~~Designation:D1422–99~~ Designation: D 1422 – 99 (Reapproved 2008)

Standard Test Method for
Twist in Single Spun Yarns by the Untwist-Retwist Method[1]

This standard is issued under the fixed designation D 1422; 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[2] describes the determination of twist in single spun yarns when only an approximation of the true twist is required.

NOTE 1—For a more accurate method see Test Method D 1423.

1.2 This test method is applicable to spun single yarns in continuous lengths, and also to spun yarns raveled from fabrics, provided specimens at least 200 mm (8 in.) long can be obtained.

1.3 The values stated in either inch-pound or SI 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 not 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.

1.4 This test method has been found satisfactory for use in determining twist in all single ring spun yarns and 100% cotton open-end yarns. For all open-end spun yarns that are not 100 % cotton this test method has not been found to be satisfactory for determining twist but may be used to measure deviation from an average value.

1.5 This specification shows the values in both inch-pound units and SI units. The "inch-pound" units is the technically correct name for the customary units used in the United States. The "SI" units is the technically corrected name for the system of metric units known as the International System of Units. The values stated in either acceptable metric units or in other units shall be regarded separately as standard. The values expressed in each system may not be exact equivalents; therefore, each system must be used independently of the other, without combining in any way.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility 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:*[3]

D 123 Terminology Relating to Textiles

D 1059 Test Method for Yarn Number Based on Short-Length Specimens

D 1423~~Test Method for Twist in Yarns by the Direct-Counting Method[3]~~

~~D2258Practice for Sampling Yarn for Testing[3]~~ Test Method for Twist in Yarns by Direct-Counting

3. Terminology

3.1 *Definitions:*

3.1.1 *direction of twist*, *n*—the right or left direction of the helix formed in a twisted strand as indicated by superimposition of the capital letter "S" or "Z."

3.1.1.1 *Discussion*—Yarn has **S** twist if, when the yarn is held in a vertical position, the visible spirals or helices around its central axis conform in direction of slope to the central portion of the letter" S," and **Z** twist if the visible spirals or helices conform in direction of slope to the central portion of the letter "Z." When two or more yarns, either single or plied, are twisted together, the letters "S" and "Z" are used in a similar manner to indicate the direction of the last twist inserted.

3.1.2 *single yarn*, *n*—the simplest strand of textile material suitable for operations such as weaving, knitting, etc.

3.1.2.1 *Discussion*—A single yarn may be formed from fibers with more or less twist; from filaments with or without twist; from

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[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 Aug. 1, 2008. Published October 2008. Originally approved in 1956. Last previous edition approved in 1999 as D 1422 – 99.

[2] This test method is commonly designated by the less precise term" Untwist-Twist Method."

[3] 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* ~~, Vol 07.01.~~volume information, refer to the standard's Document Summary page on the ASTM website.

narrow strips of materials such as paper, cellophane, or metal foil; or from monofilaments. A yarn which is either twistless or can be rendered twistless in a single untwisting operation. When twist is present, it is usually all in the same direction.

3.1.3 *spun yarn*, *n—in a staple system*, a continuous strand of fibers held together by some binding mechanism.

3.1.3.1 *Discussion*—The binding mechanism most commonly used in spun yarns is twist. Other useful mechanisms that are used are chemical additives, wrapping, entanglement, or some combination of these. Test Method D 1422 is applicable only to yarns which have twist.

3.1.4 *twist*, *n—in textile strands*, the helical or spiral configurations induced by turning a strand about its longitudinal axis.

3.1.4.1 *Discussion*—Twist is usually expressed as the number of turns about the axis that are observed in a specified length either metres (tpm) or inches (tpi).

3.1.5 *twist factor,* TF, *n*—the product obtained when the twist expressed in turns per centimetre is multiplied by the square root of the yarn number expressed in tex:

$$\text{Twist factor (TF)} = \text{tpcm} \times \sqrt{T} \tag{1}$$

where:

T = yarn number expressed in tex.

