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Leather — Determination of flex resistance —

Part 1: Flexometer method

*Cuir — Détermination de la résistance à la flexion —
Partie 1: Méthode au flexomètre*



Reference numbers
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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).

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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.

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 document was prepared by the Physical Testing 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*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 5402-1:2017), which has been technically revised.

The main changes are as follows:

- an Introduction has been added;
- [Figures 1](#) and [3](#) (previously Figure 1 in ISO 5402-1:2011) have been added;
- [Clause 5](#) has been technically revised, in particular subclause [5.1.2](#) to allow the use of 2 types of upper clamps;
- [Clause 7](#) has been technically revised;
- a new bullet point c) has been added to the test report.

A list of all parts in the ISO 5402 series can be found on the ISO website.

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.

Introduction

This document describes a widely-used method with a flexing apparatus for determining the dry or wet flex resistance of leather and finishes applied to leather. The number of flexing cycles chosen depends on the end use of the leather and the expected performance. The leather specification normally defines the number of flex cycles that the leather is required to achieve without damage. In addition, the flexing process can be used as a pre-treatment for other test procedures.

This type of flexing apparatus was developed in 1963 and the flexing equipment described in this document is available commercially from a range of manufacturers globally. The robust equipment is typically used by tanneries and test laboratories for many decades. Over the years, small differences in the geometry of the upper clamp ([5.1.2](#)) develop. In ISO 5402-1:2017 a modified upper clamp design was introduced. In this document the upper clamp differences have been grouped together into 2 categories: Specification 1 (as in ISO 5402-1:2017) and Specification 2 (as in ISO 5402-1:2011).

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Leather — Determination of flex resistance —

Part 1: Flexometer method

1 Scope

This document specifies a method for determining the dry or wet flex resistance of leather and finishes applied to leather. It is applicable to all types of flexible leather below 3,0 mm in thickness.

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 3696, *Water for analytical laboratory use — Specification and test methods*

3 Terms and definitions

No terms and definitions are listed in this document.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

4 Principle

A test piece is folded with the surface to be tested inwards and clamped in an upper movable clamp and with the surface to be tested outwards in a lower fixed clamp. Movement of the upper clamp causes a fold in the test piece to run along it. The test piece is examined periodically for damage.

5 Apparatus and reagents

5.1 Test machine

5.1.1 The test machine consists of a movable upper clamp, a fixed lower clamp and a counter as described in 5.1.2 to 5.1.4. Examples of suitable commercial suppliers of this machine are given in Annex A.

5.1.2 Upper clamp

5.1.2.1 The upper clamp comprises:

- a pivoting pair of plates (H and I) with flat mating faces, each of maximum 4 mm thickness, as in [Figure 2](#) and [Figure 3](#). The small plate (H) has the basic shape of a trapezium but with a radius of 2 mm at the acute corner. It has a ledge (G) to support the folded test piece. The larger plate (I) has a shape as shown in [Figure 2](#) and [Figure 3](#).
- a clamp tightening screw (F) to draw the two plates (H and I) together and also serve as a stop to correctly locate the test specimen;
- a mechanism that ensures that the mating faces of the plates remain parallel when clamping the test specimen while ensuring that the test specimen is securely clamped at the sloping edge and apex (nose) of the clamp.
- the upper clamp shall be reciprocated by a motor about a horizontal axis, descending through an angle of $(22,5 \pm 0,5)^\circ$ at a frequency of (100 ± 5) cycles/min.

