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USACE / NAVFAC / AFCEC / NASA UFGS-02 56 13.19 (February 2021)

Preparing Activity: USACE

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Superseding without Revision  
UFGS--02 56 15 (February 2010)

## UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2023

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### SECTION 02 56 13.19

#### GEOSYNTHETIC CLAY LINER WASTE CONTAINMENT 02/21

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NOTE: This guide specification covers the requirements for geosynthetic clay liners.

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

### 1.1 UNIT PRICES

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

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Measurement will be made of the total surface area covered by GCL in square m yards as shown on the contract drawings. Final quantities will be based on as-built conditions. Allowance will be made for GCL in anchor and drainage trenches; however, no allowance will be made for waste, overlap, repairs, or materials used for the convenience of the Contractor. GCL installed and accepted 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.

\*\*\*\*\*

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 D792	(2013) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D1505	(2018) Standard Test Method for Density of Plastics by the Density-Gradient Technique
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 D5887/D5887M	(2020) Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter
ASTM D5888	(2006; R 2016) Standard Guide for Storage and Handling of Geosynthetic Clay Liners
ASTM D5889/D5889M	(2018) Standard Practice for Quality Control of Geosynthetic Clay Liners
ASTM D5890	(2011) Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
ASTM D5891/D5891M	(2002; R 2016; E 2016) Fluid Loss of Clay Component of Geosynthetic Clay Liners

ASTM D5993	(2014) Measuring Mass Per Unit of Geosynthetic Clay Liners
ASTM D5994/D5994M	(2010; R 2015; E2015) Standard Test Method for Measuring Core Thickness of Textured Geomembranes
ASTM D6072/D6072M	(2019) Standard Practice for Obtaining Samples of Geosynthetic Clay Liners
ASTM D6243/D6243M	(2020) Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method
ASTM D6496/D6496M	(2020) Standard Test Method for Determining Average Bonding Peel Strength Between Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners
ASTM D6768/D6768M	(2020) Standard Test Method for Tensile Strength of Geosynthetic Clay Liners

### 1.3 ADMINISTRATIVE REQUIREMENTS

Submit GCL panel [layout and detail drawings](#), for approval, a minimum of [14] [\_\_\_\_] days prior to deployment. Include GCL panel layout and penetration detail drawings.

### 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, 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-02 Shop Drawings

Layout and Detail Drawings; G[, [\_\_\_\_\_]]

#### SD-03 Product Data

Manufacturer's Quality Control (QC) Manual

GCL Properties

Submit certified test results at least [14] [\_\_\_\_\_] working days prior to delivery of the GCL.

Warranty

Tests, Inspections, and Verifications

Qualifications; G[, [\_\_\_\_\_]]

Manufacturer's, installer's, QC inspector's, and QC laboratory's qualification statements including resumes of key personnel involved in this project.

#### SD-04 Samples

Samples

Deliver QC samples at the specified frequencies.

#### SD-06 Test Reports

Tests, Inspections, and Verifications

Conformance Tests

Subgrade Preparation

### 1.5 QUALITY CONTROL

#### 1.5.1 Manufacturer's Quality Control (QC) Manual

Submit the manufacturer's quality control (QC) manual which describes testing procedures, frequency of testing and acceptance/rejection criteria for QC testing at least [14] [\_\_\_\_\_] days prior to delivery of the GCL.

### 1.5.2 Qualifications

#### 1.5.2.1 Manufacturer

Provide geosynthetic clay liner that is the product of a GCL Manufacturer who has produced the proposed GCL using the same bentonite, polyethylene geomembrane, geotextiles, sewing thread, and adhesive for at least 5 completed projects and has produced a minimum of [186,000] [\_\_\_\_\_] square meters [2,000,000] [\_\_\_\_\_] square feet of the proposed GCL.

