Designation: ~~D1423 – 02 (Reapproved 2008)~~ D1423/D1423M – 16

Standard Test Method for Twist in Yarns by Direct-Counting[1]

This standard is issued under the fixed designation ~~D1423;~~D1423/D1423M; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method covers the determination of the amount and direction of twist at the completion of any stage of twisting in single (spun or filament), plied, cabled, or novelty (exclusive of long-term repeat patterns) yarns. The procedures are designed primarily for yarns in packages, but, with special precautions, they are applicable to yarns taken from fabrics. The procedure for spun yarn in 9.2 is also applicable to rovings.

1.2 For plied yarns, this test method covers the determination of the twist of the plied yarns and the twist of the single yarn before plying. For cabled yarns, the test method covers the determination of the cable or hawser twist; the twist of the plied yarn after plying, but prior to the last twisting operation; and the twist of the single yarn before plying. Procedures are also included for the determination of the twists of the single and plied yarn components as they lie in the final structure. Also, directions are included for the determination of twist in plied yarn made with direct cabling technology.

1.3 This test method is not intended for yarns that extend more than 5.0 % when tension is increased from 2.5 to 7.5 mN/tex ~~(0.25~~[0.25 to 0.75 ~~gf/tex).~~gf/tex]. Following the procedures of this test method for such yarns would be independent of the bias and precision determined for this test method. The report from such testing should include the tension used for this testing.

1.4 *Units*—The values stated in either ~~inch-pound or~~ SI units or inch-pound units are to be regarded separately as standard. ~~Within the text, the SI units are shown in parentheses.~~ The values stated in each system ~~are~~may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in ~~nonconformance within this test method.~~non-conformance with the standard.

NOTE 1—For a more rapid but less accurate method of determining twist in single spun yarns, refer to Test Method D1422.
NOTE 2—This test method has been evaluated for use in determining twist in open end yarns and is not recommended.

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
D1059 Test Method for Yarn Number Based on Short-Length Specimens (Withdrawn 2010)[3]
D1422 Test Method for Twist in Single Spun Yarns by the Untwist-Retwist Method
D1776 Practice for Conditioning and Testing Textiles
D1907 Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method
D3888 Terminology for Yarn Spinning Systems
D4849 Terminology Related to Yarns and Fibers

3. Terminology

3.1 Refer to Terminology D4849 for definitions of the following terms used in this standard: direction of twist, single yarn, spun yarn, twist, twist factor, twist multiplier, and yarn.

---

[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, 2008~~July 1, 2016. Published ~~August 2008~~October 2016. Originally approved in 1956. Last previous edition approved in ~~2002~~2008 as ~~D1423~~D1423–02(2008).~~– 02.~~ DOI: ~~10.1520/D1423-02R08.~~10.1520/D1423_D1423M-16.

[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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

3.2 Refer to Terminology D123 and Terminology D3888 for definitions of other terms used in this standard.

4. Summary of Test Method

4.1 A specified length of specimen is mounted in a twist device. One end is rotated until all the elements are free of twist. The number of turns is counted and the turns per unit length are calculated.

4.2 The amount of twist in the component elements of a plied or cabled yarn is determined by either of two options.

4.2.1 In the procedure for determining original twist, one end of the yarn is fixed while the other end is rotated until the structural components are parallel. Any one or all of these components may then be used as test specimens.

4.2.2 In the procedure for determining final twist in components, both ends of one component of the yarn are held fixed while all the other components are removed and discarded. The twist is then determined in the remaining component.

5. Significance and Use

5.1 Test Method D1423 for testing twist in yarns by direct-counting is considered satisfactory for acceptance testing of commercial shipments because current estimates of between-laboratory precision are acceptable and the method has been used extensively in the trade for acceptance testing.

5.1.1 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 comparative tests as homogeneous as possible, drawn from the same lot of material that resulted in the disparate test results and randomly in equal numbers to each laboratory. The test results from the laboratories involved should be compared using a statistical test for unpaired data, at 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 The determination of twist in a straight section of a yarn is not the simple straightforward operation it appears to be, for the test results may be greatly influenced by variations in test procedures and techniques. In all manipulations, extreme care is necessary to prevent specimen rotation altering the twist level before testing begins.

