
**Rubber- or plastic-coated fabrics —
Physical and mechanical test —
Determination of bending force**

*Supports textiles revêtus de caoutchouc ou de plastique — Essai
physique et mécanique — Détermination de la force de flexion*





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Foreword

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Rubber- or plastic-coated fabrics — Physical and mechanical test — Determination of bending force

1 Scope

This document specifies a test method for the determination of the bending force of rubber or plastics-coated fabrics.

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 2231:1989, *Rubber- or plastics-coated fabrics — Standard atmospheres for conditioning and testing*

ISO 2286-3, *Rubber- or plastics-coated fabrics — Determination of roll characteristics — Part 3: Method for determination of thickness*

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

3.1

bending force

force exerted by the specimen on the measuring bar at a specified *bending angle* (3.2), *bending length* (3.3) and *bending rate* (3.4)

3.2

bending angle

angle at which the *bending force* (3.1) is measured

3.3

bending length

length around which the specimen is bent

Note 1 to entry: 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

3.5

compression-bending

compression of the coating layer during bending

3.6

extension-bending

extension of the coating layer during bending

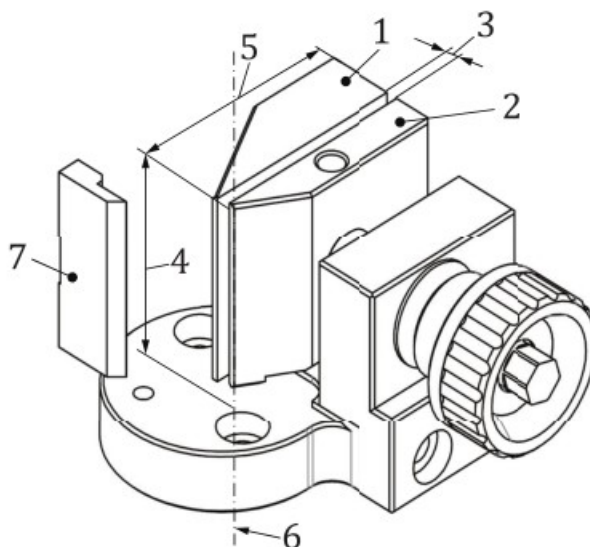
4 Principle

The bending force is determined based on the bar method/two-point 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 A device for determining the bending force according to the bar method (two-point bending method) comprising the following.

5.1.1 A clamping mechanism in which the specimen shall be able to be clamped vertically. The clamping jaws shall have a depth of (35 ± 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 at known clamping pressure, i.e. by torque wrench or any other adapted method. The clamping device shall allow for affixing the specimen without it touching the bar in its initial position.



Key

- 1 fixed clamping jaws
- 2 moving clamping jaws
- 3 aperture > 6 mm
- 4 jaw width > 30 mm
- 5 jaw depth (35 ± 1) mm
- 6 pivot axis
- 7 vertical metering bar

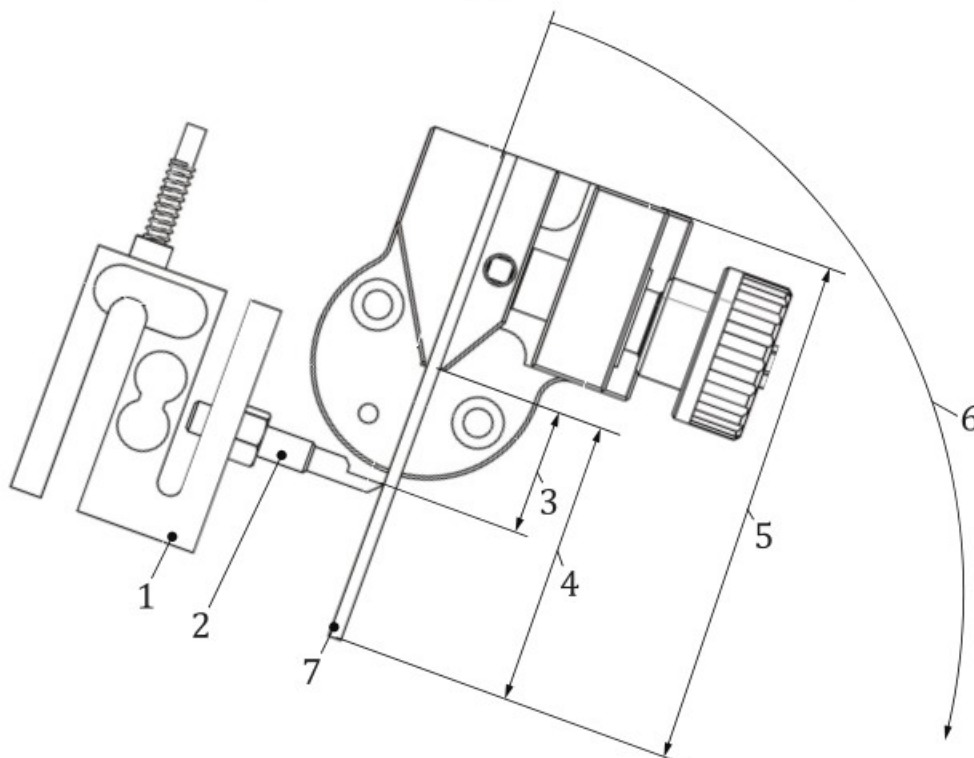
Figure 1 — Clamping jaws

5.1.2 A means of 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 to 91° with a maximum deviation of 1,5 %. The rotational speed shall be able to be adjusted up to 10°/s with an accuracy of 0,1°/s. At maximum load, the maximum deviation of the rotational speed allowed is 1 %.

