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## Rubber- or plastics-coated fabrics — Physical and mechanical tests — Determination of flex resistance by the flexometer method

*Supports textiles revêtus de caoutchouc ou de plastique — Essais  
physiques et mécaniques — Détermination de la résistance à la  
flexion à l'aide d'un flexomètre*

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**Contents**

Page

<b>Foreword</b> .....	<b>iv</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Principle</b> .....	<b>1</b>
<b>5 Apparatus</b> .....	<b>2</b>
<b>6 Test specimens</b> .....	<b>3</b>
6.1 Sampling.....	3
6.2 Number of test specimens.....	4
6.3 Conditioning of the test specimens.....	4
<b>7 Procedure</b> .....	<b>4</b>
<b>8 Expression of results</b> .....	<b>6</b>
<b>9 Test report</b> .....	<b>7</b>
<b>Annex A (informative) Important clarifications</b> .....	<b>8</b>
<b>Bibliography</b> .....	<b>9</b>



## ISO 32100:2018(E)

## Foreword

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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](http://www.iso.org/directives)).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 4, *Products other than hoses*.

This second edition cancels and replaces the first edition (ISO 32100:2010), which has been technically revised:

The main changes compared to the previous edition are as follows:

- the list of apparatus has been updated;
- the procedure has been amended;
- in 7.12, an additional procedure has been added;
- the Bibliography has been updated.

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](http://www.iso.org/members.html).

# Rubber- or plastics-coated fabrics — Physical and mechanical tests — Determination of flex resistance by the flexometer method

## 1 Scope

This document specifies a test method for determining the flex resistance of rubber- or plastics-coated fabrics in the folded condition. The test method is applicable only to products which can be clamped in the test apparatus used and to products with which the fold made in the test specimen can be caused to move back and forth along the specimen during the test.

The appearance of the test specimen, after completion of either the flex number (see 3.1) or a specified number of flex cycles, is taken as a measure of the flex resistance in the folded condition.

## 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, *Rubber- or plastics-coated fabrics — Standard atmospheres for conditioning and testing*

## 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

#### flex number

number (agreed between the interested parties) of *flex cycles* (3.2) to which the test specimen is subjected, the specimen being subsequently examined using a magnifying lens with  $\times 6$  magnification to determine whether any damage or other visible change is observable

### 3.2

#### flex cycle

cycle comprising one forward and one backward (i.e. a complete to-and-fro) movement of the moveable clamp of the test apparatus

## 4 Principle

One end of a test piece is folded with the surface to be tested facing inwards and clamped in an upper (moveable) clamp and the other end of the test piece is folded with the surface to be tested facing outwards and clamped in a lower (fixed) clamp. The upper clamp is then moved in such a way that the fold is caused to run along the test piece. The test piece is examined periodically for damage or any other visible change.



## ISO 32100:2018(E)

## 5 Apparatus

**5.1 Test machine**, consisting of a movable upper clamp, a fixed lower clamp and a counter as described in 5.1.1 to 5.1.3 and as shown in Figure 1 as an example.

