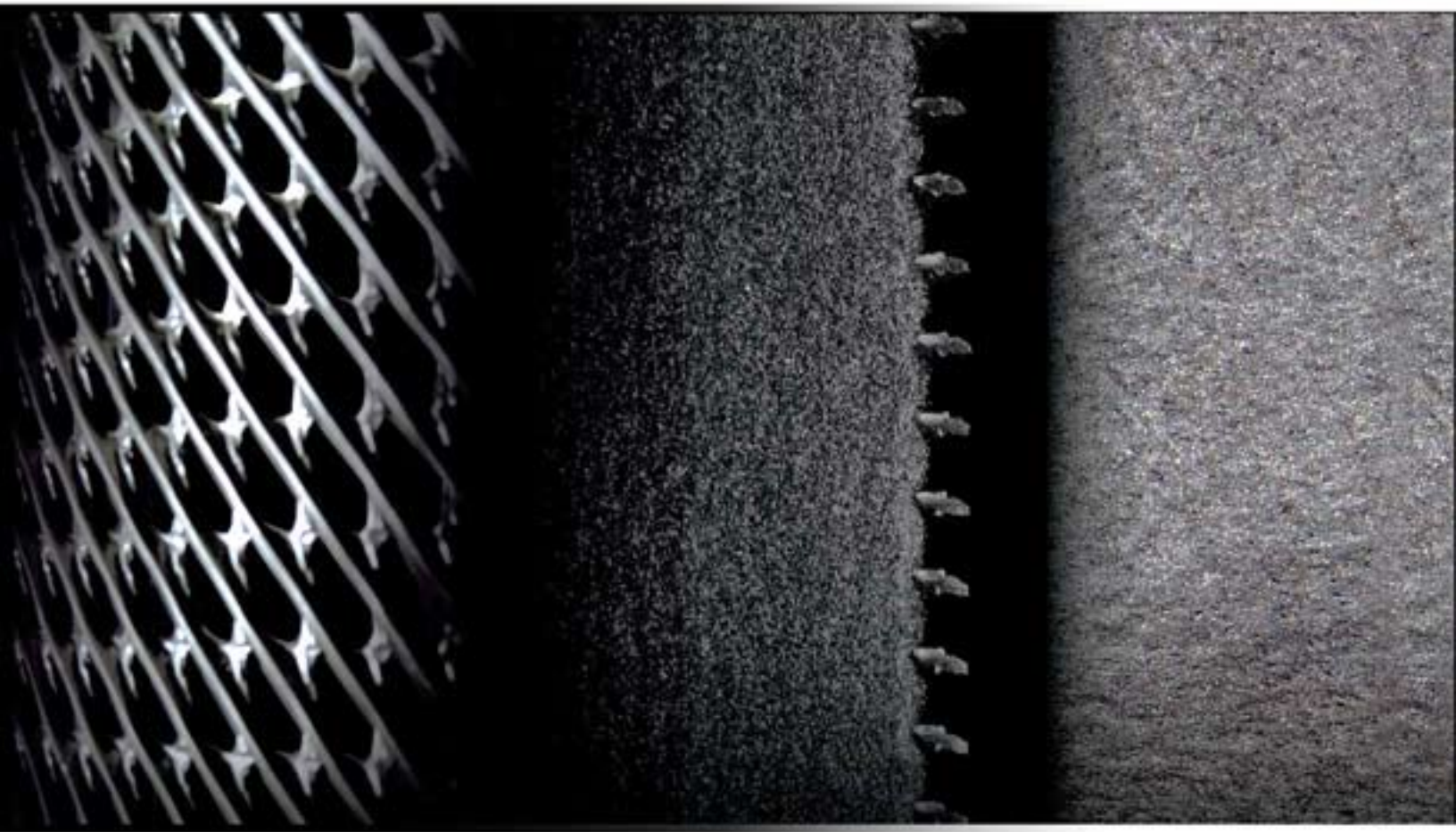


Manufacturing Quality Assurance Manual



Geonet & Geocomposite Products





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1.0 INTRODUCTION

This manual provides an overview of the GSE Manufacturing Quality Assurance Program for GSE geonet and geocomposite products. It is intended for use by GSE's customers to enhance their understanding of the quality system under which GSE geonet and geocomposite products are manufactured.

2.0 COMMITMENT TO QUALITY

GSE is committed to meeting or exceeding customer's requirements and industry standards. This commitment to quality is established through a documented quality management system, continuous employee training, investment in technology and emphasis on process control. GSE has allocated resources to ensure that this commitment to quality translates into the best products and services for its customers.

3.0 MANUFACTURING QUALITY ASSURANCE

GSE has an on-site quality assurance laboratory at each manufacturing facility worldwide. Each facility has a fully equipped, well staffed, dedicated laboratory with strict guidelines to maintain a high level of quality and up-to-the-minute results on GSE's finished products.

GSE has a rigorous set of minimum standards and an effective test program to assure compliance has been established. These procedures and requirements are frequently reviewed and adjusted to assure compliance with current market demands and/or predetermined project specifications. Also raw materials and process parameters are controlled to provide products complying with GSE's minimum characteristics and regulatory standards.

4.0 MANUFACTURING QUALITY ASSURANCE ORGANIZATION

GSE quality assurance department assures that only products meeting GSE and/or the customer's requirements are released for shipment. The quality assurance personnel are directly responsible for monitoring, testing, and providing feedback to the manufacturing department ensuring the production of the specified product quality. Each member of the quality assurance team must participate in detailed training that includes factory exposure.

The GSE quality assurance team consists of the manufacturing quality assurance laboratories, engineering staff and manufacturing personnel. The combination of expertise and experience from these groups provide GSE with the proper tools to maintain the highest level of product quality and customer service in the industry.

