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Rubber and plastics hoses and tubing, and their assemblies — Determination of permeability to gas

Tuyaux et flexibles en caoutchouc et en plastique — Détermination de la perméabilité au gaz

FDIS stage

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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~~document 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).

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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 1, *Rubber and plastics hoses and hose assemblies*.

This fifth edition cancels and replaces the fourth edition~~,~~ (ISO 4080:2009), which has been technically revised.

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

— ~~—~~ revised gas permeability test as a whole;

— ~~—~~ ~~standard~~ title ~~has been~~ changed ~~towards the previous 4th version~~;

— ~~—~~ ~~term 3.1~~terms 3.1 and 3.2~~3.2~~ added.

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.

Rubber and plastics hoses and tubing, and their assemblies — Determination of permeability to gas

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.

1 Scope

This document specifies three methods to determine the permeability to gas by measuring the volume of gas diffusing through a rubber or plastics hose or length of tubing used for gas applications in a specified time.

— Method 1: For is for determining the permeability of the complete hose wall or length of tubing wall, excluding end fittings, to the test gas.

— Method 2: For is for determining the permeability at the hose and fitting interface, to the test gas.

— Method 3: For is for precisely determining the permeability of the complete hose or length of tubing, including end fittings.

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 8330, *Rubber and plastics hoses and hose assemblies — Vocabulary*

ISO 23529, *Rubber — General procedures for preparing and conditioning test pieces for physical test methods*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 8330 and the following 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
end fitting
device attached to the end of a hose or tubing to facilitate connection to equipment constituting hose assembly

Note 1 to entry: End fitting can include an attached matching part to facilitate the test, if necessary.

3.2
permeability
property of a material of transmitting gases and liquids by passage through one surface and out at another surface by diffusion and sorption processes

Note 1 to entry: Not to confuse with "~~"~~porosity~~."~~".

Note 2 to entry: The property of a permeability involves the diffusion of molecules, called the permeant, through a membrane or interface. The permeability property works through diffusion~~,~~≤ the permeant will move from high concentration to low concentration across the interface.

Note 3 to entry: In a pressurized hose the permeant can pass from the inside of the hose to the outside through the hose lining and cover.

[~~source~~SOURCE: ISO 8330:2022, 3.8.5]

4 Test pieces

4.1 Method 1

The test piece shall be a length of hose or tubing fitted with end fittings long enough to ensure that the length of the exposed hose or tubing under the gas-collecting trough is 1 m ± 0,01 m. The test piece shall be a pricked cover or a textile braid cover.

4.2 Method 2

The test piece shall be a length of hose fitted with end fittings. It shall have a length of 1 m ± 0,01 m between the end fittings. The test piece shall be a textile reinforced hose with an unpricked cover.

NOTE The type of coupling used and the method by which the fittings are fixed to the test piece can affect the permeability results obtained using this method.

4.3 Method 3

The test piece shall be a length of hose or tubing fitted with end fittings. It shall have a minimum test length of 0,5 m with ~~±~~ ± 1 % tolerance between the end fittings. A test length of 1 m ± 0,01 m between the end fittings may be used when comparison of test result among the three methods are necessary.

NOTE The type of end fittings used and the method by which the end fittings are fixed to the test piece can affect the permeability results obtained using this method.

5 Apparatus

~~5.1~~ Schematic layouts of the test arrangements for the three test methods are shown in Figure 1~~Figure 1~~ to Figure 3~~Figure 3.~~.

5.~~2~~1 **Gas supply,** provided with a suitable pressure regulator gauge and emergency excess flow shutoff valves in case of test piece failure.

5.~~3~~2 **Calibrated pressure gauge or pressure transducer with digital readout,** chosen for each test so that the test pressure is between 15 % and 85 % of the full-scale reading.

5.~~4~~3 Water bath, capable of being maintained at a specified temperature and of sufficient length to accommodate the test piece.

5.~~5~~4 Gas-collecting apparatus, comprising measuring cylinders and in some instances additional apparatus appropriate to each of the three methods, as illustrated in Figure 1~~Figure 1~~ (collecting trough), Figure 2~~Figure 2~~ (collecting funnels) and Figure 3~~Figure 3~~ (collecting funnel and transparent glass tube), respectively. The capacity and accuracy of the measuring cylinders shall be selected in accordance with the volume of gas that is expected to be collected.

