Designation: D 3937 – 01

Standard Test Method for Crimp Frequency of manufactured Staple Fibers[1]

This standard is issued under the fixed designation D 3937; 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 crimp frequency of manufactured staple fibers. This test method is applicable to all crimped provided the crimp can be viewed two-dimensionally as a sine-wave configuration.

1.1.1 It should be recognized that yarn manufacturing processes or treatments to manufactured yarns can influence or modify crimp in fiber. Hence, the value for crimp of fibers taken from spun yarns may be different than that of the same fiber prior to the manufacturing or treatment processes.

1.2 Three options are provided for preparation of the specimens. Option One (preferred) uses single fibers for the specimens with a low magnification available, Option Two (optional for staple or tow samples) uses fiber chips as the specimens, and Option Three uses projected images of single fibers.

1.3 The values stated in SI units are to be regarded as the standard. The inch-pound units in parentheses are for information only.

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]

D 123 Terminology Relating to Textiles
D 1776 Practice for Conditioning and Testing Textiles
D 2258 Practice for Sampling Yarn for Testing
D 3333 Practice for Sampling manufactured Staple Fibers, Sliver, or Tow for Testing

3. Terminology

3.1 *Definitions:*

3.1.1 *crimp*, *n—in a textile strand*, the undulations, waviness, or succession of bends, curls, or waves in the strand induced either naturally, mechanically, or chemically.

3.1.1.1 *Discussion*—Crimp has many characteristics, among which are its amplitude, frequency, index, and type. In this test method, crimp is characterized by a change in the directional rotation of a line tangent to the fiber as the point of tangent progresses along the fiber. Two changes in rotation constitute one unit of crimp.

3.1.2 *crimp frequency*, *n—in manufactured staple fibers,* the number of crimps or waves per unit length of extended or straightened fiber.

3.1.3 *crimp index*, *n*—an indirect measure of the amplitude of crimp.

3.1.3.1 *Discussion*—Crimp index is calculated as the difference in the distance between two points on the fiber as it lies in an unstretched condition in one plane and the distance between the same two points when the fiber is straightened under a specified tension expressed as a percentage of the unstretched distance. To improve reproducibility, the unstretched distance may be measured under a specified, very low tension to align the fiber in one plane.

3.1.4 *fiber chip*, *n—in manufactured textiles,* staple fibers that are massed together as a unit and that maintain a single geometry or alignment.

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

4. Summary of Test Method

4.1 For Option One, a fiber specimen of manufactured staple is placed on a short pile or plush surface. The crimps along the entire length of the specimen is counted. After the specimen is counted, the fiber is straightened without deformation and its uncrimped length measured. Crimp frequency is reported as the number of crimps per unit of extended length.

4.2 For Option Two, the number of crimps is counted in fiber chip specimens. The specimen length is measured on fibers taken from each of the chips.

4.3 For Option Three, the fiber specimen is mounted between microscope slides. The image of the specimen is projected and its crimp is counted. The extended length of the specimen is measured as in Option One.

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.58 on Yarn and Fiber Test Methods.

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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.

4.4 In each option, the crimp frequency is calculated from the numbers of crimp counted and the fiber lengths measured.

5. Significance and Use

5.1 Test Method D 3937 for the determination of crimp frequency of manufactured staple fibers may be used for the acceptance testing of commercial shipments but caution is advised since between-laboratory precision is known to be poor. Comparative tests conducted as directed in 5.1.1 may be advisable.

5.1.1 If there are differences or 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, test samples that are as homogeneous as possible, drawn from the material from which the disparate test results were obtained, and randomly assigned in equal numbers to each laboratory for testing. The test results from the two laboratories should be compared using a statistical test for unpaired data, at a probability level chosen prior to 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 is used for quality control. It is an unsophisticated procedure which is particularly useful in detecting major differences in crimp frequency. This test method is not considered to be useful in research and development where minor differences or more complete crimp characterization, including amplitude and index, may be necessary.

5.3 Crimp in fiber affects the carding and subsequent processing of the fiber into either a yarn or a nonwoven fabric.

5.4 Staple crimp in fiber will also affect the bulk or openness of a yarn and therefore the hand and visual appearance of the finished textile product.

6. Apparatus

6.1 *Short Pile or Plush Surface*, of a color contrasting with color of fibers under investigation.

6.2 *Magnifier*, with no greater than 10× magnification, optional for counting crimp of fibers of low linear density in Option One or in measuring lengths.

6.3 *For Option Three*:

6.3.1 *Projector*, capable of a magnification of 10×.

6.3.2 *Microscope Slides*, 25 by 75 mm (1 by 3 in.).

6.4 *Specimen Board*, covered with a short pile or plush.

6.5 *Tweezers*, two pair.

6.6 *Scale*, graduated in millimetres or 1/16-in. units.

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 the supplier, such as an agreement to use Practice D 3333 or Practice D 2258. Consider shipping containers to be the primary sampling units.

NOTE 1—An adequate specification or other agreement between the purchaser or the 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 the purchaser and the supplier such as an agreement to use Practice D 3333 or Practice D 2258. 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.

7.2.1 *For Staple Fiber*—Take 50-g samples from laboratory sampling units.

7.2.2 *For Sliver (or Top) or Tow*—Take 1 m from the leading end which has a clean, uniform appearance.

7.3 *Test Specimens*—From each laboratory sampling unit, take twenty-five specimens at random. For Options One and Three, each specimen is a fiber, and for Option Two, the specimen is a fiber chip. If the standard deviation determined for the ten specimens is more than a value agreed upon between the purchaser and the supplier, continue testing in groups of ten specimens from the same laboratory sampling unit until the standard deviation for all specimens tested is not more than the agreed to value or, by agreement, stop testing after a specified number.

8. Conditioning

8.1 Condition the specimens as directed in Practice D 1776.

9. Procedure

9.1 Test conditioned specimens in the standard atmosphere for testing textiles, which is 21 ± 1°C (70 ± 2°F) and 65 ± 2 % relative humidity.

9.2 *Specimen Preparation Options*:

9.2.1 *Option One Single Fiber (Preferred)*—Carefully remove 25 fibers at random from each laboratory sampling unit, using tweezers. Place these specimens on a specimen board. Using fingertip pressure, flatten each specimen with the crimp in a plane parallel with the board. Take care not to destroy the crimp.

9.2.2 *Option Two Fiber Chip*—Carefully remove 25 fiber chips at random from each laboratory sampling unit using tweezers. Place these specimens on a specimen board and flatten with fingertip pressure as in 9.2.1. Take care not to destroy the crimp.

9.2.3 *Option Three Fiber Projection*—Carefully remove 25 fiber at random from each laboratory sampling unit, using tweezers. Place these specimens on microscope slides without disturbing the crimp. Place the prepared slide on the stage of the projector. Project the image onto a smooth white surface.

9.3 *Counting Crimp*: