
Standard Specification for Geosynthetics for Highway Applications

AASHTO Designation: M 288M/M 288-24¹

Technically Revised: 2024

Editorially Revised: 2024

**Technical Subcommittee: 4g, Geosynthetics and Erosion
Control Products**



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1. SCOPE

- 1.1. This is a materials specification covering geosynthetics for use in subsurface drainage, separation, stabilization, erosion control, temporary silt fence, and soil (walls and slopes). This is a material purchasing specification and a review of design and construction practices is recommended.
- 1.2. This specification sets forth a set of physical, mechanical, and endurance properties that shall be met or exceeded by the geosynthetic being manufactured.
- 1.3. The values stated in US Customary or SI units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other.
- 1.4. In the context of quality systems and management, this specification represents a manufacturing quality control (MQC) document. However, its general use is essentially as a recommended design document.
- 1.5. This specification is intended to assure both good quality and performance of geosynthetics used as listed in Section 1.1 but is possibly not adequate for the complete specification in a specific situation, especially in reinforcement applications. Additional tests, more restrictive values for the tests indicated, or values based on project specific design may be necessary under conditions of a particular application.
- 1.6. Minimum strength values provided in this specification are based on geosynthetic survivability from installation stresses. Designers should be aware that the classes and property requirements, or both, in this specification reflect this basic premise. Refer to Appendix X1 for most geosynthetic construction guidelines.

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
 - M 339M/M 339, Thermometers Used in the Testing of Construction Materials
 - R 69, Determination of Long-Term Strength for Geosynthetic Reinforcement
 - T 88, Particle Size Analysis of Soils
 - T 90, Determining the Plastic Limit and Plasticity Index of Soils
 - T 99, Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop
 - T 289, Determining pH of Soil for Use in Corrosion Testing
- 2.2. *ASTM Standards:*

- D123, Standard Terminology Relating to Textiles
- D4354, Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products (RECPs) for Testing
- D4355/D4355M, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus
- D4439, Standard Terminology for Geosynthetics
- D4491/D4491M, Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- D4533/D4533M, Standard Test Method for Trapezoid Tearing Strength of Geotextiles
- D4595, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
- D4603, Standard Test Method for Determining Inherent Viscosity of Poly(Ethylene Terephthalate) (PET) by Glass Capillary Viscometer
- D4632/D4632M, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- D4751, Standard Test Methods for Determining Apparent Opening Size of a Geotextile
- D4759, Standard Practice for Determining the Specification Conformance of Geosynthetics
- D4873/D4873M, Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
- D5141, Standard Test Method for Determining Filtering Efficiency and Flow Rate of the Filtration Component of a Sediment Retention Device
- D5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles
- D6241, Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe
- D6637/D6637M, Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method
- D7409, Standard Test Method for Carboxyl End Group Content of Polyethylene Terephthalate (PET) Yarns
- D7737/D7737M, Standard Test Method for Individual Geogrid Junction Strength
- D8102, Standard Practice for Manufacturing Quality Control of Geotextiles
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers

2.3. *U.S. Environmental Protection Agency:*

- EPA/600/R-93/182, Quality Assurance and Quality Control for Waste Containment Facilities

2.4. *Other Standards:*

- ISO 13438:2004(en), Geotextiles and geotextile-related products—Screening test method for determining the resistance to oxidation
- GRI GG8, Determination of the Number Average Molecular Weight of PET Yarns Based on a Relative Viscosity Value

3. TERMINOLOGY

- 3.1. *effective design temperature*—The temperature that is halfway between the average yearly air temperature and the normal daily air temperature for the warmest month at the reinforced soil structure site.

- 3.2. *formulation*—The mixture of a unique combination of ingredients identified by type, properties, and quantity. For geosynthetics, a formulation is defined as the exact percentages and types of resin(s), additives, and/or carbon black.
- 3.3. *geogrid (uniaxial or biaxial)*—A geosynthetic formed by a regular network of integrally connected elements with apertures greater than $\frac{1}{4}$ in. to allow interlocking with surrounding soil, rock, earth, and other surrounding materials to function primarily as reinforcement.
- 3.3.1. *biaxial geogrid*—A biaxial geogrid is defined as a geogrid that develops tensile stiffness and strength in two orthogonal directions.
- 3.3.2. *uniaxial geogrid*—A uniaxial geogrid is defined as a geogrid that develops tensile stiffness and strength primarily in one direction.
- 3.4. *geosynthetic*—A class of products consisting of manufactured planar materials used in geotechnical applications and inclusive of both geotextiles and geogrids.
- 3.5. *geotextile (woven or nonwoven)*—A permeable geosynthetic comprised solely of textiles.
- 3.6. *manufacturing quality control (MQC)*—A planned system of inspections that is used to directly monitor and control the manufacture of a material that is factory originated. MQC is normally performed by the manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the manufacturer to determine compliance with the requirements for materials and workmanship as stated in certification documents and contract specifications (refer to EPA/600/R-93/182).
- 3.7. *minimum average roll value (MARV)*—For geosynthetics, a MQC tool used to allow manufacturers to establish published values such that the user/purchaser will have a 97.7 percent confidence that the property in question, when tested, will meet published values. For normally distributed data, MARV is calculated as the average value minus two standard deviations from documented quality control test results for a defined population from one specific test method associated with one specific property (refer to ASTM D8102).
- 3.8. *minimum value*—The lowest sample value from documented MQC test results for a defined population from one test method associated with one specific property.
- 3.9. *maximum value*—The highest sample value from documented MQC test results for a defined population from one test method associated with one specific property.
- Note 1**—Other terminology related to textiles (e.g., nonwoven) and geosynthetics (e.g., apparent opening size [AOS]) may be used in this specification. Definitions for this terminology may be found in ASTM D123 or D4439.