Two specifications for the upper clamp are permitted; Specification 1 as described in [5.1.2.2](#) and [Figure 2](#), and Specification 2 as described in [5.1.2.3](#) and [Figure 3](#). The type of upper clamp used and the manufacturer shall be reported in the test report.



a) Specification 1 ([5.1.2.2](#))

b) Specification 2 ([5.1.2.3](#))

Figure 1 — Illustration of upper clamp Specifications 1 and 2

5.1.2.2 Specification 1

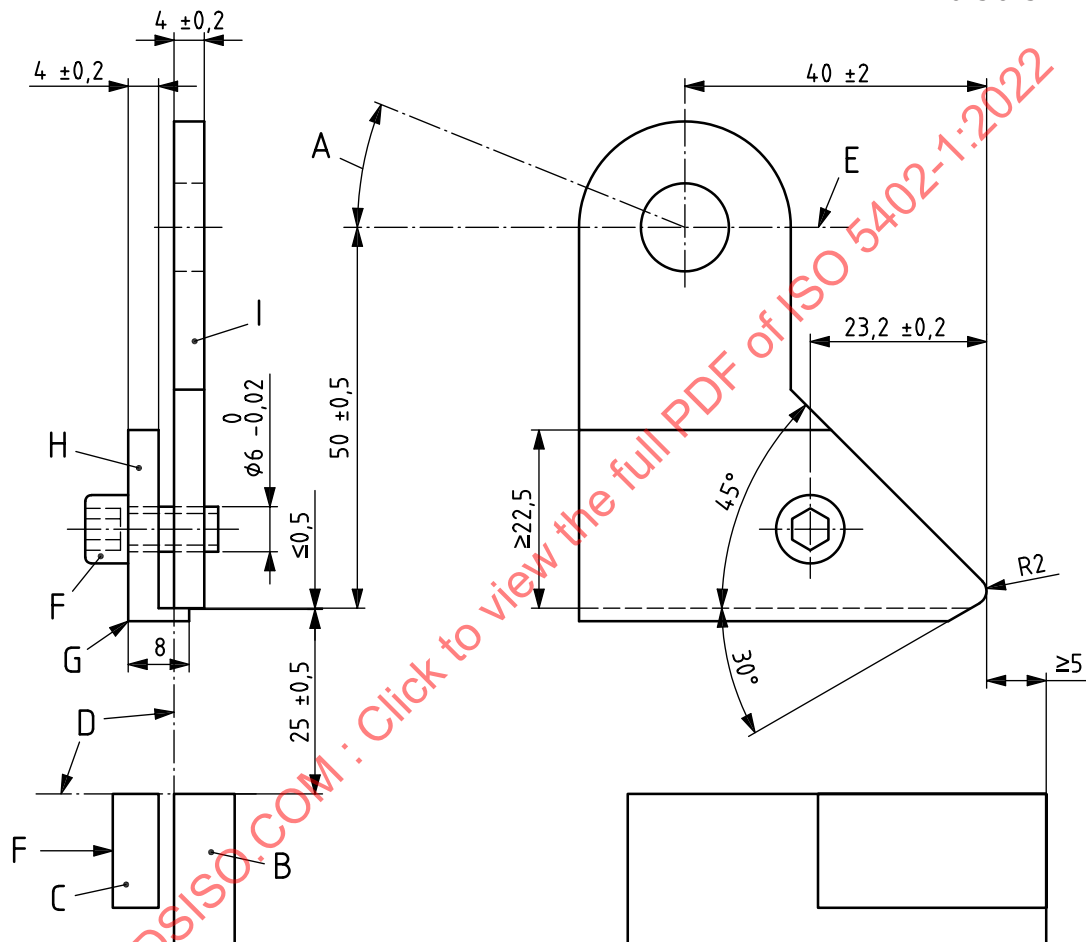
Specification 1 is illustrated in [Figure 1 a\)](#) and described in [Figure 2](#).

The clamp tightening screw (F) acts as a stop to prevent the test piece from being less than (15 ± 1) mm from the vertical through the pivot point (E).

NOTE The clamp tightening screw (F) is threaded and is used repeatedly. The threads will wear over time, which can result in the tolerance in Figure 2 being exceeded, so the dimensions given are nominal. This dimension is not critical to the test providing the material under test is securely clamped.

The fold of the test specimen (7.3) sits on the ledge (G) and the end of the test specimen butts up against the clamp tightening screw (F).

