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Polymeric materials, cellular, flexible — Determination of air flow value at constant pressure-drop

Matériaux polymères alvéolaires souples — Détermination de l'indice d'écoulement d'air à chute de pression constante

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Contents

Page

Foreword

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This document was prepared by Technical Committee ISO/TC45, *Rubber and rubber products*, Subcommittee SC 4, *Products (other than hoses),* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 249, *Plastics,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 7231:2010), which has been technically revised.

The main changes are as follows:

— the previous Annex A has been moved to Clause 6 as method B2;

— the previous 6.5 (the precision of method B1) has been moved to a new Annex A.

— the previous precision of method B2 has been added to a new Annex A.

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Polymeric materials, cellular, flexible — Determination of air flow value at constant pressure-drop

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 determine the applicability of any national regulatory conditions.

1 Scope

This document specifies two methods for determining the air flow value of flexible cellular polymeric materials:

— method A, for conventional types of flexible cellular polymeric material;

— method B, for all types of flexible cellular polymeric material, but especially for materials with a low permeability to air.

For method B, two methods are specified in this document:

— method B1: with manual measurement;

— method B2: with automatic measurement.

NOTE 1 Air flow values can be used to give an indication of the effects of formulation and production variables on the cellular structure.

NOTE 2 In this document, the expression “conventional type of flexible cellular polymeric material” means types which are unsuitable for sealing purposes.

2 Normative references

There are no normative references in this document.

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
air flow value
volume flow rate required to maintain a constant pressure differential across a flexible foam test piece

4 Principle

A specified constant air pressure differential is created across a standard flexible foam specimen. The rate of flow of air required to maintain this pressure differential is measured as the air flow value.

5 Method A

5.1 Apparatus

The usual laboratory apparatus and, in particular, the following shall be used. Diagrams of suitable apparatus are shown in Figure 1 (using an air pressure below atmospheric) and Figure 2 (using an air pressure above atmospheric). The essential parts are described in 5.1.1 to 5.1.4.

5.1.1 Flow meters, low-pressure-drop, with an accuracy of up to ±2 %. These are required for air flow measurements. The actual air flow shall be adjusted by a combination of valve restriction, as shown in Figures 1 and 2, and blower or vacuum pump speed, so that the required pressure difference across the specimen [see 5.4 c)] is maintained constant.

Air flow meters with at least 250 mm scales are recommended. Flow-meters measuring in the range 0 dm^3/s to 10 dm^3/s cover a wide variety of cellular polymeric materials.

5.1.2 Manometer, graduated in the 0 Pa to 250 Pa range and with an accuracy of ±2 %. Traps to prevent manometer fluid being drawn into the test chamber by accidental pressure changes shall be provided. A plunger in the fluid reservoir is used to set the zero point after levelling the manometer.

The use of an inclined manometer with 2 Pa graduations is recommended. A level mounted on the manometer should be used to ensure that the proper degree of inclination from the horizontal is maintained.

5.1.3 Air supply or suction equipment, where the air supply or suction may be such that positive or negative pressure differences from atmospheric pressure are obtained across the test piece, using compressed air, an exhaust blower or a vacuum pump, etc.

NOTE A particular apparatus can be constructed to use only positive or negative pressure.

5.1.4 Test piece mounting, with a chamber of nominal dimensions 140 mm diameter × 150 mm depth (see Figure 1) or 75 mm diameter × 1 000 mm length (see Figure 2), incorporating a test piece mounting and fittings for the manometer and exhaust. The test piece cavity shall be (50 ± 0,05) mm × (50 ± 0,05) mm × (25 ± 0,05) mm.

The test piece shall be supported by suitable means, e.g. by the use of vanes, wires or a perforated support. The support shall provide a minimum open proportion of 70 % of the overall area, evenly distributed over its area (see Figures 1 and 2 for the positioning of the supports). Manometer and exhaust fittings shall be as shown in Figures 1 and 2.

