
**Leather — Determination of flex
resistance —**

Part 1:
Flexometer method

Cuir — Détermination de la résistance à la flexion —

Partie 1: Méthode au flexomètre

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Published in Switzerland

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 5402-1 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 first edition of ISO 5402-1 cancels and replaces ISO 5402:2002. Subclauses 4.1.1, 4.8, 4.9, 4.10, 5.1, 6.6 and 6.10 have been technically revised.

ISO 5402 consists of the following part, under the general title *Leather — Determination of flex resistance*:

— *Part 1: Flexometer method*

The following part is planned:

— *Part 2: Vamp flex method*

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Leather — Determination of flex resistance —

Part 1: Flexometer method

1 Scope

This part of ISO 5402 specifies a method for determining the wet or dry flex resistance of leather and finishes applied to leather. It is applicable to all types of flexible leather which are less than 3,0 mm thick.

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 3696:1987, *Water for analytical laboratory use — Specification and test methods*

3 Principle

A test piece is folded with the surface to be tested inwards and clamped in an upper moveable clamp, 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.

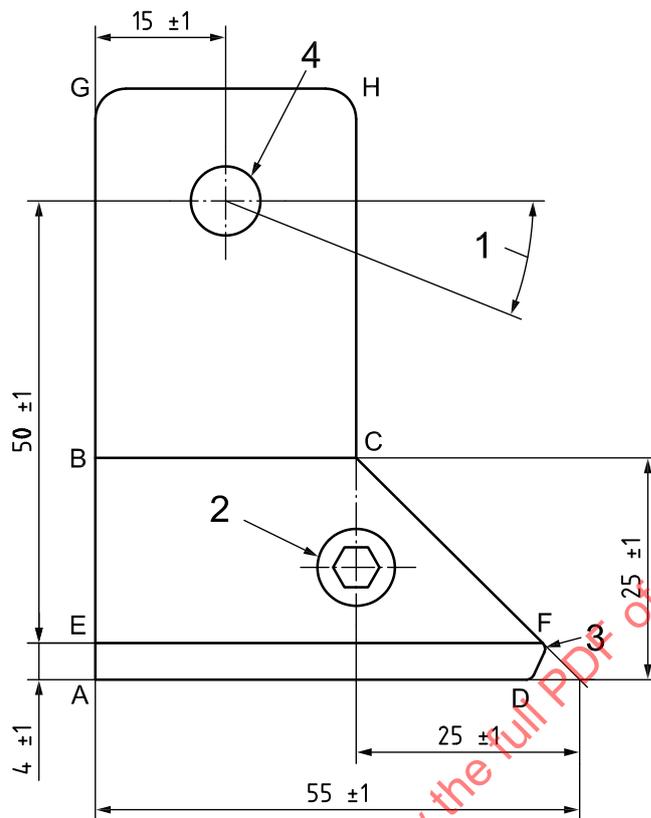
4 Apparatus and materials

4.1 Test machine, including the parts described in 4.1.1 to 4.1.3.

4.1.1 Upper clamp, consisting of a pivoting pair of flat plates of maximum 4 mm thickness as shown in Figure 1. One plate has the basic shape of a trapezium ABCFD but with a radius of 2 mm at F. It has a ledge EF 4 mm \pm 1 mm thick to support the folded test piece. The other plate has the shape EGHCF. The clamp tightening screw draws the plates together and also acts as a stop to prevent the test piece from being positioned closer to AB than the vertical through C. A stop near the edge AB and approximately midway between A and B ensures that the plates clamp more effectively near point F. The upper clamp can be reciprocated by a motor about a horizontal axle, descending through an angle of 22° 30' \pm 0° 30' at a frequency of 100 cycles/min \pm 5 cycles/min.

4.1.2 Lower clamp, fixed and lying directly beneath (planar to) the upper clamp and consisting of a pair of flat plates to hold the test piece. The position of the lower clamp is such that the distance between the ledge EF and the upper edge of the fixed lower clamp, when the ledge EF is horizontal, is 25,0 mm \pm 1,0 mm.

