

INTERNATIONAL  
STANDARD

ISO  
14087

IULTCS/IUP  
54

First edition  
2011-12-01

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**Leather — Physical and mechanical  
tests — Determination of bending force**

*Cuir — Essais physiques et mécaniques — Détermination de la force  
de flexion*

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Reference number  
ISO 14087:2011(E)  
IULTCS/IUP 54:2011(E)

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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 14087 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).

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.

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# Leather — Physical and mechanical tests — Determination of bending force

## 1 Scope

This International Standard describes a test method for the determination of the bending force of leather.

## 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

#### **bending force**

force exerted by the specimen on the measuring bar at a specified bending angle, bending length and bending rate

### 3.2

#### **bending angle**

angle at which the bending force is measured

### 3.3

#### **bending length**

length around which the specimen is bent

NOTE The bending length is the distance between the clamping device of the specimen and the bar onto which the force of the specimen is transferred.

### 3.4

#### **bending rate**

rate of bending of the specimen

NOTE The bending rate is expressed in degrees per sec ( $^{\circ}/s$ ).

### 3.5

#### **compression bending**

compression of the grain side or coating of the leather during bending

**3.6 extension bending**

extension of the grain side or coating of the leather during bending

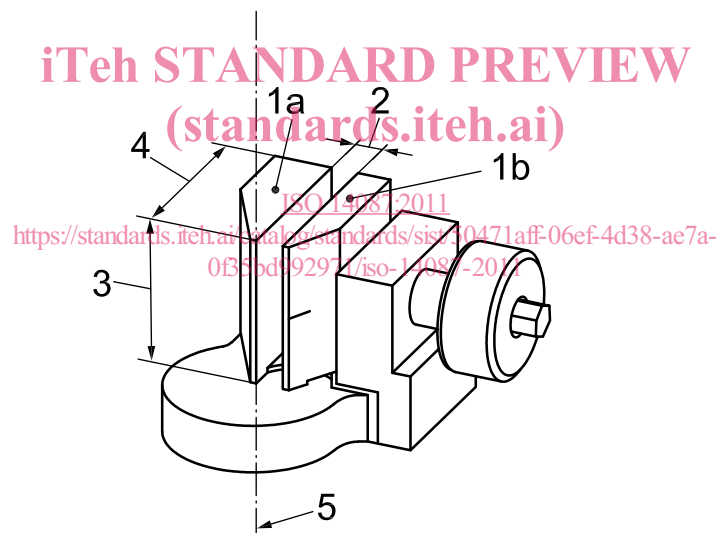
**4 Principle**

The bending force is determined based on the bar method (two-point bending method). In this method, the specimen is clamped in a rotating fixture. During the rotation, the specimen exerts a force onto a bar. The force acting at a specified bending angle is measured.

**5 Apparatus**

**5.1 Device for determining the bending force according to the bar method** (two-point bending method) comprising the following.

**5.1.1 Clamping mechanism**, in which the specimen shall be able to be clamped vertically. The clamping jaws shall have a depth of  $(35 \pm 1)$  mm and a minimum width of at least 30 mm (see Figure 1). The clamping device shall enable parallel clamping with an even pressure distribution on the specimen. It shall move smoothly and allow tightening with a torque wrench. The clamping device shall allow for affixing the specimen without it touching the bar in its initial position.



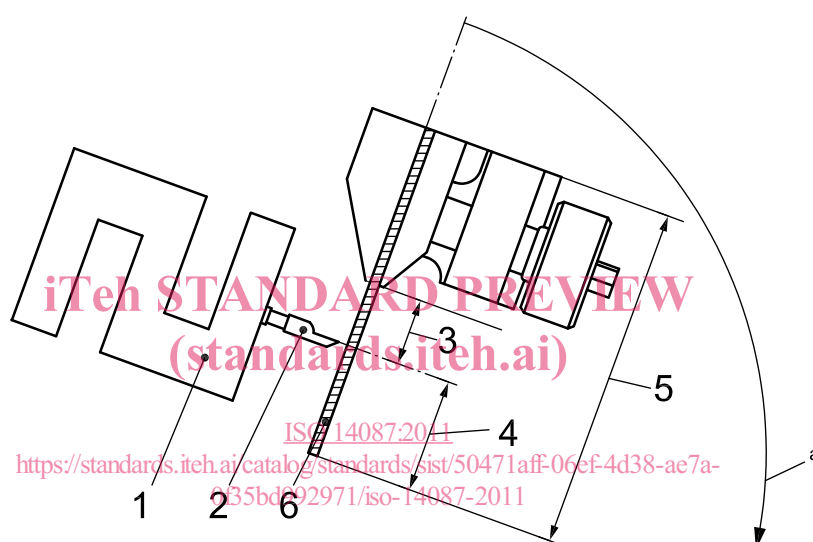
- Key**
- 1a fixed clamping jaws
  - 1b moving clamping jaws
  - 2 aperture > 6 mm
  - 3 jaw width > 30 mm
  - 4 jaw depth  $(35 \pm 1)$  mm
  - 5 pivot axis

**Figure 1 — Clamping jaws**

**5.1.2 Means for rotating the clamping device about the pivot axis.** The pivot axis is located exactly at the front edge of the fixed clamp (deviation of  $\pm 0,1$  mm) (see Figure 1). Rotation shall be possible within the range of  $1^\circ$  to  $91^\circ$  with a maximum deviation of  $0,1^\circ$ . The rotational speed shall be able to be adjusted up to  $10^\circ/s$  with an accuracy of  $0,1^\circ/s$ . At maximum load, the maximum deviation of the rotational speed allowed is  $0,1\%$ .

