Designation: D3759/D3759M – 05 (Reapproved 2019)

Standard Test Method for Breaking Strength and Elongation of Pressure-Sensitive Tape[1]

This standard is issued under the fixed designation D3759/D3759M; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method covers the measurement of tensile strength at break (breaking strength) and stretch properties (elongation) for pressure-sensitive tapes and labels. It includes procedures for machine direction and cross direction, for high-strength filament reinforced backings and for high stretch backings. It also includes a procedure for obtaining force ("F" value) in conjunction with a specified elongation. These procedures employ a constant-rate-of-extension (CRE)-type testing machine.

1.2 The values stated in either SI or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; conversions between measurement systems must be conducted carefully.

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]

D828 Test Method for Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus

D882 Test Method for Tensile Properties of Thin Plastic Sheeting

D996 Terminology of Packaging and Distribution Environments

D3715/D3715M Practice for Quality Assurance of Pressure-Sensitive Tapes

D4332 Practice for Conditioning Containers, Packages, or Packaging Components for Testing

E4 Practices for Force Verification of Testing Machines

E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

2.2 *AFERA Documents (Association Des Fabricants Europeens De Reubans Auto-Adhesifs–Europe:*

AFERA 4004 Self Adhesive Tapes—Measurement of Breaking Strength

AFERA 4005 Self Adhesive Tapes—Measurement of Elongation

2.3 *European Norm (EN) Documents:*

EN 1940 Self Adhesive Tapes—Measurement of Breaking Strength

EN 1941 Self Adhesive Tapes—Measurement of Elongation at Break

2.4 *PSTC Documents (Pressure Sensitive Tape Council):*

PSTC 131 Tensile Strength and Elongation of Pressure-Sensitive Tapes

3. Terminology

3.1 Terminology found in Terminology D996 shall apply.

4. Summary of Test Method

4.1 *Procedure A–Machine Direction for Tapes with Elongation Under 200 %*—A strip of tape is mounted between two clamps aligned in a straight flat plane and force applied at a specified rate until breaking of the strip of tape occurs. Force and elongation are determined at the moment of breakage.

4.2 *Procedure B–Machine Direction for Filament Reinforced Tape*—A strip of tape is applied to two drums aligned in a flat plane and force applied until breakage of tape occurs.

[1] This test method is under the jurisdiction of ASTM Committee D10 on Packaging and is the direct responsibility of Subcommittee D10.14 on Tape and Labels.

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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.

TABLE 1 Test Preparation and Specimen Dimensions

	Gage Length, mm [in.]	Cross Head Velocity, mm [in.]/min	Specimen Width,[A] mm [in.]	Specimen Length, mm [in.]
A. Machine Direction Elongation Under 200 %	100 [4]	300 [12]	12–24 [0.5–1]	225 [9]
B. Machine Direction Reinforced Tapes	250 [10]	300 [12]	12–24 [0.5–1]	700 [28]
C. Machine Direction Elongation Over 200 %	50 [2]	50 [2]	12 [0.5]	150 [6]
D. Cross Direction	25 [1]	25 [1]	12 [0.5]	125 [5]

[A] The specimen widths shown are for tests in which the specimen is cut from within the sample dimension.

Force and elongation are determined at the moment of breakage. This procedure may also be suited for other high strength tapes such as those with tensilized or highly oriented film backings.

4.3 *Procedure C–Machine Direction for Tapes with Elongation Over 200 %*—A strip of tape is mounted between two clamps aligned in a straight flat plane and force applied at a specified rate until breaking of the strip of tape occurs. Force and elongation are determined at moment of breakage.

4.4 *Procedure D–Cross Direction*—A strip of tape is mounted between two clamps aligned in a straight flat plane and force applied at a specified rate until breaking of the strip of tape occurs. Force and elongation are determined at the moment of breakage.

4.4.1 If the sample provides ample material, CD tests may be made in the same way machine direction (MD) tests are. This would occur with web material or sufficiently wide rolls.

4.4.2 If a tape has an ultimate elongation in the cross direction (CD) over 200 %, it is recommended to use the test preparation for high stretch materials.

