Designation: D8204 – 18 (Reapproved 2022)

Standard Practice for Burial and Retrieval of Samples in a Test Pad to Evaluate Installation Effects on Geosynthetic Clay Liners[1]

This standard is issued under the fixed designation D8204; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers standardized procedures for obtaining samples of geosynthetic clay liners (GCLs) from a test pad for use in assessment of the effects immediately after installation caused only by the installation techniques. The assessment may include physical testing. This practice is applicable to GCLs only.

1.2 This practice is limited to full-scale test pads, and does not address laboratory modeling of field conditions. This practice does not address which test method(s) to use for quantifying installation damage.

1.3 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1557 Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))

D1883 Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils

D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D4429 Test Method for CBR (California Bearing Ratio) of Soils in Place (Withdrawn 2018)[3]

D4439 Terminology for Geosynthetics

D5887/D5887M Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter

D5888 Guide for Storage and Handling of Geosynthetic Clay Liners

D5993 Test Method for Measuring Mass per Unit Area of Geosynthetic Clay Liners

D6072/D6072M Practice for Obtaining Samples of Geosynthetic Clay Liners

D6102 Guide for Installation of Geosynthetic Clay Liners

D6496/D6496M Test Method for Determining Average Bonding Peel Strength Between Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners

D6768/D6768M Test Method for Tensile Strength of Geosynthetic Clay Liners

D6913/D6913M Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

2.2 *GRI Standard:*[4]

GRI Guide GS11 Standard Guide for Constructing Test Pads to Assess Protection Materials Intended to Avoid Geomembrane Puncture

3. Terminology

3.1 *Definitions:*

3.1.1 *geosynthetic clay liner (GCL), n*—a manufactured hydraulic barrier consisting of clay bonded to a layer or layers of geosynthetics.

3.1.2 *multi-component GCL, n*—GCL with an attached film, coating, or membrane decreasing the hydraulic conductivity or protecting the clay core, or both.

3.1.3 *sample, n*—(*1*) a portion of material that is taken for testing or for record purposes; (*2*) a group of specimens used,

[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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from Geosynthetic Institute, 475 Kedron Avenue, Folsom, PA 19033-1208, http://www.geosynthetic-institute.org.

or of observations made, which provide information that can be used for making statistical inferences about the population(s) from which the specimens are drawn.

3.1.4 *test pad, n*—a distinct area of actual or simulated full-scale construction.

3.2 For definitions of other geosynthetics terms used in this practice, refer to Terminology D4439.

4. Summary of Practice

4.1 Damage to geosynthetic clay liners (GCLs) from installation operations may be quantified by evaluating specimens from a sample(s) exhumed from a full-scale installation. The sample(s) should be installed using project-specific procedures and materials. When project-specific materials or procedures (or both) are unknown, generally accepted, representative materials and procedures should be used and thoroughly documented and reported. Addressed within this practice are: amount of GCL sample(s) to install; procedures for installing the GCL sample(s); procedures for exhuming the GCL sample(s); procedure for obtaining control sample(s); and report preparation guidelines. The sample(s) should be retrieved immediately after installation to minimize potential aging of the GCL. Comparison of test results on exhumed and control specimens may be used to assess effects of installation. Tests to perform are not addressed herein, and will vary with the type and function of geosynthetic and project requirements.

5. Significance and Use

5.1 The ability to maintain design function (for example, barrier) or design properties (for example, peel strength, chemical resistance, etc.), or both, of a geosynthetic clay liner may be affected by damage to the physical structure of the GCL due to the rigors of field installation. The effect of damage may be assessed by analyzing specimens cut from sample(s) retrieved after installation in a representative test pad. Analysis may be performed with visual examination or laboratory testing of specimens from the control sample(s), and from the exhumed sample(s).

5.2 A uniform practice for installing and retrieving representative sample(s) from a test pad is needed to assess installation damage using project-specific or generally accepted, representative materials and procedures. Damage of a specific grade and type of GCL under specific installation procedures may be assessed with sample(s) exhumed from a full-scale test pad.

