

Project Name:  
Project Number:

## **Section 31 32 19**

### **Specification for Woven High Modulus Geotextile Used in Subgrade Stabilization/Restraint and Base Reinforcement Applications**

#### **1. GENERAL**

##### **1.1 SECTION INCLUDES**

- A. Geotextile to stabilize and reinforce an aggregate cover material (subbase, base, select embankment, etc.) of an unpaved or paved roadway.

##### **1.2 RELATED SECTIONS**

- A. Section 02 50 00 - Site Remediation
- B. Section 01 89 13 - Site Preparation Performance Requirements
- C. Section 31 00 00 - Earthwork
- D. Section 32 10 00 - Bases, Ballasts, Pavements, and Appurtenances

##### **1.3 UNIT PRICES**

- A. Method of Measurement: By the square yard (or square meter - as indicated in contract documents) including seams, overlaps, and wastage.
- B. Basis of Payment: By the square yard (or square meter - as indicated in contract documents) installed.

##### **1.4 REFERENCES**

- A. AASHTO Standards:
  - 1. T088-10-UL - Particle Size Analysis of Soils
  - 2. T090-00-UL - Determining the Plastic Limit and Plasticity Index of Soils
  - 3. T099-10-UL - The Moisture-Density Relations of Soils Using a 5.5lb (2.5 kg) Rammer and a 12in (305 mm) Drop.
  - 4. M288 - Geotextile Specification for Highway Applications
- B. American Society for Testing and Materials (ASTM):
  - 1. D422 - Standard Test Method for Particle-Size Analysis of Soils

2. D4354 - Practice for Sampling of Geosynthetics for Testing
  3. D4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
  4. D4439 - Terminology for Geosynthetics
  5. D4491 - Test Methods for Water Permeability of Geotextiles by Permittivity
  6. D4595 - Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
  7. D4751 - Test Method for Determining Apparent Opening Size of a Geotextile
  8. D4759 - Practice for Determining the Specification Conformance of Geosynthetics
  9. D4884 - Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles
  10. D4873 - Guide for Identification, Storage, and Handling of Geotextiles
  11. D5321 - Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
  12. D6241 - Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe
  13. D6706 - Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil
  14. D8102 – Standard Practice for Manufacturing Quality Control of Geotextiles
- C. Geosynthetic Accreditation Institute-Laboratory Accreditation Program (GAI-LAP)
- D. International Standards Organization (ISO) - 9001:2015
- E. National Transportation Product Evaluation Program (NTPEP)

## 1.5 DEFINITIONS

- A. Minimum Average Roll Value (MARV): Property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported. MARV for geotextiles shall be determined in accordance with ASTM D8102.

## 1.6 SUBMITTALS

- A. Submit the following:
1. Certification: The contractor shall provide to the Engineer a certificate stating the name of the manufacturer, product name, style number, and chemical composition of the filaments or yarns and other pertinent information to fully describe the geotextile. The Certification shall state that the furnished geotextile meets MARV requirements of the specification as evaluated under the Manufacturer's quality control program per ASTM D8102 and include

supporting QC test results. The Certification shall be attested to by a person having legal authority to bind the Manufacturer. Certifications from Private Label distributors will not be accepted.

2. If an alternate product is submitted, full scale performance testing performed by an Independent testing agency shall be provided to the Engineer that quantifies the structural benefit of the geotextile. The benefit must meet or exceed the benefit of the design geotextile under similar conditions. A design including the alternate product must be stamped by a professional engineer in the state where the project is located and submitted for review.
3. Coefficient of Interaction ( $C_i$ ) test results performed by a lab with GRI accreditation should be provided to confirm conformance to the specified value.
4. Manufacturer's installation Guidelines shall be provided.
5. Three 1' x 1' sample shall be provided.
6. Quality Standards: The contractor shall provide to the Engineer the Manufacturer's Quality Control Plan along with their current GAI-LAP and ISO 9001:2015 certificates.
7. Alternate products must be submitted as outlined in Section 1.6.A a minimum of 15 days prior to bid date to engineer and should include information on five similar projects in size and scope.

