**GEOSYNTHETICS:**

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| (2-16-16) | 1056 | SP10 R25 |

Revise the *2012* *Standard Specifications* as follows:

Replace Section 1056 with the following:

**SECTION 1056**

**GEOSYNTHETICS**

**1056-1 DESCRIPTION**

Provide geosynthetics for subsurface drainage, separation, stabilization, reinforcement, erosion control, filtration and other applications in accordance with the contract. Use geotextiles, geocomposite drains and geocells that are on the NCDOT Approved Products List. Prefabricated geocomposite drains include sheet, strip and vertical drains (PVDs), i.e., “wick drains” consisting of a geotextile attached to and/or encapsulating a plastic drainage core. Geocells are comprised of ultrasonically welded polymer strips that when expanded form a 3D honeycomb grid that is typically filled with material to support vegetation.

If necessary or required, hold geotextiles and sheet drains in place with new wire staples, i.e., “sod staples” that meet Subarticle 1060-8(D) or new anchor pins. Use steel anchor pins with a diameter of at least 3/16" and a length of at least 18" and with a point at one end and a head at the other end that will retain a steel washer with an outside diameter of at least 1.5".

**1056-2 HANDLING AND STORING**

Load, transport, unload and store geosynthetics so geosynthetics are kept clean and free of damage. Label, ship and store geosynthetics in accordance with Section 7 of AASHTO M 288. Geosynthetics with defects, flaws, deterioration or damage will be rejected. Do not unwrap geosynthetics until just before installation. Do not leave geosynthetics exposed for more than 7 days before covering except for geosynthetics for temporary wall faces and erosion control.

**1056-3 CERTIFICATIONS**

Provide Type 1, Type 2 or Type 4 material certifications in accordance with Article 106-3 for geosynthetics. Define “minimum average roll value” (MARV) in accordance with ASTM D4439. Provide certifications with MARV for geosynthetic properties as required. Test geosynthetics using laboratories accredited by the Geosynthetic Accreditation Institute (GAI) to perform the required test methods. Sample geosynthetics in accordance with ASTM D4354.

**1056-4 GEOTEXTILES**

When required, sew geotextiles together in accordance with Article X1.1.4 of AASHTO M 288. Provide sewn seams with seam strengths meeting the required strengths for the geotextile type and class specified.

Provide geotextile types and classes in accordance with the contract. Geotextiles will be identified by the product name printed directly on the geotextile. When geotextiles are not marked with a product name or marked with only a manufacturing plant identification code, geotextiles will be identified by product labels attached to the geotextile wrapping. When identification is based on labels instead of markings, unwrap geotextiles just before use in the presence of the Engineer to confirm that the product labels on both ends of the outside of the geotextile outer wrapping match the labels affixed to both ends of the inside of the geotextile roll core. Partial geotextile rolls without the product name printed on the geotextile or product labels affixed to the geotextile roll core may not be used.

Use woven or nonwoven geotextiles with properties that meet Table 1056-1. Define “machine direction” (MD) and “cross-machine direction” (CD) in accordance with ASTM D4439.

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| **TABLE 1056-1 GEOTEXTILE REQUIREMENTS** | | | | | | |
| **Property** | **Requirement** | | | | | **Test Method** |
| **Type 1** | **Type 2** | **Type 3A** | **Type 4** | **Type 5B** |
| *Typical Application* | *Shoulder Drains* | *Under Rip Rap* | *Silt Fence Fabric* | *Soil Stabilization* | *Temporary Walls* |
| Elongation  (MD & CD) | ≥ 50% | ≥ 50% | ≤ 25% | < 50% | < 50% | ASTM D4632 |
| Grab Strength  (MD & CD) | Table 1**D**, Class 3 | Table 1**D**, Class 1 | 100 lb**C** | Table 1**D**, Class 3 | – | ASTM D4632 |
| Tear Strength  (MD & CD) | – | ASTM D4533 |
| Puncture Strength | – | ASTM D6241 |
| Ultimate Tensile Strength  (MD & CD) | – | – | – | – | 2,400 lb/ft**C** (unless required otherwise in the contract) | ASTM D4595 |
| Permittivity | Table 2**D**,  15% to 50% *in Situ* Soil  Passing 0.075 mm | Table 6**D**,  15% to 50% *in Situ* Soil  Passing 0.075mm | Table 7**D** | Table 5**D** | 0.20 sec-1,**C** | ASTM D4491 |
| Apparent  Opening Size | 0.60 mm**E** | ASTM D4751 |
| UV Stability  (Retained Strength) | 70%**C**  (after 500 hr  of exposure) | ASTM D4355 |

**A.** Minimum roll width of 36" required.

**B.** Minimum roll width of 13 ft required.

**C.** MARV per Article 1056-3.

**D.** AASHTO M 288.

**E.** Maximum average roll value.

**1056-5 GEOCOMPOSITE DRAINS**

Provide geocomposite drain types in accordance with the contract and with properties that meet Table 1056-2.