5.1.5 Vacuum chamber operated at below atmosphere pressure.

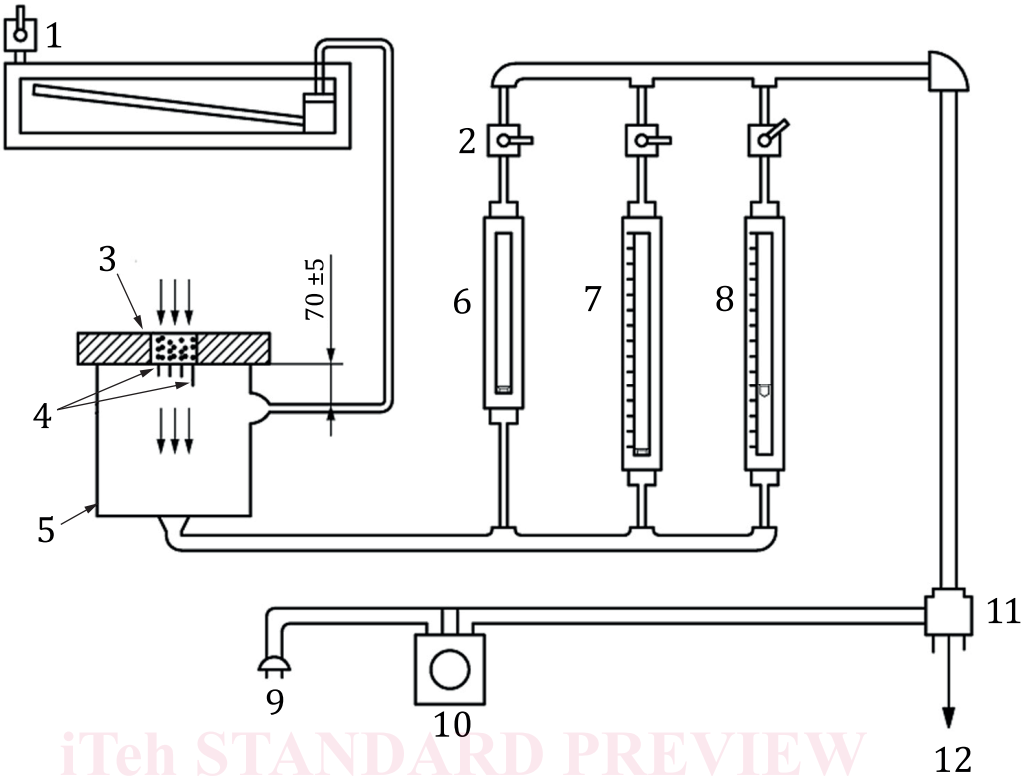
The apparatus, shown in Figure 1, shall be checked for leaks in the following manner.

a) Seal the test piece mounting cavity with masking tape.

b) With all the flow-meter valves closed, turn the air supply to approximately one-third of the maximum setting and observe any movement of the manometer. The manometer reading shall not exceed 1 Pa after 30 s.

c) Open the valve on the lowest-range flow-meter very slightly. The flow shall be essentially zero, as shown by a movement of less than 3 mm of the flow-meter float from its static position.

Dimensions in millimetres

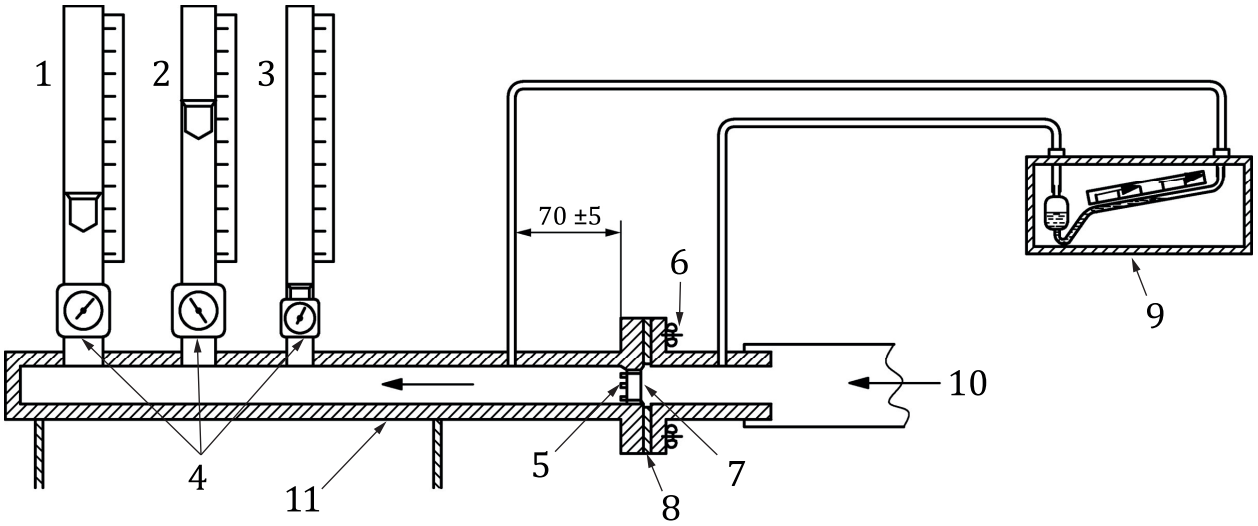


Key

1 inclined oil manometer
2 two-way ball valve
3 test piece
4 test piece support vanes
5 vacuum chamber
6 low-range air flow-meter
7 medium-range air flow-meter
8 high-range air flow-meter
9 power supply
10 voltage control
11 vacuum pump
12 exhaust

