW	40-mil text. LLDPE	1	2.6	6.5	72	120	step-load	0.004	32 °	5	28 °	5	embossed textured geomembrane
PGL	Mar-08	DN	white NW	60-mil text. HDPE	5	7	9	24 hrs @ load		0.04	22.5 °	309	22.5 °	305		
EMCON	May-03	DN		Textured HDPE	13.9		Partially hydrated b/w 2 GMs with 0.3" holes		0.04	18.8 °	0	14.3 °	0	Encapsulated b/w GMs with 0.3" holes		
GT	Aug-07	DN	black NW	60-mil text. HDPE	18		Hydrated		0.04	26.6 °	0	18.5 °	0	embossed textured geomembrane		

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												Peak		Large Displacement ⁷		
			Normal Stresses			Hydration. ³		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)			
GCL	Other	(psi)	psf	hrs	(deg)	(psf)	(deg)			(psf)						
SGI	Feb-00	DN	black NW	60-mil text. HDPE	7	14	35	72	72	step-load	0.0016	29 °	370	18 °	375	
PGL	Jul-05	DN		60-mil text. HDPE	13.9	27.8	41.7	48 hrs @ load			0.04	17.2 °	359	15.4 °	275	
SGI	Jul-03	DN	black NW	60-mil text. HDPE	10.4	20.8	41.7	48 hrs @ load			0.04	27 °	60	18 °	25	co-extruded textured geomembrane
SGI	Feb-08	DN	black NW	60-mil text. HDPE	15	30	50	1440	48	24 hrs @ load	0.04	27 °	530	16 °	390	co-extruded textured geomembrane
PGL	Jan-05	DN	white NW	80-mil text. HDPE	15	30	50	1440	48	24 hrs @ load	1	17.2 °	151	8.5 °	303	
PGL	Feb-07	DN		60-mil text. HDPE	10	30	60	24 hrs @ load			0.02	24 °	254	22.6 °	65	
PGL	Dec-06	DN		60-mil text. HDPE	10	30	60	24 hrs @ load			0.02	19.2 °	155	15.5 °	147	
PGL	Dec-06	DN		60-mil text. HDPE	10	30	60	24 hrs @ load			0.02	18.5 °	342	18.6 °	108	
SGI	Jul-02	DN	white NW	60-mil text. HDPE	6.9	34.7	69.4	125	24	48 hrs @ load	0.04	23 °	520	12 °	380	co-extruded textured geomembrane
SGI	Jun-03	DN		40- and 60-mil textured HDPE	69.4			Partially hydrated b/w 2 GMS with 0.25" holes			0.04	29 °	0	21 °	0	Encapsulated b/w GMS with 0.25" holes
EMCON	Jun-03	DN		Textured HDPE	69.4			Partially hydrated b/w 2 GMS with 0.3" holes			0.04	19.6 °	0	6.5 °	0	Encapsulated b/w GMS with 0.3" holes
SGI	Feb-08	DN	white NW	60-mil text. HDPE	25	50	75	1440	48	24 hrs @ load	0.04	23 °	570	10 °	420	co-extruded textured geomembrane
SGI	Feb-08	DN	white NW	60-mil text. HDPE	25	50	75	1440	48	24 hrs @ load	0.04	28 °	345	13 °	415	co-extruded textured geomembrane
PGL	Mar-08	DN	black NW	60-mil text. HDPE	25	50	75	24 hrs @ load			0.04	23.6 °	0	22.2 °	0	
SGI	Apr-09	DN	black NW	60-mil text. HDPE	75			200	24	step-load	0.04	30 °	0	14 °	0	embossed textured geomembrane
TRI	Oct-07	DN	black NW	60-mil textured HDPE	25	50	75	24 hrs @ load			0.04	22.7 °	52	11.9 °	409	co-extruded textured geomembrane

