Preparing Activity: USACE Superseding without Revision
UFGS-31 05 20 (August 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

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GEOGRID SOIL STABILIZATION
02/21

NOTE: This guide specification covers the requirements for geosynthetic drainage layers including both geonets and geocomposites.

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).

PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

NOTE: Delete this paragraph when lump sum bidding is used.

Measure the total surface area in square meters feet covered by geosynthetic drainage layer. Base final quantities on as-built conditions. Allowance will be made for geosynthetic drainage layer in anchor and/or drainage trenches but no allowance will be made for waste, overlap, or materials used for the convenience of the Contractor. Geosynthetic drainage layer accepted by the Contracting Officer will be paid for at the respective contract unit price in the bidding schedule.

1.2 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 D1505	(2018) Standard Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D1603	(2020) Carbon Black Content in Olefin Plastics
ASTM D4218	(2020) Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
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 D4716/D4716M	(2008; R 2013) Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
ASTM D4751	(2020) Standard Test Method for Determining Apparent Opening Size of a

	Geotextile
ASTM D4833/D4833M	(2007; R 2020) Standard Test Method forIndex Puncture Resistance of Geomembranes and Related Products
ASTM D5035	(2011) Breaking Force and Elongation of Textile Fabrics (Strip Method)
ASTM D5199	(2012) Measuring Nominal Thickness of Geosynthetics
ASTM D5261	(2010; R 2018) Standard Test Method for Measuring Mass Per Unit Area of Geotextiles
ASTM D7005	(2003; R 2008) Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites

1.3 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, Air Force, and NASA 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.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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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.][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

Sampling and Testing

Penetrations

Construction Quality Control (QC) Laboratory

SD-04 Samples

Geosynthetic Drainage Layer

Seams and Overlaps

SD-06 Test Reports

Sampling and Testing

Geosynthetic Drainage Layer

1.4 QUALITY ASSURANCE

Provide a construction quality control (QC) laboratory that has also performed quality assurance (QA) testing, if required, of geosynthetic drainage layers for at least five completed projects, having a total minimum area of [186,000] [_____] square meters [2] [_____] million square feet. Submit qualifications of laboratory carrying current accreditation via the Geosynthetic Accreditation Institute's Laboratory Accreditation Program (GAI-LAP) for the tests it will be required to perform.

1.5 DELIVERY, STORAGE, AND HANDLING

The QC inspector must be present during delivery and unloading of the geosynthetic drainage layer. Ensure the drainage layer material has not been damaged during shipping, storage, or handling. Repair or replace any drainage layer material found to be damaged. Accept delivery of material only after the required submittals have been approved. Label each roll with the manufacturer's name, product identification, lot number, roll number, and roll dimensions. Wrap rolls that have attached geotextiles individually in plastic. Store the rolls in a level and dry area.

PART 2 PRODUCTS

2.1 GEOSYNTHETIC DRAINAGE LAYER

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NOTE: The flow capacity required for the geosynthetic drainage layer should be determined using a procedure such as the one described in GRI Report Number 19 - The Design of Drainage Systems Over Geosynthetically Lined Slopes. Appropriate global safety factors and reduction factors should be applied to transmissivity values reported by

manufacturers. A global factor of safety of 2 is typically used. Guidance on reduction factors for intrusion, creep, chemical clogging, and biological clogging are provided in Designing with Geosynthetics by Dr. Robert Koerner and GRI Standard-GC8 Determination of the Allowable Flow Rate of a Drainage Geocomposite.

If high long term normal stresses are anticipated (e.g. 192 kPa 4000 psf or greater), requirements for maximum allowable creep strain should be included in Table 1. Creep strain requirements for geosynthetic drainage layers are determined using test method GRI GS 4 - Time Dependent (Creep) Deformation Under Normal Pressure. Typically, a normal stress of 2 to 3 times the design stress for a period of at least 10000 hours is used for creep strain testing.

Delete paragraphs and sentences which describe geotextile material and construction requirements if geotextiles will not be attached to the geonet.

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Use polyethylene polymer, which is clean and free of any foreign contaminants, to manufacture the geonet component of the geosynthetic drainage layer. Submit one properly identified 610 by 610 mm 24 by 24 inch minimum size geosynthetic drainage layer sample; fasteners proposed for use; and the method of seaming and overlapping. Submit manufacturer's quality control test results. Use regrind material which consists of edge trimmings and other scraps to manufacture the geonet; however, do not use post-consumer recycled materials. Conform the geosynthetic drainage layer to the property requirements listed in Table 1. Component criteria for the geonet alone and geotextile alone are also listed in Table 1. Cover the geonet on [one] [both] sides with nonwoven geotextile. Create geocomposite by heat bonding geotextile to the geonet. Do not bond the geotextile to the drainage net within 150 mm 6 inches of the edges of the rolls. Where applicable, Table 1 property values represent minimum average roll values (MARV). The value for AOS represents the maximum average roll value (MaxARV).

