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Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)[1]

This standard is issued under the fixed designation D 5035; 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 Department of Defense.*~~

ε^1 NOTE—Editorial changes were made in October 2008.

1. Scope

1.1 This test method covers raveled strip and cut strip test procedures for determining the breaking force and elongation of most textile fabrics. Provision is made for wet testing.

1.1.1 The raveled strip test is applicable to woven fabrics while the cut strip test is applicable to nonwoven fabrics, felted fabrics, and *dipped* or coated fabrics.

1.2 This test method is not recommended for knitted fabrics or for other textile fabrics which have high stretch (more than 11 %).

NOTE 1—For the determination of the breaking force and elongation of textile fabrics using the grab test and modified grab test procedures, refer to Test Method D 5034.

NOTE 2—For determination of the breaking force and elongation of some specific types of fabrics which use the strip test, refer to Specifications D 579 and D 580.

1.3 This test method shows the values in both inch-pound units and SI units. Inch-pound units is the technically correct name for the customary units used in the United States. SI units is the technically correct name for the system of metric units known as the International System of Units. The values stated in either acceptable metric units or in other units shall be regarded separately as standard. The values expressed in each system may not be exact equivalents; therefore, each system must be used independently of the other, without combining in any way.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D 76 Specification for Tensile Testing Machines for Textiles
D 123 Terminology Relating to Textiles
D 579 Specification for Greige Woven Glass Fabrics
D 580 Specification for Greige Woven Glass Tapes and Webbings
D 629 Test Methods for Quantitative Analysis of Textiles
D 1776 Practice for Conditioning and Testing Textiles
D 4848 Terminology Related to Force, Deformation and Related Properties of Textiles
D 4849 Terminology Related to Yarns and Fibers
D 4850 Terminology Relating to Fabrics and Fabric Test Methods
D 5034 Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)

3. Terminology

3.1 For definitions of textile terms used in this test method: breaking force, elongation, tensile test, refer to Terminology D 4848.

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[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.60 on Fabric Test Methods, Specific.
Current edition approved ~~Jan. 15, 2006.~~June 1, 2008. Published ~~February 2006.~~October 2008. Replaces strip testing sections, Sections 17 through 20, of Test Method D 1682. Originally approved in 1990. Last previous edition approved in ~~2003~~2006 as ~~D5035–95(2003).~~ D 5035 – 06.

[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.

3.2 For definitions of textile terms used in this test method: constant-rate-of-extension, constant rate of load, constant rate of traverse, refer to Terminology D 4849.

3.3 For definitions of textile terms used in this test method: cut strip test, raveled strip test, strip test, refer to Terminology D 4850.

3.4 For other textile terms used in this test method, refer to Terminology D 123.

4. Summary of Test Method

4.1 A test specimen is clamped in a tensile testing machine and a force applied to the specimen until it breaks. Values for the breaking force and elongation of the test specimen are obtained from machine scales, dials, autographic recording charts, or a computer interfaced with the testing machine.

4.2 This test method describes procedures for carrying out fabric tensile tests using four types of specimen, and three alternative types of testing machines. For reporting, use the following system to identify specific specimen and machine combinations.

4.2.1 *Type of specimen*:

4.2.1.1 1R—25 mm (1.0 in.) raveled strip test

4.2.1.2 2R—50 mm (2.0 in.) raveled strip test

4.2.1.3 1C—25 mm (1.0 in.) cut strip test

4.2.1.4 2C—50 mm (2.0 in.) cut strip test

4.2.2 *Type of tensile testing machine* :

4.2.2.1 E—constant-rate-of-extension (CRE)

4.2.2.2 L—constant-rate-of-load (CRL)

4.2.2.3 T—constant-rate-of-traverse (CRT)

4.2.3 Possible combinations can be identified as follows:

	Type of Tester		
Test Specimen	Constant-Rate-of-Extension	Constant-Rate-of-Load	Constant-Rate-of-Traverse
25-mm (1-in.) raveled strip	1R-E	1R-L	1R-T
50-mm (2-in.) raveled strip	2R-E	2R-L	2R-T
25-mm (1-in.) cut strip	1C-E	1C-L	1C-T
50-mm (2-in.) cut strip	2C-E	2C-L	2C-T

4.2.3.1 For example, 1R-E refers to a 25-mm (1-in.) raveled strip test carried out on a constant-rate-of-extension tensile testing machine.