4.1.3 Counter, to indicate the number of cycles.



Key

- 1 flexing angle $22^{\circ} 30' \pm 0^{\circ} 30'$
- 2 clamp tightening screw
- 3 2 mm radius F
- 4 horizontal axle

Figure 1 — Upper clamp

- 4.2 **Press knife**, conforming to the requirements of ISO 2419, the inner wall of which is a rectangle $(70 \text{ mm} \pm 1 \text{ mm}) \times (45 \text{ mm} \pm 1 \text{ mm})$.
- 4.3 **Magnifier**, with a magnification of 4 to 6 times.
- 4.4 **Desiccator**, or other vessel that can be evacuated.
- 4.5 **Vacuum pump**, capable of reducing the pressure in the desiccator to less than 4 kPa.
- 4.6 **Distilled or deionized water**, of grade 3 in accordance with the requirements of ISO 3696:1987.
- 4.7 **Glass dishes**, minimum diameter 100 mm and minimum depth 25 mm.
- 4.8 **Mandrel**, having a diameter of 10 mm and a minimum length of 70 mm.
- 4.9 **Metal clip**, 70 mm wide, capable of fixing a specimen around the mandrel (4.8) at a slight stretch.
- 4.10 **Stereomicroscope**, with a magnification of 25 times.

5 Sampling and sample preparation

5.1 Sample in accordance with ISO 2418. From the sample, cut at least four pieces for the dry test and/or four pieces for the wet test by applying the press knife (4.2) to the grain surface. Cut at least 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.

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

5.3 For wet-flex testing, place the test pieces in a glass dish (4.7), add sufficient distilled or deionized water 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.

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

6 Procedure

6.1 Open the upper and lower clamps (4.1.1 and 4.1.2) so that the gap is at least twice the thickness of the test piece.

6.2 Turn the motor until the ledge EF on the upper clamp (4.1.1) is parallel to the upper edge of the fixed lower clamp, as shown in Figure 2 c).

6.3 Fold the test piece in two with the surface to be tested inwards so that the two longer sides are brought together. Clamp the folded test piece as shown in Figure 2 a) with the folded edge against the ledge and the end against the stop formed by the clamping screw.

