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Leather — Physical and mechanical tests — Determination of tensile strength and percentage extension

Cuir — Essais physiques et mécaniques — Détermination de la résistance à la traction et du pourcentage d'allongement

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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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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 3376 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 289, *Leather*, in collaboration with the Physical Test Commission of the International Union of Leather Technologists and Chemists Societies (IUP Commission, IULTCS), in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

IULTCS, originally formed in 1897, is a world-wide organization of professional leather societies to further the advancement of leather science and technology. IULTCS has three Commissions, which are responsible for establishing international methods for the sampling and testing of leather. ISO recognizes IULTCS as an international standardizing body for the preparation of test methods for leather.

This third edition cancels and replaces the second edition (ISO 3376:2002), which has been technically revised in 4.4, 6.2.1, 7.1 and 8.

Leather — Physical and mechanical tests — Determination of tensile strength and percentage extension

1 Scope

This International Standard specifies a method for determining the tensile strength, elongation at a specified load and elongation at break of leather. It is applicable to all types of leather.

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 2418, *Leather — Chemical, physical and mechanical and fastness tests — Sampling location*

ISO 2419, *Leather — Physical and mechanical tests — Sample preparation and conditioning*

ISO 2589, *Leather — Physical and mechanical tests — Determination of thickness*

ISO 7500-1:2004, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

3 Principle

A test piece is extended at a specified rate until the forces reach a predetermined value or until the test piece breaks.

4 Apparatus

4.1 Tensile testing machine, with:

— a force range appropriate to the specimen under test;

— a means of recording the force to an accuracy of at least 2 % as specified by Class 2 of ISO 7500-1;

— a uniform speed of separation of the jaws of 100 mm/min ± 20 mm/min;

— a means of recording the force, e.g. as an extension curve;

— jaws, minimum length 45 mm in the direction of the applied load, designed to apply constant clamping by mechanical or pneumatic means. The texture and design of the inside faces of the jaws shall be such that, at the maximum load attained in the test, the specimen does not slip in either jaw by an amount exceeding 1 % of the original jaw separation.

4.2 A means of determining the extension of the test piece, either by monitoring the separation of the jaws or by sensors which monitor the separation of two fixed points on the test piece.

4.3 Thickness gauge, as specified in ISO 2589.

4.4 Press knives, as specified in ISO 2419, capable of cutting a test piece as shown in Figure 1 to the dimensions given in Table 1.

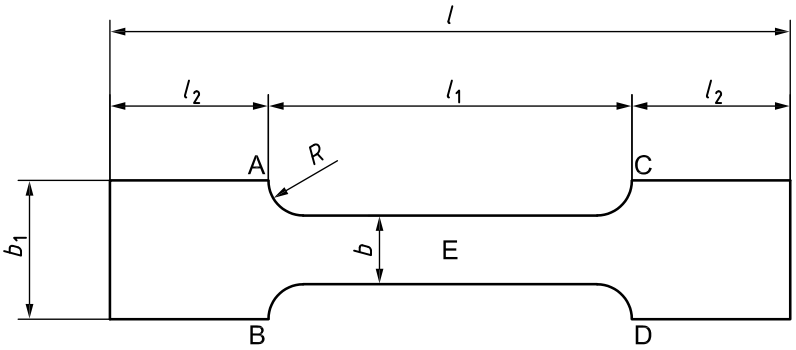

Figure 1 — Shape of test piece

Table 1 — Dimensions of test pieces

Dimensions in millimetres

Designation	l	l_1	l_2	b	b_1	R
Standard	110	50	30	10	20	5
Large	190	100	45	20	40	10

4.5 Vernier callipers, reading to 0,1 mm.

5 Sampling and sample preparation

5.1 Sample in accordance with ISO 2418.

5.2 From the sample, cut six test pieces in accordance with ISO 2419 by applying a press knife (4.4) to the grain surface, three test pieces with the longer sides parallel to the backbone and three test pieces with the longer sides perpendicular to the backbone. If previous testing has shown that there is slippage of the test piece in the jaws, use the large press knife (4.4).

If there is a requirement for more than two hides or skins to be tested in one batch, then only one test piece in each direction need be taken from each hide or skin, provided that the overall total is not less than three test pieces in each direction.

5.3 Condition the test pieces in accordance with ISO 2419.

6 Procedure

6.1 Determination of dimensions

6.1.1 Using vernier callipers (4.5), measure the width of each test piece to the nearest 0,1 mm at three positions on the grain side and three on the flesh side. In each group of three measurements, make one at the mid-point E (as shown in Figure 1) and the other two at positions approximately midway between the mid-point E and the lines AB and CD. Take the arithmetic mean of the six measurements as the width of the test piece, w. For soft ("flexible") leather, the width shall be taken as the width of the press knife.

6.1.2 Measure the thickness of each test piece in accordance with ISO 2589. Make the measurements at three positions, namely the mid-point E and at positions approximately midway between the mid-point E and the lines AB and CD. Take the arithmetic mean of the three measurements as the thickness of the test piece, t.

6.2 Determination of tensile strength

6.2.1 Set the jaws of the tensile testing apparatus (4.1) 50 mm ± 1 mm apart if using the standard test piece or 100 mm apart if using the large test piece. Clamp the test piece in the jaws so that the edges of the jaws lie along the lines AB and CD. When the test piece is clamped, ensure its grain surface lies in one plane. The length axis shall be parallel to the traction direction.

6.2.2 Run the machine until the test piece breaks and record the highest force exerted as the breaking force, F.

6.3 Determination of the percentage elongation caused by a specified load

6.3.1 Clamp the test piece between the jaws of the apparatus, as described in 6.2.1. Measure the distance between the jaws at least to the nearest 0,5 mm and record this distance, L_0, as the initial length of the test piece for the purpose of the test.

6.3.2 Start the test. Unless the apparatus automatically draws a force/extension curve with the necessary accuracy (see 4.2), follow the distance between the pair of jaws or the sensors as the force increases.

6.3.3 Note the distance, in millimetres, between the pair of jaws or sensors at the instant when the force first reaches the specified value. This distance represents the length of the test piece at this force, L_1. Do not stop the apparatus if results from the procedures described in 6.2 or 6.4 are also required.

6.4 Determination of the percentage elongation at break

6.4.1 Carry out the steps given in 6.3.1.

6.4.2 Run the tensile test machine until the test piece breaks.

6.4.3 Record the distance between the jaws or sensors at the instant when rupture of the test piece occurs.

This distance represents the length of the test piece at break, L_2.

6.5 Slippage

If there is slippage of the test piece in either jaw when tested according to 6.2, 6.3 or 6.4, and the slippage is greater than 1 % of the initial jaw separation, reject the result and repeat the determination with a new test piece cut using the large press knife (4.4).

7 Expression of results

7.1 Tensile strength

The tensile strength, T_n, in MPa (or newtons per square millimetre, if required) shall be calculated using the equation:

$$T_n = \frac{F}{\bar{w} \cdot \bar{t}}$$

where

F is the highest force recorded, in newtons;

$\bar{w}$ is the mean width of the test piece, in millimetres;

$\bar{t}$ is the mean thickness of the test piece, in millimetres.

NOTE The relationship between MPa and N/mm^2 is the following: 1 N/mm^2 = 1 MPa.

7.2 Percentage elongation caused by a specified load

The percentage elongation caused by a specified load, E_1, shall be calculated using the equation:

$$E_1 = \frac{L_1 - L_0}{L_0} \times 100$$

where

L_1 is the separation of the jaws or sensors at the specified load;

L_0 is the initial separation of the jaws or sensors.

7.3 Percentage elongation at break

The percentage elongation at break, E_b, shall be calculated using the equation:

$$E_b = \frac{L_2 - L_0}{L_0} \times 100$$

where

L_2 is the separation of the jaws or sensors at break;

L_0 is the initial separation of the jaws or sensors.

8 Test report

The test report shall include the following:

a) a reference to this International Standard, i.e. ISO 3376:2011;

b) the mean tensile strength, in MPa (or newtons per square millimetre), to the nearest 0,1 MPa, for the test pieces with the longer edge cut parallel to the backbone;

c) the mean tensile strength, in MPa (or newtons per square millimetre), to the nearest 0,1 MPa, for the test pieces with the longer edge cut perpendicular to the backbone;

d) the mean percentage elongation at break to the nearest 1 %, for the test pieces with the longer edge cut parallel to the backbone;

e) the mean percentage elongation at break to the nearest 1 %, for the test pieces with the longer edge cut perpendicular to the backbone;

f) the mean percentage elongation at a specified load to the nearest 1 %, for the test pieces with the longer edge cut parallel to the backbone; if required;

g) the mean percentage elongation at a specified load to the nearest 1 %, for the test pieces with the longer edge cut perpendicular to the backbone, if required;

h) the thickness of the sample, in millimetres, in accordance with ISO 2589;

i) any deviations from the method specified in this International Standard;

j) full details for identification of the sample and any deviation from ISO 2418 with respect to sampling;

k) if required by the customer or in specifications, it is permitted to report the results described in 8 l), 8 m) and 8 n) instead of 8 b) to 8 g);

l) the average tensile strength, in MPa (or newtons per square millimetre), to the nearest 0,1 MPa [i.e. the arithmetic mean of b) and c)];

m) the average percentage elongation at break to the nearest 1 % [i.e. the arithmetic mean of d) and e)];

n) the average percentage elongation at a specified load to the nearest 1 % [i.e. the arithmetic mean of f) and g)], if required;

o) the standard atmosphere used for conditioning and testing, as given in ISO 2419.