985 GEOSYNTHETIC MATERIALS
(REV 10-26-21) (FA 1-11-22) (7-22)

SECTION 985 is deleted and the following substituted:

985-1 Description.

Geosynthetic materials are used for nonstructural and structural applications and shall be either geotextiles (woven or non-woven) or geogrids (woven or extruded) that are used for drainage, erosion control, reinforcement, separation or stabilization.

985-2 General Requirements.

985-2.1 Product Acceptance: All geosynthetic materials shall be one of the products listed on the Department's Approved Product List (APL). Manufacturers seeking evaluation of products for inclusion on the APL shall submit an application in accordance with Section 6 and include the following documentation. A separate application must be submitted for each geotextile type to be evaluated, showing that the product meets the applicable requirements.

Documentation	Requirements
Installation Instructions	Include surface preparations, installation, overlap or sewing instructions, and repair procedures.
NTPEP Audit Report, for Structural Geosynthetic Materials Only	manufacturer's facility included on NTPEP's list of compliant producers.
NTPEP Test Results	Product meets requirements of this Section
Product Label Photo	Displays the Product Name
Product Photo	Displays the significant features of the product as required in this section. Displays location of Manufacturer name and model number.
Technical Data Sheet	Uniquely identifies the product and includes product specifications, reporting requirements, and storage instructions

Products will be listed on the APL according to the geosynthetic application type.

985-2.2 Material Application: In addition to the general requirements, meet the following physical requirements:

985-2.3 Materials: The geosynthetic material shall be a woven, non-woven or extruded material consisting of long-chain polymeric filaments or yarns such as polypropylene, polyethylene, polyester, polyamides or polyvinylidene chloride formed into a stable network such that the filaments or yarns retain their relative position to each

other. The base plastic shall contain stabilizers and/or inhibitors to make the filaments resistant to deterioration due to ultra-violet light, heat exposure and potential chemically damaging environment. The edges of the material shall be selvaged or otherwise finished to prevent the outer yarn from pulling away from the material and shall be free of any treatment which may significantly alter its physical properties.

985-2.4 Physical Requirements: Each geosynthetic material shall be tested by an independent third party in accordance with the methods shown. All testing and reported values, except Apparent Opening Size (AOS), are to be minimum average roll values in the weakest principal direction, unless indicated otherwise in this Section. Values for AOS are maximum average roll values.

985-2.5 Packaging and Labeling: Geosynthetics shall be packaged in a protective covering sufficient to protect the material from temperatures greater than 140 F, sunlight, dirt, and other debris during shipment and storage. The manufacturer's name, product name, style number, roll dimensions and LOT numbers must be clearly labeled on all packaging.

985-2.6 Overlaps and Seams: Overlaps shall be in accordance with the manufacturer's recommendations, unless specified otherwise in the Contract Documents for a particular application. To reduce overlaps, the geosynthetic material may be sewn together in accordance with the manufacturer's recommendations. Sew the seams with thread meeting the chemical requirements and minimum seam strength requirements for the application.

985-3 Drainage.

985-3.1 Application: Select geotextile materials based on the following applications:

Table 985-1
Drainage Applications

Geotextile Type	Description	Standard Plans Index
D-1	Revetment (Special)	
	Rock, Rubble without bedding stone	
	Ditch Pavement (Rubble Riprap) without bedding stone	524-001
D-2	Revetment (Standard)	
	Articulating Block	
	Gabions	524-001
	Rock, Rubble, and Broken Concrete with bedding stone	
	Ditch Pavement (Rubble Riprap) with bedding stone	524-001
	Joint Cover for Mechanically Stabilized Retaining Wall with Coarse Aggregate Backfill	
	Joint Cover for Mechanically Stabilized Retaining Wall Supporting Spread Footing Foundations	
D-3	Underdrain: Types II, III, and V	440-001
	French Drain	443-001

Table 985-1 Drainage Applications		
Geotextile Type	Description	Standard Plans Index
	Sheet Piling Filter	
	Filter Fabric Jacket (Culvert)	430-001
	Box Culvert Joints	400-289 and 400-291
	Concrete Pavement Subdrainage	446-001
	Joint Cover for Mechanically Stabilized Retaining Wall with Sand or Limerock Backfill	
D-4	Slope Pavement	
	Ditch Pavement (Sand-Cement Riprap or Concrete)	524-001
D-5	Separation Geotextile	
	Cast-In-Place Retaining Wall	

985-3.2 Physical Requirements: Materials for drainage applications must be tested in accordance with and meet the following physical requirements:

Table 985-2 Geotextile Selection	
In-situ Soil Type or Drainage Application	Class for Type D1, D2, D3 Materials
< 15% passing a No. 200 Sieve*	a
15% to 50% passing a No. 200 Sieve*	b
> 50% passing a No. 200 Sieve*	c
> 50% passing a No. 200 Sieve* with Plastic Index >7	d
MSE Joint Cover for Sand or Limerock Backfill	e
MSE Joint Cover for Coarse Aggregate Backfill	f
*as per AASHTO T88.	