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| **TABLE 1056-2 GEOCOMPOSITE DRAIN REQUIREMENTS** | | | | |
| **Property** | **Requirement** | | | **Test Method** |
| **Sheet Drain** | **Strip Drain** | **Wick Drain** |
| Width | ≥ 12"  (unless required otherwise in the contract) | 12" ±1/4" | 4" ±1/4" | N/A |
| In-Plane Flow Rate**A**  (with gradient of 1.0 and 24-hour seating period) | 6 gpm/ft  @ applied normal compressive stress of 10 psi | 15 gpm/ft  @ applied normal compressive stress of 7.26 psi | 1.5 gpm**B**  @ applied normal compressive stress of 40 psi | ASTM D4716 |

**A.** MARV per Article 1056-3.

**B.** Per 4" drain width.

For sheet and strip drains, use accessories (e.g., pipe outlets, connectors, fittings, etc.) recommended by the Drain Manufacturer. Provide sheet and strip drains with Type 1 geotextiles heat bonded or glued to HDPE, polypropylene or high impact polystyrene drainage cores that meet Table 1056-3.

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| **TABLE 1056-3 DRAINAGE CORE REQUIREMENTS** | | | |
| **Property** | **Requirement (MARV)** | | **Test Method** |
| **Sheet Drain** | **Strip Drain** |  |
| Thickness | 1/4" | 1" | ASTM D1777 or D5199 |
| Compressive Strength | 40 psi | 30 psi | ASTM D6364 |

For wick drains with a geotextile wrapped around a corrugated drainage core and seamed to itself, use drainage cores with an ultimate tensile strength of at least 225 lb per 4" width in accordance with ASTM D4595 and geotextiles with properties that meet Table 1056-4.

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| **TABLE 1056-4 WICK DRAIN GEOTEXTILE REQUIREMENTS** | | |
| **Property** | **Requirement** | **Test Method** |
| Elongation | ≥ 50% | ASTM D4632 |
| Grab Strength | Table 1**A**,  Class 3 | ASTM D4632 |
| Tear Strength | ASTM D4533 |
| Puncture Strength | ASTM D6241 |
| Permittivity | 0.7 sec-1,**B** | ASTM D4491 |
| Apparent Opening Size (AOS) | Table 2**A**,  > 50% *in Situ* Soil  Passing 0.075 mm | ASTM D4751 |
| UV Stability  (Retained Strength) | ASTM D4355 |

**A.** AASHTO M 288.

**B.** MARV per Article 1056-3.

For wick drains with a geotextile fused to both faces of a corrugated drainage core along the peaks of the corrugations, use wick drains with an ultimate tensile strength of at least 1,650 lb/ft in accordance with ASTM D4595 and geotextiles with a permittivity, AOS and UV stability that meet Table 1056-4.

**1056-6 GEOCELLS**

Geocells will be identified by product labels attached to the geocell wrapping. Unwrap geocells just before use in the presence of the Engineer. Previously opened geocell products will be rejected.

Manufacture geocells from virgin polyethylene resin with no more than 10% rework, also called “regrind”, materials. Use geocells made from textured and perforated HDPE strips with an open area of 10% to 20% and properties that meet Table 1056-5.

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| **TABLE 1056-5 GEOCELL REQUIREMENTS** | | |
| **Property** | **Minimum Requirement** | **Test Method** |
| Cell Depth | 4" | N/A |
| Sheet Thickness | 50 mil -5%, +10% | ASTM D5199 |
| Density | 58.4 lb/cf | ASTM D1505 |
| Carbon Black Content | 1.5% | ASTM D1603 or D4218 |
| ESCR**A** | 5000 hr | ASTM D1693 |
| Coefficient of Direct Sliding  (with material that meets AASHTO M 145 for soil classification A-2) | 0.85 | ASTM D5321 |
| Short-Term Seam (Peel) Strength  (for 4" seam) | 320 lb | USACE**C** Technical Report GL-86-19, Appendix A |
| Long-Term Seam (Hang) Strength**B**  (for 4" seam) | 160 lb |

**A.** Environmental Stress Crack Resistance.

**B.** Minimum test period of 168 hr with a temperature change from 74°F to 130°F in 1-hour cycles.

**C.** US Army Corps of Engineers.

Provide geocell accessories (e.g., stakes, pins, clips, staples, rings, tendons, anchors, deadmen, etc.) recommended by the Geocell Manufacturer.