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Leather — Measurement of leather surface — Using electronic techniques

Cuir — Mesurage de la surface du cuir — Utilisation de techniques électroniques

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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).

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

ISO 19076/IUP 58 was prepared by the Physical Test Commission of the International Union of Leather Technologists and Chemists Societies (IUP Commission, IULTCS) in collaboration with the European Committee for Standardization (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).

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.

Introduction

Leather surface measuring equipment used within the European Union (EU) for legal metrology applications are also subject to the EU Directive, 2004/22/EC, on measuring instruments.

Leather — Measurement of leather surface — Using electronic techniques

1 Scope

This International Standard provides a method for the measurement of the surface of leather or leather parts by the use of electronic measuring machines.

It applies to the measurement of leather (or leather parts) fulfilling the following requirements:

— flexible leather, finished or unfinished, dry or wet leather;

— flexibility: such to allow full distension on the measuring line/surface.

NOTE For tanned and pressed wet leather, the parties involved agree on the conditioning type. In case of dispute, leather is to be conditioned according to the reference standard conditions in ISO 2419.

2 Normative references

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

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

ISO 2588, *Leather — Sampling — Number of items for a gross sample*

EN 15987, *Leather — Terminology — Key definitions for the leather trade*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 15987 and the following apply.

3.1
relative feed
<in non-static measuring machines> movement of relative translation between leather and the system detecting its presence

4 Principle

The leather surface is measured by means of a measuring device provided with a linear or rectangular array of uniformly-spaced electronic sensors, capable to detect leather presence and to integrate the relevant information (as a sum of elementary rectangular areas). Precision data are available in Annex D.

5 Apparatus and materials

5.1 Measuring machine

5.1.1 Machine design types

The measuring machines are built according to 4 basic types:

Type A roller machines, where leather passes in front of the sensor array under guidance of a series of free-rotating measuring rollers easing leather spread out by a light pressure on the sensor array, also incorporating the feeding systems.

Type B conveyor machines, where leather is transported under the sensor array by cables or belts mounted before and after the sensors themselves and substantially coplanar with them.

NOTE 1 This machine is more suitable for rigid leathers as the leather is transported on cables.

Type C flatbed scanning machines, with a horizontal plane surface (flatbed) where leather is laid flat, and a "portal-shaped" frame containing the sensors; the frame is manually or mechanically moved, over and parallel to the flatbed.

NOTE 2 This machine type is particularly used to measure the surface of small leathers or pieces of leather.

Type D bi-dimensional static measuring devices, based on the capture of a 2-dimension leather image along the normal direction to the leather plane.

5.1.2 Type A, B, and C measuring machines

The measuring machine consists at least of:

— a base frame;

— a relative feed system between leather and measuring system;

— a set of sensors (sensor array) uniformly spaced along a direction normal to the feeding movement, to detect leather presence;

— a processing system to integrate signals coming from the sensors array and from the feeding movement sensing, as shown in Clause 4;

— a numerical indicator (display) of the leather surface measure, in metric units, with 0,1 dm^2 resolution with respect to the measured value. As an option, the machine may be equipped with a stamping or printing system to record the surface measured value onto leather or onto a label.

The distance *i* between two adjacent sensors for the detection of leather presence shall not be greater than 27 mm across the feeding direction.

Let *p* be the step of the leather presence detection along the feeding direction: the values of *i* and *p* shall be such that their product *i.p* is not greater than 1/400 of the minimum measureable surface.

The feeding speed shall allow leather to spread out adequately during measurement.

NOTE 1 The machine is equipped with a feeding speed adjustment device to aid the fulfilment of this condition.

NOTE 2 In Type A and Type B machines the feeding speed can affect the spread out of the leather and consequently the measuring uncertainty.

If the machine allows temporary feeding stop (e.g. by manual holding) during measurement, this shall not significantly alter the measuring value.

Any feeding inversion, even partial and/or temporary, shall automatically cancel the measure, unless the measuring system allows for the inversion in the area calculation. Such information shall be checked in the instruction manual provided by the machine manufacturer.

5.1.3 Type D measuring machine

The measuring machine consists at least of:

— a base frame;

— a plane surface to spread and support leather;

— a bi-dimensional image capturing system, with its optical axis normal to the leather surface;

— a system for image processing and leather surface calculation.

The leather surface corresponding to the elementary area measuring unit (pixel) shall not be greater than 1/400 of the minimum measured surface.