5. Significance and Use

5.1 The raveled strip test in this test method is considered satisfactory for acceptance testing of commercial shipments of woven textile fabrics because the method has been used extensively in the trade for acceptance testing. The same is true for the cut strip test for felted or nonwoven textile fabrics.

5.1.1 If there are differences of practical significance between reported test results for two laboratories (or more), comparative test should be performed to determine if there is a statistical bias between them, using competent statistical assistance. At a minimum, use the samples for such a comparative test that are as homogeneous as possible, drawn from the same lot of material as the samples that resulted in disparate results during initial testing and randomly assigned in equal numbers to each laboratory. The test results from the laboratories involved should be compared using a statistical test for unpaired data, a probability level chosen prior to the testing series. If bias is found, either its cause must be found and corrected, or future test results for that material must be adjusted in consideration of the known bias.

5.2 The method is not recommended for knitted fabrics because of their high stretch.

5.3 Some modification of the techniques may be necessary for any fabric having a strength in excess of 200 N/cm (1140 lbf/in.) width. Special precautionary measures are provided for use when necessary with strong fabrics, or fabrics made from glass fibers (see Specification D 579), to prevent them from slipping in the clamps or being damaged as a result of being gripped in the clamps.

5.4 All of the procedures are applicable for testing fabrics either conditioned or wet.

5.5 Comparison of results from tensile testing machines operating on different principles is not recommended. When different types of machines are used for comparison testing, constant time-to-break at 20± 3 s is the established way of producing data. Even then the data may differ significantly.

5.6 Although a constant-rate-of-extension tensile testing machine is preferred in these methods, in cases of dispute, unless there is agreement to the contrary between the purchaser and supplier, a constant-time-to-break (20 ± 3 s) is to be used.

5.7 The raveled strip procedure is applicable to the determination of the force required to break a specific width of fabric. The breaking force information on woven fabrics is particularly useful for comparison of the effective strength of the yarns in the fabric with the combined strength of an equal number of the same yarns which are not woven. The procedure is not recommended for fabrics having fewer than 20 yarns across the width of the specimen. If a 20-yarns-per-specimen width cannot be obtained with a 25-mm (1-in.) strip, a 50-mm (2-in.) strip should be used. In general, the observed force for a 50-mm (2-in.) specimen is not double the observed force for a 25-mm (1-in.) specimen and the results should be reported as observed on a 50-mm (2-in.) strip

without mathematical adjustment to 25 mm (1 in.). If a fabric cannot be raveled readily, use either a cut strip or grab procedure.

5.8 The cut strip procedure is applicable to heavily fulled fabrics, woven fabrics that cannot be readily raveled, felted fabrics and nonwoven fabrics. This procedure is not recommended for fabrics which can be raveled because the yarns at the edges tend to unravel during testing. The recommendation regarding the minimum number of yarns in a woven specimen discussed in 5.7 for raveled strips applies equally to cut strips.

6. Apparatus, Reagents, and Materials

6.1 *Tensile Testing Machine*, of the CRE, CRL, or CRT type conforming to Specification D 76, with respect to force indication, working range, capacity, and elongation indicator and designed for operation at a speed of 300 ± 10 mm/min (12 ± 0.5 in./min); or, a variable speed drive, change gears, or interchangeable loads as required to obtain the 20 ± 3 s time-to-break (see 5.5 and 5.6).

