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# Leather — Physical test methods — Determination of water resistance of heavy leathers

*Cuir — Méthodes d'essais physiques — Détermination de la résistance à l'eau des cuirs épais*

[Revision of first edition (ISO 5404:2002)]

ICS 59.140.30

## ISO/CEN PARALLEL PROCESSING

This draft has been developed within the European Committee for Standardization (CEN), and processed under the **CEN-lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five-month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

**This draft International Standard is submitted to all ISO member bodies for voting, as a standard prepared by an international standardizing body in accordance with Council Resolution 42/1999. The proposer, International Union of Leather Technologists and Chemists (Commission IUP, IULTCS), has been recognized by the ISO Council as an international standardizing body for the purpose of Council Resolution 42/1999.**

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## Foreword

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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 5404 was prepared by the Physical Tests Commission of the International Union of Leather Technologists and Chemists Societies (IUP Commission, IULTCS) in collaboration with the European Committee for Standardisation (CEN) Technical Committee CEN/TC 289, *Leather*, the secretariat of which is held by UNI, in accordance with the agreement on technical co-operation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition which has been technically revised.

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# Leather — Physical test methods — Determination of water resistance of heavy leathers

## 1 Scope

This International Standard specifies a method for determining the water resistance of heavy leathers. The method allows determination of the penetration time, water absorption, area of penetration and water penetration rate as required. It is applicable to all types of heavy leathers.

## 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

## 3 Terms and definitions

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

**3.1**
**penetration time**
duration of flexing in minutes which is just sufficient to cause water to cross from the wetted (grain) surface to the other face of the test piece

**3.2**
**water absorption**
gain in mass of the test piece due to water content during any period of the test, expressed as a percentage of its conditioned mass prior to test

**3.3**
**area of penetration**
sum (in square millimetres) of the areas where water has crossed from the wetted (grain) surface to the other face of the test piece

**3.4**
**penetration rate**
water transmitted through the leather expressed in grams per square decimetre (of leather) per hour based on the mass of water transmitted in the 10 minute period after the first penetration of water

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## 4 Principle

The test piece is continuously wetted on one surface and is flexed and compressed in the same manner as the sole of a shoe during walking. This enables various aspects of heavy leather water resistance to be measured with respect to time.

## 5 Apparatus

**5.1 Test machine**, including the items described in 5.1.1 to 5.1.7. The general arrangement of the test machine is shown in Figure 1.

**5.1.1 Roller (A)**, diameter 120 mm ± 2 mm and width at least of 50 mm.

**5.1.2 Platform (C)**, measuring 100 mm ± 1 mm x 40 mm ± 1 mm, with a roughened upper surface and with sufficient perforations to allow the surface to be kept wet by a flow of water through the platform.

**5.1.3 Clamp (D)**, to hold one short side of the test piece (B) in a horizontal position on the platform (C).

**5.1.4 Clamp (E)**, to attach the other short side of the test piece to the roller with the attached side being parallel to the axis of the roller. The clamp is held by a weak spring to maintain the sample under slight tension.

NOTE The clamps must ensure a total length of the test piece on the platform of 100 mm ± 1 mm.

**5.1.5 Water supply (F)**, through the platform (C) and a means of draining away excess water.

**5.1.6 Means of moving the axis of the roller**, with a crank motion along the horizontal line XY with an amplitude of 100 mm ± 2 mm and a frequency of 20 ± 1 cycles per minute about a point directly over the mid point of the test piece. The movement of the axis causes the roller to move backwards and forwards along the test piece, raising one end and bending it to conform to the shape of the roller.

**5.1.7 Means of pressing the platform**, test piece and roller together with a force of 80 N ± 5 N.

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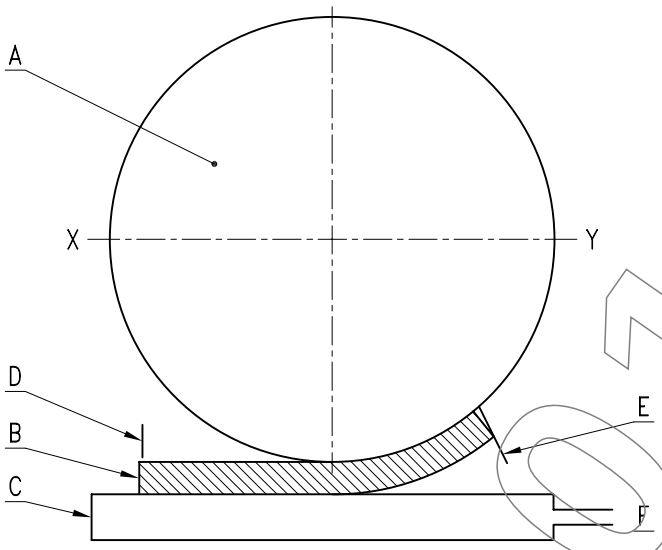


