Section 714. — GEOSYNTHETIC MATERIAL

714.01 Geotextile. Use long-chain synthetic polymers composed of at least 95 percent by mass of polyolefins or polyesters to manufacture geotextile and the threads used in joining geotextile by sewing. Form the geotextile, including selvedges, into a stable network such that the filaments or yarns retain their dimensional stability relative to each other.

Property values, with the exception of apparent opening size (AOS), in these specifications represent minimum average roll value (MARV) in the weakest principal direction (that is average test results of any roll in a lot sampled for conformance or quality assurance testing must meet or exceed the specified values). Values for AOS represent maximum average roll values.

Conform to the following physical requirements:

(a) Separation and stabilization geotextile and geotextile filter. Conform to Table 714-1.

Table 714-1
Separation and Stabilization Geotextile and Geotextile Filter Requirements (1)

Strength and Durability Properties						
Property	**Test Method ASTM**	**Units**	**Class 1**		**Class 2**	
Type of Geotextile			**Woven**	**Nonwoven**	**Woven**	**Nonwoven**
Elongation at break	D4632	%	< 50	≥ 50	< 50	≥ 50
Minimum grab strength	D4632	lb (N)	320 (1420)	200 (890)	250 (1110)	160 (710)
Minimum sewn seam strength	D4632	lb (N)	290 (1290)	180 (800)	220 (980)	140 (620)
Minimum tear strength	D4533	lb (N)	110 (490)	80 (360)	90 (400)	55 (240)
Minimum puncture strength	D6241	lb (N)	620 (2760)	430 (1910)	500 (2220)	310 (1380)
Minimum ultraviolet stability	D4355	%	50% retained strength after 500 hours of exposure			

Hydraulic Properties							
Property	**Test Method ASTM**	**Units**	**Type A**	**Type B**	**Type C**	**Type D**	**Type E**
Minimum permittivity	D4491	s^{-1}	0.7	0.5	0.2	0.1	0.1
Maximum apparent opening size (AOS)	D4751	Sieve size U.S. (mm)	No. 40 (0.425)	No. 40 (0.425)	No. 60 (0.250)	No. 40 (0.425)	No. 70 (0.212)

(1) Do not use woven slit film geotextile.

(b) Paving geotextile. Furnish nonwoven geotextile conforming to Table 714-2.

Table 714-2
Paving Geotextile Requirements

Property	Test Method ASTM	Units	Specifications
Grab strength	D4632	lb (N)	110 (490)
Elongation at break	D4632	%	≥ 50
Asphalt retention	D6140	gal/yd^2 (L/m^2)	See Note (1)
Mass per unit area	D5261	oz/yd^2 (g/m^2)	4 - 6 (135 - 200)
Melting point	D276	ºF (ºC)	300 (150)

(1) Asphalt required to saturate fabric only. Value supplied by manufacturer in material certification. Value does not indicate the asphalt application rate required for construction. Product asphalt retention property must meet the MARV provided by the manufacturer's certification.

714.02 Geocomposite Drain. Furnish a prefabricated geocomposite drain composed of a drainage core and a nonwoven geotextile that permits in-flow from both sides. Geocomposites that only permit in-flow from one side may only be used directly against a concrete surface. Furnish geotextile and drainage core manufactured from long chain synthetic polymers composed at least 95 percent by mass of polypropylene, polyester, polyamide, polyvinyl chloride, polyolefin, or polystyrene. Build the core up in thickness by columns, cones, nubs, cusps, meshes, stiff filaments, or other configurations. Fabricate the core in sheets, panels, or rolls of adequate strength to resist installation stresses and long-term loading conditions.

Property values, with the exception of fungi resistance, in these specifications represent MARV in the weakest principal direction (that is average test results of any roll in a lot sampled for conformance or quality assurance testing must meet or exceed the specified values).

Furnish a nonwoven encapsulating geotextile meeting requirements of Table 714-1. Firmly attach the encapsulating geotextile to the core at the manufacturing plant, so that folding, wrinkling, or other movement cannot occur during handling or after placement. Use a nonwater-soluble adhesive, heat sealing, or other methods recommended by the geotextile manufacturer. Do not use adhesive on areas of the geotextile where flow is intended to occur.

If heat sealing is used, do not weaken the geotextile below the required strength values. Extend the geotextile beyond the core length on all sides sufficiently to encapsulate the core and collector pipe.

