

645 Geosynthetics

645.1 Description

- (1) This section describes providing geotextiles for subgrade separation and stabilization, drainage filtration, subgrade reinforcement, and under culverts and riprap.
- (2) This section also describes providing geogrid for subgrade, marsh, and slope stability reinforcement.

645.2 Materials

645.2.1 General

- (1) Furnish material that is insect, rodent, mildew, and rot resistant in a wrapping that protects it from ultraviolet radiation and from abrasion due to shipping and hauling. Keep material dry until installed. Clearly mark rolls to show the material type.
- (2) The engineer will obtain material samples for testing from the job site as specified here in 645.2 for individual materials.
- (3) If no minimum values are specified here in 645.2, use those the contract special provisions specify.

645.2.2 Geotextile

645.2.2.1 General

- (1) Furnish geotextiles of either woven or nonwoven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Geotextile must have the minimum required strength values in the weakest primary direction. The contractor may use nonwoven geotextile that is one or a combination of the following: needle punched, heat bonded, or resin bonded.
- (2) Furnish a manufacturer's certified report of test or analysis that shows the geotextile delivered meets the requirements of this specification to the engineer at least 15 days before use in the work. Mark the delivered geotextile to clearly identify it with the applicable test report furnished to the engineer.
- (3) If using sewn seams, furnish a field sewn seam sample produced from the geotextile and thread sewn with the equipment that will be used on the project, before incorporating into the work.

645.2.2.2 Geotextile, Type SAS (Subgrade Aggregate Separation)

- (1) Furnish geotextile conforming to the following physical properties:

TEST	METHOD	VALUE ^[1]
Minimum grab tensile strength	ASTM D4632	170 lb
Minimum puncture strength	ASTM D6241	350 lb
Maximum apparent opening size	ASTM D4751	No. 70 sieve
Minimum permittivity	ASTM D4491	0.35 s ⁻¹

^[1] Numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

- (2) For quantities over 10,000 square yards, the engineer will obtain a sample of geotextile for testing from the job site. The engineer will obtain additional samples for each additional 10,000 square yards or lesser portion used in the work.

645.2.2.3 Geotextile, Type MS (Marsh Stabilization)

- (1) Furnish geotextile conforming to the physical properties specified in a required Geotextile Type MS contract special provision.
- (2) Submit a sample of the geotextile material to the engineer at least 15 days before incorporating into the work. At the same time, submit a sewn seam sample using the same geotextile and thread as well as using the same seam spacing, number of seams, and overlap distance that will be used in the work.
- (3) The engineer will obtain samples of geotextile for testing from the job site for each 10,000 square yards or lesser portion used in the work.

645.2.2.4 Geotextile, Type DF (Drainage Filtration)

- (1) Furnish geotextile conforming with the physical requirements of either schedule A, schedule B, or schedule C as the contract specifies.

SCHEDULE A TEST	METHOD	VALUE ^[1]
Minimum grab tensile strength	ASTM D4632	110 lb
Minimum puncture strength	ASTM D6241	200 lb
Minimum apparent breaking elongation	ASTM D4632	30%
Maximum apparent opening size	ASTM D4751	300 µm

Minimum permittivity	ASTM D4491	0.70 s ⁻¹
SCHEDULE B TEST		
	METHOD	VALUE ^[1]
Minimum grab tensile strength	ASTM D4632	180 lb
Minimum puncture strength	ASTM D6241	350 lb
Minimum apparent breaking elongation	ASTM D4632	30%
Maximum apparent opening size	ASTM D4751	300 µm
Minimum permittivity	ASTM D4491	1.35 s ⁻¹
SCHEDULE C TEST		
	METHOD	VALUE ^[1]
Minimum grab tensile strength	ASTM D4632	180 lb
Minimum puncture strength	ASTM D6241	350 lb
Minimum apparent breaking elongation	ASTM D4632	15%
Maximum apparent opening size	ASTM D4751	600 µm
Minimum permittivity	ASTM D4491	1.00 s ⁻¹

^[1] Numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

- (2) Do not use slit film woven geotextile for this work.
- (3) For quantities over 1,500 square yards, the engineer will obtain a sample of geotextile for testing from the job site. The engineer will obtain additional samples for each additional 1,500 square yards or lesser portion used in the work.