5.0 STAFF & SCHEDULING

The quality assurance laboratories are staffed during any manufacturing run. A continuous communication link is maintained between the laboratory and manufacturing personnel, maximizing production efficiency and product quality.



6.0 PRODUCT IDENTIFICATION & DOCUMENTATION

A. Roll Numbering

Each roll of geonet and geocomposite is assigned a unique roll number. The quality assurance laboratory maintains records documenting the raw materials and resulting product quality information.

B. Approval Procedure

Results for each tested roll of product are checked against both GSE and customer's specifications for compliance. The quality assurance laboratory approves those materials that meet these requirements for shipment.

C. Non-Conformance

Material that does not meet GSE's minimum standards or customer's specifications is given a roll number, but is rejected and separated from the approved material. The rejected material is then identified as non-conforming and will not be used. Material that meets GSE's minimum standards, but does not meet a stricter customer's specification will not be allocated to that customer, but will be placed into inventory as a GSE's standard material.

D. Documentation

Quality assurance certificates are generated and supplied for each roll of geonet and geocomposite product to include all relevant quality assurance information about the material. The geotextile components of the drainage geocomposite materials are tracked throughout the manufacturing process. Therefore, traceability reports are available.

7.0 RECORDS RETENTION

GSE maintains reports and/or samples for products produced and sold. Records and/or samples are maintained according to GSE's standard retention policy as outlined below.

MATERIAL	ITEM	YEAR
Raw Materials	Resin Supplier Test Reports and Certifications	≥ 2
	GSE Resin Test Reports	≥ 2
	Resin Sample Retain (Archive)	≥ 2
Geonets & Geocomposites	Raw Test Data (in computer database)	≥ 5
	Quality Control Certificates (in computer database)	≥ 5
	Sample Retain (approximately one square foot)	≥ 5

8.0 TESTING CAPABILITIES

GSE maintains high capacity, state-of-the-art laboratory equipment suitable for performing the procedures (see Appendixes) in Houston, Texas, and Kingstree, South Carolina. Both quality assurance laboratories are accredited by the GAI-LAP Program. The appropriate certificates are maintained for review upon request by authorized parties.

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A. *Routine Testing*

GSE has developed a strict quality assurance program, which exceeds all industry's standard practices and/or customer's specifications. The testing program covers raw materials and finished goods and is adhered to by all GSE's quality assurance laboratories. The laboratory equipment used by GSE represents the most modern equipment available and it meets or exceeds the requirements of all the test standards used. Test frequencies and the number of test specimen per sample are established based on statistical analysis and complexity of procedures.

B. *Other Testing Capabilities*

In addition to routine testing, GSE's laboratories are equipped to perform a wide variety of other tests as required for unusual requests or product development. Further, although the GSE quality assurance laboratories are fully equipped and able to perform most routinely specified tests in the industry, there are some tests that are more economically performed by a dedicated testing facility. GSE believes requirements for such testing should be carefully considered and defined in terms of specific design requirements if they are found to be necessary.

9.0 MATERIAL QUALITY ASSURANCE

GSE has established strict specifications for all raw materials and finished products. Test results must fall within the acceptable limits of GSE and customer's specifications.

A. *Raw Material*

GSE uses two types of raw materials in the manufacture of geonet products: natural resin and masterbatch. Natural resin is the base material that is used to make a geonet. It contains stabilizers to prevent degradation from occurring during and after extrusion. Masterbatch is the term referring to the concentrated carbon black material blended with the natural resin to produce the finished product. The natural resin and masterbatch are blended at the appropriate ratio at the manufacturing stage. The masterbatch can contain other additives depending upon the geonet product to be produced. GSE verifies the properties of each lot of raw material prior to their utilization.

When natural resin is received, samples are taken and subjected to the tests as outlined in Appendix A. All test data are entered into the computer database and checked for accuracy, consistency and compliance with GSE's specifications. The material is not accepted unless all standard test requirements are met and the GSE's test values meet the requirements set forth in the raw material specifications.

The GSE test results for each lot of resin are provided in a separate report upon request. Virgin resin is normally received in railcar lots. If resin is received by other transport and/or in other quantities, an equivalent suitable sampling procedure is provided (i.e. not less than one sample per shipment or one sample for each 50,000 lb, 23,000 kg).

In the production of geocomposite products, geotextiles laminated to one or both sides of the geonet can also be considered a raw material or component of the finished product. Quality assurance certificates are provided for all geotextile rolls bonded to the geocomposite.



B. *Geonet Products*

Geonet drainage products are produced with biplanar geometry. Please see GSE geonet data sheets for test methods, frequencies and specifications in Appendixes B-E.

1. Sampling

A one foot by roll width sample is cut for quality assurance testing from every tenth roll produced. An archive sample is cut from each tested roll. This sample is taken from a random location then labeled and stored for future reference. Test frequencies and the number of test specimen per sample are established based on statistical analysis of the available data and complexity of the test procedures.

2. Evaluation of Results

All data are entered into a computer database for calculation and comparison to established order specifications. If materials do not meet the required GSE's standards and/or the customer's specifications, the manufacturing personnel will appropriately make the adjustments. Only products meeting GSE's standards and/or customer's specifications will be approved for shipment.

3. Reporting

A quality assurance certificate is issued for every roll of finished product. This report identifies the standards on which the GSE approval is based along with the actual test results demonstrated by the material.

C. *Geocomposite Products*

Geocomposite products are produced by heat bonding a geotextile to one or both sides of a geonet product. Sampling evaluation of results and reporting practices are the same as for geonet products with the exception of testing for composite products. Please see GSE geocomposite data sheets for test methods, frequencies and specifications in Appendixes F-O.

