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

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

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 289, *Leather*, the secretariat of which is held by UNI, 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 fourth edition cancels and replaces the third edition (ISO 3376:2011), which has been technically revised in 7.3.1 to allow a pre-load.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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

1 Scope

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia. available at http://www.electropedia.org/

4 Principle

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

5 Apparatus

5.1 Tensile testing machine, with:

a) a force range appropriate to the specimen under test;

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

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

d) a means of recording the force, for example as an elongation curve;

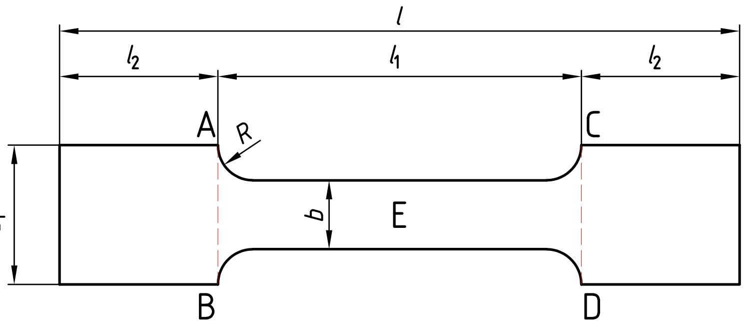
e) jaws, minimum length of 45 mm in the direction of the applied load, designed to apply constant clamping by mechanical or pneumatic means. The texture and design of the inside faces of the jaws

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.

5.2 A means of determining the elongation 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.

5.3 Thickness gauge, as specified in ISO 2589.

5.4 Press knives, as specified in ISO 2419, capable of cutting a standard or large size test piece as shown in Figure 1 to the dimensions given in Table 1.



Key

AB and CD upper and lower clamping position, respectively
E mid-point
l length of each section
b width of each section

Figure 1 — Shape of test piece

Table 1 — Dimensions of test pieces

Dimensions in millimetres

Test piece size	l	l_1	l_2	b	b_1	R
Standard	110	50	30	10	20	5
Large[a]	190	100	45	20	40	10

[a] The standard size should be used; however, if slippage (7.5) cannot be prevented by appropriate means, the large test piece should be used.

5.5 Vernier callipers, reading to 0,1 mm.

6 Sampling and sample preparation

6.1 Sample in accordance with ISO 2418.

6.2 After conditioning in accordance with ISO 2419, cut six test pieces from the sample by applying a press knife (5.4) 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 (5.4).

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.

6.3 If the test pieces are removed from standard atmosphere for cutting and not tested within 30 minutes, then the test pieces shall be returned straight away to the standard atmosphere for conditioning in accordance with ISO 2419.

7 Procedure

7.1 Determination of dimensions

7.1.1 Using vernier callipers (5.5), 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 b (in Figure 1) shall be taken as the width of the press knife.

7.1.2 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.

7.2 Determination of tensile strength

7.2.1 If 7.3 and/or 7.4 are also required to be carried out, then the same test piece may be used to complete 7.2, 7.3 and/or 7.4 in a single test, providing the pre-load and initial length measurement described in 7.3.1 is carried out at 7.2.1.

7.2.2 Set the jaws of the tensile testing apparatus (5.1) (50 ± 1) mm apart if using the standard test piece or (100 ± 1) 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.

7.2.3 Run the machine until the test piece breaks and record the highest force exerted as maximum force, F_{max}.

7.2.4 For tensile strength determination, the recorded F_{max} value shall be used for calculation.

NOTE Variable results can occur if using the force at the test piece's break, F_{break}, instead of F_{max}, depending on the type of leather.

7.3 Determination of the percentage elongation caused by a specified load

7.3.1 Clamp the test piece between the jaws of the apparatus, as described in 7.2.2. For measurement of elongation a slight tension shall be applied by means of a pre-load. This may be achieved by:

a) manually applying a low load below the clamping position CD as the lower jaw is closed, or

b) instrumentally using the tensile testing machine (5.1) to apply a pre-load.

An instrumental pre-load value may be chosen according to the maximum force, $F_{max,}$ of the leather to be tested or as otherwise specified by the client. Examples of instrumental pre-load values are:

— for F_{max} ≤ 100 N, a pre-load of 0,5 N;

— for 100 N < F_{max} ≤ 300 N, a pre-load of 2,0 N;

— for F_{max} > 300 N, a pre-load of 5 N;

and in each case there should be no significant elongation.

If the leather's maximum force, $F_{max,}$ is unknown, a pre-test as described in 7.2 using an additional test piece for each test direction is required; for these additional test pieces and only for this pre-test determination, it is not necessary to carry out the determination of dimensions described in 7.1.

Measure the distance between the jaws to at least 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.

7.3.2 Start the test. Unless the apparatus automatically draws a force/elongation curve with the necessary accuracy (see 5.1 b), follow the distance between the pair of jaws or the sensors as the force increases.

7.3.3 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 7.2 or 7.4 are also required.

7.4 Determination of the percentage elongation at maximum force

7.4.1 Carry out the steps given in 7.3.1.

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

7.4.3 Record the distance, L_2, between the jaws or sensors at maximum force F_{max}.

NOTE Variable results can occur if using the elongation at the test piece's break, E_{break}, instead of E_{max}, depending on the type of leather.

7.5 Slippage

If any visible sign of slippage of the test piece is seen in either jaw when tested according to 7.2, 7.3 or 7.4, reject the result and repeat the determination with a new test piece cut using the large press knife (5.4).

8 Expression of results

8.1 Tensile strength

The tensile strength, T_n, in MPa (or newtons per square millimetre, if required) shall be calculated using Formula (1).

$$T_n = \frac{F_{max}}{\bar{w} \cdot \bar{t}} \quad (1)$$

where

F_{max} 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 as follows: 1 N/mm^2 = 1 MPa.

8.2 Percentage elongation caused by a specified load

The percentage elongation caused by a specified load, E_1, shall be calculated using Formula (2).

$$E_1 = \frac{L_1 - L_0}{L_0} \times 100 \tag{2}$$

where

E_1 is the percentage elongation, %;

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

L_0 is the initial separation, in millimetres, of the jaws or sensors.

8.3 Percentage elongation at maximum force

The percentage elongation at maximum force, E_{max}, shall be calculated using Formula (3).

$$E_{max} = \frac{L_2 - L_0}{L_0} \times 100 \tag{3}$$

where

E_{max} is the percentage elongation, %, at maximum force;

L_2 is the separation, in millimetres, of the jaws or sensors at maximum force;

L_0 is the initial separation, in millimetres, of the jaws or sensors.

9 Test report

The test report shall include the following:

a) a reference to this document, i.e. ISO 3376:2020;

b) size of test piece used, standard or large (5.4);

c) the pre-load value if instrumentally applied;

d) 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;

e) 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;

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

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

h) 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;

i) 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;

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