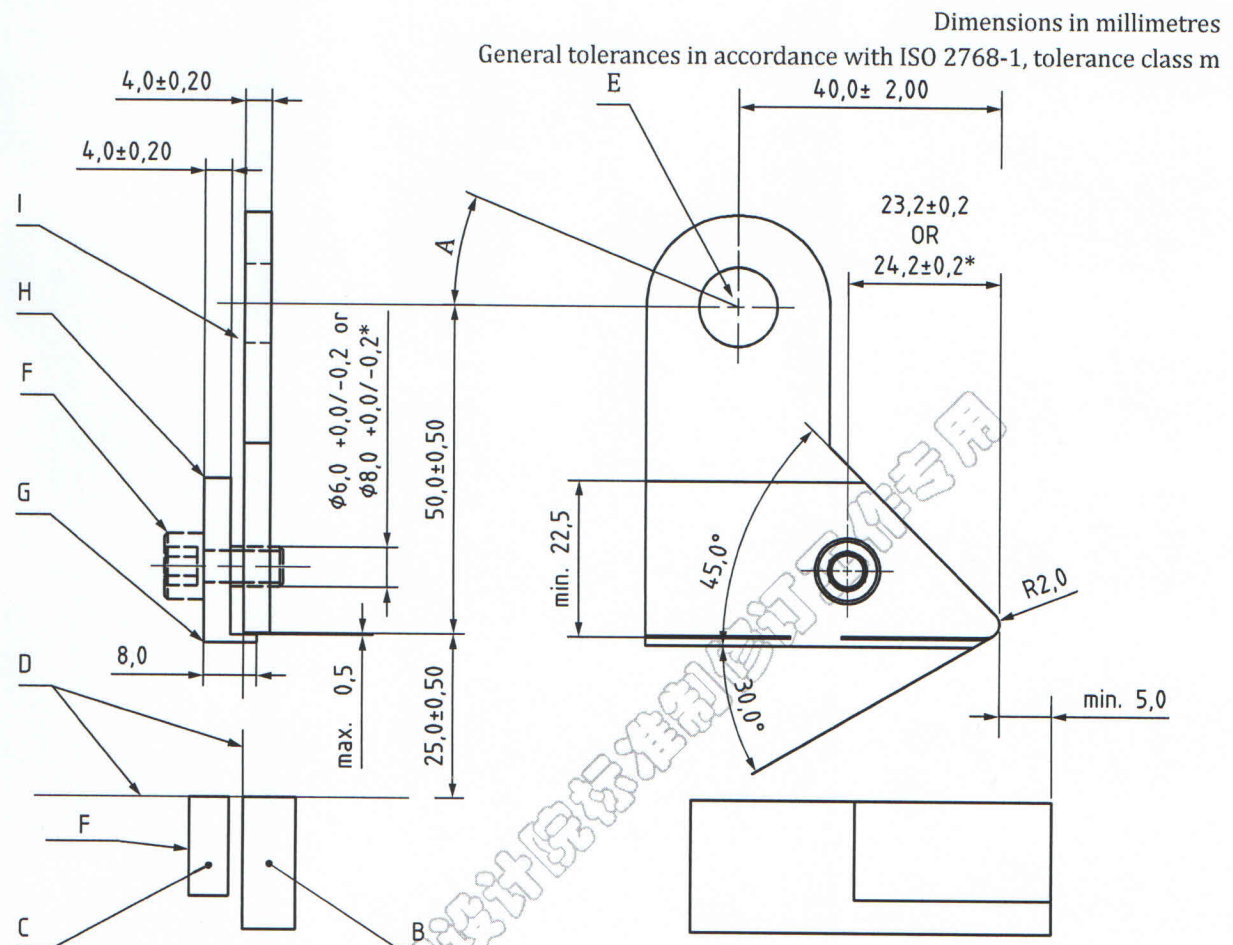
**5.1.1 Upper clamp**, consisting of a pivoting pair of flat plates of 4 mm thickness as shown in Figure 1. The small plate (H) has the basic shape of a trapezium but with a radius of 2 mm at the acute corner. It has a ledge (G) to support the folded test piece. The larger plate (I) has a shape as shown in figure 1. The clamp tightening screw (F) is tightening the plates together and also acts as a stop to prevent the test piece from being incorrectly positioned. The design of the clamp should ensure the two faces of the clamp remain parallel when clamping the test piece. The upper clamp is reciprocated by a motor about a horizontal axle, descending through an angle (A) of  $22,5^{\circ} \pm 0,5^{\circ}$  at a frequency of 100 cycles/min  $\pm 5$  cycles/min.

**5.1.2 Lower clamp**, fixed and lying directly beneath (planar to) the upper clamp and consisting of a pair of flat plates (B and C) to hold the test piece. 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  $25,0 \text{ mm} \pm 0,5 \text{ mm}$ .

**5.1.3 Counter**, to indicate the number of cycles.

**5.2 Magnifier**, with a magnification of 6 times.

**5.3 Mandrel**, having a diameter of 10 mm and minimum length of 70 mm.

**Key**

- A flexing angle  $22,5^\circ \pm 0,5^\circ$
- 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
- G ledge (For testing of thick test pieces the ledge can be increased to more than 8 mm)
- H small part of upper clamp with ledge (G)
- I large part of upper clamp
- \* Values for devices with 8 mm bolt.

**Figure 1 — Example of an upper (moveable) and a lower (fixed) clamp**

## 6 Test specimens

### 6.1 Sampling

From the product to be tested, take test specimens either of dimensions 70 mm × 45 mm or, in certain cases as described in 7.9, in accordance with Figure 2.