## **1.7 QUALITY ASSURANCE**

### **A. Manufacturer Qualifications:**

1. The geotextile Manufacturer shall have all the following credentials:
  - a. ISO 9001:2015 Quality Management System
  - b. Geosynthetic Accreditation Institute (GAI) Laboratory Accreditation Program (LAP)

### **B. The geotextile Manufacturer shall have a GAI-LAP accredited laboratory at the location of production or receiving location capable of performing the ASTM tests as outlined in the specification and Manufacturers Quality Control Plan.**

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- ### **A. Geotextile labeling, shipment, and storage shall follow ASTM D4873. Product labels shall be color-coded to specifically identify each product and clearly show the**

Manufacturer's name, style name, and roll number. The geotextile shall be labeled directly on the product at an interval not greater than every 5 meters (15 feet) indicating the product name and manufacturing number per NTPEP GTX labeling requirements.

- B. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight, and contaminants.
- C. During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, excess temperatures, and any other environmental conditions that may damage the physical property values of the geotextile.

## **2. PRODUCTS**

### **2.1 MANUFACTURERS**

- A. TenCate Geosynthetics Americas  
365 South Holland Drive, Pendergrass, GA, USA 30567  
1-800-685-9990; 1-706-693-2226; [www.tencategeo.us](http://www.tencategeo.us); [spec@tencategeo.com](mailto:spec@tencategeo.com)

### **2.2 MATERIALS**

- A. Geotextile:
  - 1. The geotextile with orange identification yarns and super high-tenacity polypropylene yarns with a weave pattern to maximize strength, water flow, soil interaction and soil retention. The yarns shall be from high-tenacity long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins or polyesters. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages. The geotextile is produced with a unique patented double layer weave pattern utilizing two different weft yarns in weft sets and a stuffer pick, as recited in U.S. Patent 8,598,054.
  - 2. The geotextile shall meet the requirements of Table 1. Values for AOS represent maximum average roll values.

**TABLE 1 - SUBGRADE STABILIZATION GEOTEXTILE**

When sewn, seams are required refer to **Section 3 - Execution**.

Roadway Design and Performance Properties	Guidance Document / Test Method	Unit	Design / Calibration Value	
Base Course $M_R$ Improvement Factor <sup>1</sup>	AASHTO R50-09	---	1.40	
Subgrade $M_R$ Improvement / Increase <sup>2</sup>	AASHTO R50-09	lb/in <sup>2</sup> (MPa)	9,000 (62.0)	
Cyclic Tensile Modulus: $J_{cyclic}$ <sup>3</sup>	ASTM D7556	kip/ft (kN/m)	MD	CD
			60 (876)	160 (2,336)
Resilient Interface Shear Stiffness: $G_i$ <sup>3</sup>	ASTM D7499	kip/in <sup>2</sup> (MPa)	329 (2,268)	
Traffic Benefit Ratio: TBR <sup>4,5,6</sup>	AASHTO R50-09	---	9.0 / 13.1 / 39.0	
Interaction Coefficient: $C_i$ <sup>7</sup>	ASTM D6706	---	0.90	
Pore Pressure Dissipation Ratio <sup>4</sup>	Measured	---	2.0	
Typical Dynamic Filtration Pore Size $O_{95} / O_{50}$ <sup>8</sup>	ASTM D6767	microns	337 / 192	
Maximum Percent Open Area: MPOA <sup>9</sup>	ASTM D6767	Percent	7.3	
Tensile Strength @ 2% Strain (MARV)	ASTM D4595	lb/ft (kN/m)	480 (7.0)	1,800 (26.3)
Tensile Strength @ 5% Strain (MARV)	ASTM D4595	lb/ft (kN/m)	1,440 (21.0)	4,380 (63.9)

Index Properties	Test Method	Unit	Roll Value
Apparent Opening Size, AOS (Maximum Roll Value)	ASTM D4751	U.S Sieve (mm)	40 (0.425)
Hydraulic Flow Rate (MARV)	ASTM D4491	gal/min/ft <sup>2</sup> (l/min/m <sup>2</sup> )	75 (3,056)
Permittivity (MARV)	ASTM D4491	sec <sup>-1</sup>	1.0
UV Resistance (at 500 hours exposure)	ASTM D4355	% strength retained	90

