
USACE / NAVFAC / AFCEA UFGS-02373 (September 2003)

Preparing Activity: USACE Superseding
UFGS-02373 (September 2001)

UNIFIED FACILITIES GUIDE SPECIFICATION

References are in agreement with UMRL dated 25 June 2004

Latest change indicated by CHG tags

SECTION 02373

GEOTEXTILE
09/03

NOTE: This guide specification covers requirements
for geotextiles.

Comments and suggestions on this guide specification
are welcome and should be directed to the technical
proponent of the specification. A listing of
technical proponents, including their organization
designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as
a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer
choices or locations where text must be supplied by
the designer.

PART 1 GENERAL

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.

1.1 REFERENCES

NOTE: Issue (date) of references included in
project specifications need not be more current than
provided by the latest guide specification. Use of
SpecsIntact automated reference checking is
recommended for projects based on older guide
specifications.

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 D 4354	(1999) Sampling of Geosynthetics for Testing
ASTM D 4355	(2002) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D 4491	(1999a) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(1991; R 1996) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 1996) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1999a) Determining Apparent Opening Size of a Geotextile
ASTM D 4759	(2002) Determining the Specification Conformance of Geosynthetics
ASTM D 4833	(2000e1) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4873	(2002) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

1.2 MEASUREMENT

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

Measurement shall be made of the as-built surface area in square meters yards covered by geotextile. 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.

1.3 PAYMENT

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

1.4 SUBMITTALS

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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 projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Thread

A minimum of [7] [_____] days prior to scheduled use, proposed thread type for sewn seams along with data sheets showing the physical properties of the thread.

Manufacturing Quality Control Sampling and Testing

A minimum of [7] [_____] days prior to scheduled use, manufacturer's quality control manual.

SD-04 Samples

Quality Assurance Samples and Tests

Samples for quality assurance testing; [7] [_____] days shall be

allotted in the schedule to allow for testing.

SD-07 Certificates

Geotextile

A minimum of [7] [_____] days prior to scheduled use, manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. For needle punched geotextiles, the manufacturer shall also 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. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

Delivery, storage, and handling of geotextile shall be in accordance with ASTM D 4873.

1.5.1 Delivery

The Contracting Officer shall be notified a minimum of 24 hours prior to delivery and unloading of geotextile rolls. Rolls shall be packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. If quality assurance samples are collected, rolls shall be immediately rewrapped with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Each roll shall be labeled with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.5.2 Storage

Rolls of geotextile shall be protected 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, rolls shall either be elevated off the ground or placed on a sacrificial sheet of plastic in an area where water will not accumulate.

1.5.3 Handling

Geotextile rolls shall be handled and unloaded with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 PRODUCTS

2.1 RAW MATERIALS

2.1.1 Geotextile

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 AOS REQUIREMENTS

SOIL TO BE FILTERED	MINIMUM PERMITIVITY	MAXIMUM AOS
TEST METHOD	ASTM D 4491	ASTM D 4751
UNITS	(1/SECONDS)	(MM)
LESS THAN 15 PERCENT PASSING NO. 200	0.5	0.43 (NO. 40 SIEVE)
15 TO 50 PERCENT PASSING NO. 200	0.2	0.25 (NO. 60 SIEVE)
GREATER THAN 15 PERCENT PASSING 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 D 5322 - 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 D 4632
PUNCTURE	N	930	ASTM D 4833
TRAP TEAR	N	555	ASTM D 4533
MASS/ UNIT AREA	G/SQ M	350	ASTM D 4751
UV DEGRADATION	PERCENT	50 AT 500 HRS	ASTM D 4355

Apparent opening size and permittivity are not critical properties when specifying geotextiles used for puncture protection. Seams for protection geotextiles are generally overlapped a minimum of 305 mm (12 inches). Sewn seams are generally not used for puncture protection geotextiles.

Geotextile shall be a [woven] [nonwoven] pervious sheet of polymeric material and shall consist 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. Stabilizers and/or inhibitors shall be added 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] [shall not] be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Geotextiles shall 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
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TABLE 1
MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

GRAB STRENGTH	N	[700] [_____]	ASTM D 4632
SEAM STRENGTH	N	[_____]	ASTM D 4632
PUNCTURE	N	[250] [_____]	ASTM D 4833
TRAPEZOID TEAR	N	[250] [_____]	ASTM D 4533
APPARENT OPENING SIZE	U.S. SIEVE	[_____]	ASTM D 4751
PERMITTIVITY	SEC -1	[_____]	ASTM D 4491
ULTRAVIOLET DEGRADATION	PERCENT	50 AT 500 HRS	ASTM D 4355

TABLE 1
MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
GRAB STRENGTH	LBS	[160] [_____]	ASTM D 4632
SEAM STRENGTH	LBS	[_____]	ASTM D 4632
PUNCTURE	LBS	[55] [_____]	ASTM D 4833
TRAPEZOID TEAR	LBS	[55] [_____]	ASTM D 4533
APPARENT OPENING SIZE	U.S. SIEVE	[_____]	ASTM D 4751
PERMITTIVITY	SEC -1	[_____]	ASTM D 4491
ULTRAVIOLET DEGRADATION	PERCENT	50 AT 500 HRS	ASTM D 4355

2.1.2 Thread

Sewn seams shall be constructed with high-strength polyester, nylon, or other approved thread type. Thread shall have ultraviolet light stability equivalent to the geotextile and the color shall contrast with the geotextile.

