



Designation: D2102 – 02 (Reapproved 2012)<sup>ε1</sup>

## Standard Test Method for Shrinkage of Textile Fibers (Bundle Test)<sup>1</sup>

This standard is issued under the fixed designation D2102; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

<sup>ε1</sup> NOTE—Section 3, Terminology, was updated editorially in March 2012.

### 1. Scope

1.1 This test method covers the measurement of the unrestrained shrinkage of a bundle of crimped or uncrimped fibers from exposure to some environment, for instance, boiling water for 15 min.

1.1.1 This test method may be used on fibers from tow and fibers removed from spun or continuous filament yarn.

NOTE 1—For measurement of shrinkage of single fibers, refer to Test Method [D5104](#).

1.2 The values stated in either inch-pound or SI units are to be regarded separately as the standard. The values stated in each system are not exact equivalents, therefore, each system must be used independently of the other.

1.3 *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:*<sup>2</sup>

- [D123 Terminology Relating to Textiles](#)
- [D1776 Practice for Conditioning and Testing Textiles](#)
- [D2258 Practice for Sampling Yarn for Testing](#)
- [D3333 Practice for Sampling Manufactured Staple Fibers, Sliver, or Tow for Testing](#)
- [D4849 Terminology Related to Yarns and Fibers](#)
- [D5104 Test Method for Shrinkage of Textile Fibers \(Single-Fiber Test\)](#)

### 3. Terminology

3.1 For terminology related to Yarns and Fibers see Terminology [D4849](#).

<sup>1</sup> This test method is under the jurisdiction of the ASTM Committee [D13](#) on Textiles and is the direct responsibility of Subcommittee [D13.58](#) on Yarns and Fibers.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.2 The following terms are relevant to this standard: shrinkage.

3.3 For definition of other terms related to textiles, see Terminology [D123](#).

### 4. Summary of Test Method

4.1 A uniform bundle of conditioned parallel fibers is lightly loaded between clamps and the nip to nip length measured. Without being removed from the clamps, the bundle specimen is then exposed to the test environment, typically, boiling water for 15 min. After reconditioning, the bundle length is remeasured under the same light loading.

NOTE 2—Due to the very high variability of the shrinkage of individual fibers of high shrinkage types, to obtain a reliable average value would require an excessive number of determinations, each rather tedious. The bundle method does not give the true average value, but rather a weighted value approaching the highest shrinkage fiber in the bundle. Since the weighted value more closely approximates the properties found in a high bulk yarn made from such fibers, the weighted value would seem to be more appropriate.

### 5. Significance and Use

5.1 Limited accuracy in measuring the change in length produces errors in estimating values for shrinkage below 10 %. However, this test is being used for low level shrinkage fibers because the results give have been found to give an adequate indication of average shrinkage at the lower levels. The test is not adequate for determining variability in average shrinkage at low levels. 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 This test method for testing the shrinkage of fibers is not recommended for acceptance testing of commercial shipments of fibers because only a limited amount of data is available. See Section 14.

5.3 This test method may be used for acceptance testing of commercial shipments of fibers; but caution is advised since information on between laboratory precision is incomplete. Comparative tests as directed in 5.1 are advised.

## 6. Apparatus

6.1 *Jig*,<sup>3</sup> consisting of a frame with fixed upper clamp suitable for holding a small parallel bundle of fibers, a smoothly sliding lower clamp and a means for locking this lower clamp in position, and a suitable scale inscribed on the jig to measure the distance between clamps to the nearest 0.2 mm (0.01 in.).

6.2 *Tape* Adhesive Cellophane or Masking, 25.4 mm (1 in.).

## 7. Sampling

7.1 *Lot sampling*—As a lot sample for acceptance testing, take at random the number of shipping containers directed in the applicable material specification or other agreement between the purchaser and supplier, such as an agreement to use Practice D3333 or Practice D2258, as appropriate. Consider shipping containers to be the primary sampling units.

