Designation: D6774 – 02 (Reapproved 2010)

Standard Test Method for
Crimp and Shrinkage Properties for Textured Yarns Using a Dynamic Textured Yarn Tester[1]

This standard is issued under the fixed designation D6774; 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 crimp contraction, residual fiber shrinkage and their variability of all types of filament yarns (partially oriented yarn (POY), fully oriented yarn (FOY), flat yarns, textured and bulked continuous filament (BCF) carpet yarns) using an automated tester.

NOTE 1—For another method of testing crimp in textured yarns, refer to Test Method D4031.

1.1.1 This method may also be used for non-textured yarns.

1.2 This test method is limited to crimped, multi-filament yarns ranging from 22.0 to 890 dtex (15 to 800 denier) and for BCF yarns from 890 to 4200 dtex (800 to 3800 denier).

1.3 The values stated in either SI or US customary units are to be regarded separately as standard. Within the text, the U.S. customary units are 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 the method.

1.4 *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
D2258 Practice for Sampling Yarn for Testing
D4031 Test Method for Bulk Properties of Textured Yarns
D4849 Terminology Related to Yarns and Fibers

3. Terminology

3.1 For definitions of textile terms in this test method, refer to Terminology D4849. For other textile terms used in this test method, refer to Terminology D123.

4. Summary of Test Method

4.1 The specimen passes through a pretension device to remove crimp. The specimen then passes, at a constant speed, around an input roller, to a calibrated sensor which maintains a specific tension.

4.1.1 Subsequently, the specimen passes through a heating element, at a low tension, where the specimen shrinks and again is crimped.

4.1.2 The crimped specimen then goes to an intermediate roll, at a low tension.

4.1.3 The specimen then travels to a second sensor, which maintains a tension equal to the pretension applied, to remove developed crimp.

4.2 Residual fiber shrinkage, crimp developed, and maximum total contraction are calculated by the computer software using speeds of the input, intermediate and output rolls.

5. Significance and Use

5.1 Test Method D6774, for determining maximum total contraction, crimp, and residual fiber shrinkage in textured filament yarns is suitable for acceptance testing of commercial shipments.

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 the samples for such a 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, a probability level chosen prior to the testing series. If a 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 properties and their variability as measured by this method relate to bulk appearance, stretch and recovery of fabrics and dyeability of yarns.

5.3 For some yarns, elapsed time between processing and testing has a marked effect on the results, of this test, especially during the first 72 h. The effect is caused by stress decay which is known to be minimal beyond the seventh day and after which time the yarn remains relatively stable. Therefore, specimens should only be compared if tested after the same elapsed time. Samples can be tested at-line, thus having little to no elapsed time between processing and testing.

6. Apparatus

6.1 *Textured Yarn Tester*[3], equipped with the following:

6.1.1 *Non-contact Heater Tube,* with a temperature range from 100 to 205°C (with an accuracy of ± 1°C), for filament yarns 22.0 to 890 dtex (15 to 800 denier): or

6.1.1.1 *Non-contact Heater Tube,* with a temperature range from 185 to 250°C (with an accuracy of ± 1°C), for textile and BCF yarns 890 to 4200 dtex (800 to 3800 denier).

6.1.2 *Pretension Device*

6.1.2.1 For filament yarns 22.0 to 890 dtex (15 to 800 denier), to control the tension within a range of 5 to 25 g, with an accuracy of ±3 %: or

6.1.2.2 For textile and BCF yarns 890 to 4200 dtex (800 to 3800 denier), to controls the tension within a range of 10 to 250 g, with an accuracy of ± 3 %.

6.1.3 *Sensor Assemblies,* for Zones 1 and 2 (see Fig. 1).

6.1.3.1 *Fine Yarn Sensors,* 22.0 to 890 dtex (15 to 800 denier).

6.1.3.2 *Heavy Yarn Sensors,* 890 to 4200 dtex (800 to 3800 denier).

6.1.4 *Computer, Software and Printer.*

6.2 *Static Eliminator,* optional if necessary.

NOTE 2—A static eliminator is used when the static level in the yarn is great enough to cause the filaments to flare out and cause snagging of the filaments on components of the tester.

6.3 *Automatic Package Changer,* for high volume production testing, optional.

6.4 *Tensiometer.*

7. Sampling

7.1 *Lot Sample*—For acceptance testing, take a lot sample of shipping containers as directed in an applicable specification, or as agreed upon between the purchaser and supplier. In the absence of an applicable specification or agreement, take a lot sample as directed in Practice D2258.

NOTE 3—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 plan with a meaningful producer's risk, consumer's risk, acceptable quality level and limiting quality level.

7.2 *Laboratory Sample*—For acceptance testing, take at random from each shipping container in the lot sample the
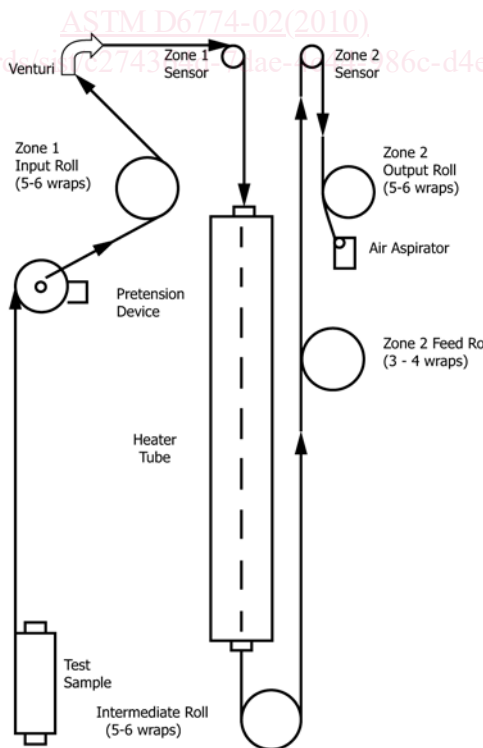

FIG. 1 Diagram of the Yarn Thread Path through the Textured Yarn Tester

number of laboratory sampling units as directed in an applicable material specification or other agreement between purchaser and supplier such as an agreement to use Practice D2258. Preferably, take the same number of laboratory units from each shipping container in the lot sample.