Conform to Table 714-3.

Table 714-3
Geocomposite Drain Requirements

Property	Test Method	Units	Specifications		
			Sheet Drain	Strip Drain	
			Type 1	Type 1	Type 2
Transmissivity (flow rate) [1]	ASTM D4716	gal/min/ft (m^3/sec/m)	5.0 (0.0010)	15.0 (0.0031)	20.0 (0.0041)
Compressive strength at yield	ASTM D1621	psi (kPa)	100 (690)	50 (340)	50 (340)
Applied normal compressive stress	ASTM D4716[4]	psi (kPa)	14.5 (100)	1.45 (10)	1.45 (10)
Hydraulic gradient	ASTM D4716[2][3][4]	dimensionless	1.0	0.1	0.1
Fungi resistance	ASTM G21	–	No visible growth		

(1) If core construction separates the flow channel into two or more discrete sections, only the flow rate on one in-flow face is considered in determining the core's acceptability.

(2) 14-inch (350 millimeter) long specimen.

(3) 100-hour seating period.

(4) Rubber membrane between platens and geocomposite.

714.03 Stabilization Geogrid. Furnish biaxial geogrid manufactured using long-chain synthetic polymers composed of at least 95 percent by mass of polyolefins, polyesters, or polyamides. Fabricate the geogrid into a stable network such that the ribs, filaments, or yarns retain their dimensional stability relative to each other, including selvages.

Property values, with the exception of maximum opening size, represent MARV (that is average test results of any roll in a lot sampled for conformance or quality assurance testing must meet or exceed the minimum specified values). The value for maximum opening size represents maximum average roll value.

Conform to Table 714-4.

Table 714-4
Stabilization Geogrid Requirements

Property	Test Method	Specifications[1]
Minimum opening size	N/A[2]	½ in (13 mm)
Maximum opening size	N/A[2]	3 in (75 mm)
Tensile strength at 2% strain	ASTM D6637	400 lb/ft (5.8 kN/m)
Tensile strength at 5% strain	ASTM D6637	800 lb/ft (11.7 kN/m)
Ultimate tensile strength	ASTM D6637	1300 lb/ft (19.0 kN/m)
Junction strength	GRI[3] GG2	25 lb (110 N)
Ultraviolet stability	ASTM D4355	50% retained strength after 500 hours of exposure

(1) Strength values are in the weaker principal direction.
(2) Direct measure with caliper.
(3) Geosynthetic Research Institute.

714.04 Reinforcement Geotextile and Geogrid. Furnish reinforcement geotextile manufactured using long-chain, synthetic polymers, composed at least 95 percent by mass of polyolefins or polyesters. Form the geotextile, including selvedges, into a stable network such that the filaments or yarns retain their dimensional stability relative to each other.

Furnish reinforcement geogrid manufactured as a regular network of integrally-connected longitudinal and transverse polymer tensile elements with a geometry that permits significant mechanical interlock with the backfill. Provide geogrid composed of fibers or ribs that are at least 95 percent by mass polypropylene, polyethylene, or polyester. The geogrid structure must remain dimensionally stable under construction stresses and have a high resistance to damage during construction, to ultraviolet degradation, and to chemical and biological degradation encountered in the soil being reinforced.

Conform to Tables 714-5 and Table 714-6. Property values represent MARV (that is average test results of any roll in a lot sampled for conformance or quality assurance testing must meet or exceed the minimum specified values).

The nominal long-term strength (T_{al}) is based on:

$$T_{al} = T_{ult}/RF$$

where $RF = RF_{ID} \times RF_{CR} \times RF_{D}$.

RF_{ID}, RF_{CR}, and RF_{D} values must be substantiated by evaluation of independent test results by Highway Innovative Technology Evaluation Center (HITEC), AASHTO National Transportation Product Evaluation Program (NTPEP), or an equivalent third party report. Provide a copy of the report to the CO. Determine RF_{ID}, RF_{CR}, and RF_{D} according to the following:

(a) RF_{ID}: Determine the reduction factor for installation damage from the results of full scale construction damage tests conducted according to ASTM D5818. Conduct the tests with a soil having the same maximum particle size, D_{50}, and angularity as the soil to be used for construction. Tests using coarser soils (same or larger maximum particle size and D_{50}) may be an acceptable substitution. The CO will make the final determination as to whether the test data based on the substitute soil is acceptable. Interpolation of RF_{ID} will not be allowed, the results for the coarser soils will be used. The Contractor may elect to perform a test using project specific fill, placement, and compaction techniques and equipment to determine the RF_{ID}. Use a default value of 3.0 if no installation damage testing has been conducted. The minimum value for RF_{ID} is 1.1.