**Key**

A Roller
B Test piece
C Platform
D Clamp
E Clamp
F Water supply

**Figure 1 — General arrangement of test machine**

**5.2 Undyed cotton gauze**, cut into rectangles with suitable dimension to be fixed on the platform.

**5.3 Press knife**, the inner wall of which is a rectangle of suitable length to be fixed in the clamps so that the total length of the test piece on the platform is 100 mm ± 1 mm and width of 40 mm ± 1 mm as specified in ISO 2419.

**5.4 Thickness gauge**, as specified in ISO 2589.

**5.5 Absorbent cellulosic board**, thickness 1,6 mm ± 0,1 mm and mass 1200 g/m$^2$ ± 300 g/m$^2$ cut into rectangles 105 mm ± 5 mm x 60 mm ± 5 mm.

**5.6 Abrasive paper**, grade P120, as defined in the P-series grain size standard published by the Federation of European Producers of Abrasive Products.

**5.7 Balance**, reading to 0,001 g.

**5.8 Clock**, reading to 1 s.

**5.9 Flexible waterproof adhesive**, for example polychloroprene, polyvinyl chloride or polyurethane.

**5.10 Transparent overlay**, minimum size 100 mm x 40 mm, marked with a central matrix of 28 x 10 squares of area 9 mm$^2$ as shown in Figure 2.

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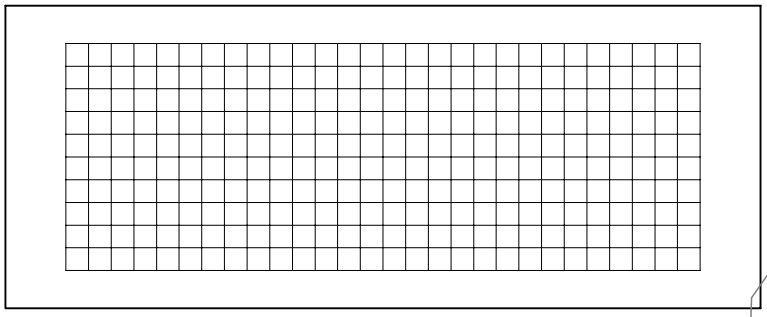

**Figure 2 — Transparent overlay**

## 6 Sampling and sample preparation

**6.1** Sample in accordance with ISO 2418. Cut at least three test pieces from the laboratory sample by applying the press knife (5.3) to the grain surface oriented with the longer side parallel to the backbone.

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

**6.2** Place the surface which is to be in contact with the ground (normally the grain surface), on a fresh piece of abrasive paper (5.6). Press the test piece against the abrasive paper with a force of 10 N ± 1 N. Roughen the leather surface by moving the test piece 10 times backwards and forwards over the abrasive paper for 100 mm ±10 mm each time.

NOTE Thin waterproof finish applied to the grain of sole leather may greatly reduce penetration of water into it during the test, but be ineffective on a sole because it is rapidly removed during wear. For this reason, the test pieces are roughened as described above prior to testing. The aim of this preparation is to remove the finish. If a heavier finish has been applied then more abrasion may be required.

**6.3** Apply a coat of flexible adhesive (5.9) to the cut edges of the test piece, ensuring that there are no air bubbles within the coat. Allow to dry for 35 min ± 5 min and, if necessary, apply a second coat of adhesive.

**6.4** Condition the test piece in accordance with ISO 2419.

**6.5** If the water penetration rate is to be determined, condition the cellulosic board (5.5) in accordance with ISO 2419.

## 7 Procedure

### 7.1 General

**7.1.1** Weigh the test piece, $M_0$, to the nearest 0,001 g.

**7.1.2** Determine the thickness in accordance with ISO 2589.

**7.1.3** Place the cotton gauze (5.2) on the platform and adjust the flow of water to give a flow of 7,5 ml/min ± 2,5 ml/min over the platform.

**7.1.4** Lay the test piece on the gauze with the roughened surface downwards and attach the narrow ends to the platform and roller.

**7.1.5** Press the test piece on the roller with a force of 80 N ± 5 N.

**7.1.6** Set the roller in motion and record the time.

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### 7.2 Determination of penetration time

Note the time at which water is clearly seen on the leather surface adjacent to the roller, ignoring any penetration in an area 5 mm from the edge of the test piece.