D. *Third Party Conformance Sampling*

Some specifications require independent quality assurance and/or conformance testing. GSE can provide assistance with the sampling of products by arranging for the conformance samples to be taken during production. By taking samples during production rather than on site or after production, the customer can be assured that the samples are clean and available for conformance testing in a timely manner.

GSE encourages customers to audit its manufacturing operations, to collect samples and conduct independent conformance testing prior to shipment of materials.

E. *Product Shipping*

It is GSE's policy to ship only products that have been tested and approved. All shipments are packaged according to industry's standard practices and/or customer's specifications. Only approved handling methods are used to move rolls into and out of shipping containers, please see the GSE Installation Quality Assurance Manual for more details.



Appendix A: Minimum Testing Frequencies for GSE Raw Materials

Property	Test Method	Natural Resin
Density	ASTM D 1505	once per resin lot
Melt Flow Index	ASTM D 1238 (190/2.16)	once per resin lot
Carbon Black Content	ASTM D 1603*/4218	N/A
Carbon Black Dispersion	ASTM D 5596	NA

NOTES:

- GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.
- Refer to GSE's ISO 9000 quality manual for raw material requirements for individual products.
- *Modified.



Appendix B: GSE HyperNet Geonet Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE			
			HyperNet	HyperNet HF	HyperNet HS	HyperNet UF
Transmissivity ⁽¹⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²	9.66 (2 x 10 ³)	14.49 (3 x 10 ³)	28.98 (6 x 10 ³)	38.64 (8 x 10 ³)
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	0.94	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	45 (7.9)	55 (9.6)	65 (11.5)	75 (13.3)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	2.0	2.0	2.0	2.0
NOMINAL ROLL DIMENSIONS						
Geonet Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	200 (5)	250 (6.3)	275 (7)	300 (7.6)
Roll Width ⁽²⁾ , ft (m)			15 (4.5)	15 (4.5)	15 (4.5)	15 (4.5)
Roll Length ⁽²⁾ , ft (m)			330 (100)	290 (88)	270 (82)	250 (76)
Roll Area, ft ² (m ²)			4,950 (460)	4,350 (404)	4,050 (376)	3,750 (348)

NOTES:

- ⁽¹⁾Gradient of 0.1, normal load of 10,000 psf, water at 70° F (20° C), between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- ⁽²⁾Roll widths and lengths have a tolerance of ±1%.
- *Modified.



Appendix C: GSE PermaNet HL and UL Geonet Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE	
			PermaNet HL (High Load)	PermaNet UL (Ultra Load)
Transmissivity ⁽¹⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²	19 (4 x 10 ⁻³) ⁽²⁾	24 (5 x 10 ⁻³) ⁽³⁾
Compression Strength, lb/ft ² (kPa)	ASTM D 1621	1/540,000 ft ²	40,000 (1,913)	40,000 (1,913)
Creep Reduction Factor	GRI GC8	1/formulation	1.2 @ 15,000 psf	1.3 @ 25,000 psf
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	100 (17)	100 (17)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	2.0	2.0
NOMINAL ROLL DIMENSIONS				
Geonet Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	270 (6.9)	300 (7.6)
Roll Width ⁽⁴⁾ , ft (m)			15 (4.6)	15 (4.6)
Roll Length ⁽⁴⁾ , ft (m)			200 (60)	200 (60)
Roll Area, ft ² (m ²)			3,000 (278)	3,000 (278)

NOTES:

- ⁽¹⁾This is an index transmissivity value used for quality control under test conditions listed under notes (2) and (3). Contact GSE for a performance transmissivity value for use in design.
- ⁽²⁾Stress = 15,000 psf; gradient = 0.1; time = 15 minutes; and boundary conditions = plate/geonet/plate.
- ⁽³⁾Stress = 25,000 psf; gradient = 0.1; time = 15 minutes; and boundary conditions = plate/geonet/plate.
- ⁽⁴⁾Roll widths and lengths have a tolerance of ±1%.
- *Modified.



Appendix D: GSE HyperNet TRx Geonet Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE
Transmissivity ⁽¹⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²	43.5 (9.0 x10 ⁻³)
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	> 0.94
Tensile Strength ⁽²⁾ , lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	75 (13.3)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	> 2.0
NOMINAL ROLL DIMENSIONS			
Geonet Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	300 (7.6)
Roll Width ⁽³⁾ , ft (m)			15 (4.5)
Roll Length ⁽³⁾ , ft (m)			200 (60)
Roll Area, ft ² (m ²)			3,000 (279)

NOTES:

- ⁽¹⁾This is an index transmissivity value measured at stress = 1,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geonet/plate. Contact GSE for performance transmissivity value for use in design.
- ⁽²⁾Tested in machine direction (MD).
- ⁽³⁾Roll widths and lengths have a tolerance of ±1%.
- *Modified.



Appendix E: GSE PermaNet TRx Geonet Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE
Transmissivity ⁽¹⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²	19.2 (4.0 x10 ⁻³)
Creep Reduction Factor	GRI-GC8	once per formulation	1.2 @ 15,000 psf
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	> 0.94
Tensile Strength ⁽²⁾ , lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	75 (13.3)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	> 2.0
NOMINAL ROLL DIMENSIONS			
Geonet Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	300 (7.6)
Roll Width ⁽³⁾ , ft (m)			15 (4.5)
Roll Length ⁽³⁾ , ft (m)			200 (60)
Roll Area, ft ² (m ²)			3,000 (279)

NOTES:

- ⁽¹⁾This is an index transmissivity value measured at stress = 10,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geonet/plate. Contact GSE for performance transmissivity value for use in design.
- ⁽²⁾Tested in machine direction (MD).
- ⁽³⁾Roll widths and lengths have a tolerance of ±1%.
- *Modified.



