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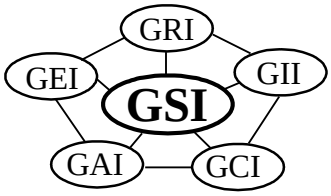


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**GRI-GCL4***

Standard Guide for

"Gripping of Reinforced GCLs to End Platens During Direct (Interface) Shear Testing"

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1. Scope

1.1 This guide is focused on a specific method of gripping reinforced geosynthetic clay liners (GCLs) to a rigid end platen during direct (interface) shear testing. It applies to ASTM D5321, ASTM D6243, and ISO 12957; all of which present the basics of the direct shear test method.

Note 1: The word "gripping" is used throughout this guide, but in related literature the words "clamping" or "attachment" are also used.

1.2 This guide is relevant to all types of top and bottom geotextiles on GCLs since uniformity of gripping over the entire surface area is necessary for representative test results.

Note 2: In this regard, clamping or attaching of only the leading edge and/or sides of the GCL often results in distortion in the central region of the material during the test and thus leads to anomalous results.

1.3 This guide does <u>not</u> address the conducting of the shear test, per se, since such details are adequately covered in the referenced test methods.

*This GRI standard is developed by the Geosynthetic Research Institute through consultation and review by the member organizations. This specification will be reviewed at least every 2-years, or on an as-required basis. In this regard it is subject to change at any time. The most recent revision date is the effective.

1.4 This guide does not address the gripping of geomembranes, geogrids, or geonets to end platens since they are typically done in a satisfactory manner by gluing, stapling, or other methods of attachment. Furthermore, drainage through these geosynthetic is rarely an issue.

1.5 The primary targeted audiences for this guide are commercial testing laboratories, manufacturers testing laboratories, design engineers, construction quality control and construction quality assurance personnel.

2. Referenced Documents

2.1 ASTM Standards

D 5321 Test Method for Determining the Coefficient of Soil and Geosynthetics or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
D 6243 Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liners by the Direct Shear Method

2.2 ISO Standards

12957 Test Method for Determination of Friction Characteristics: Part 1: Direct Shear Test

2.3 Technical Reference

Lacey, R. and Koerner, G. R. (2005), "Clamping/Gripping of Geosynthetic Clay Liners for Mid-Plane Shear Strength Testing," Proc. GRI-18 Conference at GeoFrontiers, ASCE/GeoInstitute, Reston, VA, January, 2005.

3. Summary of Guide

3.1 The guide describes in detail how the upper and/or lower surface of reinforced GCLs are to be gripped to, and by, the opposing rigid end platen (usually a PVC or plexiglass board) that is contained in the upper and/or lower portion of the shear box being utilized for the test.

3.2 A major objective of the guide is that the gripping method engages the entire surfaces of the geotextiles covering the GCLs so that slippage does not occur or is minimized in a very localized area.

3.3 At the same time that gripping occurs, many situations call for drainage of expelled liquid to occur during the test and such is provided for in this guide.

3.4 The situation is markedly different in shear testing of geomembrane, geogrid, and geonet interfaces without geotextiles being involved, since these geosynthetics can usually be attached continuously to the end platen and drainage through them is rarely an issue.

4. Significance and Use

4.1 Commercial testing laboratories, manufacturers testing laboratories, design engineers, construction quality control and construction quality assurance personnel, as well as regulatory personnel and facility owner/operators, should use or require this guide to be used, so to compliment the appropriately designated direct shear standard.

4.2 Use of the guide should provide for more consistent direct shear test results than at present, where many different gripping, attachment, and clamping methods are being used.

Note 3: Other geotextile gripping methods that have been used are rasp boards, needle boards, textured geomembranes, and talons. See Lacey and Koerner (2005) for test results and comparison curves.

4.3 The following methodology describes the internal testing of geotextile-related reinforced GCLs, but the general gripping procedure applies to all geotextiles either by themselves, on geonet composites, or interfaces of GCLs and GT/GN composites.

5. Specimen Preparation

5.1 Specimens are to be 305 mm (12 in.) wide by 508 mm (20 in.) long, with the long direction in the direction of the test.

5.2 Separate 102 mm (4 in.) on each end of the 508 mm (20 in.) length. Careful separation with a utility knife aids in cutting the fibers and separating the cover from the carrier geotextiles.

5.3 Shake or otherwise clean out the infilled bentonite from the separated ends.

6. Material Needed for Spike Board Preparation

6.1 Cut two pieces of 305 mm (12 in.) by 305 mm (12 in.) 16 gauge truss plates. Dimensions of plates may be up to 13 mm (0.5 in.) to accommodate different box configurations. They can be purchased from different vendors. An example is Eagle Metal Products, P. O. Box 1267, Mabank, TX 75147, 800-521-3245 (EAGL), www.eaglemetal.com.