Dimensions in millimetres

General tolerances in accordance with ISO 2768-1, tolerance class m

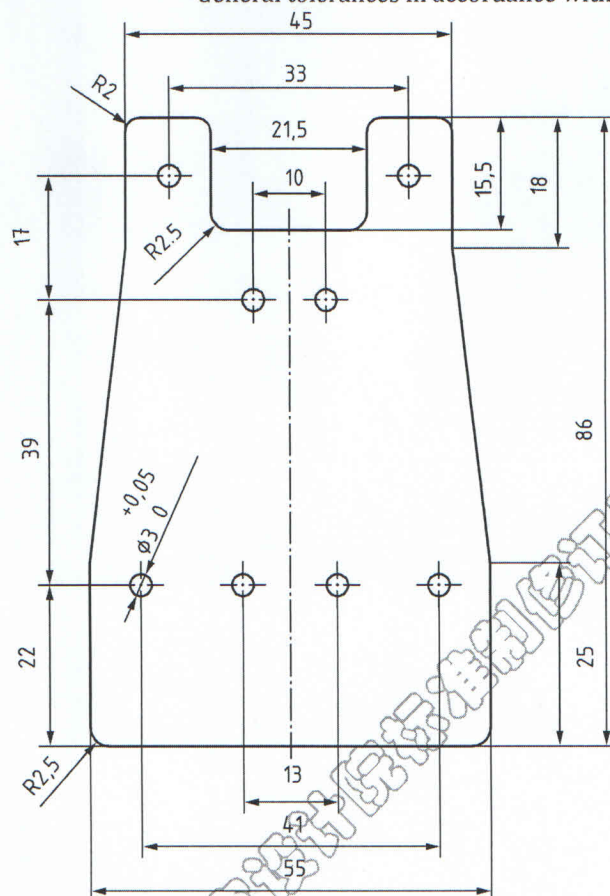


Figure 2 — Test specimen for special cases (see 7.9)

## 6.2 Number of test specimens

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.

## 6.3 Conditioning of the test specimens

Prior to testing, condition the test specimens in standard atmosphere B as defined in ISO 2231 (23 °C and 50 % r.h.) for the length of time specified in ISO 2231.

## 7 Procedure

7.1 Unless otherwise specified, carry out the test in standard atmosphere B as defined in ISO 2231.

7.2 Open the upper and lower clamps (5.1.1 and 5.1.2) so that the gap is at least twice the thickness of the test piece.

7.3 Turn the motor until the lower side of the upper clamp (5.1.1) is parallel to the upper edge of the fixed lower clamp (5.1.2) as shown in Figure 1 (the point at which the direction of rotation of the horizontal axle changes).



**7.4** Fold the test piece in half lengthwise such that the two long edges are brought together exactly and the surface to be tested meets face to face. Clamp the folded test piece as shown in [Figure 3 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. It has to be ensured that the corners of the test piece within the upper clamp are securely fixed and cannot slip during the test.

**7.5** Draw the free corners of the test piece outward and downward around the clamp as shown in [Figure 3 b\)](#).

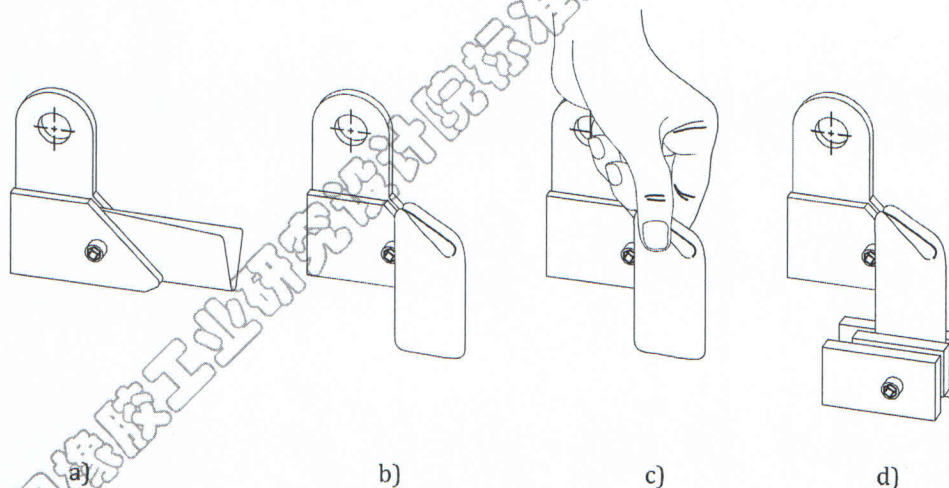
Bring the inner surfaces together and place the free end in the opened lower clamp.

**7.6** Press the test piece against the outer surfaces of the upper clamp as shown in [Figure 3 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 3 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. See [Annex A](#).

