

*Delete Section 630 in its entirety and substitute the following:*

**SECTION 630  
GEOTEXTILE FOR EMBANKMENT AND ROADWAY  
SEPARATION, STABILIZATION AND REINFORCEMENT**

**630-1.01 DESCRIPTION.** Prepare ground surface, and furnish and place geotextiles for separation, stabilization, and/or reinforcement as shown on the Plans.

**630-2.01 MATERIALS.** Use materials that conform to the following:

Geotextiles and Sewn Seam Strength                      Subsection 729-2.01

Sewing Thread. Use high strength polypropylene, or polyester. Do not use nylon thread. Use thread of contrasting color to that of the geotextile itself.

**630-3.01 CONSTRUCTION.**

1. Surface Preparation. Prepare ground surface by removing stumps, brush, boulders, and sharp objects. Fill holes and ruts over 3 inches deep, with material shown on the Plans or as approved by the Engineer.
2. Geotextile Placement. Unroll geotextile directly onto the prepared surface. Stretch geotextile to remove any creases, folds or wrinkles. Do not drag the geotextile through mud or over sharp objects that could damage the geotextile. Do not expose geotextiles to sunlight for longer than 14 days after removal of protective covering. Do not allow geotextiles to get wet prior to installation.
  - a. Separation and Stabilization. Lay geotextile for embankment separation and stabilization parallel to roadway centerline. On horizontal curves, place in segment lengths not exceeding those listed in Table 630-1, with butt ends cut to match and sewn or overlapped. On tangents, straighten the geotextile and sew or overlap butt ends. Shingle overlaps in the same direction as fill placement. Prevent overlapped edges from lifting during construction.
  - b. Reinforcement. Lay the machine direction of the geotextile for embankment reinforcement perpendicular to the roadway centerline or as shown on the Plans. Join segments by sewing or an approved bonding or attachment process. Shingle overlaps in the same direction as fill placement if seams are not sewn. Prevent overlapped edges from lifting during construction.

**TABLE 630-1  
GEOTEXTILE PLACEMENT ON CURVES**

Degree of Curve	Maximum Segment Length (ft.)
1	125
2	90
3	75
4	65
5	55
6	50

3. Joining. Join adjacent geotextiles for separation or stabilization by overlapping or sewing. Join adjacent geotextiles for reinforcement by sewing or as shown on the Plans.
  - a. Sew seams with a Butterfly or J-Seam using a double-thread chain stitch (lock stitch). Bring adjacent sections of geotextile together and fold so that the stitching penetrates four layers of geotextile for the full seam length. Make the stitching line 1-1/4 inches ( $\pm 1/4$  inch) from the folded edge of the seam and at least 1/2 inch from the free edge of the geotextile. Sew seams so that they face upward and can be easily inspected by the Engineer. Illustrations showing correct stitch formation and seam configurations are provided in Figure 1-2 (page 1-28) of the FHWA publication, *Geosynthetic Design & Construction Guidelines*, FHWA-NHI-07-092, August 2008.
  - b. Overlap geotextile sections by a minimum of 3 feet at all longitudinal and transverse joints. Place the beginning of each new roll beneath the end of the previous roll to prevent the advancing fill from lifting the geotextile. Shingle in the direction of construction.
4. Material Placing and Spreading. During placing and spreading of material, maintain a minimum depth of 12 inches of cover material; or a minimum depth equal to the separation distance between multiple layers of geotextile as shown on the Plans when this separation distance is less than 12 inches; at all times between the geotextile and the wheels or tracks of the construction equipment. Limit the size and weight of construction equipment to reduce rutting in the initial lift above the geotextile to not greater than 3 inches deep to prevent overstressing the geotextile.

Spread the material in the direction of the upper overlapped geotextile. Maintain proper overlap and geotextile continuity. If sewn or bonded seams are used, place the cover material and spread in only one direction for the entire length of the geotextile. On weak subgrades limit height of dumped cover material to prevent localized subgrade and/or geotextile failure. Do not drop stones or frozen material larger than 1 foot in diameter directly onto the geotextile from a height of more than 1 foot.

Compact using a smooth drum roller. Do not allow construction equipment to make sudden stops, starts, or turns on the cover material. Do not allow turning of vehicles on the initial lift of cover material above the geotextile. Fill any ruts over 3 inches deep occurring during construction with material shown on the Plans; do not grade adjacent material into rut; and compact to the specified density.