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												Peak		Large Displacement ⁷			
			GCL	Other	Normal Stresses (psi)			Hydration. ³		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)		
psf	hrs																
TRI	Oct-07	DN	black NW	60-mil textured HDPE	25	50	75	24 hrs @ load			0.04	10.8 °	1516	5.4 °	1194	co-extruded textured geomembrane	
TRI	Oct-07	DN	black NW	60-mil textured HDPE	25	50	75	24 hrs @ load			0.04	20.4 °	455	9.6 °	644	co-extruded textured geomembrane	
PGL	Mar-07	DN	white NW	60-mil text. LLDPE	25	50	75	24 hrs @ load			0.04	23 °	0	22 °	0	embossed textured geomembrane	
PGL	Mar-06	DN	white NW	60-mil text. LLDPE	25	50	75	24 hrs @ load			0.04	20 °	334	8.6 °	1216	embossed textured geomembrane	
GA	Mar-02	DN	black NW	80-mil text. LLDPE	20.8	41.7	83.3	288	24	10 minutes	0.04	21.7 °	789	11.7 °	559	co-extruded textured geomembrane	
GA	Mar-02	DN	black NW	60-mil text. LLDPE	20.8	41.7	83.3	288	24	10 minutes	0.04	21.5 °	361	6.7 °	880.5	embossed textured geomembrane	
PGL	Apr-07	DN		60-mil text. HDPE	20.8	41.7	83.3	48 hrs @ load			0.04	20.9 °	0	12.3 °	545		
JLT	May-07	DN	black NW	60-mil text. HDPE	20	45	90	115	4 days	step-load	0.005	22.1 °	77	13 °	239	co-extruded textured geomembrane	
SGI	May-08	DN	black NW	60-mil text. HDPE	1.4 100			200	24	48 hrs @ load	0.04	24 °	130	12 °	80	co-extruded textured geomembrane	
TRI	Jul-08	DN		60-mil text. HDPE	139			144	24	step-load	0.04	22 °	0	10.2 °	0	co-extruded textured geomembrane	
VE	May-03	DN		40- and 60-mil text. HDPE	13.9	27.8	55.6	111	250	48	16 hrs @ load	0.04	24 °	260	10 °	650	Encapsulated design
SGI	Jul-09	DN	black NW	60-mil text. HDPE	13.9	27.8	55.6	111	144	24	24 hrs @ load	0.04	22 °	560	11 °	585	co-extruded textured geomembrane
VE	May-03	DN		40- and 60-mil text. HDPE	27.8 111			As-received (25% moisture)			0.04	26 °	0	16 °	140	Encapsulated design	
EMCON	Nov-02	DN		60-mil text. HDPE	27.8	55.6	111	48 hrs @ load			0.04	26 °	0	16.8 °	0	co-extruded textured geomembrane	
SGI	2003	DN		40- and 80-mil HDPE	5	20	80	120	wetted conditions (not fully hydrated)			0.04	27 °	150	19 °	95	Encapsulated design (slip b/w 80-mil + GCL)
SGI	2003	DN		40- and 80-mil HDPE	5	20	80	120	wetted conditions (not fully hydrated)			0.04	29 °	270	19 °	120	Encapsulated design (slip b/w 80-mil + GCL)

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Lab ¹	Report Date	GCL Tested	Interface Tested ²		Testing Conditions							Mohr-Coulomb Failure Envelopes ⁶				Comments ⁸	
												Peak		Large Displacement ⁷			
			Normal Stresses				Hydration. ³		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)			
GCL	Other	(psi)				psf	hrs										
SGI	2003	DN		40- and 80-mil HDPE	5	20	80	120	wetted conditions (not fully hydrated)		0.04	28 °	140	20 °	20	Encapsulated design (slip b/w 80-mil + GCL)	
SGI	2003	DN		40- and 80-mil HDPE	5	20	80	120	wetted conditions (not fully hydrated)		0.04	29 °	145	19 °	50	Encapsulated design (slip b/w 80-mil + GCL)	
SGI	2003	DN		40- and 80-mil HDPE	5	20	80	120	wetted conditions (not fully hydrated)		0.04	27 °	580	20 °	70	Encapsulated design (slip b/w 80-mil + GCL)	
SGI	2003	DN		40- and 80-mil HDPE	5	20	80	120	wetted conditions (not fully hydrated)		0.04	27 °	235	19 °	95	Encapsulated design (slip b/w 80-mil + GCL)	
SGI	Jun-08	DN	black NW	60-mil text. HDPE	41.7	83.3	125		24 hrs @ load		0.04	26 °	105	15 °	620	2-inch displacement	
SGI	Jun-08	DN	black NW	60-mil text. HDPE	41.7	83.3	125		24 hrs @ load		0.04	25 °	165	13 °	870	2-inch displacement	
SGI	Jun-08	DN	black NW	60-mil text. HDPE	41.7	83.3	125		24 hrs @ load		0.04	26 °	110	16 °	485	2-inch displacement	
SGI	Jun-08	DN	black NW	60-mil text. HDPE	41.7	83.3	125		24 hrs @ load		24 hrs @ load	0.04	26 °	20	16 °	350	2-inch displacement
SGI	Jun-08	DN	black NW	60-mil text. HDPE	41.7	83.3	125		24 hrs @ load		0.04	26 °	50	15 °	165	2-inch displacement	
SGI	Jul-08	DN	black NW	60-mil text. HDPE	125				24 hrs @ load		24 hrs @ load	0.04	25.1 °	0	16.4 °	0	2-inch displacement
SGI	Aug-03	DN	white NW	60-mil text. HDPE	41.7	83.3	125		0	24	48 hrs @ load	0.04	22 °	835	15 °	40	2-inch displacement
SGI	Aug-03	DN	white NW	60-mil text. HDPE	41.7	83.3	125		0	24	48 hrs @ load	0.04	25 °	315	16 °	255	2-inch displacement
TRI	Jun-09	DN		60-mil text. HDPE	20.8	55.6	104	139	125	20	24 hrs @ load	0.04	24.9 °	0	8.7 °	617	embossed textured geomembrane
GTX	Apr-07	DN		HDPE	34.7	69.4	104	139	48 hrs @ load			0.04	26 °	588	12 °	398	
SGI	Feb-00	DN	black NW	60-mil text. HDPE	7 to 150 psi				72	72	step-load	0.0016	22 °	760	11 °	710	
SGI	Oct-02	DN		80-mil text. HDPE	15	25	100	150	1440	48	24 hrs @ load	0.04	23 °	120	14 °	330	co-extruded textured geomembrane

