INTERNATIONAL STANDARD

ISO 4674-1

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Rubber- or plastics-coated fabrics — Determination of tear resistance —

Part 1: Constant rate of tear methods

Supports textiles revêtus de caoutchouc ou de plastique — Détermination de la résistance au déchirement —

Partie 1: Méthodes à vitesse constante de déchirement

Reference number
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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Contents

Annexes

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4674-1 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses)*.

Together with part 2 (see below), this part of ISO 4674 cancels and replaces ISO 4674:1977, which has been technically revised.

ISO 4674 consists of the following parts, under the general title *Rubber- or plastics-coated fabrics — Determination of tear resistance*:

— *Part 1: Constant rate of tear methods*

— *Part 2: Ballistic pendulum method*

Introduction

Tearing is amongst the more usual ways of destruction for many thin materials such as paper, coated or uncoated textiles, plastic films and leather. Knowledge of the resistance of these materials to this type of behaviour is therefore very important.

In practice, tearing can result from very different circumstances; hence the large number of test methods that have been developed in order to predict the behaviour of materials in various situations.

The present International Standard deals with initiated tearing, i.e. the propagation of a tear from an initiating cut. It consists of the following two parts:

— Part 1: Constant rate of tear methods;

— Part 2: Ballistic pendulum method.

The first part describes two methods using a tensile-testing machine at constant rate of elongation. The second part describes a dynamic method using the kinetic energy of a falling pendulum.

Rubber- or plastics-coated fabrics — Determination of tear resistance —

Part 1:

Constant rate of tear methods

WARNING — Persons using this part of ISO 4674 should be familiar with normal laboratory practice. This part of ISO 4674 does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

1 Scope

This part of ISO 4674 describes two methods for determining the forces necessary to initiate and propagate tearing of a coated fabric using the constant rate of tear method. The methods described are:

— method A: tongue tear;

— method B: trouser tear.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1421:1998, *Rubber- or plastics-coated fabrics — Determination of tensile strength and elongation at break*

ISO 2231:1989, *Rubber- or plastics-coated fabrics — Standard atmospheres for conditioning and testing*

ISO 2286-1:1998, *Rubber- or plastics-coated fabrics — Determination of roll characteristics — Part 1: Methods for determination of length, width and net mass*

ISO 2602:1980, *Statistical interpretation of test results — Estimation of the mean — Confidence interval*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

peak

point on an autographic trace where the gradient, relative to the force values recorded, changes from positive to negative

NOTE For tear recordings, a peak to be used for calculation is defined by a drop in force of at least 10 % of the last increasing force value.

3.2
length of tear
measured length of a tear produced by a tearing force from the initiation of the force until its termination

4 Apparatus

4.1 Constant rate of extension tensile-testing machine, complying with ISO 1421. The width of each jaw shall be not less than the width of the portions of the test piece to be clamped, i.e. $\geqslant$ 150 mm and $\geqslant$ 50 mm for a tongued test piece, $\geqslant$ 50 mm for a normal trouser test piece and $\geqslant$ 100 mm for a large trouser test piece (half of 200 mm). Tear forces shall be recorded by an autographic recorder. If recording of force and extension is obtained by means of data-acquisition boards and software, the frequency of data collection shall be not less than 8 s^{-1}.

NOTE For method B, the jaws need to be twice as wide as the width of the portion to be clamped. This is necessary to ensure that the two legs are positioned as shown in Figure 6 with the edges of each leg correctly aligned with the axis of force application.

5 Atmospheres for conditioning and testing

The atmospheres for conditioning and testing shall be in accordance with those in ISO 2231.

If tests are to be made on wet test pieces, totally immerse them for a minimum of 1 h at the temperature selected for testing from ISO 2231 in an aqueous solution of a wetting agent of concentration not more than 1 % by mass. Thoroughly rinse in water and test within 1 min of removal from the water.

The minimum time lapse between manufacture and testing shall be 16 h.

6 Method A — Tongued (double-tear) test piece

6.1 Selection and preparation of test pieces

Select ten test pieces, each 200 mm long × 150 mm wide. Select five test pieces in the longitudinal direction and five in the transverse direction, from the full usable width and length of the sample (see ISO 2286-1).

Select test pieces for tearing in the transverse direction (i.e. tearing across longitudinal or warp threads in the case of woven substrates) so that their width is parallel to the longitudinal edge of the coated fabric.

Select test pieces for tearing in the longitudinal direction (i.e. tearing across transverse or weft threads in the case of woven substrates) so that their width is perpendicular to the longitudinal edge of the coated fabric.

In each test piece, cut a tongue measuring 100 mm × 50 mm as shown in Figures 1 and 2. Across each face of the test piece, mark a line ABCD at a distance of 50 mm from the end of the tongue as illustrated in Figure 2.

