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Breaking Strength and Elongation of Pressure Sensitive Tapes

1. SCOPE

1.1 The procedures in this test method describe the measurement of breaking strength, elongation at break, and energy to break, of pressure sensitive tapes.

1.1.1 Test Procedure A gives the breaking strength and elongation of tapes having 200% or less elongation, other than filament reinforced tapes.

1.1.2 Test Procedure B gives the breaking strength and elongation of filament reinforced tapes.

1.2 These procedures provide a means of assessing the uniformity of breaking strength and elongation of a given type of pressure sensitive tape. The assessment may be within a roll of tape, between rolls or between production lots.

1.3 This test method may be used in comparing one product with another.

Afera: Association des Fabricants Europeens de Rubans Auto-Adhesives (Association of European Tape Manufacturers)

ASTM: American Society for Testing and Materials (USA)

EN: European Norm (Europe)

PSTC: Pressure Sensitive Tape Council (North America)

2. REFERENCED DOCUMENTS

2.1 ASTM Standards

2.1.1 D 3759/D 3759M Test Method for Breaking Strength and Elongation of Pressure Sensitive Tape.

2.2 AFERA Standards

2.2.1 AFERA 5004 Test Method for Breaking Strength and Elongation of Pressure Sensitive Tape

2.3 European Norm (EN) Standards

2.3.1 EN 14410 – Self Adhesive Tapes - Measurement of Breaking Strength and Elongation at Break

2.4 PSTC Standards

2.4.1 PSTC 131 replaces PSTC 31.

3. SUMMARY OF TEST METHOD

3.1 Procedure A – 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. Elongation is determined at moment of breakage.

A Summary of Changes section appears at the end of this test method.

3.2 Procedure B – 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. Elongation is determined at the moment of breakage.

4. SIGNIFICANCE AND USE

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

4.2 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.

4.2.1 When relative strength is of interest, the test should be performed on the tape-as-received, that is, without cutting the material to a specimen width less than the as-received width.

4.2.1.1 Usually tapes wider than 24 or 25 mm are not tested due principally to the limitation of equipment. Tapes as narrow as 3 mm can be tested.

4.2.1.2 Comparison of materials by different procedures should be avoided because test parameters of specimen dimensions and crosshead velocity determine outcome. Changes in the parameter levels will produce different results for the same material.

Note 1: It is usual to find breaking strength increasing significantly with increasing crosshead velocity.

4.2.2 When identity of material characterization is of interest, the test method should be performed on a specimen cut from within the sample material boundaries using a sharp razor cutter, such as defined in section 5.

Note 2: Some of the traditional tools for specimen preparation must be avoided when 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 shearing or chopping can cause tearing to occur before the true breaking strength level is reached. Tapes with fibrous backings may be cut to satisfactory specimens with these tools.

Note 3: Elongation measurements become difficult to perform on stretchy materials (greater than 200% ultimate elongation) when the ratio of specimen length to width is small (approaching 2). The results show high variability and do not allow for practical use of this information except when one wishes to demonstrate large differences between materials.

5. APPARATUS - See Appendix B

5.1 Tension tester - A constant-rate-of-extension (CRE) type with a capacity such that the maximum expected specimen strength does not exceed 90% of its normal limit. The tester shall have two clamps with centers in the same plane, parallel with the direction of the motion of the stressing clamp, and so aligned that they will hold the specimen wholly in the same plane; a means of moving the stressing clamp at a uniform rate of 5.0 ± 0.2 mm/s and a device for recording the load. The instrument shall be calibrated to an accuracy of 0.5% of a full scale and the scale used for any test shall be such that the test level falls within 20% to 80% of full scale.

5.1.1 Test information should be recorded by such a means that it will be available for use during calculations (see Section 11).

