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Textiles — Yarns from packages — Determination of single-end breaking force and elongation at break

Textiles — Fils sur enroulements — Détermination de la force de rupture et l'allongement à la rupture du fil individuel

Reference number
ISO 2062:1993(E)

Foreword

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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.

International Standard ISO 2062 was prepared by Technical Committee ISO/TC 38, *Textiles*, Sub-Committee SC 5, *Yarn testing*.

This second edition cancels and replaces the first edition (ISO 2062:1972), which has been technically revised.

Annex A of this International Standard is for information only.

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Introduction

In the 1950s and 1960s when this International Standard was first prepared, three types of tensile tester were in wide use: constant rate of specimen extension (CRE), constant rate of travel (CRT), and constant rate of loading (CRL). It was therefore advisable to state the rate of operation in a way which would be common to all three types of tester. In addition, the best possible agreement was sought between test results of the three types of tester. Consequently, the principle of constant time to break was adopted and 20 s to break was chosen for this International Standard and also for a number of national standards.

In the early 1990s when the present revision was prepared, CRE testers were recognized as the best type, while CRT and CRL testers were quickly becoming obsolete. However, since CRT and CRL testers are still in use internationally, the procedure for using them is included in an informative annex. There is no assurance that the results from the three types of tester will agree.

This International Standard considers CRE testers only, so the time-to-break principle is no longer needed and a simpler statement of rate of displacement is used. The rate of extension of 100 % per minute is adopted as standard, but higher rates are permitted by agreement for automatic testers.

INTERNATIONAL STANDARD ISO 2062:1993(E)

Textiles — Yarns from packages — Determination of single-end breaking force and elongation at break

1 Scope

1.1 This International Standard specifies methods for the determination of the breaking force and elongation at break of textile yarns taken from packages.

Four methods are given:

— A: manual; specimens are taken directly from conditioned packages;

— B: automatic; specimens are taken directly from conditioned packages;

— C: manual; relaxed test skeins are used after conditioning;

— D: manual; specimens are used after wetting.

1.2 Method C should be used in cases of dispute regarding elongation at break of the yarn.

NOTE 1 Methods A, B and C are expected to give the same results for yarn strength but method C may give somewhat truer (and higher) values of elongation than A or B. Method D is likely to give results differing, for both breaking force and elongation at break, from those obtained by method A, B or C.

1.3 This International Standard specifies methods using constant rate of specimen extension (CRE) tensile testers. Testing on the now obsolete constant rate of travel (CRT) and constant rate of loading (CRL) instruments is covered, for information, in annex A, in recognition of the fact that these instruments are still popular and may be used by agreement.

1.4 This International Standard applies to all types of yarn except glass yarns, elastomeric yarns, aramid yarns, ceramic yarns, carbon yarns and polyolefin tape yarns.

NOTE 2 A method for the testing of glass yarns is given in ISO 3341:1984, *Textile glass — Yarns — Determination of breaking force and breaking elongation.*

1.5 This International Standard is applicable to yarns from packages but can be applied to yarns extracted from fabrics, subject to agreement between the interested parties.

1.6 It is intended for the single-end (single-strand) testing of yarns.

NOTE 3 The skein method of testing is given in ISO 6939:1988, *Textiles — Yarns from packages — Method of test for breaking strength of yarn by the skein method.*

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 indicated 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:—[1], *Textiles — Yarn from packages — Determination of linear density (mass per unit length) by the skein method.*

3 Definitions

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

1) To be published. (Revision of ISO 2060:1972)

3.1 breaking force (load): Maximum force applied to a specimen in a tensile test carried to rupture. For yarns, it is preferably expressed in centinewtons.

3.2 elongation at break: Increase in length of a specimen produced by the breaking force. It is expressed as a percentage of the original nominal length.

3.3 breaking tenacity: Ratio of a yarn's breaking force to its linear density. It is usually expressed in centinewtons per tex.

3.4 constant rate of specimen extension (CRE) tester: Testing machine in which one end of the specimen is held in a virtually stationary clamp and the other end is gripped in a clamp that is driven at a constant speed. A suitable system is provided for detecting and recording the force applied and the elongation.

3.5 clamp: That part of a tensile testing machine used to grip the specimen by means of suitable jaws.

3.6 jaws: Those elements of a clamp which grip the specimen.

3.7 gauge length: Length of the specimen measured between the points of attachment to clamps while under tension. In bollard or capstan clamps, it is the distance between their gripping points, measured along the path of the yarn.

3.8 package: Length of yarn in a form suitable for use, handling, storing, etc. Packages can be supported (e.g. cones, bobbins) or unsupported (e.g. skeins, balls).

4 Principle

A specimen of yarn is extended until rupture by a suitable mechanical device, and the breaking force and elongation at break are recorded. A constant rate of specimen extension of 100 % per minute (based on the initial specimen length) is used, but higher rates are permitted for automatic testers on agreement. Two gauge lengths are permitted: usually 500 mm (with a rate of displacement of 500 mm/min), and exceptionally 250 mm (with a rate of displacement of 250 mm/min).

5 Apparatus and materials

5.1 Constant rate of specimen extension (CRE) tester, which complies with the following requirements.

a) The tester shall be capable of being set at gauge lengths of 500 mm ± 2 mm or 250 mm ± 1 mm, or preferably both.

b) The constant rate of displacement of the moving clamp shall be 500 mm/min or 250 mm/min, to an accuracy of ± 2 %, with higher rates being permitted for automatic testers on agreement.

c) The maximum error of the indicated force shall not exceed 2 % of the true force.

d) The tester may be of the manual or automatic type.

e) The clamps for gripping the specimens shall prevent slipping or cutting of the specimens and breaks at the jaws. Flat-faced unlined jaws shall be the normal type but, if these cannot prevent slippage, then other types of clamp may be used on agreement, such as lined jaws, bollard clamps or other types of snubbing device. As the type of clamp may influence the reading of the elongation, all parties shall use the same type.

f) The tester shall be equipped with an autographic force/elongation recording device of sufficiently fast response, or with a system directly recording the breaking force and elongation at break.

g) The tester shall be capable of setting a pretension either by means of a set of pretensioning weights or by the use of the force-measuring device.

5.2 Reel, for preparing test skeins from the laboratory sample (for methods C and D).

5.3 Swift, or similar device, for holding the test skein under zero tension and permitting easy transfer of the yarn to the tensile tester (for method C).

5.4 Receptacles, for immersing the sample or the specimens in water (for method D).

5.5 Tap water, at room temperature (for method D).

5.6 Nonionic surfactant, 0,1 % aqueous solution (for method D).

6 Sampling

6.1 Samples shall be taken in accordance with

a) the directions given in the material specification when available, or

b) the procedures described in 6.2 to 6.7.

6.2 A bulk sample shall be taken of one or more cases, as representative of the lot to be tested as follows:

No. of cases	No. of cases selected at random
3 or less	1
4 to 10	2
11 to 30	3
31 to 75	4
76 or more	5

6.3 If only mean values are required, then 10 packages shall be taken from the bulk sample, distributed as evenly as possible among the cases and among the levels in each case.

6.4 Except for the provisions of 6.5, the minimum number of specimens to be tested shall be 50 for single spun yarns and 20 for other yarns. The specimens shall be distributed as evenly as possible among the 10 packages.

6.5 If the variability of the tests is known and only mean values are required, then the number of specimens shall be calculated as $0{,}17v^2$, where v is the coefficient of variation of the individual breaks (expressed as a percentage) obtained from experience on similar material.

NOTES

4 This number of specimens will give a precision (1,96 × the standard error of the mean) of ± 4 % at a probability level of 90 %.

5 Strength testing is a "one-tail" test; that is, "yarn shall not be weaker than ..." but "may be stronger than ..." When specifying 90 % probability, one tail of the distribution is 5 %, or exactly the same as the two tails together of the more common 95 % probability appropriate for a "two-tail" test.

6.6 If the coefficient of variation is to be determined in addition to the mean, then 20 packages shall be taken from the bulk sample and at least 200 specimens shall be tested for single spun yarns and at least 100 specimens for all other types of yarn.

6.7 If specimens are to be extracted from fabrics [not suitable for automatic testers (method B)], then the fabric sample shall be large enough to furnish a sufficient number and length of specimens. The test specimens shall be taken so that the twist in the yarn is not changed during sampling. In woven fabrics, warp specimens shall be taken from different ends and weft specimens shall be taken at random from several sections of the sample to be as representative of the yarn as possible. In knitted fabrics, specimens shall represent as many different yarns as possible.

7 Preconditioning and conditioning

7.1 The atmospheres for preconditioning, conditioning and testing shall be as specified in ISO 139.

7.2 For methods A to C, the sample packages or test skeins shall be preconditioned for a minimum of 4 h.

NOTE 6 Preconditioning can often be dispensed with if the samples are conditioned directly "from the dry side".

7.3 After preconditioning, the sample shall be brought to moisture equilibrium under the conditioning atmosphere. For skeins, overnight conditioning is usually sufficient, but for tightly wound packages a minimum of 48 h is necessary.

7.4 Preconditioning and conditioning are not required for wet tests (method D).

8 Procedure

8.1 General

8.1.1 If more than one condition of testing is permitted, usually by agreement, then all parties interested in the test results shall perform the test under the same conditions (i.e. gauge length, rate of displacement, type of clamp, temperature, pretension).

8.1.2 Two gauge lengths are permitted: the usual length of 500 mm, and a length of 250 mm which can be used only if

a) the extension of the instrument is insufficient to accommodate a 500 mm specimen, or

b) by agreement between the parties.

8.1.3 If calculation of the breaking tenacity is required, determine the linear density of the yarn in accordance with ISO 2060.

8.1.4 Use a rate of displacement of 500 mm/min at the gauge length of 500 mm, and 250 mm/min at the gauge length of 250 mm. In addition, for automatic testers only (method B), higher rates are permitted by agreement; 400 %/min or 1 000 %/min are recommended.

8.1.5 Unwind the yarn from the package as is done in normal use.

8.1.6 Before clamping the specimen, check that the jaws are correctly aligned and parallel, so that the force applied produces no angular deviation.

8.1.7 Insert the specimen in the clamps with a pretension of 0,5 cN/tex ± 0,1 cN/tex for conditioned specimens, or 0,25 cN/tex ± 0,05 cN/tex for wet specimens. For textured yarns, use a pretension which will remove the crimp but not stretch the yarn.

NOTE 7 For textured yarns, the following pretensions are recommended (unless otherwise agreed), calculated on the nominal linear density of the yarn:

2,0 cN/tex ± 0,2 cN/tex, for polyester and polyamide yarns;

1,0 cN/tex ± 0,1 cN/tex, for acetate, triacetate and viscose yarns;

0,5 cN/tex ± 0,05 cN/tex, for for bi-shrinkage and jet-bulked yarns, except for carpet yarns heavier than 50 tex.

8.1.8 Finally, secure the specimen in the clamps.

8.1.9 Perform the test under the standard atmosphere for testing, as specified in 7.1.

8.1.10 During the test, check that the specimen does not slip between the jaws by more than 2 mm. If it does so repeatedly, change the clamps or jaw lining. Discard the results of the tests where slippage occurs. Also discard results of jaw breaks where breaks occur 5 mm to the jaws or closer.

8.1.11 Record the breaking force and elongation at break (done automatically in method B). For fancy yarns, record values for the first component that breaks.

NOTES

8 The values recorded for fancy yarns may be lower than those defined in 3.1 and 3.2.

9 With bollard or capstan clamps, measurement of the elongation is not accurate and is discouraged.

8.2 Method A, manual

Take specimens directly from the conditioned packages.

Follow the procedures given in 8.1.1 to 8.1.11. Insert the test specimens manually into the clamps to perform the tensile test.

8.3 Method B, automatic

Take specimens directly from the conditioned packages.

Follow the procedures given in 8.1.1 to 8.1.6 and 8.1.9 to 8.1.11. Set the instrument to take specimens from the 10 or 20 packages of the sample (see 6.3 and 6.6). The test will be performed automatically.

8.4 Method C, manual, conditioned specimens

8.4.1 Using the reel (5.2), take one test skein from each package of the sample. The test skeins shall be of sufficient length to give the required number and length of test specimens.

8.4.2 Using the swift (5.3), allow the test skeins to relax under minimal tension in the preconditioning and conditioning atmospheres (see 7.1).

8.4.3 Follow the procedures given in 8.1.1 to 8.1.11. When taking a specimen from the test skein for insertion between the clamps, make sure its length is at least 100 mm greater than the selected gauge length; an excess of 500 mm is recommended. Be careful not to change the twist.

NOTE 10 With suitable modifications (see 6.7), this method may also be used for yarns from fabrics.

8.5 Method D, manual, wet specimens

8.5.1 Take test skeins as described in 8.4.1.

8.5.2 Before removing the test skein from the reel, wrap two or three turns of a strong thread (e.g. sewing thread) tightly around the skein at two places about 2 cm apart and securely tie the ends of the thread. Cut the skein midway between the two places. Fill a receptacle (5.4) with water (5.5). Lay the cut skein flat on the surface of the water and leave it until it sinks below the surface under its own weight.