Appendix F: GSE FabriNet Geocomposite Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE ⁽¹⁾		
			6 oz/yd ²	8 oz/yd ²	10 oz/yd ²
Geocomposite					
Transmissivity ⁽²⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²			
Double-Sided Composite			0.48 (1 x 10 ⁻⁴)	0.48 (1 x 10 ⁻⁴)	0.43 (9 x 10 ⁻⁵)
Single-Sided Composite			4.83 (1 x 10 ⁻³)	4.83 (1 x 10 ⁻³)	4.34 (9 x 10 ⁻⁴)
Ply Adhesion, lb/in (g/cm)	ASTM D 7005	1/50,000 ft ²	1.0 (178)	1.0 (178)	1.0 (178)
Geonet Core⁽³⁾ - GSE HyperNet					
Transmissivity ⁽²⁾ , gal/min/ft (m ² /sec)	ASTM D 4716		9.66 (2 x 10 ⁻³)	9.66 (2 x 10 ⁻³)	9.66 (2 x 10 ⁻³)
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	45 (7.9)	45 (7.9)	45 (7.9)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	2.0	2.0	2.0
Geotextile^(3,4)					
Mass per Unit Area, oz/yd ² (g/m ²)	ASTM D 5261	1/90,000 ft ²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft ²	160 (710)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft ²	90 (395)	120 (525)	165 (725)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft ²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec ⁻²)	ASTM D 4491	1/540,000 ft ²	1.5	1.3	1.0
Flow Rate, gpm/ft ² (lpm/m ²)	ASTM D 4491	1/540,000 ft ²	110 (4,480)	95 (3,865)	75 (3,050)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	200 (5)	200 (5)	200 (5)
Roll Width ⁽⁵⁾ , ft (m)			14.5 (4.4)	14.5 (4.4)	14.5 (4.4)
Roll Length ⁽⁵⁾ , ft (m)	Double-Sided Composite		270 (82.3)	260 (79.2)	230 (70.1)
	Single-Sided Composite		300 (91.4)	310 (94.5)	290 (88.4)
Roll Area, ft ² (m ²)	Double-Sided Composite		3,915 (364)	3,770 (350)	3,335 (310)
	Single-Sided Composite		4,350 (404)	4,495 (418)	4,205 (391)

NOTES:

- ⁽¹⁾AOS in mm is a maximum value.
- ⁽²⁾Gradient of 0.1, normal load of 10,000 psf, water at 70°F between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- ⁽³⁾Component properties prior to lamination.
- ⁽⁴⁾Refer to geotextile product data sheet for additional specifications.
- ⁽⁵⁾Roll widths and lengths have a tolerance of ±1%.
- *Modified.

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Appendix G: GSE FabriNet HF Geocomposite Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE ⁽¹⁾		
			6 oz/yd ²	8 oz/yd ²	10 oz/yd ²
Geocomposite					
Transmissivity ⁽²⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²			
Double-Sided Composite			2.41 (5 x 10 ⁻⁴)	2.41 (5 x 10 ⁻⁴)	1.45 (3 x 10 ⁻⁴)
Single-Sided Composite			7.24 (1.5 x 10 ⁻³)	7.24 (1.5 x 10 ⁻³)	4.83 (1 x 10 ⁻³)
Ply Adhesion, lb/in (g/cm)	ASTM D 7005	1/50,000 ft ²	1.0 (178)	1.0 (178)	1.0 (178)
Geonet Core⁽³⁾ - GSE HyperNet HF					
Transmissivity ⁽²⁾ , gal/min/ft (m ² /sec)	ASTM D 4716		14.49 (3 x 10 ⁻³)	14.49 (3 x 10 ⁻³)	14.49 (3 x 10 ⁻³)
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	55 (9.6)	55 (9.6)	55 (9.6)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	2.0	2.0	2.0
Geotextile^(3,4)					
Mass per Unit Area, oz/yd ² (g/m ²)	ASTM D 5261	1/90,000 ft ²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft ²	160 (710)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft ²	90 (395)	120 (525)	165 (725)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft ²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec ⁻²)	ASTM D 4491	1/540,000 ft ²	1.5	1.3	1.0
Flow Rate, gpm/ft ² (lpm/m ²)	ASTM D 4491	1/540,000 ft ²	110 (4,480)	95 (3,865)	75 (3,050)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	250 (6.3)	250 (6.3)	250 (6.3)
Roll Width ⁽⁵⁾ , ft (m)			15 (4.5)	15 (4.5)	15 (4.5)
Roll Length ⁽⁵⁾ , ft (m)	Double-Sided Composite		230 (70.1)	230 (70.1)	210 (64.0)
	Single-Sided Composite		260 (79.2)	260 (79.2)	250 (76.2)
Roll Area, ft ² (m ²)	Double-Sided Composite		3,450 (321)	3,450 (321)	3,150 (293)
	Single-Sided Composite		3,900 (362)	3,900 (362)	3,750 (348)

NOTES:

- ⁽¹⁾AOS in mm is a maximum value.
- ⁽²⁾Gradient of 0.1, normal load of 10,000 psf, water at 70°F between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- ⁽³⁾Component properties prior to lamination.
- ⁽⁴⁾Refer to geotextile product data sheet for additional specifications.
- ⁽⁵⁾Roll widths and lengths have a tolerance of ±1%.
- *Modified.

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Appendix H: GSE FabriNet HS Geocomposite Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE ⁽¹⁾		
			6 oz/yd ²	8 oz/yd ²	10 oz/yd ²
Geocomposite					
Transmissivity ⁽²⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²			
Double-Sided Composite			3.4 (7 x 10 ⁻⁴)	3.4 (7 x 10 ⁻⁴)	2.4 (5 x 10 ⁻⁴)
Single-Sided Composite			9.6 (2 x 10 ⁻³)	9.6 (2 x 10 ⁻³)	7.2 (1.5 x 10 ⁻³)
Ply Adhesion, lb/in (g/cm)	ASTM D 7005	1/50,000 ft ²	1.0 (178)	1.0 (178)	1.0 (178)
Geonet Core⁽³⁾ - GSE HyperNet HS					
Transmissivity ⁽²⁾ , gal/min/ft (m ² /sec)	ASTM D 4716		28.98 (6 x 10 ⁻³)	28.98 (6 x 10 ⁻³)	28.98 (6 x 10 ⁻³)
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	65 (11.5)	65 (11.5)	65 (11.5)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	2.0	2.0	2.0
Geotextile^(3,4)					
Mass per Unit Area, oz/yd ² (g/m ²)	ASTM D 5261	1/90,000 ft ²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft ²	160 (710)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft ²	90 (395)	120 (525)	165 (725)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft ²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec ⁻²)	ASTM D 4491	1/540,000 ft ²	1.5	1.3	1.0
Flow Rate, gpm/ft ² (lpm/m ²)	ASTM D 4491	1/540,000 ft ²	110 (4,480)	95 (3,865)	75 (3,050)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	275 (7)	275 (7)	275 (7)
Roll Width ⁽⁵⁾ , ft (m)			15 (4.5)	15 (4.5)	15 (4.5)
Roll Length ⁽⁵⁾ , ft (m)	Double-Sided Composite		212 (64.6)	200 (61.0)	190 (57.9)
	Single-Sided Composite		240 (73.2)	240 (73.2)	230 (70.1)
Roll Area, ft ² (m ²)	Double-Sided Composite		3,180 (295)	3,000 (279)	2,850 (265)
	Single-Sided Composite		3,600 (334)	3,600 (334)	3,450 (321)

NOTES:

- ⁽¹⁾AOS in mm is a maximum value.
- ⁽²⁾Gradient of 0.1, normal load of 10,000 psf, water at 70°F between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- ⁽³⁾Component properties prior to lamination.
- ⁽⁴⁾Refer to geotextile product data sheet for additional specifications.
- ⁽⁵⁾Roll widths and lengths have a tolerance of ±1%.
- *Modified.



Appendix I: GSE FabriNet UF Geocomposite Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE ⁽¹⁾		
			6 oz/yd ²	8 oz/yd ²	10 oz/yd ²
Geocomposite					
Transmissivity ⁽²⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²			
Double-Sided Composite			4.35 (9 x 10 ⁻⁴)	4.35 (9 x 10 ⁻⁴)	3.40 (7 x 10 ⁻⁴)
Single-Sided Composite			14.5 (3 x 10 ⁻³)	14.5 (3 x 10 ⁻³)	9.6 (2 x 10 ⁻³)
Ply Adhesion, lb/in (g/cm)	ASTM D 7005	1/50,000 ft ²	1.0 (178)	1.0 (178)	1.0 (178)
Geonet Core⁽³⁾ - GSE HyperNet UF					
Transmissivity ⁽²⁾ , gal/min/ft (m ² /sec)	ASTM D 4716		38.64 (8 x 10 ⁻³)	38.64 (8 x 10 ⁻³)	38.64 (8 x 10 ⁻³)
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	75 (13.3)	75 (13.3)	75 (13.3)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	2.0	2.0	2.0
Geotextile^(3,4)					
Mass per Unit Area, oz/yd ² (g/m ²)	ASTM D 5261	1/90,000 ft ²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft ²	160 (710)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft ²	90 (395)	120 (525)	165 (725)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft ²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, (sec ⁻²)	ASTM D 4491	1/540,000 ft ²	1.5	1.3	1.0
Flow Rate, gpm/ft ² (lpm/m ²)	ASTM D 4491	1/540,000 ft ²	110 (4,480)	95 (3,865)	75 (3,050)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	300 (7.6)	300 (7.6)	300 (7.6)
Roll Width ⁽⁵⁾ , ft (m)			15 (4.5)	15 (4.5)	15 (4.5)
Roll Length ⁽⁵⁾ , ft (m)	Double-Sided Composite		190 (57.9)	170 (51.8)	170 (51.8)
	Single-Sided Composite		220 (67.1)	220 (67.1)	200 (61.0)
Roll Area, ft ² (m ²)	Double-Sided Composite		2,850 (265)	2,550 (237)	2,550 (237)
	Single-Sided Composite		3,300 (307)	3,300 (307)	3,000 (279)

NOTES:

- ⁽¹⁾AOS in mm is a maximum value.
- ⁽²⁾Gradient of 0.1, normal load of 10,000 psf, water at 70°F between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- ⁽³⁾Component properties prior to lamination.
- ⁽⁴⁾Refer to geotextile product data sheet for additional specifications.
- ⁽⁵⁾Roll widths and lengths have a tolerance of ±1%.
- *Modified.

MOA-DRAWN-RO1/18/110



Appendix J: GSE FabriNet TRx Geocomposite Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE		
			4 oz/yd ²	6 oz/yd ²	8 oz/yd ²
Geocomposite					
Transmissivity ⁽¹⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²			
Double-Sided Composite			12.1 (2.5 x 10 ⁻³)	12.1 (2.5 x 10 ⁻³)	10.1 (2.2 x 10 ⁻³)
Single-Sided Composite			15.7 (3.2 x 10 ⁻³)	15.7 (3.2 x 10 ⁻³)	13.8 (2.9 x 10 ⁻³)
Ply Adhesion, lb/in (g/cm)	ASTM D 7005	1/50,000 ft ²	1.0 (178)	1.0 (178)	1.0 (178)
Geonet Core - GSE HyperNet TRx					
Transmissivity ⁽²⁾ , gal/min/ft (m ² /sec)	ASTM D 4716		43.5 (9.0x 10 ⁻³)	43.5 (9.0x 10 ⁻³)	43.5 (9.0x 10 ⁻³)
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	>0.94	>0.94	>0.94
Tensile Strength ⁽³⁾ , lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	75 (13.3)	75 (13.3)	75 (13.3)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	>2.0	>2.0	>2.0
Geotextile (prior to lamination)⁽⁴⁾					
Mass per Unit Area, oz/yd ² (g/m ²)	ASTM D 5261	1/90,000 ft ²	4	6	8
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft ²	120 (530)	160 (710)	220 (975)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft ²	60 (265)	90 (395)	120 (525)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft ²	70 (0.212)	70 (0.212)	80 (0.180)
Permittivity, (sec ⁻¹)	ASTM D 4491	1/540,000 ft ²	1.8	1.5	1.3
Flow Rate, gpm/ft ² (lpm/m ²)	ASTM D 4491	1/540,000 ft ²	135 (5,495)	110 (4,480)	95 (3,865)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	300 (7.6)	300 (7.6)	300 (7.6)
Roll Width ⁽⁵⁾ , ft (m)			15 (4.5)	15 (4.5)	15 (4.5)
Roll Length ⁽⁵⁾ , ft (m)	Double-Sided Composite		140 (42.7)	130 (39.6)	130 (39.6)
	Single-Sided Composite		160 (48.8)	150 (45.7)	150 (45.7)
Roll Area, ft ² (m ²)	Double-Sided Composite		2,100 (195)	1,950 (175)	1,950 (175)
	Single-Sided Composite		2,400 (223)	2,250 (209)	2,250 (209)

NOTES:

- ⁽¹⁾This is an index transmissivity value measured at stress = 1,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geocomposite/plate. Contact GSE for performance transmissivity value for use in design.
- ⁽²⁾This is an index transmissivity value measured at stress = 1,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geonet/plate. Contact GSE for performance transmissivity value for use in design.
- ⁽³⁾Tested in machine direction (MD).
- ⁽⁴⁾All properties are minimum average values except AOS (mm) which is a maximum value and UV resistance which is a typical value.
- ⁽⁵⁾Roll widths and lengths have a tolerance of ±1%.
- *Modified.

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Appendix K: GSE PermaNet TRx Geocomposite Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE		
			4 oz/yd ²	6 oz/yd ²	8 oz/yd ²
Geocomposite					
Transmissivity ⁽¹⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²			
Double-Sided Composite			4.8 (1 x 10 ⁻³)	4.8 (1 x 10 ⁻³)	4.8 (1 x 10 ⁻³)
Single-Sided Composite			6.2 (1.3 x 10 ⁻³)	6.2 (1.3 x 10 ⁻³)	6.2 (1.3 x 10 ⁻³)
Ply Adhesion, lb/in (g/cm)	ASTM D 7005	1/50,000 ft ²	1.0 (178)	1.0 (178)	1.0 (178)
Geonet Core - GSE PermaNet TRx					
Transmissivity ⁽²⁾ , gal/min/ft (m ² /sec)	ASTM D 4716		19.2 (4.0 x 10 ⁻³)	19.2 (4.0 x 10 ⁻³)	19.2 (4.0 x 10 ⁻³)
Creep Reduction Factor	GRI-GC8	once per formulation	1.2 @ 15,000 psf	1.2 @ 15,000 psf	1.2 @ 15,000 psf
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	>0.94	>0.94	>0.94
Tensile Strength ⁽³⁾ , lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	75 (13.3)	75 (13.3)	75 (13.3)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	>2.0	>2.0	>2.0
Geotextile (prior to lamination)⁽⁴⁾					
Mass per Unit Area, oz/yd ² (g/m ²)	ASTM D 5261	1/90,000 ft ²	4	6	8
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft ²	120 (530)	160 (710)	220 (975)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft ²	60 (265)	90 (395)	120 (525)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft ²	70 (0.212)	70 (0.212)	80 (0.180)
Permittivity, (sec ⁻¹)	ASTM D 4491	1/540,000 ft ²	1.8	1.5	1.3
Flow Rate, gpm/ft ² (lpm/m ²)	ASTM D 4491	1/540,000 ft ²	135 (5,495)	110 (4,480)	95 (3,865)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	300 (7.6)	300 (7.6)	300 (7.6)
Roll Width ⁽⁵⁾ , ft (m)			15 (4.5)	15 (4.5)	15 (4.5)
Roll Length ⁽⁵⁾ , ft (m)	Double-Sided Composite		170 (51.9)	160 (48.8)	160 (48.8)
	Single-Sided Composite		190 (57.9)	180 (54.9)	180 (54.9)
Roll Area, ft ² (m ²)	Double-Sided Composite		2,550 (236)	1,950 (175)	1,950 (175)
	Single-Sided Composite		2,850 (265)	2,700 (251)	2,700 (251)

NOTES:

- ⁽¹⁾This is an index transmissivity value measured at stress = 10,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geocomposite/plate. Contact GSE for performance transmissivity value for use in design.
- ⁽²⁾This is an index transmissivity value measured at stress = 10,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geonet/plate. Contact GSE for performance transmissivity value for use in design.
- ⁽³⁾Tested in machine direction (MD).
- ⁽⁴⁾All properties are minimum average values except AOS (mm) which is a maximum value and UV resistance which is a typical value.
- ⁽⁵⁾Roll widths and lengths have a tolerance of ±1%.
- *Modified.