6. Procedure

6.1 *Objective*—Geosynthetic clay liner and soil placement techniques shall model the methods anticipated during construction, but may also be designed to model hypothetical conditions such as various degrees of compaction, lift heights, drop heights, equipment operations, types of fill material, or combinations thereof.

6.2 *Test Pad Configurations:*

6.2.1 The test pad configuration is an important consideration, and Fig. 1 is crafted so as to present several of the various options. In this regard, test pads are either above or below the ground surface and used either for specific design confirmation or to investigate various stone thicknesses. Typically, test pads are designed with soil coverage on top (6.3.1 – 6.3.4).

6.2.2 Lateral confinement of the cover soil should be considered during the compaction of the soils to simulate realistic site conditions.

6.3 The four test pad configurations shown in Fig. 1 (adapted from GRI Guide GS11) are described in 6.3.1 – 6.3.4 and could utilize various different GCL barrier systems (for example, GCL alone, multi-component GCL, GCL with geotextile, GCL with geomembrane, GCL with geosynthetic drainage layer, etc.).

6.3.1 *Above Ground with Uniform Cover Soil Thickness:*

6.3.1.1 This cross section is meant to confirm a given design, including the intended GCL barrier system, soil type, and soil thickness.

6.3.2 *Above Ground with Variable Soil Thickness:*

6.3.2.1 This investigative type cross section is meant to discover what minimum stone thickness is necessary to avoid puncture to the underlying GCL barrier system. The GCL system is held constant along with the soil type, but not its thickness.

6.3.3 *Below Ground with Uniform Soil Thickness:*

6.3.3.1 Unlike in the above-ground configuration, the cover soil in this cross section is restrained from lateral movement by the surrounding soil.

6.3.4 *Below Ground with Variable Soil Thickness:*

6.3.4.1 This cross section is used to discover what minimum stone thickness is necessary to avoid puncture to the underlying GCL. Unlike the above-ground configuration, however, the stone will be laterally confined, which is an advantage for thick layers of stone.

6.3.5 *GCL Without Cover Soil:*

6.3.5.1 GCL test pads can be constructed without additional cover soil, that is, only being covered by a geomembrane, to investigate moisture uptake, desiccation, panel separation, etc. Other test methods, as mentioned in 7.1, and testing procedures might be needed to be specified.

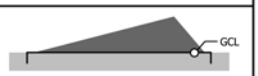
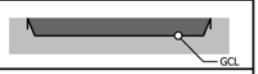
Location	Purpose	Longitudinal Cross Section
Above ground surface	Confirm a given design cross section	
Above ground surface	Investigate damage from various cover soil thicknesses	
Below ground surface	Confirm a given design cross section	
Below ground surface	Investigate damage from various cover soil thicknesses	

FIG. 1 Design of Test Pad Cross Sections

6.3.5.2 GCL test pads can be constructed without cover soil to demonstrate that vehicles can drive over the GCL, if needed, to install other geosynthetic materials (Guide D6102 mentions that low ground pressure vehicles such as four-wheeled all-terrain vehicles may be suitable) such as geomembranes, geosynthetic drainage systems, geotextiles, geogrids, or other geosynthetic materials.

6.4 The type of soil or rock (or both) of the foundation material upon which the GCL is placed is a critical item. If stones (or rock) are present, the GCL can likely be punctured from below. It might be necessary to place an additional protection geotextile beneath the GCL. If this is not the intent, then a proper foundation material must be agreed upon by the parties involved.

6.5 The type(s) of traffic loading/repetitions is another critical item, and must be agreed upon by the various parties involved.

6.6 *Size of Test Pad:*

6.6.1 The width of the test pad should be at least 100 % greater than the width of the agreed-upon placement and compaction equipment or the trafficking equipment for the two above-ground options and 50 % greater for the two below-ground options. In this regard, the confinement by natural soil is an advantage. Other advantages are that equipment will not have to ramp up or ramp down from an elevated test pad placed on the original ground surface, as well as the associated safety considerations.

6.6.2 The length of the test pad should be 300 % greater than the length of the agreed-upon placement and compaction equipment for the constant-thickness option, and from five to ten times greater for the variable-thickness options.

