

# INTERNATIONAL STANDARD

**ISO**  
**4646**

Second edition  
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## Rubber- or plastics-coated fabrics — Low-temperature impact test

*Supports textiles revêtus de caoutchouc ou de plastique — Essai de choc à basse température*



Reference number  
ISO 4646 : 1989 (E)

## 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 4646 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*.

This second edition cancels and replaces the first edition (ISO 4646 : 1978), clauses 3, 7 and 8 of which have been technically revised.

Annex A of this International Standard is for information only.

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International Organization for Standardization

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# Rubber- or plastics-coated fabrics — Low-temperature impact test

## 1 Scope

**1.1** This International Standard specifies a procedure for determining the lowest temperature at which fabrics coated with rubber or plastics will not exhibit fractures or coating cracks when subjected to specific impact conditions.

**1.2** Fabrics coated with rubber or plastics are used in many applications involving low-temperature flexing with or without impact. Data obtained by this method may be used to predict the behaviour of these coated fabrics at low temperatures only in the applications in which the conditions of deformation are similar to those specified in the method.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO 2286 : 1986, *Rubber- or plastics-coated fabrics — Determination of roll characteristics.*

## 3 Apparatus

A number of different impact testers are available commercially.<sup>1)</sup> The apparatus used shall meet the requirements specified below for certain of the components.

### 3.1 Test piece clamps and striking arm (see figure 1).

The test piece clamps shall be designed to hold the test piece or pieces as a cantilever beam. Each individual test piece shall be held firmly and securely in the clamps without causing distortion to the test piece.

The striking edge shall move relative to the test piece(s) along a trajectory normal to the upper surface of the test piece at a linear speed of 1,8 m/s to 2,1 m/s at impact and during at least the following 6 mm of travel after impact. In order to maintain this velocity consistently within the heat-transfer medium (3.3), the striking arm shall be positively driven. It may be necessary in some cases to reduce the number of test pieces tested at one time (see annex A).

The striking edge shall have a radius of  $1,6 \text{ mm} \pm 0,1 \text{ mm}$ .

The striking arm and the test piece clamps shall have a clearance at and immediately following impact in accordance with the dimensions listed in table 1.

### 3.2 Insulated tank.

1) Any impact tester may be used which is found to be suitable for performing the test. Impact testers which have been reported as suitable are obtainable in the UK from H.W. Wallace, 172 St. James's Road, Croydon CR9 2HR, and in the USA from Testing Machines Inc., 400 Bayview Avenue, Amityville L.I., NY 11701 and from Precision Scientific Co., 3737 W. Cortland St., Chicago, IL 60647.

**3.3 Heat-transfer medium.**

Any liquid heat-transfer medium that remains fluid at the test temperature and which will not appreciably affect the materials being tested may be used.

**CAUTION** – Where a flammable or toxic solvent is used as the heat-transfer medium, the customary precautions in handling such a material shall be exercised.

Methanol is the recommended heat-transfer medium for rubber.

NOTE – The following materials have been used down to the indicated temperatures:

Ethanol	– 60 °C
Dow Corning 200 fluids	
– kinematic viscosity 5 mm <sup>2</sup> /s	– 60 °C
– kinematic viscosity 2 mm <sup>2</sup> /s	– 76 °C
Methanol	– 90 °C
Dichlorodifluoromethane	– 120 °C

When dichlorodifluoromethane refrigerant is used, it shall be cooled below its boiling temperature of –29,8 °C before being transferred from the cylinder to the tank of the testing machine.

**3.4 Stirrer,** to provide thorough circulation of the heat-transfer medium.

**3.5 Temperature control,** automatic or manual, for controlling the temperature of the heat-transfer medium to within ±0,5 °C of the desired temperature.

Powdered solid carbon dioxide (dry ice), liquid nitrogen or liquid carbon dioxide are recommended for lowering the temperature. An electric immersion heater is required for raising the temperature.

**3.6 Thermocouple,** with associated temperature indicator graduated in 1 °C divisions and having a range suitable for the temperature at which the tests are to be made.

The thermocouple shall be constructed of copper-constantan wire between 0,2 mm and 0,5 mm in diameter and shall be fusion-bonded at the junction. It shall be located as near the test piece as possible.