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Lab ¹	Report Date	GCL Tested	Interface Tested ²		Testing Conditions							Mohr-Coulomb Failure Envelopes ⁶				Comments ⁸	
												Peak		Large Displacement ⁷			
			Normal Stresses			Hydration. ³		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)				
GCL	Other	(psi)	psf	hrs													
SGI	Nov-02	DN		80-mil text. HDPE	25	100	150	As-received (25% moisture)			0.04	24 °	335	18 °	120	co-extruded textured geomembrane	
SGI	Feb-00	DN	black NW	60-mil text. HDPE	35	100	150	72	72	step-load	0.0016	21 °	1305	9 °	1105		
GTX	Jul-05	DN	white NW	60-mil text. HDPE	69.4	111	167	24 hrs @ load			0.04	16 °	102	5 °	707		
SGI	Apr-09	DN	black NW	60-mil text. HDPE	75	150	250	400	200	24	step-load	0.04	18 °	2450	5 °	2220	embossed textured geomembrane
SGI	Jul-09	DN	black NW	60-mil text. HDPE	150	250	400	200	24	step-load	0.04	17 °	3705	4 °	3435	GCL internal failure @ 400 psi	
TRI	Mar-07	SDN	black NW	40-mil text. LLDPE	0.7	2.8	4.9	100	24	24 hrs @ load	0.04	32.6 °	148	22.5 °	83	embossed textured geomembrane	
TRI	Mar-07	SDN	black NW	60-mil text. HDPE	0.7	2.8	4.9	24 hrs @ load			0.04	39.3 °	31	26.7 °	44	embossed textured geomembrane	
TRI	Mar-07	SDN	black NW	50-mil text. LLDPE	0.7	2.8	4.9	24 hrs @ load			0.04	44.3 °	97	44.5 °	0	structured GM/Drainage Liner	
TRI	Mar-07	SDN	black NW	40-mil text. LLDPE	0.7	2.8	4.9	100	24	24 hrs @ load	0.04	32.6 °	148	22.5 °	83	embossed textured geomembrane	
SGI	May-03	SDN	black NW	40-mil text. HDPE	0.7	3.5	6.9	100	24	24 hrs @ load	0.04	30 °	25	19 °	20	co-extruded textured geomembrane	
TRI	Jul-08	SDN	Black NW	60-mil text. HDPE	3.5	13.9	31.3	62.5	200	24	step-load	0.04	15.8 °	243	6.5 °	303	co-extruded textured geomembrane
TRI	May-07	SDN		60-mil text. HDPE	6.9	41.7	83.3	250	24	step-load	0.04	23.8 °	467	10.6 °	365	embossed textured geomembrane	
SGI	Oct-06	SDN	white NW	60-mil text. HDPE	5	20	90	115	24	step-load	0.04	23 °	695	8 °	425	co-extruded textured geomembrane	
PGL	Apr-04	SDN		60-mil text. HDPE	25	60	100	24 hrs @ load			0.04	24.7 °	308	14.1 °	155		
PGL	Sep-04	SDN		60-mil text. HDPE	25	60	100	24 hrs @ load			0.04	22.6 °	0	14.5 °	203		
PGL	Sep-04	SDN		60-mil text. HDPE	25	60	100	24 hrs @ load			0.04	18.9 °	387	15.2 °	333		