7.3 *Number of Specimens*—Test ten, 2-m length, specimens from each package in the laboratory sample.

NOTE 4—Current software for the test apparatus is designed to measure only in meters. When available, tests can be run in 2 yd increments.

8. Conditioning

8.1 Conditioning and preconditioning are not required. Testing may be performed in the production area (at-line).

9. Preparation and Calibration of Apparatus

9.1 For yarn types and deniers not previously tested, and for which initial set-up conditions have not been established, follow the directions in Annex A1 before proceeding to 9.2.

9.2 For previously tested yarn types and deniers for which set-up procedures have been established, prepare and calibrate the tester using the established set-up procedure for that yarn, manufacturer's manual, A1.1 – A1.10 and the following information.

9.2.1 Turn on the motor and check the speed on the computer monitor.

9.2.2 Check that both appropriate sensor assemblies (zone 1 and zone 2) for freedom of movement.

9.2.3 Set the zero adjustment for the sensing arms and calibrate the tester.

9.2.4 Set sensing arm tension and pretension as prescribed in A1.4 – A1.6 or refer to manufacturer's operational manual.

9.2.5 Stop the tester motor.

10. Procedure

10.1 Operate the test apparatus as directed in the manufacturer's operating manual.

10.2 When performing routine testing and the parameters have previously been set as directed in Section 9, follow the procedure below.

10.2.1 Thread the yarn in the tester and let the tester run about a minute. Check to ensure that the yarn moves freely through the tester in the center of the heating tube.

10.2.2 Stop the tester.

10.2.3 Set the pretension as required for the yarn under test.

10.2.4 Set the test length to 2 m and the number of tests to ten.

10.2.5 Enter the yarn identification information into the computer and start the test.

10.2.6 When testing multiple packages, with different linear densities, it may be necessary to reset the tensions in the sensing zones and pretension, with the change in linear density.

10.2.7 Remove specimen from the tester when testing is complete.

11. Calculation of Results

11.1 All calculations shown below, including averages, standard deviation and coefficient of variation for the laboratory sampling units and for the lot, are determined using the computer software. Equations used for determining the property values are given in the following sections (see Fig. 2).

11.2 *Total Contraction*—Calculate the total contraction to the nearest 0.1 % using Eq 1.
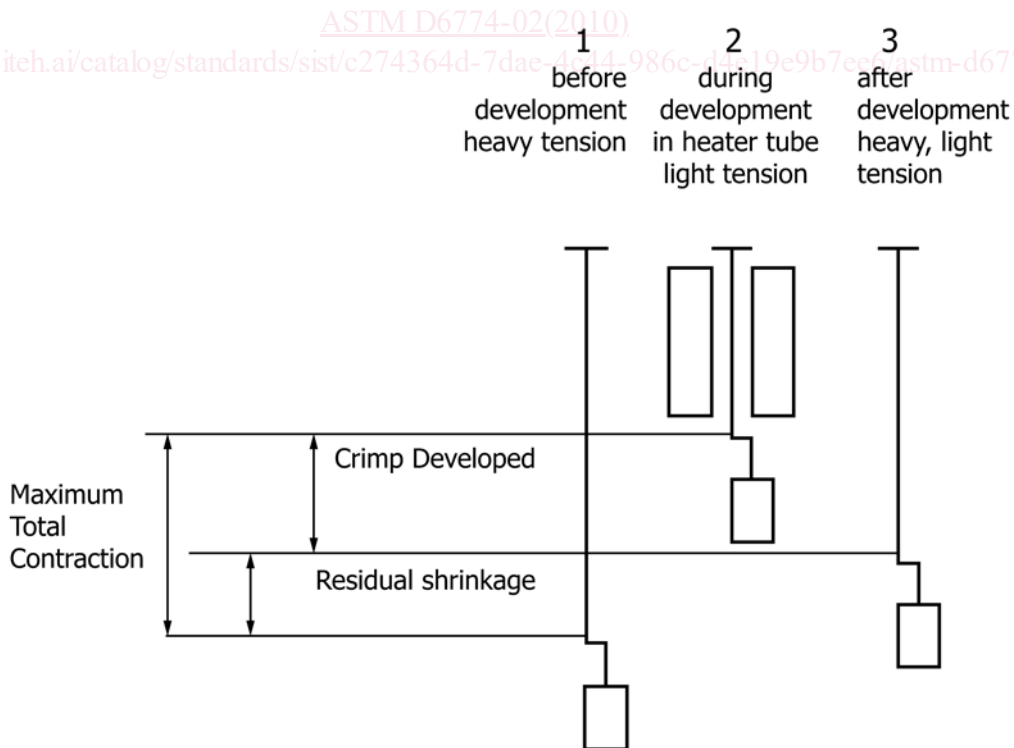
$$T = 100 \frac{(R1 - R2)}{R1} \qquad (1)$$

FIG. 2 Diagram Relating the Terminology of Textured Yarn Tester