

INTERNATIONAL STANDARD

ISO
9290

First edition
1990-11-15

Textiles — Woven fabrics — Determination of tear resistance by the falling pendulum method

iTeh STANDARD PREVIEW
*Textiles — Tissus — Détermination de la résistance au déchirement par
la méthode du mouton-pendule*
(standards.iteh.ai)

ISO 9290:1990

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Reference number
ISO 9290:1990(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 voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

International Standard ISO 9290 was prepared by Technical Committee ISO/TC 38, *Textiles*.

Annex A of this International Standard is for information only.

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Textiles — Woven fabrics — Determination of tear resistance by the falling pendulum method

1 Scope

This International Standard specifies a method for determining the force required to propagate a tear, through a specified distance and from a specified slit, cut in a test specimen of textile fabric, under specified conditions of loading. The test method is suitable for all types of woven fabric (treated and untreated). The method is not applicable to nonwovens or knitted fabrics. Two procedures are given for preparing test specimens.

2 Normative reference

The following standard contains provisions which through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was 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 edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

3 Definition

For the purposes of this International Standard, the following definition applies.

tear resistance: The average force, in newtons, required to tear a test specimen over a specified length.

4 Principle

A rectangular test specimen having a specified pre-cut slit is subjected to a tearing force generated by the energy stored in a pendulum-sector of specified

dimensions. The energy expended in tearing the specimen is used to determine the tear resistance of the specimen.

5 Apparatus

5.1 Elements of the apparatus.

The apparatus essentially consists of a frame, mounted on a rigid base, carrying a pendulum and pointer assembly. It shall also satisfy the details as given below with respect to various parts.

5.1.1 Pendulum, preferably formed by a sector of a circle, suitably mounted, free to swing about a horizontal axis from bearings of very low frictional resistance.

5.1.2 Augmenting mass, the apparatus shall have provision of augmenting masses that may be attached to the pendulum sector for further increasing the working capacity of the apparatus.

5.1.3 Jaws: a pair of jaws each 16 mm \pm 0,5 mm deep and 37 mm \pm 0,5 mm wide, one stationary jaw, fixed with respect to the base, and the other movable jaw, fixed with respect to the pendulum. When the pendulum is in the initial position, ready for the test, the jaws shall be separated by a distance of 2,8 mm \pm 0,4 mm and so aligned that the test sample when clamped lies in a plane perpendicular to the plane of oscillation of the pendulum sector with the edges of the jaws gripping the test specimen in a horizontal line, a perpendicular to which through the axis of suspension of the pendulum sector is 104 mm \pm 1 mm long. The angle made by this imaginary line and the vertical shall be 27,5° \pm 5°.

5.1.4 Pendulum-sector release mechanism, for holding the pendulum-sector in a raised position, and for releasing it without imparting shock.

5.1.5 Pointer and pointer-stop, for registering the maximum arc through which the pendulum-sector swings when released. The pointer is mounted on the same axis as the pendulum-sector, there being constant friction just sufficient to stop the pointer at the highest point reached by the swing of the pendulum-sector. The adjustable pointer-stop provides a means for setting the zero of the apparatus.

5.1.6 Levelling screws, for levelling the apparatus.

5.1.7 Cutting die (specimen size), having essentially the shape and dimensions shown in figure 1. The die is used to cut out the basic rectangular test specimen that is $100 \text{ mm} \pm 2 \text{ mm}$ long and $63 \text{ mm} \pm 1 \text{ mm}$ wide, plus an additional 8 mm of fabric at the top edge of the specimen to ensure that the last portion of the fabric is torn (not ravelled) and 4 mm of fabric at the bottom edge as an aid to centring it in the jaws.

5.1.8 Means of making a slit of $20 \text{ mm} \pm 0,5 \text{ mm}$ in the centre of the bottom edge of the specimen to initiate the tear. The slit may be cut by the cutting die (5.1.7) or, alternatively, the initial cut may be made by a knife (that is mounted on the apparatus) when the specimen is in place.

