



Designation: **D 5647 – 9501**

Standard Guide for Measuring Hairiness of Yarns by the Photo-Electric Apparatus¹

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1. Scope

1.1 This guide covers the determination of the hairiness of most filament and spun yarn using a photo-electric sensor apparatus. It is not intended for use on novelty yarns.

1.2 This guide shows the values in SI units. “SI units” is the technically correct name for a system of metric units known as the International System of Units.

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:*

¹ This guide is under the jurisdiction of ASTM Committee D-13 on Textiles and is the direct responsibility of Subcommittee D13.58 on Yarn Test Methods, General. Current edition approved Sept. 10, ~~1995~~, 2001. Published November 2001. Originally published as D 5647–95. Last previous edition as D 5647–95.

D 123 Terminology Relating to Textile Materials²

D 1776 Practice for Conditioning Textiles for Testing Textiles²

D 2258 Practice for Sampling Yarn for Testing²

3. Terminology

3.1 Definitions:

3.1.1 *broken filament, n*—in multifilament yarn, breaks in one or more filaments. (See also *stripback*, *skinback*.)

3.1.2 *frayed, adj*—in textiles, a worn condition characterized by damaged yarn surfaces, projecting yarn ends, hairiness, etc.

3.1.3 *fuzzy, adj*—characterized by a hairy appearance due to broken fibers or filaments. (Syn., hairy.)

3.1.4 *hair, n*—natural animal fiber other than sheep's wool or silk.

3.1.5 *hairiness, n*—of yarns, an overall condition characterized by ~~tangled hairs, filaments, filaments~~ or fibers protruding from the yarn surface and uniformly distributed along the ~~yarn length. (Compare wild fibers.)~~ length of the yarn.

3.1.6 *loopy, adj*—a descriptive term for yarns having randomly sized loops of ~~hairs, fibers or filaments~~ protruding from the yarn surface.

3.1.6.1 *Discussion*—Loopiness may or may not be desirable depending on the yarn's end-use.

3.2 For definitions of other textile terms used in this guide, refer to Terminology D 123.

4. Summary of Guide

4.1 A yarn is passed through a photo-electric device containing a light beam that is interrupted by the occurrence of protruding fibers or filaments. By the use of a digital volt meter or computer interface, the number of protruding fibers or filaments of a specific length along a specified surface length of yarn are counted and reported as hairiness.

5. Significance and Use

5.1 The photo-electric method for measuring the hairiness of yarns is not recommended for acceptance testing of commercial shipments since experience has shown that results obtained from machines produced by one manufacturer cannot usually be verified by machines produced by another manufacturer. This guide is intended to increase the awareness of the user to available techniques for measuring hairiness. In some cases the purchaser and the supplier may have to test a commercial shipment of one or more specific materials by the best available guide though it has not been recommended for acceptance testing of commercial shipments.

5.1.1 ~~In such a case, if~~

5.1.1 ~~If there is a disagreement arising from are differences in values of practical significance between reported by the purchaser and the supplier when using this guide test results for acceptance testing, the statistical bias, if any, between the two laboratories and between the machines in each laboratory (or more), comparative tests should be determined. Competent statistical assistance performed to determine if there is recommended for the investigation of bias. a statistical bias between them, using competent statistical assistance. As a minimum, the two parties should take a group of test specimens samples that are as homogeneous as possible and that are possible, drawn from a lot of the material of from which the type in question. The disparate test specimens should then be results were obtained, and randomly assigned in equal numbers to each laboratory for testing. The average test results from the two laboratories should be compared using Student's t-test a statistical test for unpaired data and an acceptable data, at a probability level chosen by prior to the two parties before the testing begins. series. If a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results with consideration for that material must be adjusted in consideration of the known bias.~~

5.2 There may be a distinct difference in testing speed and tension devices of machines supplied by different manufacturers that may give differences in reported test results.

5.3 The measurement of hairiness is important to yarn producers. This guide is useful for process control and research of the yarn surface design at an individual manufacturing facility. Hairiness also is used to provide yarn processing machine design, and indications of malfunctioning process equipment, such as rotors, doffing mechanisms, guides, and travelers. It can be used to identify some causes of barrenness and shade variation in fabrics.

6. Apparatus

6.1 *Yarn Hairiness Meter*³, photo-electric type measuring head, equipped with digital volt meter or computer interfacing capable of counting the number of protruding fibers or broken filaments of a specific length along the surface of a yarn of known length, preferably at a measuring height of 1 mm.

6.2 *Yarn Take-Up Device*, capable of winding yarn at variable speeds, and preferably a means for obtaining 30 m/min.

² *Annual Book of ASTM Standards*, Vol 07.01.

³ Testing apparatus for measuring hairiness are available from: Meiners-Del, Rayner House, 23 Higher Hillgate, Stockport, Cheshire SK1 3ER, England; Microdynamics, P.O. Box 27578, Atlanta, GA 30327; Shirley Developments Limited, P.O. Box 6, 856 Wilmslow Road, Manchester, M20 8SA, England; Shikibo Limited; Zellweger Uster, 4404 Chesapeake Drive, P.O. Box 16348, Charlotte, NC 28297-6348; Zweigle GmbH & Co. KG, Textilprufmaschinen Postfach 1953, Bismarckstrasse 95, D-7410 Reutlingen 1/Germany.

