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Standard Test Methods for BREAKING LOAD AND ELONGATION OF TEXTILE FABRICS[1]

This standard is issued under the fixed designation D 1682; 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.

[ε1] NOTE—Section 1.2 was added editorially and Notes 1 through 20 renumbered in August 1986.

1. Scope

1.1 These test methods cover procedures for determining the breaking load and elongation of textile fabrics using the Grab, Ravelled Strip, and Cut Strip methods, presented in two sections as follows:

1.1.1 *Part I* describes aspects of the procedure which are common to all three methods.

1.1.2 *Part II* describes those details of procedure especially applicable to the method under discussion.

1.2 The values stated in inch-pound units are to be regarded as the standard.

PART I—GENERAL

2. Applicable Documents

2.1 *ASTM Standards:*

D 76 Specification for Tensile Testing Machines for Textiles[2,3]

D 123 Terminology Relating to Textiles[2,3]

D 259 Specification for Woven Tapes[2]

D 315 Specification for Woven Asbestos Tape[3]

D 461 Methods of Testing Felt[2]

D 579 Specification for Greige Woven Glass Fabrics[3]

D 580 Specification for Greige Woven Glass Tapes and Webbings[3]

D 629 Test Methods for Quantitative Analysis of Textiles[3]

D 1117 Methods of Testing Nonwoven Fabrics[2]

3. Definitions

3.1 *grab test—in fabric testing*, a tension test in which only a part of the width of the specimen is gripped in the clamps. For example, if the specimen width is 4 in. (100 mm) and the width of the jaw faces 1 in. (25 mm), the specimen is gripped centrally in the clamps.

3.2 *strip test*—a tension test in which the full width of the specimen is gripped in the clamps.

3.3 *modified grab test*—a test in which only a part of the width of the specimen is gripped in the clamps and in which lateral slits are made in the specimen to sever all yarns bordering the portion whose strength is to be tested, reducing to a practical minimum the "fabric assistance" inherent in the grab method.

3.4 *raveled strip test*—a strip test in which the specified specimen width is secured by raveling away yarns.

3.5 *cut strip test*—a strip test in which the specimen width is secured by cutting the fabric.

3.6 *constant-rate-of-extension tensile testing machine (CRE)*—a testing machine in which the rate of increase of specimen length is uniform with time.

3.7 *constant-rate-of-traverse tensile testing machine (CRT)*—a testing machine in which the pulling clamp moves at a uniform rate and the load is applied through the other clamp which moves appreciably to actuate a weighing mechanism, so that the rate of increase of load or

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[2] *Annual Book of ASTM Standards*, Vol 07.01.

[3] *Annual Book of ASTM Standards*, Vol 07.02.

elongation is dependent upon the extension characteristics of the specimen.

3.8 *constant-rate-of-load tensile testing machine (CRL)*—a testing machine in which the rate of increase of the load being applied to the specimen is uniform with time after the first 3 s.

3.9 For definitions of other terms used in this method, refer to Terminology D 123.

4. Summary of Method

4.1 A continually increasing load is applied longitudinally to the specimen, and the test is carried to rupture in a specific time. Values for the breaking load and elongation of the test specimen are obtained from machine scales or dials or autographic recording charts.

5. Uses and Significance

5.1 Most woven, nonwoven, or felted textile fabrics may be tested by at least one of the methods. The methods are not recommended for knitted fabrics. Some modification of the techniques is likely to be necessary for any fabric having a strength in excess of 1000 lb/in. (179 kg/cm) width. Special precautionary measures are provided for use when necessary with strong fabrics or fabrics made from glass fibers, to prevent them from slipping in the clamps or being damaged as a result of being gripped in the clamps.

5.2 All of the procedures are applicable for testing fabrics either dry or wet. They may be used with constant-rate-of-traverse, constant-rate-of-load, or constant-rate-of-extension type tension machines. The results obtained may, however, depend upon the type of machine used for the test. Constant-time-to-break has been specified because it is the best known way of providing good agreement between the results from different types of tensile testers. However, data obtained on constant-rate-of-load testers may differ from that obtained on constant-rate-of-traverse or constant-rate-of-extension testers when testing fabrics made from fibers whose behavior is strongly dependent upon the rate of extension used, for example, high-density polyethylene. An optional procedure for the constant-rate-of-traverse tester using a machine speed of 12 ± ½ in. (305 ± 10 mm)/min is permitted whenever a constant-time-to-break is not specified.

5.3 *Grab Method*—The grab method is applicable whenever it is desired to determine the "effective strength" of the fabric in use, that is, the strength of the yarns in a specific width together with the additional strength contributed by adjacent yarns. The breaking load determined by the grab method is not a reflection of the strength of the yarns actually gripped between clamps and cannot be used for direct comparison with yarn strength determinations. Grab tests are as precise as ravelled strip tests and the specimens require much less time to prepare though they require more fabric per specimen. There is no simple relationship between grab tests and strip tests since the amount of fabric assistance depends on the type of weave, fabric count, mobility of yarns, etc.

