INTERNATIONAL STANDARD

ISO 4080

Third edition
1991-11-15

Rubber and plastics hoses and hose assemblies — Determination of permeability to gas

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

Reference number
ISO 4080:1991(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 voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 4080 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Sub-Committee SC 1, *Hoses (rubber and plastics)*.

This third edition cancels and replaces the second edition (ISO 4080:1987), which has been technically revised to include an additional method (method 3).

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

Rubber and plastics hoses and hose assemblies — Determination of permeability to gas

1 Scope

This International Standard specifies three methods for the determination of the volume of gas diffusing through the wall of a rubber or plastics hose in a specified period.

Method 1: For determining the permeability of the complete hose wall, excluding end-fittings, to the test gas. This method is used when evaluating gas permeability characteristics of hoses with pricked covers.

Method 2: For determining the permeability of the hose inner lining and the reinforcement to the test gas. This method is used when determining the permeability characteristics of hoses with an unpricked cover when the gas usually issues from the textile reinforcement at the cut ends.

Method 3: For determining precisely the permeability of the wall of a hose during a specified period of time to the test gas.

The methods are applicable only to test gases which are insoluble in water.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was 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 edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 471:1983, *Rubber — Standard temperatures, humidities and times for the conditioning and testing of test pieces.*

3 Apparatus

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

3.2 Gas supply, provided with a suitable pressure gauge and emergency excess flow shutoff valves in case of hose failure.

3.3 Gas-collecting apparatus, comprising measuring cylinders and in some instances additional apparatus appropriate to each of the three methods, and as illustrated in figures 1 to 3 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.

3.4 Barometer, to record the barometric pressure during the test.

3.5 Two thermometers, to record water and air temperatures at the gas-collection point.

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

4 Test pieces

4.1 Method 1

The test piece shall be a suitable piece of hose long enough to ensure that the length of exposed hose under the gas-collecting trough is 1 m.

4.2 Method 2

The test piece shall be a free length of hose 1 m long.

4.3 Method 3

The test piece shall have a 0,5 m length of hose between end fittings.

5 Conditioning of test pieces

No test shall be carried out within 24 h of manufacture. Before testing, the test pieces shall be conditioned for at least 3 h at the chosen temperature and humidity, in accordance with ISO 471.

6 Test temperature

The test shall be carried out at a temperature in accordance with ISO 471.

7 Test pressure

Unless otherwise specified, the test shall be carried out at a gas pressure of 1 MPa*).

8 Procedure

8.1 Method 1

Seal one end of the test piece and connect the other end to the specified gas supply (3.2). Purge the test assembly with gas for 30 s to expel entrapped air before finally sealing the test assembly.

Adjust the temperature of the water bath (3.1) to the specified value.

Immerse the test assembly in the water bath. Apply the gas pressure and maintain this pressure for 72 h prior to collecting gas.

Arrange the gas-collecting apparatus (3.3) above the test sample as shown in figure 1 and note the time taken to collect 3,0 cm^3 of gas. Repeat the measurement twice. Alternatively, measure the volume of gas collected in a 24 h period.

If it is desired to determine the permeability at different pressures, test at the lowest pressure first and then at increasing pressure levels.

8.2 Method 2

Attach the appropriate feed and tail couplings to the test piece. Connect the feed end to the specified gas supply (3.2) and blank off the tail coupling. Purge the assembly with gas to expel any air before finally sealing the test assembly.

Apply the test pressure to the assembly for 24 h and then immerse the test assembly and its end connections in the water bath (3.1) (see figure 2).

Collect and measure any escaping gas at both ends for a period of 1 h in the two graduated measuring cylinders (3.3). Maintain the gas pressure in the test assembly and remove it from the water bath.

Re-immerse the test assembly in the water bath and measure the volume of escaping gas over a 1 h period at 24 h intervals to give a further six measurements. It is important to remove the assembly after the 1 h period and not leave it immersed, since the exposed textile reinforcement may swell and lead to unrepresentative results.

8.3 Method 3

Partially seal one end of the test piece and connect the other end to the specified gas supply (3.2). Purge the test assembly with gas for 30 s to exclude any entrapped air before finally sealing the test assembly. Adjust the temperature of the water bath (3.1) to the specified temperature.

Insert the test assembly into the glass tube and immerse in the water bath so that they are inclined at approximately 20° from the horizontal (see figure 3). Apply the gas pressure and maintain for 14 days. At the end of this period, collect the gas for 6 h or collect between 450 cm^3 and 500 cm^3 of gas. Repeat this procedure every 24 h until two successive gas volumes are within 5 % of each other. Use the average of two successive readings for the calculation of the permeability.

If it is wished to determine the permeability at different pressures, test the lowest pressure first and then test at ascending pressure levels.

9 Expression of results

9.1 Method 1

From the results of the three measurements, calculate the average time to collect 1 cm^3 of gas. From this value, calculate the permeability to gas, expressed in cubic centimetres of gas per metre of hose per hour [$cm^3/(m \cdot h)$]. A similar calculation can be made if the alternative method was used and the gas was collected over a 24 h period (see 8.1, fourth paragraph).

*) 1 MPa = 1 N/mm^2 = 10 bar

9.2 Method 2

Discard the first reading, as the test assembly may still contain some air. Average the remaining six readings and express the permeability to gas in cubic centimetres of gas per metre of hose per hour [$cm^3/(m \cdot h)$].

9.3 Method 3

The area to be considered is the inner hose surface in contact with the gas. Express the permeability to gas of the inner hose surface in contact with the gas in cubic centimetres of gas per square metre per second [$cm^3/(m^2 \cdot s)$]. Correct all results to a standard temperature of 273,15 K and standard pressure of 101,325 kPa in a dry condition. Measure the inside diameter of the hose at both ends and average these measurements in the calculation. Calculate the permeability to gas, expressed in cubic centimetres of gas per square metre per second, from the formula

$$\frac{858{,}09 \times V(p - p_w)}{dLt(273{,}15 + \theta)}$$

where

V is the volume, in cubic centimetres, of gas collected (accuracy $\pm$ 2,0 cm^3);

p is the barometric pressure, in kilopascals, at the time of collection (accuracy $\pm$ 0,7 kPa);

p_w is the saturated vapour pressure of water, in kilopascals, at temperature θ (see table 1) (accuracy $\pm$ 0,01 kPa);

d is the inside diameter, in millimetres, of the hose (accuracy $\pm$ 0,5 mm);

t is the time period, in seconds, of gas collection (accuracy $\pm$ 30 s);

θ is the temperature, in degrees Celsius, of the collection unit at the time of collection (accuracy $\pm$ 0,10 °C);

L is the length, in metres, of the hose (accuracy $\pm$ 0,001 m).

10 Test report

The test report shall include the following information:

a) a reference to this International Standard;

b) a full description of the hose tested;

c) the test gas used;

d) the test pressure used;

e) the method of test used;

f) the ambient temperature;

g) the test temperature;

h) the permeability to gas, expressed, in cubic centimetres of gas per metre of hose per hour [$cm^3/(m \cdot h)$] for methods 1 and 2, and in cubic centimetres of gas per square metre per second [$cm^3/(m^2 \cdot s)$] for method 3;

i) any special observations;

j) the date of the test.

Table 1 — Saturated vapour pressure (p_w) of liquid water at temperatures (θ) between 15 °C and 35 °C

