INTERNATIONAL STANDARD

**ISO 7229**

Third edition
2022-08

# Rubber- or plastics-coated fabrics — Measurement of gas permeability

*Supports textiles revêtus de caoutchouc ou de plastique — Mesure de la perméabilité aux gaz*



Reference number
ISO 7229:2022(E)



ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

# Contents

Page

**Foreword** ..... **iv**
**Introduction** ..... **v**
**1 Scope** ..... **1**
**2 Normative references** ..... **1**
**3 Terms and definitions** ..... **1**
**4 Principle** ..... **2**
**5 Test pieces** ..... **2**
5.1 Shape and dimensions ..... 2
5.2 Measurement of thickness ..... 2
5.3 Number of test pieces ..... 2
5.4 Sealing and masking ..... 2
5.5 Conditioning ..... 3
5.6 Test atmosphere ..... 3
5.7 Gas transmission area ..... 3
**6 Pressure sensor method** ..... **4**
6.1 Apparatus ..... 4
6.2 Test gas ..... 5
6.3 Procedure ..... 5
6.4 Calculation and expression of results ..... 7
6.4.1 Gas transmission rate ..... 7
6.4.2 Gas permeability coefficient ..... 8
**7 Gas chromatography method** ..... **8**
7.1 Apparatus ..... 8
7.2 Test gas ..... 9
7.3 Carrier gas ..... 9
7.4 Calibration curve ..... 10
7.5 Procedure ..... 10
7.6 Calculation and expression of results ..... 11
7.6.1 Gas transmission rate ..... 11
7.6.2 Gas permeability coefficient ..... 11
**8 Test report** ..... **11**
**Annex A** (informative) **Gas chromatography method with equal pressure condition** ..... **13**

# 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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

For an explanation of 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 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 third edition cancels and replaces the second edition (ISO 7229:2015), which has been technically revised.

The main changes are as follows:

— in 5.4, Figure 1 has been divided into a) and b);

— in 6.3.10, $\theta$ (delay time) has been added to the key in Figure 3.

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.

# Introduction

The measurement of the permeability of rubber-or plastics-coated fabrics to gases is important in the evaluation of materials for products such as leisure boats, balloons or hoses, and other gas containers in addition to the materials for seals and diaphragms. The permeability of the material is crucial when a product is exposed to differential pressure conditioned environment in its service field.

# Rubber- or plastics-coated fabrics — Measurement of gas permeability

**WARNING — Persons using this document should be familiar with normal laboratory practice. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to conform to any national regulatory conditions.**

## 1 Scope

This document specifies two methods for measuring gas transmission through rubber- or plastics-coated fabrics, a property known as permeability.

## 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*

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



## 3 Terms and definitions



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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

**3.1**
**gas transmission rate**
volume of test gas passing through a test piece per unit area, per unit time with unit partial-pressure difference between the two sides of the test piece

**3.2**
**gas permeability coefficient**
volume of test gas passing through a test piece of unit thickness, per unit area, per unit time with unit partial-pressure difference between the two sides of the test piece

**3.3**
**gas transmission curve**
curve plotted against time, in the pressure sensor method, of the pressure change on the low-pressure side of the test cell until the gas transmission reaches a steady state after starting the test

Note 1 to entry: See Figure 3.

# 4 Principle

A test piece is placed between two parts of a hermetically sealed measurement cell. Each part of the cell is vacuumed, then one part is filled with test gas to a certain pressure level. The quantity of gas that permeates through the test piece to the lower pressure side is measured and determined by a pressure sensor or by a gas chromatograph. In the gas chromatograph method, measurement condition using equal pressure between two parts of the cell divided by the test piece is given for information in Annex A.

# 5 Test pieces

## 5.1 Shape and dimensions

The test piece shall be of uniform shape and have a thickness of more than 0,10 mm and less than 4,00 mm. When using test pieces other than this, the thickness shall be agreed between the interested parties. The test piece shall be large enough to cover the full area of the test cell.

## 5.2 Measurement of thickness

Measure the thickness of the test piece at five or more points including the centre part of the gas transmission area to the nearest 0,01 mm in accordance with ISO 2286-3 and take the arithmetic mean.

## 5.3 Number of test pieces

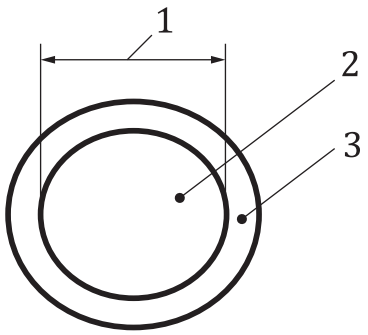
Three or more test pieces shall be used.