5.2 Capacity and accuracy.

The apparatus shall be of suitable capacity so that the tearing occurs between 20 % and 80 % of the full-scale force. It shall also meet the following requirements:

Scale error	< 1 %
Zero error	< 0,5 % of full scale load
Zero stability	< 1 % of full scale load
Pointer friction	< 3 and > 2 scale divisions
Pendulum friction	> 35 oscillations

5.3 Adjustment and maintenance.

The apparatus shall be maintained properly and adjusted regularly in accordance with the instructions of the manufacturer. A brief description of adjustment and maintenance of an apparatus functioning on the above principle is given in annex A.

6 Preparation of test specimens

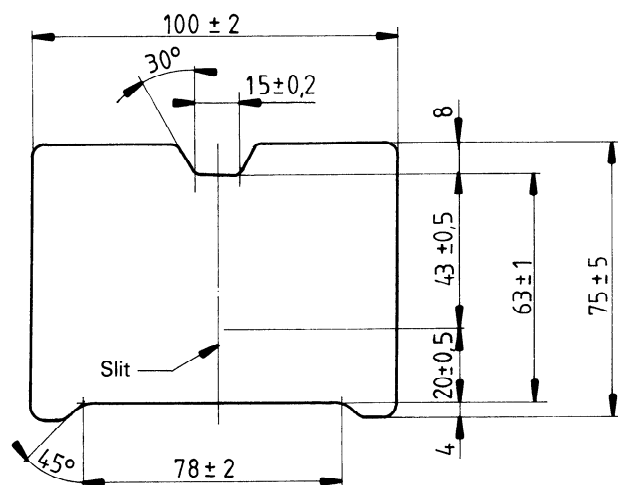
6.1 Sampling

The test sample shall be taken from a laboratory bulk sample that is representative of the lot to be tested. The test sample shall not be cut within 2 m of the ends of a piece nor closer than 50 mm to a selvedge.

The critical dimensions of the test specimen are the distance of $43 \text{ mm} \pm 0,5 \text{ mm}$ that is to be torn during the test, and the distance above the clamp of the end of the pre-cut slit of $4,0 \text{ mm} \pm 0,5 \text{ mm}$.

For method A, cut specimens as shown in figure 1. For method B, cut specimens $100 \text{ mm} \pm 2 \text{ mm}$ by $63 \text{ mm} \pm 1 \text{ mm}$.

Dimensions in millimetres (unless otherwise stated) / Radii 3 mm



NOTE — For some apparatus the appropriate dimensions vary, particularly in the width of the test specimen. If specimens with widths other than those specified are used, this shall be stated in the test report.

Figure 1 — Cutting die

6.2 Test specimens

One set of not less than five specimens shall be cut for each direction to be tested, using the cutting die (5.1.7). The set for the warp tear tests (i.e. tearing across the warp threads) shall have the shorter dimension parallel to the weft threads, and the set for weft tear tests (i.e. tearing across the weft threads) shall have the shorter dimension parallel to the warp threads. Each set of specimens shall be cut from the sample in such a manner that no two specimens in the set include the same threads. In preparing the specimens, care shall be taken to align the threads running in the short direction parallel to the die so that when the slit is cut, the subsequent tear will take place between these threads and not across them. This precaution is most important when testing bowed fabrics.

NOTE 1 Where it is necessary to determine the results to within a given confidence interval of the mean, it is recommended that the number of test specimens be determined using ISO 2602:1980, *Statistical interpretation of test results — Estimation of the mean — Confidence interval*.

7 Atmosphere for conditioning and testing

The specimens shall be conditioned and testing shall be conducted in one of the standard atmospheres for conditioning and testing textiles, specified in ISO 139.

8 Procedure

8.1 Preparation of apparatus

8.1.1 Before testing, level the apparatus with the levelling screws (5.1.6) and check both the equilibrium position of the pendulum-sector and the zero reading.

8.1.2 Select the capacity of the apparatus (5.2) according to the fabric under test, so that the specimens tear between 20 % and 80 % of the full-scale value. Carry out a preliminary test, if necessary, to determine the appropriate range.

8.2 Test procedure for method A

8.2.1 Raise the pendulum-sector (5.1.1) to the starting position, secure it by the pendulum-sector release mechanism (5.1.4), and set the pointer against its stop (5.1.5).