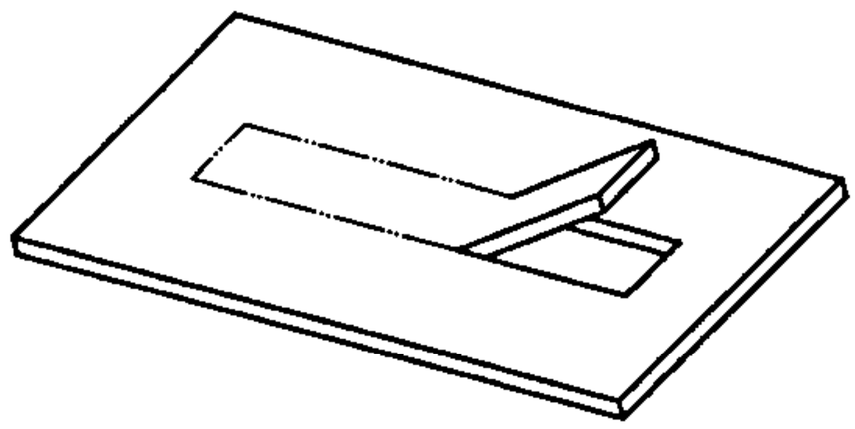
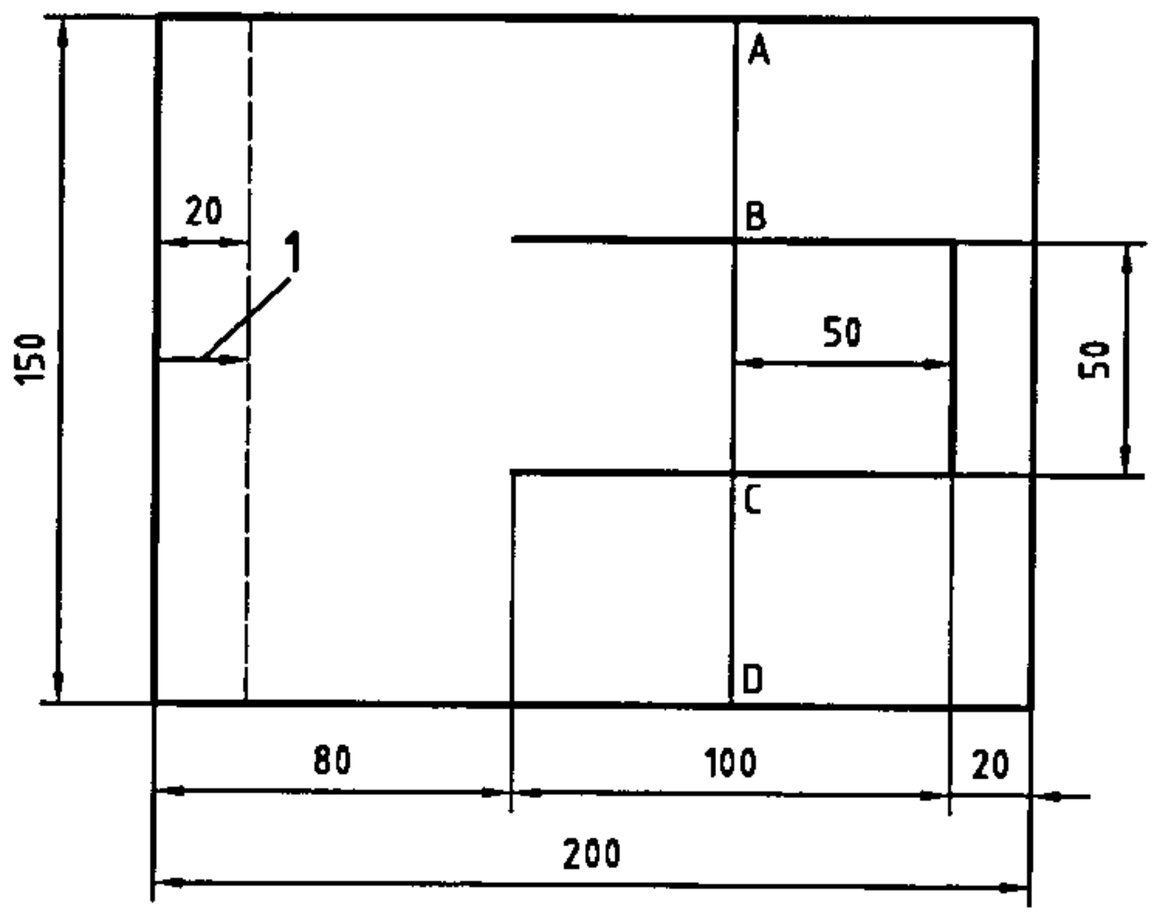


Figure 1 — Principle of tongued test piece

Dimensions in millimetres



Key

1 mark indicating end of tear

Figure 2 — Dimensions of tongued test piece

Mark the end of the tear 20 mm from the uncut end in the middle of the strip to indicate the position of the tear at the completion of the test.

6.2 Procedure

Adjust the test machine to give a rate of jaw traverse of (100 ± 10) mm/min, and select the appropriate load capacity range. Engage and zero the autographic recorder. Adjust the jaw separation to 100 mm.