EXAMPLE If the image capturing system is able to transfer a (2 m × 2 m) area into a (512 × 512) pixels array, the surface corresponding to 1 pixel (elementary area) is:

(2 m/512) × (2 m/512) = 0,15 cm^2

The minimum measurable surface is therefore:

400 × 0,15 cm^2 = 60 cm^2 = 0,60 dm^2.

5.2 Reference calibrated templates for machine verification

Calibrated templates complying with Annex A requirements, such that the area of the calibrated template is not less than 50 % of the area of the measured leather, or 1,4 m^2, whichever is smaller.

6 Sampling and conditioning

6.1 Batch sampling shall be according to ISO 2588, unless there is a different agreement between the parties. Label and identify each leather piece making up the batch.

6.2 For dry leather, spread out or hang leathers in a standard atmosphere according to ISO 2419, so that air may freely flow on both leather faces (grain and flesh); whenever possible use continuous and fast air circulation. The minimum duration of conditioning is 48 h.

In case of wet leather, conditioning shall be agreed between the parties, in order to ensure adequate leather spread out.

For the conditioning of wet-blue, soak the wet-blue hides in water at a temperature of 37 °C for a minimum period of 2 h or until dry fold lines have fully relaxed. Sammy the hides in a way that a final moisture content of 60 % ± 5 % is ensured. Then lay them flat, fully extended but not stretched until they are measured.

6.3 If measurement is performed in an unconditioned environment, it shall be carried out within 30 min from test sample extraction from the conditioning atmosphere.

6.4 In case of leather where a finish or a coating protrudes over the leather edges, these protruding parts shall be removed before measuring.

In case of haired leather, care is needed to avoid hair protruding over the leather edge, since with these types of machines hair presence can influence the measurement result significantly.

7 General measurement criteria

7.1 General requirement

The results obtained for the leather surface area can vary depending on the type of machine (see Annex D). Therefore the parties involved in a commercial transaction intending to refer to this International Standard shall agree on the specific instrument to be adopted among type A, B, C and D machines.

7.2 Leather orientation during measurement

7.2.1 General

Place leather in the measuring machine in such a way that leather surface is completely spread out and flattened, without creases or folds which might modify the optical projection onto the measuring line.

7.2.2 Measuring whole leathers

In order to ease spreading out, the leather shall be fed into the measuring machine with its backbone aligned with the feeding direction. The leather should preferably be fed in such a way that its wider part is measured first: this usually corresponds to feed the leather from the animal's back part ("rump").

This subclause does not apply to Type C and Type D machines.

7.2.3 Measuring half leathers

Since these leathers have a straight edge, it is fundamental to avoid the edge to be parallel to the feeding direction. To avoid significant measuring errors, half leathers shall be fed in such a way that the straight edge forms an angle of 10° to 20° to the feeding direction or, in Type D machines, to the sensor line.

7.2.4 Measuring leather cut pieces

Leather pieces shall be fed in from the longer edge, assuring that any straight edge forms an angle of at least 10° to 20° with the feeding direction or, in Type D machines, with the sensor (pixel) line.

7.3 Measurement operations

7.3.1 Roller machines

Lay and spread out the forward part of the leather (or of the calibrated template) on the front bench leaving the remaining part to hang down.

Move the leather front edge towards the rollers until the leather begins to be dragged in.

While the leather is dragged in, keep it spread out towards the lateral edges, preventing creases and folds. In case of folding, the leather can be temporarily stopped in its central part on the outer edge of the feeding bench, in order to help crease removal. However, this operation shall come to an end as soon as possible.

Should the leather be fed under the rollers not adequately spread out despite of such actions, the measurement shall be cancelled and repeated.

In order to ensure correct spread out of large leathers (i.e. with area greater than 2,5 m^2 or with width greater than 1,5 m), two operators are required, respectively on the right and left side of the feeding bench. In this case, once the leather is driven in the operators use one hand to spread the leather and remove the creases, while the other hand, in case of need, can brake or stop the leather feeding temporarily.

7.3.2 Conveyor machines

Lay the leather (or the calibrated template) on the feeding conveyor and spread it out before the conveyor drives it towards the measuring sensor array.

Should creases be observed, the conveyor can be temporarily stopped to help crease removal before the leather arrives under the measuring sensors.