3.1.5.1 *Discussion*—Twist multiplier and twist factor are a measure of the "twist hardness" of yarn because they are approximately proportional to the tangent of the angle between fibers on the outer yarn surface and the axis of the 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. Twist multiplier and twist factor are proportional to each other and differ only in the units used.
The two are related by Eq 2 and Eq 3:

$$TF = k \times TM \tag{2}$$

$$k = 277.29/\sqrt{L} \tag{3}$$

where:

L = length in yards of the hank used to define the indirect yarn number of the type,
N = hanks/lb. In particular for cotton count,
k = 9.567 so that Eq 2 becomes Eq 4:

$$TF = 9.567 \times TM \tag{4}$$

3.1.6 *twist multiplier,* TM, *n*—the quotient of the twist expressed in turns per inch and the square root of the yarn number in an indirect system.

$$\text{Twist multiplier (TM)} = \text{tpi}/\sqrt{N} \tag{5}$$

where:

N = yarn number in an indirect system, the cotton system unless otherwise specified.

3.1.7 *yarn*, *n*—a generic term for a continuous strand of textile fibers, filaments, or material in a form suitable for knitting, weaving, or otherwise intertwining to form a textile fabric.

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

4. Summary of Test Method

4.1 A specimen is untwisted and then retwisted in the opposite direction until it contracts to its original length. It is assumed that the same amount of twist has been inserted as was originally present. Twist, as turns per unit length, is calculated as half the number of turns registered on the counter divided by the specimen length.

5. Significance and Use

5.1 This test method is used for acceptance testing in the trade for economic reasons even though it is less accurate than the direct method, Test Method D 1423.

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 their is a statistical bias between them, using competent statistical assistance. As a minimum, the test samples should be used that are as homogeneous as possible, that are drawn from the material from which the disparate test results are obtained, and that are assigned randomly in equal numbers to each laboratory for testing. Other materials with established test values may be used for this purpose. The test results from the two laboratories 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 must be adjusted in consideration of the known bias.

5.2 The "setting" of twist in some fibers causes excessive contraction when the yarn is retwisted in the reverse direction. Therefore, the number of turns required to bring the specimen back to its original length may be less than the number of turns removed in untwisting. This effect may be partially offset by the use of higher pretensioning loads; but this increases the danger

of stretching the yarn. Little information is available on the correct tensions to use for yarns made from different fibers or with different amounts of twist.

5.3 In addition to being less tedious, this test method requires fewer specimens than the direct-counting method and the results may be sufficiently accurate for certain purposes. This test method can be useful in those cases where the main objective is to measure variations from an average value. Another possible application is where a large amount of twist testing is required on yarns of similar type and twist. In this case preliminary tests comparing this method and the direct method could be used to determine the correct pretension.

5.4 Twist has important effects on the physical properties of yarn. Low-twist yarn is lofty and is usually preferred for knitting because of its softness, covering power, and warmth. Increasing the amount of twist causes an increase in yarn strength by increasing fiber cohesion, but as the twist angle increases beyond an optimum point, strength decreases due to a loss in effective fiber contribution. Maximum yarn strength is obtained by inserting a medium amount of twist to obtain an optimum balance between these two opposing forces. High twist produces yarns of high density ("hard" or "wiry") and high elongation and may improve the abrasion and impact resistance of fabrics.

5.5 The optimum twist for either manufacturing efficiency or physical properties usually increases as staple length decreases.

5.6 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 turn (or wrap) on the package.

NOTE 2—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.) diameter package, the difference would be about 13 tpm or about one third tpi.

5.7 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.

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 having the length prescribed in 10.2. The tester shall be provided with a variable tensioning device so constructed that a specific force may be applied to the specimen at the beginning and end of the test and removed completely during the intervening untwisting and twisting operations.

6.2 Dissecting needle or stylus.

6.3 Metal ruler to verify gage length (accurate to 2 mm or 0.1 in.).

7. Sampling

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 Sample*—For packaged yarns, take a minimum of five packages for the laboratory sample unless otherwise agreed upon between purchaser and seller. For yarns from woven or knitted fabrics, the sample must be large enough to furnish specimens of the length and number specified in 7.3.3.

7.3 *Selection of Specimens*:

7.3.1 As nearly as possible take an 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 manufacturing processes. When preparing specimens, conditioning them, or inserting them in the tester, take care to avoid any change in twist.

7.3.2 For packaged yarns, remove and discard the first 25 m (25 yd) of yarn. Using a minimum of tension, take specimens at random intervals greater than 1 m (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 2). 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.

7.3.3 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. If a strip about 2 m (2 yd) long is used as a source of specimens.

7.3.4 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 type of feed is not known, take specimens at random from the whole sample.

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