6.2 Cut two pieces of 305 mm (12 in.) by 305 mm (12 in.) by 19 mm (3/4 in.) thick. Type 1 Gray PVC Normal Impact PVC Sheet. They can be purchased from many vendors. Examples are Total Plastics Inc., TPI, 2810 N. Burdick St., Kalamazoo, MI 49004, (866) 956-6925, Laird Plastics, Inc., 211 Sinclair St., Bristol, PA 19007, (215) 785-3776 and McMaster Carr, 473 Ridge Rd., Dayton, NJ 08810, (732) 329-3200, Cat # 87 47 K117

6.3 Purchase a roll of 20 × 20 mesh metal window screen.

7. Machining

7.1 Machine the truss plates on a milling machine so that the teeth of the plate conform to the dimensions of Figure 1. Note that these 16 gauge plates should have tooth layout similar as described in Figure 2.

7.2 To facilitate drainage underneath the machined truss plate, cut eleven, 2.5 mm wide by 2.5 mm deep horizontal slots in the PVC plate. Evenly space the slots on the top side of the plate so that the eleven slots in the one direction intersect the eleven slots in the opposite direction at right angles as shown in Figure 3.

7.3 To facilitate vertical flow, drill 121 evenly spaced 6.4 mm (1/4 in.) diameter holes through the PVC plate at the intersections of the damage slots as shown in Figure 3.

8. Spike Board Assembly

8.1 The spike boards can now be assembled by bolting or screwing the machined truss plate through a 20 by 20 mesh steel screen into the PVC plate. A sketch of this detail is shown in Figure 4. Furthermore, Figure 5 shows a photograph of the components and the assembly spike board. Note that two boards (one above and one below) are needed for internal shear strength testing of GCLs.

8.2 It has been found by experience that eight #8 ×3/4 in. socket cap screws with flat heads hold the assembly together well. It is best to drill 1/8" pilot hole in the PVC to receive the screw. A screw pattern of two rows of three, divide by one row of two works well. The flat screw head should be made to sit flush.

9. Specimen Assembly

9.1 Prepare GCL specimen as shown in Figure 6. Delaminate 6 in. (150 mm) of each end by pulling the GCL apart by hand. One may need to cut a few initial fibers with a utility knife to start the separation.

9.2 Wrap the geotextile ends around the spike boards as shown in Figures 7 and 8. Note that both ends are wrapped around the boards. The technique is a compromise but has been shown to give good results.

9.3 With hot melt glue, lay a bead of glue on top of the board to lock in the fibers of the geotextile ends as shown in Figure 8. Rotate the assembly over and repeat the process so that one has a needle board-GCL-needle board sandwich as shown in Figure 9.

9.4 Force fit the assembly into the shear box as shown in Figure 10 with the bentonite layer centered between the box halves.

9.5 The specimen is now ready for testing per the appropriate ASTM or ISO test method.

10. Summary

This guide presents a specific method of gripping the geotextiles of reinforced GCLs to a rigid end platen during shear testing. It is specifically focused on midplane GCL testing (as illustrated herein). The primary purpose of the guide is to obtain consistent test results between the various laboratories performing such testing services. The following requirements should be kept in mind.

10.1 The grips cannot interfere with the interface being sheared.

10.2 Grips must keep the GCL surface flat and should develop uniform resistance over the interface or surface being sheared.

10.3 Observation of slippage or tearing of either of the geotextiles or the GCL invalidates the test.

10.4 If applicable, the grips must permit fluid flow into and out of the specimen, through the holes in the grips, within the slots behind the grips, and out of the shear box sections so as not to build up pore water pressure in the test specimen.

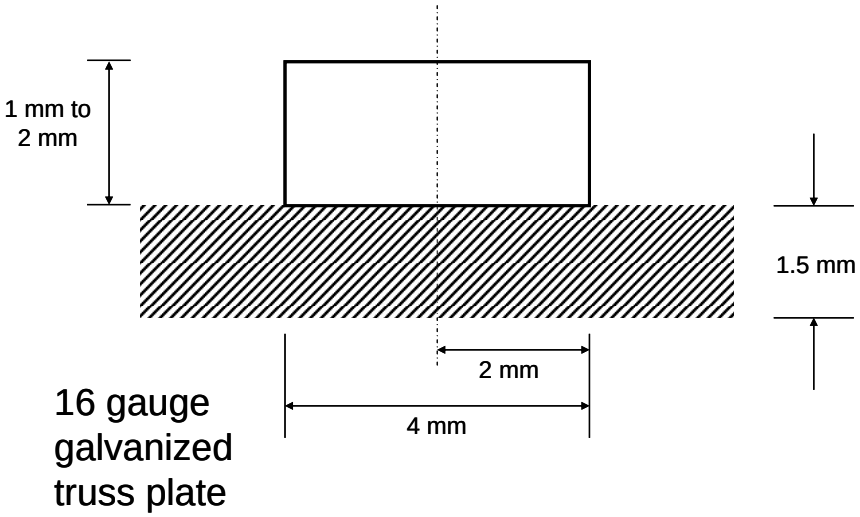


Figure 1. Detailed dimensions of plate tooth cross section.