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Table 985-3 Drainage Geotextiles Test Methods and Requirements for Types D-1, D-2 and D-3			
Property/Test Method	D-1	D-2	D-3
Limitation	Woven Monofilament Geotextiles only	Woven Geotextiles only. No Slit Film Geotextiles	No Slit Film Geotextiles
Minimum Permittivity (Sec -1) per ASTM D4491	D-1a = 0.7 D-1b = 0.2 D-1c = 0.1 D-1d = 0.1 D-1e = 0.25 D-1f = 1.5	D-2a = 0.7 D-2b = 0.2 D-2c = 0.1 D-2d = 0.1 D-2e = 0.25 D-2f = 1.5	D-3a = 0.5 D-3b = 0.2 D-3c = 0.1 D-3d = 0.1 D-3e = 0.7
Maximum AOS (mm, US Sieve No.) per ASTM D4751	D-1a = 0.425 (40) D-1b = 0.250 (60) D-1c = 0.212 (70) D-1d = 0.300 (50) D-1e = 0.212 (70) D-1f = 0.600 (30)	D-2a = 0.425 (40) D-2b = 0.250 (60) D-2c = 0.212 (70) D-2d = 0.300 (50) D-2e = 0.212 (70) D-2f = 0.600 (30)	D-3a = 0.425 (40) D-3b = 0.250 (60) D-3c = 0.212 (70) D-3d = 0.300 (50) D-3e = 0.212 (70)
Minimum Grab Tensile Strength (lbs) per ASTM D4632	315	Woven Monofilament = 248 Other Woven Geotextiles = 315	Elongation <50% = 248 Elongation ≥50% = 158
Mass per Unit Area (oz/sy) per ASTM D5261	Provide Test Result	Provide Test Result	Provide Test Result
Minimum Puncture Strength (lbs) per ASTM D6241	618	Woven Monofilament = 495 Other Woven Geotextiles = 618	Elongation <50% = 495 Elongation ≥50% = 309
Minimum Trapezoidal Tear (lbs) per ASTM D4533	113	Woven Monofilament = 57 Other Woven Geotextiles: = 113	Woven Monofilament = 57 Other Geotextiles: Elongation <50% = 90 Elongation ≥50% = 57

Minimum UV Resistance per ASTM D4355 (% Retained Strength)	50% @500 hours	50% @500 hours	50% @500 hours

Table 985-4
Test Methods and Requirements for Drainage Geotextiles
Types D-4 and D-5

Property/Test Method	D-4	D-5
Minimum Permittivity (Sec^{-1}) per ASTM D4491	0.5	0.5
Maximum AOS (mm, US Sieve No.) per ASTM D4751	0.425 (40)	0.212 (70)
Minimum Grab Tensile Strength (lbs) per ASTM D4632	180	90
Mass per Unit Area (oz/sy) per ASTM D5261	Provide Test Result	Provide Test Result
Minimum Puncture Strength (lbs) per ASTM D6241	223	223
Minimum Trapezoidal Tear (lbs) per ASTM D4533	70	40
Minimum UV Resistance per ASTM D4355 (% Retained Strength)	50% @500 hours	50%@500 hours

985-4 Erosion Control.

985-4.1 Application: Materials may contain natural fibers added to acceptable plastic erosion mats for the sole purpose of facilitating turf growth. However, materials used for erosion control applications must be tested without any natural fiber components in accordance with and meet the physical requirements Table 985-6.

