

Geosynthetic Materials for Separation and Stabilization

SCDOT Designation: SC-M-203-1 (07/17)

1.0 DESCRIPTION

1.1 The requirements of this specification consist of furnishing geosynthetic materials (geotextiles or geogrids) to be used for separation and stabilization of subgrade soils, including all necessary submittals. Install these geosynthetic materials in accordance with the details shown on the plans or as directed by the Resident Construction Engineer (RCE).

2.0 TESTING STANDARDS

2.1 Use the latest edition of the testing standards indicated in this specification. Substitution of standards will require the prior written approval of the Materials and Research Engineer (MRE) with concurrence of the Geotechnical Engineer-of-Record (GEOR). Provide copies of all substituted standards to the RCE if requested. The RCE will provide the copies to the MRE and GEOR for approval and concurrence.

3.0 MATERIALS

3.1 A geosynthetic is defined as planar polymeric material used with foundation, soil, rock, earth, or any other geotechnical engineering related material, as an integral part of a civil engineering project, structure, or system. The geosynthetic materials used for separation and stabilization consist of either geotextiles or geogrids. Use geosynthetic materials having a high resistance to damage during construction, to ultraviolet degradation, and to all forms of chemical and biological degradation encountered in the soil being stabilized.

3.2 Geotextiles are manufactured from fibers consisting of long-chain polymers, composed of at least 95 percent by weight of polyolefins or polyesters. Geotextiles use fibers or yarns formed into a stable network. Such that the network retains its dimensional stability, including selvages (edges), during shipping, handling, placement, and in service. The geotextile shall be free from defects or tears.

3.3 Geogrids shall consist of a regular network of integrally connected polymer tensile elements with aperture geometry (apertures ≥ 0.25 inches) sufficient to permit significant mechanical interlock with the surrounding soil, aggregate, or other material. The structure of the geogrid reinforcements shall be dimensionally stable and able to retain its geometry under construction stresses.

3.4 Furnish geosynthetic materials meeting the strength property requirements of Table 1 and the Apparent Opening Size (AOS), permittivity, and ultraviolet stability requirements of Table 2 for separation geosynthetic, or Table 3 for stabilization geosynthetic. Do not use woven slit film geotextiles as stabilization geosynthetic materials (i.e. geotextiles made from yarns of a flat, tape-like character). The geotextile properties required for each class of survivability are dependent upon geotextile type, i.e. woven (≤ 50 percent elongation) or nonwoven (> 50 percent elongation).

TABLE 1 - GEOSYNTHETIC STRENGTH PROPERTY REQUIREMENTS¹

| PROPERTY | TEST METHODS | UNITS | Moderate Survivability ($500 \leq \tau^2 \leq 1,000$ psf) | | High Survivability ($\tau^2 < 500$ psf) | |
|------------------------------|----------------------|-------|---|-----------------------|---|-----------------------|
| | | | Woven | Nonwoven | Woven | Nonwoven |
| GEOTEXTILE | | | | | | |
| Grab Elongation | ASTM D4632 | % | < 50 | ≥ 50 | < 50 | ≥ 50 |
| Grab Strength | ASTM D4632 | lbs | 250 | 160 | 315 | 200 |
| Sewn Seam Strength | ASTM D4632 | lbs | 225 | 145 | 285 | 180 |
| Tear Strength | ASTM D4533 | lbs | 90 | 55 | 110 | 80 |
| Static Puncture Strength | ASTM D6241 | lbs | 490 | 310 | 620 | 430 |
| GEOGRID | | | XMD³ | MD³ | XMD³ | MD³ |
| Ultimate Tensile Strength | ASTM D6637, Method B | lb/ft | 1300 | 850 | 1970 | 1310 |
| Tensile Strength @ 5 Percent | ASTM D6637, Method B | lb/ft | 920 | 580 | 1340 | 810 |
| Junction Strength | ASTM D7737 | lb/ft | 25 | 25 | 25 | 25 |

Notes:

1. All numeric values represent Minimum Average Roll Value (MARV) in the weaker principal direction. Provide geotextiles whose average test results from any roll sampled in a lot for conformance or quality assurance testing meets or exceeds minimum values provided in this Table.
2. τ – Undrained shear strength.
3. XMD – Cross-machine Direction; MD – Machine Direction

TABLE 2 - SEPARATION GEOSYNTHETIC MATERIAL PROPERTY REQUIREMENTS

| | TEST METHODS | UNITS | REQUIREMENTS |
|---|--------------|--------------------|--------------------------------------|
| GEOTEXTILE | | | |
| Permittivity ¹ | ASTM D4491 | sec. ⁻¹ | ≥ 0.02 |
| AOS ^{2,3} | ASTM D4751 | Sieve Size (mm) | #30 (≤ 0.60) |
| Ultraviolet Stability ⁴ (Retained Strength) | ASTM D4355 | % | ≥ 50 after 500 hrs. of exposure |
| GEOGRID | | | |
| Opening Size | Calipered | in | 0.8 – 1.3 x 1.0 – 1.6 (MD x XMD) |
| Ultraviolet Stability ⁴ (Retained Strength) | ASTM D4355 | % | ≥ 50 after 500 hrs. of exposure |