NOTE An acoustic or optical signal may be used to assist in the detection of initial water penetration, but the effective penetration of water must be checked by visual observation.

### 7.3 Determination of water absorption

**7.3.1** At the end of a specified period of time (i.e. 15 minutes, 30 minutes, 60 minutes or when penetration of water occurs), stop the machine, remove the test piece and blot it lightly with filter paper to remove water adhering to the surface, taking care not to force water out of the sample. Weigh the test piece, $M_1$, to the nearest 0,001 g.

**7.3.2** If the determination of water absorption after longer periods of time is required, return the test piece to the machine and continue the test.

**7.3.3** Repeat the procedure until the test is completed (see NOTE in 7.5.3).

### 7.4 Determination of area of penetration

**7.4.1** At the end of the first hour of testing, stop the machine and remove the test piece. Lay the transparent overlay over the upper surface of the test piece and estimate the total area of penetration by comparing the wetted areas, if any, with the areas marked on the overlay. If visual examination shows that wetting of the upper surface is taking place from the edge then the test is to be regarded as invalid and repeated with a fresh test piece.

**7.4.2** If is required the determination of area of penetration after longer periods of time, return the test piece to the machine and continue the test.

**7.4.3** Repeat the procedure until the test is completed (see NOTE in 7.5.3).

### 7.5 Determination of water penetration rate

**7.5.1** Weigh a rectangle of cellulosic board (5.5), $W_0$, to the nearest 0,001 g.

**7.5.2** When first penetration of water occurs, stop the machine and wipe the roller to remove any water adhering to it. Place a weighed rectangle of cellulosic board between the test specimen and roller and restart the machine. After a further 10 min ± 0,2 min stop the machine, remove the board and reweigh, $W_1$. If the cellulosic board has no dry parts, the results are to be rejected and the test repeated with a fresh test piece and absorbent board with the test period being reduced and a corresponding correction being made to the calculation for water penetration rate.

**7.5.3** If the determination of water penetration rate after longer periods of time is required, return the test piece to the machine and continue the test.

NOTE The period when the machine is stopped for weighing the test piece, the measurement of area of penetration or for inserting or removing absorbent boards should be as short as possible and the fact that the machine was stopped during these periods is ignored in the measurement of the intervals.

## 8 Expression of results

### 8.1 Water absorption

The water absorption $W_a$, expressed as a percentage (%), shall be calculated using the formula:

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$$W_a = \frac{(M_1 - M_2) \times 100}{M_0}$$

where:

$M_1$ is the mass of test piece after any test period, in grams

$M_0$ is the initial conditioned mass of the test piece, in grams

### 8.2 Water penetration rate

The water penetration rate $W_p$, in grams per square centimetre hour ($g/cm^2 \cdot h$), shall be calculated using the formula:

$$W_p = \frac{(W_1 - W_{0)}}{t \times A}$$

where:

$W_1$ is the mass of the absorbent board, in grams, after any 10 minute test period

$W_0$ is the initial conditioned mass of the absorbent board, in grams

T is the period of calculation of penetration rate in hours (i.e. 10 minutes after penetration of water)

A is the contact area of the test piece on the platform (i.e. 40 $cm^2$)

## 9 Test report

The test report shall include the following for each test piece:

a) reference to this International Standard, i.e. ISO 5404;

b) the average thickness of the test piece in mm to the nearest 0,1 mm;

c) the average penetration time in minutes to the nearest 1 minute, if determined;

d) the average percentage water absorption at each test period to the nearest 1%, if measured;

e) the average area of penetration at each test period in $mm^2$ to the nearest 1 $mm^2$, if measured;

f) the average water penetration rate at each test period in $g/cm^2$ h to the nearest 1 $g/cm^2$ h, if measured;

g) the standard atmosphere used for conditioning and testing as given in ISO 2419;

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

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

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# Annex A
(informative)

## Sources of apparatus

Examples of suitable products available commercially are given below. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of these products.

The recommended apparatus is manufactured, for example, by:

Giuliani Apparecchi Scientifici via Centrallo 68/18, I-10157 Torino Italy

SODEMAT, 29 rue Jean Moulin, ZA Coulmet, F-10450 Breviandes, France

SATRA Technology Centre, Rockingham Road, Kettering, Northants, NN16 9JH, England.

Muver - Francisco Muñoz Irles, Avda Hispanoamerica 42, E-03610 Petrer (Alicante), Spain.

ZIPOR - Equipamentos e Tecnologia Industrial, S.A. - Rua dos Açores, 278 - Zona Industrial nº 1 - 3700-018 S. João da Madeira - PORTUGAL

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