4.4.3 Cross direction tests are limited to sample rolls of tape at least 48 mm in width.

NOTE 1—Procedures A and B are harmonized to be technically equivalent with test procedures published by PSTC, AFERA, and EN. Procedures C and D are harmonized to be technically equivalent with test procedures published by PSTC.

5. Significance and Use

5.1 This test method provides information that can be used in material specifications for product design and quality assurance applications. It can be used in comparing different products.

5.2 The use of this test method must be related to the purpose for which the test is performed. One purpose is for determining the relative strength of the tape in the size in which it is purchased or used. Another purpose is to identify or characterize a particular backing material.

5.2.1 The test may be performed on the tape as-received, that is, without cutting the material to a specimen width less than the as-received width. Usually tapes wider than 48 mm [2 in.] are not tested due principally to the limitations of equipment. Tapes as narrow as approximately 3 mm [0.125 in.] can be tested.

5.2.2 The test may be performed on a specimen cut from within the sample material boundaries using a sharp razor cutter, such as that defined in Section 6. This method is usually used for material characterization, determining quality of conformance, and for specification compliance.

5.3 Stretch characteristics of elongation at break or force to a specified elongation can be related to the tape's intended use or for identifying or characterizing a material.

6. Apparatus

6.1 *Tension Tester*—A constant-rate-of-extension (CRE) type with load cell capacity such that the maximum expected specimen strength does not exceed 90 % of its normal limit. The tension tester must be capable of the crosshead speeds described in Table 1 with tolerances of ±10 %.

6.1.1 The tensile testing machine must be equipped with a measurement system which records the force and deformation (elongation) of the test specimen during the test. This may be a pen and stylus, digital output, microprocessor, or computer based system. The accuracy should be verified in accordance with Practice E4 or equivalent.

6.1.2 *Extensometer (Optional)*—A suitable instrument, if desired, may be used for determining the distance between two designated points of the test specimen as the specimen is stretched.

6.1.3 *Integrator (Optional)*—A suitable instrument, microprocessor, or software analysis system may be used for determining the energy or work required to break the specimen.

6.1.4 *Clamps,* preferably the pneumatic action type at least 50 mm [2 in.] wide by 38 mm [1½ in.] deep. Faces shall have a light cross-hatch serration.

NOTE 2—Plastic materials are reduced in width and thickness while being stretched. This causes them to be drawn out of the clamps. Pneumatic clamps minimize this effect. It can be further reduced by the appropriate choice of surface of the clamps. One improvement, both with respect to the above mentioned shrinkage problem and simple slippage, may be found from the use of urethane film which can be obtained as a pressure-sensitive tape approximately 0.5 mm [20 mils] thick. This material has a very high coefficient of friction, is somewhat malleable, and is easily replaced. Alternative materials are coated abrasive, rubber (neoprene or other synthetic type), or other tape.

6.1.5 *Cylinders,* in place of clamps for testing high strength tapes by Procedure B. Each of two cylinders shall be 100 mm [4 in.] in diameter by 38 mm [1.5 in.] thick held in the position ordinarily occupied by the clamps so that the tape, when applied to the cylinders and extending between them, falls in the line of stress otherwise occupied by the specimens when clamps are used. See Fig. 1.

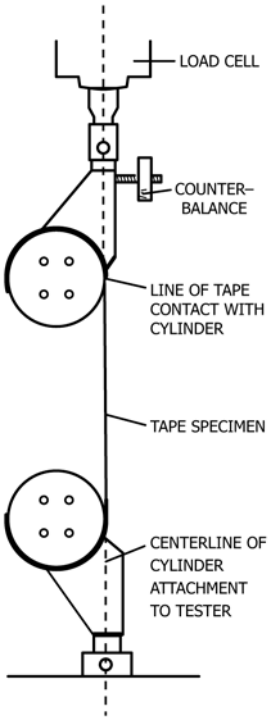

FIG. 1 Test Configuration for Reinforced Tapes

6.1.6 *Scale (Optional),* approximately 22 mm [1 in.] in length divided into 2 mm [0.1 in.] increments attached to each cylinder. The zero point or (origin) shall be at the point of tangency of the tape with the cylinder during the test and the scale shall increase upward on the lower cylinder and downward on the upper cylinder.

