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Cotton fibres — Determination of breaking tenacity of flat bundles

Fibres de coton — Détermination de la ténacité de rupture des faisceaux plats

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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 3060 was drawn up by Technical Committee ISO/TC 38, *Textiles,* and circulated to the Member Bodies in March 1973.

It has been approved by the Member Bodies of the following countries :

Australia	Hungary	Romania
Belgium	India	South Africa, Rep. of
Brazil	Ireland	Spain
Bulgaria	Israel	Sweden
Canada	Japan	Switzerland
Czechoslovakia	Netherlands	Thailand
Egypt, Arab Rep. of	New Zealand	Turkey
Finland	Norway	United Kingdom
France	Poland	U.S.A.

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

Germany

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Cotton fibres — Determination of breaking tenacity of flat bundles

0 INTRODUCTION

It is difficult and time consuming to estimate the average breaking tenacity of samples of cotton from tests on individual fibres. For both commercial and technical purposes, quicker estimates may be obtained from determinations made on flat bundles of parallel fibres. In this procedure, short fibres are combed out and the measured fibre strength corresponds with the breaking strength of the longer fibres in the sample.

The bundles of fibres may be secured by clamps which are either in close contact (zero gauge length) or separated to give a specified nominal gauge length. Fibre strength testing at zero gauge length is current commercial practice, although some investigations suggest that tests at a gauge length of 3,2 mm are more closely related to the tenacity of many classes of cotton yarn.

International Calibration Cotton Standards for zero gauge and national Calibration Cotton Standards for 3,2 mm gauge have been established to enable different operators to adjust their personal levels of testing to an agreed common level. These standards may also be used by operators to adjust the level of test results obtained from measurements made on instruments with different rates of loading to the agreed level for the standard.

1 SCOPE AND FIELD OF APPLICATION

1.1 This International Standard specifies a method of test for the determination of the breaking tenacity of cotton fibres arranged in a parallel manner in a flat bundle. The method applies to fibres from raw cotton, or to fibres from various stages in the manufacturing process, or to fibres separated or extracted from manufactured cotton products. The method is applicable to fibres being tested either at a nominal gauge length of zero, or at a finite gauge length.

1.2 The method is especially intended to be used with tensile strength test instruments which have been designed for specific use on flat bundles of cotton fibres (see the annexes). It may be used with other tensile strength test instruments if equipped to accommodate the fibre clamps.

2 REFERENCES

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

ISO/R 220, *Method of sampling raw cotton for testing.*

3 DEFINITIONS

3.1 gauge length : The length of a specimen under specified pre-tension measured from nip-to-nip of the jaws of holding clamps in their starting position at the beginning of the test.

3.2 breaking load : The maximum load (or force) applied to a specimen in a tensile test carried to rupture.

3.3 tensile strength : The strength shown by a specimen subjected to tension, as distinct from torsion, compression or shear, and expressed as force per unit cross-sectional area of the unstrained specimen.

3.4 tenacity : The tensile force per unit of linear density of the unstrained specimen, expressed in centinewtons per tex.

3.5 breaking tenacity : The tenacity corresponding to the breaking load.

4 APPARATUS AND MATERIALS

4.1 Tensile testing instrument suitable for determining the breaking load of a flat bundle of fibres with an accuracy of 0,5 %.

NOTE — Two commercially available fibre bundle strength test instruments are described in the annexes. Other tensile testing instruments may be used if equipped with adapters to accommodate the fibre clamps.

4.2 Specimen clamps, which can be removed from the test instrument.

A total clamp thickness of 11,8 mm and a spacer with a thickness of 3,2 mm are recommended because the precision data (see 9.2) are based on clamps of these dimensions.

4.3 Clamp vice, consisting of a jig equipped with a locking screw or cam for holding the clamps while they are being loaded and unloaded. A vice having a device to indicate approximately 9 daN·cm torque is recommended.

4.4 Balance, sensitive to ± 0,01 mg.

A capacity of 3 to 5 mg is sufficient for most fibre bundle strength tests, but balances having a larger capacity may be used if they have the required sensitivity.