**Notes:**

- <sup>1</sup> Value Determined from Results of Independent Testing Performed at Kansas State University in accordance with NCHRP Report 512 "Accelerated Pavement Testing: Data Guidelines" and AASHTO R50-09 Geosynthetic Reinforcement of the Aggregate Base Course of Flexible Pavement Structures." Multiplier for Unbound Granular Material; for SG  $M_R$  between 4.5 and 6.9 ksi (30.9 and 47.4 MPa).
- <sup>2</sup> Value Determined from Results of Independent Testing and Geosynthetic Calibrations to AASHTO Ware ME Reported by NCHRP 01-50 "Quantifying the Influence of Geosynthetics on Pavement Performance." Subgrade  $M_R$  Increase for SG  $M_R$  between 5 and 25 ksi (69 and 172 MPa).
- <sup>3</sup> Value Determined from Results of Independent Testing and Geosynthetic Calibrations Reported by WTI / MTSU "Relative Operational Performance of Geosynthetics Used as Subgrade Stabilization." Cyclic Tensile Modulus Measured at 2% Permanent Strain; Resilient Interface Shear Stiffness Normal Stress = 5.08 psi (35 kPa); Interface Shear Stress = 0.73 psi (5 kPa).
- <sup>4</sup> Value Determined from Results of Independent Testing Performed at GeoTesting Express (GeoComp) "A Laboratory Evaluation of the Performance of TenCate Mirafi® Geosynthetics in Roadway Stabilization Applications – Georgia Silt Subgrade," September 1, 2011. 9-kip (40 kN) Wheel Load, SG CBR = 1%, 12-inch (300-mm) Crushed Aggregate BC (CBR > 25%), 3-inch (75-mm) Rut Depth.
- <sup>5</sup> Value Determined from Results of Independent Testing Performed at LTRC "Performance of Reinforced–Stabilized Unpaved Test Sections Built Over Native Soft Soil Under Full-Scale Moving Wheel Loads," TRR Volume 2511, 2015. Measured at 0.34-inch (8.64 mm) Rut Depth; Peak Pore Pressure 6-inches (150 mm) Below Geosynthetic.
- <sup>6</sup> Value Determined from Results of Independent Testing Performed at GeoTesting Express (GeoComp) "A Laboratory Evaluation of the Performance of TenCate Mirafi® Geosynthetics in Roadway Stabilization Applications – Montana Clay Subgrade," September 1, 2011. 9-kip (40 kN) Wheel Load, SG CBR = 1.8%, 8-inch (200-mm) Rounded Aggregate BC (CBR > 25%), 3-inch (75-mm) Rut Depth.
- <sup>7</sup> Interaction Coefficient value is for sand (SP) or gravel (GW) based on testing conducted by SGI Testing Services.
- <sup>8</sup> Typical Value Determined from Specimen Results of Independent Testing Performed at TRI Environmental, Various Dates.
- <sup>9</sup> Maximum Value Determined from Specimen Results of Independent Testing Performed at TRI Environmental, Various Dates.

4. Approved geotextile is **Mirafi® RS580i**. Any submitted product other than **Mirafi® RS580i** is considered an alternate.

### **2.3 QUALITY CONTROL**

- A. Manufacturing Quality Control: Testing shall be performed at an on-site laboratory accredited by GAI-LAP for tests required for the geotextile, at frequency meeting or exceeding ASTM D4354 and reported MARV values per ASTM D8102.
- B. Manufacturer's certifications and testing of quality assurance samples obtained using Procedure B of ASTM D4354. A lot size for conformance or quality assurance sampling shall be the shipment quantity of the given product or a truckload of the given product, whichever is smaller.

### **3. EXECUTION**

- 3.1 See Manufacturer's Installation guidelines provided in the submittal.

**END OF SECTION**