6.2 *Clamps and Jaw Faces*—Each jaw face shall be smooth, flat, and with a metallic or other agreed upon surface. The faces shall be parallel and have machining centers with respect to one another in the same clamp and to the corresponding jaw face of the other clamp.

6.2.1 For all strip tests or for narrow fabrics and tapes being tested full width, each jaw face shall measure at least 10 mm (0.5 in.) wider than the specimen being tested and at least 25 mm (1.0 in.) in the direction of the applied force.

6.3 *Metal Clamp*, auxiliary, weighing 170 g (6.0 oz) with 100-mm (4-in.) width anvils.

6.4 *Distilled Water*, for wet testing.

6.5 *Nonionic Wetting Agent*, for wet testing.

6.6 *Container*, for wetting out specimens.

6.7 *Standard fabrics*, ~~for use in verification of apparatus.~~[3] ~~(See~~ , for use in verification of apparatus. (See Annex A1.)

6.8 *Pins*, stainless-steel, 10-mm (⅜-in.) diameter by 125 mm (5 in.) long, two required if used.

7. Sampling

7.1 *Lot Sample*—Take a lot sample as directed in the applicable material specification. In the absence of such a specification randomly select the rolls or pieces that constitute the lot sample using the following schedule:

Number of Rolls, Pieces in Lot, Inclusive	Number of Rolls or Pieces in Lot Sample
1 to 3	All
4 to 24	4
25 to 50	5
Over 50	10 % to a maximum of 10 of the rolls or pieces

NOTE 3—An adequate specification or other agreement between the purchaser and supplier requires taking into account the variability between rolls of fabric and between specimens from a swatch from a roll of fabric to provide a sampling plan with a meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quality level.

7.2 *Laboratory Sample*—From each roll or piece of fabric taken from the lot sample, cut at least one laboratory sample the full width of the fabric and 1 m (1 yd) along the selvage (machine direction).

NOTE 4—Results obtained on small hand samples or swatches can only be considered as representative of the sample swatch submitted and cannot be assumed to be representative of the fabric piece from which the hand sample or swatch was taken.

7.3 *Test Specimens*— From each laboratory sample, take five specimens from the warp (machine) direction and eight specimens from the filling (cross) direction (if tested) for each testing condition.

7.3.1 Testing conditions include the following:

7.3.1.1 *Warp or Machine Direction*—Standard conditions for testing textiles,

7.3.1.2 *Warp or Machine Direction*—Wet at 21°C (70°F),

7.3.1.3 *Filling or Cross Direction* —Standard conditions for testing textiles, and

7.3.1.4 *Filling or Cross Direction* —Wet at 21°C (70°F).

7.3.2 When using the constant-time-to-break technique and unfamiliar fabrics, prepare two or three extra specimens to establish the proper rate of loading (speed for testing).

8. Conditioning

8.1 *For Conditioned Testing*:

8.1.1 If the samples have a higher moisture content than the moisture present when at equilibrium in the standard atmosphere for testing textiles, precondition as directed in Practice D 1776.

8.1.2 Bring samples to moisture equilibrium in the standard atmosphere for testing textiles as directed in Practice D 1776. Equilibrium is considered to have been reached when the increase in mass of the specimen in successive weighings made at

[3] ~~Plain weave and sateen standard fabrics are available from Test Fabrics, Inc., P.O. Drawer O, Middlesex, NJ 08846.~~

[3] Apparatus and accessories are commercially available.

intervals of not less than 2 h does not exceed 0.1 % of the mass of the specimen.

NOTE 5—It is recognized that, in practice, materials are frequently not weighed to determine when moisture equilibrium has been reached. While conditioning for a fixed time cannot be accepted in cases of dispute, it may be sufficient in routine testing to expose the material to the standard atmosphere for testing textiles for a reasonable period of time before the specimens are tested. As a guide, the following conditioning periods are suggested:

Fiber	Minimum Conditioning Period, h[4]
Animal Fibers (for example, wool and regenerated proteins)	8
Vegetable Fibers (for example, cotton)	6
Viscose	8
Acetate	4
Fibers having a regain less than 5 % at 65 % relative humidity	2

8.2 *For Wet Testing*:

8.2.1 Specimens to be tested in the wet condition shall be immersed in water at room temperature until thoroughly wetted (Note 6). To thoroughly wet a specimen, it may be necessary to add not more than 0.05 % of a nonionic wetting agent to the water. A test of any specimen shall be completed within 2 min after its removal from the water.