645.2.2.5 Geotextile, Type SR (Subgrade Reinforcement)

- (1) Furnish geotextile conforming to the physical properties specified in a required Geotextile Type SR contract special provision.
- (2) The engineer will obtain samples of geotextile for testing from the job site for each 10,000 square yards or lesser portion used in the work.

645.2.2.6 Geotextile, Type R (Riprap)

- (1) Use geotextile conforming to the following physical properties:

TEST	METHOD	VALUE ^[1]
Minimum grab tensile strength	ASTM D4632	205 lb
Minimum puncture strength	ASTM D6241	400 lb
Minimum apparent breaking elongation	ASTM D4632	15%
Maximum apparent opening size	ASTM D4751	No. 30 sieve
Minimum permittivity	ASTM D4491	0.12 s ⁻¹

^[1] Numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

^[2] For quantities over 1,500 square yards, the engineer will obtain a sample of geotextile for testing from the job site. The engineer will obtain additional samples for each additional 5,000 square yards used in the work.

645.2.2.7 Geotextile, Type HR (Heavy Riprap)

- (1) Use geotextile conforming to the following physical properties:

TEST	METHOD	VALUE ^[1]
Minimum grab tensile strength, lb	ASTM D4632	305 lb
Minimum puncture strength, lb	ASTM D6241	500 lb
Minimum apparent breaking elongation, %	ASTM D4632	15%
Maximum apparent opening size	ASTM D4751	No. 30
Minimum permittivity	ASTM D4491	0.40, s ⁻¹

^[1] Numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

^[2] For quantities over 1,500 square yards, the engineer will obtain a sample of geotextile for testing from the job site. The engineer will obtain additional samples for each additional 5,000 square yards used in the work.

645.2.2.8 Geotextile, Type C (Modified SAS)

- (1) Use geotextile conforming to the following physical properties:

TEST	METHOD	VALUE ^[1]
Grab tensile strength, lb	ASTM D4632	205 lb

Puncture strength, lb	ASTM D6241	350 lb
Maximum apparent opening size	ASTM D4751	No. 50 sieve
Minimum permittivity	ASTM D4491	0.12 s ⁻¹

^[1] Numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

^[2] For quantities over 1,500 square yards, the engineer will obtain a sample of geotextile for testing from the job site. The engineer will obtain additional samples for each additional 5,000 square yards used in the work.

645.2.2.9 Geotextile, Type ES (Embankment Stabilization)

- (1) Furnish geotextile conforming to the physical properties specified in a required Geotextile Type ES contract special provision.
- (2) Submit a sample of the geotextile material to the engineer at least 15 days before incorporating it into the work. At the same time, furnish a sewn seam sample using the same geotextile, thread, seam spacing and number, and overlap distance as are intended or required for use in the work.
- (3) The engineer will obtain samples of geotextile for testing from the job site for each 10,000 square yards or lesser portion used in the work.

645.2.3 Geogrid

645.2.3.1 General

- (1) Furnish geogrid that consists of a single layer of a uniform square or rectangular grid of bonded, formed, or fused polymer tensile strands. Furnish polyester, polypropylene, polyamide, or polyethylene material that maintains dimensional stability during handling, placing, and installation. Use geogrid that is at least 6.0 feet wide.
- (2) Furnish a manufacturer's certified report of test or analysis that shows that the geogrid delivered meets the requirements of this specification to the engineer at least 15 business days before use in the work. Mark the delivered geogrid to clearly identify it with the applicable test report furnished to the engineer. The engineer will obtain samples of geogrid for testing from the job site for each 10,000 square yards or lesser portion used in the work.

645.2.3.2 Geogrid, Type SR (Subgrade Reinforcement)

- (1) Provide geogrid for subgrade reinforcement that complies with the following physical properties:

TEST	METHOD	VALUE ^[1]
Tensile Strength at 5% Strain (both principal directions in lb/ft)	ASTM D6637	500 min
Overall Flexural Rigidity (mg-cm)	ASTM D7748	250,000 min
Aperture Area (in ²)	Inside Measurement	5.0 max
Aperture Dimension (in)	Inside Measurement	0.5 min

^[1] Numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

645.2.3.3 Geogrid, Type MR (Marsh Reinforcement)

- (1) Furnish geogrid for marsh reinforcement that complies with the physical properties specified in a required Geogrid Type MR contract special provision.

645.2.3.4 Geogrid, Type SSR (Slope Stability Reinforcement)

- (1) Furnish geogrid for slope stability reinforcement that complies with the physical properties specified in a required Geogrid Type SSR contract special provision.

