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Textiles — Determination of twist in yarns — Direct counting method

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FOREWORD

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Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2061 was drawn up by Technical Committee ISO/TC 38, *Textiles*.

It was approved in December 1970 by the Member Bodies of the following countries :

Chile	Italy	Spain
Czechoslovakia	Japan	Sweden
Denmark	Korea, Rep. of	Switzerland
Finland	Netherlands	Thailand
France	New Zealand	Turkey
Germany	Norway	United Kingdom
Greece	Poland	U.S.A.
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India	Romania	
Israel	South Africa, Rep. of	

The Member Body of the following country expressed disapproval of the document on technical grounds :

Belgium

Textiles — Determination of twist in yarns — Direct counting method

1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard specifies a method for the determination of the direction of twist in yarns, the amount of twist in terms of turns per unit length and change in length on untwisting, by the direct counting method.

NOTE — Determinations based on the untwist-twist procedure are not recommended since they may reflect appreciable errors under some conditions due to a lack of knowledge of the proper tensions to use. However, the untwist-twist procedure is sometimes preferred for spun yarns, but its use should be the result of prior agreement between the parties concerned.

1.2 This method¹⁾ is applicable to

- a) single yarns (spun or multifilament);
- b) folded (plied) yarns;
- c) cabled yarns.

Separate procedures are given for each type of yarn. The method is designed primarily for yarns in packages, but with special precautions the procedures can be used for yarns taken from fabrics. It is not suitable for the determination of twist in a monofilament.

1.3 This method is not applicable, except by agreement, to yarns which stretch more than 0.5 % when the tension increases from 0.5 to 1.0 centinewtons per unit linear density of the yarn in tex. Such yarns may be tested under special conditions of tension which are accepted by all parties interested in the test results.

1.4 This method is not suitable for products of open-end spinning.

1.5 This method is not applicable to yarns which are too large to permit of their being placed in the clamps of the testing apparatus without crushing or distortion severe enough to affect the test results.

1.6 The method covers the determination of twist in plied and cabled yarns as follows :

In plied yarns — the final twist of the plied yarns and the original twist of the single yarn before plying.

In cabled yarns — a) the final cabling twist of the yarn;

- b) the original twist of the plied yarn after plying, but prior to the last stage of processing;
- c) the twist of the single yarn before plying.

1.7 If desired, the twist of the single and plied yarn components as they lie in the final structure may be determined by the special procedure given in 10.5.7.

2 REFERENCES

ISO/R 2, *Designation of the direction of twist in textile yarns and related products.*

ISO/R 139, *Standard atmospheres for conditioning and testing textiles.*

3 DEFINITIONS

3.1 twist : The turns about its axis, existing in a yarn based on the nominal gauge length before untwisting. Twist should be expressed preferably as

turns per metre — turns/m, but it may be expressed as

turns per centimetre — turns/cm.

3.2 twist, direction of : The direction of twist in yarns and other textile strands is indicated by the capital letters "S" and "Z". See ISO/R 2 for full definitions.

3.3 change in length on untwisting : The increase or decrease in length observed when the specimen is untwisted, expressed as the percentage extension, or contraction, based on the specimen length between the clamps before removal of the twist.

3.4 moisture equilibrium for testing : 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. For test purposes, moisture equilibrium must be reached by absorption, starting from a relatively low moisture content. Moisture equilibrium for testing is considered as having been reached when the rate of increase in mass of a sample or specimen does not exceed that prescribed for the material being tested. (See ISO/R 139.)

1) See also ISO/R 1890, *Textile glass — Determination of the twist in textile glass continuous filament yarns and staple fibre yarns*, which was prepared especially for the needs of glass textile technology.

3.5 yarn package : A length or lengths of yarn in a form suitable for use, handling, storing, or shipping. Packages may be unsupported such as balls or supported such as skeins or cakes, bobbins, cops, cones, pirns, spools, tubes or beams.

4 PRINCIPLE

Removal of the twist in a known length of yarn by rotating one end of the specimen with respect to the other until the components of the yarn being tested are parallel. Reporting the exact number of turns required to remove the twist in terms of turns per unit length.

5 APPARATUS

5.1 Twist counter

5.1.1 A twist counter consisting of a pair of clamps, one of which is rotatable in either direction and positively connected to a revolution counter. The position of one or both clamps must be adjustable to permit testing yarn lengths from 10 to 500 mm. There must be no play in the clamp which might affect the gauge length. Means must be provided for applying tension to the specimen and for rapidly determining the specimen length with an accuracy of ± 0.5 mm or $\pm 2\%$, whichever is the smaller. The limit of 2% is consistent with the highest accuracy required in counting the number of turns in the specimen. The counting device shall be capable of recording the number of revolutions of the rotatable clamp.