4. PHYSICAL REQUIREMENTS

- 4.1. Fibers, yarns, straps, and sheets used in the manufacture of geotextiles and geogrids used in a reinforcement application, and the threads used in joining geotextiles by sewing, shall consist of long-chain synthetic polymers, composed of at least 95 percent, by weight, polyolefins or polyesters. They shall be formed into a stable network such that the filaments, yarns, or ribs retain their dimensional stability relative to each other, including selvages.
- 4.2. Geotextiles used for subsurface drainage, separation, soil stabilization, and permanent erosion control applications shall conform to the physical requirements of Section 8. Geotextiles used for temporary silt fence shall conform to the physical requirements of Section 9. Geotextiles and geogrids used for reinforced soil applications shall conform to the physical requirements of

Section 10. Geotextiles and geogrids used for subgrade stabilization shall conform to the physical requirements of Section 11.

- 4.3. All property values, with the exceptions of apparent opening size (AOS) and property values in Table 8 and Table 9, in these specifications represent MARV in the weakest principal direction (i.e., average test results of any roll in a lot sampled for conformance or quality assurance testing shall meet or exceed the minimum values provided herein). Values for AOS represent maximum average roll values. Values for properties in Table 8 and Table 9 are as indicated in those tables.

5. CERTIFICATION

- 5.1. *The contractor shall provide to the engineer a manufacturer certificate stating:*
- 5.1.1. Manufacturer name;
- 5.1.2. Product name;
- 5.1.3. Style number;
- 5.1.4. Chemical composition of the filaments, yarns, straps, or sheets; and
- 5.1.5. Other pertinent information to fully describe the geosynthetic.
- 5.2. For soil reinforcement, independent third-party test data used to identify values for creep, durability, and installation damage must be included with the product certification.
- 5.3. The manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available on request. The manufacturer shall have a quality control program that includes an on-site laboratory accredited by the Geosynthetic Accreditation Institute, Laboratory Accreditation Program (GAI-LAP) to perform the required test methods.
- 5.4. The manufacturer's certificate shall state that the furnished geosynthetic meets MARV requirements of this specification, except as otherwise specified, as evaluated under the manufacturer's quality control program. A person having legal authority to bind the manufacturer shall attest to the certificate.
- 5.5. Products without proper identification or labeling, mislabeling, or misrepresentation of materials shall be reason to reject those geosynthetic products.

6. SAMPLING, TESTING, AND ACCEPTANCE

- 6.1. All geosynthetics shall be subject to sampling and testing to verify conformance with this specification. Sampling shall be in accordance with ASTM D4354C. In the absence of purchaser's testing, verification of quality assurance samples collected in accordance with ASTM D4354, Procedure B may be based on manufacturer's certifications from testing by the manufacturer or by an independent third-party laboratory accredited by Geosynthetic Accreditation Institute, Laboratory Accreditation Program (GAI-LAP) to perform the required test methods. The lot size is the shipment quantity of the given product or a truckload of the given product, whichever is smaller.
- 6.2. Testing shall be performed in accordance with the methods referenced in this specification for the indicated application. The number of specimens to test per sample is specified by each test

method. Geosynthetic product acceptance shall be based on ASTM D4759. Product acceptance is determined by comparing the average test results of all specimens within a given sample to the specification MARV except as otherwise specified. Refer to ASTM D4759 for more details regarding geosynthetic acceptance procedures.

Note 2—The purchasing agency may specify and require the geosynthetic manufacturer to participate in the applicable AASHTO Product Evaluation & Audit Solutions Program for Geosynthetics (GTX, REGEO, and SSGEO), depending on the product application. Along with this Product Evaluation & Audit Solutions participation requirement, purchasing agencies may require the manufacturer to have public status data in the Product Evaluation & Audit Solutions DataMine, current publicly released Product Evaluation & Audit Solutions Reports on Laboratory Results of Evaluations, or product or product lines submitted for evaluation under the applicable product application program. The purchasing agency may require the public status data or Product Evaluation & Audit Solutions Reports on Laboratory Results of Evaluations to show the physical properties of the geosynthetic product or product line is in compliance with either M 288M/M 288 or the required project design requirements for reinforced soil applications (geosynthetic reinforcement).

7. IDENTIFICATION, SHIPMENT, AND STORAGE

- 7.1. The identification, shipment, and storage of geosynthetics shall follow ASTM D4873/D4873M. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer's certificate.

