



Designation: D8479 – 24

Standard Test Method for Determining the Peel Strength of GCCM Materials¹

This standard is issued under the fixed designation D8479; 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 The purpose of this test method is to determine the peel strength of GCCM materials to include the various layers these multilayer materials possess. Both uncured and cured/hydrated materials are tested as a part of this method.

1.2 As an index test, this method will be used relatively infrequently and to test large lots of material. This test is not intended for routine quality control testing of GCCMs.

1.3 The values in SI units are to be regarded as the standard. Values in inch-pound units are in parentheses for information.

1.4 *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.*

1.5 *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

D76/D76M Specification for Tensile Testing Machines for Textiles

D4354 Practice for Sampling of Geosynthetics and Rolled Erosion Control Products (RECPs) for Testing

D4439 Terminology for Geosynthetics

D8030/D8030M Practice for Sample Preparation for GCCM

3. Terminology

3.1 For definitions of common technical terms used in this standard, refer to Terminology D4439.

¹ This test method is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.05 on Geosynthetic Erosion Control.

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

3.2 Definitions:

3.2.1 *additional functional layer, n*—an additional individual layer attached to the GCCM top or bottom layer that provides a specific in-service function, for example, impervious or reinforcement layers. Multiple additional functional layers may be attached to the top or bottom layer.

3.2.2 *bottom layer, n*—the lower layer of the GCCM in contact with the cementitious material that would face toward the subgrade (downwards) in a normal installation. Without this layer, the loose cementitious fill will no longer be constrained.

3.2.3 *cured, adj*—a description of the state of a GCCM after initial hydration of the cementitious material and after setting has begun.

3.2.4 *geosynthetic cementitious composite mat (GCCM), n*—a factory-assembled composite consisting of a cementitious material contained within a layer or layers of geosynthetic materials that becomes hardened when hydrated.

3.2.5 *peak peel strength, n*—the maximum peel strength, expressed in N/m (lbf·in.), is calculated from the maximum load of a GCCM specimen oriented in either the machine or cross-machine direction and divided by the specimen width being tested.

3.2.6 *peel layer, n*—the element or elements that are to be peeled (at a 180° angle) away from the remaining components of the GCCM, which remain flat.

3.2.7 *top layer, n*—the upper layer of the GCCM in contact with the cementitious material that would face away from the subgrade (upwards) in a normal installation. Without this layer, the loose cementitious fill will no longer be constrained.

3.2.8 *uncured, adj*—a description of the state of a GCCM before it has been exposed to a hydration source and typically describes the “as received” dry product after conditioning in a prescribed manner.

4. Significance and Use

4.1 This test method is applicable for testing GCCM materials in both a cured and uncured state. This determines the peel strength of various layers of these multilayer materials to determine critical interface strength. It is used with a constant rate of extension type of tensile testing machine.

4.2 The peel strength provides a measure of the strength of the connection between the top and bottom layers due to any linking elements present between them (such as connecting fibers/yarns or other linking elements), or the strength of the connection between the additional functional layers attached to the top or bottom layer that are necessary for the GCCM to function as a composite. In particular:

4.2.1 Uncured peel strength is important when installing a GCCM because the top and bottom layers must be securely connected in order to constrain the cementitious material when dragging/tensioning the GCCM into position. If the top/bottom layers become detached during handling, the cementitious material is no longer constrained and may overhydrate or can potentially fall or wash out from the GCCM, causing the set composite to have poor mechanical properties.

4.2.2 Cured peel strength is important in an installed GCCM because if the top layer is insufficiently attached it may become detached due to hydraulic shear or wind loads, or become completely detached and washed downstream, causing blockages and environmental damage. If the additional functional layers are poorly attached to the top/bottom/other additional functional layers, the layers may no longer act as a composite, which could lead to durability issues and multiple potential failure modes.

5. Summary of Test Method

5.1 The method of clamping/positioning GCCMs differs from other peel test methods, because rather than bending the

top/bottom/additional functional layers so they are clamped perpendicular (90°) to the specimen, a backplate is used so that the peel layer of the GCCM is peeled back in the same plane (that is, at 180°) as the test specimen as shown in Fig. 1. This prevents rotation due to the thickness of the samples.

5.2 GCCM peel strength must be tested in both uncured and cured states, to include peeling the top layer, bottom layer, and any additional functional layers. The number of required peel tests for a GCCM is dependent on the number of additional functional layers present in the GCCM (see Section 8).

