Designation: D7005 – 03(Reapproved 2008)

Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites[1]

This standard is issued under the fixed designation D7005; 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 It has been widely discussed in the literature that bond strength of flexible multi-ply materials is difficult to measure with current technology. The above is recognized and accepted, since all known methods of measurement include the force required to bend the separated layers, in addition to that required to separate them. However, useful information can be obtained when one realizes that the bending force is included and that direct comparison between different materials, or even between the same materials of different thickness, cannot be made. Also, conditioning that affects the moduli of the plies will be reflected in the bond strength measurement.

1.2 This index test method defines a procedure for comparing the bond strength or ply adhesion of geocomposites. The focus is on geotextiles bonded to geonets or other types of drainage cores; for example, geomats, geospacers, etc. Other possible uses are geotextiles adhered or bonded to themselves, geomembranes, geogrids, or other dissimilar materials. Various processes can make such laminates: adhesives, thermal bonding, stitch bonding, needling, spread coating, etc.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are provided for information purposes only.

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 and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in 11.1.1

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D76 Specification for Tensile Testing Machines for Textiles

D2905 Practice for Statements on Number of Specimens for Textiles (Withdrawn 2008)[3]

D4354 Practice for Sampling of Geosynthetics for Testing

D4439 Terminology for Geosynthetics

D5321 Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method

3. Terminology

3.1 *Definitions:*

3.1.1 *bond strength (ply adhesion)*—amount of force required (per unit width) to separate plies of material or materials in peeling mode plus the force to bend the plies.

3.1.2 *necking*—localized reduction in cross section, which may occur in a material under tensile stress.

3.1.3 *geocomposite*—a product composed of two or more materials, at least one of which is a geosynthetic.

3.1.4 *geosynthetic*—a planar product manufactured from polymeric material used with soil, rock, earth, or other geotechnical engineering related material as an integral part of a man-made project structure, or system.

3.1.5 *geotextile*—a permeable geosynthetic comprised solely of textiles.

3.1.6 *geonet*—a geosynthetic consisting of integrally connected parallel sets of ribs overlying similar sets at various angles for planar drainage of liquids or gases.

3.1.7 *geomat/geospacer*—any three dimensional, polymeric material used with soil, rock, or other geotechnical engineering related material as an integral part of a man-made project, structure, or system.

3.1.8 *index test*—a test procedure, which may contain a known bias but may be used to establish an order for a set of specimens with respect to the property of interest.

3.1.9 *machine direction*—the direction in the plane of the fabric parallel to the direction of manufacture.

[1] This test method is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.01 on Mechanical Properties.

Current edition approved July 1, 2008. Published October 2008. Originally approved in 2003. Last previous edition approved in 2003 as D7005–03. DOI: 10.1520/D7005-03R08.

[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.

3.1.10 *atmosphere for testing geosynthetics*—air maintained at a relative humidity between 50 to 70 % and a temperature of 21 ± 2°C (70 ± 4°F).

3.2 For definitions of other terms refer to Terminology D4439.

4. Summary of Test Method

4.1 Initially the geotextile is separated from its associated material with care. The separated plies of the test specimen are placed into the grips of a tensile testing machine. The grips are then separated and the force required to further separate the plies is defined as bond strength.

NOTE 1—The force to bend the separated plies is included in the measured force.

5. Significance and Use

5.1 This test method is to be used as a quality control or quality assurance test. As a manufacturing quality control (MQC) test, it would generally be used by the geocomposite product manufacturer or fabricator. As a construction quality assurance (CQA) test, it would be used by certification or inspection organizations.

5.2 This test method can also be used to verify if the adhesion or bond strength varies after exposure to various incubation media in durability and/or chemical resistance testing.

5.3 Whatever use is to be associated with the test, it should be understood that this is an index test.

NOTE 2—There have been numerous attempts to relate the results of this test to the interface shearing resistance of the respective materials determined per Test Method D5321. To date, no relationships have been established between the two properties.

5.4 Test Method D7005 for determining the bond strength (ply adhesion) strength may be used as an acceptance test of commercial shipments of geocomposites, but caution is advised since information about between-laboratory precision is incomplete. Comparative tests as directed in 5.4.1 are advisable.

5.4.1 In the case of a dispute arising from differences in reported test results when using the procedure in Test Method D7005for acceptance of commercial shipments, the purchaser and the supplier should first confirm that the tests were conducted using comparable test parameters including specimen conditioning, grip faces, grip size, etc. Comparative tests should then be conducted to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens that are as homogeneous as possible and that are from a lot of the material in question. The test specimens should be randomly assigned to each laboratory for testing. The average results from the two laboratories should be compared to the Student's t-test for unpaired data and an acceptable probability level chosen by the two parties before the testing is begun. If a bias is found, either its cause must be found and corrected or the purchaser and supplier must agree to interpret future test results in the light of the known bias. Refer to Practice D2905, Table 1.

6. Apparatus

6.1 *Grips*—A gripping system that minimizes both slippage and uneven stress distribution is required. Grips lined with thin rubber, crocus clothe or pressure sensitive tape, as well as file-faced or serrated grips has been successfully used for many materials. Air-actuated grips have been found advantageous, particularly in the case of materials that tend to "neck" in the grips, since pressure is maintained at all times. Grip faces shall measure not less than 50.8 mm (2.0 in.) wide by no less than 100 mm (4 in.) long, with the longer dimension perpendicular to the direction of the applied load.

6.2 *Testing Machine*—A tensile testing machine with computer acquisition capabilities conforming to the requirements for Specification D76.

6.3 *Specimen Cutter*—A die 101.6 ± 2 mm (4 ± 0.08 in.) wide by at least 200 mm (8 in.) long.

7. Sampling, Test Specimens, and Test Units

7.1 Sampling must be performed in a manner that will provide the desired information. No single procedure can be given for all situations. Therefore, Practice D4354 should be used as a guide in planning sampling procedures.

7.2 *Laboratory Sample*—For sampling, disregard the first meter (3 ft) and the last meter (3 ft) of material from the sample roll. Consider the units in the laboratory sample. For the laboratory sample, take a swatch at a minimum of 30 cm (1 ft) in the machine direction by the roll width.

7.3 *Test Specimens*—Take no specimen nearer the selvedge or edge of the sample than 1/20 of the width of the roll, or 150 mm (6 in.), whichever is larger, from the bonded material. Cut strips 101.6 ± 2 mm (4 ± 0.08 in.) wide and at least 200 mm (8 in.) long, parallel to the direction under test. For geocomposites consisting of geotextiles bonded to both sides of the geonet, mark the specimens to differentiate between the two sides, typically referred to as "Side A" and "Side B." It is important that the test specimens are precision cut with clean, uniform edges so as not to affect the test results.

7.4 *Test Unit*—Test five specimens distributed evenly from across the width of each laboratory sample in the longitudinal (machine) direction only. It may be desirable to test specimens in the transverse (cross-machine) direction for special purposes.

NOTE 3—Depending on the application of the geocomposite, transverse (cross-machine) direction specimens can be tested at the client's request, but they are not a requirement.

8. Preparation of Apparatus

8.1 Equip the tensile testing machine according to manufacturer's instructions for Tensile Testing Machine- a constant rate of extension (CRE) type conforming to the requirements of Specification D76.

8.2 Set the machine speed at 305 ± 10 mm/min (12 ± 0.5 in./min).

8.3 Readings of force and time shall be taken at a minimum rate of 20 readings per second.