INTERNATIONAL STANDARD

ISO 9512

Second edition
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Cigarettes — Determination of ventilation — Definitions and measurement principles

Cigarettes — Détermination du taux de ventilation — Définitions et principes de mesurage

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 9512 was prepared by Technical Committee ISO/TC 126, *Tobacco and tobacco products*, Subcommittee SC 1, *Physical and dimensional tests*.

This second edition cancels and replaces the first edition (ISO 9512:1993), which has been technically revised.

Annexes A and B form a normative part of this International Standard. Annexes C to E are for information only.

Cigarettes — Determination of ventilation — Definitions and measurement principles

1 Scope

This International Standard specifies a method for the determination of ventilation which is applicable to cigarettes.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3308, *Routine analytical cigarette-smoking machine — Definitions and standard conditions*

ISO 3402, *Tobacco and tobacco products — Atmosphere for conditioning and testing*

ISO 6565, *Tobacco and tobacco products — Draw resistance of cigarettes and pressure drop of filter rods — Standard conditions and measurement*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
ventilation
aspiration of atmospheric air into an unlit cigarette other than through its front area

NOTE Dilution is the effect of ventilation on the smoke concentration.

3.2
front area
that end of a cigarette which is intended to be lit

3.3
total airflow
100 % of the volumetric airflow leaving the mouth end of an unlit cigarette which is encapsulated in a measurement device having an insertion depth as defined in ISO 3308

NOTE Under standard test conditions, the total airflow, Q, is 17,5 ml/s.

3.4
generator for total airflow
device to maintain a constant total airflow at the exit of the mouth end of a cigarette when encapsulated in a measurement head having an insertion depth as defined in ISO 3308

3.5
ventilation airflow
volumetric airflow entering an unlit cigarette other than through the front area of the cigarette

NOTE The ventilation airflow is standardized to the negative pressure at the mouth end of the cigarette, created by the draw resistance of the cigarette when encapsulated in a measurement device having an insertion depth as defined in ISO 3308.

3.6
total ventilation
total amount of lateral air entering the cigarette (other than through its front area) when encapsulated in a measurement device having an insertion depth as defined in ISO 3308

3.7
degree of ventilation
ratio, expressed as a percentage, of the ventilation airflow to the total airflow

See Figures 1 b), 1 c) and 1 d).

3.8
components of total ventilation
that air entering through the cigarette paper, and through the materials comprising and attaching the filter to the tobacco rod, contributing to total ventilation

See Figures 1 b), 1 c) and 1 d).

3.9
filter ventilation
that air entering the cigarette through the filter joining paper (tipping paper) between the covered part of the mouth end and the beginning of the tobacco rod

See Figure 1 b).

3.10
paper ventilation
that air entering the cigarette through the envelope covering the whole length of the tobacco rod

See Figure 1 b).

3.11
butt ventilation
that air entering the cigarette between the covered part of the mouth end of the cigarette and the position defined by the butt length appropriate to the cigarette

See Figure 1 c).

3.12
burnable tobacco rod ventilation
that air entering the cigarette through its paper between the position defined by the butt length appropriate to the cigarette and the end of the cigarette which would be lit

See Figure 1 c).

3.13
tipping-paper ventilation
that air entering the cigarette through the filter joining paper (tipping paper) between the covered part of the mouth end and the tobacco rod end of the tipping paper

See Figure 1 d).

3.14
cigarette-paper ventilation
air entering the cigarette through the cigarette paper between the end of the cigarette which would be lit and the mouth end of the tipping paper

See Figure 1 d).

4 Principle

Air is drawn, at a constant flow rate, in the standard smoking direction through an unlit cigarette. The individual components of ventilation are measured separately. The degrees of ventilation are obtained by calculation.

5 Standard conditions

5.1 Prior to measurement, the cigarettes shall be conditioned in an atmosphere as specified in ISO 3402.

5.2 Ventilation measurements shall be made on unlit cigarettes in accordance with the test atmosphere as specified in ISO 3402.

5.3 The direction of airflow in the cigarette shall be that which would occur when the cigarette is smoked.

6 Requirements for apparatus

6.1 The apparatus used shall allow separate assessment of the ventilation components shown in Figure 1.

6.2 The cigarettes shall be held in the measurement head, by an encapsulation device, with an encapsulation depth as defined by ISO 3308.

6.3 Seals used to hold the cigarette and partition ventilation measurement regions shall be sized and positioned appropriately to the dimensions of the product under test to minimise any systematic influence on measured parameters. See Figure 2.

6.4 The measuring pressure surrounding the cigarette contained in the measurement head, other than at the front end and the mouth end enclosed in the holding seal, shall not be more than 20 Pa lower than that of the testing atmosphere when the total airflow is applied.

NOTE Experiments conducted during the development of this method show that the measured ventilation flows reduce proportionally to increased pressure drop of the apparatus' ventilation measurement path.