2.2 MANUFACTURING QUALITY CONTROL SAMPLING AND TESTING

The Manufacturer shall be 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 upon request. Manufacturing quality control sampling and testing shall be performed in accordance with the manufacturer's approved quality control manual. As a minimum, geotextiles shall be randomly sampled for testing in accordance with ASTM D 4354, Procedure A.

Acceptance of geotextile shall be in accordance with ASTM D 4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

PART 3 EXECUTION

3.1 QUALITY ASSURANCE SAMPLES AND TESTS

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.

3.1.1 Quality Assurance Samples

The Contractor shall provide assistance to the Contracting Officer in the collection of quality assurance samples. Samples shall be collected upon delivery to the site for quality assurance testing [at the request of the Contracting Officer.] [in accordance with ASTM D 4354, Procedure B. Lot size for quality assurance sampling shall be considered to be the shipment quantity of the product or a truckload of the product, whichever is smaller. The unit size shall be considered one roll of geotextile.] [at a frequency of one per 10,000 square meters 100,000 square feet]. Samples shall be identified with a waterproof marker by manufacturer's name, product identification, lot number, roll number, and machine direction. The date and a unique sample number shall also be noted on the sample. The outer layer of the geotextile roll shall be discarded prior to sampling a roll. Samples shall then be collected by cutting the full-width of the geotextile sheet a minimum of 1 meter 3 feet long in the machine direction. Rolls which are sampled shall be immediately resealed in their protective covering.

3.1.2 Quality Assurance Tests

The [Contractor shall] [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. Test method ASTM D 4355 shall not be performed on the collected samples. Geotextile product acceptance shall be based on ASTM D 4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

3.2 INSTALLATION

3.2.1 Subgrade Preparation

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

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile. Subgrade materials and compaction requirements shall be in accordance with Section [____].

3.2.2 Placement

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.

The Contractor shall notify the Contracting Officer a minimum of 24 hours prior to installation of geotextile. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles. On slopes steeper than 10 horizontal on 1 vertical, the geotextile shall be laid with the machine direction of the fabric parallel to the slope direction.

3.3 SEAMS

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 D 4886 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.

3.3.1 Overlap Seams

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.

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

3.3.2 Sewn Seams

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

Seam strength can be specified based on ASTM D 4632 for applications where the geotextile will not be placed in tension. In this case, seam strength is typically measured in accordance with ASTM D 4632 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 D 4884 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.

Factory and field seams shall be continuously sewn [on all slopes steeper than 1 vertical on [4] [] horizontal] [at the locations shown on the drawings.] The stitch type used shall be a 401 locking chain stitch or as recommended by the manufacturer. [For field and factory seams which are sewn, the Contractor shall provide at least a 2-meter sample of sewn seam before the geotextile is installed. For seams that are field sewn, the seams shall be sewn 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, samples of seams from both directions shall be provided.] [Quality Assurance seam samples shall be provided to the Government at the request of the Contracting Officer]. Seam strength shall meet the minimum requirements specified in Table 1. The thread at the end of each seam run shall be tied off to prevent unraveling. Skipped stitches or discontinuities shall be sewn with an extra line of stitching with a minimum of 450 mm 18 inches of overlap.

3.4 PROTECTION

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.

The geotextile shall be protected during installation from clogging, tears, and other damage. Damaged geotextile shall be repaired or replaced as directed. Adequate ballast (e.g. sand bags) shall be used to prevent uplift by wind. The geotextile shall not be left uncovered for more than [14] [_____] days after installation.

3.5 REPAIRS

Torn or damaged geotextile shall be repaired. Clogged areas of geotextile shall be removed. Repairs shall be performed by placing a patch of the same type of geotextile over the damaged area. The patch shall extend a minimum of 300 mm 12 inches beyond the edge of the damaged area. Patches shall be continuously fastened using approved methods. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Geotextile rolls which cannot be repaired shall be removed and replaced. Repairs shall be performed at no additional cost to the Government

3.6 PENETRATIONS

Engineered penetrations of the geotextile shall be constructed [as shown on the drawings] [by methods recommended by the geotextile manufacturer].

3.7 COVERING

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.

Geotextile shall not be covered prior to inspection and approval by the Contracting Officer. Cover soil shall be placed 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, soil backfill shall be placed from the bottom of the slope upward. Cover soil shall not be dropped onto the geotextile from a height greater than 1 m 3 feet. No equipment shall be operated directly on top of the geotextile without approval of the Contracting Officer. Equipment with ground pressures less than 50 kPa 7 psi shall be used to place the first lift over the geotextile. A minimum of [300] [_____] mm [12] [_____] inches of soil shall be maintained between full-scale construction equipment and the geotextile. Cover soil material type, compaction, and testing requirements are described in Section [_____] . Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding [2.2] [_____] m/s [5] [_____] mph.

-- End of Section --