Designation: D 1425 – 96

Standard Test Method for Unevenness of Textile Strands Using Capacitance Testing Equipment[1]

This standard is issued under the fixed designation D 1425; 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 indirect measuring of unevenness of textile strands from tow, top, sliver, roving, and yarn produced from staple fibers and filament yarns by means of continuous runs using capacitance testing equipment.

1.2 The test method provides a value of "short-term unevenness," a single value expressing the complicated strand property that is unevenness.

1.3 The test method is applicable to all yarns, rovings, slivers, and tops, except as indicated below.

1.3.1 Low twist filament yarns should be tested only if additional twist is inserted during testing.

NOTE 1—In many cases, low twist yarns tend to flatten to a ribbon while passing through the condenser of the instrument, and the recorded value of unevenness is increased above the true value.

1.3.2 Strands made from fiber blends should be tested only if blending is uniform along the strand.

NOTE 2—Nonuniform blending may cause a higher reading of unevenness than the true value if the component fibers differ in dielectric constant. The magnitude of the increase of unevenness readings due to nonuniform blending cannot be stated in general terms.

1.4 The values stated in either acceptable metric units or in other units shall be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system must be used independently of the other, without combining values in any way.

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:*

D 123 Terminology Relating to Textiles[2]

D 2258 Practice for Sampling Yarn for Testing[2]

3. Terminology

3.1 *Definitions:*

3.1.1 *coefficient of variation unevenness, CV%, n—in textiles*, the standard deviation of the linear densities over which unevenness is measured expressed as a percentage of the average linear density for the total length within which unevenness is measured. (See also *unevenness, mean deviation unevenness*.)

3.1.2 *integrator, n—in textile unevenness testing*, a device that calculates the coefficient of variation unevenness or the mean deviation unevenness.

3.1.2.1 *Discussion*—The terms "integrator" and "integration" as applied to textile unevenness testing do not imply integration in the strict mathematical sense. The type integrator, linear or quadratic, must be carefully selected depending upon a known irregularity of the material; that is, purely random or purely periodic.

3.1.3 *length between, L_b, n—in textile unevenness testing*, the length between which unevenness is measured; the equivalent of the length of strand segments weighed in a direct method of measuring unevenness.

3.1.4 *length within, L_w, n—in textile unevenness testing*, the length over which unevenness is measured.

3.1.4.1 *Discussion*—The total length of the strand from which the segments weighed were sampled in a direct method of measuring unevenness. For indirect methods, the maximum value of length within is the tested length from the specific package.

3.1.5 *linear integrator, n—in textile unevenness testing*, an integrator that operates continuously and reports unevenness for a certain, and unchanging, time past.

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

3.1.5.1 *Discussion*—The input to the integrator immediately preceding the moment of taking a reading receives greater "weight" than the prior input, and this "weighting" gradually decreases with the lapse of time. (*Syn.* fading memory integrator)

3.1.6 *mean deviation unevenness, U%, n—in textiles*, the average of the absolute values of the deviations of the linear densities of the integrated lengths between which unevenness is measured and expressed as a percentage of the average linear density for the total length within which unevenness is measured. (See also *unevenness, coefficient of variation unevenness*.)

3.1.7 *quadratic integrator*, *n—in textile unevenness testing*, an integrator that operates continuously and reports unevenness for the time during which it has been active, giving equal weight to all portions of the input. (*Syn.* compensated-memory integrator)

3.1.8 *strand*, *n*—(1) a single fiber, filament, or monofilament, (2) an ordered assemblage of textile fibers having a high ratio of length to diameter and normally used as a unit, including slivers, rovings, single yarns, plied yarns, cords, braids, ropes, etc.

3.1.9 *strand irregularity*, *n—in textiles*, variation in a property along a strand.

3.1.10 *unevenness*, *n—in textiles*, variation in the linear density of a continuous strand or of a portion of a strand. (See also *coefficient of variation unevenness, mean deviation unevenness*.)

3.1.11 *unit length of instrument, L_c, n—in textile unevenness testing*, the length of strand being measured between the sensing elements at any moment.

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

4. Basic Principles of Test Method

4.1 Properties of a strand vary along its length and these variations are termed strand irregularity. The variation of one specific property, linear density, is termed unevenness. This method is concerned with measuring the unevenness of a textile strand.

4.2 Unevenness is always expressed as between successive lengths and over a total length. When the length between which unevenness is measured (L_b) is very short, 8 mm (0.3 m) for yarn and roving and 12 mm (0.5 m) for slivers, then reference is often made to short-term unevenness.

4.3 Unevenness can be measured by direct method or indirect methods. The direct method consists of cutting and weighing strand segments of length L_b and is the reference method of determining unevenness. Unevenness testing instruments, as covered in Method D 1425, use the indirect method where unevenness is determined by the measurement of strand properties closely related to and dependent on linear density. The accuracy of the indirect method and of an instrument utilizing it can be judged by a comparison of the value of unevenness it gives with one obtained by the direct method of cutting and weighing.

4.4 The unevenness testing instruments measure those properties of the strand which change the capacitance when the strand passes between the plates of a capacitor.

4.5 A number of mathematical concepts are used to express the unevenness of a strand. They are all based on the coefficient of variation or its square. There is, therefore, some advantage in using an unevenness testing instrument that gives the coefficient of variation and thereby fits into the general mathematical scheme.

4.6 If the method is followed exactly and the testing instrument has been adjusted to eliminate bias in the results, then unevenness values obtained on different instruments will agree for the same strand, or will be comparable for different strands, provided that the following are the same in all cases: (*1*) the measure of unevenness used (see 3.1.5 and 3.1.6); (*2*) the length between, L_b (see 3.1.3); and (*3*) the length within, L_w (see 3.1.4). When different models of instruments are used, then one or more of the three items are often not identical and the test results may differ from instrument to instrument.

5. Summary of Test Method

5.1 A strand is passed through the sensing device of the evenness tester at constant speed and a momentary value proportional to the linear density of the strand is recorded. The instruments are equipped with an integrator that calculates the unevenness automatically and the value is read while the strand is passing through the instrument after 40 m 50 yd of yarn have been tested.

6. Significance and Use

6.1 Test Method D 1425 for the determination of unevenness of textile strands is considered satisfactory for acceptance testing of commercial shipments of filament or spun yarn, roving, sliver, tow, or top since the method has been used extensively in the trade for acceptance testing.

6.1.1 In case of a dispute arising from differences in reported test results when using Test Method D 1425 for acceptance testing of commercial shipments, the purchaser and supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens that are as homogenous as possible and that are from a lot of material of the type in question. The test specimens should then be randomly assigned in equal numbers to each laboratory for testing. The average result from the two laboratories should be compared using appropriate statistical analysis for unpaired data and an acceptable probability level chosen by the two parties before the testing is begun. 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 to the known bias.

6.2 The interpretation of results of unevenness tests is a complex matter and a detailed discussion is outside the scope of Method D 1425. Unevenness is a fundamental feature of yarn construction and influences many properties of the yarn. Unevenness cannot be fully expressed as a single number and various methods exist for a more complete presentation. The value for short-term unevenness determined as directed in this