NOTE – A thermometer may be used if it is shown to be in agreement with the specified thermocouple.

**4 Test pieces**

**4.1 Test pieces** shall be die-punched. Each shall be 6,4 mm ± 0,5 mm wide. Test pieces shall be cut with the longer dimensions parallel to the lengthwise and transverse direction of the coated fabric across the full usable width of the coated fabric unless otherwise specified.

Dimensions in millimetres

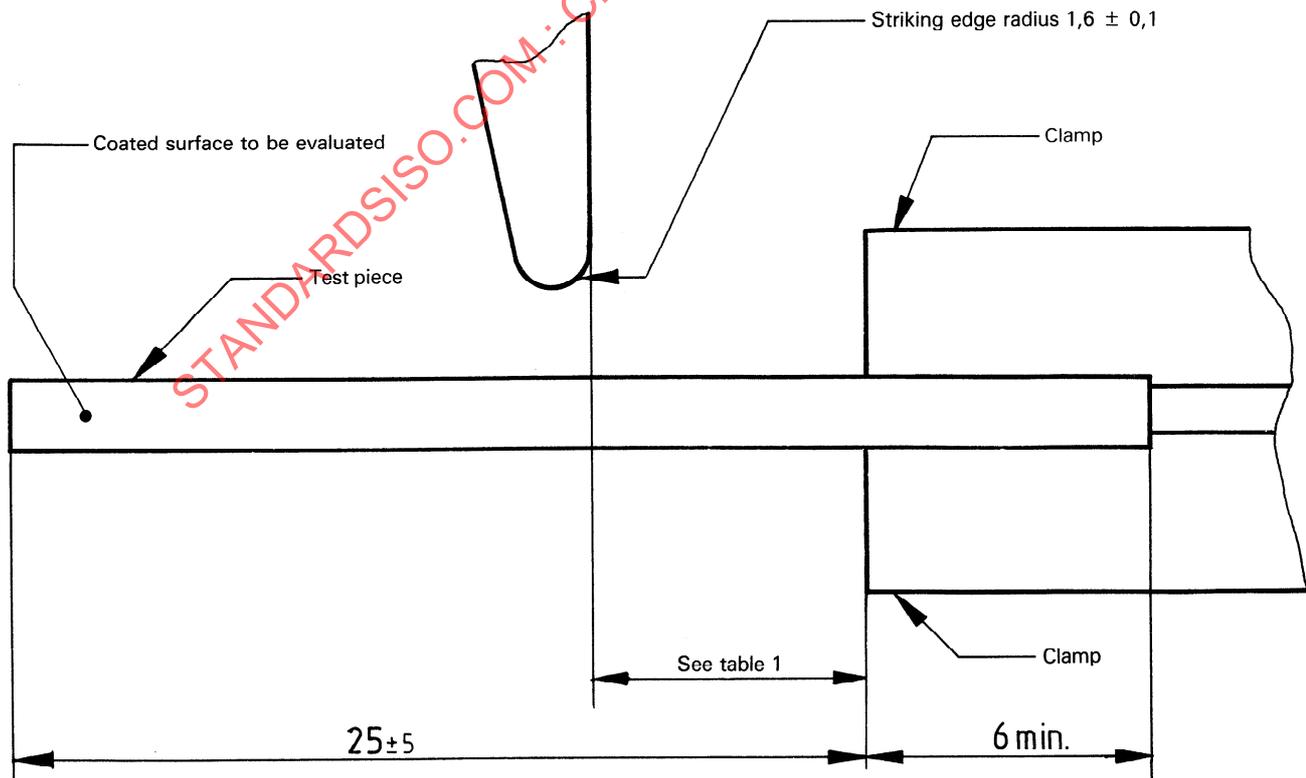


Figure 1 – Test piece clamps and striking arm

**Table 1 — Clearance of striking arm and test piece clamps**

Dimensions in millimetres

Thickness of test piece	Required clearance
1,65 to 2,15	6,4 ± 0,3
1,05 to 1,64	5,7 ± 0,3
0,55 to 1,04	5,2 ± 0,3
0,10 to 0,54	4,8 ± 0,3

**NOTES**

1 The thickness of the test piece shall be determined in accordance with ISO 2286.

2 The required clearance may be obtained by fabricating an adjustment plate or individual plates to fit the test piece clamps illustrated in figure 1.