5. Geotextile Repair. Repair and replace damaged geotextile (torn, punctured, or disturbed at the overlaps or sewn joints). For damage evidenced by visible geotextile damage, subgrade pumping, intrusion, or embankment distortion, remove the backfill around and under the damaged or displaced area, and repair with material matching the damaged material. Make patches overlap or sew patches to the existing geotextile..
  - a. Separation and Stabilization. Overlay torn area with geotextile with a minimum 3 foot overlap around the edges of the torn or damaged area or sew and bond according to Subsection 630-3.01.3.a. Ensure the patch remains in place when cover material is placed over the affected area.
  - b. Reinforcement. Sew according to Subsection 630-3.01.3.a unless joining by overlap is shown on the Plans. Ensure the patch remains in place when cover material is placed over the affected area.

**630-4.01 METHOD OF MEASUREMENT.** By multiplying plan neat line width by the measured length in final position parallel to installation centerline along the ground surface. No allowance will be made for overlap, whether at joints or patches.

**630-5.01 BASIS OF PAYMENT.** Payment will be made at the contract unit price per square yard. Material used to fill ruts and holes will be paid for under separate materials pay items.

Pay Item	Pay Unit
630(1) Geotextile, Separation, Class 3	Square Yard
630(2) Geotextile, Stabilization, Class 1	Square Yard
630(3A) Geotextile, Reinforcement – Type 1	Square Yard
630(3B) Geotextile, Reinforcement – Type 2	Square Yard

*Delete Section 631 in its entirety and substitute the following:*

**SECTION 631  
GEOTEXTILE FOR SUBSURFACE  
DRAINAGE AND EROSION CONTROL**

**631-1.01 DESCRIPTION.** Prepare ground surface, and furnish and place geotextiles for subsurface drainage and erosion control, as shown on the Plans.

**631-2.01 MATERIALS.** Use materials that conform to the following for the class specified in the bid schedule:

Geotextiles and Sewn Seam Strength Subsection 729-2.01

Sewing Thread. Use high strength polypropylene, or polyester. Do not use nylon thread. Use thread of contrasting color to that of the geotextile itself.

**631-3.01 CONSTRUCTION.**

1. Surface Preparation. Prepare ground surface by removing stumps, brush, boulders, and sharp objects. Fill holes and ruts over 3 inches deep, with material shown on the Plans or as approved by the Engineer. Construct smooth and stable trench walls.
  
2. Geotextile Placement. Unroll geotextile directly onto the prepared surface. Stretch geotextile to remove any creases, folds or wrinkles. Place geotextile in a manner which will ensure intimate contact between the trench wall and the geotextile (i.e., no voids, folds, or wrinkles). The geotextile may be held in place with securing pins at 3-foot spacing along all edges (but not closer than 2 inches from the edge) to prevent movement during construction. Do not expose geotextiles to sunlight for longer than 14 days after removal of protective covering. Do not allow geotextile rolls to get wet prior to installation.
  - a. Subsurface Drainage. In trenches, after placing the geotextile and material shown on the Plans, fold the geotextile over the top of the material shown on the Plans to produce a minimum overlap of 12 inches, for trenches greater than 12 inches wide. In trenches less than 12 inches wide, make the overlap equal to the width of the trench. Then cover the geotextile with the subsequent course of material.
  
  - b. Erosion Control. Place and anchor geotextile on the approved surface so it will not be torn or excessively stretched by placement of the overlying materials. Secure the geotextile to the slope but secure it loosely enough so that the geotextile will not tear when riprap or other cover material is placed on the geotextile. The geotextile shall not be keyed at the top of the slope until the riprap or other cover material is in place at the top of the slope. Anchor the

terminal ends of the geotextile using key trenches or aprons with a minimum of 24 inches depth into the soil substrate at the crest and toe of slope, or as shown on the Plans. Place geotextile with the machine direction parallel to the direction of water flow (normally parallel to the slope for erosion control runoff and wave action, and parallel to the stream or channel).

