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Standard Test Method for Stretch Properties of Textile Fabrics – CRE Method[1]

This standard is issued under the fixed designation D6614; 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 covers the determination of the amount of fabric stretch and fabric growth after a specified extension and held for a specified time.

1.2 While this method can be used for any fabric, knit fabrics having high stretch are better measured by test method D2594.

1.3 This test method should not be used to measure the breaking strength and elongation of woven fabrics, which is covered in Test Methods D5034 and D5035.

1.4 The values listed in either SI units or inch-pound units are to be regarded separately as the standard. Within the text, the inch-pound units are shown in parentheses. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with specification.

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

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D123 Terminology Relating to Textiles
D1776 Practice for Conditioning and Testing Textiles
D2594 Test Method for Stretch Properties of Knitted Fabrics Having Low Power
D4849 Terminology Related to Yarns and Fibers
D4850 Terminology Relating to Fabrics and Fabric Test Methods
D5034 Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)
D5035 Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)

3. Terminology

3.1 For all terminology relating to D13.59, Fabric Test Methods, General, see Terminology D4850.

3.2 For all terminology related to D13.58, Yarns and Fiber, see Terminology D4849.

3.2.1 The following terms are relevant to this standard: fabric stretch, fabric growth, stretch yarn.

3.3 For definitions of all other textile terms see Terminology D123.

4. Summary of Test Method

4.1 *Fabric Stretch and Fabric Growth*— A specified load is applied to a fabric specimen, using a constant rate of extension tensile tester at a prescribed rate of extension. After holding at the specified load for a predetermined time, the length is measured. The load is removed from the specimen and allowed to relax for a specified time. A small amount of force, enough to remove any wrinkles or folds, is applied and the specimen length measured. The amount of fabric stretch is calculated from the difference in length prior to load and under load. Fabric growth is calculated from the difference in length prior to loading and after relaxation.

5. Significance and Use

5.1 This method is used to determine the stretch and growth properties which a garment made of the fabric may be expected to exhibit during use.

5.2 This is a new method and therefore the history of data is very small, however the excellent agreement of between-laboratory data suggest this method may be considered for acceptance testing of commercial shipments.

5.2.1 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. As a minimum, samples used for such comparative tests should be as homogeneous as possible, drawn from the same lot of material as the samples that resulted in disparate results

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.59 on Fabric Test Methods, General.

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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.

during initial testing, and randomly assigned in equal numbers to each laboratory. Other fabrics with established test values may also be used for these comparative tests. The test results from the laboratories involved should be compared using a statistical test for unpaired data, at 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 must be adjusted in consideration of the known bias.

6. Apparatus

6.1 *Tensile Testing Machine*[3], of the CRE type with capability to maintain a constant load and measurement of the location of the moveable crosshead.

6.2 *Grips and Jaw Faces,* a minimum of 50 mm (2 in.) faces to hold the full width of the specimen.

7. Sampling, Selection, and Number of Specimens

7.1 *Primary Sampling Unit*—Consider rolls, bolts or pieces of fabric, or cartons of fabric components of fabricated systems such as garments to be the primary sampling unit, as applicable.

7.2 *Laboratory Sampling Unit*—As a laboratory sampling unit take from the primary sampling unit at least one full-width piece of fabric that is 1M (1 yd) in length along the selvage (machine direction), after removing the first 1M (1 yd) length. For circular knit fabrics cut a band at least 300 mm (12 in.) wide. When applicable, use the entire fabric component of the fabricated systems.

7.3 *Test Specimen Selection*—From each laboratory sampling unit, take test specimens with the long direction parallel to the stretch direction. Consider the long direction as the direction of test. Specimen preparation need not be carried out in the standard atmosphere for testing. Label to maintain specimen identity.

7.3.1 When the end-use fabric component of fabricated systems is provided, take specimens from different areas. That is, if the product is a garment worn on the upper body, then take specimens from the shoulder, shirt tail, shirt back and front, and sleeve.

7.3.2 For fabric widths 125 mm (5 in.) or more, take no specimen closer than 25 mm (1 in.) from the selvage edge.

7.3.3 For fabric widths less than 125 mm (5 in.), use the entire width for specimens.

7.3.4 Cut specimens representing a broad distribution diagonally across the width of the laboratory sampling unit. Take lengthwise specimens from different positions across the width of the fabric. Take widthwise specimens from different positions along the length of the fabric.

7.3.5 Ensure specimens are free of folds, creases, or wrinkles. Avoid getting oil, water, grease, etc. on the specimen when handling.

7.3.6 If the fabric has a pattern, ensure that the specimens are a representative sampling of the pattern.

7.4 *Specimen Preparation*—As test specimens from each laboratory sampling unit, proceed as follows:

7.4.1 For woven fabrics, cut two strips 65 by 350 mm (2.5 by 14 in.) with the long dimension parallel to the stretch direction.