5.1.2 In addition to the above, whenever it is desired to measure the contraction or extension of the untwisted specimen, the movable but non-rotatable clamp must be capable of being traversed with substantially no friction.

5.2 Dissecting needle.

5.3 Means for magnifying the specimen being tested.

5.4 Equipment for producing and maintaining the standard atmosphere for testing in the laboratory.

5.5 Equipment for reeling laboratory sample skeins, if desired.

6 STANDARD ATMOSPHERE

6.1 The standard atmospheres for conditioning and testing are those defined in ISO/R 139.

6.2 The amount of twist is not affected directly by changes in relative humidity, but since wide changes in humidity cause changes in length of some materials, it is desirable to make all determinations on samples in equilibrium with the appropriate standard atmosphere.

6.3 Generally it is not necessary to pre-condition samples before conditioning for twist tests.

7 SAMPLES

7.1 Samples shall be taken in one of the following ways :

- a) according to directions, if any, given in the material specification;
- b) according to procedures approved by ISO for textile products, if directions on sampling are not included in the material specification;
- c) according to the method given in Appendix Z, if neither a) nor b) is applicable.

7.2 The bulk sample shall be taken as directed in Z.1 of the Appendix.

7.3 The laboratory sample packages shall be taken from the bulk sample as directed in Z.2 of Appendix Z.

8 SPECIMENS

8.1 Length

8.1.1 Single spun yarns

The length of the specimen between the clamps shall be as great as possible but shall be somewhat less than the average length of the staple fibre used to spin the yarn.

The lengths of specimens listed in Table 1 are commonly used :

TABLE 1 — Specimen lengths

Material	Specimen length
	mm
Cotton-type yarns	10 and 25
Worsted-type yarns	25 and 50
Woollen-type yarns	25 and 50
Best fibre-type yarns	100 and 250

8.1.2 Single multifilament yarns

Take a length of 250 mm or 500 mm for each specimen.

8.1.3 Folded and cabled yarns

Take a length of 250 mm or 500 mm for each specimen.

8.2 Selection

8.2.1 Specimens shall be taken, at the least tension practicable, from the end of the package if this is the normal method of use; otherwise, take the yarn from the side of the package. Discard the few metres of yarn at the beginning and end of the package in order to avoid damaged sections.

NOTE — If it is desired to reel laboratory sample skeins, the yarn shall be taken as specified in 8.2.1 and shall be representative of the original package.

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

8.3 Number of 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 designed to give the precision specified below, following the directions given in 8.3.3 or 8.3.4, depending on the information available about the variability of twist in the production being tested.

8.3.3 If information on variability is available, take a number of specimens, n , calculated by the formula given in Table 2, to secure the precision specified at a probability of 95 %.

8.3.4 If no information on variability is available or in the case of dispute, take the number of specimens, n , specified in Table 3, which also indicates the variability assumed to calculate n .

9 PROCEDURE 1 — 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, filaments or component yarns) conforms to the slope of the central portion of the letters "S" or "Z". Note the direction of twist as "S" or "Z" as observed.

TABLE 2 — Number of specimens, using information on variability

Type of yarn	Range of twist	Precision	Formula for n
Single multifilament	less than 40 turns/m	± 4.0 turns/m	$0.240 \sigma^2$
Single multifilament	40 to 100 turns/m	± 5.0 turns/m	$0.154 \sigma^2$
All other yarns	—	$\pm 5 \%$	$0.154 \nu^2$

where

σ is the standard deviation of individual results, determined from extensive past records on similar material;

ν is the coefficient of variation of individual test results, determined from extensive past records on similar materials.

TABLE 3 — Number of specimens, in the absence of information on variability

Type of yarn	Range of twist	n	Assumed variability
Single, spun	All	100	$\nu = 25 \%$
Single, multifilament	less than 40 turns/m	15	$\sigma = 8.0$ turns/m
Single, multifilament	40 to 100 turns/m	15	$\sigma = 10.0$ turns/m
Single, multifilament	more than 100 turns/m	10	$\nu = 8 \%$
Folded yarns and cabled yarns	All	10	$\nu = 8 \%$

NOTE — The values for σ and ν assumed to calculate n in Table 3 are somewhat higher than will usually be found in practice. As a consequence, the formulae specified in Table 3 will in most cases give a lower number of specimens.

10 PROCEDURE 2 – AMOUNT OF TWIST

10.1 Initial preparation

Bring the laboratory sample packages, or the laboratory sample skeins reeled from the packages, to equilibrium in the standard atmosphere for testing. Expose the sample to the appropriate standard atmosphere for testing for 24 h or until there is no progressive change in mass greater than 0.1 % in successive exposures of at least 30 min duration. Take care, when unwinding and handling the samples, to avoid any change in the original twist. Unwind the yarn over the end or from the side of the package, as in normal use of the package and at the least practicable tension. Unwind and discard approximately 5 m of yarn before taking the first specimen. Mount the specimen in the clamps before cutting it free from the package. If additional specimens are to be taken from the package, hold the free end in a stationary clip or clamp, or under a weight, to prevent loss of twist.

10.2 Single, spun yarn

10.2.1 Set the movable clamp at the distance specified for the nominal staple length of the fibres in the spun yarn being tested ± 0.5 mm (8.1.1). Remove any lateral play in the clamps which might significantly affect the gauge length of the specimen. Verify the nominal gauge length by measuring the clamp separation with an accurate gauge or caliper. Set the twist counter to zero.

10.2.2 Taking care not to disturb the twist, mount the specimen in the clamps under a pre-tension equivalent to 0.5 ± 0.1 cN/tex.

NOTE – If it is desired to test yarns which extend 0.5 % or more under the specified tension, they must be subjected to a pre-tension which produces an extension not greater than 0.5 %. The pre-tension used in these exceptional cases shall be reported and shall be agreed to by all persons interested in the test results.

10.2.3 Remove the twist by turning the rotatable clamp until it is possible to pass a needle from the face of the non-rotatable clamp to the face of the rotatable clamp between the untwisted fibres. Use a means of magnification, if necessary, to make sure that all the twist has been removed.

10.2.4 Note the direction of twist as indicated on the twist counter. Be sure it checks the direction determined by inspection of the specimen. (See section 9.)

10.2.5 Record the initial length, the direction of twist and the number of turns (to the accuracy specified in 5.1) in the specimen.

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

10.3 Single, multifilament yarns

10.3.1 Set the clamps at a distance of 250 mm (or by agreement 500 mm) ± 1.0 mm. Remove any lateral play in the clamps that might significantly affect the gauge length of the specimen. Verify the nominal gauge length of the specimen by measuring the clamp separation with an accurate gauge or caliper. Set the counter to zero.

10.3.2 Proceed as directed for single spun yarns in 10.2.2, 10.2.3 and 10.2.4.

10.3.3 Record the initial length, the direction of twist and the number of turns (to the accuracy specified in 5.1) in the specimen.

10.3.4 When information on change in length on untwisting is desired, release the mechanism fixing the movable clamp and determine the length of the original components after untwisting and under the original tension. Note the change in length.

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

10.4 Folded yarns

10.4.1 Determine the folding twist by the procedures given for single, multifilament yarns in 10.3.1, 10.3.2 (i.e. 10.2.2, 10.2.3 and 10.2.4), 10.3.3 and 10.3.4.

10.4.2 After removing the folding twist, cut loose and remove all but one (see Notes below) of the component yarns to obtain an individual end of the single yarn.

NOTES

1 The directions given in 10.4.2 assume that all components of the original yarn have the same direction and amount of twist. If this is not known, it must be verified. If any difference in kind exists, each component yarn must be tested and reported separately.

2 If the component yarns are spun yarns, additional specimens will be required, and it is desirable to save the cut away strands without loss of twist to secure the additional specimens.

10.4.3 If the single yarn component has been spun from staple fibres, determine the twist in the single yarn as directed under 10.2 et. seq., but if the single yarn component is multifilament, determine the twist as directed under 10.3 et. seq.

10.4.4 When information on change in length on untwisting is desired, release the mechanism fixing the movable clamp and determine the length of the original components after untwisting and under the original tension. Note the change in length.

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

10.5 Cabled yarns

10.5.1 Determine the cable twist as directed for single multifilament yarns in 10.3.1, 10.3.2 (i.e. 10.2.2, 10.2.3 and 10.2.4), 10.3.3 and 10.3.4 to obtain the total number of turns of hawser or cable twist in the specimens.

10.5.2 After removing the cable twist, cut loose and discard all but one of the component yarns to obtain an individual strand of folded yarn. Note the length under the original tension and determine the folding twist as directed for multifilament yarns in 10.3.1, 10.3.2, 10.3.3 and 10.3.4 to obtain the total number of turns of the folded yarn component (see Note 1, 10.4.2).

10.5.3 Cut loose and remove all but one of the component yarns to obtain an individual single yarn (see Notes, 10.4.2).

10.5.4 If the single yarn has been spun from staple fibres, determine the single yarn twist as directed under 10.2 et. seq., but if the single yarn is multifilament, determine the single yarn twist as directed under 10.3 et. seq.

10.5.5 When information on change in length on untwisting is desired, release the mechanism fixing the movable clamp and determine the length of the original components after untwisting and under the original tension. Note the change in length.