3 Apparatus for this test may be powered in any way, provided that it meets the dimensional and velocity requirements given above and in clause 3. If the striker is electrically driven, a means of controlling and regulating the voltage is needed to control the speed when testing light gauge material.

**4.2** A minimum of 6 mm of the test piece shall be held in the clamps, and the length extending from the clamp shall be 25 mm ± 5 mm.

NOTE — Sharp dies must be used in the preparation of test pieces for this test if reliable results are to be obtained. Light honing of the cutting edges with a jeweller's honing stone should be carried out daily.

## 5 Time-interval between manufacturing and testing

**5.1** For all test purposes, the minimum time between manufacturing and testing shall be 16 h.

**5.2** For non-product tests, the maximum time between manufacturing and testing shall be 4 weeks and, for evaluations intended for comparison purposes, all tests should, as far as possible, be carried out after the same time-interval.

**5.3** For product tests, wherever possible, the time between manufacturing and testing should not exceed 3 months. In other cases, tests shall be made within 2 months of the date of receipt by the customer.

## 6 Conditioning of test pieces

Condition the test piece in accordance with method 1 of ISO 2231 : 1989.

NOTE — In ISO 2231, three standard atmospheres are defined for method 1, namely:

— temperature 20 °C ± 2 °C, relative humidity 65 % ± 5 % R.H.;

or

— temperature 23 °C ± 2 °C, relative humidity 50 % ± 5 % R.H.;

— for tropical countries only, temperature 27 °C ± 2 °C, relative humidity 65 % ± 5 % R.H.

## 7 Procedure

**7.1** Prepare the insulated tank (3.2) and bring the apparatus to the desired temperature. This may be accomplished by placing a suitable amount of solid carbon dioxide (dry ice) in the tank and slowly adding the heat-transfer medium (3.3) until the tank is filled to within 50 mm of the top. During the test, the temperature of the bath shall be maintained constant by judicious addition of small quantities of dry ice.

NOTE — The desired temperature may also be obtained by filling the tank with the heat-transfer medium and lowering the temperature by the addition of liquid carbon dioxide, controlled by a solenoid-actuated valve with an associated temperature control unit. Where temperatures below that obtainable with dry ice or liquid carbon dioxide are required, liquid nitrogen may be used.

**7.2** Determine the thickness of the test pieces in accordance with the method described in ISO 2286.

**7.3** Mount the test pieces in the clamps and immerse them for 3,0 min ± 0,5 min at the desired temperature. The side to be evaluated shall face toward the striking arm unless otherwise specified.

**7.4** After immersion for the specified time at the test temperature, record the temperature and deliver a single impact.

**7.5** For each test, check the speed of the striker, which shall be between 1,8 m/s and 2,1 m/s. (See annex A.)

**7.6** After removing the test pieces from the tank, examine each test piece to determine whether or not it has failed. Failure is defined as any fracture or crack visible in the coating when examined under a × 5 magnifier. Bend each test piece to an angle of 180° around a 6 mm diameter mandrel in the same direction as the bend caused by the impact prior to examining it under the × 5 magnifier.

**7.7** Use new test pieces for each test temperature.

NOTE — For routine testing, subject five test pieces to the impact test for each face, at the temperature specified in the relevant material specification.

## 8 Test report

The test report shall include the following particulars:

- a) reference to this International Standard;
- b) identification of the coated fabric;
- c) the temperature at which the test pieces were tested;
- d) the type of test apparatus used;
- e) the conditioning temperature, humidity and period;
- f) the length of time the test pieces were immersed, if different from that specified in 7.3;
- g) the number of test pieces tested;
- h) the speed of the striker at impact;
- i) the behaviour of each individual test piece;
- j) the thickness of the coated fabric;
- k) which face or side of the coated fabric was tested;
- l) details of the heat-transfer medium used.