4.5 Devices for preparing specimens and removing them from the clamps :

4.5.1 Coarse comb, approximately 3 teeth per centimetre or comb used with length testing instruments.

4.5.2 Fine comb, approximately 20 teeth per centimetre.

4.5.3 Wrench for tightening the clamps. A torque wrench is needed if the clamp vice is not equipped with a torque device (see 4.3).

4.5.4 Shearing knife.

4.5.5 Tweezers.

4.6 Standard Calibration Samples, having specified, or agreed, strength values.[1)]

5 STANDARD ATMOSPHERE FOR CONDITIONING AND TESTING

The atmosphere for conditioning and testing textiles is that defined in ISO 139. This atmosphere has a relative humidity of 65 ± 2 % and a temperature of 20 ± 2 °C. In tropical regions a temperature of 27 ± 2 °C can be used subject to the agreement of the interested parties.

6 SAMPLING

6.1 Select the sample of cotton for testing in accordance with ISO/R 220, or in other ways as agreed upon by the interested parties.

6.2 Bring the laboratory sample into equilibrium with the standard atmosphere for conditioning and testing textiles as defined in clause 5, starting from a dry state. A minimum of 4 h conditioning time is normally required.

NOTE — Cotton is normally received at the laboratory in a relatively dry condition; for this reason, special pre-conditioning is not enforced. Samples which obviously have more moisture should be subjected to pre-conditioning before conditioning in the laboratory. The pre-conditioning atmosphere should have a relative humidity between 10 and 25 % at a temperature not higher than 50 °C. An atmosphere with a relative humidity of 65 % at 20 °C will give this pre-conditioning atmosphere when heated to 47 ± 3 °C.

7 TEST SPECIMENS

Take the test specimens (flat bundles) from small sub-samples (tufts or beards prepared for use in length testing) which have been prepared from the laboratory sample as directed below.

Prepare a tuft by taking for example 16 small pinches at random from the laboratory sample and blending them by successive doubling and dividing. When one end of the tuft has been combed, reverse the tuft and comb the other end, making sure that the middle portion of the tuft is well combed. Approximately 10 strokes are necessary for combing each end of the tuft.

Prepare at least 6 specimens.

NOTE — Preferably carry out the test with the participation of two operatives, each testing 3 tufts; with three operatives each carrying out one test on 2 tufts, greater reliability is achieved.

8 PROCEDURE

8.1 Check the test instrument and clamp vice for mechanical adjustment in accordance with the manufacturer's instructions, or as directed for specific instruments in the annexes.

8.2 Inspect the clamp leathers to ensure that they are in good condition. Replace the leathers if grooves are evident. Keep the leathers trimmed flush with the metal surfaces of the clamps.

8.3 Prepare the specimen as follows :

Grasp the prepared tuft about one-fourth the distance from the end of the tuft and pull out a portion of the fibres. Hold these extracted fibres firmly by one end and pull them through the fine comb two or three times to remove loose fibres, neps, and trash. The depth of penetration of the comb teeth into the tuft should be regulated to ensure minimum fibre breakage. Comb the other end of the specimen in the same manner, keeping the fibre ends aligned while the middle portion is combed. Maintain the width of the specimen at approximately 6 mm. If the specimen is too heavy, remove fibres from either side to obtain the correct mass. The specimen is now ready to be placed in the clamps.

NOTE — The preparation of the tuft for 3,2 mm length of test poses problems in the case of fibres of shorter length. Except in the case where precautions are taken to include only long fibres, certain fibres in the tuft cannot be held in the jaws and come out on the other side.

