INTERNATIONAL STANDARD

ISO 6939

Second edition
1988-10-15

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
ORGANISATION INTERNATIONALE DE NORMALISATION
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Textiles — Yarns from packages — Method of test for breaking strength of yarn by the skein method

Textiles — Fils sur enroulements — Détermination de la résistance de rupture d'un fil par la méthode de l'échevette

Reference number
ISO 6939 : 1988 (E)

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.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 6939 was prepared by Technical Committee ISO/TC 38, *Textiles.*

This second edition cancels and replaces the first edition (ISO 6939 : 1982), of which it constitutes a minor revision.

Annex A forms an integral part of this International Standard.

Printed in Switzerland

Introduction

The skein method of testing yarn strength was developed very early in the history of textile testing. Within recent decades the skein method has been supplanted to a large extent by the single strand method, especially since the development of automatic single strand strength testing machines. However, the skein test is still widely used in some countries for some types of yarn.

This method is not intended to substitute for the measurement of breaking strength by the single strand method (ISO 2062). It is intended to provide an additional method for measurement of yarn strength since the single strand method is costly, time consuming and relatively difficult to control precisely in industrial situations. It is particulary important when yarn is received as raw material that breaking strength be determined quickly. This method provides a means of comparative measurement of yarn strength which can be very useful in plants which spin yarn and manufacture fabrics.

This method is not recommended as a reference test method. The skein method is essentially comparative when tests are made on similar yarns. It is useful in control programmes in which yarns made from the same fibre are tested periodically and it is important that test conditions are as near identical as possible.

Results from tests between laboratories have shown that a correlation exists between the tenacity of yarn measured by the skein method and tenacity measured by the single strand method. It should be noted that the tenacity of a yarn measured in skein form is always less than tenacity obtained by the single strand method. The average skein strength depends not only on the strength of individual yarns, but also on breaking elongation, coefficient of variation of breaking elongation, the initial modulus of each strand, and yarn-to-yarn cohesion.

Details of a sampling procedure are given in annex A.

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Textiles — Yarns from packages — Method of test for breaking strength of yarn by the skein method

1 Scope

This International Standard specifies a method for the determination of the breaking strength of yarn by the skein method.

It is applicable to spun single and folded yarns of any fibre or mixture of fibres manufactured by any spinning system.

It is not recommended for testing filament yarns; for testing glass yarns; for more complex structures such as cabled yarns or cords; for yarns that stretch more than 5 % when the tension increases from 0,5 cN to 1,0 cN per unit of linear density of the yarn in tex; nor is it applicable to those yarns having a diameter so great as to prevent the winding of the skein in two even layers.

With suitable precautions as to skein circumference and the tension used in reeling, the skeins broken in this test may be used for the determination of linear density.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO 2060 : 1972, *Textiles — Yarn from packages — Determination of linear density (mass per unit length) — Skein method.*

ISO 2062 : 1972, *Textiles — Yarn from packages — Method for determination of breaking load and elongation at the breaking load of single strands (CRL, CRE and CRT testers).*

3 Definitions

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

3.1 breaking strength: The maximum tensile force observed during a test in which the specimen is stretched until it breaks.

3.2 skein: A continuous strand of yarn in the form of a flexible coil having a large circumference in proportion to its thickness.

3.3 test skein: A small skein which has a prescribed length of yarn and is used in this International Standard for the determination of linear density or breaking strength or both; also called a lea or numbering skein.

3.4 tenacity: The ratio of the breaking strength to the linear density of the unstrained specimen, usually expressed in centinewtons per tex.

3.5 skein breaking tenacity: The maximum tensile stress developed in a test skein before rupture, expressed in force per unit linear density of the yarn; for example, centinewtons per tex.

4 Principle

A test skein is broken on a tensile testing machine and the breaking strength is observed.

If the linear density is required for the calculation of skein breaking tenacity, the broken skein may be weighed and the linear density calculated according to ISO 2060.

5 Apparatus

5.1 Reel: a hand- or motor-driven reel, having a perimeter of 1 m. This reel shall be fitted with a traversing mechanism that will space the yarn evenly on the reel in not more than two layers, and an indicator of the length wound. A warning bell or an automatic cutoff that will operate at the specified number of turns is desirable. If linear density is to be determined from the same skeins, refer to ISO 2060 for additional reel specifications.

NOTE — Existing reels with perimeters other than 1 m may be used, if mutually agreed and, if used, this should be reported.

5.2 Yarn package holders: vertical spindles for bobbins or cones (usually provided as an integral part of the reel); shafts on which tubes or flanged spools can turn freely; heavy supports for beams.