645.3 Construction

645.3.1 Geotextiles

645.3.1.1 General

- (1) For geotextiles that require sewing, sew factory and field seams with a thread having the same or greater durability as the geotextile material. Use a 401 stitch conforming to Federal Standard No. 751a for seams. Ensure that seams develop a tensile strength equal to or greater than 60 percent of the specified grab tensile strength of the geotextile, unless specified otherwise.
- (2) Place, spread, and compact fill material above the geotextile as the contract specifies for that particular type of cover material.

645.3.1.2 Geotextile, Type SAS

- (1) Before placing the geotextile, smooth, shape, and compact the subgrade to the required grade, section, and density. After placing the geotextile on the subgrade area, the engineer will not allow traffic or construction equipment to travel directly on the geotextile.
- (2) Roll the geotextile out on the roadway and pull taut manually to remove wrinkles. Join separate pieces of geotextile by overlapping or sewing. Place the geotextile in the overlapped joints so it overlaps at least 18 inches.
- (3) The engineer may require the use of weights or pins to prevent the wind from lifting the geotextile.
- (4) After placing, do not expose the geotextile longer than 48 hours before covering.
- (5) Place backfill material over the geotextile by back dumping with trucks and leveling with a crawler dozer. Do not use construction equipment that causes ruts deeper than 3 inches. Fill ruts with additional material. The engineer will not allow the contractor to smooth ruts without adding additional material. Cover damaged areas with a patch of geotextile using a 3-foot overlap in all directions.

645.3.1.3 Geotextile, Type MS

- (1) Complete clearing operations before placing the geotextile. Within the area being covered by geotextile, cut stumps and sharp objects level with the ground surface. Do not remove sod, grass, and roots that extend beneath the ground surface. Carefully place the geotextile on the ground using hand methods to avoid disturbing the existing root mat and vegetation. Roll the geotextile out as smoothly as possible and pull taut manually to remove wrinkles. The engineer may require the use of weights or pins to prevent the wind from lifting the geotextile. After placement, do not expose the geotextile longer than 48 hours before covering. If visible defects exist, replace the defective section of geotextile with a new defect-free section of geotextile.
- (2) Place the geotextile with the machine direction perpendicular to the roadway alignment. Sew seams with 2 parallel stitch lines according to plan details. Space the parallel stitching no more than one inch apart. Place seams perpendicular to the roadway alignment and facing upward. Ensure that seams develop at least 80 percent of the specified cross direction tensile strength of the geotextile, as determined by the same testing methods. Do not make butt splices between individual roll ends. One stitch line may not cross another stitch line. Repair breaks or faults in any seam as the engineer directs.
- (3) Place the initial fill layer over the geotextile to a depth not less than one-foot but not more than 2 feet by carefully end dumping and pushing on to the geotextile. Do not use construction equipment that causes ruts deeper than 3 inches and does not excessively deform the marsh surface. Do not drive vehicles directly on the geotextile. Complete the initial lift and install instrumentation before placing any additional material. After placing the initial lift, place subsequent lifts no deeper than one foot. Do not begin any lift until completing the preceding lift and obtaining the engineer's approval. Conduct spreading operations so that no damage occurs to the geotextile. Unless the engineer directs otherwise, place and spread lifts by expanding outward from the centerline of the fill. If fill placement damages the geotextile, remove the fill material around the damaged area and the engineer will examine the damaged area to determine if the material requires replacement.

645.3.1.4 Geotextile, Type DF

- (1) Before placing the geotextile in trench drains, construct the trench to the grades and dimensions the plans show or as the engineer directs. Remove protruding stones and other matter that might damage the geotextile from the trench walls and base before placing the geotextile. Place the geotextile in the trench so it conforms to the trench walls and remains in proper position during drain construction and backfilling. The contractor may join separate pieces of geotextile by overlapping or sewing. If overlapping, place the geotextile in overlap joints of at least 18 inches in the direction of drain flow. Correct misaligned geotextile as the engineer directs. The engineer will direct treatment of damaged geotextile areas by one of the following methods:
 1. Place an additional section of geotextile extending at least 24 inches beyond any point of the damaged area and position between the trench walls and the damaged geotextile.
 2. Remove the section of geotextile containing the damaged area and replace it with a new section of geotextile.
- (2) After placing, do not expose the geotextile longer than 48 hours before covering.
- (3) For applications other than trench drains, construct the surface on which placing the geotextile to the grades and dimensions the plans show. Prepare the surface by removing or covering objects that might damage the geotextile. Carefully place the geotextile to prevent damage and secure in position. Conduct backfilling or covering operations so that no damage or misalignment occurs to the geotextile.