8.4 Place the test specimen in the fibre clamps as directed in either 8.4.1 or 8.4.2.

8.4.1 Using a vice without a pre-tensioning device, lock the clamps in the vice, and open the clamps. Hold both ends of the specimen, keeping it approximately 6 mm wide, and place it in the centre of the open clamps. Apply sufficient tension to hold the fibres straight while the jaws

1) International Calibration Cotton Standards for zero gauge tests and United States Calibration Cotton Standards for 3,2 mm gauge tests are available from the US Dept of Agriculture, Agricultural Marketing Service, Cotton Division, Box 17723, Memphis, Tennessee 38117, U.S.A. Correction factors (see 9.1.3) do not usually exceed the range of 0,90 — 1,10 for one of these instruments and the range of 1,10 to 1,30 for the other.

of the clamps are lowered and tightened in place by applying a 9 daN·cm torque. The torque may be controlled either by a vice-mounted torque-indicating attachment, or by a friction-disk wrench. Remove the clamps from the vice. Shear off the protruding ends of the specimen with the shearing knife, shearing downward and away from the leather face of the clamps.

8.4.2 Using a vice with a pre-tensioning device, lock the clamps in the vice and open the clamps. Lift the fixed clamp on the vice and insert the loose ends of the flat bundle specimen held in the fibre clip. Draw the fibre clip forward until it falls into place over the back of the tension lever. Apply sufficient pressure on the fixed clamp to prevent fibre slippage and release the ring lever to apply tension on the specimen. Close and tighten the clamps, applying a torque of 9 daN·cm. Tighten the clamp farthest from the clip first to ensure correct tension between the clamps. Remove the clamps from the vice and shear off the protruding fibres as in 8.4.1.

8.5 Operation of the test instrument :

Insert the prepared clamps in the strength testing instrument and break the test specimen in accordance with instructions furnished by the manufacturers of specific instruments (see annexes).

After the specimen has broken, record the breaking load. Remove the clamps from the instrument, check to see that all fibres are broken, and place the clamps in the vice. If all fibres are not broken, are broken irregularly (i.e. an irregular cut forming an angle with the jaws of the clamp), or if the breaking load is less than the required minimum for the instrument used, discard the specimen and make a new test. If the break is acceptable, open the clamps, collect the broken fibres with tweezers, and determine their mass to the nearest 0,01 mg (see note). Collect all the fibres so that the correct mass may be obtained. To avoid a gain in mass from moisture pick-up, do not touch the fibres with the fingers while collecting and determining the mass of the specimen.

NOTE – If desired, the broken specimens may be placed temporarily in folded black papers, stored in the standard atmosphere for testing, and their mass determined.

8.6 Use of Standard Calibration Cotton Samples :

Each day before making other tests, make a check test of at least three specimens per technician on one or more standard calibration samples to check the reproducibility and uniformity of results. If available, use standard calibration samples with test values within the range of the unknown samples being tested.

Make additional check tests in a similar manner at least three more times during a working day to obtain results for the calculation of correction factors.

The calculated breaking tenacity values of the samples tested during the same period can be adjusted to the standard level by applying the correction factor (see 9.1.3) calculated from the check test. This factor is used to adjust the level of observed results for operator, instrument and other uncontrolled sources of difference in testing.

9 CALCULATION AND EXPRESSION OF RESULTS

9.1 Method of calculation and formulae

9.1.1 *Unadjusted breaking tenacity*

Calculate, for each specimen, the unadjusted breaking tenacity, in centinewtons per tex, by the following formulae :

– for zero gauge length tests, based on a bundle length of 11,8 mm.

$$\text{breaking tenacity} = \frac{F_r \times 11{,}8}{m}$$

– for 3,2 mm gauge length tests, based on a bundle length of 15 mm,

$$\text{breaking tenacity} = \frac{F_r \times 15{,}0}{m}$$

where

F_r is the breaking load, in centinewtons[1];

m is the bundle mass, in micrograms.

Express the result to one decimal place.

9.1.2 *Mean breaking tenacity*

Calculate the mean breaking tenacity of each sample from the values calculated for the six specimens.

