INTERNATIONAL STANDARD

ISO 6179

Third edition
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Rubber, vulcanized or thermoplastic — Rubber sheets and rubber-coated fabrics — Determination of transmission rate of volatile liquids (gravimetric technique)

Caoutchouc vulcanisé ou thermoplastique — Feuilles de caoutchouc et supports textiles revêtus de caoutchouc — Détermination du taux de transmission des liquides volatils (technique gravimétrique)

Foreword

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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.

International Standard ISO 6179 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Physical and degradation tests.*

This third edition cancels and replaces the second edition (ISO 6179:1989), which has been technically revised.

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Rubber, vulcanized or thermoplastic – Rubber sheets and rubber-coated fabrics – Determination of transmission rate of volatile liquids (gravimetric technique)

WARNING – Persons using this International Standard should be familiar with normal laboratory practice. This standard 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 ensure compliance with any national regulatory conditions.

1 Scope

This International Standard specifies two methods for determining, by measurement of the transmission rate, the permeability of rubber to volatile liquids diffusing into open air.

It is applicable only to materials in sheet form and to coated fabrics, having thicknesses of between 0,2 mm and 3,0 mm.

It is restricted to transmission rates of more than 0,1 g/m^2·h.

The methods are particularly useful for comparing the relative transmission rates of one liquid through different materials, or of several liquids through one material.

Method A, with refilling, is used when testing mixtures of liquids which give different transmission rates.

Method B, with no refilling, is used for a single-component liquid.

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 indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 188:1998, *Rubber, vulcanized or thermoplastic – Accelerated ageing and heat resistance tests.*

ISO 471:1995, *Rubber – Temperatures, humidities and times for conditioning and testing.*

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

ISO 2286-3:1998, *Rubber- or plastics-coated fabrics – Determination of roll characteristics – Part 3: Method for determination of thickness.*

ISO 3310-1:1990, *Test sieves – Technical requirements and testing – Part 1: Test sieves of metal wire cloth.*

ISO 4648:1991, *Rubber, vulcanized or thermoplastic – Determination of dimensions of test pieces and products for test purposes.*

ISO 4661-1:1993, *Rubber, vulcanized or thermoplastic – Preparation of samples and test pieces – Part 1: Physical tests.*

NOTE – A method for the determination of water vapour transmission rate is given in ISO 2528:1995, *Sheet materials – Determination of water vapour transmission rate – Gravimetric (dish) method.*

3 Definition

For the purposes of this International Standard, the following definition applies.

3.1 transmission rate: The mass, in grams, of a volatile liquid which permeates through each square metre of a rubber test sheet of a given thickness per hour under the test conditions specified in this standard.

4 Apparatus

4.1 Container assembly, consisting of a container for the test liquid, a suitable clamping device for the test piece which does not impose a shearing force on the test piece, and a suitable support for the container, so that the test piece and the test liquid are in contact at all times (with the apparatus inverted after filling), and such as to permit free circulation of air across the surface of the test piece.

The container shall have a volume of 60 cm^3 to 100 cm^3 and an inlet valve for filling and refilling.

NOTE – For method B, an inlet valve is not necessary when introducing the test liquid before mounting the test piece in place.

The mass of the container, the clamping ring, the test piece and 50 cm^3 of the test liquid shall not exceed the capacity of the balance (4.2).

The open end of the container and the hole in the clamping ring shall have a diameter such that approximately 10 cm^2 of the surface of the test piece is exposed on each side.

A suitable apparatus is shown in figure 1.

When testing materials without fabric and with a high transmission rate or when testing at high test temperatures, a circular piece of stainless-steel wire mesh of aperture size 1 mm (in accordance with ISO 3310-1) shall be mounted together with the test piece so as to support the latter on its outer surface during the test.

4.2 Balance, with a capacity of at least 200 g and accurate to 1 mg.

4.3 Cabinet oven, complying with the requirements of ISO 188, for tests performed at elevated temperatures.

5 Test pieces

5.1 Preparation

The standard test piece shall be circular and cut from a flat sheet in the way specified in ISO 4661-1. The surface shall be flat, smooth and free from defects.

Each test piece shall be of a suitable size to fit the container assembly and to be securely clamped in position.

The thickness of each test piece shall be 2 mm ± 0,2 mm. The difference in the mean thickness of test pieces used for comparison tests shall not be more than 0,05 mm.

Test pieces may also be cut from finished products made from sheets or coated fabrics. In this case, the thickness shall not be less than 0,2 mm and not more than 3,0 mm.

5.2 Thickness measurement

Measure the thickness of the test pieces in accordance with ISO 2286 or ISO 4648, as appropriate.

5.3 Number of test pieces

Use at least three test pieces for each test.

6 Time-interval between vulcanization and testing

The requirements of ISO 471 shall apply.

7 Conditioning

Before the test, condition the test pieces in accordance with ISO 471, or ISO 2231 in the case of coated fabrics, i.e. at 23 °C ± 2 °C and (50 ± 5) % relative humidity or 27 °C ± 2 °C and (65 ± 5) % relative humidity, depending on national practice.

8 Test conditions

8.1 Temperature

The normal test temperature is 23 °C ± 2 °C or 27 °C ± 2 °C (see clause 7).

If, for technical reasons, an elevated temperature is required, choose it from the following list of temperatures:

40 °C ± 1 °C
55 °C ± 1 °C
70 °C ± 1 °C
85 °C ± 1 °C
100 °C ± 1 °C

If an elevated test temperature is used, a pressure will be generated within the container, which may have some effect on the results of the determination.

Irrespective of the test temperature, carry out all weighing operations at 23 °C ± 2 °C or 27 °C ± 2 °C.

8.2 Length of test

The preferred test period is 24 h ± 2 h.

Alternatively, for materials having high transmission rates, a shorter test period of 8 h or 16 h is recommended. For materials having low transmission rates, a test period of 3 days or 7 days is recommended.

> NOTE – In the case of mixtures of liquids, the test period can be limited by a component with a low concentration and large partial transmission rate. This can cause a rapid change in the composition of the liquid and therefore of the transmission rate.

Each test period commences immediately after the container has been weighed and placed so that the liquid is in contact with the inner surface of the test piece. If the test is carried out at elevated temperature, the test period commences immediately after placing the apparatus in the oven, which shall be not more than 30 min after weighing, and the container shall be allowed to cool to standard temperature (23 °C ± 2 °C or 27 °C ± 2 °C) at the end of each test period before it is weighed. This cooling period (which is not included in the test period) shall not exceed 1 h.

9 Procedure

9.1 Preliminary operations

Measure the thickness of a test piece, with an accuracy of 0,01 mm, at four points along the circumference of the area exposed to the test liquid and at the centre as specified in ISO 2286 or ISO 4648, as appropriate. If any two measurements differ by more than 0,05 mm, discard the test piece. Report the mean value.

Put the test piece on the open end of the container, together with the stainless-steel wire mesh if necessary (see 4.1), and close the container with the clamping ring.

Take care to avoid damaging or displacing the test piece. If it is not tightly sealed, glue or paste may be used.

Using a pipette or funnel, introduce into the container through one of the filling valves about 50 cm^3 of the test liquid.

Weigh the container to the nearest 1 mg, place on a suitable support (see 4.1) with the filling valves uppermost and maintain at the test temperature with the test liquid in contact with the inner surface of the test piece for 24 h ± 2 h. Reweigh at the end of this period (see 8.1).

Excessive loss in mass indicates that leakage has occurred due to improper sealing. In such cases, discard the test piece.

Carry out all weighing operations at a temperature of 23 °C ± 2 °C or 27 °C ± 2 °C.

9.2 Method A

After the preliminary operations described in 9.1, empty the container through the filling valves and refill it with approximately 50 cm^3 of test liquid.

After conditioning for 1 h, weigh the container to the nearest 1 mg, making sure that it is clean and dry on the outside surfaces, to obtain the mass m_1

Maintain the container with the test liquid in contact with the test piece at the test temperature for a period t of 24 h ± 2 h. Reweigh at the end of this period (see 8.2) to obtain the new mass m_2.

Calculate the change in mass per unit time, k, in milligrams per hour, for the test piece as follows:

$$k = (m_1 - m_2)/t$$

Repeat the operations until the value of k for any one of three consecutive 24 h ± 2 h test periods does not differ by more than 10 % from the mean value k_m for the three test periods.

NOTE – Depending on the transmission rate, other test periods may be more suitable (see 8.2).

Repeat the procedure with the remaining test pieces, starting in each case at the beginning of 9.1.

The mean values k_m obtained for the three test pieces shall be within 15 % of their median value K_M. If this is not the case, repeat the determination and use the full set of data from both determinations to calculate the result (see clause 10).