Clamp the tongue of the test piece centrally and symmetrically in the jaw so that the line BC is just visible, as illustrated in Figure 3. Clamp the legs of the test piece symmetrically in the other jaw of the machine so that the lines AB and CD are just visible and the legs of the test piece are parallel to the tearing force.

Set the test machine in motion at the specified rate of traverse and stop the test after 60 mm of the test piece has been torn, i.e. at the termination line.

Observe if the tear does not proceed along the direction of force and whether any threads slip out from the fabric rather than being torn. The test is to be considered correct if no slippage occurs in the jaws, no delamination takes place between coating and base fabric during the test and the tear proceeded and was completed along the direction of application of the force. Other results shall be rejected.

If three or more test pieces have to be rejected, consider the method as unsuitable.

NOTE In this case, and if the test has been performed with normal test pieces, the tear resistance may be assessed either by using another method, e.g. Part 2 of this International Standard, or by re-testing by the present method using large test pieces as described in Annex B.

Dimensions in millimetres

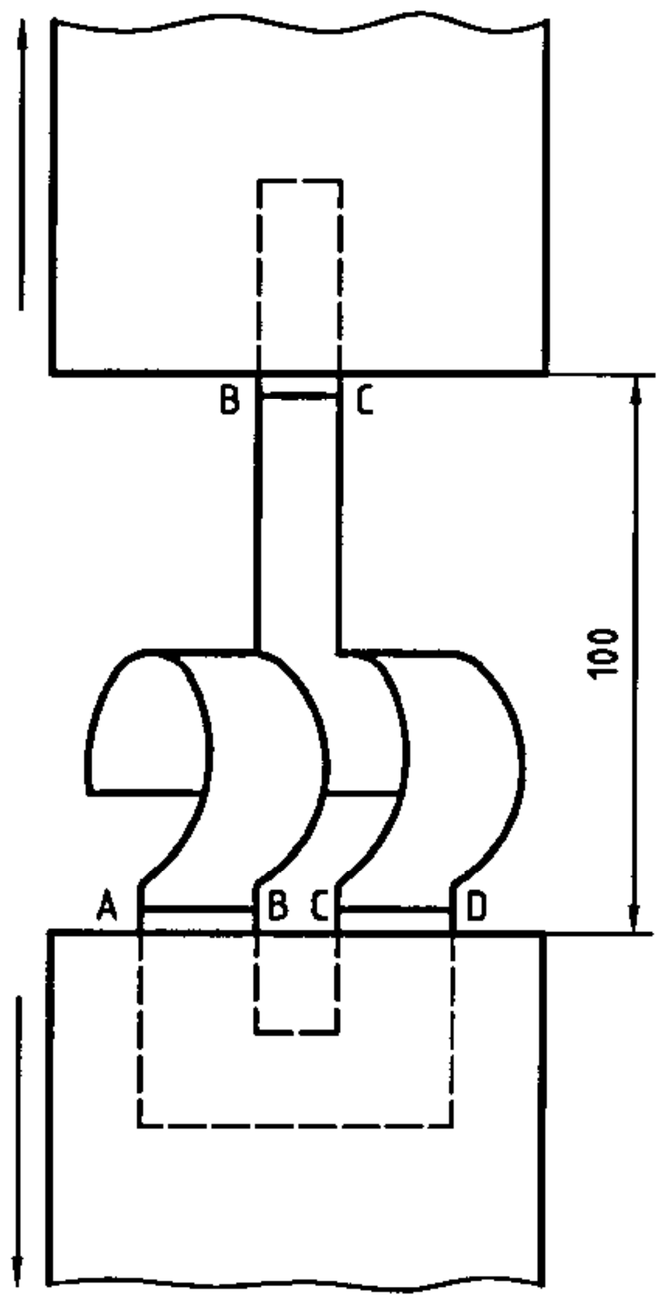


Figure 3 — Method of clamping tongued test piece

6.3 Calculation and expression of results

6.3.1 Trace with a series of definite peaks

6.3.1.1 Manual evaluation of tear forces from the chart recording

Annex A gives an example of a calculation.

Divide the tear trace, beginning with the first peak and ending with the last, into four equal subsections (see Annex A). Do not use the first subsection for the calculation. From each of the remaining three subsections, select and note the two highest and the two lowest peaks. A peak for calculation is characterized by at least a 10 % drop in force as defined in 3.1.

NOTE 1 If the evaluation of peaks derived from dense fabrics with large numbers of threads per centimetre is to be done from the chart recording manually, the speed of the chart paper should preferably be set to 2:1 in relation to the tearing speed.

For each test piece, calculate the arithmetic mean of the 12 peak values obtained, in newtons. If required, record the minimum and maximum peak force from the three subsections for each test piece.

NOTE 2 For manual evaluations, a limited number of selected peaks is chosen to keep calculation time within acceptable limits. For calculations including all peaks, the electronic evaluation method (see 6.3.1.2) is recommended.

From the mean calculated for each test piece, calculate the overall arithmetic mean of the tear force in newtons for each direction tested and round it to two significant figures.

