



Standard Practice for Quality Control of Geosynthetic Clay Liners¹

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1. Scope

1.1 This practice covers the manufacturing quality control of geosynthetic clay liners (GCLs), describing types of tests, the proper test methods, and the minimum testing frequencies.

1.2 This practice is intended to aid manufacturers, suppliers, purchasers and users of GCLs in establishing a minimum level of effort for manufacturing quality control.

1.3 This practice does not address manufacturing quality assurance, product acceptance testing, or conformance testing. These are independent activities taken by organizations other than the GCL manufacturer.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

- D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D882 Test Method for Tensile Properties of Thin Plastic Sheeting
- D1505 Test Method for Density of Plastics by the Density-Gradient Technique
- D4439 Terminology for Geosynthetics

¹ This practice is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.04 on Geosynthetic Clay Liners.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- D4632/D4632M Test Method for Grab Breaking Load and Elongation of Geotextiles
- D5199 Test Method for Measuring the Nominal Thickness of Geosynthetics
- D5261 Test Method for Measuring Mass per Unit Area of Geotextiles
- D5887 Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter
- D5890 Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
- D5891/D5891M Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners
- D5993 Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners
- D5994/D5994M Test Method for Measuring Core Thickness of Textured Geomembranes
- D6243/D6243M Test Method for Determining the Internal and Interface Shear Strength of Geosynthetic Clay Liner by the Direct Shear Method
- D6496/D6496M Test Method for Determining Average Bonding Peel Strength Between Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners
- D6693/D6693M Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
- D6768/D6768M Test Method for Tensile Strength of Geosynthetic Clay Liners

2.2 Government Document:

- EPA/600/R-93/182 Technical Guidance Document Quality Assurance and Quality Control for Waste Containment Facilities³

3. Terminology

3.1 Definitions:

3.1.1 Geosynthetic Definitions:

3.1.1.1 *adhered geosynthetic clay liner (GCL), n*—GCL product in which the clay component is bonded to a film or membrane by adhesion.

³ Available from U.S. Government Publishing Office, 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.gpo.gov>.



3.1.1.2 *coated GCL, n*—GCL product with at least one layer of a synthetic substance applied to the GCL as a fluid and allowed to solidify.

3.1.1.3 *geomembrane, n*—an essentially impermeable geosynthetic composed of one or more synthetic sheets.

3.1.1.4 *geotextile, n*—a permeable geosynthetic comprised solely of textiles.

3.1.1.5 *laminated GCL, n*—GCL product with at least one film or membrane layer superimposed and bonded to the GCL by an adhesive usually under heat and pressure.

3.1.1.6 *multicomponent GCL, n*—GCL with an attached film, coating, or membrane decreasing the hydraulic conductivity or protecting the clay core, or both.

3.1.1.7 *needle-punched GCL, n*—reinforced GCL manufactured using needles that punch fibers from a nonwoven through the cover and carrier geotextile as well as the clay core to bond the components together to increase internal shear strength.

3.1.1.8 *reinforced GCL, n*—GCL that has a discrete component to increase internal shear strength.

3.1.1.9 *stitch-bonded GCL, n*—reinforced GCL manufactured by stitching in which yarns or threads are passed through the cover geosynthetic, the clay core, and the carrier geosynthetic creating a directional orientation; therefore, the direction of allowable shear transfer is predetermined.

3.1.1.10 *unreinforced GCL, n*—GCL that does not have a discrete component to increase internal shear strength.

3.1.2 *Organizational Definitions:*

3.1.2.1 *installer, n*—the party who installs, or facilitates installation of, any materials purchased from manufacturers or suppliers.

3.1.2.2 *manufacturer, n*—the group, corporation, partnership, or individual that manufactures a product.

3.1.2.3 *purchaser, n*—the person, company, or organization that purchases any materials or work to be performed.

3.1.2.4 *supplier, n*—the party who supplies material or services.

3.1.3 *Quality Definitions:*

3.1.3.1 *quality assurance (QA), n*—all those planned or systematic actions necessary to provide adequate confidence that a material, product, system, or service will satisfy given needs.

3.1.3.2 *quality control (QC), n*—a planned system of activities whose purpose is to provide a level of quality that meets the needs of users; also, the use of such a system.

3.2 For definitions of other terms, see Terminology D4439.

4. Significance and Use

4.1 GCLs must be properly manufactured in a manner consistent with a minimum level of quality control as determined by in-house testing of the final product. This practice suggests the types of tests, the methods of the testing and the minimum testing frequencies.

4.2 It should be clearly recognized that manufacturers may perform additional tests or at greater frequency than required in this practice, or both. In this case, the manufacturer's quality control plan will then take precedence over this practice. The quoted tests and test methods in Table 1 must appear in the QC plan and the QC report.

4.3 It should also be recognized that purchasers and installers of GCLs may require additional tests or at a great frequency than called for in this practice, or both. The organization(s) producing such project specific specification or quality assurance plan should recognize that such requirements are beyond the current state of the practice. If such a request is made by purchasers or installers, they should clearly communicate the requirements to the manufacturer or supplier during the contract decisions in order that disputes do not arise at a subsequent time.

5. Procedure

5.1 The procedure for this practice is embodied in Table 1.

5.1.1 The minimum recommended quality control tests for the manufacture of GCLs are given in Table 1. The tests are performed on the clay, the geosynthetic component material(s) and the finished GCL.

6. MQC Report

6.1 Report the following information:

- 6.1.1 Supplier's letter of certification or MQC data, or both,
- 6.1.2 Description or title of product MQC activity, or both,
- 6.1.3 Data of GCL production,
- 6.1.4 GCL roll numbers, brand name, and specific type,
- 6.1.5 Test results,
- 6.1.6 Signature from person in charge for MQC report.

7. Keywords

7.1 geosynthetic clay liner; geosynthetics; manufacturing quality control; multicomponent GCL; testing



MD = machine direction

CD = cross-machine direction

Minimum = lowest result for the produced lot from which the supplied rolls were selected

Maximum = highest result for the produced lot from which the supplied rolls were selected

n/a = not applicable

TABLE 1 Minimum Types of Tests and Their Frequencies for the MQC of GCLs

Test Designation	Test Method	Reinforced			Unreinforced			MQC Report Values
		Single Component	Multi-component		Single Component	Multi-component		
			with coating	with film or membrane		with coating	with film or membrane	
		Frequency of Testing						
1. Bentonite Clay								Minimum Maximum Average value
1.1 Swell index ^{A, B}	D5890	50 tonnes raw material control						
1.2 Fluid loss ^{A, B}	D5891/D5891M	50 tonnes raw material control						
1.3 Clay moisture content ^C	D5993	50 tonnes raw material control						
2. Geotextile ^{A, B, D}								Minimum Minimum
2.1 Mass per unit area	D5261	20 000 m ² [200 000 ft ²]						
2.2 Grab tensile strength (MD and CD)	D4632/D4632M	20 000 m ² [200 000 ft ²]						
3. Multi-component Barrier ^{A, B, D}								Minimum MARV ^E or minimum MARV ^E or minimum Minimum
3.1 Density of geomembrane, membrane, film backing	D792 (other resins) or D1505 (PE)	n/a	n/a	20 000 m ² [200 000 ft ²]	n/a	n/a	20 000 m ² [200 000 ft ²]	
3.2 Thickness of geomembrane, membrane, film backing	D5199 (smooth) D5994/D5994M (textured)	n/a	n/a	20 000 m ² [200 000 ft ²]	n/a	n/a	20 000 m ² [200 000 ft ²]	
3.3 Tensile strength at break and yield (MD and CD) of geomembrane, membrane, film backing	D882 (film or membrane), D6693/D6693M (geomembrane)	n/a	n/a	20 000 m ² [200 000 ft ²]	n/a	n/a	20 000 m ² [200 000 ft ²]	
3.4 Mass per unit area	D5261	n/a	20 000 m ² [200 000 ft ²]	n/a	n/a	20 000 m ² [200 000 ft ²]	n/a	
4. Finished GCL:								Minimum Minimum Average value MARV ^E or minimum Minimum Maximum
4.1 Total mass per unit area (dried) ^{F, C}	D5993	4000 m ² [40 000 ft ²]						
4.2 Clay mass per unit area (dried) ^{F, C}	D5993	4000 m ² [40 000 ft ²]						
4.3 Clay moisture content ^C	D5993	4000 m ² [40 000 ft ²]						
4.3 Tensile Strength	D6768/D6768M	20 000 m ² [200 000 ft ²]						
4.4 Bonding peel strength (MD) ^G	D6496/D6496M	20 000 m ² [200 000 ft ²]			n/a			
4.4 GCL index flux ^H or base bentonite only/GCL for multi-component GCLs	D5887	25 000 m ² [250 000 ft ²]						

^A The tests on the bentonite are to be performed on the as-received material before fabrication into the GCL product.^B Cert letter from component manufacturer or QA from GCL manufacturer, or both. Cert letters must arrive and be checked before the components are used for the GCL production.^C If the moisture content from the bentonite added during production did not change, the mass per unit area and moisture content of the bentonite (evaluated according to 1.3 in Table 1) can be used to determine the values of the finished GCL product.^D Components from finished GCL product should not be separated and tested, because the production process may alter the properties of the components.^E MARV—minimum average roll value, only evaluated for a one-year production period with an average value minus 2 standard deviations. If the production period is less than one year, for example, for job-specific products, a MARV value may not be able to be evaluated, then the minimum value shall be reported.^F Dried bentonite should be defined as 0 % moisture content.^G Internal shear testing (Test Method D6243/D6243M) may be applicable to quality control of the bonding strength of non-needle-punched reinforced and stitch-bonded GCLs.^H This test is not applicable for multi-component GCLs (for example, products with geomembrane backing(s), geofilm backing(s), or polymer backing(s)).

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