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Lab ¹	Report Date	GCL Tested	Interface Tested ²		Testing Conditions						Mohr-Coulomb Failure Envelopes ⁶				Comments ⁸	
											Peak		Large Displacement ⁷			
			Normal Stresses (psi)	Hydration. ³ psf hrs		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)					
PGL	Sep-04	SDN		60-mil text. HDPE	25	60	100	24 hrs @ load		0.04	26.4 °	0	24.1 °	0		
PGL	Sep-04	SDN		60-mil text. HDPE	25	60	100	24 hrs @ load		0.04	22.6 °	0	14.5 °	203		
PGL	Sep-04	SDN		60-mil text. HDPE	25	60	100	24 hrs @ load		0.04	18.9 °	387	15.2 °	333		
PGL	Sep-04	SDN		60-mil text. HDPE	25	60	100	24 hrs @ load		0.04	26.4 °	0	24.1 °	0		
EMCON	Dec-02	SDN	white NW	60-mil text. HDPE	27.8	55.6	111	220	24	24 hrs @ load	0.04	21.2 °	0	11.4 °	0	co-extruded textured geomembrane
TRI	Oct-07	SDN	black NW	60-mil text. HDPE	41.7	83.3	125	200	24	step-load	0.04	22.7 °	0	10.5 °	0	embossed textured geomembrane
GA	Oct-08	SDN		60-mil smooth LLDPE	75	150	300	24 hrs @ load		0.04	18.3 °	662	12.4 °	2246		
SGI	Jun-03	SDN		80-mil text. LLDPE	150	250	400	48 hrs @ load		0.04	11 °	540	7 °	325	co-extruded textured geomembrane	
TRI	Jun-07	STM	white NW	60-mil text. LLDPE	100			200	24	step-load	0.04	20.1 °	0	11.5 °	0	co-extruded textured geomembrane
SGI	May-07	STM	white NW	40-mil text. LLDPE	100			200	24	48 hrs @ load	0.04	24 °	0	10 °	0	co-extruded textured geomembrane
SGI	Aug-09	STM	white NW	60-mil text. LLDPE	39	78	156	96 hrs @ load		0.04	21 °	720	9 °	1185	embossed textured geomembrane	
Interface Shear Results (with soil)																
ARD	Aug-01	ST	W	SOIL	2.3	3	3.75	24 hrs @ load		0.04	38.7 °	0	38.7 °	0	CIDCO Pit sand	
ARD	Aug-01	ST	NW	SOIL	2.3	3	3.75	24 hrs @ load		0.04	36.5 °	0	36.5 °	0	CIDCO Pit sand	
ARD	Aug-01	ST	W	SOIL	2.3	3	3.75	24 hrs @ load		0.04	38.1 °	0	38.1 °	0	Michigan Pit sand	
ARD	Aug-01	ST	NW	SOIL	2.3	3	3.75	24 hrs @ load		0.04	36.7 °	0	35.6 °	0	Michigan Pit sand	
STS	Jan-00	ST	W	SOIL	1	2	4	48 hrs @ load		0.04	28.6 °	293	28 °	241	Topsoil: 62 pcf, 15%	

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Lab ¹	Report Date	GCL Tested	Interface Tested ²		Testing Conditions							Mohr-Coulomb Failure Envelopes ⁶				Comments ⁸	
												Peak		Large Displacement ⁷			
			GCL	Other	Normal Stresses (psi)			Hydration. ³		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)		
psf	hrs																
TRI	Nov-03	ST	NW	SOIL	1.4	3.6	7.1	24 hrs @ load			0.04	17.7 °	139	18.2 °	135	Soil: 99 pcf, 17%	
TRI	Oct-05	ST	W	SOIL	2	5	10	24 hrs @ load			0.04	23.2 °	134	19.9 °	117	Soil: 114 pcf, 14%	
TRI	Aug-09	ST	NW	SOIL	7.4	15.4	23.5	24 hrs @ load			0.04	28.1 °	5	25.9 °	0		
PGL	Mar-07	ST	W	SOIL	13.9	27.8	55.6	500	6 days	24 hrs @ load	0.04	21.4 °	279	8.7 °	926	Soil: 110 pcf, 15.2%	
TRI	Jul-08	ST	NW	SOIL	3.5	13.9	55.6	24 hrs @ load			0.04	28.7 °	176	16.1 °	474	Soil: 94 pcf, 14.2%	
TRI	Nov-06	ST	NW	SOIL	8.1	27.8	55.7	24 hrs @ load			0.04	21.6 °	0	21.6 °	0	Soil: 110 pcf, 12.4%	
SGI	Jul-04	ST	W	SOIL	1	20	40	60	24 hrs @ load			0.04	23 °	145	22 °	120	
SGI	Aug-08	ST	NW	SOIL	10	35	60	100	24	24 hrs @ load	0.04	7 °	475	7 °	360		
SGI	Feb-04	ST	W	SOIL	20.8	52.1	79.9	72	7 days	step-load	0.0016	9.9 °	930	6.7 °	500	Clay	
SGI	Feb-04	ST	W	SOIL	20.8	52.1	79.9	72	7 days	step-load	0.0016	10 °	1025	7 °	590	Clay	
EMCON	Jul-05	ST	W	SOIL	13.9	55.6	83.3	300	48	24 hrs @ load	0.04	15.6 °	561.1	15.6 °	435.8		
NTH	2005	ST	NW	SOIL	25	50	100	144	24	--	0.04	11.9 °	0	7.9 °	0	Clay: 95 pcf, 8%	
SGI	Apr-06	ST	W	SOIL	20.8	79.9	139	72	7 days	step-load	0.004	12 °	905	--	--	Clay: GCL internal failure at 139 psi load	
JLT	Jan-03	DN		SOIL	0.3	0.7	1.4	24 hrs @ load			0.04	36.3 °	2	29 °	1	Angular gravel	
CETCO	Mar-00	DN	black NW	SOIL	0.7	1.4	2.1	24 hrs @ load			0.04	25.2 °	315	--	--	SP, 108 pcf, 11%	
GTX	Jul-05	DN	black NW	SOIL	0.7	1.4	2.8	24 hrs @ load		24 hrs @ load	0.04	31 °	60	18 °	27		

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Lab ¹	Report Date	GCL Tested	Interface Tested ²		Testing Conditions							Mohr-Coulomb Failure Envelopes ⁶				Comments ⁸
												Peak		Large Displacement ⁷		
			Normal Stresses			Hydration. ³		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)			
(psi)			psf	hrs	(deg)	(psf)	(deg)			(psf)						
TRI	Nov-08	DN	white NW	SOIL	0.8	1.6	2.9	24 hrs @ load			0.04	41.1 °	0	28.4 °	29	Soil: 105 pcf, 13.5%
SGI	Nov-08	DN	black NW	SOIL	1	2	3	240	48	24 hrs @ load	0.04	32 °	25	31 °	5	
SGI	Nov-08	DN	black NW	SOIL	1	2	3	240	48	24 hrs @ load	0.04	31 °	25	31 °	5	
TRI	Nov-08	DN	black NW	SOIL	0.7	1.5	3	24 hrs @ load			0.04	18.9 °	70	10.9 °	82	Soil: 105 pcf, 14.1%
PGL	Jun-01	DN	white NW	SOIL	1.3	2.6	6.3	72	72	step-load	0.001	21.2 °	207	21.6 °	184	2-inch displacement; soil: 103 pcf, 17%
PGL	Jun-01	DN	white NW	SOIL	1.3	2.6	6.3	216	72	step-load	0.001	23.2 °	206	20.8 °	194	2-inch displacement; soil: 103 pcf, 17%
SGI	Jun-01	DN	white NW	SOIL	1.0	2.6	6.5	72	120	step-load	0.004	35 °	65	34 °	40	
PGL	Mar-08	DN	black NW	SOIL	5	7	9	24 hrs @ load			0.04	33.6 °	342	33.6 °	337	Soil: 107 pcf, 13.4%
ARD	Oct-05	DN	white NW	SOIL	2	5	9.9	48 hrs @ load			0.04	28.2 °	64	28.4 °	47	Medium to fine silty sand: 117 pcf, 9.5%
ARD	Oct-05	DN	black NW	SOIL	2	5	9.9	48 hrs @ load			0.04	29.3 °	42	29.4 °	38	Medium to fine silty sand: 117 pcf, 9.5%
SGI	Apr-01	DN	black NW	SOIL	1	5	10	48 hrs @ load			0.04	36 °	35	35 °	10	Soil: 124 pcf, 9 %
GT	Aug-07	DN	white NW	SOIL	3	5	10	18	Hydrated		0.04	25.8 °	81	24.3 °	92	Soil: 100 pcf, 19.4%
GT	Aug-07	DN	white NW	SOIL	3	5	10	18	Hydrated		0.04	25.1 °	96	16.1 °	135	Soil: 93 pcf, 20.9%
SGI	Jul-03	DN	white NW	SOIL	10.4	20.8	41.7	48 hrs @ load			0.04	28 °	40	26 °	10	
SGI	Mar-01	DN	white NW	SOIL	55.6			1000	24	24 hrs @ load	0.04	26 °	0	23 °	0	
PGL	Dec-06	DN		SOIL	10	30	60	24 hrs @ load			0.02	32.5 °	491	7.5 °	1319	Soil: 92 pcf, 17.5%