8.2.2 Clamp a specimen securely in the jaws (5.1.3) so that it is centred with the bottom edge set against the stops and the upper edge parallel to the top of the jaws. Close the jaws by tightening the setting screws, using approximately the same tension on both. Where applicable operate the knife

(5.1.8) to make the initial slit in the lower edge of the specimen. The specimen shall lie free with its upper edge directed towards the pendulum-sector so as to ensure a shearing action.

8.2.3 Depress the pendulum-sector release mechanism as far as it will go and hold it down until tearing is completed. (This is particularly important in order to prevent the pendulum stop from interfering with the initial swing of the pendulum-sector.) Catch the pendulum-sector by hand on the return swing without disturbing the position of the pointer.

8.2.4 Record the position of the pointer as indicated by the nearest whole scale division for the capacity used.

8.2.5 Repeat operations 8.2.1 to 8.2.4 on the remaining test specimens.

8.2.6 Discard readings obtained when the specimen slips in the jaws or where tearing deviates beyond the base of the slit in such a way that the tear is not completed in the notch at the top of the specimen.

8.3 Test procedure for method B

Carry out the procedure generally as described in 8.2 but, after mounting the specimen on the apparatus, make a slit using the means provided (5.1.8).

9 Expression of results

9.1 Record the tearing force in newtons.

NOTE 2 Depending on the type of apparatus used, this may mean multiplying the scale reading obtained by an appropriate factor as specified by the manufacturer of the test apparatus.

9.2 Calculate and record the average force, in newtons, required to tear the test specimens across

- the warp threads;
- the weft threads.

9.3 If required, calculate the coefficients of variation of the results.

10 Test report

The test report shall include the following:

- a) that the test was conducted in accordance with this International Standard and the method used (A or B);
- b) the type of material tested;

- c) the number of readings in both warp and weft directions; if required, the coefficient of variation for each direction of tear;
- d) the individual values and the average tearing force, in newtons, for each direction of tear and, e) the number of tests rejected because of cross-wise tearing or for other reasons.

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Annex A (informative)

Adjustment and maintenance of the apparatus

A.1 General

Follow the procedure described in clause A.2 to clause A.6 for each of the pendulum/additional-mass combinations used.

A.2 Inspection

Check the following items and make any necessary adjustments:

- a) check that the pendulum shaft (5.1.1) is not bent;
- b) check that the distance between clamps (5.1.3) is $2,8 \text{ mm} \pm 0,4 \text{ mm}$ and that, when the pendulum is in its initial position, the clamps are aligned;
- c) check that the knife (5.1.8) fitting is secure, and that the cutting edge is sharp and undamaged (the blade should be situated midway between, and at right angles to, the top of the clamps);
- d) ensure that the pointer (5.1.5) is undamaged and is rigidly attached to the sleeve.

A.3 Levelling

A.3.1 Mount the apparatus on a rigid bench; if possible, firmly attach it to the bench.

A.3.2 With the pendulum clamp closed, adjust the apparatus with the help of the levelling screws (5.1.6) so that the pendulum hangs vertically and the index marks on the pendulum and base coincide. With the stop (5.1.5) depressed, displace the pendulum

slightly and, after it comes to rest, check that the index marks still coincide.

A.4 Zero adjustment

After levelling, operate the apparatus several times with the clamps empty and closed to ascertain whether the pointer registers zero. If zero is not registered, move the adjustable pointer stop.

A.5 Pendulum friction

A.5.1 Make a reference mark on the stop mechanism (5.1.4) 25 mm to the right of the edge of the pendulum catch. Raise the sector to its initial position and set the pointer so that it does not meet the pointer stop when the apparatus is in operation.

A.5.2 When the sector is released and the pendulum stop held down, the sector should make at least 35 complete oscillations before the edge of the sector which engages with the catch no longer passes to the left of the reference mark. Otherwise, clean, oil or adjust the bearing.

A.6 Tearing length

The tearing length shall be $43,0 \text{ mm} \pm 0,5 \text{ mm}$. If this is not the case, adjust the dimensions of the guillotine or template used.

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UDC 677.074:677.017.4:620.176.245

Descriptors: textiles, fabrics, woven fabrics, tests, tear tests.

Price based on 5 pages