During this operation, attention shall be paid not to induce movements in the leather part already under the sensor line while the rest of the leather is spread.

Should the leather be fed under the measuring sensors not adequately spread out despite of such actions, the measurement shall be cancelled and repeated.

In order to ensure correct spread out of large leathers (i.e. with area greater than 2,5 m^2 or with width greater than 1,5 m), two operators are recommended, respectively on the right and left side of the conveyor frame.

7.3.3 Flatbed scanner machines and bi-dimensional static measuring devices

Lay and spread out the leather (or of the calibrated template) on the machine plane, removing any crease or fold.

For flatbed scanner machines, let the sensor line array translate over the leather for the whole surface, at a constant speed included within the range suggested by the machine manufacturer.

For bi-dimensional measuring devices, start the measuring process according to the machine manufacturer's instructions.

NOTE Bi-dimensional measuring devices are often inserted in automatic cutting systems, where the leather supporting surface is provided with a porous or perforated cover (e.g. fabric cover, drilled plane) and with a vacuum system to keep the leather in position while being cut. The friction between the supporting surface and the leather, especially for fabric-covered surfaces, influences the measurement result significantly, particularly in case of very elastic leather or large-dimension leathers.

8 Measurement procedure

8.1 Switch the surface measuring machine on and let it run for the time specified by the machine manufacturer before the measuring operations.

8.2 Choose the calibrated template with an area similar to that of the leathers to be measured, according to the requirements specified in 5.2.

8.3 Measure the area of the chosen calibrated template 10 times and record the obtained values.

In roller and conveyor machines, the 10 measures shall be distributed in such a way that four of them are in the central third of the measuring sensor line, and three in each of the right and left third of the line itself.

In flatbed scanner machines and bi-dimensional devices, measure the area of the calibrated template in 10 positions uniformly spaced all over the scanner or device surface.

8.4 The average value of the 10 measures shall not deviate by more than 0,5 % from the calibrated template area (MM) obtained from the template calibration procedure (see Annex A and Annex B). The difference between maximum and minimum measured values shall not be greater than 1,5 % of the average measured value.

8.5 Measure the area of the first leather sample twice. The difference between the two values shall not be greater than 1 % of their average. Should not be the case, the area shall be measured again, and the new couple of measures shall be assumed as a reference for the evaluations of 8.6.

8.6 Should the measurement of 8.5 have provided a difference less than 1 %, the leathers can be measured once only. Otherwise, any leather shall be measured at least twice, recording both values. In case the difference between the two values exceeds 2 %, this shall be reported in the test report. In case of dispute, measure each hide two times, recording both values.

8.7 At the end of the measurement session, repeat the operating procedure specified in 8.3 with the same reference sample. If the two conditions in 8.4 are not fulfilled, the results of the measurements carried out (8.5 and 8.6) shall be rejected.

9 Calculation and expression of results

9.1 Record each leather area measurement, rounding its value to 0,1 dm^2; for area values equal to or greater than 100 dm^2 rounding of each leather measured value to 1 dm^2 is allowed. If a leather has been measured twice, the average of the two measured values, rounded as specified before, shall be recorded as the measured leather area.

9.2 Calculate the arithmetic average (Mm) of the 10 area measures of the calibrated template obtained as specified in 8.3 before measuring leathers and 10 area measurements of the calibrated template obtained as specified in 8.7 after measuring leathers, using the rounding criteria specified in 9.1, and record this value on the laboratory log (see Annex C).

9.3 Calculate the correction factor *F,* rounded to 0,001, according to Formula (1):

$$F = \frac{MC}{Mm} \tag{1}$$

where

MC is the area value of the calibrated template used, obtained from the calibration procedure as specified in Annex A;

Mm is the average value of the same calibrated template, obtained as specified in 9.2.

9.4 Multiply the area of each leather, obtained as in 9.1, for the correction factor *F* calculated in 9.3, to obtain the actual area of each leather. Round the obtained values using the rounding criteria specified in 9.1.

The correction can be omitted if $|F - 1| < 0{,}005$, i.e. if it is less than 0,5 %.

10 Test report

The test report shall include at least the following:

a) reference to this International Standard, i.e. ISO 19076;

b) date of measurement;

c) type of measuring machine used (see 5.1.1 and 7.1);

d) complete identification of the leather sample;

e) conditioning mode;

f) leather area values obtained for each leather, as specified in 9.4;

g) any measurement differences exceeding the 2 % limit specified in 8.6;

h) details of any deviations from the test method specified in this International Standard.