8.5.3 If the skein will not sink in the water, then hold the yarn under the surface, e.g. by means of weights attached to the ends, until the yarn is thoroughly saturated (e.g. for 30 min). When the yarns are normally resistant to wetting, use a nonionic wetting agent (5.6). Rinse out the wetting agent thoroughly with water before testing the yarn.

8.5.4 Remove the specimens individually from the water and test them within 60 s thereafter, following the procedures given in 8.1.1 to 8.1.11.

9 Test report

9.1 General information

The test report shall include the following information:

a) a reference to this International Standard (ISO 2062);

b) lot number or other identification of the sample;

c) type of package (cone, bobbin, etc.), its condition (dyed, bleached, etc.), and the manner in which

the yarn was withdrawn from the package (over-end or from the side);

d) conditioning atmosphere and testing atmosphere used;

e) sampling scheme used, the number of specimens tested, and number of specimens discarded;

f) make of tester used;

g) test method used (A to D);

h) gauge length, rate of displacement and pretension used;

i) type of clamp and jaws used;

j) date of the test.

9.2 Test results

The following test results shall be given:

a) mean breaking force, in centinewtons (to three significant figures);

b) mean elongation at break, as a percentage (to two significant figures);

c) coefficient of variation of the breaking force, if required (to the nearest 0,1 %);

d) coefficient of variation of percent elongation at break, if required (to the nearest 0,1 %);

e) linear density of the yarn, if determined, in tex (to three significant figures);

f) breaking tenacity, if required, in centinewtons per tex (to the nearest 0,1 cN/tex).

Annex A
(informative)

Alternative methods using constant rate of travel (CRT) and constant rate of loading (CRL) testers

A.1 Scope

This annex describes seven methods:

— E: CRT testers, manual; specimens are taken directly from conditioned packages;

— F: CRT testers, manual; relaxed test skeins are used after conditioning;

— G: CRT testers, manual; relaxed test skeins are used after wetting;

— H: CRL testers, manual; specimens are taken directly from conditioned packages;

— J: CRL testers, automatic, specimens are taken directly from conditioned packages;

— K: CRL testers, manual; relaxed test skeins are used after conditioning;

— L: CRL testers, manual; relaxed test skeins are used after wetting.

These methods are given for information only and can be used on agreement between the interested parties.

A.2 Procedure

A.2.1 General

Follow 8.1.2, 8.1.3, 8.1.5, 8.1.6, if possible 8.1.7, and also 8.1.8 to 8.1.11 and clause 9.

A.2.2 Method E: CRT testers, manual

A.2.2.1 Use a pendulum tester which complies with the following requirement. After the first 2 s of the test, the average rate of travel for the pulling clamp in any 2-s interval shall not differ by more than 5 % from the average rate of travel over the whole period of the test.

Adjust the instrument so that the average time-to-break shall be 20 s $\pm$ 3 s. Also adjust the tester so that the recorded breaking force lies between 15 % and 85 % of the instrument's scale.

A.2.2.2 Follow the procedure given in method A (8.2), omitting 8.1.4.

A.2.3 Method F: CRT testers, manual

Follow the procedure given in A.2.2.1 and then follow method C (8.4), omitting 8.1.4.

A.2.4 Method G: CRT testers, manual

Follow the procedure given in A.2.2.1 and then follow method D (8.5), omitting 8.1.4.

A.2.5 Method H: CRL testers, manual

A.2.5.1 Use an inclined-plane tester complying with the following requirement. After the first 4 s of the test, the average rate of increase of force in any 2-s interval shall not differ by more than 25 % from the average rate of increase of the force over the whole period of the test.

Adjust the instrument so that the average time-to-break shall be 20 s $\pm$ 3 s. Also adjust the tester so that the recorded breaking force lies between 15 % and 85 % of the instrument's scale.

A.2.5.2 Follow the procedure given for method A (8.2), omitting 8.1.4.

A.2.6 Method J: CRL testers, automatic

Follow the procedure given in A.2.5.1 and then follow method B (8.3), omitting 8.1.4.

A.2.7 Method K: CRL testers, manual

Follow the procedure given in A.2.5.1 and then follow method C (8.4), omitting 8.1.4.

A.2.8 Method L: CRL testers, manual

Follow the procedure given in A.2.5.1 and then follow method D (8.5), omitting 8.1.4.

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