If required, calculate the coefficient of variation to the nearest 0,1 % and the 95 % confidence limits of the mean values calculated for each direction (see ISO 2602).

6.3.1.2 Calculation using an electronic device

Annex A gives an example of a calculation.

Divide the tear trace, beginning with the first peak and ending with the last, into four equal subsections (see Annex A). Do not use the first subsection for the calculation. From each of the remaining three subsections, record all peaks. A peak for calculation is characterized by at least a 10 % drop in force as defined in 3.1.

For each test piece, calculate the arithmetic mean using all the peaks recorded.

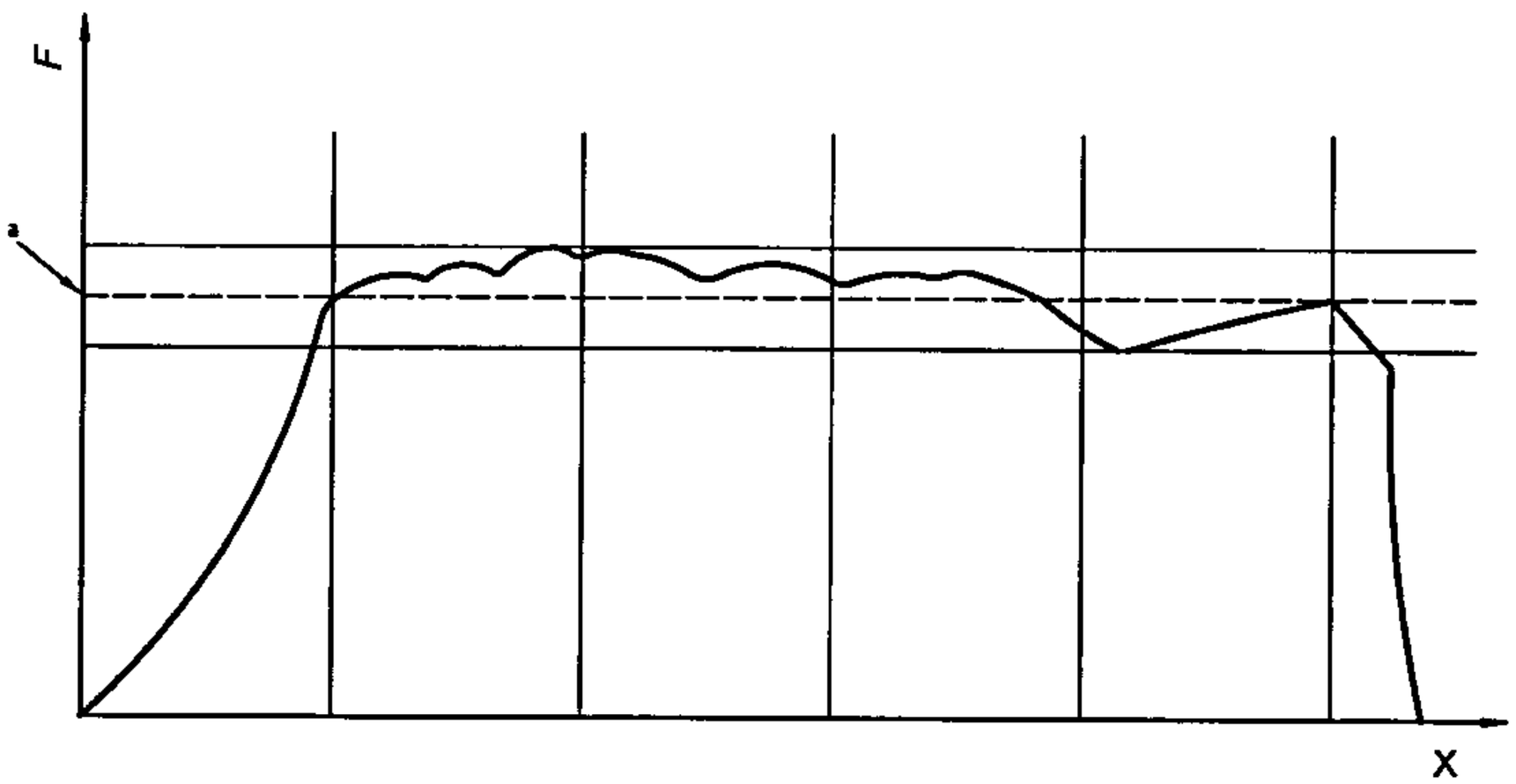
From the mean calculated for each test piece, calculate the overall arithmetic mean of the tear force, in newtons, for each direction tested and round it to two significant figures.

If required, calculate the coefficient of variation to the nearest 0,1 % and the 95 % confidence limits of the mean values calculated for each direction (see ISO 2602).

6.3.2 Trace without definite peaks

When the trace does not show definite peaks and consists of a relatively smooth curve as shown in Figure 4, divide up the trace as in 6.3.1 and ignore the first subsection. Draw two lines parallel to the baseline so that one forms a tangent with the highest part of the curve and the other with the lowest part of the curve. Determine the forces corresponding to these lines and record the arithmetic mean as the result.

Express the result in newtons. Calculate the arithmetic mean of the results for each direction tested and round it to two significant figures.



Key

X direction of tear

F load

[a] Mid-point value.

Figure 4 — Autographic trace without definite peaks

If required, calculate the coefficient of variation to the nearest 0,1 % and the 95 % confidence limits of the mean values calculated for each direction (see ISO 2602).

7 Method B — Trouser-shaped (single-tear) test piece

7.1 Selection and preparation of test pieces

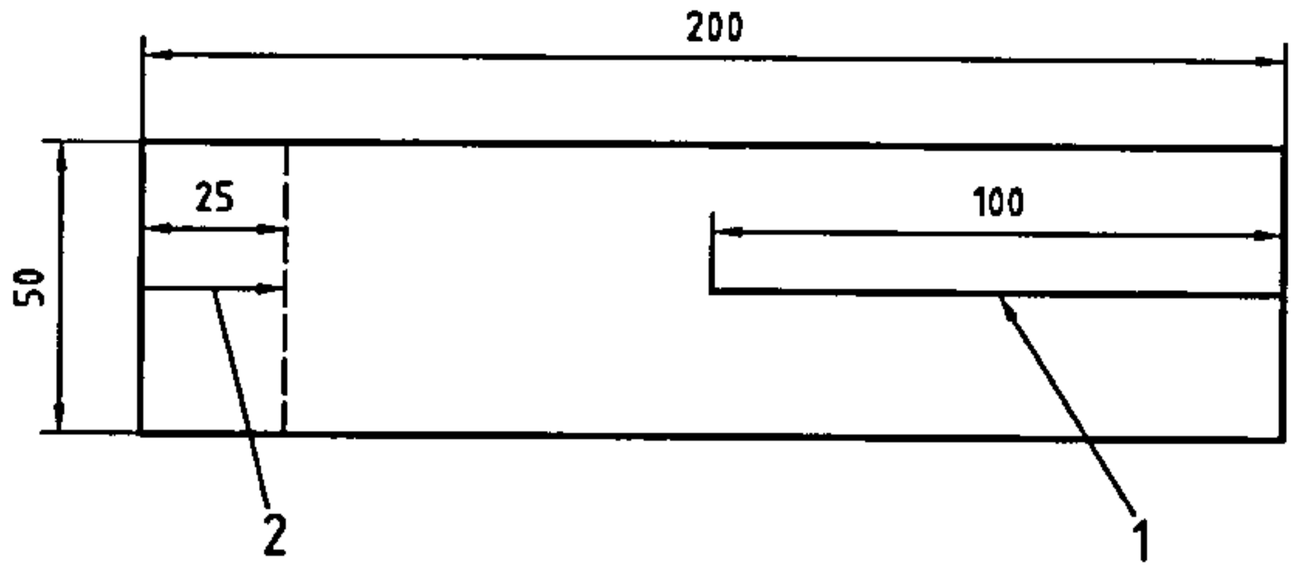
Select ten test pieces each 200 mm long × 50 mm wide. Select five test pieces in the longitudinal direction and five in the transverse direction, from the full usable width and length of the sample (see ISO 2286-1).

Select test pieces for tearing in the transverse direction (i.e. tearing across longitudinal or warp threads in the case of woven substrates) so that their width is parallel to the longitudinal edge of the coated fabric.

Select test pieces for tearing in the longitudinal direction (i.e. tearing across transverse or weft threads in the case of woven substrates) so that their width is perpendicular to the longitudinal edge of the coated fabric.

Make a slit longitudinally in each test piece, beginning from the middle of the width, 100 mm in length (see Figure 5).

Dimensions in millimetres



Key

1 cut

2 mark indicating end of tear

Figure 5 — Trouser-shaped test piece

Make a mark 25 mm from the uncut end in the middle of the strip to indicate the position of the end of the tear on completion of the test.

Test pieces 200 mm wide may be tested (see Note to 7.2) by agreement between the interested parties. Recommendations for the use of such test pieces are given in Annex B.

7.2 Procedure

Adjust the test machine to give a rate of jaw traverse of (100 ± 10) mm/min, and select the appropriate load capacity range. Engage and zero the autographic recorder. Adjust the jaw separation to 100 mm.

Clamp a test piece symmetrically in the jaws with one leg in each jaw and with the uncut end of the test piece remaining free (see Figure 6).

Take care to ensure that each leg is fixed in a jaw so that the beginning of the tear is parallel to the direction in which the tearing force is applied.

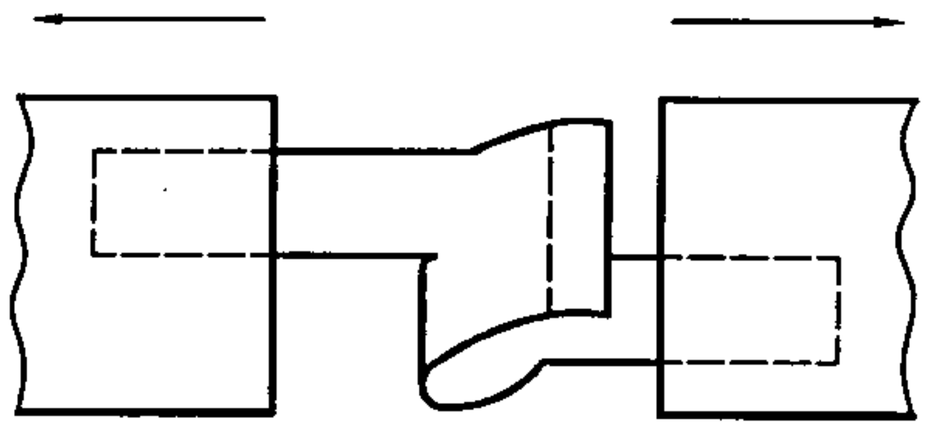


Figure 6 — Clamping of trouser-shaped test piece

Set the test machine in motion at the specified rate of traverse and continue tearing until the test piece is torn to the termination line.

Observe if the tear does not proceed along the direction of force and whether any threads slip out from the fabric rather than being torn. The test is to be considered correct if no slippage occurs in the jaws, no delamination takes place between coating and base fabric during the test and the tear proceeded and was completed along the direction of application of the force. Other results shall be rejected.

If three or more test pieces have to be rejected, consider the method as unsuitable.

NOTE In this case, and if the test has been performed with normal test pieces, the tear resistance may be assessed either by using another method, e.g. Part 2 of this International Standard, or by re-testing by the present method using large test pieces as described in Annex B.

7.3 Calculation and expression of results

From the trace obtained, calculate the results as described in 6.3.

8 Precision

The precision of the methods is not known.

9 Test report

The test report shall include the following particulars:

a) a reference to this part of ISO 4674;

b) the method used (method A or method B);

c) the date of the test;

d) a description or details of the coated fabric tested;

e) the mean tear strength, in newtons, in the longitudinal and transverse directions, and (if required) the coefficient of variation and 95 % confidence limits of each mean value;

f) the sampling scheme used, if known;

g) whether the test pieces were tested in their conditioned state or wet, the test atmosphere used and the duration of the conditioning or immersion period;

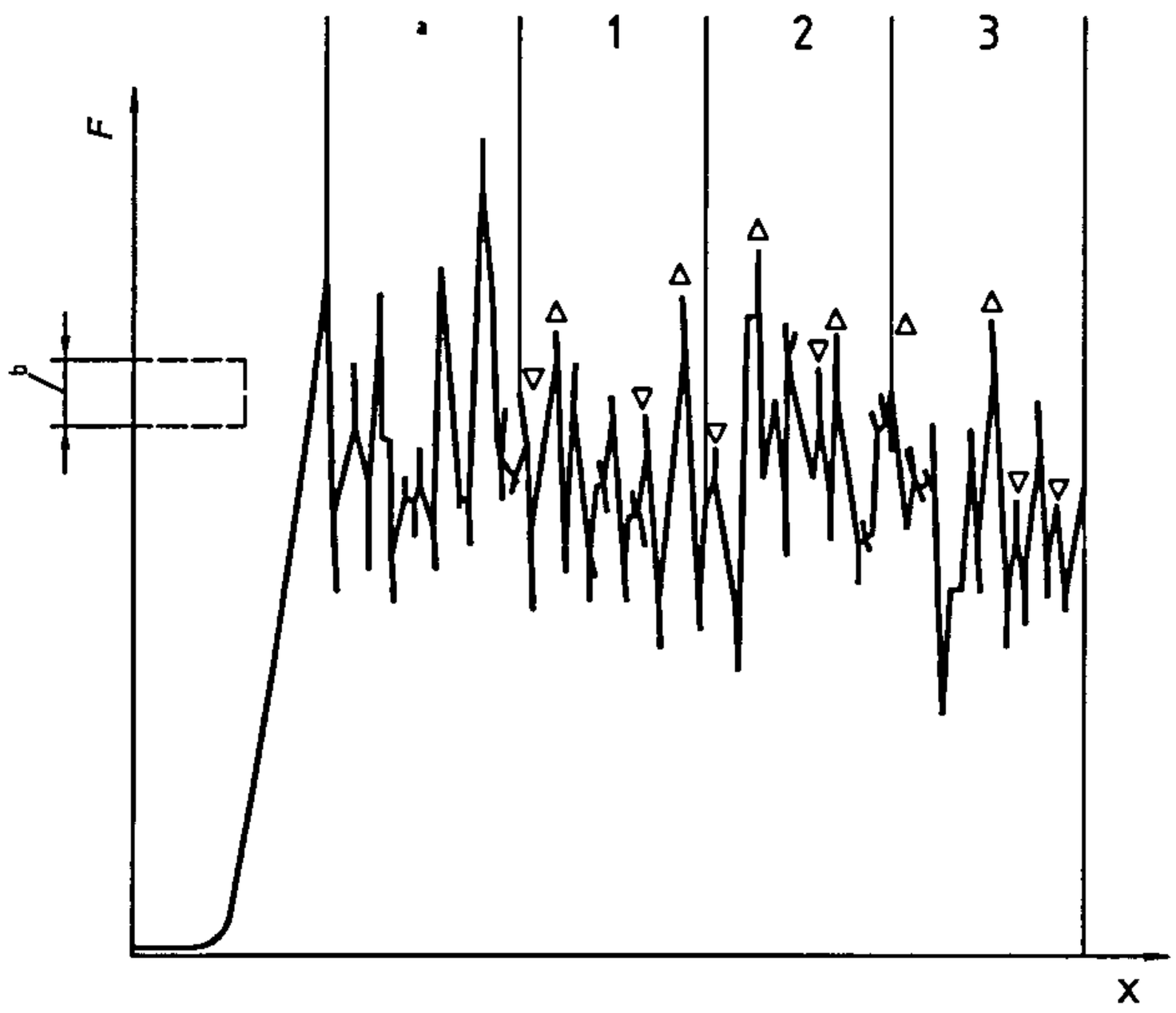
h) any deviations from the procedures specified.