9.3 Method B

Determine the rate of change in mass in accordance with 9.1 and 9.2 but without emptying and refilling the container between successive weighings.

10 Expression of results

10.1 Method of calculation

Use the median value K_M of the three mean values k_m to calculate the transmission rate Q, in g/m^2·h, as follows:

$$Q = 10 \times K_M/A$$

where

K_M is the median of the mean values obtained for the individual test pieces, in milligrams per hour;

A is the exposed area of the test piece, in square centimetres.

10.2 Graphical method

The initial increase in transmission and the subsequent equilibrium state can be clearly identified from a plot of either mass or rate of change in mass against exposure time. When plotting rate of change in mass, the appropriate point on the time axis is the mid-point of the time interval.

11 Test report

The test report shall include the following information:

a) a reference to this International Standard;

b) all details necessary for identification of the material tested;

c) the mean thickness of each test piece and the method of measurement used;

d) all details necessary for identification of the test liquid used;

e) the method used (A or B);

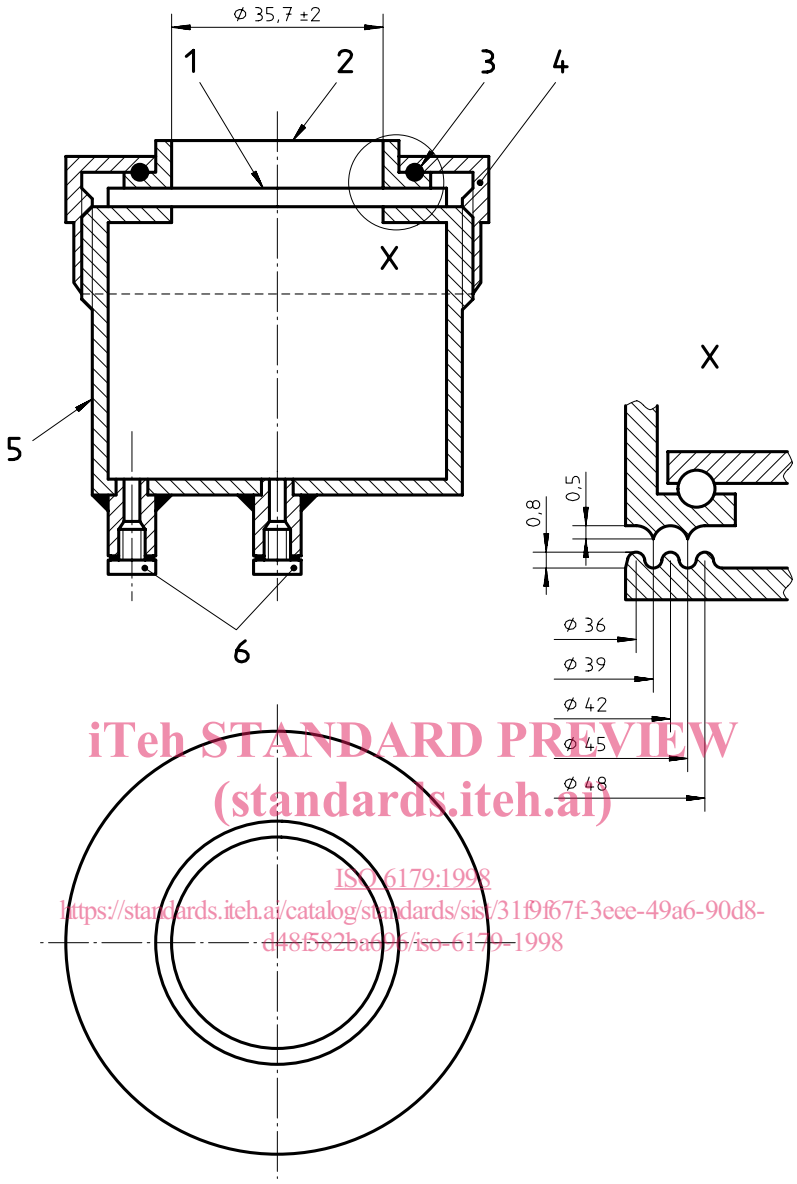
f) the test temperature;

g) the test period;

h) the value of the transmission rate, expressed in grams per square metre per hour;

i) the date of the test.

Dimensions in millimetres



Key:

1 Test piece
2 Non-rotating clamp
3 Ball bearing
4 Screw top
5 Liquid container (volume 60 cm^3 ^{3})
6 Filling valve(s)

Figure 1 – Test apparatus