**5.1.3 Means of measuring the bending force.** The rotation of the specimen causes it to be pressed against a vertical metering bar. (See Figure 2.) The bar is connected to a load cell that allows measurement of forces up to 10 N (optionally, 1 N for very flexible materials) with a minimum resolution of 0,1 % and a maximum deviation of 0,1 %. The bar design shall exhibit a sharp edge ( $R = 0,05 \pm 0,01$  mm) and a width of at least 30 mm. The weight of the bar shall not influence the measured value.

The distance between the bar and the pivot point shall be adjustable in a range from 0,1 mm to 50 mm with an accuracy of 0,1 mm. At the start of the measurement, the specimen is moved towards the bar until contact is made and a defined preliminary force is reached. This preliminary force shall be able to be adjusted with an accuracy of 1 mN. When the preliminary force is reached, the measurement shall start (angle =  $0^\circ$  and force = preliminary force setting). The evaluation unit shall ensure measurement of the force at one or more previously defined angles. These angles shall not be identical to the maximum angle of rotation. The measuring apparatus shall ensure that all significant parameters (force, length, speed) can be checked, calibrated and restored. It is recommended that the measured data (raw data and parameter settings) are able to be electronically archived.



**Key**

- 1 load cell
- 2 vertical metering bar
- 3 bending length – adjustable
- 4 free sample length
- 5 sample length
- 6 sample
- <sup>a</sup> Rotating direction.

**Figure 2 — Clamping jaws with specimen, load cell and bar with sharp edge**

NOTE An example of a commercial source for a suitable device is given in Annex A.

**5.2 Torque wrench**, suitable for a range from 0,05 Nm to 0,2 Nm with an accuracy of 0,01 Nm.

**5.3 Press knife**, as specified in ISO 2419 for the corresponding specimen size.

## 6 Sampling and sample preparation

Sampling is conducted according to ISO 2418 if possible and conditioning according to ISO 2419. The dimensions of the specimens shall be taken from the relevant parameter sets (see 7.1). Other dimensions are permissible but shall be indicated in the test report. The sample is taken parallel with and perpendicular to the backbone. Other sampling angles (e.g. diagonal) are also permissible and details shall be given in the test report. If the orientation of the backbone is not known, each specimen shall be taken in two directions running perpendicular to each other. At least three specimens shall be used in each direction.

If both the compression and extension bending tests are to be conducted on the leather sample, an additional three specimens shall be used for each sampling direction.

## 7 Test procedure

7.1 Each specimen shall be tested only once and shall then be discarded. The specimen shall be carefully clamped into the test device such that the free-standing part of the specimen corresponds to the clamping length specified in Table 1. A torque wrench (5.2) with a setting of 0,08 Nm shall be used to tighten the clamping jaws. Then, the test shall be started with one of the specified parameter sets specified in the table below. The measurement starts at 0° when the specified preliminary force is reached. The measured forces shall be recorded at the required bending angle.

Both extension and compression bending of the grain/coated side is possible. For the extension bending test, the leather specimen shall be inserted so that the bar will press on the grain/coated side. For the compression bending test, the leather specimen shall be inserted so that the bar will press on the flesh/back side.

Three different sets of parameters can be used. If no set is specified, use set A as the standard set.

Table 1 — Parameter sets

	Parameter set		
	A (standard)	B	C
bending length (mm)	5	10	15
free clamping length (mm)	15	20	25
measurement in bending angle of (°)	60	60	60
bending up to an angle of (°)	63	63	63
bending rate (°/s)	1,5	1,5	1,5
bending rate up to preliminary force (°/s)	1,5	1,5	1,5
dimensions of sample (width × length) (mm)	30 × 50	30 × 55	30 × 60
preliminary force (mN)	3	3	3

Unless otherwise specified, calculate the mean value for all sampling directions (using all individual values). For measurements testing both bending parameters of the leather (compression and extension), mean values for each bending parameter shall be calculated. The mean values shall be given in the test report.

7.2 Measure the thickness of the leather in accordance to ISO 2589. The same specimens used for the measurement of flexural properties can be used. In this case, thickness shall be measured after the measurement of flexural properties.



## 8 Test report

The test report shall include the following:

- a) reference to this International Standard (i.e. ISO 14087);
- b) a description of the test specimen(s);
- c) sampling angle;
- d) mean value of the thickness;
- e) parameter set used for measurement;
- f) indication of which side was measured (compression and/or extension);
- g) average of bending force in mN with three significant digits;
- h) any deviations from this International Standard.

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