7.4.1.1 Ravel the strips to form test specimens to 50 ± 0.5 mm (2 ± 0.02 in.) width by taking approximately the same number of yarns from each side of the specimen.

7.4.2 For knitted and nonwoven fabrics, cut two test specimens, 50 ± 0.5 mm (2 ± 0.02 in.) wide by 350 mm (14 in.) with the long dimension parallel to the stretch direction.

8. Conditioning

8.1 Condition each sample as directed in Practice D1776, prior to cutting the test specimens.

9. Preparation and Calibration of Test Apparatus

9.1 Set-up procedures for machines from different manufacturers may vary. Prepare and verify calibration of the tensile tester using directions supplied by the manufacturer.

9.2 Set the distance between the jaw faces 250 ± 0.5 mm (10 ± 0.02 in.).

9.3 Select an appropriate extension speed. Fabrics with very little stretch should be extended at a slow speed and fabrics with high stretch at a faster speed. The extension speed is not critical to the test but consideration must be given to the response of the test apparatus to ensure the machine stops without overriding the stop point and the time required to perform the test.

10. Procedure

10.1 Make all tests in the standard atmosphere for testing textiles.

10.2 Place one specimen in the upper jaw, making sure the long direction of the specimen is parallel to the sides of the jaw faces.

10.3 Place the other end of the specimen in the bottom jaw, applying just enough force to remove any folds or wrinkles.

10.4 Start the machine and hold at 1814 ± 1.0 g (4.0 ± 0.02 lb.) for 5 ± 0.1 min. The electronically controlled machine should record all the measurements necessary for the final calculations.

10.5 If the machine is not electronically controlled, stop the crosshead at 1814 ± 1.0 g (4 ± 0.02 lb.) Maintain the load by adjusting the crosshead until 5 ± 0.1 min. has elapsed. Measure the distance between the jaw faces.

10.6 Return the crosshead to the starting position and hold for 5 ± 0.1 min.

10.7 Move the crosshead to a position where all the slack is removed or the load increases above the zero load line. Measure the distance between jaw faces at this point.Table 1

TABLE 1 Components of Variance, % Stretch, % Growth

	Single-operator Component	Between-operator Component
Percent Stretch	0.189	0.124
Percent Growth	0.104	0.116

[3] Apparatus is commercially available.

11. Calculations

11.1 Calculate the fabric stretch and the fabric growth of each specimen to the nearest 0.2 percent using Eq 1 and 2.

$$\textit{Fabric stretch, percent} = [(B - A)/A] \times 100 \quad (1)$$

$$\textit{Fabric growth, percent} = [(C - A)/A] \times 100 \quad (2)$$

where:

A = original distance between jaw faces, (from 9.2)
B = distance between jaw faces measured while the specimens under 1814 ± 1.0 g (4 ± 0.02 lb) as directed in 10.4 and 10.5, and
C = distance between jaw faces measured after removal of slack as directed in 10.7.

11.2 Calculate the average stretch and fabric growth of all specimens tested. To the nearest 0.2 % for the laboratory sampling unit and the primary sampling unit.

12. Report

12.1 State that the specimens were tested as directed in Test Method D6614. Describe the material or product sampled and the method of sampling used.

12.2 Report the following information:

12.2.1 The average percentage fabric stretch and the average fabric growth.

13. Precision and Bias

13.1 *Interlaboratory Test Data*—An interlaboratory test was performed in April 1997. Following section 8.1, 2 test specimens were cut from each laboratory sample and their stretch and growth measured. The averages of percent stretch and growth were calculated as in section 11.2. A total of 10 specimens from each of three materials were tested in two laboratories by a single operator in each laboratory. This generated 5 averages of 2 specimens as directed in section 11.2. Using SAS Proc Varcomp[4] the within-laboratory and between-laboratory components of variance as Standard Deviations for percent stretch and percent growth were determined. These results appear in Table 1.

13.2 *Precision*—For the components of variance reported in Table 1, two averages of observed values should be considered significantly different at the 95 % probability level if the difference exceeds the critical differences listed in Table 2.

A determination is the average of 2 specimens as specified in section 11.2.

13.3 *Bias*—The procedure of this test method produces a test value that can be defined only in terms of a test method. There is no independent, referee method by which bias may be determined. This test method has no known bias.

14. Keywords

14.1 fabric growth; fabric stretch

[4] SAS PROC VARCOMP components-of-variance procedure, available from SAS Institute, Box 8000, Cary, North Carolina 27511.

TABLE 2 Critical Difference, % Stretch, % Growth

	Number of Determinations Per Average	Single-operator Precision	Between-operator Precision
% Stretch	1	0.52	0.63
	2	0.37	0.51
	3	0.23	0.41
% Growth	1	0.29	0.43
	2	0.20	0.38
	3	0.13	0.35