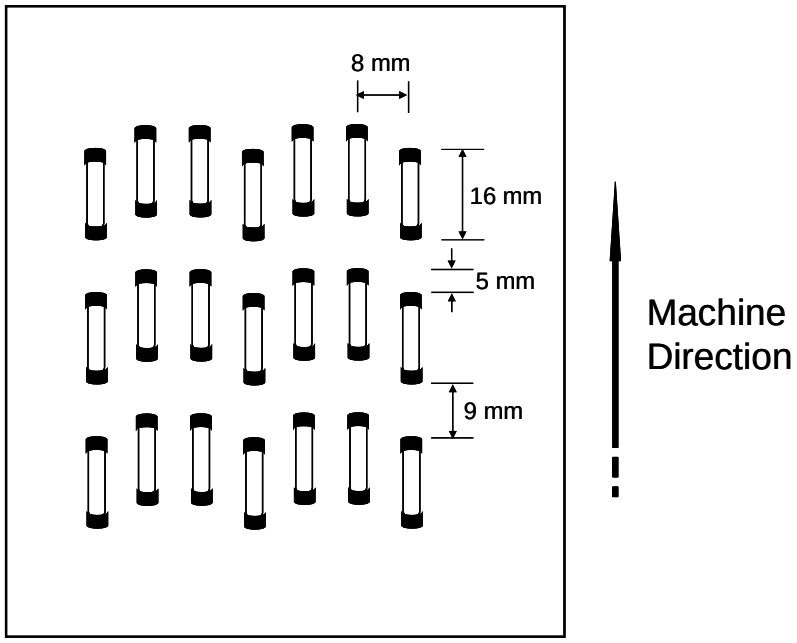


Figure 2. Plan view of plate tooth layout.

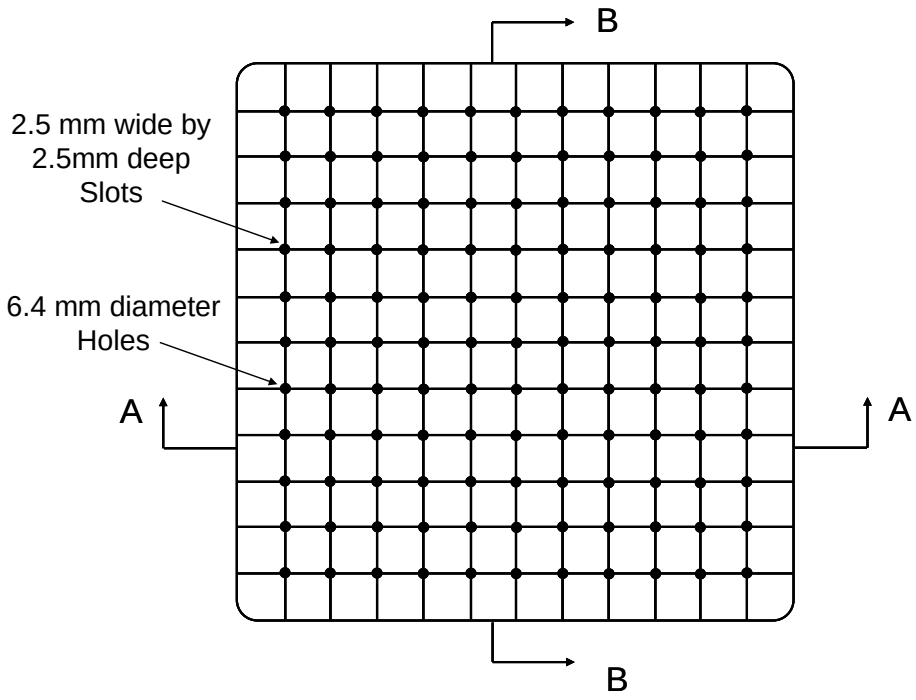


Figure 3. Plan view of PVC support plate with 22 slopes and 121 holes.