#### 1.5.2.2 Installer

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NOTE: Small projects may not require the use of a specialized GCL installer. If a specialized GCL installer will not be required, this paragraph should be omitted and the submittal requirements above edited accordingly.  
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The installer will have installed GCL at a minimum of 5 projects of comparable scope and complexity and will have installed a minimum of 186,000 [\_\_\_\_\_] square meters 2,000,000 [\_\_\_\_\_] square feet of the proposed GCL.

#### 1.5.2.3 QC Inspector

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NOTE: An independent third party inspector should be considered based on the qualifications of the Government quality assurance personnel, the size and importance of the project, and impacts of a GCL failure. Delete this paragraph if a third party inspector will not be used.  
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The independent QC inspector is responsible for monitoring and documenting activities related to the QC of the GCL from manufacturing through installation. The QC inspector will have provided QC and/or QA inspection during installation of GCL material for at least 5 projects and performed QC and/or QA inspection on a minimum of [186,000] [\_\_\_\_\_] square meters [2] [\_\_\_\_\_] million square feet of GCL.

#### 1.5.2.4 QC Laboratory

An independent QC laboratory is responsible for QC GCL testing. The QC laboratory will have provided QC and/or QA testing of GCL for at least 5 completed projects and performed QC and or QA testing for a minimum of [186,000] [\_\_\_\_\_] square meters [2] [\_\_\_\_\_] million square feet of GCL. The QC laboratory must be accredited via the Geosynthetic Accreditation Institute's Laboratory Accreditation Program (GAI-LAP).

### 1.6 DELIVERY, STORAGE, AND HANDLING

Perform delivery, storage, and handling of GCL in accordance with ASTM D5888.

### 1.6.1 Delivery

The Contracting Officer will be present during unloading of the GCL. Package rolls in an opaque, waterproof, protective covering and wrapped around a central core. Repair tears in the packaging to restore a waterproof protective barrier around the GCL. Unload rolls from the delivery vehicles in a manner that prevents damage to the GCL and its packaging.

### 1.6.2 Storage

Provide field storage flat dry areas where water cannot accumulate and the GCL rolls can be protected from damage. Storage of the rolls on blocks or pallets will not be allowed unless the GCL rolls are fully supported as approved by the Contracting Officer. Do not stack GCL rolls greater than three high. Cover rolls with a water proof tarpaulin or plastic sheet if stored outdoors.

### 1.6.3 Handling

During handling, do not drag, lift by one end, drop to the ground or otherwise damage rolls. Use a pipe or solid bar of sufficient strength to support the full weight of the roll without significant bending for all unloading and handling activities. If recommended by the manufacturer, a sling handling method utilizing appropriate loading straps may be used.

## 1.7 WARRANTY

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NOTE: Several manufacturers should be contacted to determine what length of warranty is available for GCL materials and installation. Manufacturers provide prorated material warranties ranging from 1 to 30 years depending on the application. Installation warranties are generally specified as 1 to 2 years in length.  
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Provide manufacturer's warranty stating that the GCL materials meet all requirements of the contract documents and that for the intended use, the GCL is warranted for [\_\_\_\_\_] years against deterioration. Provide installer's warranty stating that the GCL will not fail due to improper installation within [\_\_\_\_\_] years.

## PART 2 PRODUCTS

### 2.1 GCL PROPERTIES

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NOTE: Test method ASTM D5887 is an index test used to determine the flux rate of water through a GCL specimen. If a contaminated fluid will contact the GCL, compatibility testing should be considered during the design phase to ensure that the GCL can perform as desired. The following ASTM test methods should be referenced when performing compatibility testing:  
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ASTM D6141 - Standard Guide for Screening the Clay



Portion of a Geosynthetic Clay Liner (GCL) for  
chemical Compatibility to Liquids, and

ASTM D6766 - Standard Test Method for Evaluation of  
Hydraulic Properties of Geosynthetic Clay Liners  
Permeated with Potentially Incompatible Liquids.

Additional geomembrane or geotextile requirements  
can be added to Table 1 or placed in a separate  
section of the specification package and referenced  
here.

Remove geotextile and/or geomembrane requirements  
from Table 1 as required for the type of product  
being specified.