NOTE 6—The material has been thoroughly wet out when it has been determined that additional immersion time does not produce any additional changes in breaking strength of test specimens. This method of determination must be used in cases of dispute; however, for routine testing in the laboratory, it may be sufficient to immerse the material 1 h.

8.2.2 The procedures in this test method should be used with caution when testing fabrics that do not wet out uniformly and thoroughly because of the presence of sizing, oil, protective coatings, or water repellents.

8.2.3 When the strength of wet specimens without sizing, water repellents, etc. is required, before preparing the test specimens, treat the material as directed in Test Methods D 629, using appropriate de-sizing, etc. procedures, that will not affect the normal physical properties of the fabric.

9. Preparation of Specimens

9.1 *General*:

9.1.1 Cut specimens with their long dimensions parallel either to the warp (machine) direction or to the filling (cross) direction, or cut specimens for testing both directions as required. Preferably, specimens for a given fabric direction should be spaced along a diagonal of the fabric to allow for representation of different warp and filling yarns, or machine and cross direction areas, in each specimen. When possible, filling specimens should contain yarn from widely separated filling areas. Unless otherwise specified, take specimens no nearer to the selvage or edge of the fabric than one tenth of the width of the fabric (see 7.3.2).

9.1.2 Ribbons and other narrow fabrics which are 50 mm (2 in.) or less wide are usually tested full width.

9.2 *Raveled Strip Test—1R, 25 mm (1 in.)*:

9.2.1 Cut each specimen either 35 mm (1.5 in.) or 25 mm (1 in.) plus 20 yarns, whichever is wider, by at least 150 mm (6 in.) long (Note 7). The long dimension should be accurately parallel to the direction of testing and force application.

NOTE 7—The length of the specimen depends on the type of clamps being used. The specimen should be long enough to extend through the clamps and project at least 10 mm (0.5 in.) at each end. The specimen length may be calculated using Eq 1or Eq 2:

$$\text{Specimen length, mm} = C + 2W \quad (1)$$

$$\text{Specimen length, in.} = K + 2W \quad (2)$$

where:

C = constant based on a gage length of 75 mm + 20 mm for projections beyond clamp, 95 mm,
K = constant based on a gage length of 3 in. + 1 in. for projections beyond clamps, 4 in., and
W = jaw face width in direction of load, mm (in.).

9.2.2 Ravel each specimen to give a testing width of 25 mm (1 in.) by removing an approximately equal number of yarns from each side, or 10 yarns from each side, depending upon the width cut in 9.2.1.

9.2.3 If, by mutual consent, it is agreed to perform a test on strips containing less than 20 yarns across the width to be tested, the actual number of yarns shall be stated in the report.

NOTE 8—Under some circumstances it may be necessary to ravel the strip to a constant number of yarns instead of a constant width. This number shall never be less than 20 mm (0.75 in.) and the width never less than 15 mm (0.5 in.). This technique is particularly useful when comparing the breaking force of a conditioned fabric after a wet finishing operation in which shrinkage has taken place with that of the same fabric before finishing. Such a procedure may be used by mutual consent of the interested parties.

[4] These periods are approximate and apply only to fabrics, spread out in single thickness, and exposed to freely moving air in the standard atmosphere for testing textiles. Heavy or coated fabrics may require conditioning periods longer than those suggested. If a fabric contains more than one fiber, it should be conditioned for the period required by the fiber component which requires the most time (for example, 8 h for a wool and acetate blend).