INTERNATIONAL STANDARD

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Textiles — Determination of twist in single spun yarns — Untwist/retwist method

Textiles — Détermination de la torsion des filés de fibres simples — Méthode de détorsion/retorsion

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 17202 was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 23, *Fibres and yarns*.

Annex A of this International Standard is for information only.

Introduction

The direct twist method (see [1] and [2]) has, for a long time, been recognized as the most accurate method of twist determination but the much faster untwist/retwist method has long been used in industry in many countries. In the 1980s the hope was expressed by some Institutes that the untwist/retwist method would be suitable for the measurement of twist of open-end yarns that cannot be measured by the direct method. First experiments in the 1970s and later in the 1990s showed, however, that the untwist/retwist method is not suitable to OE yarns. The present method is therefore restricted to ring spun yarns.

Textiles — Determination of twist in single spun yarns — Untwist/retwist method

1 Scope

This International Standard specifies a method for the determination of the direction of twist in single yarns and the amount of twist, in terms of turns per unit length, by the indirect untwist/retwist method.

This International Standard is applicable to single spun yarns.

This International Standard is not applicable to:

a) open-end spun yarns;

b) false twist and self twist yarns;

c) air-jet yarns;

d) yarns that stretch more than 0,5 % when the tension increases from 0,5 cN/tex to 1,0 cN/tex.

NOTE Such yarns may be tested under special conditions of tension which are accepted by all parties interested in the test results.

e) yarns that are too large to permit their being placed in the clamps of testing apparatus without crushing or distortion severe enough to affect the test results.

The method is designed primarily for yarns in packages, but by the application of special precautions the procedures can be used for yarns taken from fabrics.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2:1973, *Textiles — Designation of the direction of twist in yarns and related products*

ISO 139:1973, *Textiles — Standard atmospheres for conditioning and testing*

ISO 2060:1994, *Textiles — Yarn from packages — Determination of linear density (mass per unit length) by the skein method*

EN 12751, *Textiles — Sampling of fibres, yarns and fabrics*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
twist
number of turns about the axis of a yarn based on its nominal gauge length before untwisting

NOTE Twist should preferably be expressed as turns per metre (turns/m).

3.2
gauge length
distance between two effective clamping points of the test specimen mounted in the testing equipment

3.3
initial length
length of a test specimen under a specified pretension at the beginning of a test

3.4
moisture equilibrium for testing
that state reached when the rate of increase in mass of a sample or specimen in a specified (test) atmosphere does not exceed that prescribed for the material being tested

(See ISO 139.)

NOTE A textile material is in moisture equilibrium with the ambient atmosphere when it does not exchange water with this atmosphere; its mass then remains constant as long as the experiment is carried out in an unchanged atmosphere.

3.5
yarn package
length or lengths of yarn in a form suitable for use, handling, storing or shipping

NOTE Packages may be comprised of unsupported yarn, such as balls and skeins, or supported yarn, such as cakes, bobbins, cops, cones, pirns, spools, tubes or beams.

3.6
twist factor
measure of the spiralling orientation of the fibres in a spun yarn or of the filaments in a filament yarn

NOTE It is related to the angle that fibres on the surface of the yarn make with the axis of the yarn and is a measure of the hardness of the resulting yarn due to twist.

4 Principle

4.1 General

The untwist/retwist method is an indirect method for determining twist. It involves untwisting a specimen and then retwisting it in the opposite direction until it has regained its initial length. It is assumed that the number of turns inserted during retwisting is equal to the initial twist of the specimen and that consequently, half the number of turns recorded on the counter represents the twist of the specimen.

The untwist/retwist method is very sensitive to the pretension used, therefore two methods are proposed: the generally-used method A and a double method B which is less sensitive to inaccuracies in pretension and therefore gives more reliable accurate results. Method B is, however, more time-consuming than method A and it is therefore recommended mainly for automatic twist testers.

4.2 Method A — Single method

Specimens are tested according to the principle described in 4.1.

4.3 Method B — Double method

An initial specimen is tested as described in 4.1. A second specimen is tested by untwisting to a quarter of the turns obtained on the initial specimen, then retwisting back to the initial length to correct for errors caused by pretensioning.

4.4 Comparison of methods

The untwist/retwist method, whether A or B, is used for acceptance testing for economic reasons because it requires less testing time and fewer specimens than the reference direct-counting method. The accuracy of the untwist-retwist method, especially of method B, is good, that is, the results are comparable to those of the direct method, provided appropriate pretension and extension control limits have been utilized.