10.5.6 Repeat the procedure until the required number of specimens has been tested.

10.5.7 If it is desired to determine the final twist in the single and folded yarn components, all strands shall be cut free from the original specimen except for the component to be tested. The strands remaining in the clamps may be tested as directed for spun or single filamentous yarns in 10.2 or 10.3.

11.1.2 Compute and report the amount of twist separately for all components of folded yarns or cabled yarns.

11.1.3 If desired, the increase or decrease in length during untwisting may be measured and reported as a percentage of the length before removal of the twist for multifilament, folded, or cabled yarns.

11.2 Calculation

11.2.1 Average twist per specimen, in turns per metre,

$$= \frac{\text{total number of turns observed in the specimen} \times 1000}{\text{length of the specimen before untwisting, in millimetres}}$$

11.2.2 Average twist per sample

$$= \frac{\text{sum of the calculated twist in all specimens}}{\text{number of specimens}}$$

11.3 Variability of observations

If desired, the coefficient of variation of the twist shall be calculated by standard statistical methods.

11.4 Change in length on untwisting

If desired, the change in length shall be calculated according to the following formula and reported as extension or contraction :

Extension or contraction on untwisting, in per cent,

$$= \frac{\text{difference in length between twisted and untwisted specimen}}{\text{length of twisted specimen}} \times 100$$

Values calculated for yarns spun from short fibres are considered too unreliable to be reported.

11 CALCULATION OF RESULTS

11.1 Units

11.1.1 Report the amount of twist in all yarns as

- a) turns per metre, preferably or
- b) turns per centimetre.

12 TEST REPORT

The test report shall state that the tests were performed in accordance with this International Standard and should 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 :

12.1 Single yarns

- a) for each package, the average twist in the yarn, in turns/m or turns/cm;
- b) for all packages, the average twist in the yarn in turns/m or turns/cm;
- c) the direction of twist in the yarn, "S" or "Z";
- d) the average change in length¹⁾ after removal of the twist, in per cent (multifilaments yarns only);
- e) the form of the material sampled (yarn packages, warps, fabrics);
- f) the sampling scheme used;
- g) the number of specimens examined;
- h) the average length of the test specimens, in millimetres;
- i) the pre-tension used;
- j) the coefficient of variation of twist¹⁾ in each yarn, in per cent.

12.2 Folded yarns

- a) for each package, the average folding twist, in turns/m or turns/cm;
- b) for all packages, the average folding twist in turns/m or turns/cm;
- c) for each package, the average single yarn twist, in turns/m or turns/cm (specify, if after processing);

- d) for all packages, the average single yarn twist in turns/m or turns/cm (specify, if after processing);
- e) the direction of each twist "S" or "Z";
- f) the average change in length after removal of each twist, in per cent, and items 12.1e) to 12.1j).

12.3 Cabled yarns

- a) for each package, the average cable twist, in turns/m or turns/cm;
- b) for all packages, the average cable twist in turns/m or turns/cm;
- c) for each package, the average folding twist, in turns/m or turns/cm (specify, if after final processing);
- d) for all packages, the average folding twist, in turns/m or turns/cm (specify, if after final processing);
- e) for each package, the average single yarn twist, in turns/m or turns/cm (specify, if after final processing);
- f) for all packages, the average single yarn twist in turns/m or turns/cm (specify, if after final processing);
- g) the direction of each twist, "S" or "Z";
- h) the average change in length¹⁾ after removal of each twist, in per cent, and items 12.1e) to 12.1j).

1) If this characteristic has been specified.

APPENDIX Z

SUGGESTED PROCEDURE FOR SAMPLING

Z.1 Bulk sample (Number of cases from a shipment or lot)

Take a bulk sample of one or more cases as representative of the lot to be tested, according to Table 4 :

TABLE 4 – Bulk sample

Number of cases in shipment or in lot	Minimum number of cases to be selected at random
3 or less	1
4 to 10	2
11 to 30	3
31 to 75	4
76 or more	5

Take care that none of the cases selected for sampling shows signs of damage or dampness incurred during transit.

Z.2 Number of laboratory sample packages

In the absence of material specification, take ten yarn packages from the bulk sample, taking as nearly as possible the same number of packages from each case. Take packages at random from the top, middle and bottom layers in the cases and from the middles and the sides of the layers. Take, as nearly as possible, the same number of specimens from each package of the laboratory sample.

NOTE — If it is desired to sample woven or knitted fabrics, the sample must be large enough to furnish a sufficient number of test specimens. The test specimens shall be taken in such a manner that the twist of the yarns is not changed during sampling. When yarns in a woven fabric are to be tested, warp specimens shall be taken from different ends and weft yarns shall be taken so as to represent as many cops or pirns as practicable. The specific sampling procedure shall be reported.