3. Joining. Join geotextile by sewing or overlapping.
  - a. Sew seams with a Butterfly or J-Seam using a double thread chain stitch (lock stitch). Bring adjacent sections of geotextile together and fold so that the stitching penetrates four layers of geotextile for the full seam length. Make the stitching line 1-1/4 inches ( $\pm 1/4$  inch) from the folded edge of the seam and at least 1/2 inch from the free edge of the geotextile. Sew seams so that they can be easily inspected by the Engineer or representative. Illustrations showing correct stitch formation and seam configurations are provided in Figure 1-2 (page 1-28) of the FHWA publication, *Geosynthetic Design & Construction Guidelines*, FHWA-NHI-07-092, August 2008. Conform both factory and field sewn seams to the strength requirements of Table 1 as outlined in the AASHTO M288 for subsurface drainage and erosion control applications.
  - b. Overlap geotextile sections by a minimum of 3 feet at all longitudinal and transverse joints. Overlap successive geotextile sheets in the direction of flow so that the upstream sheet is placed over the downstream sheet and/or upslope over downslope. In trenches, where overlapped seams are constructed in the longitudinal trench direction, make the overlap equal to the width of the trench.
4. Placement of Cover Material. Following placement of the geotextile on the prepared surface, place cover material of the type shown on the Plans. Place the cover material and armor from the bottom to the top of the slope using methods which minimize tearing and/or excessive stretching of the geotextile. In underwater applications, place the geotextile and the required thickness of cover material in the same day. Maintain proper overlap and geotextile continuity. Do not exceed the allowable drop heights for cover material shown in Table 631-1. Do not allow stones with a weight of more than 100 pounds to roll down the slope on the geotextile. Do not grade the slope in a way that will disturb the cover material or armor stone once it has been placed. Backfill all voids in the riprap or other cover material, which allows the geotextile to be visible, with material shown on the Plans, so that the geotextile is completely covered.

**TABLE 631-1 ALLOWABLE DROP HEIGHT FOR GEOTEXTILE**

INDIVIDUAL STONE Max. Weight (lbs)	ALLOWABLE DROP HEIGHT (ft)	
	UNPROTECTED GEOTEXTILE	PROTECTED GEOTEXTILE*
< 5	3	3
5-250	0	3
> 250	0	0**

\* Protected geotextile is defined as having a gravelly covering (cushion layer) at least 6 inches thick.

\*\* If stones greater than 250 pounds must be dropped or if a height of drop greater than 3 feet is required, then perform field trials to determine the minimum cushion thickness and/or maximum height of safe drop without damaging the geotextile.

Maintain a minimum depth of 12 inches of cover material between the geotextile and the wheels or tracks of the construction equipment.

5. Geotextile Repair. Should the geotextile be torn, punctured, or the overlaps or sewn joints disturbed – as evidenced by visible geotextile damage – remove the backfill around the damaged area and

repair or replace the damaged area at no additional expense to the State. Make repairs to the damaged area with a patch of the same type of geotextile originally placed. Overlay torn area with geotextile with a minimum 3 foot overlap around the edges of the torn area. Ensure that the patch remains in place when material is placed over the affected area.

**631-4.01 METHOD OF MEASUREMENT.** By multiplying plan neat line width by the measured length in final position parallel to installation centerline along the ground surface. No allowance will be made for geotextile in key trenches or for overlap, whether at joints or patches.

**631-5.01 BASIS OF PAYMENT.** Payment will be made at the contract unit price per square yard. Material used to fill ruts and holes will be paid for under separate materials pay items at the unit price for the type of material used.

Pay Item	Pay Unit
631(1) Geotextile, Drainage, Class <u>2</u>	Square Yard
631(2) Geotextile, Erosion Control, Class <u>1</u>	Square Yard

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*Delete Section 632 in its entirety and substitute the following:*

**SECTION 632**

**PAVING FABRIC**

**632-1.01 DESCRIPTION.** Furnish and install geotextile paving fabric where shown on the Plans.

**632-2.01 MATERIALS.** Use materials that conform to the following:

- Paving Fabric                      Subsection 729-2.03
- Asphalt Binder                    Subsection 702-2.01 (for grade of asphalt used in the overlay)
- Emulsified Asphalt              Subsection 702-2.03