Figure 1 — Method A: Air flow apparatus (using air pressure below atmospheric)

Dimensions in millimetres



Key

1 high-range air flow-meter
2 medium-range air flow-meter
3 low-range air flow-meter
4 valves
5 horizontal steel rods to retain test piece in position
6 wing nut
7 test piece
8 gasket
9 inclined manometer
10 air supply
11 test chamber

Figure 2 — Method A: Air flow apparatus (using air pressure above atmospheric)

5.2 Test pieces

The test pieces shall normally be in the form of a right parallelepiped of dimensions (51,0 ± 0,3) mm × (51,0 ± 0,3) mm × (25,0 ± 0,3) mm. If test pieces of a different thickness are used, the thickness shall be stated in the test report. Any test pieces with length or breadth dimensions outside the required tolerance shall be discarded as they will lead to inaccurate air flow values. The test pieces shall be cut out without deformation of the original cell structure. Three test pieces shall be tested.

NOTE Test pieces both with and without surface skin can be tested by this method, but the results will not be comparable.

5.3 Test conditions

Testing shall be carried out under the standard conditions of either (23 ± 2) °C and (50 ± 5) % relative humidity or (27 ± 2) °C and (65 ± 5) % relative humidity, unless otherwise specified.

NOTE Since the flow-meter calibration is sensitive to temperature, the results obtained with these two sets of conditions will not necessarily be comparable.

5.4 Procedure

The method of measurement shall be as follows:

a) Place the test piece in the test cavity with any skin on the side exposed to the lower pressure. Make sure that the test piece is free from undue strain and that a good air seal is obtained between the edges of the test piece and the apparatus.

b) Close the flow-meter valves and switch on the blower or vacuum pump.

c) Open the high-range flow-meter slowly and adjust the air flow to obtain a pressure differential of (125 ± 1) Pa on the manometer.

d) If this reading is less than 10 % of full scale, close the valve of this flow-meter and open the medium-range flow-meter valve. Repeat this procedure until the correct flow-meter has been selected and the reading obtained.

   For greater accuracy, it is preferable to use two adjacent flow-meters, holding the higher-range one steady on an appropriate graduation mark and making the adjustment on the lower-range one. In this case, the air flow value is obtained from the sum of the two flow-meter readings after maintaining the pressure differential for 10 s.

e) Record the reading obtained as described in step d), in cubic decimetres per second, as the air flow value for the specimen.

NOTE Calibration of the apparatus can be carried out using a plate of known flow-rate value which is usually supplied by the manufacturer.

5.5 Test report

The test report shall include the following information:

a) a reference to this document including its year of publication, i.e. ISO 7231:2023;

b) the method used, i.e. method A;

c) all details necessary to identify the material tested;

d) the individual test results and the mean air flow value (in dm^3/s);

e) if test pieces of thickness different from that specified in 5.2 were used, the thickness of the test pieces;

f) the orientation of the test pieces with respect to the direction of any anisotropy and the presence or absence of any skins;

g) the test conditions used, i.e. temperature, relative humidity, apparatus type and pressure direction;

h) any deviations from the procedure;

i) any unusual features observed;

j) the date of the test.

6 Method B

6.1 Method B1 with manual measurement

6.1.1 Apparatus

The usual laboratory apparatus and, in particular, the following shall be used. An example of the manual test apparatus is shown in Figure 3. The essential parts of the apparatus are as described in 6.1.1.1 to 6.1.1.4.

6.1.1.1 Air orifice.

A metal plate with an orifice of a suitable size shall be mounted in the partition in the cylindrical test chamber. Generally, 10 such plates with different sizes of orifice are available, and one of them is chosen according to the air flow value of the test piece.

6.1.1.2 Clamping ring.

A metal ring shall be used to hold the test piece on top of the cylinder as shown in Figure 3. It shall have a hole in the centre to allow air to pass through the central uncovered area of the test piece. The diameter of the hole is normally 70 mm, although holes of other diameters may be used, depending on the particular test apparatus.

6.1.1.3 Manometers, both inclined and vertical, graduated to an accuracy of ±2 %.

The inclined-manometer range shall be 0 Pa to 250 Pa (25 mm H_2O), and 2,0 Pa (0,2 mm H_2O) graduations are recommended.

The vertical manometer should be capable of measuring from 0 Pa to 3 000 Pa (300 mm H_2O). Graduations of 25 Pa (2,5 mm H_2O) are recommended.