5.3 The twist in a yarn before it is packaged may be different from that of the yarn after it has been withdrawn from the package because of changes in tension and the effect of the method of withdrawal. If the yarn is withdrawn over-end, a slight increase or decrease in twist will take place, depending upon the direction of the twist in the yarn, the direction of winding on the package, and the length of the wrap on the package.

5.4 When a yarn is incorporated into or removed from a more complex structure, alterations may occur as a result of the plying, untwisting, or raveling operation. For example, when determining the twist in plied yarn by the procedure for determining original twist, as the plied yarn is untwisted, a comparable amount of twist is reinserted in, or removed from, the single-yarn components. As a consequence, the single yarns have approximately the original twist prior to the plying operation but not the twist they have when they are functioning as components of the plied yarn. The latter or final twist may be estimated by adding the ply twist to (or subtracting it from) the single-yarn twist depending on the directions of the ply and singles twist. For a more precise determination, the test procedure must be modified. There are thus two different procedures for preparing specimens of the component elements of a plied or cabled yarn for twist determination. The procedure for the original twist measures the twist in a component of a complex strand after the components have been untwisted. The procedure for final twist measures the twist in a component as it lies in the complex strand. Although the original twist procedure is most often used, selection of a particular procedure will depend on the type of information needed.

NOTE 3—The difference in twist between unwinding from the side and over-end is $1/\pi d$, where d is the diameter of the package.[4] Thus, for a 25-mm ~~(1-in.)~~[1-in.] diameter package, the difference would be about 13 tpm or about ⅓ tpi.

5.5 When a yarn is taken from a more complex yarn structure or from a fabric, the resultant twist should be considered only an approximation of the original value because of alterations that may have occurred as a result of the effects of unwinding, handling, and mechanical strains met in processing.

5.6 The optimum amount of twist depends upon the use for which the yarn is intended. The amount of twist affects both the strength and elongation properties of the yarn with increased twist being associated with increased elongation. The relationship between twist and strength is more complex.

5.6.1 In filament yarns, some twist up to 280 tpm ~~(7 tpi)~~[7 tpi] or a suitable sizing is required to facilitate textile operations. A small increase in twist results in a slight increase in strength, but a further increase results in a loss in strength. However, higher twist in such yarns may be used to subdue luster or increase elongation, or to secure other special effects, as in crepe fabrics.

5.6.2 In conventional ring spun yarns a certain minimum amount of twist is necessary to bind or hold the individual fibers together to produce a useful yarn. A limited increase in twist will result in an increase in strength until the critical twist level for the particular yarn involved has been reached, but further increase in twist results in a loss in strength.

[4] Woods, H. J., "The Kinematics of Twist, I, The Definition of Twist," *Journal of Textile Science*, Vol 4, 1931, pp 33–36.

5.7 The same amount of twist in yarns of different sizes (diameter) will produce yarns with different degrees of compactness, twist character, and twist angles. The twist multiplier or twist factor is approximately proportional to the tangent of the angle that the surface fibers make with the axis of the yarn. Therefore, the greater the angle, the greater the twist multiplier. A constant twist multiplier indicates comparable compactness and degree of liveliness in yarns of different sizes and conversely a difference in twist multiplier indicates a difference in compactness in yarns of the same size. Yarns intended for different uses are frequently made with different twist multipliers, for example, warp yarns and filling yarns.

5.8 Different cabling processes will influence the calculation of twist from single component twist measurement. The length of cabled yarn before untwisting is used for the calculation of twist for single components using direct cabling technology. In case of 2 or more step twist technology the length of the cabled yarn after untwisting is used for calculation of the twist level in the single yarn components.

5.9 Twist multiplier and twist factor are a measure of the "twist hardness" of spun yarn because they are approximately proportional to the tangent of the angle between fibers on the outer yarn surface and the axis of the spun yarn; the larger this angle, the harder the twist. Furthermore, this angle is a function of both the twist content (turns per unit length) and the number of fibers per yarn cross section (yarn number). Hence, twist content alone cannot provide a measure of the twist hardness of a yarn.