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Lab ¹	Report Date	GCL Tested	Interface Tested ²		Testing Conditions							Mohr-Coulomb Failure Envelopes ⁶				Comments ⁸	
												Peak		Large Displacement ⁷			
			Normal Stresses (psi)			Hydration. ³ psf hrs		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)				
PGL	Dec-06	DN		SOIL	10	30	60			24 hrs @ load		0.02	36.9 °	305	23.2 °	751	
PGL	Aug-04	DN	white NW	SOIL	6.9	41.7	69.4	125	20	16 hrs @ load	0.04	28.6 °	312	15.6 °	854	Soil: 120 pcf, 12%	
PGL	Aug-04	DN	white NW	SOIL	6.9	34.7	69.4	125	20	16 hrs @ load	0.04	20.8 °	177	17.3 °	190	Soil: 114 pcf, 14.9%	
PGL	Aug-04	DN	white NW	SOIL	6.9	41.7	69.4	125	20	16 hrs @ load	0.04	28.6 °	312	15.6 °	854	Soil: 120 pcf, 12%	
PGL	Aug-04	DN	white NW	SOIL	6.9	34.7	69.4	125	20	16 hrs @ load	0.04	20.8 °	177	17.3 °	190	Soil: 114 pcf, 14.9%	
PGL	Mar-06	DN	black NW	SOIL	25	50	75	24 hrs @ load			0.04	32 °	61	32 °	0	Soil: 109 pcf, 14.9%	
PGL	Apr-07	DN		SOIL	20.8	41.7	83.3	48 hrs @ load			0.04	32.2 °	0	31.9 °	0		
PGL	Jul-03	DN		SOIL	3.5	20.8	41.7	83.3	125	24	16 hrs @ load	0.04	22.3 °	320	19 °	322	Soil: 91 pcf, 22%; GCL internal failure at 83 psi
GTX	Apr-07	DN		SOIL	34.7	69.4	104	139	48 hrs @ load			0.04	20 °	1940	-3 °	3247	Brown silty gravel
GTX	Jul-05	DN	black NW	SOIL	69.4	111	167	24 hrs @ load			0.04	11 °	1833	4 °	975	Brown clay with silt: 69 pcf, 45%	
OSU	Jan-05	SDN	white NW	SOIL	0.8			Dry			0.04	40.5 °	0	33.2 °	0	Topsoil: 93 pcf, 18%	
OSU	Jan-05	SDN	white NW	SOIL	0.8			2 days @ load			0.04	36.1 °	0	25.5 °	0	Topsoil: 93 pcf, 37.8%	
OSU	Jan-05	SDN	black NW	FGD	0.8			Dry			0.04	44.8 °	0	41.5 °	0	FGD: 93 pcf, 68.4%	
OSU	Jan-05	SDN	black NW	FGD	0.8			2 days @ load			0.04	38.3 °	0	35.3 °	0	FGD: 93 pcf, 68.4%	
OSU	Jan-05	SDN	white NW	SOIL	0.8			2 days @ load			0.04	36.3 °	0	14.3 °	0	Topsoil: 93 pcf, 38.2%	
JLT	Feb-07	SDN		SOIL	0.7	2.1	12 hrs @ load			0.04	27 °	44	17 °	41	Soil: 116 pcf, 16.4%		