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## Annex A (informative)

### Speed calibration of a solenoid-actuated low temperature impact tester<sup>1)</sup>

#### A.1 Speed calibration prior to testing

##### A.1.1 Principle

The height  $h$  to which a steel ball, suspended on the striker mechanism of the tester, rises after the striker has had its upward motion halted by contact with a mechanical stop is measured. The ball decelerates in such a manner that the law governing a body moving freely under the influence of gravity applies.

##### A.1.2 Procedure

###### A.1.2.1 Securing ball support

Remove either one of the nuts that fasten the striking bar guide rods to the solenoid armature yoke. Place the small hole in the ball support (see figure A.1) over the guide rod and replace and secure the nut.

###### A.1.2.2 Adjusting stroke of striker

Remove the metal guard from around the solenoid. Spread open the rubber bumper (see figure A.2) and insert it around the armature. Replace the solenoid guard. Insert a typical test piece into the specimen holder of the tester. Raise the striking mechanism by hand until the end of the stroke is reached. It is essential that, with the striking mechanism raised to its maximum height, the striker bar of the tester is in contact with the test piece but that the bar is not in the plane of the test piece. If the striker bar is not in contact with the test piece, the rubber bumper shall be removed and replaced by a thinner bumper. Conversely, if the striker bar moves into the plane of the test piece, the bumper shall be replaced by a thicker one.

###### A.1.2.3 Placement of ball and measuring tube

Place a 19 mm diameter steel ball on the ball holder. (In theory, the upward flight of the ball is independent of the mass of the ball. However, if the mass is too large, the motion of the striker bar may be impeded.) Clamp a glass or clear plastic tube with a minimum inside diameter of 25,4 mm in a vertical position directly over the ball. The tube should contain a scale divided into 5 mm intervals. The zero position on the scale should be aligned with the top of the ball when the ball is at the top of the stroke of the striker mechanism.

###### A.1.2.4 Measurement and calculation

With the tester equipped as described above and devoid of test pieces and immersion medium, actuate the solenoid and read

the ball height to the nearest 5 mm. Make at least five measurements. Average all results and convert the average to metres. Determine the striker speed  $v$ , in metres per second, from the following equation :

$$v = \sqrt{2gh}$$

where

$g$  is the acceleration due to gravity, in metres per second squared (= 9,8 m/s<sup>2</sup>);

$h$  is the average ball height, in metres.

NOTE — Calibration measurements should be made with the tester supported on a non-resilient surface, such as a laboratory bench or concrete floor. Resilient mountings tend to absorb some of the striker energy causing low ball height values.

#### A.2 Speed calibration during testing

**A.2.1** With the tester equipped with ball support, ball and measuring tube (see clause A.1), but without the rubber bumper (tester in normal operating condition) and devoid of test pieces and immersion medium, actuate the solenoid and read the ball height to the nearest 5 mm. Make ten measurements. From the lowest and highest ball height readings, determine the range in striker speed, using the equation in A.1.2.4. This range is termed "range of speed at the top of the stroke".

**A.2.2** With the tester equipped as described in A.2.1, but also with test piece(s) and immersion medium, conduct the brittleness test as described in clause 7. Read the ball height each time the solenoid is actuated. Convert the ball height to speed as shown in A.1.2.4. If the speed lies within the predetermined range of speed at the top of the stroke, the test should be considered valid. If the speed lies outside the predetermined range, the test is invalid and should not be reported. Should successive tests be invalid, adjustments should be made to bring the speed at the top of the stroke within the acceptable, predetermined range. This may be accomplished by reducing the number of test pieces tested per impact.

**A.2.3** The following example typifies the entire speed calibration procedure for solenoid-actuated testers:

- a) Using the procedure specified in clause A.1, the striker speed at the point of impact of a tester devoid of test pieces and immersion medium was found to be 1,9 m/s. This speed is within the specified limits of 7.5.
- b) Using the procedure in A.2.1, with the tester devoid of test pieces and immersion medium, the range of striker

1) Users should note that this annex applies only to certain types of impact tester.

speeds at the top of the stroke was found to be 2,5 m/s to 2,7 m/s. This range becomes the acceptable range for this series of tests. The acceptable range should be established each time the striker speed at the point of impact is determined (see clause A.1).

c) Using the procedure of A.2.2, with the tester containing a test piece(s) and immersion medium, the speed at the top of the stroke during the first solenoid actuation was found to be 2,5 m/s. The speed is within the acceptable range and the test is valid.

d) The speeds at the top of the stroke during the second and third solenoid actuations were found to be 2,4 m/s and 2,3 m/s, respectively. These speeds are outside the acceptable range and both tests are invalid.

e) Adjustments were made to increase the speed at the top of the stroke, using the procedure given in A.2.2.

f) The speeds at the top of the stroke during the fourth and all subsequent solenoid actuations were found to lie between 2,5 m/s and 2,7 m/s. The results of all these tests are valid.