MOA DRAIN R01/18/10



Appendix L: GSE PermaNet HL Geocomposite Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE		
			6 oz/yd ²	8 oz/yd ²	10 oz/yd ²
Geocomposite					
Transmissivity ⁽¹⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²			
Double-Sided Composite			4.8 (1 x 10 ⁻³)	4.8 (1 x 10 ⁻³)	4.8 (1 x 10 ⁻³)
Single-Sided Composite			6.2 (1.3 x 10 ⁻³)	6.2 (1.3 x 10 ⁻³)	6.2 (1.3 x 10 ⁻³)
Ply Adhesion, lb/in (g/cm)	ASTM D 7005	1/50,000 ft ²	1.0 (178)	1.0 (178)	1.0 (178)
Geonet Core - GSE HyperNet HL					
Transmissivity ⁽²⁾ , gal/min/ft (m ² /sec)	ASTM D 4716		19 (4x10 ⁻³)	19 (4x10 ⁻³)	19 (4x10 ⁻³)
Compression Strength, lbs/ft ² (kPa)	ASTM D 1621	1/540,000 ft ²	40,000 (1,913)	40,000 (1,913)	40,000 (1,913)
Creep Reduction Factor	GRI-GC8	once per formulation	1.2 @15,000 psf	1.2 @15,000 psf	1.2 @15,000 psf
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	100 (17)	100 (17)	100 (17)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	2.0	2.0	2.0
Geotextile (prior to lamination)⁽³⁾					
Mass per Unit Area, oz/yd ² (g/m ²)	ASTM D 5261	1/90,000 ft ²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft ²	160 (710)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft ²	90 (395)	120 (525)	165 (725)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft ²	70 (0.21)	80 (0.180)	100 (0.150)
Permittivity, (sec ⁻²)	ASTM D 4491	1/540,000 ft ²	1.5	1.3	1.0
Flow Rate, gpm/ft ² (lpm/m ²)	ASTM D 4491	1/540,000 ft ²	110 (4,480)	95 (3,865)	75 (3,050)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	270 (6.9)	270 (6.9)	270 (6.9)
Roll Width ⁽⁴⁾ , ft (m)			15 (4.5)	15 (4.5)	15 (4.5)
Roll Length ⁽⁴⁾ , ft (m)	Double-Sided Composite		160 (48.8)	150 (45.7)	140 (42.7)
	Single-Sided Composite		160 (48.8)	150 (45.7)	140 (42.7)
Roll Area, ft ² (m ²)	Double-Sided Composite		2,400 (223)	2,250 (209)	2,100 (195)
	Single-Sided Composite		2,400 (223)	2,250 (209)	2,100 (195)

NOTES:

- ⁽¹⁾This is an index transmissivity value measured at stress = 15,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geocomposite/plate. Contact GSE for performance transmissivity value for use in design.
- ⁽²⁾This is an index transmissivity value measured at stress = 15,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geonet/plate. Contact GSE for performance Transmissivity value in design.
- ⁽³⁾All geotextile properties are minimum average values except AOS (in mm) which is a maximum value (Max ARV); and UV resistance which is a typical value.
- ⁽⁴⁾Roll widths and lengths have a tolerance of ±1%.
- *Modified.

MOA BRAN 801/18/10



Appendix M: GSE PermaNet UL Geocomposite Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE		
			6 oz/yd ²	8 oz/yd ²	10 oz/yd ²
Geocomposite					
Transmissivity ⁽¹⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²			
Double-Sided Composite			4.8 (1 x 10 ⁻³)	4.8 (1 x 10 ⁻³)	4.8 (1 x 10 ⁻³)
Single-Sided Composite			6.2 (1.3 x 10 ⁻³)	6.2 (1.3 x 10 ⁻³)	6.2 (1.3 x 10 ⁻³)
Ply Adhesion, lb/in (g/cm)	ASTM D 7005	1/50,000 ft ²	1.0 (178)	1.0 (178)	1.0 (178)
Geonet Core - GSE HyperNet UL					
Transmissivity ⁽²⁾ , gal/min/ft (m ² /sec)	ASTM D 4716		24 (5x10 ⁻³)	24 (5x10 ⁻³)	24 (5x10 ⁻³)
Compression Strength, lbs/ft ² (kPa)	ASTM D 1621	1/540,000 ft ²	40,000 (1,913)	40,000 (1,913)	40,000 (1,913)
Creep Reduction Factor	GRI-GC8	once per formulation	1.3 @25,000 psf	1.3 @25,000 psf	1.3 @25,000 psf
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	0.94	0.94	0.94
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	100 (17)	100 (17)	100 (17)
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	2.0	2.0	2.0
Geotextile (prior to lamination)⁽³⁾					
Mass per Unit Area, oz/yd ² (g/m ²)	ASTM D 5261	1/90,000 ft ²	6 (200)	8 (270)	10 (335)
Grab Tensile, lb (N)	ASTM D 4632	1/90,000 ft ²	160 (710)	220 (975)	260 (1,155)
Puncture Strength, lb (N)	ASTM D 4833	1/90,000 ft ²	90 (395)	120 (525)	165 (725)
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft ²	70 (0.21)	80 (0.180)	100 (0.150)
Permittivity, (sec ⁻²)	ASTM D 4491	1/540,000 ft ²	1.5	1.3	1.0
Flow Rate, gpm/ft ² (lpm/m ²)	ASTM D 4491	1/540,000 ft ²	110 (4,480)	95 (3,865)	75 (3,050)
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	300 (7.6)	300 (7.6)	300 (7.6)
Roll Width ⁽⁴⁾ , ft (m)			15 (4.5)	15 (4.5)	15 (4.5)
Roll Length ⁽⁴⁾ , ft (m)	Double-Sided Composite		150 (45.7)	140 (42.7)	130 (39.6)
	Single-Sided Composite		150 (45.7)	140 (42.7)	130 (39.6)
Roll Area, ft ² (m ²)	Double-Sided Composite		2,250 (209)	2,100 (195)	1,950 (175)
	Single-Sided Composite		2,250 (209)	2,100 (195)	1,950 (175)