A normal stress equal to anticipated field  
conditions should be specified in Table 1 for  
mid-plane shear strength testing.

A residual mid-plane shear strength should never be  
specified. The designer must ensure that the design  
is configured such that the allowable peak mid-plane  
shear stress is not exceeded.

GCL constructed with nonwoven geotextiles on both  
sides should be considered for situations where  
increased frictional resistance is required.

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GCL must be a manufactured product consisting of a sodium montmorillonite  
clay (bentonite) layer evenly [distributed between two geotextiles] [or]  
[attached to a polyethylene geomembrane. The exposed surface of the  
polyethylene membrane must be [smooth] [textured]]. Provide GCL  
conforming to the property requirements listed in Table 1 and free of  
tears, holes, or other defects that may affect its serviceability.  
Mechanically bond encapsulating geotextiles together using a needle punch  
or stitch bonding process. Inspect needle punched and stitch bonded GCLs  
for broken needles using an in-line metal detector and remove broken  
needles. Provide minimum manufactured GCL sheet width of 4.1 m 13.5 feet  
and minimum manufactured GCL sheet length of 30 m 98 feet.

Submit manufacturer's certified raw and roll material data sheets. If  
needle punching or stitch bonding is used in construction of GCL, indicate  
that the GCL has been continuously inspected for broken needles using an  
in-line metal detector and all broken needles have been removed in the  
certification. The certified data sheets must be attested to by a person  
having legal authority to bind the GCL manufacturing company.

TABLE 1 - GCL PROPERTIES		
	TEST METHOD	TEST VALUE
BENTONITE		
Swell Index Test, minimum	ASTM D5890	24 mL

TABLE 1 - GCL PROPERTIES		
	TEST METHOD	TEST VALUE
Fluid Loss, maximum	ASTM D5891/D5891M	18 mL
UPPER GEOTEXTILE PROPERTIES		
Material Type		[Woven][Nonwoven]
Mass per Unit Area, min.	ASTM D5261	[204] [_____] g/sq m[6] [_____] ounces/square yard
LOWER GEOTEXTILE PROPERTIES		
Material Type		[Woven][Nonwoven]
Mass per Unit Area, min.	ASTM D5261	[204] [_____] g/sq m[6] [_____] ounces/square yard
GEOMEMBRANE		
Thickness, minimum	ASTM D5199 ASTM D5994/D5994M	[_____]
Sheet Density, minimum	ASTM D1505 ASTM D792	0.92 g/cc
COMPOSITE		
Bentonite Mass/Unit Area, minimum, Note 1	ASTM D5993	3700 g/sq m0.75 lbs/sq foot
Moisture Content, maximum	ASTM D5993	40 percent
Tensile Strength, minimum, (MD and CD)	ASTM D6768/D6768M	[_____] kN/m[_____] lbs/in
Peak Mid-Plane Shear Strength (hydrated), minimum at a normal stress of [_____] kPa	ASTM D6243/D6243M	[_____] kPa[_____] psf

TABLE 1 - GCL PROPERTIES		
	TEST METHOD	TEST VALUE
[Peak][Large Displacement]Interface Friction Angle (hydrated), minimum	ASTM D6243/D6243M	[_____] degrees
Index Flux, maximum	ASTM D5887/D5887M	0.00000001 cubic m/sq m-sec
Peel Strength, min. MD Peel Strength, MARV MD Note 2	ASTM D6496/D6496M	400 N/m2.3 lbs/inch
Note 1: Compute bentonite mass/unit area at 0 percent moisture content. Bentonite mass/unit area is exclusive of glues added to the bentonite. Note 2: The peel test applies to geotextile backed GCL products only.		

## 2.2 TESTS, INSPECTIONS, AND VERIFICATIONS

### 2.2.1 Manufacturing Sampling and Testing

Sample and test GCL and its components in accordance with the manufacturer's approved QC manual. The manufacturer's QC procedures must be in accordance with ASTM D5889/D5889M. Test results not meeting the requirements specified in Table 1 will result in the rejection of applicable rolls. Describe procedures used to determine rejection of applicable rolls in the manufacturer's QC manual. As a minimum, test rolls produced immediately prior to and immediately after the failed roll tested for the same failed parameter. Continue testing until a minimum of three successive rolls on both sides of the original failing roll pass the failed parameter.