Treat geotextile damage or misalignment as specified in the previous paragraph. After placement, do not expose the geotextile longer than 48 hours before covering or backfilling.

645.3.1.5 Geotextile, Type SR

- (1) Before placing the geotextile, smooth and shape the roadway to the required grade and section, and if the engineer requires, compact to the specified density. After placing the geotextile on the earth grade, do not allow traffic or construction equipment to travel directly on the geotextile.
- (2) Roll out the geotextile on the roadway and pull taut manually to remove wrinkles. Join parallel strips of geotextile by overlapping or sewing. Sew seams as specified in [645.3.1.1](#), except ensure a tensile strength equal to or greater than 60 percent of the specified directional tensile strength of the geotextile. Overlap the geotextile in joints at least 24 inches. Overlap butt splices between geotextile rolls at least 36 inches. The engineer may require the use of weights or pins to prevent the wind from lifting the geotextile.
- (3) Cover tears, holes, or rips in the geotextile with a patch of geotextile overlapping the defect 36 inches in all directions.
- (4) Cover geotextile within 48 hours of placement.
- (5) Place the backfill material in an initial lift of 12 inches. Do not place subsequent lifts, in layers exceeding 12 inches thick. Spread each lift with a crawler type tractor or dozer and compact with suitable compaction equipment. Do not use construction equipment that causes ruts deeper than 4 inches. The engineer will not allow turning movements for any hauling or spreading equipment on the geotextile until at least 2 lifts of backfill, at least 18 inches deep, are placed and compacted. Do not begin subsequent lifts until spreading and compacting a distance of at least 1000 feet of the previous lift. Maintain a 1000-foot interval between subsequent lifts until completing each lift. If ruts greater than 4 inches develop during construction operations, the engineer may require the contractor to use lighter equipment, equipment with lower contact pressure, or smaller loads on existing equipment.
- (6) Fill ruts in the surface of each lift of backfill with additional material. Do not smooth ruts without adding additional backfill.

645.3.1.6 Geotextile, Type R

- (1) Before placing the geotextile, grade the area smooth and remove stones, roots, sticks, or other matter that might prevent the geotextile from completely contacting the soil.
- (2) Place the geotextile loosely and lay it parallel to the direction of water movement. The engineer may require pinning or stapling to hold the geotextile in place. Join separate pieces of geotextile by overlapping or sewing. Overlap the geotextile in the joints at least 24 inches in the direction of flow. After placing, do not expose the geotextile longer than 48 hours before covering.
- (3) Cover damaged areas with a patch of geotextile that overlaps 3 feet in all directions.
- (4) Place riprap from the base of the slope upward. The engineer will determine the freefall height of riprap, but in no case should this height exceed one foot.

645.3.1.7 Geotextile, Type HR

- (1) Place as specified in [645.3.1.6](#), except that the freefall height of riprap must not exceed 6 inches.

645.3.1.8 Geotextile, Type C

- (1) Before placing geotextile, construct and shape the grade to the required grade and section. After placing the geotextile, the engineer will not allow traffic or construction equipment to travel directly on the geotextile.
- (2) Roll out the geotextile on the excavation and pull taut manually to remove wrinkles. Join separate pieces of geotextile by overlapping or sewing. Overlap geotextile joints at least 18 inches. The engineer may require the use of weights or pins to prevent the wind lifting the geotextile.
- (3) After placing, do not expose the geotextile longer than 48 hours before covering.
- (4) Then place the specified backfill material over the geotextile. Do not use construction equipment that causes ruts over 3 inches deep. Fill ruts with additional material and level to required grade. Do not smooth ruts without adding additional material.

645.3.1.9 Geotextile, Type ES

- (1) Before placing the geotextile, construct the embankment to the required elevation and make the surface smooth and level. Place the geotextile on the prepared surface to the limits the plans show with the machine direction of the geotextile oriented in the direction the plans show. Roll out the geotextile as smoothly as possible and pull taut manually to remove wrinkles. The engineer may require the use of weights or pins to prevent the wind lifting the geotextile. After placing, do not expose

the geotextile longer than 48 hours before covering. If visible defects or damage to the geotextile exists, remove the section containing the defect or damage and replace with a new section of defect-free geotextile.