TABLE 1 - GEOSYNTHETIC DRAINAGE LAYER PROPERTIES			
PROPERTY	TEST METHOD	TEST VALUE	MINIMUM MQC TESTING FREQUENCY
GEONET COMPONENT			
Thickness, minimum avg, Note 1	ASTM D5199	5 mm200 mil	9300 sq m100,000 sq ft
Polymer Density, minimum avg	ASTM D1505	0.940 g/cc	9300 sq m100,000 sq ft
Carbon Black Content	ASTM D1603 ASTM D4218	1-3 percent	9300 sq m100,000 sq ft
Tensile Strength, minimum avg, Note 2	ASTM D5035	7884 N/m45 lbs/inch	9300 sq m100,000 sq ft
GEOTEXTILE COMPONENT			

TABLE 1 - GEOSYNTHETIC DRAINAGE LAYER PROPERTIES			
PROPERTY	TEST METHOD	TEST VALUE	MINIMUM MQC TESTING FREQUENCY
Mass/Unit Area, MARV	ASTM D5261	0.2 kg/sq m6.0 oz/SY	9300 sq m100,000 sq ft
Grab Strength, MARV	ASTM D4632/D4632M	698 N157 lbs	9300 sq m100,000 sq ft
Grab Elongation, MARV	ASTM D4632/D4632M	50 percent	9300 sq m100,000 sq ft
Tear Strength, MARV	ASTM D4533/D4533M	245 N55 lbs	9300 sq m100,000 sq ft
Puncture Strength, MARV	ASTM D4833/D4833M	245 N55 lbs	9300 sq m100,000 sq ft
Permittivity, MARV	ASTM D4491/D4491M	.2/sec	46,500 sq m500,000 SF
AOS(O95), MaxARV	ASTM D4751	.25 mm	46,500 sq m500,000 SF
UV Stability, percent retained (500 hours)	ASTM D4355/D4355M	50 percent	Note 3
GEOCOMPOSITE			
Transmissivity, min, including attached geotextiles, Note 4	ASTM D4716/D4716M	[_____] gal/min-foot	18,600 sq m200,000 sq ft
Geonet/Geotextile Adhesion, minimum avg, Note 5	ASTM D7005	0.5 lbs/inch	9300 sq m100,000 sq ft
Note 1: The diameter of the presser foot must be 56 mm 2.22 inches and the pressure must be 20 kPa 2.9 psi. For other thickness options, see manufacturer's literature.			
Note 2: This is the average peak value for five equally spaced machine direction tests across the roll width.			
Note 3: Manufacturer's historical data.			
Note 4: Measure manufacturing quality control transmissivity tests using a gradient of [0.1] [_____] under a normal pressure of [10] [100] [_____] kPa [1.45] [14.5] [_____] psi. Use a minimum seating period of 15 minutes. Perform the test between rigid end platens.			
Note 5: Average of five tests across the roll width. Discounting the outer 305 mm 1 foot of each side of the roll, collect samples at the 10, 30, 50, 70, and 90 percent positions across the roll width. Test both sides for double sided geocomposites.			

2.2 SAMPLING AND TESTING

2.2.1 Manufacturing Quality Control Testing

Provide manufacturing quality control test methods and frequencies in accordance with Table 1 unless otherwise approved. Submit manufacturer's quality control manual and construction quality control test results.

2.2.2 Construction Quality Control Testing

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NOTE: One or more additional performance type transmissivity tests are often required to be performed by the Contractor's quality control laboratory. These tests should be performed at gradients and normal stresses that model site conditions. The type of material in contact with the geosynthetic drainage layer affects the flow properties of the drainage layer. Performance tests should use site specific soils and geosynthetics when such materials are known.

Typically, normal loads for CQC transmissivity tests are seated on the geosynthetic drainage layer for 100 hours prior to testing to account for long-term intrusion and creep. A reduction factor for intrusion should be used if a seating period of less than 100 hours is used.

The transmissivity requirement for the construction quality control transmissivity tests will generally be lower than the value shown in Table 1 for the manufacturing quality control tests.