If there is disagreement arising from differences in values reported by the purchaser and the seller when the untwist/retwist method is used for acceptance testing, then the statistical bias, if any, between the laboratory of the purchaser and that of the seller should be determined; each comparison shall be based on test specimens randomly drawn from one sample of material of the type being evaluated.

The "setting" of twist in some fibres 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 pre-tensioning load; but this increases the danger of stretching the yarn. Little information is available on the correct tensions to use, either for yarns made from different fibres or with different amounts of twist.

The untwist/retwist method can be useful where the 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 the results of the untwist/retwist method with the results of the reference direct method could be used to determine the correct pre-tension.

5 Apparatus

5.1 **Twist counter** or **twist tester**, consisting of a pair of clamps, one of which is rotatable in either direction and positively connected to a revolution counter.

The tests are carried out preferably on a motorized twist tester with a speed of 1 000 turns/min ± 200 turns/min.

The position of one clamp (or both clamps) shall be adjustable to accommodate specimens having the length prescribed in 8.1. The tester shall be provided with a variable tensioning device so constructed that a specific load 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 Standard atmosphere

The atmosphere for conditioning and testing shall be as specified in ISO 139. The procedure for conditioning shall follow ISO 139. Preconditioning is not necessary.

The amount of twist is not directly affected by changes in relative humidity, but since wide changes in humidity cause changes in length of some materials, all determinations shall be made after conditioning the sample for at least 24 h in the appropriate standard atmosphere.

7 Sampling

Samples shall be taken in one of the following ways:

a) according to directions, if any, given in the material specification;

b) according to EN 12751 if directions on sampling are not included in the material specification;

c) according to the method given in annex A, if neither a) nor b) is applicable.

Bulk samples shall be taken as directed in A.1.

Packages of the laboratory sample shall be taken from the bulk sample as directed in A.2.

8 Test Specimens

8.1 Length

The initial length of the specimen shall be 500 mm ± 1 mm.

8.2 Selection

8.2.1 The test specimens shall be taken at the lowest tension practicable, in the manner in which the yarn would normally be taken from the package during subsequent processing (i.e. by unrolling from the side of the package). The few metres of yarn at the beginning and, if relevant, at the end of package shall be discarded in order to avoid damaged sections.

8.2.2 If two or more test specimens are taken from an individual yarn package, they shall be taken at random intervals of at least 1 m in order to minimize the effects of cyclic variation introduced during manufacture. If more than two specimens are taken from an individual package, take groups of specimens, not more than five to a group, at intervals of several metres.

8.2.3 For woven fabrics, take warp specimens from separate ends, since each represents a separate package. Because the fabrics may have been woven on any of a variety of looms which are either random quilling (traditional), sequential quilling or shuttleless, take weft specimens at random through the whole laboratory sample to obtain data as representative as possible. If a strip 2 m long is used as a source of specimens, this procedure will usually provide specimens from several different bobbins of weft yarns.

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

8.2.5 In warp-knit fabrics, it is, in most cases, impossible to unravel specimens with the necessary length. Therefore, the untwist/retwist method is usually not applicable.

8.3 Number of test specimens

8.3.1 Take the number of specimens required in the material specification, when applicable.

8.3.2 In the absence of material specification, take a number of specimens such that the user may expect at the 95 % probability level that the test results are not more than 5 % of the average above or below the true average of the lot. Determine the number of specimens for each lot sample as follows.

a) Reliable estimate of v: when there is a reliable estimate of v based upon extensive past records for similar materials tested in the user's laboratory as directed in the method, calculate the required number of specimens using equation (1):

$$n = \left(t^2 \times v^2\right) / A^2 = 0{,}154\, v^2 \quad (1)$$

where

n is the number of specimens (rounded upward to a whole number when n is less than 50 or to a multiple of five when n is 50 or more);

t = 1,96, the value of Student's t for infinite degrees of freedom, two-sided limits, and a 95 % probability level (t^2 = 3,842);

v is the reliable estimate of the coefficient of variation of individual observations on similar materials in the user's laboratory under conditions of single-operator precision;

A = 5 % of the average, the value of the permissible variation, and 0,154 is calculated by t^2/A^2.

b) No reliable estimate of v: when there is no reliable estimate of v for the user's laboratory, equation (1) shall not be used directly. Instead, specify a fixed number of 16 specimens. This number of specimens is calculated using v = 10,5 % of the average which is a somewhat larger value of v than is usually found in practice. When a reliable estimate of v for the user's laboratory becomes available, equation (1) will usually require fewer than 16 specimens.

9 Procedure 1 — Determination of direction of twist

Hold one end of the yarn in such a position that a short length (at least 100 mm) is suspended in a vertical position. Examine the vertical section of the yarn and determine if the slope of the yarn elements (fibres) conforms to the slope of the central portion of the letters "S" or "Z". Designate the direction of twist as "S" or "Z" as observed, in accordance with ISO 2.

