Designation: D2653 – 07 (Reapproved 2012)

Standard Test Method for Tensile Properties of Elastomeric Yarns (CRE Type Tensile Testing Machines)[1]

This standard is issued under the fixed designation D2653; 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 tensile properties of "as produced" elastomeric yarns made from natural rubber, spandex or other elastomers, using a constant-rate-of-extension (CRE) type tensile testing machine. The properties included in this test method are: (*1*) force at first filament break, (*2*) tenacity at first filament break, (*3*) elongation at first filament break, (*4*) work to break at first filament break, and (*5*) toughness at first filament break.

1.2 This test method does not apply to covered, wrapped, or core-spun yarns or yarns spun from elastomeric staple.

1.3 This test method is applicable to elastomeric yarns in the range from 40 to 3200 dtex (36 to 2900 denier).

1.4 The values stated in either SI units or U.S. Customary units are to be regarded separately as standard. Within the text, the U.S. Customary units are given in parentheses. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other.

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]

D76 Specification for Tensile Testing Machines for Textiles
D123 Terminology Relating to Textiles
D1776 Practice for Conditioning and Testing Textiles
D2258 Practice for Sampling Yarn for Testing
D2591 Test Method for Linear Density of Elastomeric Yarns (Short Length Specimens)
D4848 Terminology Related to Force, Deformation and Related Properties of Textiles
D4849 Terminology Related to Yarns and Fibers
D6717 Test Method for Linear Density of Elastomeric Yarns (Skein Specimens)

3. Terminology

3.1 For all terminology relating to D13.58, Yarns and Fibers, refer to Terminology D4849.

3.1.1 The following terms are relevant to this standard: elastomeric yarn, elongation, force, linear density, tenacity, toughness, work, work to break.

3.2 For definitions of other terms related to force and deformation, refer to Terminology D4848. For all other terminology related to textiles, refer to Terminology D123.

4. Summary of Test Method

4.1 A specimen is clamped in a CRE-type tensile testing machine and extended to rupture. Force at first filament break and elongation at first filament break, work and toughness are calculated from a force-elongation curve or with an interfaced computer. Tenacity at first filament break can be calculated based on the determined linear density of the yarn. Other properties, such as force at specified elongation (FASE), elongation at specified force (EASF), may also be calculated.

5. Significance and Use

5.1 This test method is considered satisfactory for acceptance testing of commercial shipments since current estimates of between-laboratory precision are acceptable and the method is used extensively in the trade for acceptance testing.

5.1.1 If there are differences of practical significance between reported test results for two laboratories (or more), comparative tests should be performed to determine if there is a statistical bias between them, using competent statistical assistance. As a minimum, use samples for such comparative tests 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, at a probability level chosen prior to the testing

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.58 on Yarns and Fibers.

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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.

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 force at first filament break of elastomeric yarns may depend on its construction and manufacturing process and provides an indication of the breaking strength of fabrics made from the yarn.

5.3 Elongation is an indication of the ability of a fiber to absorb energy. The elongation of yarn or fabric must be great enough to withstand strains experienced in processing and end use, and to absorb the energies of applied forces repeatedly.

5.4 Fabric manufacturers use force and elongation information of elastomeric yarns in determining machine set-up conditions.

5.5 Other parameters such as elongation at specified force (EASF), force (or tenacity) at specified elongation (FASE, TASE), work and toughness may be calculated from force-elongation curves. EASF and FASE information is needed for tests involving cycling of yarn in determination of elastic properties.

5.6 This test method was developed using elastomeric yarns in the "as-produced" condition, but may be used for treated elastomeric yarns provided the treatment is specified. The method does not cover the removal of finish for determination of tensile properties of "finish-free" elastomeric yarns.

6. Apparatus [3]

6.1 *Specimen Boards*, with short pile or plush surfaces or black or contrasting color, for storing specimens during conditioning.