5.1.2 Clamps, preferably the pneumatic action type.

5.1.2.1 Clamp faces at least 50 mm wide by 38 mm deep. Faces shall have a light crosshatch serration.

Note 4: Plastic materials are reduced in width and thickness while being stretched. This causes them to draw down out of the clamps. Pneumatic clamps minimize this effect. It can be further reduced by the appropriate choice of surface of the clamps. The greatest 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 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 types) or other tapes.

Note 5: The use of clamps for testing a reinforced tape is discouraged because the strength of reinforced tapes requires excessive clamping pressure, which can cause crushing of the reinforcing filaments. When this occurs, the tape usually breaks at the jaw edge, which can result in lower breaking values. Hence the use of cylinders described in 5.1.3 is recommended for reinforced tapes.

5.1.3 Cylinders, in place of clamps for testing reinforced tapes. Each of two cylinders shall be approximately 100 mm in diameter and approximately 38 mm wide, held in the position ordinarily occupied by the clamps so that the tape, when applied to the cylinders and extended between them falls in the line of stress otherwise occupied by the specimens when clamps are used. See Figure 1.

5.1.4 Scale, approximately 22 mm in length divided into 2 mm increments attached to each cylinder. The zero point (origin) shall be at the point of tangency of the tape with the cylinder during test and the scales shall increase upward on the lower cylinder and downward on the upper cylinder.

Note 6: These scales shall be used to observe and measure the tape slippage during breaking strength test of reinforced tapes.

5.2 Specimen cutter - The specimen cutter shall hold two single edge razor blades in parallel planes, a precise distance apart, to form a cutter of exact specimen width. Two cutters, 12 and 24 mm cutting width, shall be available. Appropriate alternates, which will not cause edge damage, may be used.

5.2.1 The 12 mm cutter shall consist of a 12 mm thick by approximately 200 mm length of aluminum bar stock. The edges, for 125 mm from one end, slightly rounded to form a handle. The width of the bar, for approximately 75 mm from the opposite end, shall be narrowed to exactly 12 mm 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 45° angle to expose the cutting edges at one end of the blade. The edges shall be separated by 12 ± 0.10 mm. The 24 mm cutter shall follow the same description except the bar stock shall be 24 mm and shall be narrowed exactly to 24 mm minus the thickness of a single edge razor blade.

6. SAMPLING

6.1 Sampling shall be in accordance with Practice D 3715/D 3715M.

6.2 Sampling for other purposes - The sampling and the number of test specimens depends on the purpose of the testing. Practice E 122 is recommended. It is common to test at least five specimens of a particular tape. Test specimens should be taken from several rolls of a tape and, whenever possible, among several production runs of tape. Strong conclusions about a specific property of a tape cannot be based on the test result of a single unit (roll) of product.

7. TEST SPECIMENS

7.1 Test specimens shall be no less than 3 mm or more than 24 mm wide, except that 25 mm widths may be used when supplied. Length shall be 200 mm for non-reinforced tapes and 700 mm for reinforced tapes.

7.2 Unwind and discard at least three, but no more than six, outer wraps of the tape from the sample roll before taking specimens for testing.

7.3 Test one specimen per roll, unless otherwise specified. More than one test per roll is permitted so that a total of five specimens are tested for each determination.

7.4 For non-reinforced tapes, specimen ends that are clamped shall be prepared by covering the adhesive with paper, some other tape or folded onto itself (folding onto itself requires an extra 100 mm in specimen length).

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

7.5 For reinforced tapes the specimen requires no further preparation other than to have the appropriate dimensions and to ensure that the adhesive is not contaminated so it will adhere to the cylinders.

8. PREPARATION OF APPARATUS

8.1 For non-reinforced tapes, set the gauge length at 100 mm.

8.2 For reinforced tapes, set the cylinders 150 mm apart so that at the start of the test, 250 mm of tape will extend between and without contact with the cylinders.

Note 7: The upper cylinder should be counter-balanced in order that the line of tape contact on the cylinder intersects an imaginary line running between the points of cylinder attachment to the tester and not side forces are exerted during the test. See Figure 1.

