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USACE / NAVFAC / AFCEC **UFGS-31 32 19.16 (February 2021)**

Preparing Activity: USACE **Superseding without Revision**
UFGS-31 05 19 (August 2008)

UNIFIED FACILITIES GUIDE SPECIFICATION

References are in agreement with UMRL dated January 2025
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DIVISION 31 - EARTHWORK

SECTION 31 32 19.16

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02/21

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SECTION 31 32 19.16

GEOTEXTILE SOIL STABILIZATION
02/21

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NOTE: This guide specification covers requirements for geotextiles.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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PART 1 GENERAL

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NOTE: The "Geotextile Engineering Manual" by the Federal Highway Administration and "Designing with Geosynthetics" by Robert M. Koerner provide information on design criteria and example calculations used for the design of geotextiles.

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1.1 MEASUREMENT

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NOTE: Delete paragraphs MEASUREMENT and PAYMENT when lump sum bidding is used.

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Measure the as-built surface area, covered by geotextile, in square meters

yards. Allowance will be made for geotextile in anchor and/or drainage trenches but no allowance will be made for waste, overlaps, damaged materials, repairs, or materials used for the convenience of the Contractor.

1.2 PAYMENT

Geotextile installed and accepted will be paid for at the respective contract unit price in the bidding schedule. This unit price will include the cost of materials, equipment, installation, testing, and other costs associated with placement of the geotextile.

1.3 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D4354	(2012; R 2020) Sampling of Geosynthetics for Testing
ASTM D4355/D4355M	(2014) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D4491/D4491M	(2017) Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4533/D4533M	(2015) Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4632/D4632M	(2015a) Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	(2020) Standard Test Method for Determining Apparent Opening Size of a

	Geotextile
ASTM D4759	(2011; R 2018) Standard Practice for Determining the Specification Conformance of Geosynthetics
ASTM D4873/D4873M	(2017) Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
ASTM D6241	(2014) Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe

1.4 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Thread
Manufacturing Quality Control Sampling and Testing

SD-04 Samples

Quality Assurance Samples and Tests

SD-07 Certificates

Geotextile

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver, store, and handle geotextile in accordance with ASTM D4873/D4873M.

1.5.1 Delivery

Notify the Contracting Officer a minimum of 24 hours prior to delivery and unloading of geotextile rolls packaged in an opaque, waterproof, protective plastic wrapping. Do not remove the plastic wrapping until deployment. If quality assurance samples are collected, immediately rewrap rolls with the plastic wrapping. Repair or replace as directed, geotextile or plastic wrapping damaged during storage or handling. Label each roll with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.5.2 Storage

Protect rolls of geotextile from construction equipment, chemicals, sparks and flames, temperatures in excess of 71 degrees C 160 degrees F, or any other environmental condition that may damage the physical properties of the geotextile. To protect geotextile from becoming saturated, either elevate rolls off the ground or place them on a sacrificial sheet of plastic in an area where water will not accumulate.

1.5.3 Handling

Handle and unload geotextile rolls with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Do not drag rolls along the ground, lift by one end, or drop to the ground.

PART 2 PRODUCTS

2.1 RAW MATERIALS

A minimum of [7] [_____] days prior to scheduled use, submit manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. For needle punched geotextiles, certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. Provide the certificate of compliance attested to by a person having legal authority to bind the geotextile manufacturer.

2.1.1 Geotextile

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NOTE: This note contains information from Standard

Specifications for Transportation Materials and Methods of Sampling and Testing, Part I - Specifications, Copyright 1999 by the American Association of State Highway and Transportation Officials (AASHTO), Washington, D.C. AASHTO has given permission to use this information.

Values for grab strength, seam strength, tear strength, and puncture strength for various applications can be obtained from the AASHTO M 288 - Standard Specification for Geotextiles. The most recent version of M 288 should be used as a reference. The table in M 288 is divided into three geotextile classes. The severity of installation conditions for the application generally dictates the required geotextile class.

The following values for permittivity and apparent opening size (AOS) are from AASHTO M 288. Values for permittivity and maximum AOS should be compared to actual values of commonly manufactured products to assure there are a sufficient number of manufacturers who can meet specifications.

AASHTO M288 PERMITIVITY AND A0S REQUIREMENTS		
SOIL TO BE FILTERED	MINIMUM PERMITIVITY	MAXIMUM A0S
TEST METHOD	ASTM D4491/D4491M	ASTM D4751
UNITS	(1/SECONDS)	(mm)
LESS THAN 15 PERCENT PASSING 75 µm NO. 200	0.5	0.43 NO. 40 SIEVE
15 TO 50 PERCENT PASSING 75 m NO. 200	0.2	0.25 NO. 60 SIEVE
GREATER THAN 15 PERCENT PASSING 75 m NO. 200	0.1	0.22 NO. 70 SIEVE

The values listed above provide general guidance only. A site specific geotextile design should be performed especially if one or more of the following problematic soil environments are encountered: unstable or highly erodible soils such as non-cohesive silts; gap graded soils; alternating sand/silt laminated soils; dispersive clays; or rock flour. For cohesive soils with a plasticity index greater than 7, the geotextile maximum average roll value for AOS should be 0.30 mm No. 50 sieve.

Compatibility testing should be considered in situations where the geotextile will be exposed to chemicals which could degrade its physical properties. Refer to ASTM D5322 - Practice for

Immersion Procedures for Evaluating the Chemical Resistance of Geosynthetics to Liquids for additional guidance on compatibility testing.

Geotextiles may also be used to provide puncture protection for geomembranes. Needle-punched nonwoven geotextiles are commonly used to provide puncture protection. GRI Report Number 13 - A Design Methodology for the Puncture Protection of Geomembranes provides guidance on the design of geotextile cushion layers. Typical index properties for a 350 g/square meter geotextile are shown below:

MINIMUM REQUIREMENTS FOR PROTECTION GEOTEXTILE			
PROPERTY	**UNITS**	**ACCEPTABLE VALUES**	**TEST METHOD**
GRAB STRENGTH	**N**	**1420**	**ASTM D4632/D4632M**
PUNCTURE	**N**	**930**	**ASTM D6241**
TRAP TEAR	**N**	**555**	**ASTM D4533/D4533M**
MASS/ UNIT AREA	**G/SQ M**	**350**	**ASTM D4751**
UV DEGRADATION	**PERCENT**	**50 AT 500 HRS**	**ASTM D4355/D4355M**

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Provide geotextile that is a [woven] [nonwoven] pervious sheet of polymeric material consisting of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. Add stabilizers and/or inhibitors to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile. Post-consumer recycled material [may also] [must not] be used. Form geotextile into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Meet the requirements specified in Table 1. Where applicable, Table 1 property values represent minimum average roll values (MARV) in the weakest principal direction. Values for AOS represent maximum average roll values.

TABLE 1 MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE			
PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD

TABLE 1 MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE			
GRAB STRENGTH	NLBS	[700][160] [_____]	ASTM D4632/D4632M
SEAM STRENGTH	NLBS	[_____]	ASTM D4632/D4632M
PUNCTURE	NLBS	[250][55] [_____]	ASTM D6241
TRAPEZOID TEAR	NLBS	[250][55] [_____]	ASTM D4533/D4533M
APPARENT OPENING SIZE	U.S. SIEVE	[_____]	ASTM D4751
PERMITTIVITY	SEC -1	[_____]	ASTM D4491/D4491M
ULTRAVIOLET DEGRADATION	PERCENT	50 AT 500 HRS	ASTM D4355/D4355M

2.1.2 Thread

A minimum of [7] [_____] days prior to scheduled use, submit proposed thread type for sewn seams along with data sheets showing the physical properties of the thread. Construct sewn seams with high-strength polyester, nylon, or other approved thread type. Provide thread with ultraviolet light stability equivalent to the geotextile and color that contrasts with the geotextile.

