Standard Test Method for
Rubber Hose for Gas Diffusion of Liquefied Petroleum Gas[1]

This standard is issued under the fixed designation D3902; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determination of the volume of liquefied petroleum gas diffusing through the wall of a hose during a specified period of time.

1.2 The values stated in SI units are to be regarded as standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* A specific precautionary statement is given in the note in Section 5.

2. Significance and Use

2.1 Rubber hose has an inherent characteristic of permitting diffusion of a gas through the hose structure. This test method quantitatively measures the loss of liquefied petroleum gas.

3. Apparatus

3.1 *Water Bath,* long enough to accommodate the gas-collecting apparatus and hose.

3.2 *Gas Supply,* provided with a suitable pressure gage and emergency excess flow shutoff valve in case of hose failure.

3.3 *Set of Gas-Collecting Apparatus,* consisting of a glass tube at least 10 % longer than the hose being tested and with an inside diameter at least 10 % larger than the outside diameter of the hose being tested, a conical funnel 25 mm in diameter, and a 500-cm^3 measuring cylinder graduated at 5.0-cm^3 intervals.

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

3.5 *Thermometers,* two, to record water and air temperature at the gas-collection point. (For a schematic diagram of the test arrangement, see Fig. 1.)

3.6 *LP-Gas,*[2] having a minimum purity of 99 mol % propane, and a sulfur content less than 0.005 mass %.

4. Test Hose

4.1 The test hose shall have a 0.50-m (19.7-in.) free length between couplings and shall be coupled with suitable couplings, that is, band-it-type couplings. If the test hose is rubber covered, then the cover should be thoroughly perforated with a pricker roll.

5. Test Pressure

5.1 Unless otherwise specified, conduct the test with the LP-gas in the liquid phase at a pressure of 1000 ± 20 kPa (145 ± 3 psi). Regulate this pressure by keeping the LP-gas tank in the water bath and adjusting the temperature of the water to obtain the desired pressure, approximately 28°C. (**Warning—**Take special precautions to ensure that the water bath temperature cannot rise accidently, as this will increase the gas pressure significantly, creating a danger of explosion. Do the testing in a well-ventilated area. The system shall be equipped with a safety relief valve set at a gage pressure of 1200 ± 35 kPa (175 ± 5 psi).)

6. Procedure

6.1 Cap or plug the hose coupling on one end of the test hose and connect the hose coupling on the other end to the LP-gas supply. (Invert the tank when testing in the liquid phase or use a tank equipped with full-length dip tube.)

6.2 Flush the inside surface of the test hose with LP-gas to remove air and seal the end.

6.3 Locate the test hose in the center of the glass tube and mount in the water bath at an incline angle of approximately 20°.

6.4 Adjust the water bath to the specified temperature. Apply the specified gas pressure to the test hose and maintain this pressure and the water bath temperature for 14 days. At the end of the 14-day conditioning period, inspect the test apparatus for leaks and, in particular, the area around the hose couplings. Leaks will be evident by the formation of gas bubbles in the water bath. If none are found, insert the funnel

---

[1] This test method is under the jurisdiction of ASTM Committee D11 on Rubber and is the direct responsibility of Subcommittee D11.31 on Rubber Hose and Belting.

Current edition approved May 1, 2012. Published July 2012. Originally approved in 1980. Last previous edition approved in 2004 as D3902 – 90 (2004)$^{\varepsilon 1}$. DOI: 10.1520/D3902-90R12.

[2] CP Grade, available from Matheson Gas Products, has been found satisfactory for this purpose.