7. Sampling and Number of Specimens, Suggested

7.1 *Lot Size*—A lot is defined as a single shipment, or production run of a single type of yarn. A lot may constitute all or part of a single customer order.

7.2 *Lot Sample*—As a lot sample when using this guide for acceptance testing, take at random the 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 D 2258. In the absence of such an agreement, take the number of packages specified in Practice D 2258. This may constitute all or part of any one customer order or production run. Consider packages of yarn to be the primary sampling unit.

NOTE 1—An adequate specification or other agreement between the purchaser and the supplier requires taking into account the variability between packages of yarn and between test specimens from a package of yarn, to produce a sampling plan with meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quality level.

7.3 *Laboratory Sample*—As a laboratory sample when using this guide for acceptance testing, proceed as directed in an applicable material specification or other agreement between the purchaser and the supplier. In the absence of such an agreement, use the lot sampling units as laboratory sampling units specified in Practice D 2258.

7.4 *Test Specimens*—As test specimens for acceptance testing, use 100-m lengths from each yarn package in the laboratory sample after discarding the outer yarn layer. Take three specimens from each laboratory sampling unit.

8. Test Equipment and Pre-Test Preparation

8.1 Unless otherwise specified in a material specification or purchase order, prepare the test equipment as follows:

8.1.1 Calibrate and service the test apparatus as specified by the manufacturer.

8.1.2 Clean the photo-electric area of the measuring head thoroughly with a soft brush and aerosol duster.

8.1.3 When possible, set the yarn take-up winder speed to 30 m/min. Otherwise, use the speed closest to 30 m/min for the machine utilized.

8.1.4 Set the fiber measuring length to 1 mm unless otherwise specified.

NOTE 2—For some types of yarn, 3 mm has been successfully used to relate to down-line performance.

8.1.5 Set fixed test length to 100 m.

8.1.6 Ensure the yarn passes centrally in the slot of the measuring head.

8.1.7 When applicable for apparatus equipped with tension adjusting capabilities, set the minimum tension to stabilize the yarn; that is, being smooth running and having no vibration.

8.1.8 For apparatus not equipped with tension adjusting capabilities, set the yarn tension to provide a smooth running yarn having no vibration using the following guide:

for greater than 125 tex	28 to 30 g
for 66 to 125 tex	18 to 20 g
for 66 tex or less	8 to 10 g

9. Conditioning

9.1 No conditioning is required unless otherwise agreed upon, such as in a material specification or contract order.

10. Procedure

10.1 Draw the free end from the yarn package over its end, through the tension device, and centrally through the slot of the measuring head. Then, secure the free end to the take-up mechanism.

10.2 Activate the take-up mechanism and allow the yarn to reach the specified speed.

10.3 Activate the hairiness tester and record the total hairiness count for the specified test length.

10.4 Obtain three determinations using three separate lengths of yarn from each sampling unit.

11. Calculation

11.1 *Hairiness Count, Specimen*—Record the hairiness count/100 m of individual specimens as read directly from the recording device to the nearest whole number.

11.2 *Average Values*—Calculate the average hairiness count/100 m to the nearest whole number for the laboratory sample and lot as applicable to a material specification or contract order.

11.3 *Computer Processed Data*—When data is automatically computer processed, calculations are generally contained in the associated software. In any event, it is recommended that computer processed data be verified against known property values.

12. Report

12.1 Report that the hairiness count was determined as directed in Guide D 5647. Describe the material or product sampled and the method of sampling used.

12.2 Report the following information for the laboratory sampling unit and lot as applicable to a material specification or contract order:

12.2.1 Average hairiness count/100 m to the nearest whole unit,

- 12.2.2 Manufacturer and model of test apparatus. For computer derived data, identify the program (software) used,
- 12.2.3 Tension applied to the yarn during the test,
- 12.2.4 When requested, standard deviation and coefficient of variation, and
- 12.2.5 Any deviation from the guide.

13. Precision and Bias

13.1 *Precision*—A pilot lab investigation was run in 1991 on a single test instrument at test speeds of 4 to 100 m. It was shown that testing speeds gave a profound effect on the test results. From the data, a test speed of 30 m/min showed the best economics while having minimal effect on the test results. Consequently a pilot interlab program was conducted in 1992 in which one-quarter pound packages of a spun yarn product obtained from one manufacturing position was evaluated. Each of these packages were evaluated in one lab using the same test instrument. Following this, each of six laboratories were supplied one of the pretested packages for evaluation on their respective test instruments. A total of five differently manufactured units were used. Measurements were made at both 1-mm and 3-mm measuring heights where possible. It was concluded from the data, that the results obtained were significantly different at 95 % confidence limits between equipment made by different manufacturer's. However, experience has shown that results from a single test machine run in a single laboratory can give meaningful results for research and process control. Subcommittee D13.58 will continue to evaluate test instruments and techniques to measure hairiness as they become available in its attempt to establish an acceptable precision statement.

13.2 *Bias*—The true value of yarn hairiness can be defined only in terms of a specific guide. When using this guide a bias may be found between test machines from different manufacturers, and machines made by the same manufacturer. The test speed, tension control and measuring height, at the least, should be examined when making comparisons between different machines using procedures described in the use and significance section of this guide.

14. Keywords

- 14.1 fiber; fuzz; hairiness; yarn

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