2.2 MANUFACTURING QUALITY CONTROL SAMPLING AND TESTING

The Manufacturer is responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. A minimum of [7] [_____] days prior to scheduled use, submit manufacturer's quality control manual. Provide documentation describing the quality control program upon request. Perform manufacturing quality control sampling and testing in accordance with the manufacturer's approved quality control manual. As a minimum, randomly sample geotextiles for testing in accordance with ASTM D4354, Procedure A. Acceptance of geotextile must be in accordance with ASTM D4759. Tests not meeting the specified requirements will result in the rejection of applicable rolls.

PART 3 EXECUTION

3.1 QUALITY ASSURANCE SAMPLES AND TESTS

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NOTE: The need for and amount of quality assurance testing should be based on site conditions and the amount of geotextile being placed. EPA/600/R-93/182 indicates that a frequency of testing of once per 10,000 square meters 100,000 square feet has been

used in the past for some large waste containment facilities.

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3.1.1 Quality Assurance Samples

Provide assistance to the Contracting Officer in the collection of quality assurance samples for quality assurance testing; assign [7] [_____] days in the schedule to allow for testing. Collect samples upon delivery to the site [at the request of the Contracting Officer.] [in accordance with ASTM D4354, Procedure B. Consider the lot size for quality assurance sampling to be the shipment quantity of the product or a truckload of the product, whichever is smaller. The unit size is considered one roll of geotextile.] [at a frequency of one per 10,000 square meters 100,000 square feet]. Identify samples with a waterproof marker by manufacturer's name, product identification, lot number, roll number, and machine direction. Note the date and a unique sample number on the sample. Discard the outer layer of the geotextile roll prior to sampling a roll. Collect samples by cutting the full-width of the geotextile sheet a minimum of 1 meter 3 feet long in the machine direction. Immediately reseal rolls which are sampled in their protective covering.

3.1.2 Quality Assurance Tests

[Provide] [The Contracting Officer will provide] quality assurance samples to an Independent Laboratory. Samples will be tested to verify that geotextile meets the requirements specified in Table 1. Do not perform test method ASTM D4355/D4355M on the collected samples. Base geotextile product acceptance on ASTM D4759. Tests not meeting the specified requirements will result in the rejection of applicable rolls.

3.2 INSTALLATION

3.2.1 Subgrade Preparation

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NOTE: Reference the appropriate sections for compaction requirements if the geotextile will be placed on a soil subgrade.

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The surface underlying the geotextile must be smooth and free of ruts or protrusions which could damage the geotextile. Provide subgrade materials and compaction requirements in accordance with Section [_____].

3.2.2 Placement

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NOTE: For collection ditches, geotextile placed in the direction of flow should be wide enough to cover the entire width of the ditch. If this is not possible, the geotextile should be placed perpendicular to the direction of flow and shingled in the down-gradient direction.

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Notify the Contracting Officer a minimum of 24 hours prior to installation of geotextile. Repair or replace geotextile rolls which are damaged or contain imperfections as directed. Lay the geotextile flat and smooth so

that it is in direct contact with the subgrade. The geotextile must also be free of tensile stresses, folds, and wrinkles. On slopes steeper than 10 horizontal on 1 vertical, lay the geotextile with the machine direction of the fabric parallel to the slope direction.

3.3 SEAMS

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NOTE: Overlapped seams are commonly used for geotextile not placed in tension. Geotextile seams can also be produced by sewing or the application of thermal energy. Contact the geotextile manufacturer for installation instructions using thermal methods. ASTM D4886 should be referenced for heat seamed geotextiles.

For geotextile placed in tension, seams should be sewn and the stitch type should be based on the manufacturer's recommendations.

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3.3.1 Overlap Seams

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NOTE: Seams are typically overlapped a minimum of 300 mm 12 inches. The specified seam overlap should be greater than 300 mm 12 inches for soft subgrades or where large amounts of differential settlement are anticipated. The maximum overlap is typically 1 meter 36 inches. For soils with a CBR value of less than 1, seams are typically sewn. Refer to AASHTO M 288 for additional guidance on overlaps for soft subgrade conditions.

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Continuously overlap geotextile panels a minimum of [300] [_____] mm [12] [_____] inches at all longitudinal and transverse joints. Where seams must be oriented across the slope, lap the upper panel over the lower panel. If approved, sewn seams may be used instead of overlapped seams.

3.3.2 Sewn Seams

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NOTE: The plans and/or specifications should indicate which seams must be sewn.

Seam strength can be specified based on ASTM D4632/D4632M for applications where the geotextile will not be placed in tension. In this case, seam strength is typically measured in accordance with ASTM D4632/D4632M and is typically specified to be equal to or greater than 85 to 90 percent of the grab strength of the geotextile. If seam strength testing will be required, add seam strength requirements to Table 1.

The need for quality assurance testing needs to be determined on a site specific basis and should be based on how critical the project is and the

consequences of failure.

If the geotextile is designed to be in tension, strength testing should be required and ASTM D4884/D4884M should be used to determine seam strength. Quality assurance and quality control testing should be performed on all seams that are designed to be in tension.

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Sew factory and field seams [on all slopes steeper than 1 vertical on [4][_____] horizontal] [at the locations shown on the drawings.] Use a 401 locking chain stitch or a stitch recommended by the manufacturer. [For field and factory seams which are sewn, provide at least a 2-meter sample of sewn seam before the geotextile is installed. For seams that are field sewn, sew the seams using the same equipment and procedures as will be used for the production seams. If seams are sewn in both the machine and cross machine direction, provide samples of seams from both directions.] [Provide Quality Assurance seam samples to the Government at the request of the Contracting Officer]. Provide seam strength meeting the minimum requirements specified in Table 1. Tie off the thread at the end of each seam run to prevent unraveling. Sew skipped stitches or discontinuities with an extra line of stitching with a minimum of 450 mm 18 inches of overlap.

3.4 PROTECTION

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NOTE: The use of staples or pins to hold geotextiles in place should not be allowed in applications where the geotextile will be located adjacent to other geosynthetic layers which could be damaged.

The purpose of limiting exposure time prior to covering geotextiles is to minimize damage due to UV radiation and to prevent direct contact by vehicles, humans, and animals. To prevent UV degradation, exposure time of polypropylene geotextile should be limited to 14 to 28 days. Polyester geotextile is more resistant to UV degradation and may be exposed to UV radiation for at least 28 days without damage.

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Protect the geotextile during installation from clogging, tears, and other damage. Repair or replace damaged geotextile as directed. Use adequate ballast (e.g. sand bags) to prevent uplift by wind. Do not leave the geotextile uncovered for more than [14] [_____] days after installation.

3.5 REPAIRS

Repair torn or damaged geotextile. Remove clogged areas of geotextile. Perform repairs by placing a patch of the same type of geotextile over the damaged area. Extend the patch a minimum of 300 mm 12 inches beyond the edge of the damaged area. Continuously fasten patches using approved methods. Align the machine direction of the patch with the machine direction of the geotextile being repaired. Remove and replace geotextile rolls which cannot be repaired. Perform repairs at no additional cost to the Government

3.6 PENETRATIONS

Construct engineered penetrations of the geotextile [as shown on the drawings] [by methods recommended by the geotextile manufacturer].

3.7 COVERING

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NOTE: This paragraph should be modified if the geotextile will be covered by another geosynthetic layer.

If large stones or riprap will be placed over the geotextile, the drop height of the stones should be addressed in the specifications. At some projects, the Contractor is required to construct a small test fill to verify his placement techniques will not damage the geotextile and to determine the maximum allowable drop height.

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Do not cover geotextile prior to inspection and approval by the Contracting Officer. Place cover soil in a manner that prevents soil from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. On side slopes, place soil backfill from the bottom of the slope upward. Do not drop cover soil onto the geotextile from a height greater than 1 m 3 feet. Do not operate equipment directly on top of the geotextile without approval of the Contracting Officer. Use equipment with ground pressures less than 50 kPa 7 psi to place the first lift over the geotextile. Maintain a minimum of [300][_____] mm [12][_____] inches of soil between full-scale construction equipment and the geotextile. Cover soil material type, compaction, and testing requirements are described in Section 31 00 00 EARTHWORK. Do not use equipment for placing cover soil that stops abruptly, makes sharp turns, spins their wheels, or travels at speeds exceeding [2.2] [_____] m/s [5] [_____] mph.

-- End of Section --