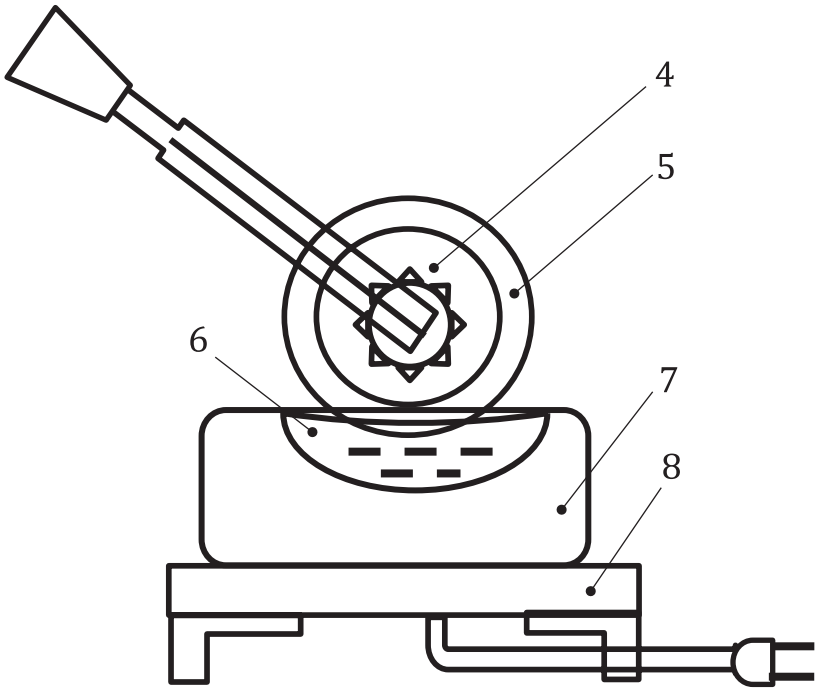
## 5.4 Sealing and masking

A substrate generally passes gas much more easily than coating materials, and even after the test piece is fixed in the cell, the test gas permeated through the coating material can leak out of the cell through the substrate. Cross section cut at the edge around the test piece shall be sealed or masked with wax or a solid type of adhesive which shall not cause any crack nor affect the gas permeability of the test piece during the test.

When a test piece of single-faced coated fabric is used, the surface of the fabric substrate outside the gas permeability measurement area shall be masked besides the edge as shown in Figure 1 a) and b).




**a) Test piece**




**b) Sealing and masking equipment**



**Key**

| | | | |
|---|---|---|---|
| 1 | 10 mm – 150 mm (see 6.1.1) | 5 | test piece |
| 2 | gas transmission area $A$ (see 5.7) | 6 | wax or adhesives |
| 3 | sealing and masking zone | 7 | vessel |
| 4 | plate to support for test piece | 8 | heater |



**Figure 1 — Example of the sealing and masking equipment**

## 5.5 Conditioning

The minimum time between vulcanization and commencement of conditioning of test pieces shall be 16 h.

Unless otherwise required in the material specification, the material shall be conditioned before testing for 16 h to 24 h using the method of conditioning "1" specified in ISO 2231. When using a test piece that can be easily affected by moisture, dry it for more than 48 h at test temperature in a desiccator containing a suitable drying agent such as anhydrous calcium chloride.

## 5.6 Test atmosphere

**5.6.1** Laboratory conditions shall be (23 ± 2) °C (atmosphere "D"), in accordance with ISO 2231.

**5.6.2** When conducting test at a temperature different from the standard laboratory temperature, the temperature shall be agreed between the interested parties. The test temperature shall be recorded.

## 5.7 Gas transmission area

The gas transmission area $A$ ($m^2$) shall be calculated from the internal diameter of the test cell. If a sealing ring is used, calculate the gas transmission area from its internal diameter.

# 6 Pressure sensor method

## 6.1 Apparatus

The testing apparatus consists of the test cell, pressure sensors, test gas supply reservoir, vacuum pump and associated pipes and valves. An example of the testing apparatus is shown in Figure 2.

**6.1.1 Test cell,** consisting of a low-pressure side and a high-pressure side, such that when a test piece is mounted in it, the gas transmission area is clearly defined. The high-pressure side has an inlet port to the supply test gas, and a pressure sensor is connected to the low-pressure side to detect the change of pressure caused by the transmitted gas. The mounting surfaces of the cell touching the sample shall be smooth and flat to prevent leakage of gas. The material of the test cell shall be inactive with regard to the test gas and shall not absorb the gas used. A seal such as an O-ring may be used to seal between the face of the test cell and the test piece, in which case, the transmission rate of the seal shall be considerably smaller than that of a test piece so that it does not affect the result of gas transmission test. The diameter of the gas transmission surface shall be within the range of 10 mm to 150 mm according to the range of gas transmission rates expected. The cell may be equipped with an electric or hot water heating jacket system capable of raising the temperature up to 80 °C. The temperature accuracy shall be controlled within ±2 °C from 40 °C to 80 °C.