NOTE 3—These scales can be used to observe and measure the tape slippage during the tension test for reinforced tapes. Scales or extensometers shall be used for referee testing.

6.2 *Cutter,* [3] the specimen cutter shall hold two single-edged razor blades in parallel planes a precise distance apart, to form a cutter of exact specimen width. Appropriate widths shall be available as specified.

6.2.1 The 12 mm [½ in.] cutter shall be constructed of aluminum bar stock approximately 12 mm [½ in.] by 12 mm [½ in.] by 200 mm [8 in.]. The edges, for about 125 mm [5 in.] from one end shall be slightly rounded to form a handle. The width of the bar, for approximately 75 mm [3 in.] from the opposite end, shall be narrowed to exactly 12 mm [0.500 in.] minus the thickness of a single razor blade (one of two used as cutting edges). The razor blades shall be held in position using side plates. The end of the cutter shall be cut away at a 0.75 rad [45°] angle to expose the cutting edges at one end of the blades. The cutting edges shall be separated by 12 ± 0.1 mm [0.500 ± 0.005 in.]. Other width cutters shall be constructed similarly.

NOTE 4—Some of the traditional tools for specimen preparation must be avoided when the backing is comprised of thin plastic sheeting. These include chopping dies and sample cutters operating on a shearing principle. The reason for this restraint is that edges sufficiently ragged and damaged resulting from chopping or shearing cause tearing to occur before the true tensile strength level is reached. Tapes with fibrous backings may be cut to satisfactory specimens with these tools.

[3] The sole source of supply of the apparatus known to the committee at this time is Chemsultants International, 9349 Hamilton Dr., Mentor, OH 44061-1118. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

7. Sampling

7.1 *Acceptance Sampling*—Unless otherwise specified, acceptance sampling shall be in accordance with Practice D3715/D3715M.

7.2 *Sampling for Other Purposes*—The sampling and the number of test specimens depends on the purpose of the testing. Practice E122 is recommended. It is common to test at least five specimens of a particular tape. Test specimens should be taken from several rolls of tape, and whenever possible, among several production runs of tape. Strong conclusions about a specific property of a tape cannot be based on tests of a single unit (roll) of a product.

8. Test Specimens

8.1 Specimens shall have the dimensions shown in Table 1.

8.2 Unwind and discard at least three, but no more than six, outer wraps of tape from the sample roll before taking specimens for testing. Test without liners, if any.

8.3 Test one specimen per sample roll, unless otherwise specified.

8.4 The following applies to non-reinforced tapes for Procedure A:

8.4.1 Specimen ends that are clamped shall be prepared by covering the adhesive with paper, some other tape, or an extension of the specimen. In the latter case the specimen must be cut at lest 100 mm [4 in.] longer than defined in Table 1.

8.4.2 The covering shall be free of wrinkles, leaving the gage-length area uncovered and completely cover the rest of the specimen so that the clamps will apply uniform pressure against the specimen.

8.5 For Procedure D, a special specimen preparation is recommended for cross-direction (C.D.) specimens from rolls less than 125 mm [5 in.] in width.

8.5.1 Lay two rectangular sample strips on a flat surface with the adhesive side facing up. See Fig. 2. Each strip shall be as wide as the sample roll and approximately 125 mm [5 in.] in length. Position these strips side by side with one long edge of one strip parallel to and 25 mm [1.0 in.] separated from one long edge of the second strip.

8.5.2 Cut a specimen from the sample roll to have the width specified in Table 1 and length equal to the width of the roll.

8.5.3 Lay this specimen adhesive side up across the 25-mm [1.0-in.] separation of the strips. Position it toward one end of the sample strips so that it rests equally on both strips and at a right angle to their parallel edges.

8.5.3.1 If needed to prevent slippage, cut two additional strips from the sample roll having the same width as the specimen. *Butt* the end of one of these at one end to form a continuation of the specimen across the remainder of the sample strip. Use the second strip to butt against the other end of the specimen in like manner.