INTERNATIONAL

Designation: D7499/D7499M – 09 (Reapproved 2023)

Standard Test Method for Measuring Geosynthetic-Soil Resilient Interface Shear Stiffness[1]

This standard is issued under the fixed designation D7499/D7499M; 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 test method details how cyclic loading is applied to geosynthetics embedded in soil to determine the apparent stiffness of the soil–geosynthetic interface.

1.2 Resilient interface shear stiffness describes the shear stiffness between a geosynthetic and its surrounding soil under conditions of small cyclic loads.

1.3 This test method is intended to provide properties for design. The test method was developed for mechanistic empirical pavement design methods requiring input of the resilient interface shear stiffness. The use of this parameter from this test method for other applications involving cyclic loading should be evaluated on a case-by-case basis. It can also be used to compare different geosynthetics, soil types, etc., and thereby be used as a research and development test procedure.

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

1.6 *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]

D123 Terminology Relating to Textiles

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D3080/D3080M Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions (Withdrawn 2020)[3]

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

D4439 Terminology for Geosynthetics

3. Terminology

3.1 For definitions of other terms used in this test method refer to Terminologies D123, D653, and D4439.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *apertures, n*—the open spaces in geogrids which enable soil interlocking to occur.

3.2.2 *atmosphere for testing geosynthetics, n*—air maintained at a relative humidity of 60 ± 10 % and a temperature of 21 ± 2 °C [70 ± 4 °F].

3.2.3 *cross-machine direction, n*—the direction in the plane of the geosynthetic perpendicular to the direction of manufacture.

3.2.4 *failure, n*—an arbitrary point at which a material ceases to be functionally capable of its intended use.

3.2.5 *geosynthetic, n*—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.

3.2.6 *geosynthetic-soil resilient interface shear stiffness, n*—a parameter that describes the apparent stiffness of the interface between the soil and the geosynthetic determined by

[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.

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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.

calculating the slope of the shear stress, shear displacement curve as the embedded geosynthetic is subjected to a cyclic load.

3.2.7 *junction, n*—the point where geogrid ribs are interconnected in order to provide structure and dimensional stability.

3.2.8 *machine direction, n*—the direction in the plane of the geosynthetic parallel to the direction of manufacture.

3.2.9 *pullout, n*—the movement of a geosynthetic over its entire embedded length, with initial pullout occurring when the back of the specimen moves, and ultimate pullout occurring when the movement is uniform over the entire embedded length.

3.2.10 *pullout force, (kN), n*—force required to pull a geosynthetic out of the soil during a pullout test.

3.2.11 *pullout resistance, (kN/m), n*—the pullout force per width of geosynthetic measured at a specified condition of displacement.

3.2.12 *rib, n*—the continuous elements of a geogrid which are either in the machine or cross-machine direction as manufactured.

3.2.13 *wire gage, n*—a displacement gage consisting of a non-extensible wire attached to the geosynthetic and monitored by connection to a dial extensometer, or electronic displacement transducer.

4. Summary of Test Method

4.1 In this test method, a horizontal layer of geosynthetic is embedded between two layers of soil. Six prescribed levels of horizontal cyclic force are applied to the geosynthetic at five specified levels of normal stress confinement. The maximum and minimum forces and corresponding displacements are recorded for the last ten cycles of each combination of normal stress and cyclic force (loading sequence).

4.2 The resilient interface shear stiffness (kPa/m or psi/in.) of the test specimen can be calculated for any loading sequence by dividing the cyclic shear stress by the corresponding net recoverable horizontal displacement of the embedded geosynthetic

5. Significance and Use

5.1 This test method is intended as a performance test to provide the user with a set of design values for the test conditions examined.

5.1.1 The test method is applicable to all geosynthetics and all soils when loaded in a cyclic manner.

5.1.2 This test method produces test data, which can be used in the design of geosynthetic-reinforced pavement structures or in applications where geosynthetics are subjected to cyclic loads.

5.1.3 The test results may also provide information related to the in-soil stress-strain response of a geosynthetic under confined loading conditions.

5.2 Information derived from this test may be a function of soil gradation, plasticity, as-placed dry unit weight, moisture content, length and surface characteristics of the geosynthetic, and other test parameters. Therefore, results are expressed in terms of the actual test conditions. The test measures the net effect of a combination of interface shear mechanisms, which may vary depending on type of geosynthetic specimen, embedment length, relative opening size, soil type, displacement rate, normal stress, and other factors.

5.3 Information between laboratories on precision is incomplete. In cases of dispute, comparative tests to determine if there is a statistical bias between laboratories may be advisable.

6. Apparatus

6.1 *Test Box*—An open rigid box consisting of two smooth parallel sides, a back wall, a horizontal split removable door, a bottom plate, and a load transfer sleeve. The door is at the front as defined by the direction of applied cyclic force. A typical box is shown in Fig. 1.

6.1.1 The box should be square or rectangular with minimum dimensions 457 mm [18 in.] long by 457 mm [18 in.] wide by 305 mm [12 in.] deep, if sidewall friction is minimized, otherwise the minimum width should be 760 mm [30 in.]. The dimensions should be increased, if necessary, so that minimum width is the greater of 20 times the D85 of the

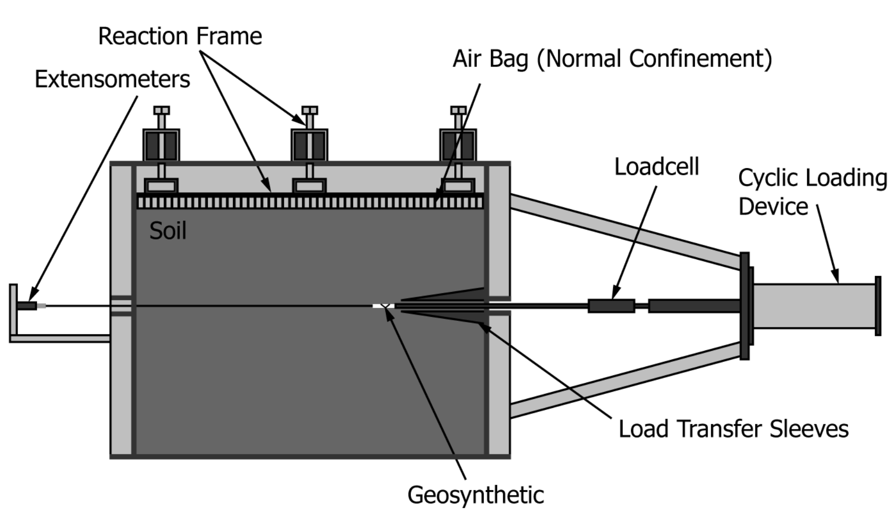

FIG. 1 Side View of Typical Test Device