Dimensions in millimetres



Key

- A flexing angle $(22,5 \pm 0,5)^\circ$
- B fixed part of fixed lower clamp
- C movable part of fixed lower clamp
- D vertical positioning of fixed part of movable upper clamp and fixed part of fixed lower clamp
- E horizontal axle (pivot point)
- F clamp tightening screws (not shown in lower clamp)
- NOTE Diameter is indicative as the threads will wear over time.
- G ledge
- H small plate of upper clamp with ledge (G)
- I large plate of upper clamp

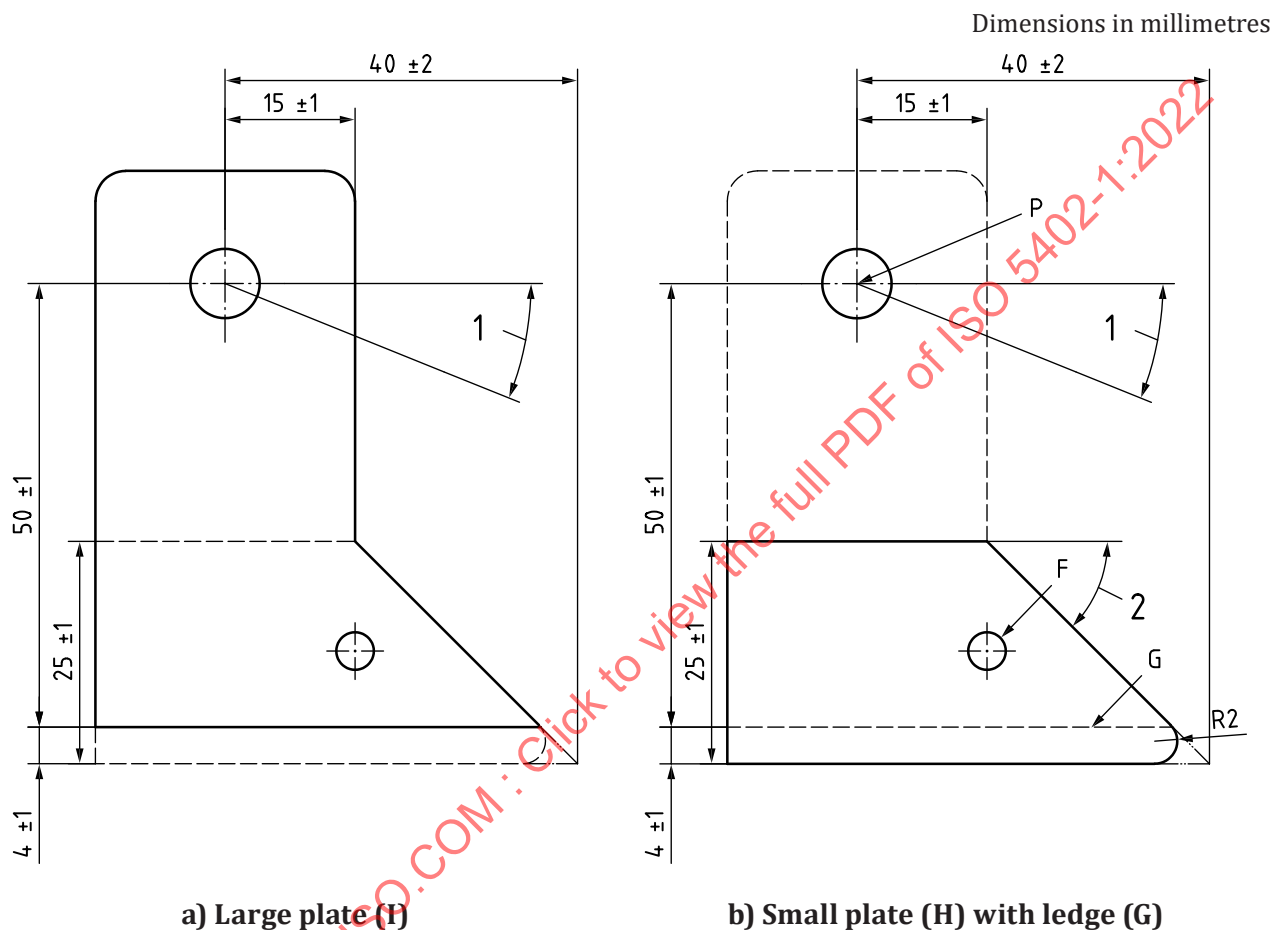
Figure 2 — Upper (moveable) clamp Specification 1 and lower (fixed) clamp

5.1.2.3 Specification 2

Specification 2 is illustrated in [Figure 1 b\)](#) and described in [Figure 3](#).