9.1.3 *Corrected breaking tenacity*

Calculate the correction factor as follows :

$$\text{Correction factor} = \frac{\text{standard value for calibration cotton}}{\text{observed value for calibration cotton}}$$

Calculate the "corrected" breaking tenacity by the following formula

$$\text{Corrected value} = \text{observed value for cotton tested} \times \text{correction factor}$$

1) The "pound-force" and the "kilogram-force" are also used on certain instruments. The values of these units are, in SI units, approximately as follows :

1 pound-force (lbf) = 4,448 N

1 kilogram-force (kgf) = 9,80 N.

9.2 Precision

The coefficient of variation of the individual observations for breaking tenacity or tensile strength is always below 5 %. The confidence interval of the mean of six observations is always below 5 %, at a confidence limit of 95 %. The calculated estimates of the confidence limit are minimum and permit assurance that the correction factor is exact.

10 TEST REPORT

The test report shall include the following particulars :

10.1 That the test was carried out in accordance with this International Standard.

10.2 Average breaking tenacity, in centinewtons per tex, to one decimal place.

10.3 Conditions of test :

a) type of testing instrument;

b) nominal gauge length;

c) the number of specimens tested;

d) the number of operators carrying out the tests;

e) the correction factor used.

ANNEX A

DESCRIPTION AND OPERATION OF THE PRESSLEY FIBRE STRENGTH TESTER[1)]

A.1 DESCRIPTION

A.1.1 The Pressley strength tester[1)] is an inclined plane fibre strength tester with a free-rolling load carriage designed to break flat bundles of cotton fibres and to indicate the load required to cause the rupture of the flat bundle. The beam scale is calibrated in pounds-force.

A.1.2 The instrument is manufactured by Joseph M. Doebrich and Company, PO Box 2789, Tucson, Arizona 85708, U.S.A.

A.2 PREPARATION OF APPARATUS

Place a thin metal strip in the clamps to prevent movement or separation and insert the clamps in position in the instrument. Level the instrument with the bubble level on the carriage track by turning the adjustment screw on the base plate of the instrument (the track angle should be approximately 1,5°). Properly adjusted, the carriage should travel from the 5 lbf reading to the 20 lbf reading in approximately 1 s.

A.3 OPERATION

Place the clamp with the specimen in the instrument. Release the carriage by gently raising the locking lever. Read the beam scale to the nearest 0,1 lbf. If the observed breaking load is less than 10 lbf discard the specimen and make a new test.

1) Mention of the name of a proprietary instrument is not intended to promote, or give preference to, the use of that instrument over others not mentioned.

ANNEX B

DESCRIPTION AND OPERATION OF THE STELOMETER[1)]

B.1 DESCRIPTION

B.1.1 The stelometer is a pendulum-type strength testing instrument designed to break a flat bundle of cotton fibres and to indicate the load required to rupture the specimen. The scale of this instrument is calibrated in kilograms-force.

B.1.2 The instrument is manufactured by Special Instruments Laboratory, Inc., PO Box 1950, Knoxville, Tennessee 37901, U.S.A.

B.2 PREPARATION OF APPARATUS

Level the instrument with the bubble level by turning the screw immediately under the right handle. Place a thin metal strip in the clamps to prevent movement or separation and insert the clamps in the instrument in the same orientation as that used during the test.

Release the pendulum by depressing the release trigger and check the time required for the load indicator to advance from 0 to 7 kgf. Adjust the valve attached to the control cylinder as required to obtain a rate of loading of 1 kgf per second. Hold the pendulum where the first indicator reads 2 kgf by grasping the instrument head and check the position of the elongation indicator, which should be on the first red line to the left of zero. If a change in the elongation indicator is needed, loosen the set-screw on the instrument head, turn the adjustment screw until the correct setting is obtained, and re-tighten the set-screw. This adjustment usually has to be changed whenever different clamps or clamp spacers are used.

B.3 OPERATION

Place the clamp with the specimen in the instrument. Release the trigger which starts both the force and elongation indicators moving across the scales. Read the force scale to the nearest 0,01 kgf. If the observed breaking load is less than 3 kgf, discard the specimen and make a new test.

1) Mention of the name of a proprietary instrument is not intended to promote, or give preference to, the use of that instrument over others not mentioned.