**632-3.01 CONSTRUCTION.**

1. Surface Preparation. Prepare the surface on which the fabric is to be placed as follows:
  - a. Remove excess asphalt material, loose aggregate, and other foreign materials from the surface.
  - b. Fill all potholes and cracks wider than 1/4 inch with emulsified asphalt (CSS-1) sand slurry.
2. Application of Sealant. Apply asphalt sealant by distributor meeting all requirements set forth under Subsection 402-3.02. Apply asphalt sealant (tack coat) uniformly at 0.20 to 0.30 gallons per square yard and at a temperature between 295°F and 320°F in the distributor tank, or as recommended by the Paving Fabric manufacturer. Do not apply asphalt material on a wet surface or when the ambient air temperature is below 45 °F or when other conditions would prevent proper application.
3. Fabric Laydown Equipment. Use approved mechanical laydown equipment to place fabric.
4. Fabric Placement. Place fabric directly on top of the asphalt sealant (tack coat) before the sealant has cooled and lost its tackiness. Lay fabric in full rolls without wrinkles and/or folds. Place the fabric per the manufacturer's recommendations. Overlap geotextile joints to ensure full closure of the joint, but do not exceed 6 inches of overlap. Overlap transverse joints in the direction of paving. Apply 0.20 gallons per square yard of additional asphalt sealant beneath all fabric joints. Remove and replace damaged geotextiles. Removal and replacement of damaged geotextiles is subsidiary to Section 632 Pay Items.

5. Bituminous Surface Course Overlay. Place the bituminous surface course closely following the fabric laydown to avoid exposure of uncovered fabric overnight or to traffic or inclement weather. Do not allow the temperature of the hot-mix asphalt to exceed manufacturer's recommendations. If asphalt sealant bleeds through the fabric before the placement of the overlay, apply sand or bituminous surface course evenly over the affected area to prevent fabric pick-up by construction equipment. Prevent paver or other construction equipment from turning and/or pivoting on the fabric.

**632-4.01 METHOD OF MEASUREMENT.** By multiplying plan neat line width by the measured length in final position parallel to installation centerline along the ground surface. No allowance will be made for overlap, whether at joints or patches.

**632-5.01 BASIS OF PAYMENT.**

Pay Item	Pay Unit
632(1) Paving Fabric	Square Yard

*Delete Section 633 in its entirety and substitute the following:*

**SECTION 633  
SILT FENCE**

**633-1.01 DESCRIPTION.** Furnish, install, maintain, and remove temporary silt fence as shown on the Plans or as directed.

**633-2.01 MATERIALS.** Use materials that conform to the following:

Geotextile	Subsection 729-2.01
Silt Fence	Subsection 729-2.04
Posts	Wood 1.5-inch x 1.5-inch x 36-inch min., steel, or approved synthetic material.
Prefabricated Silt Fence	Meet the Plans and Section 633 requirements.
Attachment Devices	Staples; wire; self-locking nylon, plastic, wire ties; or other approved means to attach fabric to posts.
Support Mesh between Posts	14-gage welded wire fencing, metal chain-link fabric, or geosynthetic mesh with equivalent strength. Use maximum mesh spacing of 6 inches. Use height shown on the Plans, or specified in the Bid Schedule.

**633-3.01 CONSTRUCTION.** Install silt fence according to Plans. Use Trenchless Detail when installing silt fence over permanently frozen ground. Drill holes for support posts, if required.

When joining to another roll, place both end posts together and wrap them with silt fence by turning them one full rotation. Drive the wrapped posts.

**633-3.02 MAINTENANCE.** Maintain the integrity of the fence to contain sediment in runoff until final stabilization.

**633-3.03 REMOVAL.** After disturbed area has been accepted as permanently stabilized or when sediment protection is no longer needed, remove silt fence.

**633-4.01 METHOD OF MEASUREMENT.** Section 109. Measure silt fence by the length of fence installed. No allowance will be made for overlap, whether at joints or patches.

**633-5.01 BASIS OF PAYMENT.** The contract price includes installation, maintenance, removal and disposal of the silt fence.

Pay Item		Pay Unit
633(1)	Silt Fence	Linear Foot
633(2)	Support Mesh Reinforced Silt Fence	Linear Foot

*Delete Section 634 in its entirety and substitute the following:*

**SECTION 634**

**GEOGRID FOR EMBANKMENT AND ROADWAY STABILIZATION AND REINFORCEMENT**

**634-1.01 DESCRIPTION.** Furnish and install geogrid material as shown on the Plans.

**634-2.01 MATERIALS.** Use materials that conform to the following:

Geogrid            Subsection 729-2.04

**634-3.01 CONSTRUCTION**

1. Surface Preparation.
  - a. Soft Ground (CBR ≤3). Prepare surface by removal of stumps, brush, boulders, and sharp objects. Fill holes and ruts over 3 inches deep, with material shown on the Plans or as approved by the Engineer.
  - b. Firm Ground (CBR >3). Compact and finish subgrade or subbase prior to placement of the geogrid.
  
