Designation: D 4964 – 96 (Reapproved 2004)

Standard Test Method for Tension and Elongation of Elastic Fabrics (Constant-Rate-of-Extension Type Tensile Testing Machine)[1]

This standard is issued under the fixed designation D 4964; 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 measurement of tension and elongation of wide or narrow elastic fabrics made from natural or man-made elastomers, either alone or in combination with other textile yarns, when tested with a constant-rate-of-extension (CRE) type tensile testing machine.

NOTE 1—For determination of similar testing using the constant-rate-of-load (CRL) type tensile testing machine, refer to Test Method D 1775.

1.2 The use of this test method requires the selection of, or mutual agreement upon, loop tension(s) and elongation(s) at which the test results will be determined.

1.3 Laundering procedures require mutual agreement on the selection of temperature and number of washing cycles and drying cycles to be used.

1.4 The values stated in SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore each system must be used independently of the other, without combining values in any way.

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]

D 76 Specification for Tensile Testing Machines for Textiles

D 123 Terminology Relating to Textiles

D 1775 Test Method for Tension and Elongation of Wide Elastic Fabrics (Constant-Rate-of-Load Type Tensile Testing Machine)

D 1776 Practice for Conditioning Textiles for Testing

3. Terminology

3.1 *Definitions:*

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

3.1.2 *constant-rate-of-load tensile testing machine (CRL), n*—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.

3.1.3 *elastic fabric, n*—a textile fabric made from an elastomer either alone or in combination with other textile materials.

3.1.4 *elongation, n*—the ratio of the extension of a material to the length of the material prior to stretching.

3.1.5 *extension, n*—the change in length of a material due to stretching.

3.1.6 *extension-recovery cycle, n—in tension testing*, the continuous extension of a specimen, with a momentary hold at a specified extension, followed by a controlled rate of return to zero extension.

3.1.7 *force, n*—a physical influence exerted by one body on another which produces acceleration of bodies that are free to move and deformation of bodies that are not free to move.

3.1.8 *loop tension, n— in elastic material testing*, the total tension at any specified extension that is exerted on a specimen in a loop formation.

3.1.9 *narrow elastic fabric, n*—an elastic fabric that is less than 150 mm or 6 in. wide.

3.1.10 *tension, n*—a uniaxial force tending to cause the stretching of a material.

3.1.11 *tension-recovery chart, n— in tension testing*, a continuously plotted graph of tension versus extension resulting from a tension-recovery cycle.

[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.

3.1.12 *tension test*, *n— in textiles*, a test designed to measure the tautness in a textile strand or fabric.

3.1.13 *wide elastic fabric*, *n*—an elastic fabric that is at least 150 mm or 6 in. wide.

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

4. Summary of Test Method

4.1 *Loop Tension at Specified Elongation(s)*—A conditioned loop specimen is mounted in a CRE-type tensile testing machine. The specimen is then extended at a specified rate to a specified loop tension, and returned at a specified rate to zero tension. The cycle is repeated two more times to give a total of three cycles. During the test, extension-recovery curves may be plotted by an automatic recorder for all or only the third cycle. The tension at specified percent elongation(s) is calculated from the graph of the third cycle or obtained from the instrument.

4.2 *Elongation at Specified Loop Tension*—A conditioned loop specimen is mounted in a CRE-type tensile testing machine. The specimen is then loaded at a specified rate to a specified loop tension, and unloaded at a specified rate to zero loop tension. The cycle is repeated two more times to give a total of three cycles. During the test, tension-recovery curves may be plotted by an automatic recorder for all or only the third cycle. The elongation at a specified loop tension is calculated from the graph of the third cycle or obtained from the instrument.

5. Significance and Use

5.1 This test method for testing loop tension and elongation of elastic fabrics is considered satisfactory for acceptance testing of commercial shipments of elastic fabrics because the test method is used in the trade for acceptance testing.

5.1.1 In case of a dispute arising from differences in reported test results when using this test method for acceptance testing of commercial shipments, the parties should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens that are as homogeneous as possible and that are from a lot of material of the type in question. The test specimens should then be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using student's *t*-test for unpaired data and an acceptable probability level chosen by the two parties before the testing is begun. If bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results with consideration to the known bias.

5.2 This test method specifies the use of the CRE-type tensile testing machine. Users of this test method are cautioned that loop tension test data obtained using this method are not comparable to tension test data obtained using Test Method D 1775 because of the differences in testing machines. Test Method D 1775 uses a CRL-type tensile testing machine.

5.3 The loop tension and extension relationship of an elastic fabric is an important criterion for judging the suitability of the fabric for various end uses, such as: foundation garments, brassieres, and swimsuits.

5.4 Data from loop tension-recovery curves can be compared only if the tension testing machine, rate-of-extension, maximum loading (or extension), and specimen specifications are comparable. Since different machine set-ups will cause different results on the same fabric, machine set-ups must always be specified before making a test and be reported with the test results.

5.5 The test for measuring loop tension at specified elongation(s) is used to determine the tension of an elastic fabric when subjected to a specified elongation which is less than the elongation required to rupture the fabric. The test prescribes points of measurement on the extending (outgoing) cycle only.

5.6 The test for measuring elongation at specified tension(s) is used to determine the elongation of an elastic fabric when subjected to a specified loop tension which is less than the tension required to rupture the fabric. The test prescribes points of measurement on the loading (outgoing) cycle only.

6. Apparatus

6.1 *Tensile Testing Machine, CRE-Type,*[3] conforming to Specification D 76, equipped with an automatic recording device and cycling controls.

6.2 *Band Clamps*, to hold loop specimen during testing. The diameter of the anvils will be 13.0± 0.25 mm (0.5 ± 0.01 in.) or 6.5± 0.25 mm (0.25 ± 0.01 in.). The length of the anvil will not be less than 76 mm (3.0 in.).

6.3 *Sewing Machine Single-Needle*.

7. Sampling

7.1 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of rolls of fabric as directed in an applicable material specification or other agreement between the purchaser and the supplier. Consider rolls of fabric to be the primary sampling units.

NOTE 2—An adequate specification or other agreement between the purchaser and the supplier requires taking into account the variability between rolls of fabric, and the variability 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*—As a laboratory sample for acceptance testing, take a full width swatch, 2 m (2 yd) long, from the end of each roll of fabric in the lot sample, after first discarding a minimum of 1 m (1 yd) of fabric from the very outside of the roll.

7.3 *Test Specimens*—Take test specimens as follows:

7.3.1 *Wide Elastic Fabrics*—If the purchaser and the supplier agree to test the fabric in only one direction, cut five specimens from each swatch in the laboratory sample with the long dimension of the specimens parallel to the direction of

[3] Machines available from the following suppliers, or the equivalent, have been found satisfactory for this purpose: E. H. Benz Company, 283 Whitford Ave., Providence, RI 02904, Instron Corporation, 100 Royall St., Canton, MA 02021, Monsanto Instruments, 2689 Wingate Ave., Akron, OH 44314, Thwing-Albert Instrument Company, 10960 Dutton Rd., Philadelphia, PA 19154, and Zwick of America, P.O. Box 997, East Windsor, CT 06088.