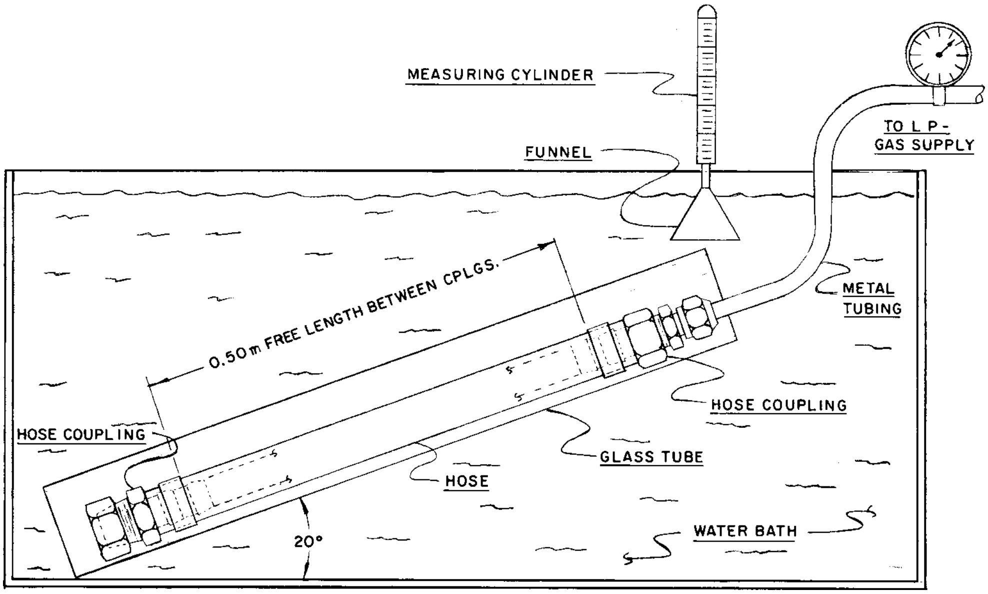

FIG. 1 Schematic Diagram of the Test Arrangement

into the measuring cylinder, fill the cylinder with water, and mount the funnel over the end of the glass tube.

6.5 Collect the gas for a 6-h period or collect 450 to 500 cm^3 of gas, whichever occurs first, and record the time and the volume of gas collected. 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 calculation of gas diffusion.

6.6 If it is desired to determine gas diffusion at different pressures, conduct the test at the lowest pressure first.

7. Calculation

7.1 Express the gas diffusion of the hose in cubic centimetres of gas per second per square metre of inner hose surface in contact with the gas.

7.2 Correct all results to the standard temperature of 273.15K and pressure of 101.35 kPa in a dry condition.

7.3 Measure the inside diameter of the test hose at both ends. Use the average of these measurements in the calculations.

7.4 Run at least two test samples on each hose. They may, however, run in parallel at the same time.

7.5 Calculate the gas diffusion as follows:

$$\text{Gas diffusion, } cm^3/m^2{\cdot}s = 857.88 \times V \times (P - P_w)/ID \times L \times t(273.15 + T) \quad (1)$$

where:

			Accuracy
ID	=	inside diameter of the hose, mm;	± 0.5 mm
L	=	length of the hose, m;	± 0.001 m
P	=	barometric pressure (at time of collection), kPa;	± 0.7 kPa
T	=	temperature of collection unit (at time of collection), °C;	± 0.10°C
V	=	volume of gas collected, cm^3;	± 2.0 cm^3
t	=	time of test, s; and	± 30 s
P_w	=	vapor pressure of water at temperature T (as taken from Table 1), kPa.	±0.01 kPa

8. Report

8.1 Report the following information:

8.1.1 Full description of the hose tested,

8.1.2 Gas used,

8.1.3 Test temperature,

8.1.4 Test pressure,

8.1.5 Gas diffusion ($cm^3/m^2 \cdot s$) corrected to standard temperature and pressure, and

8.1.6 Any special observations.

9. Precision and Bias

9.1 The precision and bias of this test method have not yet been determined. Available interlaboratory test data is inadequate. An adequate interlaboratory testing program has not been conducted since sufficient numbers of laboratories to do the work have not been located.

TABLE 1 Vapor Pressures of Liquid Water from 15 to 35°C, kPa

°C	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

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the ASTM website (www.astm.org/COPYRIGHT/).