**7.7** Inspect the vertical orientation of the test piece (rear edge). If the rear edge is not perpendicular to the lower clamp repeat [7.5](#) and [7.6](#).



- a) sample in upper clamp
- b) sample folded back
- c) sample fixed with two fingers in on upper clamp
- d) sample fully clamped

**Figure 3 — Loading of the test piece**

**7.8** Programme the test rig to carry out either an agreed number of flex cycles (the flex number — see [3.1](#)) or the intervals as agreed between the interested parties. Set the upper clamp in motion. During the swivelling motion, the fold shall run up and down along the test specimen. After completion of the

## ISO 32100:2018(E)

relevant number of flex cycles, check the test specimen for damage or other visible change by examining it under a magnifier (5.2).

Grade the damage or other visible change observed in accordance with Table 1. If necessary, the moveable clamp may be slowly swivelled manually for the purposes of the examination or the test specimen may be taken out of the test apparatus. In the latter case, the test specimen shall be repositioned in the test apparatus exactly as before (see 7.9).

Table 1 — Grading of the damage/other change

Grade	Degree of change in coated fabric
0	No change.
1	Crazing of the finish detectable only under the magnifying lens. Minor changes in the surface due to greying (stress whitening) and/or creasing.
2	Top layer of coated fabric shows crazing and/or very small tears detectable only under the magnifying lens. With poromerics, no cracks in the poromeric layer detectable even under the magnifying lens. Cracks in the finish and/or minor stress whitening; with poromerics, crazing in the protective coating.
3	Cracks in the base layer or in the poromeric layer, detectable only under the magnifying lens. Cracks in the top or protective layer. Major stress whitening; formation of blisters; separation of layers. Base layer not identical in hue with the other layers.
4	Major cracks in the top or surface layer, and/or cracks in the base or poromeric layer.
5	Coating completely broken; stratum clearly recognizable and/or hole formation.

Continue testing until all the test specimens have been tested.

**7.9** During testing, pressure marks might be produced on certain test specimens by the clamps. Some test specimens also increase in length during the test and, if so, shall not be stretched tight during reinstallation. In order to ensure exact repositioning, the use of test specimens in accordance with Figure 2 is recommended, in which case the upper and lower clamps will need to be equipped with suitable pins.

**7.10** If the test apparatus is shut down for an extended period of time, e.g. overnight, with the test specimen(s) still clamped in the apparatus, the clamps shall be positioned so that the test specimens are not stretched tight.

**7.11** When examining wet test specimens, the test apparatus shall be stopped for the absolute minimum time necessary for checking the test specimens.

**7.12** For final inspection remove the test specimen from the machine, bend it along the longitudinal axis around the mandrel (5.3) and check it for damage or other visible change by examining under a magnifier (5.2).

## 8 Expression of results

For each test specimen, express the result either as the flex number (i.e. the agreed number of flex cycles to which the specimen was subjected — see 3.1) or as the specified number of flex cycles at each interval as agreed between the interested parties, and the grade corresponding to the visible appearance of the test specimen after completion of test or at each interval (see Table 1).



## 9 Test report

The test report shall include the following information:

- a) a reference to this document including its year of publication;
- b) the type of product tested and its designation;
- c) the number of test specimens tested;
- d) details of the orientation in the sample from which the test specimens were taken;
- e) the test conditions used with wet samples, for instance;
- f) the test results:
  - i. (if testing up to an agreed flex number — see 3.1) the flex number used, the grading according to Table 1 for each test specimen and if requested description of damages or other visible changes.
  - ii. (if testing in intervals — see 3.1) the flex number and the number of flex cycle at each interval used, the grading according to Table 1 for each test specimen and if requested description of damages or other visible changes.
- g) details of any deviations from the procedure specified in this document;
- h) details of any incidents which might have had an influence on the results;
- i) the date of the test.



## **Annex A** **(informative)**

### **Important clarifications**

This test method is not applicable in cases when, due to the thickness or stiffness, for instance, of the material, no running fold can be produced during the swivelling motion of the upper clamp.

In order to ensure sufficient reproducibility of the measurement results, it is necessary for the dimensions of the various parts of the test apparatus and the speed of the swivelling motion to comply exactly with the specifications agreed between the interested parties. It is equally important to maintain the standard atmospheric conditions and to clamp the test specimens correctly.

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## Bibliography

- [1] ISO 2768-1, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*
- [2] ISO 5402-1, *Leather — Determination of flex resistance — Part 1: Flexometer method*

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