Annex A
(normative)

Calibrated templates for the verification of electronic measuring machines

A.1 Manufacturing characteristics of calibrated templates

A.1.1 Material

The calibrated templates shall be made of opaque material, 0,5 mm to 3 mm thick, with high flexibility but practically inextensible during use (this feature can be obtained, e.g. using a polymeric material with internal textile reinforcement).

The material elasticity shall be such that a strip 20 mm wide and with 200 mm free length, subjected to 200 N tensile strength shows an elongation not exceeding 5 mm.

In the temperature range between 10 °C and 40 °C, the material of the calibrated template shall not show a linear thermal extension exceeding 1 mm/m (0,1 %).

A.1.2 Shape and dimensions

Calibrated templates are usually circular-shaped. Polygonal templates are allowed provided that:

— the ratio between their maximum and minimum dimensions is not greater than 2;

— any internal angle is not less than 90°;

— it is possible to measure their surface with an uncertainty not exceeding the value specified in B.2.

The set of calibrated templates for the verification of a measuring machine shall usually consist of templates with area of about 20 dm^2 and 100 dm^2. Templates of different area can be used according to the particular measuring needs (e.g. small dimension flatbed scanners).

In any case, the calibrated template dimensions shall fulfil the requirements of 5.2.

A.1.3 Storage of calibrated templates

The calibrated templates shall be kept in normalized environmental conditions, protected from any object or substance or condition that might cause them damage or modification, and stored either in a cabinet (or shelf) in a flat, horizontal position, or in a rigid cylindrical container with an internal diameter of at least 30 times the template thickness.

A calibrated template stored in a cylindrical container shall be drawn and unrolled on a horizontal plane for a time interval sufficient to make it spread out before use.

A.1.4 Templates calibration

The reference templates shall be calibrated against measurement templates traceable to the international system of units (SI) by an accredited metrology institute.

The calibration extended uncertainty, calculated with a coverage factor $k = 2$, shall not exceed 0,2 %.

NOTE The uncertainty range allows for any reasonable uncertainty source, including the template shape, the calibration system, the measuring system and the influence of quantities.

A.1.5 Calibration frequency

The calibration of reference templates shall be repeated at least every 36 months. Moreover, every calibrated template shall be subjected to a new calibration whenever:

— any defects, even visual (e.g. cuts, permanent creases, deformations) is observed;

— it has undergone conditions that might have modified its area or shape;

— the date of the previous calibration is not known;

— suspicions arise about the validity of its calibration, e.g. as a consequence of abnormal results from the measuring machine in the routine verification with the same calibrated template.

Annex B
(normative)

Procedure for the verification of a measuring machine by calibrated templates

The procedure described in this annex shall be applied at least every 6 months, and every time any irregular condition is detected in the measuring process with the measuring machine.

B.1 Measuring scale adjustment

B.1.1 This operation shall be carried out for the first calibration of the measuring machines and is not repeated unless in case of repair or of important deviations.

B.1.2 Switch the machine on and let it run for the time specified by the manufacturer.

B.1.3 Measure the area of the calibrated template 10 times and calculate the average value (MM) of the measured area.

B.1.4 The measured averaged value (MM) shall not differ from the calibration value (MC) of the calibrated template by more than 0,5 %.

B.1.5 Should the difference exceed this value, modify the machine adjustment and repeat the procedure specified in B.1.3 until the value of the average area is as close as possible to the calibration value of the calibrated template, or at least as soon as a difference between MC and MM not exceeding 0,5 % is obtained.

B.2 Verification of measurement homogeneity among different zones in the machine measuring field

B.2.1 In flatbed scanner machines or bi-dimensional devices a calibrated template not exceeding 1/3 of the measuring field of the machine shall be used.

Measure the area of the calibrated template 10 times in the leftmost zone of the machine measuring field, and calculate the arithmetic average.

B.2.2 Repeat the operation described in B.2.1 in the central zone and in the rightmost zone of the machine measuring field, calculating the arithmetic average of the 10 measures in any case.

B.2.3 The extreme (maximum and minimum) average values shall not differ by more than 0,5 % of their average.