Notes:

1. Value represents Minimum Average Roll Value (MARV). Provide geotextiles whose average test results from any roll sampled in a lot for conformance or quality assurance testing meets or exceeds this value. Permittivity of the geotextile must be greater than that required for the soil. Use greater value as specified on the plans or in the Special Provisions.
2. Value represents Maximum Average Roll Value (MaxARV). Provide geotextiles whose average test results from any roll sampled in a lot for conformance or quality assurance testing that are no greater than this value.
3. AOS requirement does not apply to geotextiles made with polyester fibers.
4. Results of testing of the product within previous 12 months.

TABLE 3 - STABILIZATION GEOSYNTHETIC MATERIAL PROPERTY REQUIREMENTS

| | TEST METHODS | UNITS | REQUIREMENTS |
|---|--------------|--------------------|-------------------------------------|
| GEOTEXTILE¹ | | | |
| Permittivity ² | ASTM D4491 | sec. ⁻¹ | ≥ 0.10 |
| AOS ^{3,4} | ASTM D4751 | Sieve Size (mm) | #40 (≤ 0.43) |
| Ultraviolet Stability ⁵ (Retained Strength) | ASTM D4355 | % | ≥ 50 after 500 hrs. of exposure |
| GEOGRID | | | |
| Opening Size | Calipered | in | 0.8 – 1.3 x 1.0 – 1.6 (MD x XMD) |
| Ultraviolet Stability ⁵ (Retained Strength) | ASTM D4355 | % | ≥ 50 after 500 hrs. of exposure |

Notes:

1. Do not use woven slit film geotextiles.
2. Value represents Minimum Average Roll Value (MARV). Provide geotextiles whose average test results from any roll sampled in a lot for conformance or quality assurance testing meets or exceeds this value. Permittivity of the geotextile must be greater than that required for the soil. Use greater value as specified on the plans or in the Special Provisions.
3. Value represents Maximum Average Roll Value (MaxARV). Provide geotextiles whose average test results from any roll sampled in a lot for conformance or quality assurance testing that are no greater than this value.
4. AOS requirement does not apply to geotextiles made with polyester fibers.
5. Results of testing of the product within previous 12 months.

3.5 Material Qualification Approval

3.5.1 Submit, to the RCE, the following information regarding each geosynthetic material proposed for use:

- Manufacturer's name and current address;
- Full product name/number;
- Geosynthetic material and structure; and
- Proposed geotextile use(s).

3.5.2 Install geosynthetic materials only after the material has been accepted by the GEOR. Replace, as directed by the RCE, all geosynthetic materials installed prior to acceptance that do not meet specifications at Contractor's expense.

3.5.3 For products currently listed by the National Transportation Product Evaluation Program (NTPEP), base the submittal package on the posted independent product line evaluation report (see www.ntpep.org). For products that are not currently listed by the NTPEP, include in the submittal package all of the information to confirm the requirements of Tables 1, 2 and 3.

3.5.4 Provide to the RCE a manufacturing quality control certificate and conformance testing results for all geosynthetic materials delivered to the site. A manufacturing quality control program that includes comprehensive QC testing by on-site GAI-LAP (Geosynthetic Accreditation Institute – Laboratory Accreditation Program) accredited laboratory and documentation of this quality control program is to be provided by the geosynthetic manufacturer to the RCE. Sampling for quality control shall be in accordance with ASTM D4354, Table 1. Geosynthetic product acceptance shall be based on ASTM D4759. Laboratory test results documenting the ultimate tensile strength, T_{ult} , in the reinforcement direction shall be based on the minimum average roll values (MARV) for the product. The quality control

certificate shall include roll numbers and identification, sampling procedures, and results of the quality control testing with a description of test methods used.

3.6 Cut a sample, in presence of the RCE or the RCE's representative, from the geosynthetic material roll with the minimum dimensions of 4 feet by the full width of the roll beyond the first wrap. Submit the sample to the RCE for evaluation. Product acceptance is determined by comparing the average test results of all specimens within a given sample to the Minimum Average Roll Values (MARV) / Maximum Average Roll Values (MaxARV) listed in Tables 1, 2 and 3. After the sample and the required information have been submitted to the RCE, allow 30 calendar days for evaluation.