9. CONDITIONING

9.1 Condition the sample rolls of tape in the standard conditions per Appendix A

10. PROCEDURE

10.1 Procedure A - Non-reinforced tapes with elongation under 200%

10.1.1 Clamp the specimen in the grips of the testing machine. Take care to align the long axis of the specimen with an imaginary line running between points of attachment of the grips and including the center of the grips. Apply no more tension to the specimen during clamping than necessary to remove slack.

10.1.2 Start the crosshead in motion at a rate of 300 ± 30 mm/min. Ensure that the means of recording the data is operating. Continue until the specimen ruptures.

10.2 Procedure B - Filament reinforced tapes

10.2.1 Adhere approximately 230 mm of the specimen on the upper cylinder beginning at the line of tape contact (see 8.2), and wrap the specimen around the surface of the cylinder. Repeat this with the free end of the specimen on the lower cylinder, except wrap the specimen around the bottom surface of the cylinder. The applied specimen must be centered on the centerline around the cylinder surface. This elimination of skewness prevents non-uniform stress loading across the width of the specimen. The specimen shall also be sufficiently taut to remove slack. See Figure 1.

10.2.2 Mark the specimen (and the cylinder if not already done) with a marking pen making a line approximately 1 mm wide at the line where the tape contacts each cylinder. These benchmarks will be 25 mm apart and shall be checked to ensure this.

10.2.3 Start the crosshead in motion at 300 ± 30 mm/min and ensure that the data is being recorded.

10.2.4 Observe the bench marks on the specimen to determine their change in position relative to the marks on the cylinder. Use the scales appended to the cylinders. (See 5.1.4.)

10.2.5 When the specimen breaks, record the sum of the upper and lower bench mark changes to the nearest 2 mm. This will be the correction for the elongation.

10.2.6 Also record the indicated responses for breaking strength and elongation when the tester provides a numerical display of the information.

10.3 Breaking energy (optional)

10.3.1 The breaking energy to break is defined by the area under the stress-strain curve to the point of rupture. This is usually integrated electronically or by a commercially available software program.

10.3.2 With homogenous film, foil or paper backed tapes, this value can be normalized as the energy per unit volume of tape backing based on the initial gauge region of the test specimen. This may be reported in mega joules per cubic meter.

10.3.3 The test results can also be normalized to a tape width under these test conditions. This may be reported in joules per 100 mm of width.

11. CALCULATION

11.1 Determine the breaking strength at point of break from the recorded data. Express the result in N/10 mm.

11.2 Ultimate elongation

11.2.1 For non-reinforced tapes, express the elongation at break as a percentage of the original sample length.

11.2.2 For reinforced tapes, subtract the correction found in 10.2.5 from the elongation at break and express the result as a percentage of the original sample length.

12. REPORT

12.1 The report shall include the following.

12.1.1 Statement that this method was used and indicating any deviation from method as written.

12.1.2 Complete identification of each roll tested including tape source, manufacturers' code number and form.

12.1.3 Anomalous behavior during testing.

12.1.4 Report the breaking strength in newtons per 10 mm of width to three significant places.

12.2 Report the ultimate elongation in percent to two significant places.

12.3 Report energy to break (if determined).

12.4 When the desired test response includes ultimate elongation, indicate whether slippage of material within the clamps occurred and estimate the amount.

13. KEY WORDS

13.1 Elongation, pressure sensitive tape, breaking strength, tensile strength, energy at break.

ADDENDUM (Non-Harmonized)

1. SCOPE

1.1 PSTC 131 has retained procedures for high elongation tapes and cross direction breaking strength and elongation of pressure sensitive tapes, which are not part of the international harmonized test method.

1.1.1 Test Procedure Addendum I, not recognized as part of the international harmonized test method, gives the breaking strength and elongation for high stretch tapes.

1.1.2 Test Procedure Addendum II, not recognized as part of the international harmonized test method, gives the breaking strength and elongation for tapes in the cross direction.