(b) RF_{CR}. Determine the creep reduction factor according to one of the following:

(1) Conventional creep testing according to ASTM D5262; or

(2) A combination of Stepped Isothermal Method (SIM) according to ASTM D6992 and conventional creep testing. Perform testing and determine creep reduction factors for a 75 year design life according to the procedures in Appendix D of FHWA-NHI-10-025, *Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes – Volume II*. If testing has not been conducted, default values for RF_{CR} are 2.5 for polyester polymer, and 5.0 for polypropylene or polyethylene polymer.

(c) RF_D. For polypropylene or polyethylene geosynthetics conforming to the requirements of Table 714-5, a default reduction factor of 1.1 may be used for RF_D. For polyester geosynthetics conforming to the requirements of Table 714-5, a default reduction factor of 1.15 may be used for RF_D if the soil has a pH between 5 and 8; and a reduction factor of 1.3 may be used if the soil pH is between 3 and 5 or between 8 and 9.

Table 714-5
Reinforcement Geotextile and Geogrid Polymer Requirements

Polymer Type	Property	Test Method	Specifications
Polypropylene and polyethylene	Thermo-oxidation resistance	ENV ISO 13438, Method A (polypropylene) or Method B (polyethylene)	Minimum 50% retained strength after 28 days (polypropylene) or 56 days (polyethylene)
Polyester	Hydrolysis resistance	Inherent Viscosity Method ASTM D4603 & GRI (1) GG8	Minimum number average molecular weight (M_n) of 25,000
	"	GRI (1) GG7	Maximum carboxyl end group (CEG) of 30
All polymers	Ultraviolet stability	ASTM D4355	Minimum 70% retained strength after 500 hours of exposure
	Mass per unit area	ASTM D5261	Minimum 8 oz/yd^2 (270 g/m^2)
	Percent post consumer recycled material by mass	Certification of material used	Maximum 0%

(1) Geosynthetic Research Institute.

Table 714-6
Reinforcement Geotextile and Geogrid Strength Requirements

Property	Test Method ASTM	Units	Specifications[1][2]					
			Type I	Type II	Type III	Type IV	Type V	Type VI
Ultimate strength [3] (T_{ult})	D4595 or D6637 [4]	lb/ft (kN/m)	2000 (29.2)	3000 (43.8)	4000 (58.4)	5000 (73.0)	6000 (87.6)	8000 (116.8)
Nominal long-term strength (T_{al})	See Note (5)	lb/ft (kN/m)	1000 (14.6)	1500 (21.9)	2000 (29.2)	2500 (36.5)	3000 (43.8)	4000 (58.4)

(1) For reinforcement geotextile, also meet the Class 1 strength requirements in Table 714-1 and the ultraviolet stability requirements in Table 714-5.

(2) The specified strength is in the principal direction of reinforcement (that is perpendicular to the wall or slope face).

(3) Based on MARV.

(4) ASTM D4595 is for reinforcement geotextile and ASTM D6637 is for geogrid.

(5) See the nominal long-term strength (T_{al}) formula above.

714.05 Geomembrane. Furnish geomembrane that consists of textured (roughened) surface polyvinyl chloride, high density polyethylene, or linear low density polyethylene geomembrane with a thickness of 28.5 to 31.5 mils (0.72 to 0.80 millimeters). Glue or weld seams of the geomembrane to prevent leakage.

Conform to Table 714-7.

Table 714-7
Geomembrane Requirements

Geomembrane Type	Test Method
Polyvinyl chloride (PVC)	ASTM D7176[1]
High density polyethylene (HDPE)	GRI[2] Test Method GM13
Linear low density polyethylene (LLDPE)	GRI[2] Test Method GM17

(1) The minimum average asperity height is 10 mils (0.25 millimeters). Of 10 readings, 8 of 10 must be greater than or equal to 7 mils (0.18 millimeters) and the lowest individual reading must be greater than or equal to 5 mils (0.12 millimeters).

(2) Geosynthetic Research Institute.