A transparent glass tube may be replaced with a tube made from acrylic, polycarbonate and similar materials, or with a transparent collecting trough large enough to cover the whole test piece to collect escaped gas.

5.~~6~~5 Barometer, to record the barometric pressure during the test.

5.~~7~~6 Two thermometers, to record the water temperature and air temperature at the gas-collection point(s).

6 Test conditions

6.1 Test pieces

No test shall be carried out within 24 h of manufacture on rubber or plastics hoses or lengths of tubing. Before testing, the test pieces shall be conditioned in accordance with ISO 23529 for at least 3 h at the specified temperature and humidity.

Conditioning of test pieces is excluded for routine testing or maintenance inspection.

6.2 Test temperature

Unless otherwise specified in the product standard, the test shall be carried out at a temperature of 23 °C ± 2 °C for ambient and water bath. If there is an agreement between the interested parties, the test may be carried out at any temperature.

6.3 Test gas

The test shall be carried out using the test gas specified in the product standard. If there is an agreement between the interested parties, other test gases may be used.

Water-soluble gas cannot be quantified.

6.4 Test pressure

Unless otherwise specified in the product standard, the test shall be carried out at a gas pressure of 1 MPa. If there is an agreement between the interested parties, the test may be carried out at other test pressures.

7 Procedure

7.1 General

Guidance on permeability is provided in Annex A, Figure A.1~~Annex A, Figure A.1.~~.

Guidance on test methods and their application is provided in Annex B, Table B.1~~Annex B, Table B.1.~~.

The instructions in this subclause are common to all three test methods and shall be followed before method-specific procedures. Use one test piece for each method.

Measure the inside diameter of the test piece if the result is expressed in an amount per surface area.

Connect one end of the test piece to the specified gas supply (5.1~~(5.2)~~) with a suitable connector.

Purge the test piece with test gas for 30 s to expel the air and then seal the test piece by blanking off the other end.

Adjust the temperature of the water bath (5.3~~(5.4)~~) to the specified value.

Before conducting the permeability test, the test piece shall be immersed in water and checked for any leakage.

If the permeability is required to be determined at different pressures, test at the lowest pressure first and then at increasing pressure levels.

In order to keep ~~of~~ bubbles of the collected gas from sticking to the surface of the collecting devices ~~they~~, these should be washed with a surface active agent or the like before starting the test.