6. Apparatus

6.1 *Tensile Testing Machine*—A testing machine of the constant rate of extension type as described in Specification D76/D76M shall be used. The machine shall be equipped with a device for recording the tensile force and the amount of separation of the grips. Both of these measuring systems shall be accurate to $\pm 2\%$ and preferably shall be external to the testing machine. The rate of separation shall be uniform and capable of adjustment within the range of the test.

6.2 *Peel Test Clamping Apparatus*—A fixture designed for use with the tensile testing machine where the peel layer to be tested is attached so that load is applied 180° to the specimen. See Fig. 2. The faces of the clamps should be smooth, flat, and free of burrs to avoid damaging the peel layer.

6.3 *Backplate*—A plate to remain flat during the test, made of a stiff and strong material such as steel, positioned against

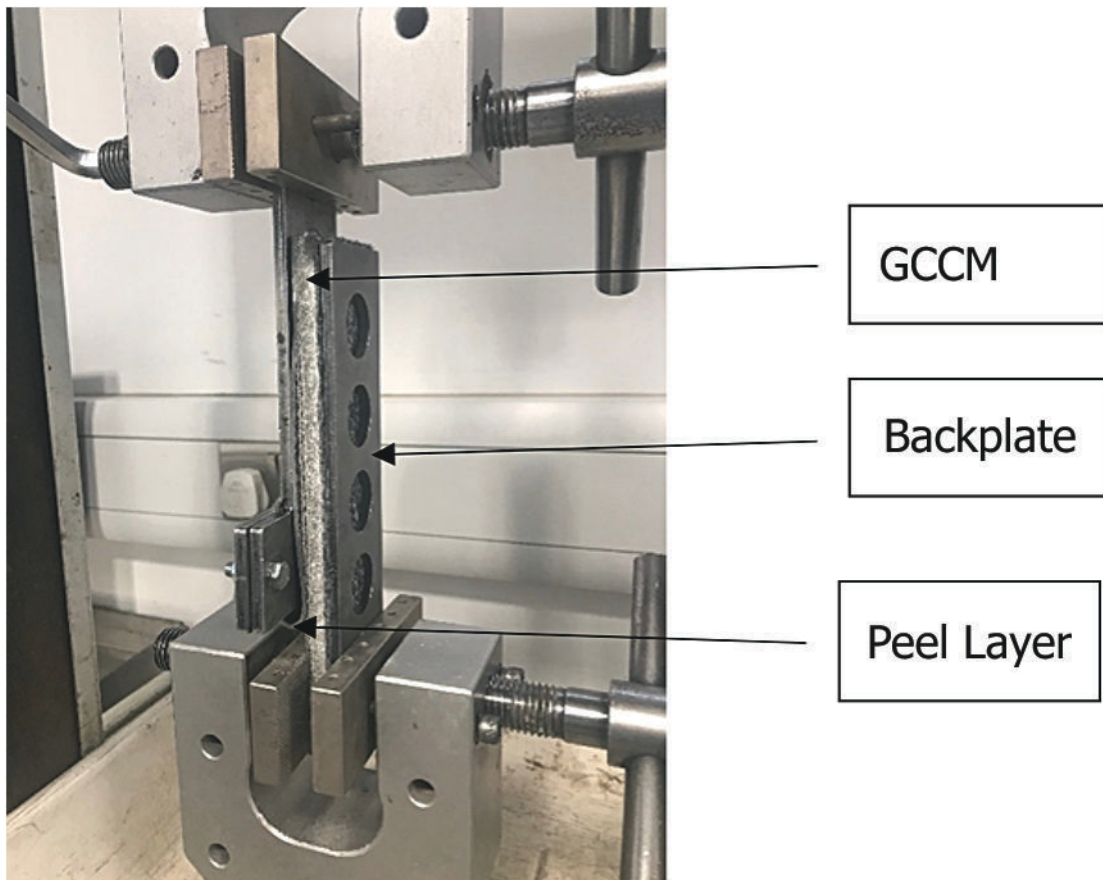


FIG. 1 GCCM Peel Strength Test Setup

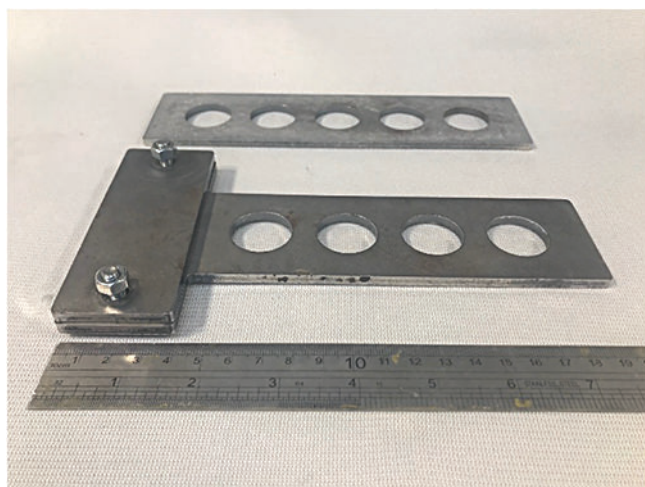


FIG. 2 Example Peel Test Clamping Apparatus (Bottom) and Backplate (Top)

the opposite side of the GCCM to the peel layer in order to prevent rotation of the GCCM test specimen. See Fig. 2.