The clamp tightening screw (F) acts as a stop to prevent the test piece from being less than (15 ± 1) mm from the vertical through the pivot point (P).

The fold of the test specimen ([7.3](#)) sits on the ledge (G) and the end of the test specimen butts up against the clamp tightening screw (F).



Key

- 1 flexing angle $(22,5 \pm 0,5)^\circ$
- 2 45°
- P pivot point
- F clamp tightening screw
- G ledge
- R2 radius approximately 2 mm
- H small plate of upper clamp with ledge (G)
- I large plate of upper clamp

Figure 3 — Upper clamp specification 2

5.1.3 Lower clamp, fixed and lying directly beneath (planar to) the upper clamp and consisting of a pair of flat plates (B and C in [Figure 2](#)) to hold the test piece with a clamp-tightening screw.

The position of the lower clamp is such that the vertical distance (D) between the upper side of the ledge (G) of the upper clamp and the upper edge of the fixed lower clamp, when the upper clamp is horizontal, is $(25,0 \pm 0,5)$ mm.

5.1.4 Counter, to indicate the number of cycles.

5.2 Press knife, conforming to the requirements of ISO 2419, the inner wall of which is a rectangle (70 ± 1) mm $\times$ (45 ± 1) mm.

5.3 Magnifier, with a magnification of four to six times.

5.4 Desiccator, or other vessel that can be evacuated.

5.5 Vacuum pump, capable of reducing the pressure in the desiccator to less than 4 kPa.

5.6 Distilled or deionized water, conforming to the requirements of grade 3 of ISO 3696.

5.7 Glass dishes, minimum diameter 100 mm and minimum depth 25 mm.

5.8 Mandrel, diameter 10 mm and minimum length 70 mm.

5.9 Metal clip, 70 mm wide, capable of fixing a test piece bent around the mandrel ([5.8](#)) with slight stretch.

5.10 Stereo microscope, with a magnification of 25 times.

6 Sampling and sample preparation

6.1 Sample in accordance with ISO 2418. From the sample, cut a minimum of four pieces for dry test and/or four pieces for wet test by applying the press knife ([5.2](#)) to the surface to be tested. Cut a minimum of two test pieces with the long edge parallel to the backbone and two with the long edge perpendicular to the backbone.

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 pieces in each direction.

6.2 For dry flex testing, condition the test pieces in accordance with ISO 2419 and test in the conditioned atmosphere.

6.3 For wet flex testing, place the test pieces in a glass dish ([5.7](#)), add sufficient distilled or deionized water ([5.6](#)) to give a minimum depth of 10 mm, put the dish in the desiccator and reduce the pressure to below 4 kPa for 2 min.

Restore to normal atmospheric pressure and repeat the pressure reduction/restoration twice. Remove the test piece and remove excess water using blotting paper. Carry out wet flexing without delay.

6.4 It is not possible to clamp thick leathers in the upper clamp. In such cases, the thickness of the test piece is reduced for a maximum length of 15 mm from one end only and this end inserted in the upper clamp. Even so, the leather can be too stiff to be tested by this method.

7 Procedure

7.1 Open the upper and lower clamps (5.1.2 and 5.1.3) so that the gap is at least twice the thickness of the test piece.

7.2 Turn the motor until the lower edge of the upper clamp (5.1.2) is parallel to the upper edge of the fixed lower clamp (5.1.3) as shown in Figure 4 d) (the point at which the direction of rotation of the horizontal axle changes).

7.3 Fold the test piece in half lengthwise, such that the two long edges are brought together exactly and the grain surface meets face to face. Clamp the folded test piece as shown in Figure 4 a) with the folded edge parallel to, and positioned against, the ledge and with the end of the test piece against the stop formed by the clamping screw. Ensure that the corners of the test piece within the upper clamp are securely fixed and cannot slip during the test.