2. Geogrid Placement. Unroll geogrid directly onto the prepared ground surface in the direction of advancing construction, parallel to the centerline of the roadway or according to the Plans. Do not drag the geogrid across the subgrade. Install the geogrid in the longest continuous practical length, free from folds, creases or wrinkles. Hold the geogrid in place with pins, staples, sandbags or piles of granular material. Do not expose geogrids to sunlight for longer than 14 days after removal of protective covering.
  - a. Soft Ground (CBR ≤3). Overlap geogrid panels a minimum of 24 inches at all joints with the upper geogrid in the direction that fill will be placed. Tie panels together securely with cable ties or hog rings at 20 foot intervals, or according to the manufacturer's recommendations.
  - b. Firm Ground (CBR >3). Overlap geogrid panels a minimum of 12 inches at all joints in the direction that fill will be placed. Tie panels together securely with cable ties or hog rings at 20 foot intervals and hand-tension geogrid and stake to the ground at the edges, overlaps, and in the center of each roll, at 30 foot intervals or as shown on the Plans.

Place the beginning of each new roll beneath the end of the previous roll to prevent the advancing fill from lifting the geogrid. Stagger end overlaps at least 10 feet from other end overlaps in adjacent rolls.

3. Placement of Cover Material. Do not operate equipment directly on the unprotected geogrid. Spread fill material in the direction of the fabric overlap. Compact using a smooth drum roller. Do not allow construction equipment to make sudden stops, starts, or turns on the cover material.
  - a. Very Soft Ground (CBR < 1). End-dump material onto previously placed material and spread over the geogrid with a low ground pressure dozer to the depth permitted. Maintain a minimum depth of 12 inches of cover material at all times between the geogrid and the wheels or tracks of the construction equipment unless otherwise shown on the Plans. Do not dump material directly onto the geogrid. To prevent a mud wave, end-dump fill along the edges of the geogrid to form toe berms or access roads that extend one to two panel widths ahead of the remainder of the embankment fill placement. After constructing the two berms, spread fill in the area between the toe berms by placing material parallel to the alignment and symmetrical from the toe berms inward toward the center to maintain a U-shaped leading edge (i.e., concave outward) to contain the mud wave. Limit height of dumped piles above the geogrid to avoid local bearing failure. Traffic on the first lift should be parallel to the embankment alignment. Do not allow construction equipment to turn on the first lift. Compact first lift by tracking in place with dozers or end-loaders. Compact with specified compaction equipment once embankment is at least 2 feet above the geogrid.
  - b. Soft Ground (1 ≤ CBR ≤ 3). End-dump material onto previously placed material and spread over the geogrid with a low ground pressure dozer to the depth permitted. Maintain a minimum depth of 6 inches of cover material at all times between the geogrid and the wheels or tracks of the construction equipment unless otherwise shown on the Plans. Place the end-dumped material along the roadway centerline and spread it outward to the roadway edges to prevent the development of wrinkles or movement of the geogrid during construction. Fill in any ruts that form during construction with material shown on the Plans. Do not cut down the fill adjacent to the ruts.
  - c. Firm Ground (CBR > 3). Maintain a minimum depth of 6 inches of cover material at all times between the geogrid and the wheels or tracks of the construction equipment.
4. Geogrid Repair. Should the geogrid be torn, punctured, or the overlaps disturbed – as evidenced by visible geogrid damage – remove the backfill around the damaged area and repair or replace the damaged area at no additional expense to the State. Make repairs to the damaged area with a patch of the same type of geogrid originally placed. Overlay torn area with geogrid with a minimum 3 foot overlap around the edges of the torn area and secure as recommended by the geogrid manufacturer.

**634-4.01 METHOD OF MEASUREMENT.** By multiplying plan neat line width by the measured length in final position parallel to installation centerline along the ground surface. No allowance will be made for overlap, whether at joints or patches.

**634-5.01 BASIS OF PAYMENT.** Payment will be made at the contract unit price per square yard. Material used to fill ruts and holes will be paid for at the unit price for the type of material used.