2. SUMMARY OF TEST METHOD

2.1 Procedure Addendum I - 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. Elongation is determined at moment of breakage.

2.2 Procedure Addendum II- 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. Elongation is determined at moment of breakage.

3. PROCEDURE

3.1 Procedure Addendum I - Tapes with elongation over 200%

3.1.1 Conduct the test the same as in 10.1 with the following exceptions:

Gauge length	50 mm
Crosshead velocity	50 mm/min
Specimen width	12 mm
Specimen length	150 mm

3.2 Procedure Addendum II - Cross direction

3.2.1 Conduct the test the same as 10.1 with the following exceptions:

Gauge length	25 mm
Crosshead velocity	25 mm/min
Specimen width	12 mm
Specimen length	125 mm

3.2.2 A special specimen preparation is required for cross direction (CD) specimens from rolls of less than 96 mm in width. Lay two rectangular sample strips on a flat surface with the adhesive side facing up (see Figure 2). Each strip shall be as wide as the sample roll and approximately 120 mm in length. Position these strips side by side with one long strip parallel to and 25 mm separated from one long edge of the second strip.

3.2.3 Cut a specimen from the sample roll to have the width specified in section 3.2.1 and length equal to the width of the roll. When identity or material characterization is of interest, the test should be performed on a specimen cut from within the sample material boundaries using a sharp razor cutter.

3.2.4 Lay this specimen adhesive side up across the 25 mm 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.

3.2.5 If needed to prevent slippage, cut two additional extension 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.

3.2.6 Fold each of the original sample strips over onto itself to form a three-ply tab that will be gripped by the clamps during the test.

3.2.7 Trim off excess (single ply of tape) of either the sample strips or the extension strips extending beyond the two-ply or three-ply parts of the assembly. See Figure 2.

Addendum Note 1: The extension serves to keep the clamping pressure uniform over the whole area of the specimen. This is an imperative factor to a successful test.

SUMMARY OF CHANGES

- Test method title
- Formatted to reflect harmonized method
- Provided addendum for additional procedures that are not a part of the harmonized method
- Updated the figures

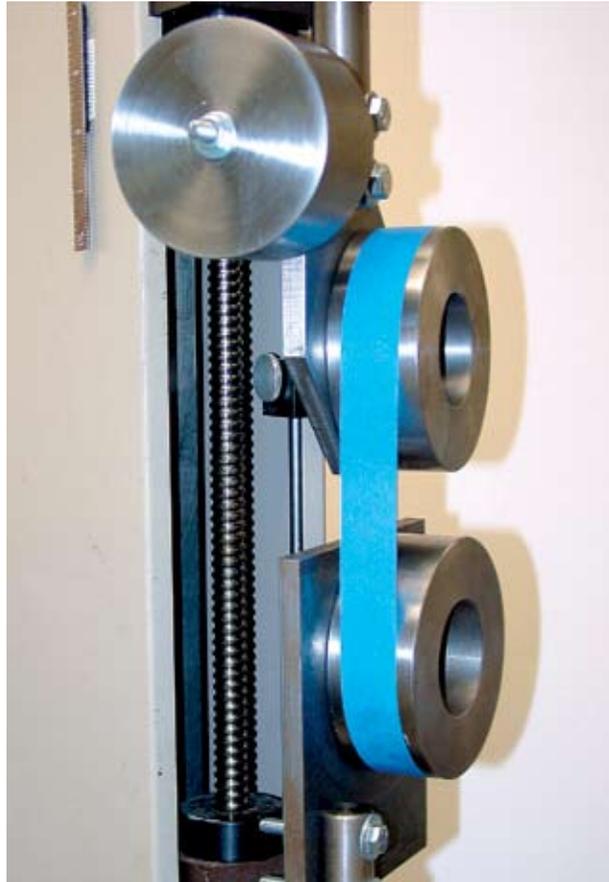


Figure 1. Tensile testing equipment set up.