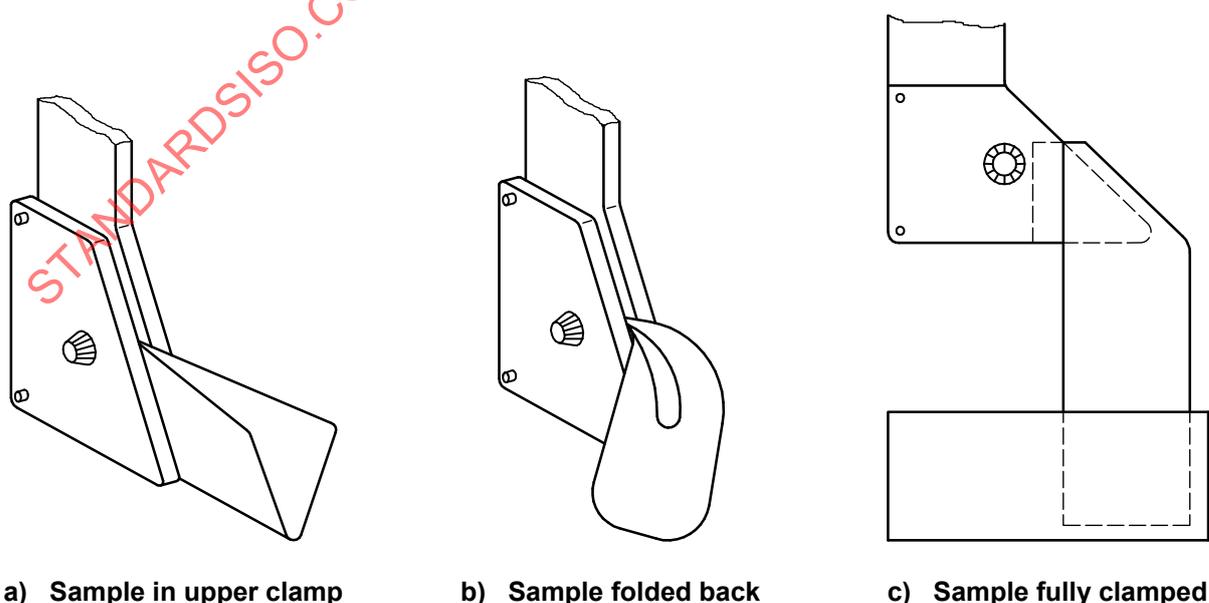


Figure 2 — Loading of the test piece

6.4 Draw the free corners of the test piece outward and downward around the clamp as shown in Figure 2 b). Bring the inner surfaces together and clamp the free end in the lower clamp as shown in Figure 2 c), keeping the part of the folded test piece in the clamps vertical and using no more force than is necessary to make the leather just taut.

6.5 Run the machine for the required number of flex cycles selected from the following lists:

- Dry flex: 500; 1 000; 5 000; 10 000; 20 000; 25 000; 50 000; 100 000; 150 000; 200 000; 250 000 cycles;
- Wet flex: 500; 1 000; 2 500; 10 000; 20 000; 25 000; 50 000 cycles.

In addition to the above inspection points, remove the wet test pieces from the machine every 25 000 cycles and examine them for spue before re-wetting (5.3) them and replacing them in the test machine.

The test pieces should flex without excessive bulging at the sides. If they do not flex in this mode, include this in the test report.

6.6 Stop the test machine and remove the test piece. Fold it along the longitudinal axis and examine it visually in good light using the naked eye and with the magnifier (4.3). Record any damage in the flexed area, ignoring damage in the clamped area.

If required, to evaluate the intensity of the cracks, bend the test piece along the longitudinal axis around the mandrel (4.8). Stretch the test piece slightly with the fingers or using a clip (4.9). Use the following wording to describe the cracks:

- cracks: visible to the naked eye;
- fine cracks: visible with magnifier (4.3);
- microcracks: visible with microscope having a magnification of 25 times (4.10).

Cut through the flexed area, if necessary, to help identify any loose leather structure.

Cutting through the test piece damages it too severely to allow further testing and may therefore only be carried out after the final inspection.

The damage may include the following:

- a) change of shade (greying) of the finish film without further damage;
- b) cracking or crazing of the finish with the cracking extending through one or more finish layers. The number of cracks may be reported if feasible;
- c) loss of adhesion of finish to the leather;
- d) loss of adhesion between finish coats;
- e) powdering or flaking of the finish coats;
- f) colour contrasts shown by finish cracking, powdering or flaking.

6.7 If required, replace the test piece in the clamps using the marks produced by the clamps as a guide to ensure that the test piece is returned to its original position in the clamps.

6.8 Restart the machine and continue to the next required number of cycles. Repeat the inspection given in 6.6.

6.9 Repeat steps 6.7 and 6.8 if required for other numbers of flex cycles.

NOTE The actual number of cycles chosen will depend on the specification, the end use of the leather and the expected performance.

6.10 If only one test piece shows slight damages in final inspection, repeat the test with a new set of at least four test pieces. If all of the additional test pieces pass the test without any damage, report the final result as “no damages”; otherwise, report the evaluation of the worst test piece.

7 Test report

The test report shall include the following:

- a) a reference to this part of ISO 5402, i.e. ISO 5402-1:2011;
- b) whether the leather was tested wet or dry;
- c) if the test pieces did not flex as described in 6.5;
- d) the number of flex cycles and damage reported for the worst test piece;
- e) the standard atmosphere used for conditioning and testing, as given in ISO 2419;
- f) any deviations from the method specified in this part of ISO 5402;
- g) full details for identification of the sample and any deviation from ISO 2418 with respect to sampling.

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