Table 985-5
Erosion Control Applications

Type	Description
E-1	Staked Silt Fence
E-2	Wind Screen
E-3	Plastic Erosion Mat (Turf Reinforcement Mat) (Type 1)
E-4	Plastic Erosion Mat (Turf Reinforcement Mat) (Type 2)
E-5	Plastic Erosion Mat (Turf Reinforcement Mat) (Type 3)

985-4.2 Physical Requirements: Each geosynthetic material shall meet the following requirements:

Table 985-6
Test Methods and Requirements for Erosion Control Materials

Property/Test Method	E-1	E-2	E-3	E-4	E-5
Permittivity (Sec^{-1})	0.05	0.05	NA	NA	NA

Table 985-6 Test Methods and Requirements for Erosion Control Materials					
Property/Test Method	E-1	E-2	E-3	E-4	E-5
per ASTM D4491					
Grab Tensile Strength (lbs) per ASTM D4632	90	90	NA	NA	NA
Minimum UV Resistance per ASTM D4355 (% Retained Strength)	80% @500 hours	80% @150 hours	80% @500 hours		
Tensile Strength **(lbs/ft) per ASTM D6818 or D5035	NA	NA	135x70	275x135	550x275
Filtration Efficiency (%) per ASTM D5141	75% and min. flow rate of 0.3 gal/sf/min	NA	NA	NA	NA
Design Shear***	NA	NA	≧2.1 psf	≧3.6 psf	≧5.0 psf

**Tensile Strength is expressed in units of measure of lbs/ft, in machine direction and cross direction as MD x CD.
***Design Shear limits for Erosion mats must be determined by 30 minutes sustained flow in an unvegetated state as determined by tests performed by Utah State University, Texas Transportation Institute or an independent testing laboratory approved by the State Drainage Engineer.

985-5 Structural.

985-5.1 Applications: Materials for reinforcement, separation and stabilization applications must be tested in accordance with and meet the physical requirements below. The ultimate tensile strength of all R-1 materials must be at least 4800 pounds per foot in both the machine and cross machine directions.

Table 985-7 Reinforcement, Separation and Stabilization Applications	
Type	Description
R-1	Geosynthetic Reinforced Soil (GRS-IBS)
R-2	Reinforcement of Foundations over Soft Soils
R-3	Reinforced Soil Slopes
R-4	Reinforced Embankment
R-5	Construction Expedient

985-5.2 Physical Requirements: Each geosynthetic material shall be tested in accordance with the following requirements:

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Table 985-8 Test Methods and Reporting Requirements for Structural Geosynthetics			
Property/Test Method	Structural Application Type	Test Methods for Woven Geotextiles	Test Methods for Woven or Extruded Geogrids
Permittivity (sec^{-1})	R - 1, 2, 3, 4, 5	ASTM D4491	NA
UV Stability (Min Retained Strength @500 hr)	R - 3	ASTM D4355	ASTM D4355
Puncture Strength (lbs)	R - 5	ASTM D6241	NA
Grab Strength (lbs)	R - 5	ASTM D4632	NA
Opening Size	R - 1, 2, 3, 4, 5	AOS (US Sieve No.) ASTM D4751	Aperture Size (in x in)
Tensile Strength (lbs/ft)		ASTM D4595	ASTM D6637
Machine Direction Ultimate, (T_{ult})			
2% Strain	R - 1, 3		
5% Strain	R - 2, 3, 4, 5		
10% Strain	R - 1, 2, 3, 4, 5		
Cross Direction Ultimate			
2% Strain	R - 1, 3,		
5% Strain	R - 2, 3, 4, 5		
10% Strain	R - 1, 2, 3, 4, 5		
Strain @ Ultimate Tensile Strength	R - 1, 2, 3, 4, 5		
Tear Strength (lbs)		ASTM D4533	NA
Machine Direction	R - 5		
Cross Direction	R - 5		
Soil-Geosynthetic Friction	R - 1, 2, 3	ASTM D5321	ASTM D5321/6706
Pullout Resistance	R - 3	ASTM D6706	ASTM D6706
Creep Resistance-T_{creep} (lbs/ft)	R - 2, 3	ASTM D5262	ASTM D5262
Creep Reduction Factor (T_{ult}/T_{creep})	R - 2, 3	NA	NA
Installation Damage (RF_{ID})		AASHTO R69	AASHTO R69
Sand	R - 2, 3, 4		
Limestone	R - 2, 3, 4		
Durability (RF_D)		AASHTO R69	AASHTO R69
Chemical	R - 2, 3, 4		
Biological	R - 2, 3, 4		
Joint Strength (RF_j)			
Mechanical	R - 2, 3	GRI: GT7	GRI: GG4(a) & GG4(b)

Table 985-8 Test Methods and Reporting Requirements for Structural Geosynthetics			
Property/Test Method	Structural Application Type	Test Methods for Woven Geotextiles	Test Methods for Woven or Extruded Geogrids
Sewn	R - 2, 3	ASTM D4884	NA