6.4 *Rotary Tile Saw*, with diamond-tipped blades capable of dry cutting samples. Used for cutting a cured sample to predetermined dimensions using a pattern marked on the cured specimen with a template and markers.

6.5 *Miscellaneous*—Knives, templates, markers, rulers, and saw as required for marking, measuring, and cutting specimens to fixed dimensions. A knife with a “snap off” type blade is recommended for cutting interface layers in GCCMs, which can dull the blade tips rapidly when cementitious material is being cut.

7. Sampling, Test Specimens, and Test Units

7.1 *Lot Sample*—For the lot sample, refer to Practice D4354 for discussion of recommended practice for breaking up shipments of GCCM into lots for testing.

7.2 *Laboratory Sample*—Cut a full-width sample from the lot sample that must be large enough to enable the required number of test specimens for both the machine and cross-machine direction tests to be cut from it (see Section 8). The laboratory sample must be cut at least 300 mm (1 ft) from the ends of the lot sample. The laboratory sample may be taken from the end portion of a roll provided there is no evidence it is distorted or different from other portions of the roll. In cases of dispute, take a laboratory sample that will exclude material from the outer wrap of the roll or the inner wrap around the core, or at least 900 mm (3 ft) from the interior end of the roll

(wrapped around the core) or exterior end of the material roll, measured from the edge of the cementitious portion of the material.

7.3 *Test Specimens*—Cut the number of test specimens directed in Section 8 from the laboratory sample. Take test specimens at random but equally spaced from the laboratory sample, with those for which the machine direction is to be aligned with the test direction taken from different positions across the laboratory sample width, and test specimens for which the cross-machine direction is to be aligned with the test direction taken from different positions along the length of the laboratory sample. Test specimens must be taken a minimum of 100 mm (4 in.) from the edge of the laboratory sample, measured from the edge of the cementitious portion of the material.

8. Test Specimen Preparation

8.1 Number of Specimens:

8.1.1 The number of test specimens to prepare is dependent on the number of interfaces to test, and therefore, dependent on the number of additional functional layers within the GCCM. A general GCCM product structure is shown in Fig. 3, which consists of a top layer and bottom layer with the fibers or linking elements and cementitious material in between. The top layer and bottom layer may have additional functional layers attached to them to improve GCCM composite performance (for example, reduce permeability or increase tensile strength). In Fig. 3, the bottom layer has two additional functional layers attached to it.

8.1.2 In the uncured state, the peel strength of the linking elements must be tested to ensure the top and bottom layers can adequately constrain the dry cementitious material as shown in Fig. 4. Additional interface layers may be tested if requested.

8.1.3 In the cured, in-service state, the peel strength of every interface must be tested. It is common to attach additional functional layers to the bottom layer of GCCMs. Fig. 5 shows the interfaces to test for a GCCM that contains two additional functional layers attached to the bottom layer. Similar interfaces can apply if additional functional layers are attached to the top layer.

8.1.4 The minimum number of interfaces to test in the cured state depends on the number of additional functional layers as illustrated in Table 1.

8.1.5 It is still necessary to test P(C-T1-28) even when the top layer is considered to be sacrificial. P(C-T1-28) may only be excluded when the top layer is removed from the GCCM by the contractor immediately after installation (so it will not be used in service), but this must be reported.

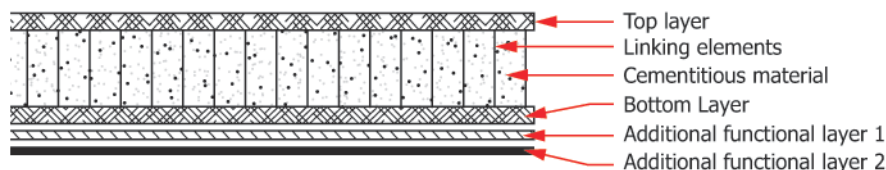


FIG. 3 Typical GCCM Product Structure