6. Apparatus

6.1 *Twist Tester,* consisting of a pair of clamps, one of which is rotatable in either direction and positively connected to a revolution counter. The tester may be hand- or power-driven. The position of one clamp (or both clamps) shall be adjustable to accommodate specimens of the lengths specified in 9.2 and 9.3 and to permit measuring the change in length during untwisting. Means shall be provided for applying the specified tensions to the specimen and for determining the specimen length with an accuracy of ±0.5 mm ~~(0.02 in.)~~.[0.02 in.]. The movable but nonrotatable clamp shall be capable of being traversed with substantially no friction to permit determining the untwisted length of the specimen under the specified tension. The counting device shall be resettable to zero count and shall indicate the total number of turns to the nearest 0.1 turn.

6.2 *Dissecting Needle or Stylus.*

6.3 ~~*Gage*~~*Gauge or Calipers.*

6.4 *Magnifying Glass with Stand.*

6.5 *Equipment for Reeling Laboratory Sample Skeins,* optional.

7. Sampling and Test Specimens

7.1 *Lot Sample*—Select one or more shipping units taken at random to represent an acceptance sampling lot and used as a source of laboratory samples.

7.2 *Laboratory Sampling Unit*—From each primary sampling unit, take a laboratory sample as specified in 7.2.1 and 7.2.2

7.2.1 For packaged yarns, take a minimum of five packages.

7.2.2 For rolls, take a full width of sufficient length that will provide the 25 yarn specimens described in 7.3 and 7.4.

7.3 *Test Specimens:*

7.3.1 *Spun Yarn Singles*—Take 25 specimens from each laboratory sampling unit of spun yarn singles.

7.3.2 *Filament Yarn Singles*—Take eight specimens from each laboratory sampling unit of filament yarn singles containing 100 tpm or 2.5 tpi or less, and five specimens per laboratory sampling unit of filament yarn singles containing more than 100 tpm or 2.5 tpi.

7.3.3 *Plied and Cabled Yarns*——Take five specimens per laboratory sampling unit of plied and cabled yarns for each component to be tested.

7.4 *Selection of Specimens:*

7.4.1 Take an approximate equal number of specimens from each package or unit of the laboratory sample. Take the specimens from each package in a random manner to minimize the effect of cyclic variations introduced during the manufacturing processes. When preparing specimens, conditioning them or inserting them in the tester, take care to avoid any change in twist.

7.4.2 For packaged yarns, remove and discard the first 25 m ~~(25 yd)~~[25 yd] of yarn. Using a minimum of tension, take specimens at random intervals greater than 1 m ~~(1 yd)~~[1 yd] along the yarn. Withdraw the yarn from the package in the direction of normal use, either from the side or over-end, if known. If the direction is not known withdraw the yarn from the side (Note 3). When more than five specimens are taken from an individual package, take groups of five or less at intervals of several yards. Do not cut the specimen free from the package or from the yarn to be discarded until after the yarn is secured in the clamps of the twist tester. When possible, take the specimen from near the center of the traverse and not at the traverse reversals.

7.4.3 For woven fabric, take warp specimens from separate ends, since each represents a separate package. Because the fabric may have been woven on any of a variety of looms which are random quilling, sequential quilling or shuttleless, take filling specimens at random through the whole laboratory sample to obtain as representative data as possible. A strip about 2 m ~~(2 yd)~~[2 yd] long is recommended as a source for filling yarn specimens.

7.4.4 For weft-knit fabric, known to be multi-feed, take specimens from successive courses in one portion of laboratory sample. For weft-knit fabric known to be single-feed or for which the method of feed is not known take specimens at random from the whole laboratory sample.

7.4.5 For warp-knit fabric, prepare specimens as directed in Test Method D1059. Cut strips from which the test specimens can be raveled for testing as needed (Note 4). Cut these strips so as to provide yarn specimens at least 75 mm ~~(3 in.)~~[3 in.] longer than the specimen length and to contain more than the required number of specimens for test. If several strips are cut, divide the number of specimens among the strips as nearly equally as possible. Use care to avoid loss of twist prior to testing.