7.2 Method 1

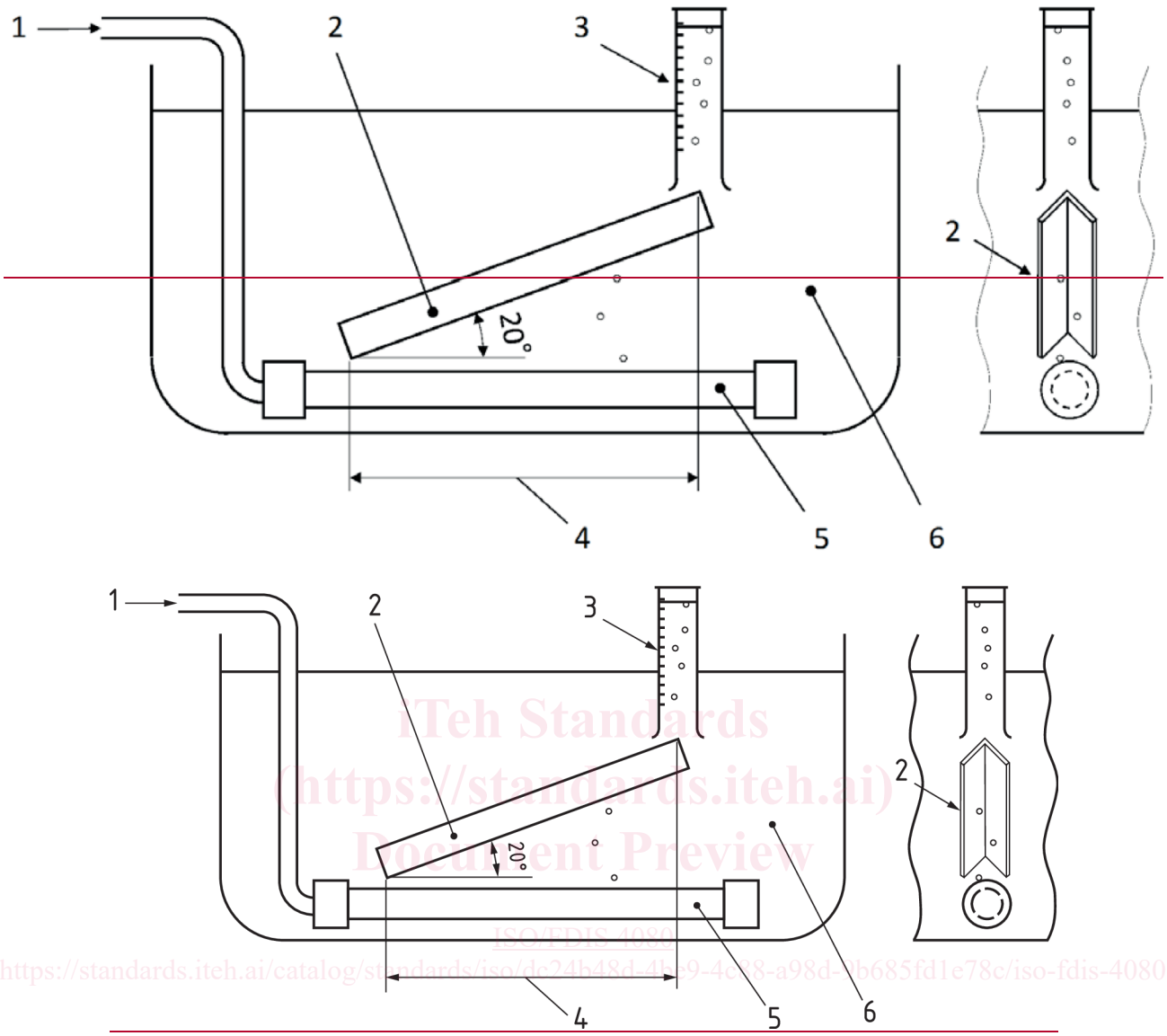
Immerse the test piece in the water bath and place the collecting trough so that it is inclined at approximately 20° to the horizontal (see Figure 1~~Figure 1).~~). The size of the collecting trough should be sufficient to collect all the gas bubbles over the 1 m length of the test piece.

Position the measuring cylinder as shown in Figure 1~~Figure 1~~ to collect and measure any gas which diffuses through the entire hose or length of tubing.

Apply the specified gas pressure to the test piece and maintain it for at least 24 h. Following this period, depending on the period to reach steady-state, collect the gas for 6 h or record the time to collect between 450 cm^3 and 500 cm^3 of gas per metre.

If the volume of gas collected after 6 h is less than 3,0 cm^3/m, measure the volume of gas collected in a 24 h period. If the volume of gas collected after 24 h is more than 1,0 cm^3, then this can be taken as the reading.

Repeat the measurement until two successive gas volume readings are within 5 % of each other. Use the average of these two successive readings to calculate the permeability.



Key

1 gas supply
2 collecting trough
3 measuring cylinder
4 test length[a]
5 test piece
6 water bath

[a] 1 m ~~±~~ ± 0,01 m

Figure 1 — Schematic apparatus for method 1

Method ~~1~~

~~7.4~~7.3 ~~Method~~ 2

Maintaining the test piece at the specified test temperature outside of the water bath, apply the specified gas pressure to the test piece and maintain it for at least 24 h. Following this period, depending on the period to

reach steady-state, immerse the test piece in the water bath (5.3~~(5.4)~~) at the specified temperature (see Figure 2~~Figure 2).~~).

Position the two measuring cylinders and the collection funnels as shown in Figure 2~~Figure 2~~ to collect and measure any gas which escapes from the two ends of the test piece for a period of 1 h. Record the total volume of gas collected as the first reading. Then remove the test piece from the water bath and hold it at the specified temperature and gas pressure for 24 h. After 24 h, ~~re-immerse~~reimmerse the test piece in the water bath and collect and measure the gas as previously.

Repeat the measurement until two successive gas volume readings are within 5 % of each other. Use the average of these two successive readings to calculate the permeability.

NOTE It is important to remove the test piece from the water bath after each 1 h period and to not leave it immersed since the exposed textile reinforcement can swell and lead to unrepresentative results.