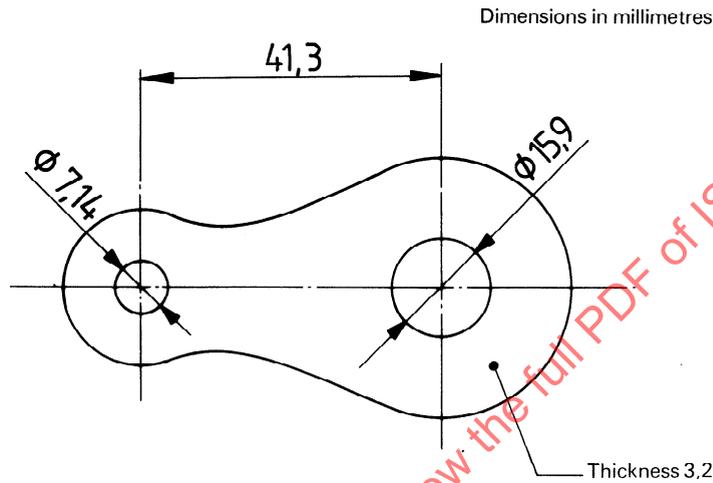


Figure A.1 — Ball support

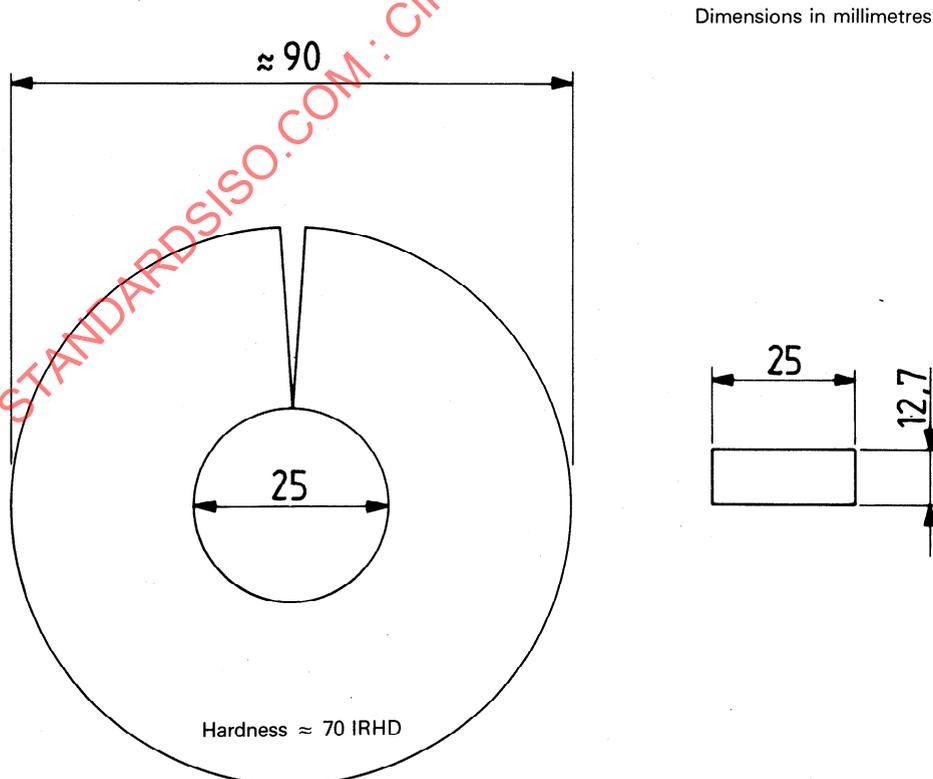


Figure A.2 — Rubber bumper

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