Annex A
(informative)

Example of calculation of tear force

A.1 Example of tear trace

An example of a typical tear trace is given in Figure A.1.



Key

X direction of tear

F load

[a] Ignore.

[b] Approximate range of medium-sized peaks.

Figure A.1 — Example of typical tear trace

For manual evaluation, △ indicates the two highest peaks in each subsection, and ▽ represents the two lowest peaks in each subsection.

For electronic evaluation, use all peaks in subsections 1, 2 and 3 which show a drop in force $\geqslant$ 10 %.

A.2 Alternative approach using medium-sized peaks

To facilitate manual evaluations, it is suggested that the approximate range covered by the medium-sized peaks be used. 1/10 of this value rounded to ± 10 % indicates the drop in force required for the peak to be usable for calculation purposes.

EXAMPLE

Approximate range of medium-sized peaks	85 N to 90 N
10 % of this	8,5 N to 9 N
Peaks usable for calculation must therefore have	a drop in force > 8 N

Annex B
(informative)

Wide-width trouser-shaped test piece

According to 6.2 and 7.2, test results are rejected if any threads slip out of the fabric, the tear is incomplete, or the tear does not proceed along the direction of the force.

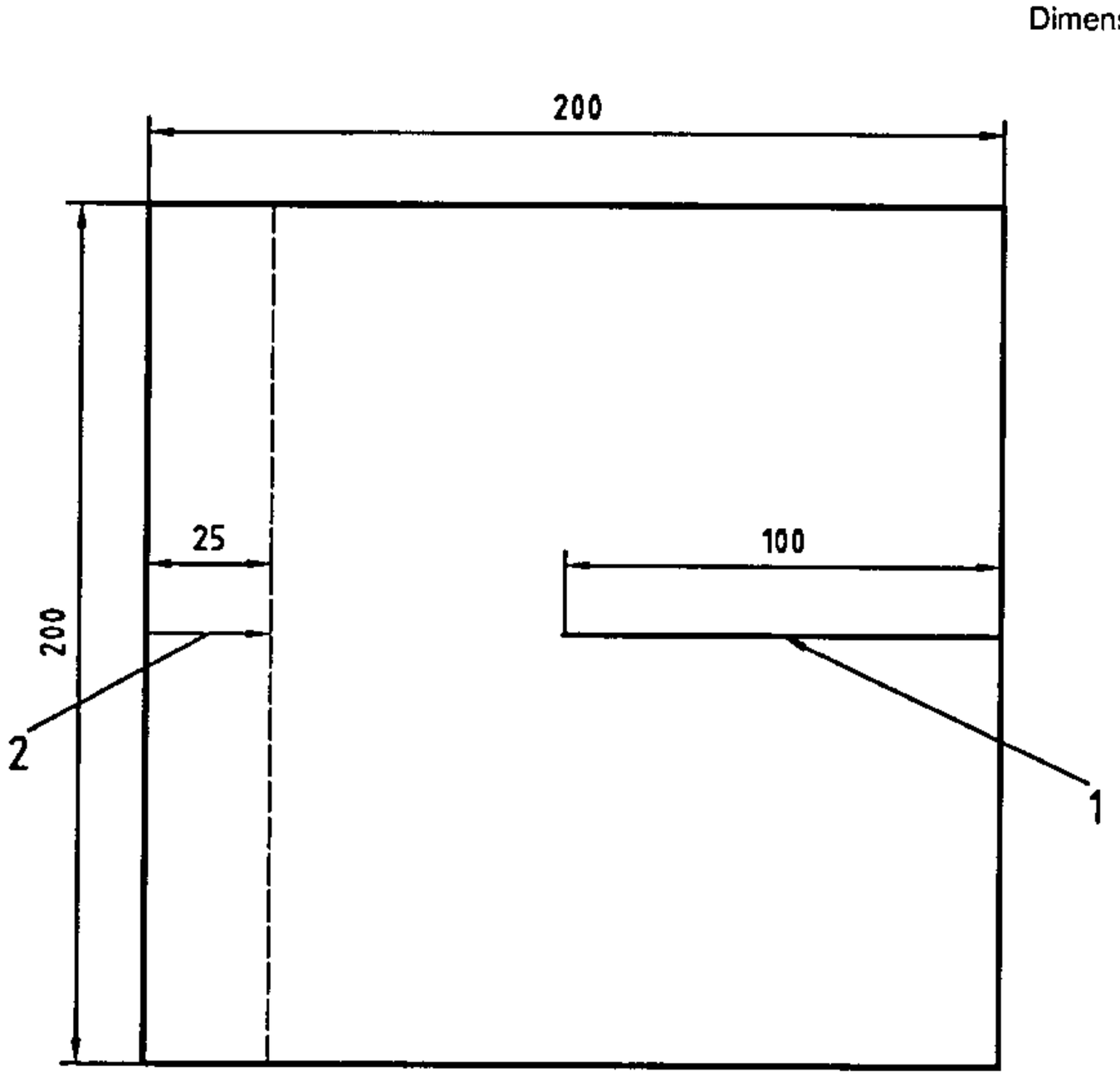
If three or more test pieces have to be rejected, the method is considered unsuitable.