### 2.2.2 Shear Strength Testing

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**NOTE:** Frictional resistance of GCL is highly dependent on the hydrating fluid, hydration state, confining stresses during saturation, confining stresses during shear, and strain rate. These parameters should be specified on a site specific basis. For interface shear strength testing, a set of direct shear tests should consist of a minimum of three tests performed at normal stresses bracketing the anticipated average normal field stresses.

The hydration state of the GCL can have a significant effect on its shear strength. The shear strength of bentonite decreases with increasing moisture content. In addition, hydration of bentonite may affect the properties of reinforced GCL by stretching the reinforcement as the bentonite swells. For geotextile backed GCLs, interface shear strength is reduced due to the bentonite extruding into the interface. As a preliminary guideline,

minimum hydration time should be 24 hours for mid-plane and interface shear strength testing. However, it must be pointed out that research indicates these hydration times will probably not result in complete hydration of the GCL. Hydration times of up to 25 days are required to attain complete hydration.

The default strain rate of 1 mm/min is currently the predominant strain rate in use for both mid-plane and interface shear strength testing. Additional guidance on determining the appropriate strain rate to prevent the build-up of pore pressure is provided in ASTM D6243/D6243M.

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Perform mid-plane and interface shear strength testing in accordance with **ASTM D6243/D6243M**. Submit mid-plane and interface shear strength test results at least [14] [\_\_\_\_\_] days prior to deployment. Use [tap water] [\_\_\_\_\_] for both mid-plane and interface shear strength testing. Include the final moisture content of the GCL at the center of each specimen with the test results. Orient GCL and adjacent geosynthetics such that the shear force is parallel to the down slope orientation of the geosynthetics in the field. Submit modifications to the test procedures described in this section for approval prior to use.

#### 2.2.2.1 Mid-Plane Shear Strength Testing

Perform [one set] [[\_\_\_\_\_] sets] of mid-plane direct shear tests. Allow specimens to hydrate prior to shearing for a minimum of [\_\_\_\_\_] hours. Provide free drainage along both sides of the GCL to aid in hydration. Allow specimens to consolidate prior to shearing for a minimum of [\_\_\_\_\_] hours. Use a normal stress of [\_\_\_\_\_] **kPa psf** during hydration, consolidation, and shearing. Do not relieve the normal stresses prior to or during shearing of the specimens. The shear rate must be [\_\_\_\_\_] . Run tests until peak strength is determined.

#### 2.2.2.2 Interface Shear Strength Testing

Perform [one set] [[\_\_\_\_\_] sets] of interface direct shear tests on both interfaces of the GCL. Allow specimens to hydrate prior to shearing for a minimum of [\_\_\_\_\_] hours. Provide free drainage along the outside of the GCL to aid in hydration. Place the other side of the GCL against the interface material on which the test will be run. Keep the interface material in place during hydration, consolidation, and shearing. Allow specimens to consolidate prior to shearing for a minimum of [\_\_\_\_\_] hours. Use normal stresses of [\_\_\_\_\_] , [\_\_\_\_\_] , and [\_\_\_\_\_] **kPa psf** during hydration, consolidation, and shearing. Do not relieve the normal stresses prior to or during shearing of the specimens. The shear rate must be [\_\_\_\_\_] . Run tests until a minimum total displacement of [50] [\_\_\_\_\_] **mm [2] [\_\_\_\_\_] inches** is reached.

### PART 3 EXECUTION

#### 3.1 SAMPLES AND TESTS

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**NOTE:** The need for and amount of QC testing performed by the QC laboratory should be determined

on a site specific basis. Permeability and tensile strength tests are often performed at a reduced frequency in comparison to the mass per unit area test referenced in this paragraph.

