Designation: D6717 – 07 (Reapproved 2012)

Standard Test Method for Linear Density of Elastomeric Yarns (Skein Specimens)[1]

This standard is issued under the fixed designation D6717; 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 linear density of "as produced" elastomeric yarns made from rubber, spandex or other elastomers using a skein.

NOTE 1—For the determination of linear density of elastomeric yarns using short length specimens, refer to Test Method D2591.

1.2 The method is not applicable to covered, wrapped, or core-spun yarns, or yarns spun from elastomeric staple, or elastomeric yarns removed from fabrics.

1.3 This test method is applicable to elastomeric yarns having a range of 40 to 3200 dtex (36 to 2900 denier).

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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
D2258 Practice for Sampling Yarn for Testing
D2591 Test Method for Linear Density of Elastomeric Yarns (Short Length Specimens)
D4849 Terminology Related to Yarns and Fibers

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: denier, elastomeric yarn, linear density, tex.

3.2 For all other terminology related to textiles, refer to Terminology D123.

4. Summary of Test Method

4.1 A specimen of specified length is wound into skein form on a reel. The skein is cut, removed from the reel and weighed. Linear density is calculated using the mass of the skein and the length of yarn.

5. Significance and Use

5.1 This test method is considered satisfactory for acceptance testing of commercial shipments because 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 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 Linear density of elastomeric yarns is used in some calculations for tensile and elastic properties.

5.3 The test method is based on 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 the determination of linear density of "finish-free" elastomeric yarns.

6. Apparatus

6.1 *Reel*[3], 1.125-m (1.230-yd) circumference, with multiple positions for making several skeins at one time, guides that apply minimal friction to the running yarn, and with vertical-mount creel, with automatic counter to set and count the

[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.

[3] This test apparatus is commercially available.

number of revolutions. The operating speed may be from 25 to 40 rpm; however, 30 rpm is preferred.

6.2 *Measuring Tape,* 6-mm (0.25-in.) wide, steel, accurate to 1 mm (0.05 in.), to verify the reel circumference.

6.3 *Pads,* sheepskin, to prevent yarn from sloughing off the bottom of the package during reeling.

6.4 *Balance,* with an accuracy of ±0.1 % of the expected mass of the specimens. Balance pan should be protected from drafts.

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 2—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 selected. If differing numbers of packages are to be taken from 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 in the laboratory sample, prepare one test specimen from each laboratory sampling unit. Select the skein length using Table 1.

8. Conditioning

8.1 No preconditioning is required for currently produced rubber and other elastomeric yarns.

TABLE 1 Suggested Skein Revolutions

Linear Density		Number of Revolutions[A]
dtex	denier	
11	10	1600
44	40	400
77	70	250
155	140	110
310	280	65
465	420	40
930	840	25
1865	1680	16
2490	2240	8

[A] The number of revolutions in a skein should give a mass between 2 and 3 g; however, skeins weighing as low as 1 g may be used, for yarns in the lower linear density ranges.

8.2 Condition the specimens, without tension, on specimen boards in the standard atmosphere for testing textiles as directed in Practice D1776 which is 21 ± 1°C (70 ± 2°F) and 65 ± 2 % relative humidity for a minimum of 4 h.

9. Preparation of Equipment and Calibration

9.1 Periodically confirm the circumference of the reel circumference at each end and the middle as directed in 9.2.

9.2 Make one wrap of the measuring tape around the reel and apply tension to the tape by attaching an 0.5 kg (1.0 lb) weight to the end. Read the circumference directly from the tape to the nearest mm (0.05 in.).

9.3 If the circumference at any of the three areas is outside the limits of ±5 mm (0. 2 in.)., adjust the reel as directed in the manufacturer's directions to bring the measurement within limits.

10. Procedure

10.1 Test all specimens in the standard atmosphere for testing textiles.

10.2 Position the reel bar with the posts in the uppermost and horizontal position..

10.3 Strip the outer layer of yarn from the package. Place the package on one of the positions on the creel. Pass the end through the reel guide that is aligned with the package position and then wrap the end of the yarn several times about the corresponding post on the reel bar.