5.4 *Raveled Strip*—The raveled strip method is applicable whenever it is desired to determine the breaking load required to rupture a specific width of fabric. The information is particularly useful for comparison of the effective strength of the yarns in the fabric with their strength before weaving. The method is not recommended for fabrics having less than 20 yarns across the width of the specimen. If the specimen cannot be obtained with a 1-in. (25.4-mm) strip, a 2-in. (50.8-mm) strip should be used. If a fabric cannot be raveled readily, use either a grab or cut strip test.

NOTE 1—The 2-in. (50.8-mm) strip may be used for any fabric if a machine of sufficient capacity is available.

NOTE 2—The observed load of a 2-in. (50.8-mm) specimen, in general, is not double the observed load of a 1-in. (25.4-mm) specimen and the results should accordingly be reported as observed on a 2-in. strip, without mathematical adjustment to a 1-in.

NOTE 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 4—Tape, ribbons, and other narrow fabrics less than 2-in. (50.8-mm) wide, not covered by Specification D 259, Specification D 580, or Specification D 315, are tested full width.

5.5 *Cut Strip*—The cut strip method is applicable instead of the raveled strip method for heavily fulled fabrics, felted fabrics, or any fabric that cannot be readily raveled. It can be used when the fabric can be raveled, but this procedure is not recommended. The recommendation regarding the minimum number of yarns in a specimen discussed in 5.4 for raveled strips applies equally to cut strips.

5.6 *Modified Grab*—The modified grab

method is applicable where it is desired to determine the breaking load required to rupture a specific width of fabric for those constructions in which the application of testing stress on raveled strip specimens produces further unraveling. This method is particularly applicable to high strength fabrics.

6. Apparatus

6.1 *Tensile Testing Machine (CRE, CRT, or CRL)*—One of the three types of testing machines described in Specification D 76, shall be used.

6.2 *Speed Adjuster*, for varying the speed of operation of the testing machine in order to break the specimens in 20 ± 3 s.

6.3 *Stop Watch*, for measuring the time required to break each specimen.

7. Sampling, Selection, and Number of Specimens

7.1 Take samples as directed in any applicable material specifications or in their absence secure two or more samples separated by several yards along the length of each cut of fabric to be sampled. Each sample shall extend the width of the fabric and ½ yd (450 mm) along the selvage.

NOTE 5—Results secured on small hand samples should be considered merely as representative of the sample submitted and cannot be assumed to be representative of the fabric piece from which the hand sample was taken.

7.2 Unless otherwise agreed upon (for example, provided for by an applicable material specification), the number of test specimens shall be such that the mean of the test results will, with a 95 % probability, be no more than 5 % below the "true" average breaking load (as would be determined by an infinite number of tests). This is equivalent to a precision of ±5 % at a probability level of 90 %.

$$n = 0.11\ v^2$$

where:

n = number of test specimens, and
v = coefficient of variation of individual test results, determined from extensive past records on similar material.

NOTE 6—The variability of elongation likely to be encountered is not sufficiently well known at the present time to be able to estimate the degree of precision to be expected. Variability of elongation is likely to be somewhat higher than variability of breaking load, however, and the precision of the result for the same number of tests is likely to be lower.

7.3 If v is not known, make five tests on warpwise specimens and eight tests on fillingwise specimens.

NOTE 7—This number of tests is based on a coefficient of variation of breaking load of 6.5 % for the warp and 8.5 % for the filling. This is a somewhat higher value of v than will be found in practice. Knowledge of the actual value of v for the fabric under test is therefore likely to permit making fewer tests than prescribed in this section. If fewer tests are performed without knowing the "true" value of v, it must be presumed that the result is obtained with reduced precision, that is, a figure higher than 5 %. The estimated precision must then be calculated as follows and quoted in the report:

For warpwise tests,

$$E = 10.7/\sqrt{n} \quad (1)$$

For fillingwise tests,

$$E = 14.0/\sqrt{n} \quad (2)$$

where:

E = precision, and
n = actual number of tests.

NOTE 8—It is desirable to prepare two or three extra specimens which may be required to establish the proper time when dealing with unfamiliar materials, using the constant-time-to-break technique.

8. Conditioning

8.1 Precondition the specimens by bringing them to approximate moisture equilibrium in the standard atmosphere for preconditioning, then bring the specimens to moisture equilibrium for testing in the standard atmosphere for testing. Equilibrium is considered to have been reached when the increase in weight of the specimen in successive weighings made at intervals of not less than 2 h does not exceed 0.1 % of the weight of the specimen.

NOTE 9—It is recognized that in practice textile materials are frequently not weighed to determine when moisture equilibrium has been reached. While such a procedure cannot be accepted in cases of dispute, it may be sufficient in routine testing to expose the material to the standard atmosphere for testing 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[A]
Animal fibers (for example, wool) and regenerated proteins	8
Vegetable fibers (for example, cotton)	6
Viscose	8