3.7 Identification, Shipment and Storage

3.7.1 Conform to ASTM D4873, *Standard Guide for Identification, Storage, and Handling of Geotextiles*. Clearly label each roll of geosynthetic material shipped to the project with the name and address of the manufacturer, full product name/number, quantity, and roll number. Submit a manufacturer's certificate of compliance signed by an authorized manufacturer's official. The certificate must attest that the geosynthetic material meets all the Minimum Average Roll Value (MARV) / Maximum Average Roll Values (MaxARV) requirements specified in Tables 1, 2 and 3 as evaluated under the manufacturer's quality control program.

3.7.2 The RCE will reject materials that are mislabeled or misrepresented. Wrap or otherwise protect each roll with a material that protects the geosynthetic material, including ends of the roll, from damage due to shipment, water, sunlight, and contaminants. Maintain the protective wrapping during periods of shipment and storage. Do not damage the geosynthetic material or wrapping when unloading or transferring from one location to another. Do not drag the rolls.

3.7.3 During storage, elevate geosynthetic material rolls off the ground and adequately cover to protect them from the following:

- Site construction damage;
- Precipitation;
- Ultraviolet radiation including sunlight;
- Chemicals that are strong acids or strong bases;
- Flames including welding sparks, temperatures in excess of 140 °F; and
- Mud, dirt, dust, debris and any other environmental condition that may damage the physical property values of the geotextile.

4.0. CONSTRUCTION REQUIREMENTS

4.1. Prepare the surface on which the geosynthetic material is to be placed so that no damage occurs to the geosynthetic material. Preparation of the site may consist of clearing, grubbing, and excavating or filling the area to the design grade. This includes removal of topsoil or vegetation unless otherwise directed by the Plans and Special Provisions. The RCE will identify soft spots and unsuitable areas during site preparation. Excavate these areas and backfill with approved granular material and compact as specified. Grade the area to be covered by the geotextile to a smooth, uniform condition, free from ruts, potholes, and protruding objects such as rocks or sticks. Do not drive construction equipment on the geosynthetic material. Dispose of material with defects, rips, holes, flaws, deterioration, or other damage. Do not use defective material in the work.

4.2. Spread the geosynthetic material immediately ahead of the covering operation. Lay the geosynthetic material smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic. Remove wrinkles and folds by pulling the geosynthetic material taut as

required. Use soil piles or the manufacturer's recommended method (as approved by the RCE) to hold the geosynthetic material in place until the specified cover material is placed. Overlap geosynthetic materials a minimum of 3 feet. Overlap in the direction shown on the plans.

4.3. On curves, cut or fold the geosynthetic material to conform to the curve. Fold or overlap in the direction of construction and hold in place using pins, staples, or piles of fill or rock.

4.4. Do not cover the geosynthetic material until inspected for damage by the RCE. Repair or replace all damaged geosynthetic material at Contractor's expense. Make repairs following the manufacturer's recommendation or use a patch of the same material placed over the damaged area, overlapped at least 3 feet from the edge of any part of the damage.

4.5. Place fill over the geosynthetic material by dumping onto previously placed material and pushing the material into place. Do not operate any construction equipment directly on the geosynthetic material under any circumstances. Place the fill material in uniform layers so that there is a minimum lift thickness (loose) of 8 inches between the geosynthetic material and equipment tires or tracks at all times. The minimum thickness of the first lift is 8 inches. Do not allow construction equipment to turn on the first lift of material above the geosynthetic material. Do not blade the first lift placed over the geosynthetic material. If the subgrade is very soft with an undrained shear strength less than 500 psf minimize pile heights to less than 3 feet and spread piles as soon as possible after dumping to minimize the potential for localized subgrade failure due to overloading of the subgrade.

4.6. Do not use sheepsfoot or studded compaction equipment on the first lift placed over the geosynthetic material. Stop vibrator on compaction equipment if pumping occurs. Do not operate any construction equipment that results in rutting in excess of 3 inches on the first lift. If rutting exceeds 3 inches, decrease the construction equipment size and/or weight or increase the lift thickness. Use only rubber-tired rollers for compaction if any foundation failures occur when placing subsequent lifts. Compact all lifts to the moisture and density requirements for earth embankment specified in the Standard Construction Specifications. Do not blade material down to remove ruts. Fill any ruts or depressions with additional material and compact to the specified density.

5.0 METHOD OF MEASUREMENT

5.1 Geosynthetic materials are measured by the square yard as staked by the RCE. Measurement excludes laps, seams, joints, and material used for testing.

6.0 BASIS OF PAYMENT

6.1 Payment at the contract unit price is full compensation for all resources necessary to complete the item of work under the contract. Payment for the completed and accepted quantities is made under the following:

| Item No. | Pay Item | Pay Unit |
|-----------------|---------------------------|-----------------|
| 2036020 | Geotextile, Separation | SY |
| 2036030 | Geotextile, Stabilization | SY |
| 2037020 | Geogrid, Separation | SY |
| 2037030 | Geogrid, Stabilization | SY |