5.1.3 A means of measuring the bending force (see [Figures 2](#) and [3](#)). The rotation of the specimen causes it to be pressed against a vertical bar. 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 an accuracy as specified by class 2 of ISO 7500-1. The main axis of the load cell shall be aligned horizontally. The bar design shall exhibit a sharp edge ($R = 0,05 \text{ mm} \pm 0,01 \text{ mm}$) and a width of at least 30 mm. The weight of the bar shall not influence the measured value by more than 1 % of its reading.

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 at least 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 at least 1 mN. When the preliminary force is reached, the measurement shall start, i.e. angle = 0° 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 and 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 rotating direction
- 7 sample

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

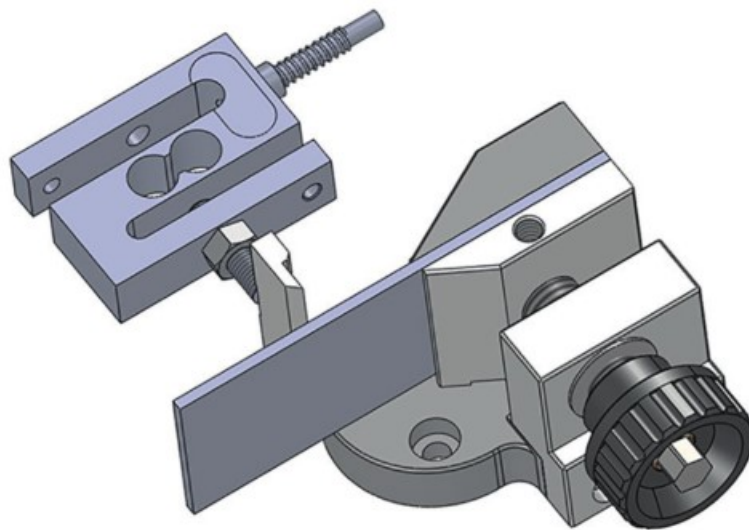


Figure 3 — 3 D drawing of clamping jaws with specimen, load cell and bar

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

6 Sampling and sample preparation

From the product to be tested, take rectangular test specimens of dimensions taken from the relevant parameter sets (see [Table 1](#)). Other dimensions are permissible but shall be indicated in the test report. Cut at least three test specimens from the sheet longitudinal to the direction of manufacture and at least another three test specimens perpendicular to the direction of manufacture. If the direction of manufacture is unknown, the directions for cutting should be agreed between the interested parties. Other sampling angles (e.g. diagonal) are also permissible and details shall be given in the test report.

Define and mark clearly the side which extended-during the test. This side is pressed by the bar during the test.

If bending tests on both sides are to be conducted on the material, an additional three specimens shall be used for each sampling direction.

7 Atmosphere for conditioning and testing

7.1 For conditioning

The atmosphere shall be the method of conditioning “1” specified in ISO 2231:1989, 6.1. For fabrics coated on one side only, a minimum exposure shall be at least 16 h. For fabrics coated on both sides, a minimum exposure shall be at least 24 h.

7.2 For testing

The atmosphere shall be selected from atmospheres “A” to “E” as specified in ISO 2231:1989, Clause 5. If it is necessary to control both temperature and humidity, select from atmospheres “A” to “C”.

NOTE The temperature 23 °C is normally the testing atmosphere in temperate countries and 27 °C is normally in tropical and subtropical countries.

8 Test procedure

8.1 Bending force

8.1.1 General

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](#). The marked side shall be pressed by the bar during the test. A torque wrench 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, given in [Table 1](#). If no set is specified, use set A as standard set. The measurement starts at 0° when the specified preliminary force is reached. The measured forces shall be recorded at the required bending angle.

8.1.2 Specimen coated on both sides

When the specimen has both sides' surfaces coated, indicate clearly which side is pressed by the bar. Both extension- and compression-bending are possible. For the extension-bending test, the specimen shall be inserted so that the bar presses on the marked side. To make the compression-bending test of the marked side, the specimen shall be inserted so that the bar presses on the non-marked side.

The coating layers on both sides can consist of the same material and have the same thickness. To get a full set of information, it is recommended that extension- and compression-bending tests of the marked side are conducted because in such cases, the results of the tests with extension and compression of the marked side can be different.

8.1.3 Specimen coated on one side

Both extension and compression-bending on the coated side is possible. For the extension-bending test, the specimen shall be inserted so that the bar presses on the coated side. To make the compression-bending test, the specimen shall be inserted so that the bar presses on the uncoated side.

Table 1 — Set of parameters

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

8.2 Thickness

Measure the total thickness of the material in accordance to ISO 2286-3. 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.

9 Expression of results

Unless otherwise specified, express the bending force in millinewton (mN) with three significant digits and calculate the mean value for all sampling directions (using all individual values). For measurements testing both bending parameters of the material (compression and extension), mean values for each bending parameter shall be calculated separately. The mean values shall be given in the test report.

10 Test report

The test report shall contain at least the following:

- a) a reference to this document (i.e. ISO 22751:2020);
- b) a description of the test specimen(s);
- c) the mean value of the thickness;
- d) the parameter set used for measurement;
- e) the indication of which side was measured under compression and/or extension;
- f) the mean value of bending force in mN with three significant digits for the test with compression and/or for the test with extension;
- g) any deviations from this document.

