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**Leather — Physical and mechanical
tests — Determination of flex resistance by
flexometer method**

*Cuir — Essais physiques et mécaniques — Détermination de la résistance
à la flexion à l'aide d'un flexomètre*

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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.

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 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 cooperation between ISO and CEN (Vienna Agreement). It is based on IUP 20 originally published in *J. Soc. Leather Trades Chemists* **47**, p. 126, (1963) and declared an official method of the IULTCS in 1963. This updated method, which differs in that it includes wet flexing as a formal part of the method rather than a note, and now includes the number of test pieces, was published in *J. Soc. Leather Tech. Chem.* **84**, p. 363, (2000) and reconfirmed as an official method in March 2001.

Leather — Physical and mechanical tests — Determination of flex resistance by flexometer method

1 Scope

This International Standard 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 leather below 3,0 mm in thickness.

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 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.

4 Apparatus

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 as shown in Figure 1. One plate has the shape of a trapezium ABCD but with the corner D rounded to a radius of 2 mm. It has a ledge EF to support the folded test piece. The other plate has the shape EGHCF. The screw K 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 mid-way between A and B ensures that the plates clamp more effectively near the point F. The upper clamp can be reciprocated by a motor about a horizontal axle J, descending through an angle of $22^{\circ} 30' \pm 0^{\circ} 30'$ 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 0,5 mm.

4.1.3 Counter, to indicate the number of cycles.

(all dimensions are in millimetres $\pm 0,5$ mm)

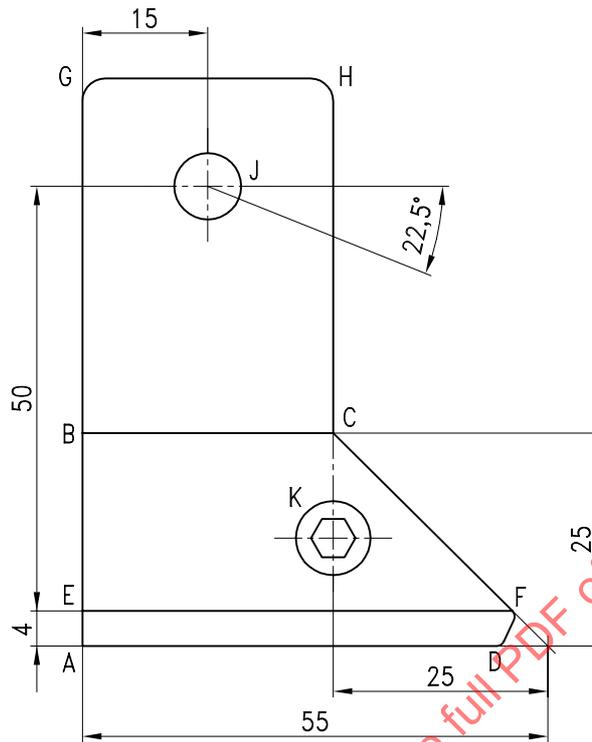


Figure 1 — Upper clamp

- 4.2 **Press knife**, conforming to the requirements of ISO 2419, the inner wall of which is a rectangle 70 mm ± 1 mm x 45 mm ± 1 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**, conforming to the requirements of grade 3 of ISO 3696:1987.
- 4.7 **Glass dishes**, minimum diameter 100 mm and minimum depth 25 mm.

5 Sampling and sample preparation

5.1 Sample in accordance with ISO 2418. From the sample, cut a total of 6 pieces for dry test and/or 6 pieces for wet test by applying the press knife (4.2) to the grain surface. Cut three test pieces with the long edge parallel to the backbone and three with the long edge perpendicular 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 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 this 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 2c).

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 2a) with the folded edge against the ledge and the end against the stop formed by the clamping screw.

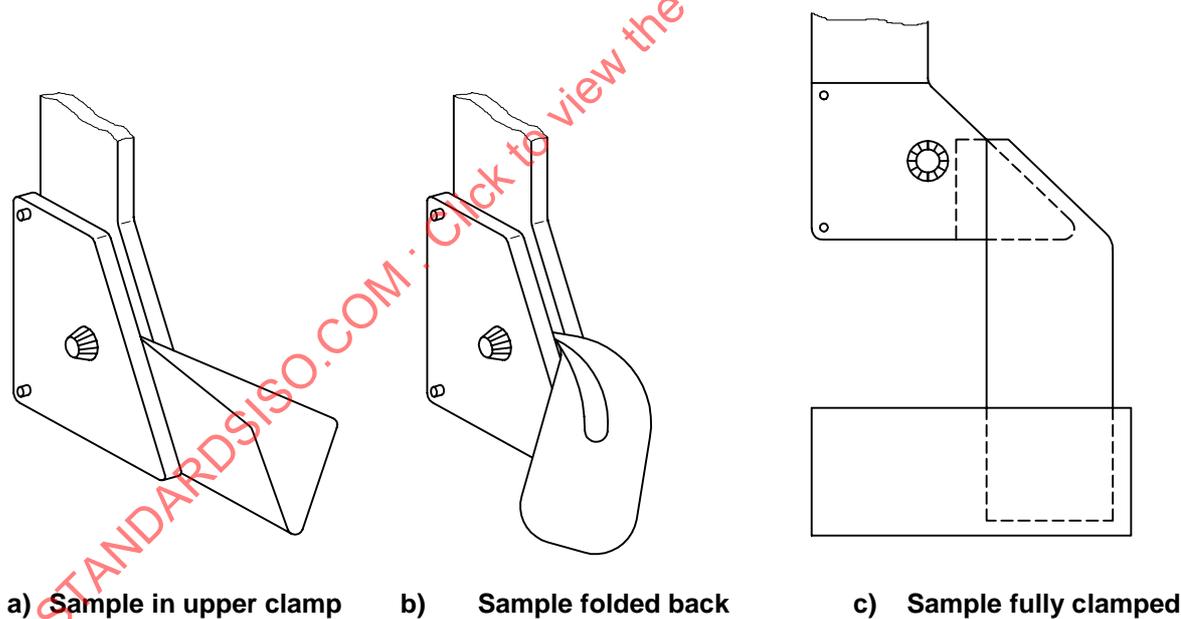


Figure 2 — Loading of the test piece

6.4 Draw the free corners of the test piece outward and downward around the clamp as shown in Figure 2b). Bring the inner surfaces together and clamp the free end in the lower clamp as shown in Figure 2c) with 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 list:

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) and replacing in the test machine.

NOTE 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 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. Cut through the flexed area if necessary to assist identification of loose leather structure.

NOTE Cutting through the test piece damages it too severely to allow further testing and may 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 it is 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.

7 Test report

The test report shall include the following:

- a) reference to this International Standard, i.e. ISO 5402:2002;
- b) whether the leather was tested wet or dry;
- c) the number of flex cycles and damage is reported for the worst test piece;
- d) the standard atmosphere used for conditioning and testing as given in ISO 2419 (i.e., 20 °C/65 % relative humidity or 23 °C/50 % relative humidity);
- e) any deviations from the method specified in this International Standard;
- f) full details for identification of the sample and any deviation from ISO 2418 with respect to sampling.