NOTES:

- ⁽¹⁾This is an index transmissivity value measured at stress = 25,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geocomposite/plate. Contact GSE for performance transmissivity value for use in design.
- ⁽²⁾This is an index transmissivity value measured at stress = 25,000 psf; gradient = 0.1; time = 15 minutes; boundary conditions = plate/geonet/plate. Contact GSE for performance transmissivity value for use in design.
- ⁽³⁾All geotextile properties are minimum average values except AOS (in mm) which is a maximum value and UV resistance which is a typical value.
- ⁽⁴⁾Roll widths and lengths have a tolerance of ±1%.
- *Modified.

MOA BRAN 10/17/18/10



Appendix N: GSE BioDrain LP Geocomposite Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE ⁽³⁾	
Geocomposite				
Transmissivity ⁽¹⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²	0.48 (1.0x10 ⁻⁴)	
Ply Adhesion ⁽⁴⁾ , lb/in (g/cm)	ASTM D 7005	1/50,000 ft ²	0.5 (89)	
Geonet Core (Prior to lamination)				
Transmissivity ⁽¹⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²	9.66 (2.0x10 ⁻³)	
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	> 0.94	
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	45 (7.9)	
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	> 2.0	
Geotextile (Prior to lamination)			Nonwoven	LP Woven
Mass per Unit Area	ASTM D 5261	1/90,000 ft ²	6	N/A
Grab Tensile, lb	ASTM D 4632	1/90,000 ft ²	160	230 x 150
Puncture Strength, lb	ASTM D 4833	1/90,000 ft ²	90	100
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft ²	70 (0.212)	70 (0.212)
Permittivity, (sec ⁻¹)	ASTM D 4491	1/540,000 ft ²	1.5	0.1
Flow Rate, gpm/ft ²	ASTM D 4491	1/540,000 ft ²	110	8
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70
NOMINAL ROLL DIMENSIONS				
Geonet Core Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	200 (5)	
Roll Width ⁽²⁾ , ft			14.5 (4.4)	
Roll Length ⁽²⁾ , ft			230 (70)	
Roll Area, ft ² (m ²)			3,335 (310)	

NOTES:

- ⁽¹⁾This is an index transmissivity value measured at stress = 10,000 psf; gradient = 0.1; between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- ⁽²⁾Roll widths and lengths have a tolerance of ±1%.
- ⁽³⁾All properties are minimum average values except AOS (mm) which is a maximum value and UV resistance which is a typical value.
- ⁽⁴⁾Tested and reported on nonwoven/geonet side only.
- *Modified.



Appendix O: GSE BioDrain HP Geocomposite Data Sheet

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE ⁽³⁾	
Geocomposite				
Transmissivity ⁽¹⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²	0.48 (1.0x10 ⁻⁴)	
Ply Adhesion ⁽⁴⁾ , lb/in (g/cm)	ASTM D 7005	1/50,000 ft ²	0.5 (89)	
Geonet Core (Prior to lamination)				
Transmissivity ⁽¹⁾ , gal/min/ft (m ² /sec)	ASTM D 4716	1/540,000 ft ²	9.66 (2.0x10 ⁻³)	
Density, g/cm ³	ASTM D 1505	1/50,000 ft ²	> 0.94	
Tensile Strength (MD), lb/in (N/mm)	ASTM D 5035/7179	1/50,000 ft ²	45 (7.9)	
Carbon Black Content, %	ASTM D 1603*/4218	1/50,000 ft ²	> 2.0	
Geotextile (Prior to lamination)			Nonwoven	HP Woven
Mass per Unit Area	ASTM D 5261	1/90,000 ft ²	6	N/A
Grab Tensile, lb	ASTM D 4632	1/90,000 ft ²	160	230 x 150
Puncture Strength, lb	ASTM D 4833	1/90,000 ft ²	90	100
AOS, US sieve (mm)	ASTM D 4751	1/540,000 ft ²	70 (0.212)	30 (0.542)
Permittivity, (sec ⁻¹)	ASTM D 4491	1/540,000 ft ²	1.5	0.5
Flow Rate, gpm/ft ²	ASTM D 4491	1/540,000 ft ²	110	36
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	once per formulation	70	70
NOMINAL ROLL DIMENSIONS				
Geonet Core Thickness, mil (mm)	ASTM D 5199	1/50,000 ft ²	200 (5)	
Roll Width ⁽²⁾ , ft			14.5 (4.4)	
Roll Length ⁽²⁾ , ft			230 (70)	
Roll Area, ft ² (m ²)			3,335 (310)	

NOTES:

- ⁽¹⁾This is an index transmissivity value measured at stress = 10,000 psf; gradient = 0.1; between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- ⁽²⁾Roll widths and lengths have a tolerance of ±1%.
- ⁽³⁾All properties are minimum average values except AOS (mm) which is a maximum value and UV resistance which is a typical value.
- ⁽⁴⁾Tested and reported on nonwoven/geonet side only.
- *Modified.



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