**6.1.2 Test piece support,** installed in the low-pressure side in order to prevent the deformation of the test piece due to the pressure difference. Any material such as filter paper or wire mesh that does not affect the result of gas transmission test may be used. When using filter paper, paper such as that used in chemical analysis is recommended, of thickness 0,1 mm to 0,3 mm according to the depth of low-pressure side of the cell.



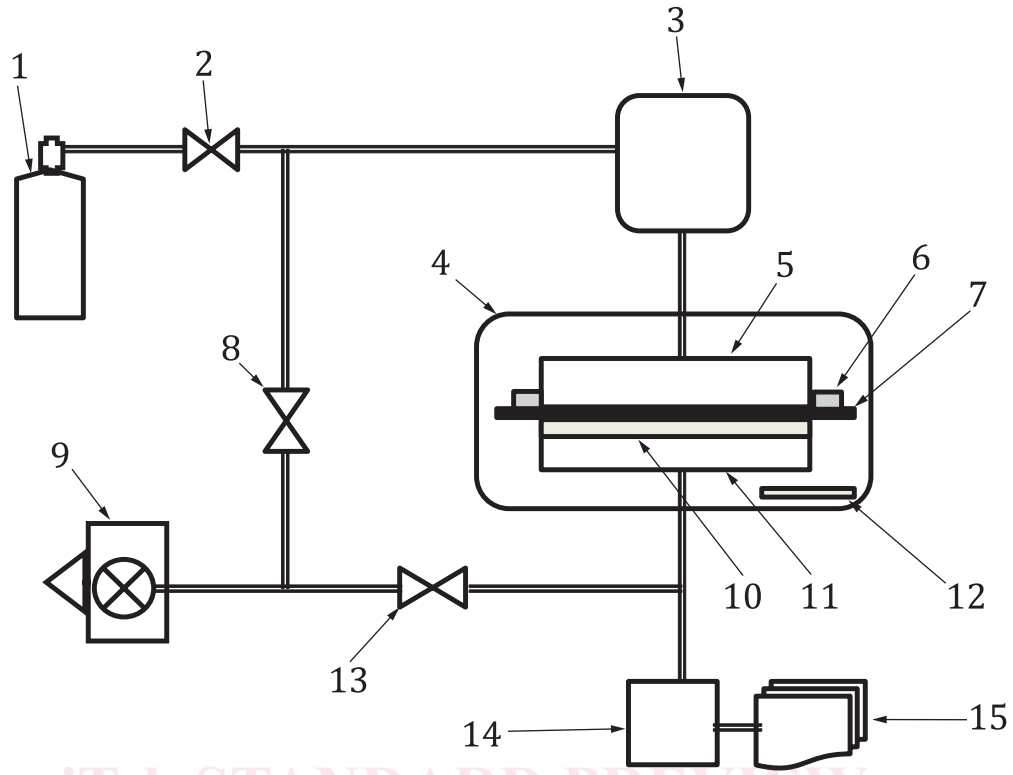
**6.1.3 Pressure sensors,** a) to measure the change in pressure on the low-pressure side of the cell, capable of reading at least to 5 Pa — vacuum gauge with no mercury, an electronic diaphragm-type sensor or other suitable sensor shall be used; b) to measure the pressure of the test gas supply tank, capable of reading at least to 100 Pa.



**6.1.4 Test gas supply reservoir,** with a pressure control system to supply test gas to the high-pressure side at a constant pressure. The volume of the reservoir shall be sufficient to ensure that the pressure drop on the high-pressure side due to the transmission of the test gas to the lower pressure side through a test piece is controlled within at least 1 % or less.

**6.1.5 Vacuum pump,** capable of evacuating the test cell to 10 Pa or lower.

**6.1.6 Temperature sensor,** installed in the test cell for measuring test temperature, and capable of reading at least to 0,1 °C.






**Key**

1 test gas tank
2 valve 1
3 test gas supply reservoir
4 test cell
5 high pressure side of test cell
6 sealing ring
7 test piece
8 valve 2
9 vacuum pump
10 test piece support
11 low pressure side of test cell
12 temperature sensor
13 valve 3
14 pressure sensor
15 data processor

**Figure 2 — Example of apparatus for gas permeability measurement (pressure sensor method)**

## 6.2 Test gas

Use a single gas or a mixture of gases such as air, nitrogen, oxygen, hydrogen, liquefied petroleum gas (in gaseous form) and coal gas. The purity of the single gas or the purity of each component used in the gas mixture shall be 99,5 % of the volume fraction or higher. When using a gas of purity less than this, it shall be agreed between the interested parties. The test gas shall not include any impurity that can affect the measurement.

**WARNING — When using a toxic gas and/or inflammable gas, necessary measures shall be taken in its use and recovery.**

## 6.3 Procedure

**6.3.1** Install a suitable test piece support (key 10 in Figure 2) on the low-pressure side of the test cell.

**6.3.2** Lightly and uniformly apply vacuum grease to the surface of the test cell where the test piece touches and mount the test piece on this surface without any wrinkle or sag.