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Lab ¹	Report Date	GCL Tested	Interface Tested ²		Testing Conditions							Mohr-Coulomb Failure Envelopes ⁶				Comments ⁸	
												Peak		Large Displacement ⁷			
			Normal Stresses			Hydration. ³		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)				
(psi)			psf	hrs	Angle (deg)	adhesion (psf)	Angle (deg)			adhesion (psf)							
SGI	2/205	SDN	black NW	COAL REFUSE	0.7	2.8	144	24	24 hrs @ load	0.04	32 °	40	31 °	40	Coal Refuse		
SGI	Jul-06	SDN	black NW	SOIL	0.7	1.4	2.8	24 hrs @ load			0.04	34 °	5	33 °	0	Gravel (34R)	
SGI	Jul-06	SDN	white NW	SOIL	0.7	1.4	2.8	24 hrs @ load			0.04	32 °	30	31 °	10	Fine brown sand	
TRI	Apr-07	SDN	white NW	SOIL	0.9	3.0	5.2	100	24	24 hrs @ load	0.04	25.3 °	108	23.6 °	117	Soil: 103 pcf, 19.6%	
ARD	Jul-03	SDN	white NW	SOIL	2	3.8	5.9	24 hrs @ load			0.04	28.5 °	72	27.7 °	79	Fine brown sand with silt	
ARD	Jul-03	SDN	black NW	SOIL	2	3.8	5.9	24 hrs @ load			0.04	33.5 °	43	33.5 °	43	Fine brown sand with silt	
TRI	Jul-08	SDN	Black NW	SOIL	3.5	13.9	31.3	62.5	100	24	step-load	0.04	19.3 °	587	19.1 °	561	Soil: 112 pcf, 17%
SGI	2/205	SDN	white NW	SOIL	83			144	24	24 hrs @ load	0.04	27 °	0	22 °	0	Compacted Subgrade	
SGI	2/205	SDN	white NW	SOIL	13.9	34.7	55.6	83.3	144	24	24 hrs @ load	0.04	23 °	365	18 °	485	Compacted Subgrade
SGI	Oct-06	SDN	black NW	SOIL	5	20	90	115	24	step-load	0.04	17 °	245	9 °	140	Compacted clay	
TRI	May-07	SDN		SOIL	9.3	52.3	91.6	250	24	step-load	0.04	21.6 °	317	6.6 °	1270	Soil: 102 pcf, 12.9%	
EMCON	Dec-02	SDN	white NW	SOIL	27.8	55.6	111	220	24	24 hrs @ load	0.04	26.8 °	1320	2.7 °	3140	Sand	
TRI	Oct-07	SDN	white NW	SOIL	41.7	83.3	125	200	24	step-load	0.04	28.8 °	0	5.8 °	2935	Soil: 100 pcf, 12.9%	
SGI	Feb-02	CL	smooth plastic	SOIL	0.7	1.4	2.8	24 hrs @ load			0.04	20 °	50	20 °	40	Graded Aggregate Base	
SGI	Feb-02	CL	smooth plastic	SOIL	0.7	1.4	2.8	24 hrs @ load			0.04	18 °	40	16 °	40	Silty sand	
SGI	Feb-02	CL	smooth plastic	SOIL	0.7	1.4	2.8	24 hrs @ load			0.04	19 °	70	18 °	70	Clay	

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Lab ¹	Report Date	GCL Tested	Interface Tested ²		Testing Conditions							Mohr-Coulomb Failure Envelopes ⁶				Comments ⁸
												Peak		Large Displacement ⁷		
			Normal Stresses (psi)			Hydration. ³ psf hrs		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)			
PGL	Dec-05	CL	smooth plastic	SOIL	0.7	1.4	2.8	Interface sprayed with water			0.04	29.6 °	67	24.4 °	54	Clayey sand: 113 pcf, 14%
PGL	Dec-05	CL	smooth plastic	SOIL	0.7	1.4	2.8	Interface sprayed with water			0.04	37 °	14	33 °	8	Silty sand: 115 pcf, 11.5%
PGL	Dec-05	CL	smooth plastic	SOIL	0.7	1.4	2.8	Interface sprayed with water			0.04	25 °	66	18.5 °	71	CL: 102 pcf, 17.5%
PGL	Dec-05	CL	smooth plastic	SOIL	0.7	1.4	2.8	Interface sprayed with water			0.04	22.9 °	78	21.8 °	49	CH: 92.8 pcf, 22.6%
PGL	Dec-05	CL	smooth plastic	SOIL	0.7	1.4	2.8	Interface sprayed with water			0.04	22.9 °	57	22.5 °	58	SP: 106.5 pcf, 5%
SGI	May-00	CL	W	SOIL	0.5	1.0	2.1	24 hrs @ load			0.04	36 °	10	36 °	10	
CETCO	Mar-00	CLT	W	SOIL	0.7	1.4	2.1	24 hrs @ load			0.04	24.9 °	278	--	--	SP, 108 pcf, 11%
CETCO	Feb-00	CLT	20-mil text. HDPE	SOIL	0.7	1.4	2.1	24 hrs @ load			0.04	41.7 °	108	--	--	SP, 108 pcf, 11%
SGI	Mar-01	CLT	20-mil text. HDPE	SOIL	55.6			1000	24	24 hrs @ load	0.04	24 °	0	21 °	0	
Interface Shear Results (with drainage geocomposites, geonets, and geotextiles)																
GT	Dec-00	ST	W	drainage geocomposite	1.4	2.8	4.2	100	24	--	0.04	25 °	0	20.7 °	1	
EMCON	Jul-05	ST	W	drainage geocomposite	13.9	55.6	83.3	300	48	24 hrs @ load	0.04	19.7 °	0	8.3 °	331	
PGL	Sep-03	ST	NW	drainage geocomposite	5	19.4	60 83.3	144	48	24 hrs @ load	0.04	19.8 °	129	13.6 °	164	
PGL	Jul-06	ST	W	geonet	1.5	3	6	24 hrs @ load			0.04	23.5 °	33.5	23.6 °	29	
GT	Dec-00	DN	black NW	drainage geocomposite	1.4	2.8	4.2	100	24	--	0.04	28 °	0	21.9 °	0	
TRI	Sep-06	DN		drainage geocomposite	1.4	2.8	5.6	24 hrs @ load			0.04	30.1 °	14	27.2 °	0	
PGL	Sep-09	DN	white NW	drainage geocomposite	0.35	2.78	6.94	24 hrs @ load			0.04	21.7 °	96	13.8 °	68	