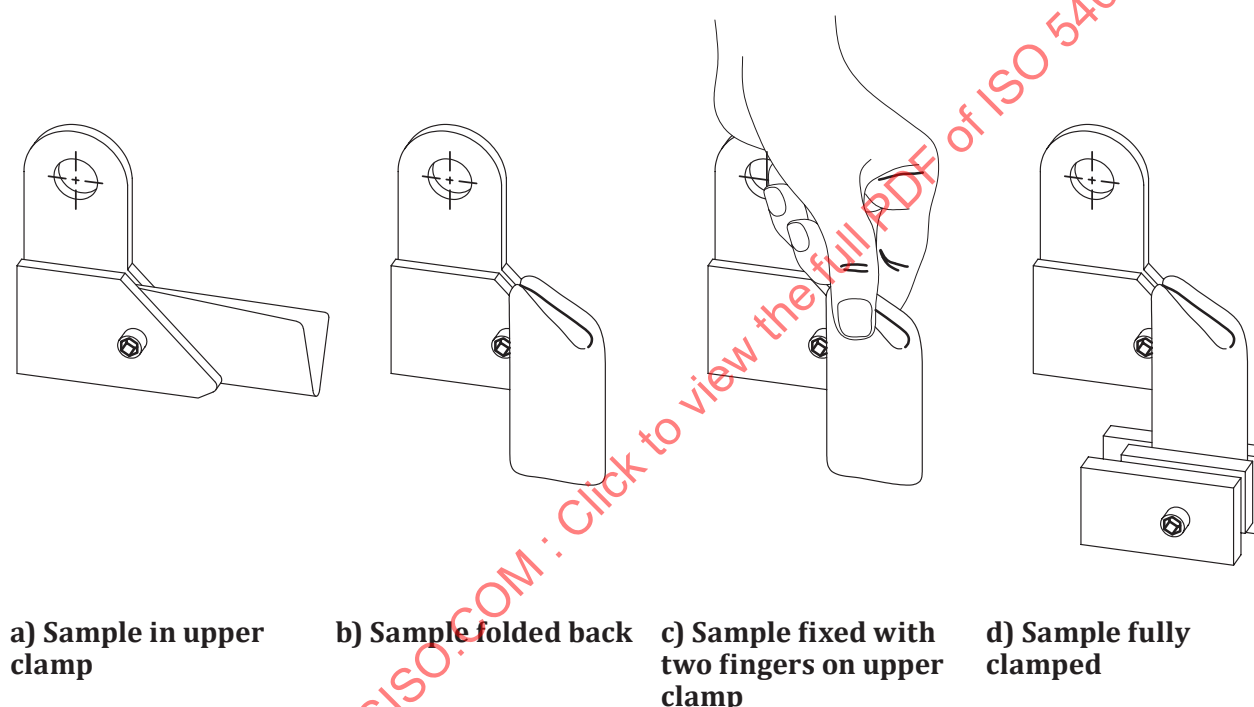


Figure 4 — Loading of the test piece

7.4 Draw the free corners of the test piece outward and downward around the clamp as shown in Figure 4 b). Bring the inner surfaces together and place the free end in the opened lower clamp.

7.5 Press the test piece against the outer surfaces of the upper clamp as shown in Figure 4 c). It is important to ensure that the test piece is in contact with the 45° sloping face of the clamp. This ensures that the lower part of the test piece is perpendicular to the lower clamp. Fix the test piece in this position in the lower clamp [see Figure 4 d)].

NOTE 1 The procedure ensures that no elongation is applied to the test piece by clamping.

NOTE 2 Flexible (soft) materials will show a direct contact of their backing on the outer face of the upper clamp. For stiffer materials, ballooning of the materials in this area is unavoidable.

7.6 Inspect the vertical orientation of the test piece (rear edge). If the rear edge is not perpendicular to the lower clamp, repeat 7.4 and 7.5.