Designation: D1425/D1425M – 14

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

This standard is issued under the fixed designation D1425/D1425M; 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 measurement of evenness (mass variation) of non-conductive textile strands, including top, comber lap, sliver, roving, and yarn produced from staple fibers and continuous filament yarns, by means of capacitance testing equipment.

1.2 Strands made from fiber blends can be tested using this test method only if the different fibers are uniformly distributed throughout the strand.

1.3 The test method provides numeric values for the measurement and evaluation of short-, mid-, and long-term mass variations of the tested strand in terms of frequently occurring faults classified as thin places, thick places, and neps and graphical representations of evenness values in the form of diagram charts, spectrograms, length variation curves, and histograms.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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:*[2]

D123 Terminology Relating to Textiles
D1776 Practice for Conditioning and Testing Textiles
D2258 Practice for Sampling Yarn for Testing
D4849 Terminology Related to Yarns and Fibers
E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions:*

3.1.1 The following terms are relevant to this standard: electric constant; evenness; imperfections; length between, L_b; length capacitance zone, L_c; mass variation; mean deviation of evenness, U%; sample length L_s; strand; strand irregularity; and total imperfections.

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

4. Basic Principles of Test Method

4.1 Properties of strand irregularity measured along its length are measured in terms of mass variation.

4.2 The direct method of evenness testing utilizes the technique of cutting and weighing strand segments of length L_b and is the reference method of determining evenness (mass variation). Utilization of the capacitance measurement technique is an indirect testing method. The accuracy of an indirect method of testing can be judged by a comparison of evenness values between it and the direct method (cutting and weighing).

4.3 In capacitance testing, a high frequency electric field is generated in the space between a pair of capacitor plates (measuring slots). If the mass of a strand moving between the plates changes, the electrical field between the plates changes accordingly, and results in electrical signal output variation proportional to the mass variation of the strand.

4.4 Evenness is always expressed as variation between successive lengths L and over a total length Ls. When the L_c evenness is measured, it corresponds to the length capacitance zone width, i.e., 8 mm [0.3 in.] for yarns, 12 mm [0.5 in.] for rovings and fine slivers, and 20 mm [0.8 in.] for slivers that are referred to as short-term evenness. Longer-term evenness may also be evaluated by electronically increasing the L_c.

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.58 on Yarns and Fibers.

Current edition approved July 1, 2014. Published August 2014. Originally approved in 1956. Last previous edition approved in 2009 as D1425/D1425M-09ε1. DOI: 10.1520/D1425_D1425M-14.

[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.

5. Summary of Test Method

5.1 A textile strand is passed through a length capacitance zone of an evenness tester at a constant speed. The mass variation of successive L_c interval lengths is measured and from which other values of evenness are derived: coefficient of variation, short-, mid- and long-term variations, and imperfections.

6. Significance and Use

6.1 This test method for the determination of evenness of textile strands is used extensively for acceptance testing of commercial shipments of filament or spun staple yarn, comber laps, roving, sliver, or tops.

6.2 Values of strand evenness are also used in quality control, process optimization, and together with yarn strength measurements, as the first appraisal of a strand's quality. A low evenness value is, in general, preferred. Higher evenness values generally indicate poor yarn manufacturing practices, lower yarn strength, and poorer fabric appearance. Experience has shown that the relationship of evenness to the prediction of yarn performance and to fabric appearance is not a simple one. An evenness value must, therefore, be used cautiously and be supplemented by additional evenness information, such as mid-term and long-term mass variations, thin, thick, and nep imperfection counts, diagram chart spectrogram chart, length variation curve, and histogram analyses.

6.3 Continuous filament yarns should be tested for mass variation on evenness testers that are specifically designed to test this yarn type; failure to do so will result in inaccurate test results. Further, low-twist, continuous filament yarns tend to flatten to a ribbon configuration while passing through the sensor of a capacitance instrument. This flattening effect will cause false mass variation measurements by the capacitive sensor (commonly referred to as shape effect). Evenness testers that are specifically designed to test continuous filament yarns insert a false twist to the yarn strand during testing to overcome the flattening effect and thus ensure accurate mass variation measurements.

6.4 Strands made from fiber blends should be tested only if the different fibers are uniformly distributed throughout the strand. Non-uniform blending may cause a higher reading of mass variation than the true value if the component fibers differ in dielectric constant.

6.5 Evenness values obtained on different instruments will be comparable for strands from the same sample provided the following parameters are the same in all cases: (1) the measure of evenness used (CV% or U%); (2) the capacitive length zone L_c; (3) the sample length, *Ls*; (4) instrument test speed, (5) laboratory temperature and humidity conditions (see 10.1); and (6) test specimen preparation, and (7) test specimen variation. When different models of an instrument are used, and one or more of the seven parameters are not identical, test results may differ.

6.6 If there are any differences of practical significance between reported test results for two (or more) laboratories, comparative tests should be performed using an agreed upon number of samples that are homogeneous and randomly assigned. Competent statistical assistance should be used to determine if there is a statistically significant difference between the laboratories. If a bias is found, either its cause must be found and corrected, or future testing for that material must be adjusted in consideration of the statistically significant differences found.

7. Apparatus

7.1 *Capacitance-Type Evenness Testing Instruments*—A textile strand evenness tester that utilizes the electronic capacitance measuring principle.

7.1.1 Differences between older and newer capacitance testers for calibration, recording devices, test settings, and data output can be found in the manufacturer's instruction manual for specific models.

7.2 *Package holders, guides, tension devices, unwinding, and take-up mechanisms*——Devices and attachments to evenness testing instruments that aid in the uniform delivery of the strand at specified speed, without undue acceleration or deceleration, at a reasonably constant tension. These devices are especially critical for loose textile strands such as sliver, roving, and comber laps

7.3 *Recording device*—Printer or computer-generated files from which numeric and graphic test data can be produced.

7.4 *Twist insertion device*—A mechanism that inserts false twist into continuous filament yarns. This mechanism is used only on evenness testers that are designed to test continuous filament yarns.

8. Sampling

8.1 Unless otherwise agreed upon, as when specified in an applicable material specification, take a lot sample and laboratory sample as directed in Practice D2258.

8.2 Typical spun yarn sample lots are ten or twenty packages, unless otherwise agreed upon.

9. Number of Specimens

9.1 Conduct a test on each yarn package or bobbin in the sample lot. Refer to 11.1, Table 1 for the recommended test length. If required, multiple tests on successive test lengths can be performed on each package or bobbin.

9.2 Conduct a test on each sample of sliver, roving, comber lap, top or the number of test recommended by the equipment manufacturer. Refer to 11.1, Table 1 for the recommended test length. If required, multiple tests on successive test lengths can be performed on each sample.

10. Conditioning

10.1 Condition strands according to Practice D1776. Preconditioning is not required unless in the case of dispute.

10.2 For yarn, the time required for conditioning depends on the fiber, the size of the package and the compactness of the yarn wound on the package. Further, a shorter conditioning time may be sufficient if only the outside layer of a yarn package is to be tested than if the whole package is to be tested.