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Perform a minimum of [one] [_____] construction quality control transmissivity test in accordance with the requirements of this paragraph. Measure transmissivity using a gradient of [_____] under a normal pressure of [_____] kPa psf. Attach geotextile to the geonet in the same configuration as will be used in the field. Sandwich the drainage layer between [_____] on the bottom and [_____] on the top. Use a minimum seating period of [100][_____] hours. Achieve a minimum transmissivity of [_____].

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Surface Preparation

Prior to placement of the geosynthetic drainage layer, provide a subgrade that is smooth and free of all materials which could damage the drainage layer.

3.1.2 Placement

Do not damage the geosynthetic drainage layer during placement. Unroll the drainage layer in the direction of maximum slope, keeping the net flat against the subgrade to minimize wrinkles and folds. Do not drag the drainage layer across textured geomembrane if a geotextile is attached to the surface facing the geomembrane. Place adequate ballast (e.g. sandbags) to prevent uplift by wind prior to covering.

3.1.3 Seams and Overlaps

3.1.3.1 Geonet Side Seams

Overlap geonet side seams a minimum of 100 mm 4 inches. Space side seam fasteners a maximum of 1.5 m 5 feet. In anchor trenches, space fasteners a maximum of 305 mm 1 foot.

3.1.3.2 Geonet End Seams

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NOTE: Flow capacity of the geosynthetic drainage layer must be adequate to ensure all flow remains in the drainage layer and head does not build up in the cover soils above the drainage layer. For this reason, consideration must be given to flow capacity of end seams on slopes. If end seam flow capacity is a concern, end seams can be prohibited on side slopes or they can be configured such that water can flow from one geonet to another without passing through any geotextile layers.

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Overlap geonet end seams a minimum of 305 mm 1 foot. Space end seam fasteners spacing a maximum of 305 mm 1 foot. Make overlaps in the direction of flow.

3.1.3.3 Geonet Fasteners

Tie geonet rolls together with plastic fasteners. Use fasteners that are a contrasting color from the geonet and attached geotextiles. Metallic fasteners will not be allowed.

3.1.3.4 Geotextile Seams

The geotextile component of the geocomposite must be [overlapped in the direction of flow] [thermally bonded using approved methods] [sewn using approved methods].

3.1.3.5 Geotextile Cap Strips

Place geotextile cap strips over any exposed edges of geocomposite. Provide cap strips that are a minimum of 610 mm 2 feet in width and thermally bond to the geotextile component of the geocomposite.

3.1.4 Stacked Geosynthetic Drainage Layers

When geosynthetic drainage layers are to be stacked, stagger roll ends and edges so that joints do not lie above one another.

3.1.5 Corners

In the corners of landfill liner side slopes, install an extra layer of drainage layer material from the top to the bottom of the slope.

3.1.6 Penetrations

Submit penetration details. Mechanically attach a geotextile apron to pipes and other appurtenances penetrating through the drainage layer so

that soil is prevented from getting into the drainage layer. Extend the apron of the attached geotextile out from the pipe or appurtenance a minimum of 610 mm 2 feet. Thermally bond the apron geotextile to the geotextile [component of the geocomposite.][overlying the geonet.]

3.2 REPAIRS

3.2.1 Geonet Damage

Make repairs by placing a patch of the geosynthetic drainage layer over the damaged area. Extend the patch a minimum of 610 mm 2 feet beyond the edge of the damage. Use approved fasteners, spaced every 150 mm 6 inches around the patch, to hold the patch in place. If more than 25 percent of the roll width is damaged, approval must be obtained to repair or replace the damaged roll.

3.2.2 Geotextile Damage

Repair damaged geotextile by placing a patch of geotextile over the damaged area with a minimum of 305 mm 12 inches of overlap in all directions. Thermally bond the geotextile patch in place.

3.3 PROTECTION AND BACKFILLING

Cover the geosynthetic drainage layer with the specified materials within [14] [_____] days of acceptance. Place cover soil from the bottom of the slope upward and do not drop directly onto the drainage layer from a height greater than 915 mm 3 feet. Push the cover soil out over the geosynthetic drainage layer in an upward tumbling motion so that wrinkles in the drainage layer do not fold over. Do not operate equipment on the top surface of the geosynthetic drainage layer without permission from the Contracting Officer. Provide an initial loose soil lift thickness of 305 mm 12 inches. Use equipment with ground pressures no greater than 50 kPa 7 psi to place the first lift of soil. Maintain a minimum of [460] [610] [915] [_____] mm [18] [24] [36] [_____] inches of soil between construction equipment with a ground pressure greater than 50 kPa 7 psi and the drainage layer. Cover soil compaction and testing requirements are described in Section 31 00 00 EARTHWORK.

-- End of Section --