10 Procedure 2 — Determination of amount of twist

10.1 Preliminary procedure — Determination of permissible extension

This parameter shall be determined separately for each lot of yarn, using specimens conditioned in a standard atmosphere.

For quality control of production, it is possible, however, to establish internal reference values.

— set the specimen length at 500 mm;

— determine linear density in accordance with ISO 2060;

— adjust the pre-tension to 0,50 cN/tex ± 0,10 cN/tex;

— fasten the specimen in the grip of the moving part;

— fasten the specimen in the rotating grip, setting the pointer at zero;

— turn the grip at 800 turns/min or more slowly if slippage is not distinct;

— read the value of slippage at the moment of breakage to within ± 1 mm;

— if the yarn does not break, take the extension corresponding to the maximum extension attained before retwisting in the opposite direction;

— carry out five tests in this way and calculate the mean;

— position the stop in order to have tolerated extension equal to 25 % of this value of slippage.

10.2 Selection of pretension

10.2.1 All spun yarns except worsted yarns

A pretension of 0,50 cN/tex ± 0,10 cN/tex shall be used.

10.2.2 Worsted yarns

Select the pretension as a function of the twist factor α.

— $\alpha < 80$: 0,10 cN/tex ± 0,02 cN/tex

— $80 \leqslant \alpha \leqslant 150$: 0,25 cN/tex ± 0,05 cN/tex

— $\alpha > 150$: 0,50 cN/tex ± 0,05 cN/tex

NOTE In special cases when the measured twist is higher or lower than the known inserted twist on the spinning machine, it is to recommend to make some preliminary tests at higher pretensions. The determination of twist shall be carried out at the determined pretension.

10.3 Procedure of the untwist/retwist test

10.3.1 Method A — Single method

— set the specimen length at 500 mm ± 1 mm;

— remove and discard a length of 2 m to 3 m of yarn;

— taking care not to disturb the twist, fasten the specimen in the grip of the moving part;

— insert the specimen in the rotating grip under the prescribed pretension, adjust its length by moving the pointer to zero, then tighten the grip;

— untwist the yarn at a speed of 1 000 turns/min ± 200 turns/min, then retwist it in the opposite direction until the pointer returns to zero;

— note the counter reading which represents the twist expressed in turn/m;

— remove about 1 m of yarn between two successive specimens.

10.3.2 Method B — Double method

— follow the complete procedure described in 10.3.1 but do not reset the counter to zero;

— take a second specimen and mount it in the grips as described above;

— untwist the yarn at a speed of 1 000 turns/min ± 200 turns/min but only until reaching a quarter of the twist (nominal, or as determined by preliminary tests), then twist back until the pointer returns to zero;

— note the counter reading which represents the twist expressed in turns/m;

— repeat the above two-specimen procedure until the required number of tests has been performed;

— remove about 1 m of yarn between successive specimens.

11 Calculations

11.1 General

The specimen length is 500 mm, therefore, the counter reading corresponds directly to the value of the twist expressed in turns per metre.

11.2 Average twist per sample

Calculate the average twist per sample, in turns/m, using the formula:

$$\overline{t_x} = \frac{\sum t_x}{n}$$

where

$\overline{t_x}$ is average twist of the sample;

$\sum t_x$ is the sum of the twist in all test specimens;

n is the number of test specimens.

11.3 Variation of observations

If the coefficient of variation and 95 % confidence interval of the twist are desired, they shall be calculated by standard statistical methods.

11.4 Twist factor (a)

If desired, the twist factor can be calculated, as follows:

$$\alpha = t\left(\frac{T}{1000}\right)^{1/2}$$

where

a is the twist factor;

t is the twist, in turns per metre;

T is the linear density, expressed in tex.

12 Test report

The test report shall state that the tests were performed in accordance with this International Standard and shall indicate which of any alternative or optional requirements have been met. In addition, it shall give the following information, depending on the type of yarn.

a) identification of material;

b) date of test;

c) apparatus used;

d) form of the material sample (yarn package, warps, fabrics);

e) sampling scheme used;

f) number of specimens examined;

g) length of the test specimens, in millimetres;

h) pretension used;

i) for each package, the mean twist in turns per metre and the coefficient of variation in percent, if required;

j) for all packages, the mean twist in turns per metre and the coefficient of variation in percent;

k) 95 % confidence interval (with appropriate dimension) if required;

l) direction of twist, “S” or “Z”, in the yarn;

m) twist factor, if required;

n) details of any deviation from the specified procedures.