Pay Item	Pay Unit
634(1) Geogrid, Stabilization, Class _____	Square Yard
634 (2) Geogrid, Reinforcement, Class _____	Square Yard



Delete Section 729 in its entirety and substitute the following:

**SECTION 729  
GEOSYNTHETICS**

**729-2.01 GEOTEXTILE FOR SUBSURFACE DRAINAGE, SEPARATION, STABILIZATION, EROSION CONTROL AND EMBANKMENT REINFORCEMENT.**

1. Subsurface Drainage. Meet AASHTO M 288 for Subsurface Drainage, except provide a minimum permittivity of  $0.50 \text{ sec}^{-1}$ , and meet Class 2 Strength Property Requirements.
2. Separation. Meet AASHTO M 288 for Separation, except provide a minimum permittivity of  $0.50 \text{ sec}^{-1}$ , and meet Class 3 Strength Property Requirements.
3. Stabilization. Meet AASHTO M 288 for Stabilization, except provides a minimum permittivity of  $0.50 \text{ sec}^{-1}$ , and meet Class 1 Strength Property Requirements.
4. Erosion Control. Meet AASHTO M 288 for Permanent Erosion Control and meet Class 1 Strength Property Requirements.
5. Reinforcement. Meet the requirements in Table 729-1 for Type 1 or Type 2.

Package, label, handle and store geotextile materials according to ASTM D 4873.

**TABLE 729-1  
GEOTEXTILE REINFORCEMENT PROPERTIES**

Property	Test Method	Units	Requirement <sup>a</sup>	
			Type 1	Type 2
Grab Tensile	ASTM D4632	lb.	200/200	400/400
Grab Elongation	ASTM D4632	% (MD)	10	10
Wide Width Tensile	ASTM D4595	lb/in. (ultimate)	200/200	400/400
Wide Width Tensile	ASTM D4595	lb/in. (@ 5% strain)	100/100	200/200
Seam Breaking Strength	ASTM D4632	lb./in.	180	360
Puncture	ASTM D6241	lb.	500	1500
Trapezoidal Tear	ASTM D4533	lb.	100	150
AOS	ASTM D4751	U.S. sieve size	#30 <sup>b</sup>	#30 <sup>b</sup>
Permittivity	ASTM D4491	$\text{sec}^{-1}$	0.20	0.20
Flow Rate	ASTM D4491	gal./min./ft <sup>2</sup>	10	10

<sup>a</sup> Minimum Average Roll Values (MARV) in machine direction (MD) / cross-machine direction (XD) unless otherwise specified

<sup>b</sup> Maximum average roll value

**729-2.02 SILT FENCE.** Meet AASHTO M 288 for Temporary Silt Fence.

**729-2.03 PAVING FABRIC.** Meet AASHTO M 288 for Paving Fabric.

**729-2.04 GEOGRID FOR EMBANKMENT AND ROADWAY STABILIZATION AND REINFORCEMENT.** Provide geogrid consisting of a regular network of connected polymer tensile elements with aperture geometry sufficient to provide significant mechanical interlock with the surrounding material. Provide dimensionally stable geogrid that is able to retain its geometry during construction. Provide geogrid structure that resists ultraviolet degradation and all forms of chemical and biological degradation encountered in the material in which it is buried.

Package, label, handle, and store geogrid material according to ASTM D 4873.

1. Stabilization. Provide geogrid that meets the survivability requirements in Table 729-2 and meets the physical requirements in Table 729-3.
2. Reinforcement. Provide geogrid that meets the survivability requirements in Table 729-2 and as shown on the Plans.

**TABLE 729-2  
GEOGRID SURVIVABILITY REQUIREMENTS**

Property	Test Method	Units	Requirement	
			CLASS 1	CLASS 2
Ultimate Multi-Rib Tensile Strength <sup>a</sup>	ASTM D6637	lb./ft.	1230	820
Junction Strength <sup>a</sup>	ASTM D7737	lb.	25	25
Ultraviolet Stability (Retained Strength)	ASTM D4355	%	50% after 500 hours of exposure	

<sup>a</sup> Minimum Average Roll Value (MARV) in any rib direction.

**TABLE 729-3  
GEOGRID PHYSICAL REQUIREMENTS**

Property	Test Method	Units	Requirement
2% Tensile Strength <sup>a</sup>	ASTM D6637	lb./ft.	≥ 400
5% Tensile Strength <sup>a</sup>	ASTM D6637	lb./ft.	≥ 800
Percent Open Area	COE, CW-02215	%	50 – 80
Aperture Size <sup>b</sup>	Direct measure	in.	0.5 – 3.0

<sup>a</sup> Minimum Average Roll Value (MARV) in machine and cross-machine directions.

<sup>b</sup> measured as the spacing between parallel ribs.