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### 3.1.1 Samples

Collect QC samples at approved locations upon delivery to the site at [the request of the Contracting Officer] [a frequency of one test sample per [9,000] [\_\_\_\_\_] square meters [100,000] [\_\_\_\_\_] square feet]. Collect, package, and transport samples in accordance with ASTM D6072/D6072M. Identify samples with a waterproof marker by manufacturer's name, product identification, lot and roll number. Also note the date, a unique sample number, the machine direction, and the top surface of the GCL on the sample. Discard the outer layer of the GCL roll prior to sampling a roll. Collect samples by cutting the full-width of the GCL sheet a minimum of 1 meter 3 feet wide in the machine direction. Collect and label an additional [610 by 610] [\_\_\_\_\_] mm [24 by 24] [\_\_\_\_\_] inch QA sample and submit to the Contracting Officer each time QC samples are collected.

### 3.1.2 Conformance Tests

Provide QC samples to the QC laboratory to determine bentonite mass per unit area (ASTM D5993) peel strength (ASTM D6496/D6496M), flux (ASTM D5887/D5887M) and tensile strength (ASTM D6768/D6768M) [at the request of the Contracting Officer] [at a frequency of once per [\_\_\_\_\_] square meters square feet of GCL placed]. Tests not meeting the requirements specified in Table 1 will result in the rejection of applicable rolls. Determine applicable rolls as described in paragraph Tests, Inspections and Verifications.

## 3.2 INSTALLATION

### 3.2.1 Subgrade Preparation

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NOTE: Subgrade and anchor trench soils are typically compacted to a minimum of 90 percent of ASTM D698 maximum density. The final subgrade surface should be rolled with a smooth drum roller. This paragraph will have to be removed or modified if the GCL subgrade will be another geosynthetic layer.

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Compact the subgrade in accordance with Section [31 00 00 EARTHWORK] [\_\_\_\_\_] . Provide subgrade surface that is smooth and free of vegetation, standing water, and angular stones or other foreign matter that could damage the GCL. At a minimum, roll the subgrade surface with a smooth-drum compactor of sufficient weight to remove any wheel ruts, footprints, or other abrupt grade changes. Remove, crush, or push into the surface with the smooth-drum compactor all protrusions extending more than [13] [\_\_\_\_\_] mm [0.5] [\_\_\_\_\_] inches from the subgrade surface (or less if recommended by the manufacturer). Each day during placement, the Contracting Officer and installer will inspect the surface on which GCL is to be placed and certify in writing that the surface is acceptable.

### 3.2.2 Placement

Install GCL as soon as practical after completion and approval of the subgrade. Deliver rolls to the work area in their original packaging. Immediately prior to deployment, carefully remove the packaging without damaging the GCL. Remove and replace GCL which has been hydrated prior to being covered by an overlying geomembrane or a minimum of 305 mm 12 inches of cover soil. Hydrated GCL is defined as having become soft as determined by squeezing the material with finger pressure or material which has exhibited swelling. If the subgrade is soil, construction equipment may be used to deploy GCL. If the subgrade is a geosynthetic, deploy GCL by hand or by use of approved light weight equipment with pneumatic tires which will not damage the underlying geosynthetic. On side slopes, anchor GCL at the top and deploy down the slope to minimize wrinkles. Minimize dragging of GCL panels over the ground surface. The Contracting Officer has the option of requiring the use of a slip sheet. Lay deployed GCL panels flat on the subgrade surface, with no wrinkles or folds.

### 3.2.3 Anchor Trench

Where anchor trenches are required, place them a minimum of [610] [\_\_\_\_\_] mm [24] [\_\_\_\_\_] inches back from the edge of slopes to be covered. Make anchor trenches a minimum of [610] [\_\_\_\_\_] mm [24] [\_\_\_\_\_] inches deep and [457] [\_\_\_\_\_] mm [18] [\_\_\_\_\_] inches wide. Round the front edge of the trench so as to eliminate sharp corners that could damage the GCL. Extend the GCL down the front wall and across the bottom of the anchor trench. Use soils used for backfill with a maximum particle size of 25 mm 1.0 inch and place in two lifts. Compaction and testing requirements are described in Section [\_\_\_\_\_] .