θ (°C)	p_w (kPa)									
	0,0	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9
15	1,705	1,716	1,727	1,738	1,749	1,760	1,772	1,783	1,794	1,806
16	1,817	1,829	1,841	1,853	1,864	1,876	1,888	1,900	1,912	1,925
17	1,937	1,949	1,962	1,974	1,987	1,999	2,012	2,025	2,037	2,050
18	2,063	2,076	2,089	2,102	2,116	2,129	2,142	2,156	2,169	2,183
19	2,196	2,210	2,224	2,238	2,252	2,266	2,280	2,294	2,309	2,323
20	2,338	2,352	2,366	2,381	2,396	2,411	2,426	2,441	2,456	2,471
21	2,486	2,501	2,517	2,532	2,548	2,563	2,579	2,595	2,611	2,627
22	2,643	2,659	2,675	2,692	2,708	2,725	2,741	2,758	2,775	2,791
23	2,808	2,825	2,842	2,860	2,877	2,894	2,912	2,930	2,947	2,965
24	2,983	3,000	3,019	3,037	3,056	3,074	3,092	3,111	3,129	3,148
25	3,167	3,186	3,204	3,223	3,243	3,262	3,281	3,301	3,321	3,340
26	3,360	3,380	3,400	3,420	3,441	3,461	3,481	3,502	3,523	3,543
27	3,564	3,585	3,606	3,628	3,649	3,670	3,692	3,713	3,735	3,757
28	3,779	3,801	3,823	3,845	3,868	3,890	3,913	3,936	3,959	3,982
29	4,005	4,028	4,051	4,075	4,100	4,122	4,146	4,170	4,194	4,218
30	4,242	4,267	4,291	4,316	4,340	4,365	4,390	4,415	4,440	4,466
31	4,492	4,517	4,543	4,569	4,595	4,621	4,647	4,674	4,700	4,727
32	4,754	4,781	4,808	4,835	4,862	4,890	4,918	4,945	4,973	5,001
33	5,029	5,058	5,086	5,115	5,143	5,172	5,201	5,230	5,260	5,289
34	5,318	5,348	5,378	5,408	5,438	5,468	5,499	5,529	5,560	5,591
35	5,622	5,653	5,684	5,716	5,747	5,779	5,811	5,843	5,876	5,908

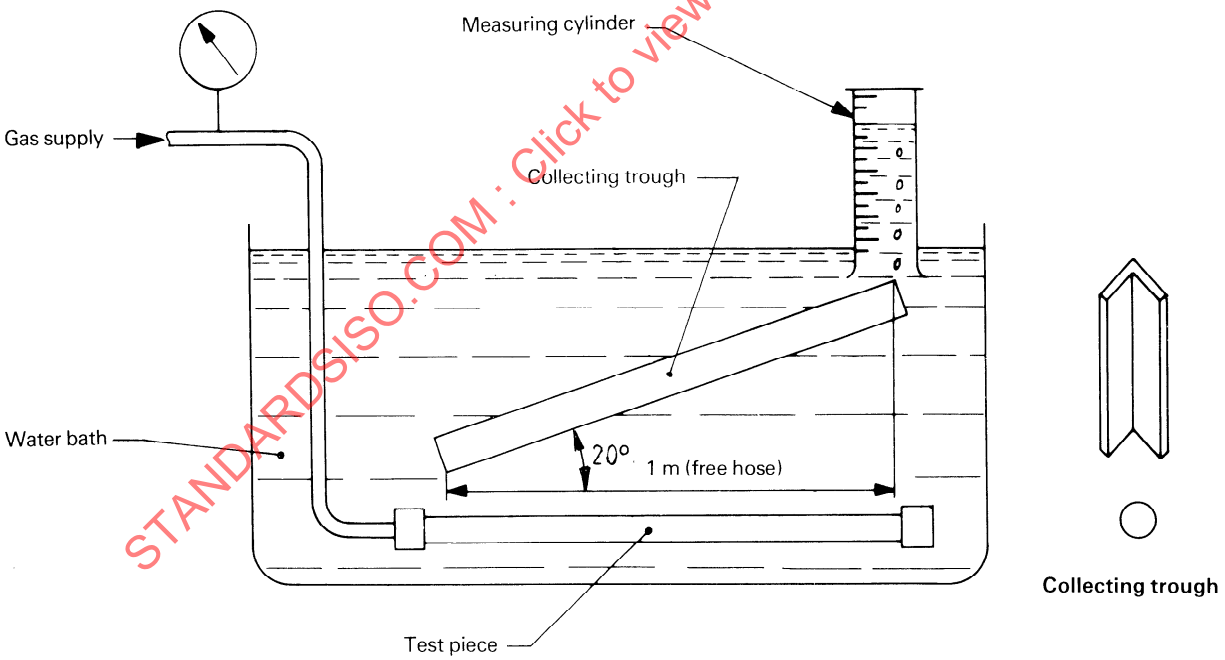

Figure 1 — Schematic apparatus for method 1