B.3 Verification of machine linearity

B.3.1 Measure the area of each one of the set of the calibrated templates and the set of (80 + 30) dm^2 and (80 + 70) dm^2 templates placed tangentially. Calculate the average value for each case, to the nearest 0,001 dm^2. The obtained values are designated MM measures, and shall be recorded in the laboratory log (see Annex C), together with the machine calibration date.

B.3.2 Calculate the correction factor, *F*, for each calibrated template or set of calibrated templates, using the following Formula (B.1):

$$F = \frac{MC}{MM} \tag{B.1}$$

where

MC is the official area value of the template used, resulting from the calibration according to A.1.4.

MM is the average value of the calibrated template area, obtained as specified in B.3.1.

B.3.3 The extreme values of the correction factors obtained in B.3.2 shall not differ by more than 2 %.

B.4 Verification of invariability of measured area in the event of interruptions of operation during the measuring operation

B.4.1 Measure the area of the 80 dm^2 calibrated template 10 times and calculate the average value.

B.4.2 Repeat the measurement of the calibrated template area 10 times, but interrupt the template feeding operation 3 times during each measuring operation. Calculate the average value for the 10 measures.

B.4.3 The average measures obtained according to B.4.1 and B.4.2 shall not differ by more than 0,3 %.

Annex C
(normative)

Laboratory record of calibrated templates

A laboratory record shall be maintained, in which the data listed below shall be chronologically recorded:

a) official area value (MC) of the calibrated templates, according to A.1.4;

b) area value (MM) of the calibrated templates obtained in the machine calibration according to Annex B;

c) area value (Mm) of the calibrated templates obtained in each leather measuring operation, according to 8.3 and 9.2.

The regular verification of the laboratory record will provide information on any anomaly or failure of the machine.

Annex D
(informative)

Repeatability and reproducibility

In order to evaluate the measurement uncertainty in the determination of the area of leathers, some series of measurements have been carried out on leathers of different dimension and nature with different machines belonging to different laboratories, and the relevant results compared.

The following trials A and B show the values of repeatability and reproducibility obtained on several leathers, each measured 10 times by each of the laboratories, with different type machines.

Table D.1 — Trial A – Measuring with roller machines (5 machines in 5 different laboratories)

Leather	Leather type	Average area, S	Repeatability, r	Reproducibility, R
		dm^2	%	%
A	Bovine leather for upholstery furniture	319,6	1,0	1,1
B	Bovine leather for footwear	243,0	0,6	1,1
C	Bovine leather for footwear	206,3	0,4	0,7
D	Sheep leather for footwear	59,5	1,7	2,2
E	Goat leather for footwear	39,0	1,2	1,4

Table D.2 — Trial B – Measuring with conveyor machines (3 machines in 3 different laboratories)

Leather	Leather type	Average area, S	Repeatability, r	Reproducibility, R
		dm^2	%	%
A	Bovine leather for upholstery furniture	307,1	0,3	—[a]
B	Bovine leather for footwear	232,5	0,5	0,6
C	Bovine leather for footwear	202,7	0,5	0,5
D	Sheep leather for footwear	58,1	1,0	1,4
E	Goat leather for footwear	38,7	1,3	1,9

[a] This sample has been measured by 1 machine only, therefore R cannot be determined.

In the following Trial C, the average area values obtained on 6 sample leathers subjected to measurement, respectively with roller and conveyor machines, are reported.

The conveyor machines show an underestimate tendency, due to lack of an active spread-out device for leather passing through the measurement zone.

This tendency varies with machines and leather behaviour (more rigid and wider leathers amplify this effect compared to softer leathers). It is necessary to allow for this when evaluating measuring uncertainty.

Table D.3 — Trial C – Comparison among machines with different measuring technology

Leather	Leather type	Roller machines	Conveyor machines	Difference
		Average area, S dm^2	Average area, S dm^2	%
A	Bovine leather for upholstery furniture	319,6	307,1	−3,9
B	Bovine leather for footwear	243,0	232,5	−4,3
C	Bovine leather for footwear	206,3	202,7	−1,7
D	Sheep leather for footwear	59,5	58,1	−2,3
E	Goat leather for footwear	39,0	38,7	−0,8

Bibliography

[1] ICT – International Council of Tanners - Code of practice for area measurement, www.tannerscouncilict.org

[2] ISO 11646, *Leather — Measurement of area*

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

[4] ISO 17186, *Leather — Physical and mechanical tests — Determination of surface coating thickness*

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