10.3.1 For yarns tending to slough from the package, place a pad between the package bottom and the creel spindle base.

10.4 Check the reel counter and set it for the number of revolutions as directed in Table 1.

10.5 Start the reel. There should be no tension on the yarn other than the mass of the yarn from the package to the first guide and the natural tension from the guides on the yarn as it is being wound onto the reel.

10.6 When the reel stops, manually turn the wheel to position the bar with the posts in the uppermost position and horizontal. Check the counter to confirm the number of revolutions made.

10.7 Cut the skein immediately below the post bar and remove it from the reel.

10.8 Weigh the skein and record the mass (M) to the nearest 0.001 g. Record the mass.

10.9 Continue as directed in 10.1-10.8 until all the required specimens for the lot have been tested.

TABLE 2 Skein Denier, Average Percent and Components of Variation expressed as Squares of Standard Deviation

NOTE 1—Response = Skein Denier.

Material	Average	V(Lab)	V(Week, Lab)	V(Date, Week, Lab)
1	40.55625	0.02476	0.01761	0.02728
2	40.78500	0.00000	0.21737	0.02286
3	40.71813	0.00704	0.24014	0.04478
4	40.67063	0.00000	0.20040	0.01254

11. Calculation or Interpretation of Results

11.1 *Length of Yarn Specimen*—Calculate the length of the yarn specimen by multiplying the number of reel wraps times the wheel circumference to the nearest mm (0.05 in.).

11.2 *Linear Density*—Calculate the linear density for each specimen to the nearest 0.1 dtex (0.1 denier), using Eq 1 or Eq 2.

$$T = 10000 \times M/L \quad (1)$$

$$D = 9000 \times M/L \quad (2)$$

where:

T = linear density, dtex,
D = linear density, denier,
M = mass of specimen, g, (from 10.8), and
L = length of specimen, m, (from 11.1).

NOTE 3—If inch-pound units are used, divide the length of the yarn in inches by 39.37 to obtain m.

11.3 Calculate the average linear density for the lot.

11.4 If requested, calculate the coefficient of variation, standard deviation.

12. Report

12.1 State that the samples were tested as directed in Test Method D6717. Describe the material or product sampled and the method of sampling used.

12.2 Report the following information for the lot:

12.2.1 Linear density for each specimen,

12.2.2 Coefficient of variation, or standard deviation, or both, if calculated,

12.2.3 Any modification to the method.

13. Precision and Bias

13.1 An interlaboratory study was performed in 1997 to estimate variability of the test method. The study included two laboratories. Eight cakes of 40 denier elastomeric yarn produced under the same conditions were used in the test. Four cakes were distributed to each laboratory. These four cakes tested 2 times per week for five weeks. One specimen per cake was tested on each test date. ANOVA was used to determine variance components.

13.2 Method repeatability is defined as the "maximum difference" that can "reasonably" be expected between two test results obtained on the same material when the test results are obtained in the same laboratory. Repeatability standard deviation, s_r, is taken to be the square root of the "specimen" variance component, and represents within-operator precision. Since only one specimen per cake is used in this method, s_r and method repeatability for this test are equal to zero. Method reproducibility is defined as the "maximum difference" that can "reasonably" be expected between two test results obtained on the same material when the test results are obtained from different laboratories.[4] s_R, the total standard deviation, is formed by taking the square root of the sum of intra- and inter-laboratory variance components.

NOTE 4—Because the interlaboratory test included less than the recommended five laboratories, estimates of precision data in Tables 1 and 2 may be either underestimated or overestimated to a considerable extent and should be used with special caution.

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 elastomeric yarn; linear density

[4] John Mandel and Theodore W. Lashof, 1987. *The Nature of Repeatability and Reproducibility*. Jour., Quality Technology, pg. 19, Vol 1.