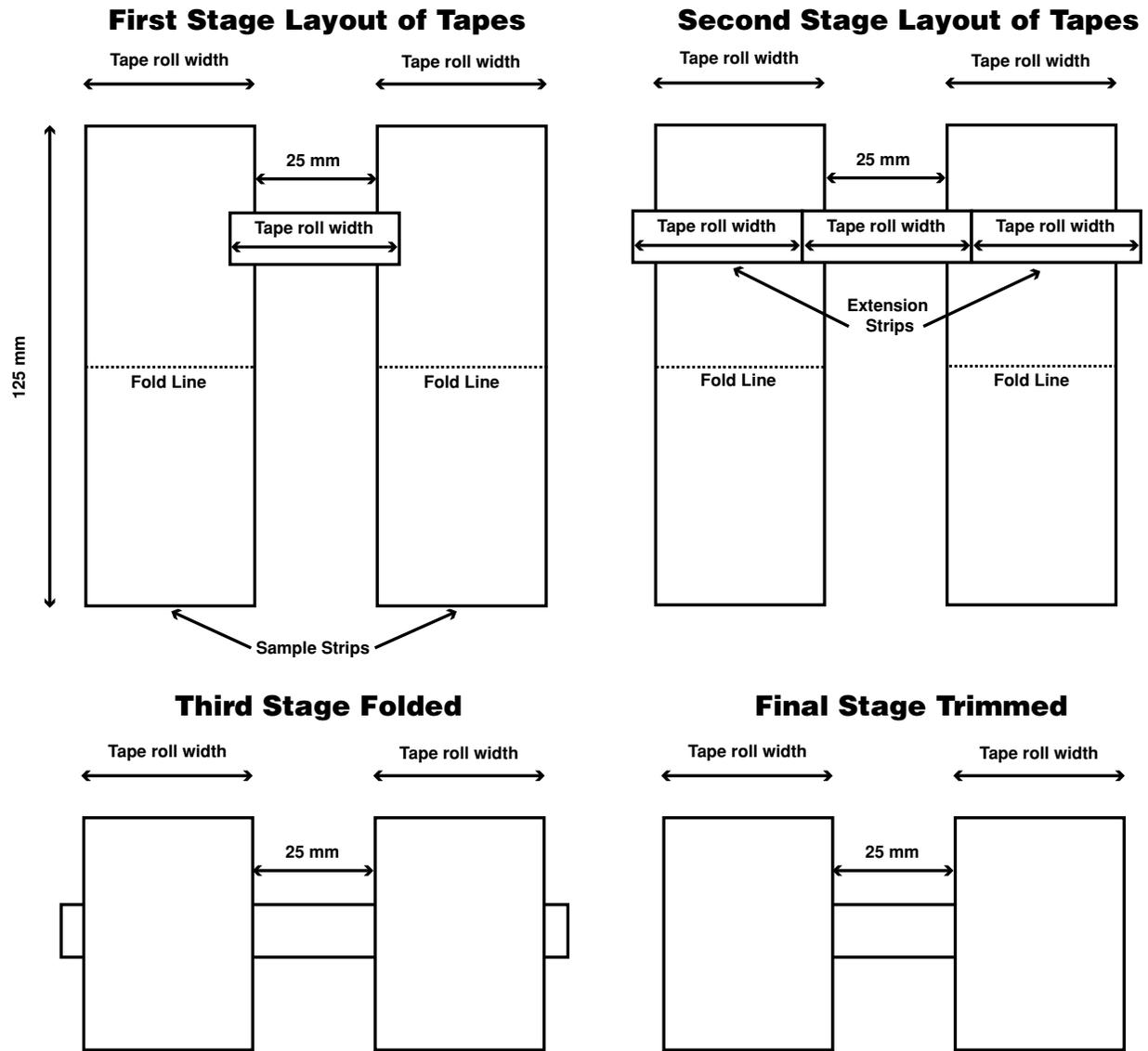


Figure 2. Sample layout for cross direction testing.