NOTE 4—To minimize changes in twist, specimens should not be unraveled from the strips until they are to be placed in the twist tester.

8. Conditioning

8.1 Bring the sample to moisture equilibrium for testing in the standard atmosphere for testing textiles as directed in Practice D1776, except that preconditioning is not necessary.

9. Procedure

9.1 *General Directions:*

9.1.1 Test all specimens in the standard atmosphere for testing ~~textiles which is a~~as directed in Practice D1776~~temperature of 21 ± 1°C (70 ± 2°F) and a relative humidity of 65 ± 2 %.~~.

9.1.2 Check the twist tester to ensure that the longitudinal play and radial play of the clamp assemblies are small enough to ensure the required precision.

9.1.3 Determine the twist with the precision stated in Table 1.

9.1.4 When the nominal yarn number is not known, determine the yarn number of the sample as directed in Test Methods D1059 or D1907.

PROCEDURE FOR ORIGINAL TWIST

9.2 *Spun Single Yarns:*

9.2.1 Set the movable clamp to obtain a ~~gage~~gauge length as long as convenient but somewhat less than the staple length of the fiber used to spin the yarn. For yarns spun on the cotton spinning system use a ~~gage~~gauge length of 15, 20, or 25 mm ~~(0.5,~~[0.5, 0.75, or 1.0 ~~in).~~in]. For yarns spun on the worsted spinning system and the woolen spinning system use a ~~gage~~gauge length of 25 or 50 mm ~~(1.0~~[1.0 or 2.0 ~~in.).~~in.]. Set the counter at zero. Mount the specimen in the clamps under a tension of 0.25 ± 0.05 cN/tex ~~(0.25~~[0.25 ± 0.05 ~~gf/tex).~~gf/tex]. Avoid any change in the twist while handling the yarn. Cut the specimen free from the package and from the yarn to be discarded, leaving less than 25 mm ~~(1 in.)~~[1 in.] of the specimen protruding from each clamp.

9.2.2 Remove the twist completely by turning the rotatable clamp until the yarn elements are parallel, as determined by visual examination, or by passing a needle or stylus between the untwisted elements from one clamp to the other.

9.2.3 Note the direction of twist as indicated on the twist tester, or as determined by inspection of the specimen according to the definition given in Terminology D4849. Record the initial length, the direction of twist, and the number of turns in the specimen with the precision described in Table 1.

9.2.4 Repeat the operation until the required number of specimens has been tested.

9.3 *Filament Single Yarns:*

9.3.1 Set the clamps to secure a ~~gage~~gauge length of 250 ± 0.5 mm ~~(10~~[10 ± 0.02 ~~in.).~~in.]. Set the counter at zero. Mount the specimen in the clamps under a tension of 0.25 ± 0.05 cN/tex ~~(0.25±~~[0.25± 0.05 ~~gf/tex)~~gf/tex] and cut both ends free as directed in 9.2.1. Measure and record the length between clamps to the nearest 0.5 mm ~~(0.02in.)~~[0.02in.] before untwisting (initial length).

9.3.2 Remove the twist completely by turning the rotatable clamp until the yarn elements are parallel as determined by visual examination, or by passing a needle or stylus between the untwisted elements from one clamp to the other. Measure and record the length, direction of twist and the number of turns in the specimen with the precision specified in Table 1.

9.3.3 Repeat the operation until the required number of specimens has been tested.

9.4 *Plied Yarns and Original Twist in Single-Yarn Components of Plied Yarn:*

9.4.1 Proceed as directed for filament yarns in 9.3 to determine the total number of turns and direction of ply twist in the specimen.

TABLE 1 Required Precision for Given Twist Level

~~Turns of Twist in Test Specimen × Length tpm (or tpi) × metres (or inches)~~	~~Precision min, in revolutions~~
Turns of Twist in Test Specimen × Length tpm [or tpi] × metres [or inches]	Precision min, in revolutions
5 or less	0.1
Over 5 through 15	0.5
Over 15	1.0