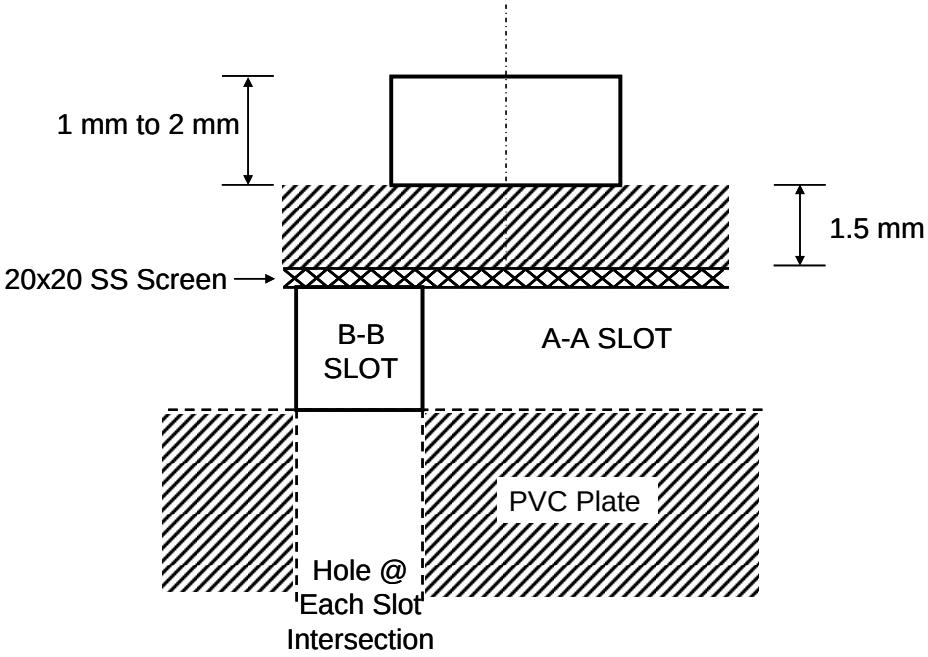


Figure 4. Cross-section of assembled spike board.

Figure 5. Internal clamps/grips assembled in background and apart in foreground.

Figure 6. Preparation of the 1 ft (300 mm) wide by 2 ft (600 mm) long GCL specimen. 6 in. (150 mm) of each end is delaminated by hand to facilitate wrap around attachment.

Figure 7. Embedding needles of clamp/grips into the geotextile of the GCL.

Figure 8. Applying a bead of hot melt glue to the back of the clamp/grips to facilitate adhesion of geotextile to the back PVC plate.

Figure 9. The entire clamp/grip assembly sandwiching the GCL in the midplane of the assembly as shown by the pen indicator.

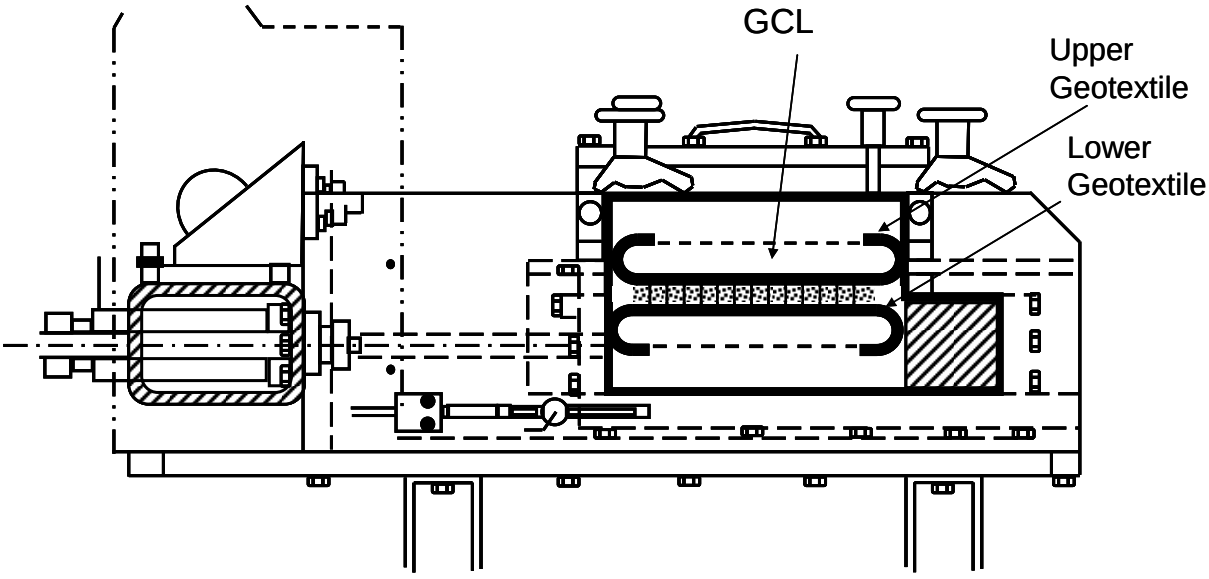


Figure 10. Cross section of shear box for internal GCL testing.