- (2) Sew seams between geotextile strips with 2 parallel stitch lines spaced no more than one inch apart according to the details the plans show. Orient seams parallel to the roadway alignment and face upward. Sew seams with a thread having the same or greater durability as the geotextile material. Use a 401 stitch conforming to Federal Standard No. 751a for all seams. Ensure that all seams develop a tensile strength equal to or greater than 50 percent of the specified cross direction tensile strength of the geotextile. Repair sewing defects in any seam as the engineer directs. Do not use butt splices between individual roll ends.
- (3) Place the initial fill layer over the geotextile to a depth not less than 8 inches or more than one foot. Carefully end dump and push this lift on to the geotextile. Perform spreading operations and use equipment in a way that does not displace or damage the geotextile. Do not make sharp turning movements while placing the initial lift over the geotextile. Do not drive vehicles directly on the geotextile. Complete the preceding lift before beginning the next lift.
- (4) Unless specified otherwise, use the backfill material the plans and special provisions specify, from at least 8 inches below to at least 8 inches the geotextile.

645.3.2 Geogrid

645.3.2.1 General

- (1) Place geogrid as the plans show or engineer directs. Pull flat and secure using pins, staples, or other devices to prevent movement or displacement. Lap butt joints between roll ends at least 12 inches unless the plans or special provisions specify otherwise. Secure lapped sections together using engineer-approved ties, straps, clips, or other devices. Do not operate vehicles or construction equipment directly on geogrid.
- (2) Cover small rips, tears, or defects in the geogrid with an additional section of geogrid secured in place overlapping the damaged area by at least 3 feet in all directions. Remove and replace geogrid sections with large rips, tears, defects, or other damage as the engineer directs before backfilling.
- (3) After placement, backfill the geogrid to the depth and with the type of material the plans or special provisions specify. Place, spread, and compact backfill conforming to contract requirements for that backfill material, except ensure that the initial lift over the geogrid is at least 4 inches deep.
- (4) Place, spread, and compact fill material above the geogrid as the contract specifies for that particular type of cover material.
- (5) Do not displace or damage the geogrid during backfill operations. The engineer may direct the contractor to repair or replace damaged, displaced, or otherwise defective geogrid and may require equipment and operations changes to prevent further damage or displacement.

645.3.2.2 Geogrid, Type SR

- (1) Before placing geogrid, establish the placement surface to the required lines, grades, and dimensions the plans show or as the engineer directs. Smooth and shape the surface to eliminate rocks, clods, roots, or other debris that may damage the geogrid during placement or backfilling.
- (2) Overlap parallel strips at least 6 inches.

645.3.2.3 Geogrid, Type MR

645.3.2.3.1 General

- (1) Complete clearing operations before placing geogrid. Cut stumps and sharp objects level with the ground surface where placing geogrid. Do not remove sod, grass, or roots that extend beneath the ground surface unless the engineer directs. Avoid disturbing the existing root mat and vegetation during geogrid placement. Unroll the geogrid and pull tight manually to remove wrinkles. If the geogrid has different strengths in the machine and cross directions, orient as the plans or special provisions specify.
- (2) Overlap parallel strips at least 12 inches unless the plans or special provisions specify otherwise.

645.3.2.4 Geogrid, Type SSR

645.3.2.4.1 General

- (1) Before placing the geogrid, smooth and shape the roadway to the required lines, grades and dimensions the plans show or as the engineer directs. Smooth and shape the surface to eliminate rocks, clods, roots, or other debris that may damage the geogrid during placement or backfilling.
- (2) Overlap parallel strips at least 12 inches unless the plans or special provisions specify otherwise.

645.4 Measurement

- (1) The department will measure the Geotextile and Geogrid bid items by the square yard acceptably completed.

645.5 Payment

- (1) The department will pay for measured quantities at the contract unit price under the following bid items:

<u>ITEM NUMBER</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
645.0100 - 0199	Geotextile (type)	SY
645.0200 - 0299	Geogrid (type)	SY

- (2) Payment for the Geotextile bid items is full compensation for providing geotextile. Payment for the Geotextile Type MS, Type ES, Type R, Type HR, and Type C bid items also includes preparing the marsh area or foundation before installation.
- (3) Payment for the Geogrid bid items is full compensation for providing geogrid. Payment for Geogrid also includes preparing the marsh area or foundation before installation.