NOTE 3—An adequate specification or other agreement between the purchaser or supplier requires taking into account the variability between shipping units, between packages, ends or other laboratory sampling unit within a shipping unit if applicable, and within specimens from a single package, end or other laboratory sampling unit to provide a sampling plan with a meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quantity level.

7.2 *Laboratory Sample*—As a laboratory sample for acceptance testing, take at random from each shipping container in the lot sample the 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 D3333 or Practice D2258, as appropriate. Preferably, the same number of laboratory sampling units are taken from each shipping container in the lot sample. If differing numbers of laboratory sampling units are to be taken from shipping containers in the lot sample, determine at random which shipping containers are to have each number of laboratory units drawn.

7.3 *Test Specimens*—From each laboratory sampling unit take five specimens at random. If the standard deviation determined for the container from which the laboratory sampling units were taken is more than a value agreed upon between the purchaser and supplier, continue testing in groups of five specimens from the same laboratory sampling units in the container until the standard deviation for all specimens

tested for the container is not more than the agreed-to value or, by agreement, stop testing after a specified number.

7.3.1 If testing fibers from yarn, carefully remove twist before taking the specimens.

## 8. Preparation of Test Specimen

8.1 Prepare test specimen bundles by drawing and lapping fibers to align the fibers in parallel. Be careful not to stretch any of the fibers.

8.1.1 If fibers are already parallel, as in sliver or tow, split-off bundles of fibers from the side of the material.

8.1.2 Draw and lap the specimen bundles such that the fiber ends at one end of the test specimen bundles are essentially aligned.

8.2 Make up each specimen bundle so that its linear density in tex will result in a loading of 0.9 cN/tex (0.1 gf/d), by the weight of the sliding clamp as obtained in accordance with 9.1.

NOTE 4—*Wrapping Bundle Ends*—Cut two short pieces of tape. Carefully wrap the tapes about the end of the specimen bundle. Space the ends to give as long a specimen as practical and compatible with the jig and fiber lengths. Trim the tape ends to fit inside the clamps.

## 9. Calibration

9.1 Weigh the sliding lower clamp to 0.1 g for determination of specimen bundle size as stated in 8.2. The jig must be partially disassembled to do this.

9.2 Clamp a scale, of approximately 40 mm (1½ in.) in length, in the jaws with exactly 25 mm (1.0 in.) nip to nip. Position the upper clamp to give a reading of 1.00 in. on the inscribed scale.

## 10. Conditioning

10.1 Precondition and condition the laboratory samples as directed in Practice D1776.

10.1.1 During preconditioning, spread the samples out to avoid any build up of temperature within the sample that could affect its shrinkage.

## 11. Procedure

11.1 Make all length measurements on specimens in the standard atmosphere for testing textiles which is  $21 \pm 1^\circ\text{C}$  ( $70 \pm 2^\circ\text{F}$ ) and  $65 \pm 2\%$  relative humidity.

11.2 Place one end of the specimen in one of the fixed clamps at the top of the jig. If used, the tape should be inside the clamp nip. With the specimen in a relaxed state, carefully place the other end in the opposite movable clamp.

11.3 Repeat 11.2 and 11.3 until all specimens are in the jig(s).

11.3.1 If the ends were taped, insert the specimens in the clamps with the tapes inside the clamp and not in the nips.

11.4 Mount the jig vertically and gently release the sliding clamps. The lower clamp and rod (plus a small additional weight, if needed) should now be imposing a loading of 0.9 cN/tex (1.0 gf/den) on the specimen bundle.

11.5 Read the initial gage lengths on the inscribed vernier scales to the nearest 0.2 mm (0.01 in.). Record the length (A).

<sup>3</sup> The sole source of supply of the apparatus known to the committee at this time is Layman and Russ Machine Co., Inc., P.O. Box 146, Orelan, PA 19075. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,<sup>1</sup> which you may attend.