5.3 Tensile testing machine: a constant-rate-of-traverse or constant-rate-of-extension testing machine of sufficient capacity to break the test skeins and capable of operating so that the

moving clamp has a uniform speed of 300 mm/min ± 10 mm/min, or is capable of operating at such a rate that the skein is broken in an average time of 20 s ± 3 s from the start of application of load to the skein. The option selected shall be by agreement of all parties and shall be stated in the report of test results. The indicated load shall be accurate to within ± 1,0 % in the range used for the tests. If an autographic load-recording device is used, its maximum pen speed shall be at least double the rate at which the load on the skein increases at the steepest part of the curve. The machine shall be equipped with spools 25 mm to 32 mm in both diameter and length, so supported that at least one spool can turn freely on its axis. The distance between the spools shall be sufficient to permit placing the skeins on the spools in a wide, flat band.

5.4 Skein holder or **skein rack,** having parallel pegs or bars placed a sufficient distance apart to hold the skeins extended to nearly their full length, without either stretching the yarn or allowing kinking which would cause entanglement.

6 Atmospheres for pre-conditioning, conditioning and testing

The atmospheres for pre-conditioning, conditioning and testing shall be those defined in ISO 139.

7 Sampling

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

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

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 annex A if neither a) nor b) is applicable.

7.2 The bulk sample shall be taken in such a manner that it is representative of the lot to be tested. The laboratory sample shall be selected from the bulk sample in a representative manner.

7.3 Reel one laboratory sample skein from each laboratory sample package, using the lowest tension practicable. The skeins shall be long enough to provide yarn for all tests required.

7.3.1 For yarns on bobbins, cops, cones, or similar packages where the yarn is normally unwound overend, draw the yarn off over the end of the package at a rotational frequency between 100 min^{-1} and 300 min^{-1} of the reel.

7.3.2 For yarns on flanged spools or other packages normally unwound from the side, mount the packages so as to turn freely, and draw the yarn from the side of the package at a rotational frequency of 20 min^{-1} to 30 min^{-1} of the reel.

7.3.3 When several ends are wound parallel on a single package, draw each end through a separate guide, and reel a skein from each end.

7.3.4 If the yarn is received in skein form, mount it on an umbrella reel or swift, and reel at a speed of 20 min^{-1} to 30 min^{-1}.

7.3.5 When the yarn is on beams, prepare the yarn in the following manner:

Place the beam containing the yarn to be tested on two bearings high enough so that the flanges of the beam clear the floor. Attach a crank arm to one end of the beam shaft. Place the reel a convenient distance from the beam and in such a position that the yarn is not drawn sidewise at an angle of more than 20 degrees. Fasten the required number of ends from the beam to the reel. Let one operator turn the beam slowly to unwind the yarn while a second operator turns the reel fast enough to take up the yarn as it comes from the beam.

NOTE — The single strand method of yarn strength testing given in ISO 2062 may be more appropriate and easier to employ for yarn on beams.

7.4 Condition the laboratory sample skeins as follows:

7.4.1 If linear density is to be determined, pre-condition the laboratory sample skeins by exposing them to freely moving air in the special atmosphere for pre-conditioning for a minimum of 4 h.

7.4.2 After pre-conditioning, or for yarns on which linear density is not to be measured, bring the skeins to moisture equilibrium for testing by exposing them 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.

7.5 The number of specimens to be tested shall be as follows:

7.5.1 Test one skein per yarn package. In the absence of other specifications or agreement, choose a number of yarn packages that will give a precision of the mean of 4 % at a probability level of 90 % (see the note). Calculate the number of test specimens according to the equation

$$n = 0{,}17\ v^2$$

where

n is the number of specimens;

v is the coefficient of variation of individual test results determined from past records on similar material.

NOTE — With a 90 % probability that the true mean of the lot is within ± 4 % of the test average, there is a 5 % probalility that it is outside these limits on the high side and 5 % that it is out on the low side. Thus, there is a 95 % probability that the true mean is not more than 4 % below the mean of the test results.

7.5.2 If v is not known, test 10 skeins of yarns spun on the cotton or worsted system and 20 skeins of yarns spun on the woollen system. These numbers of tests are based on $v = 7{,}5$ % for yarns spun on the cotton and worsted systems and on $v = 11{,}0$ % for woollen-system yarns. These values of v are somewhat higher than will usually be found in practice. Knowledge of the v actually applicable is therefore likely to permit making fewer tests than prescribed in this sub-clause.

7.5.3 Reel at least two extra skeins for adjustment of time to break if this optional procedure is used.

8 Preparation of test skeins

8.1 Mount each conditioned laboratory sample skein on equipment to facilitate easy rotation.

8.2 Reel test skeins as follows:

8.2.1 Draw each end of yarn through a separate guide and attach to the reel. Turn the reel at a uniform rotational frequency between 100 min^{-1} and 300 min^{-1}, and maintain sufficient tension to lay the yarn smoothly on the reel.

NOTE — A maximum rotational frequency of 200 min^{-1} and a tension of 0,05 g/tex or 0,1 g/tex have been found suitable.

When the required number of turns have been reeled, tie the ends of the yarn together with a non-slipping knot. For easier separation of skeins on the rack, a loose loop may be made about the skein cross-section, and the ends once again knotted. If skein breaking tenacity is to be calculated, the method of reeling shall comply with the requirement of ISO 2060.

8.2.2 Reel 100 turns on a reel of 1 m perimeter.

9 Procedure

9.1 Perform all tests in the standard atmosphere for testing.

9.2 If constant time-to-break precedure is used, select the speed of the testing machine so that it will reach the average (or specified minimum) breaking load in 20 s ± 3 s. Break one or more preliminary skeins, and if necessary, adjust the speed so that the time to break conforms to the specified limits. If an insufficient number of skeins remain after adjustment of the speed, reel enough additional skeins to meet the requirements of 7.5 and allow them to condition before testing.

If a uniform speed of testing is used, set the testing machine so that the movable clamp traverses at 300 mm/min ± 10 mm/min.

9.3 Transfer each skein separately to the testing machine without twisting the skein or allowing it to collapse. Mount the skein in such a manner that it lies as a flat ribbon on the spools mentioned in 5.3. Break the skein and record the breaking strength to the nearest 1 N if the breaking strength is under 500 N, or to the nearest 5 N if the breaking strength is 500 N or greater. Record the time to break, if required.

NOTE — When using testing machines with autographic recording equipment, the breaking strength and time to break may be read or calculated from the chart.

9.4 If the skein breaking tenacity is to be calculated, determine the mass, in grams, of each broken skein. Calculate the yarn linear density in tex by multiplying the average mass by 10.

NOTE — Additional information on the measurement of linear density can be found in ISO 2060.

10 Calculation and expression of results

10.1 Calculate the average time to break, if constant time to break is used. If not within the prescribed limits, discard the results. After adjusting the speed of the testing machine to bring the results within the prescribed limits, repeat clauses 7, 8 and 9.

10.2 Calculate the average skein breaking strength from the observed values.

10.3 If the skein breaking tenacity is required, multiply the yarn linear density by 200 to obtain the linear density of the skein. Divide the breaking strength of the skein by its linear density to obtain the skein breaking tenacity and express the result preferably in centinewtons per tex.

11 Test report

The test report shall indicate the following particulars:

a) a reference to this International Standard;

b) the operating procedure used (300 mm/min clamp speed or time to break);

c) average skein breaking strength;

d) average time to break, if a mean time to break of 20 s has been used;

e) skein breaking tenacity, if required;

f) average linear density, if required;

g) details of any deviation from the specified test procedure.

Annex A
(normative)

Procedure for sampling

A.1 Division into lots

If there is reason to believe that the yarn to be tested is not homogeneous, divide it into test lots as follows and sample and test each lot separately.

A.1.1 Treat as a "lot" any portion that differs from the rest in specifications, put-up or physical characteristics, or that is billed or designated by the supplier as a separate lot. If case numbers are not consecutive, treat as separate lots the groups between which there are gaps as large as 25 % of the number of cases. If portions of a large order are received on different dates, or from different plants or warehouses, or in more than one car-load or truck-load, sample and test each such portion as a separate lot.

A.1.2 The purpose of this procedure is to avoid including yarns of distinctly different quality in one test lot. It will also help to ensure the acceptance of yarn that meets specifications and the rejection of sub-standard material that might otherwise be accepted by being averaged with higher quality yarn.

A.2 Bulk sample

A.2.1 Take the number of cases, cartons or other units specified in table A.1.

Table A.1

Number of cases	
In lot	**In bulk sample**
1	1
2 to 4	2
5 to 9	3
10 to 19	4
20 or more	5

A.2.2 Select the cases in such a way that they are randomly distributed, by case numbers or otherwise, over the entire lot taking care not to include damaged cases or cases that have been wet in transit.

A.3 Laboratory sample

From the bulk sample take the number of yarn packages required for the laboratory sample, taking as nearly as possible the same number of packages from each case. Take packages randomly from the top, middle and bottom layers in the case and from the middles and the sides of the layers.

UDC 677.017.42 : 677.072/.073

Descriptors : textiles, yarns, tests, tension tests, determination, break strength.

Price based on 4 pages