With both manometers, traps shall be provided as shown in Figure 3 to prevent manometer fluid being drawn into the chamber by accidental pressure changes. A plunger in the trap is used to set the zero point after the manometer has been set up in the correct position. A level mounted on the manometer shall be used to ensure that this correct position is maintained during the test.

6.1.1.4 Air supply or suction equipment, designed to operate under negative applied pressure and, typically, containing an integral extractor fan. Alternatively, the test equipment can be connected to a vacuum pump.

6.1.1.5 Vacuum chamber operated at below atmosphere pressure.

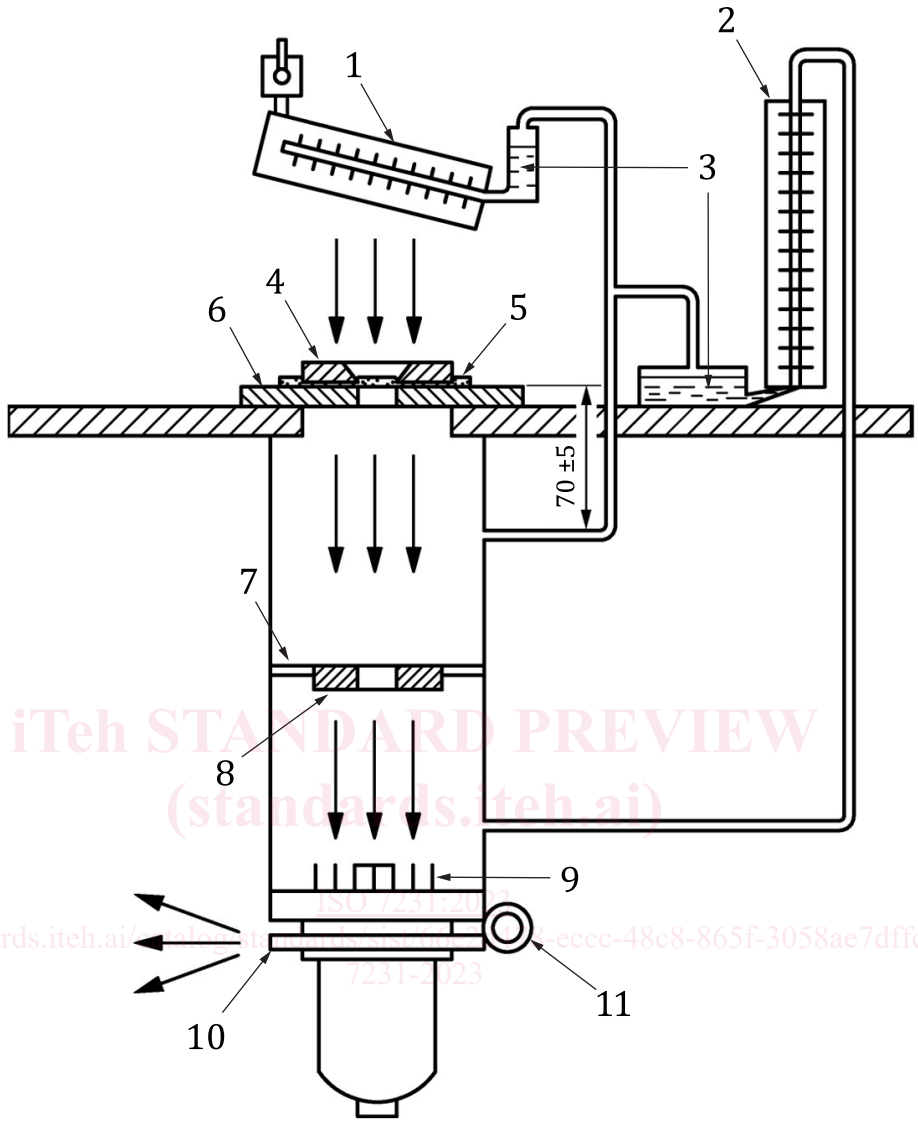
The apparatus, shown in Figure 3, shall be checked for leaks in the following manner:

a) Place an impermeable film (such as thin rubber or plastic sheet) on the test piece mounting plate and lock it in place with the clamping ring.

b) Set the pressure differential to (125 ± 1) Pa.

c) Start the measurement and confirm that the air flow value has no change.

Dimensions in millimetres



Key

1 inclined manometer
2 vertical manometer
3 traps for manometer fluid
4 clamping ring
5 test piece
6 test piece mounting plate
7 partition
8 air orifice
9 air baffles
10 extractor fan
11 air outlet

Figure 3 — Method B1: Example of a manual test apparatus