In such cases, it is recommended that the test be repeated with wider test pieces (see Figure B.1). Before clamping, the edge of each trouser leg is folded in towards the cut, parallel to the cut, so that the clamped width of each trouser leg is half the width of the leg (see Figure B.2).

All other test conditions shall be as specified in this part of ISO 4674, except the width of the jaws shall be at least half the width of the test piece. Evaluate the tear trace as specified in 6.3. Specific designs of tear-resistant fabric may result in "unusual" tear traces, due to the specific characteristic of such fabrics, and it is recommended that the interested parties agree on the kind of evaluation which seems most appropriate and that tear trace be included in the test report.

Other widths may also be used by agreement between the interested parties.

Dimensions in millimetres

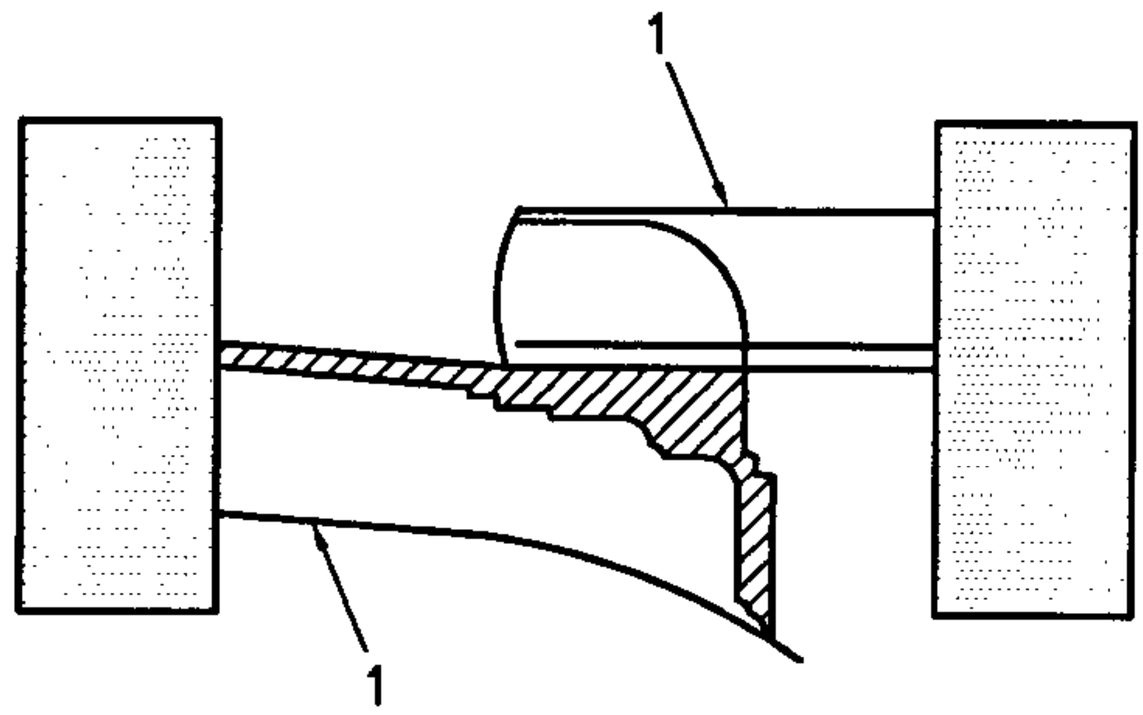


Key

1 cut

2 mark indicating end of tear

Figure B.1 — Wide-width trouser-shaped test piece



Key

1 folded edge

Figure B.2 — Clamping of wide-width test piece

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