### 3.2.4 Seams

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**NOTE: Geomembrane-backed GCLs may also be welded together. Refer to Section 02 56 13.13 GEOMEMBRANE WASTE CONTAINMENT for geomembrane seaming requirements.**  
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On side slopes, place GCL with seams oriented parallel to the line of maximum slope and free of tension or stress upon completion of installation. Position panels with the overlap recommended by the manufacturer, but not less than 150 mm 6 inches for panel sides or 450 mm 18 inches for panel ends. Remove soil or other foreign matter from the overlap area immediately prior to seaming. If recommended by the manufacturer, place granular bentonite of the same type as the bentonite used for the GCL along the entire overlap width at a minimum rate of 0.37 kg/linear meter 0.25 lbs/linear foot or as recommended by the manufacturer. Use construction adhesive or other approved seaming methods recommended by the manufacturer for horizontal seams on slopes. Construct overlaps which occur on slopes with the up slope GCL shingled over the down slope GCL. Alternate seaming methods may be approved if recommended by the manufacturer.

### 3.2.5 Protection

Unpack and install only those GCL panels which can be anchored and covered in the same day. If exposed GCL cannot be permanently covered before the

end of a working day, temporarily cover with plastic or other waterproof material to prevent hydration.

### 3.3 REPAIRS

Repair holes or tears in GCL by placing a patch of GCL extending a minimum of 305 mm 12 inches beyond the edges of the hole or tear on all sides. If recommended by the manufacturer, apply granular bentonite or bentonite mastic in the overlap area. Secure patches with a construction adhesive or other approved methods as recommended by the manufacturer.

### 3.4 PENETRATIONS

Provide penetration details as recommended by the GCL manufacturer. As a minimum, pipe penetrations must incorporate a collar of GCL wrapped around the pipe and securely fastened. Place dry bentonite or bentonite paste around the penetration as recommended by the GCL manufacturer.

### 3.5 COVERING

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

Generally, cover soil should have a maximum particle size of 25 mm 1 inch or less. The required maximum particle size should be based on manufacturer's recommendations.

In cases where a non-aqueous liquid (i.e. jet fuel, gasoline, etc.) is being contained by the GCL, it may be necessary to hydrate the GCL with water prior to use. Hydration may be accomplished by introducing water into the containment area either by flooding or by the use of sprinklers. The GCL supplier should be contacted for specific procedures if manual hydration is necessary.

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Do not cover GCL prior to inspection and approval by the Contracting Officer. Use cover soil that is free of angular stones or other foreign matter which could damage the GCL. A maximum particle size of the cover soil greater than [25] [ ] mm [1] [ ] inch is unacceptable. Do not drop cover soil directly onto the GCL from a height greater than 1 meter 3 feet. Push the soil out over the GCL in an upward tumbling motion. The direction of backfilling must proceed in the direction of down gradient shingling of GCL overlaps; except that on side slopes, place soil backfill from the bottom of the slope upward. Place cover soil such that soil does not enter the GCL overlap zone and tensile stress are not mobilized in the GCL. Do not operate equipment on the top surface of the GCL without permission from the Contracting Officer. The initial loose soil lift thickness must be [305] [ ] mm [12] [ ] inches. Use equipment with ground pressures less than 50 kPa 7.0 psi to place the first lift over the GCL. Maintain a minimum of [305] [610] [915] [ ] mm [12] [24] [36] [ ] inches of soil between construction equipment with ground pressures greater than 50 kPa 7 psi and the GCL during the covering process. Do not use equipment that stops abruptly, makes sharp turns, spins their wheels, or travels at speeds exceeding [2.2] [ ] m/s

[5] [\_\_\_\_\_] mph for placing cover soil. Cover soil compaction and testing requirements are described in Section [\_\_\_\_\_].

-- End of Section --