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Lab ¹	Report Date	GCL Tested	Interface Tested ²		Testing Conditions							Mohr-Coulomb Failure Envelopes ⁶				Comments ⁸
												Peak		Large Displacement ⁷		
			GCL	Other	Normal Stresses (psi)			Hydration. ³ psf hrs		Consol. ⁴	SDR ⁵ (in/min)	Angle (deg)	adhesion (psf)	Angle (deg)	adhesion (psf)	
GTX	Oct-00	DN	black NW	drainage geocomposite	10	30	70	144	72	24 hrs @ load	0.04	22 °	144	18 °	0	
GT	Aug-08	DN	white NW	drainage geocomposite	20.8	41.7	83.3	200	24	48 hrs @ load	0.04	28.7 °	152	16.5 °	515	
PGL	Dec-06	DN		Nonwoven geotextile	2	3.5	5	24 hrs @ load			0.04	20.7 °	160	6.3 °	167	
GT	Dec-04	SDN	black NW	drainage geocomposite	0.7	1.4	2.8	Hydrated			0.04	21.6 °	9	17.2 °	10	
TRI	Jun-07	SDN		drainage geocomposite	6.9	41.7	83.3	250	24	step-load	0.04	21.4 °	0	9.5 °	278	
TRI	Oct-07	SDN	white NW	drainage geocomposite	41.7	83.3	125	200	24	step-load	0.04	27.5 °	0	21.6 °	0	
SGI	Jul-06	SDN	white NW	Nonwoven geotextile	0.7	1.4	2.8	24 hrs @ load			0.04	27 °	35	20 °	20	
TRI	Jun-07	CL	smooth plastic	drainage geocomposite	0.7	1.4	2.8	200	24	24 hrs @ load	0.04	19.2 °	33	10.8 °	46	
ATT	Dec-98	CL	smooth plastic	drainage geocomposite	1	2	3	72	48	--	0.04	14 °	72	11.6 °	72	
SGI	Mar-01	CLT	20-mil text. HDPE	drainage geocomposite	55.6			1000	48	24 hrs @ load	0.04	23 °	0	19 °	0	

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Notes:

(1) Laboratories:

ARD = Ardaman and Associates, Orlando FL

ATT = Advanced Terra Testing, inc. Lakewood, CO

CETCO = CETCO, Hoffman Estates, IL

EMCON = Emcon Assoc. (now Shaw Group), Mahwah, NJ

GA = Golder Associates, Atlanta, Georgia

GT = Geotechnics, East Pittsburgh, PA

GTX = Geotesting Express, Boxborough, MA

JLT = J&L Testing, Canonsburg, PA

OSU = Ohio State University, Columbus, OH

PGL = Precision Laboratory, Orange, CA

SGI = SGI Testing Services LLC, Atlanta, GA (formerly GeoSyntec)

STS = STS Consultants, Ltd., Vernon Hills, IL

TRI = TRI Laboratory, Austin, TX

VE = Vector Engineering, Grass Valley, CA

(2) Internal = Failure forced within the GCL (between the geotextiles).

NW = Non-woven geotextile of Bentomat.

W = Woven geotextile of Bentomat.

(3) Hydrated = specimen was soaked under the specified load for the specified duration prior to testing. Hydration methods may vary

Dry = specimen was tested in the as-received moisture (typically 25-30 percent).

Wetted = specimen was partially hydrated.

(4) Consolidation. If the hydration load does not equal the ultimate normal load for shearing, the normal load is increased in steps.

(5) SDR = Shear Displacement Rate.

(6) Mohr-Coulomb failure envelope, $\tau = c_a + \sigma \tan \phi$, determined by a least-squares, "best-fit" straight line through the shear strength-normal stress test results. Two shear strength components are shown: c_a = adhesion and ϕ = friction angle. Caution should be exercised in using these strength parameters for applications involving normal stresses outside the range of the stresses covered. Refer to TR-264 for discussion of cohesion (or adhesion) and friction angle in direct shear tests.

(7) Measured at 3" displacement, unless otherwise noted.

(8) Including information on: geomembrane type; soil type, density, and moisture content; observed GCL internal failure during interface shearing; and any other unique testing conditions.