NOTE 1—The test pad length might need to be longer than the above-stated values, depending on the degree of accuracy required to obtain the critical soil thickness for the variable thickness option(s).

6.7 *Installation Procedure:*

6.7.1 The soil subgrade or initial lift on which the geosynthetic clay liner will be placed shall be constructed to specified conditions of soil type, moisture content, and compaction. In the case that the GCL is placed over another geosynthetic, the geosynthetic shall be recorded and be installed to the geosynthetic-specified conditions.

NOTE 2—In certain situations, it may be a requirement that the bentonite of the GCL pre-hydrates prior to further traffic over the GCL. In this case, the pre-hydration period of the bentonite with the water from the subsoil should be specified and recorded. Construction equipment used for further placement of cover materials should be the same as will be used to construct overlying lifts, unless otherwise requested. The GCL should be installed in accordance with project-specific procedures. When project-specific procedures or materials (or both) are not known, representative equipment, materials, and procedures should be used and thoroughly documented. This applies to 6.7.2 – 6.7.8 as well.

6.7.2 Note, if requested, the subgrade parameters (Practice D2487) such as particle size gradations (Test Methods D6913/D6913M), moisture content (Test Methods D2216), layer thickness, determination of Atterberg limits, Proctor density, field density of soil, CBR of soil in the field (Test Method D4429), CBR of soil in the laboratory (Test Method D1883), or other relevant parameters, geometry, and other conditions, or combinations thereof.

6.7.3 The material to be placed above the GCL under investigation will typically be a soil fill, or another geosynthetic material(s) with soil then placed upon it. When project-specific procedures or materials (or both) are not known, representative equipment, materials, and procedures should be used and thoroughly documented.

NOTE 3—In certain situations, such as multiple-layer installations, movement of individual layers in test pads may occur. Care should be taken to ensure that stress and potential slippage conditions in the test pads simulate actual field conditions as closely as possible.

6.7.4 Fill placement above the GCL shall model expected field conditions. Construction equipment used in fill placement should be the same as that to be used in subsequent construction of the earth structure. Equipment shall be operated in accordance with project-specific procedures. When project-specific equipment, procedures, materials, or combinations thereof are not known, representative equipment, materials, and procedures should be used and thoroughly documented.

6.7.5 Spread fill into lifts above the GCL modeling expected field conditions. Construction equipment used in fill spreading should be in accordance with project-specific procedures. When project-specific equipment, procedures, materials, or combinations thereof are not known, representative equipment, materials, and procedures should be used and thoroughly documented.

6.7.6 Fill lift compaction above the GCL shall model expected field conditions. Construction equipment used in soil compaction should be in accordance with project specifications. When project-specific equipment, procedures, materials, or combinations thereof are not known, representative equipment, materials, and procedures should be used and thoroughly documented.

NOTE 4—Commonly used procedures include the following: 300-mm soil lifts compacted to >90 % Modified Proctor density (Test Methods D1557) using a minimum 4500-kg (total) vibratory steel roll (single or tandem). Typical soils/aggregates include coarse gravel (GP, d50 >20 mm), concrete sand (SW d50 >1.0 mm), or silty sand (SM d50 >0.4 mm).

NOTE 5—Following placement and compaction for the lift, procedures could include the simulation of post-construction traffic such as loaded trucks moving transversely over the test pad.

6.7.7 Placement, compaction, and trafficking equipment must be decided upon by the parties involved. If available, submit equipment specification sheets for each piece of equipment. Dump trucks will generally deliver the soil material and a bulldozer will generally spread it. Compaction will be achieved by both tire pressure from trucks and earth-moving equipment. A separate roller may also be involved for additional compaction. Some important considerations that must be agreed upon are as follows:

6.7.7.1 Weight and tire pressure of trucks.

6.7.7.2 Weight and size of earth-moving equipment.

6.7.7.3 Track width and contact area of earth-moving equipment.

6.7.7.4 Method of dumping stone on the GCL barrier system.

6.7.7.5 Number of truck or earth-moving equipment (or both) passes along length of test pad.

6.7.7.6 Turning of earth-moving equipment on the test pad; for example, where and how often.