Note 3—If the purchasing agency specifies and requires the manufacturer to participate in the AASHTO Product Evaluation & Audit Solutions Program for Geosynthetics (GTX, REGEO, and SSGEO), each unique product will require additional product marking and labeling to be in compliance with the AASHTO Product Evaluation & Audit Solutions Geosynthetic GTX, REGEO, or SSGEO Work Plans, as applicable.

- 7.2. Each geotextile roll and, if required, each geogrid roll shall be wrapped with a material that will protect the geosynthetic, including the ends of the roll, from damage due to shipment, water, sunlight, and contaminants. The protective wrapping shall be maintained during periods of shipment and storage. Each geotextile roll and, if required, each geogrid roll shall include an inner core made from different material that shall protect, ensure ease of handling, and prevent damage from forklifts or other equipment used to transfer or move the geosynthetic roll.

Note 4—Polypropylene (PP) and high-density polyethylene (HDPE) geogrids may not require an outer wrapping material or an inner core material. PP and HDPE geogrids should be covered for long-term outside storage.

- 7.3. *During storage, geosynthetic rolls shall be elevated off the ground and adequately covered to protect them from the following:*

- 7.3.1. Site construction damage;
- 7.3.2. Precipitation;
- 7.3.3. Extended ultraviolet radiation, including sunlight;
- 7.3.4. Chemicals that are strong acids or strong bases;
- 7.3.5. Flames, including welding sparks;
- 7.3.6. Temperatures in excess of 160°F (71°C); and

- 7.3.7. Any other environmental condition that may damage the physical property values of the geosynthetic.

8. GEOTEXTILE PROPERTY REQUIREMENTS FOR SUBSURFACE DRAINAGE, SEPARATION, SOIL STABILIZATION, AND PERMANENT EROSION CONTROL

8.1. *General Requirements:*

- 8.1.1. Table 1 provides strength properties for four geotextile classes. The geotextile shall conform to the properties of Table 1 based on the geotextile class required in Table 2, 3, 4, 5, or 6 for the indicated application.

- 8.1.2. All numeric values in Table 1 represent MARV in the weaker principal direction. The geotextile properties required for each class are dependent on geotextile elongation. When sewn seams are used or required, the seam strength shall be equal to or greater than 90 percent of the specified grab or wide width strength.

8.2. *Subsurface Drainage Requirements:*

- 8.2.1. *Description*—This specification is applicable to placing a geotextile against a soil to allow for long-term passage of water into a subsurface drain system retaining the in situ soil. The primary function of the geotextile in subsurface drainage applications is filtration. Geotextile filtration properties are a function of the in situ soil gradation, plasticity, and hydraulic conditions.

- 8.2.2. *Geotextile Requirements*—The geotextile shall meet the requirements of Table 2. Woven slit film geotextiles (i.e., geotextiles made from yarns of a flat, tape-like character) are not allowed. All numeric values in Table 2, except AOS, represent MARV in the weaker principal direction. Values of AOS represent maximum average roll values.

Table 1—Geotextile (Class 1A and Class 1 to Class 3) Strength Property Requirements

			Geotextile Class						
			Class 1A	Class 1		Class 2		Class 3	
	Test Methods	Units	Elongation ≤15%	Elongation <50%	Elongation ≥50%	Elongation <50%	Elongation ≥50%	Elongation <50%	Elongation ≥50%
Grab Strength	ASTM D4632/ D4632M	lbf (N)	—	314 (1400)	202 (900)	247 (1100)	157 (700)	179 (800)	112 (500)
Wide Width Tensile Strength	ASTM D4595	lbf/in. (kN/m)	200 (35.0)	—	—	—	—	—	—
Tear Strength	ASTM D4533/ D4533M	lbf (N)	110 (490)	112 (500)	78 (350)	89 (400) ^e	56 (250)	67 (300)	40 (180)
Puncture Strength	ASTM D6241	lbf (N)	1000 (4450)	618 (2750)	432 (1925)	494 (2200)	309 (1375)	370 (1650)	222 (990)
Permittivity	ASTM D4491/ D4491M	sec ⁻¹	Minimum property values for permittivity, AOS, and UV stability are based on geotextile application. Refer to Table 2 for subsurface drainage, Table 3 and Table 4 for separation, Table 5 for soil stabilization, and Table 6 for permanent erosion control.						
Apparent Opening Size	ASTM D4751	U.S. Sieve (mm)							
Ultraviolet Stability	ASTM D4355/ D4355M	%							
(retained strength)									

^a Required geotextile class is designated in Table 2, 3, 4, 5, or 6 for the indicated application. The severity of installation conditions for the application generally dictates the required geotextile class. Classes 1A and 1 are specified for more severe or harsh installation conditions where there is a greater potential for geotextile damage and Classes 2 and 3 are specified for less severe conditions.

^b All numeric values represent MARV in the weaker principal direction. (See Section 8.1.2.)

^c As measured in accordance with ASTM D4595.

^d As measured in accordance with ASTM D4632/D4632M.

^e The required MARV tear strength for woven monofilament geotextiles is 56 lbf (250 N).