6.2 *Tensile Testing Machine*, CRE-type, conforming to Specification D76 with respect to force indication, working range, capacity and verification of recorded elongation, and designed for operation at a pulling speed of 500 mm/min (20 in./min) or 1000 % extension per min.

6.3 *Clamping Assembly*, pneumatically operated, with jaw faces as described in 6.3.1 or 6.3.2.

6.3.1 *Option A, Preferred*—One jaw with a flat acrylic face nominally 25 mm × 12.5 mm (1 in. × 0.5 in.) and the opposing jaw approximately 12.5 mm (0.5 in.) wide with a convex [approximately 7.1 mm (0.28 in.) radius], steel or chrome face.

6.3.2 *Option B*—One jaw with a flat, steel or chrome face nominally 25 mm × 12.5 mm (1 in. × 0.5 in.) and the opposing jaw approximately 12.5 mm (0.5 in.) wide with a convex [approximately 8.5 mm (0.375 in.) radius] acrylic face.

6.4 *Computer or Microprocessor*, interfaced, with automatic data gathering system, optional.

6.5 *Tensioning Weights*, with various masses from 10 mg to 3 g as required to pretension the specimen to 30 to 50 mN/tex (0.3 to 0.5 mgf/d) before testing.

6.6 *Air Supply*, capable of providing 415 kPa (60 psi) to the pneumatic clamps.

[3] Apparatus and accessories are commercially available. Clamps may need to be modified to accept jaw faces and attachment to some tensile testing machine.

7. Sampling, Test Specimens, and Test Units

7.1 *Lot Sample*—As a lot sample for acceptance testing, take a random number of shipping units directed in an applicable material specification or other agreement between the purchaser and the supplier, such as an agreement to use Practice D2258. Consider shipping cases or other shipping units to be the primary sampling units.

NOTE 1—An adequate specification or other agreement between the purchaser and the supplier requires taking into account the variability between shipping units, between packages or ends within a shipping unit, and between specimens from a single package to provide a sampling 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 at random from each shipping unit in the lot sample the number of packages directed in an applicable material specification or other agreement between the purchaser and the supplier, such as an agreement to use Practice D2258. Preferably, take the same number of packages from each of the shipping units, determine at random which shipping units are to have each number of packages for testing.

7.3 *Test Specimens*—From each package or end in the laboratory sample, take specimens as directed in 7.3.1.

7.3.1 Remove the outer layer of yarn from the package. Avoid any damaged areas in selecting segments for testing. Carefully unwind yarn from the package with as low as tension as possible to avoid stretching. As test specimens, cut approximately 125 mm (5 in.) long segments of yarn from each package, taking them at intervals of at least 1 m (1 yd). Three of the six specimens are used as spare to allow for unacceptable breaks, such as caused by slippage or breaking in the clamps.

7.4 Determine the tex (denier) of the yarn for each laboratory sample using Test Method D2591 or Test Method D6717.

8. Preparation of Apparatus

8.1 Prepare and verify the calibration of the tensile testing machine as directed in the manufacturer's instructions.

8.2 Set up and adjust the CRE-type tensile testing machine as follows:

8.2.1 Examine the acrylic jaw face of the clamps for wear and replace as needed. Position the clamp faces with their contact line horizontal.

8.2.2 Set the distance between clamps, (gage length) to 50 ± 1 mm (2 ± 0.05 in.), nip to nip.

NOTE 2—A convenient technique for checking the gage length is to place a piece of carbon paper and white paper in the clamps and close the clamps. The distance between the marks made on the white paper by the carbon paper represents the set gage length.

8.2.3 Use a force measuring system such that the breaking force will fall between 30 and 80 percent of its full scale capacity.

8.2.4 Set the crosshead speed to 500 mm/min (20 in./min) or 1000 % extension per min.

8.2.5 Set the extension measuring system as follows:

8.2.5.1 When using a chart recorder, set the chart speed to 500 mm/min (20 in./min). Not needed with computer interfaced testing machines.