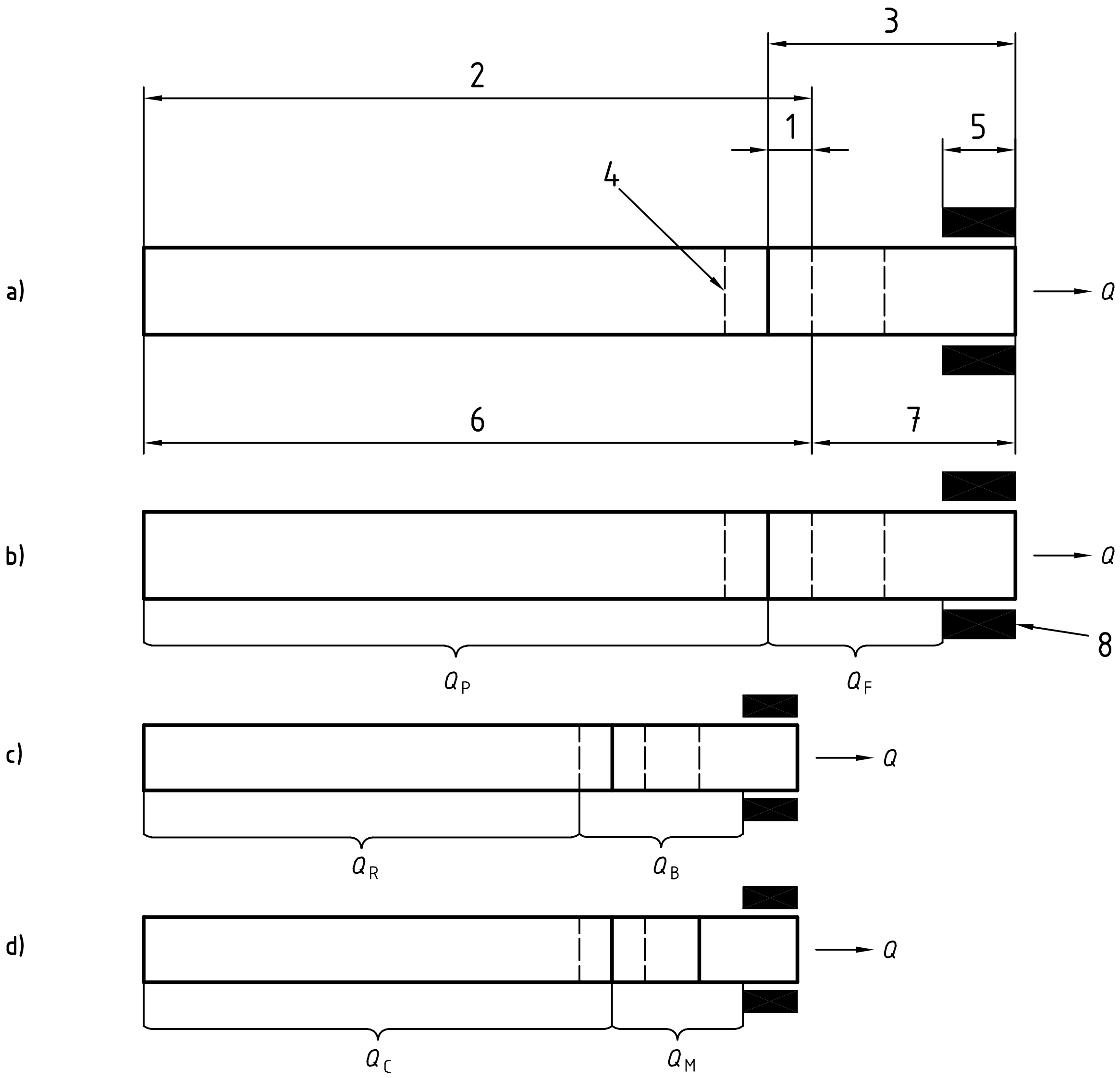
6.5 A generator for total airflow shall be used to establish the measurement conditions.

Deviations from the total airflow shall not exceed ± 0,10 ml/s.

NOTE A critical flow orifice (CFO) is normally used to establish a constant total airflow for vacuum-based measurement systems.

6.6 The device used for measurement of ventilation airflows shall have no intrinsic effect on the volumetric airflow measurement.

See Figure 2.



Key

1 Overlap
2 Cigarette paper
3 Tipping paper
4 Butt mark
5 Standard depth of encapsulation (ISO 3308)
6 Tobacco rod
7 Filter
8 Encapsulation device

Total airflow, Q = 17,5 ml/s

Degree of filter ventilation, $V_F = \frac{Q_F}{Q} \times 100\ \%$

Degree of paper ventilation, $V_P = \frac{Q_P}{Q} \times 100\ \%$

Degree of total ventilation, $V = V_F + V_P = \frac{Q_F + Q_P}{Q} \times 100\ \%$

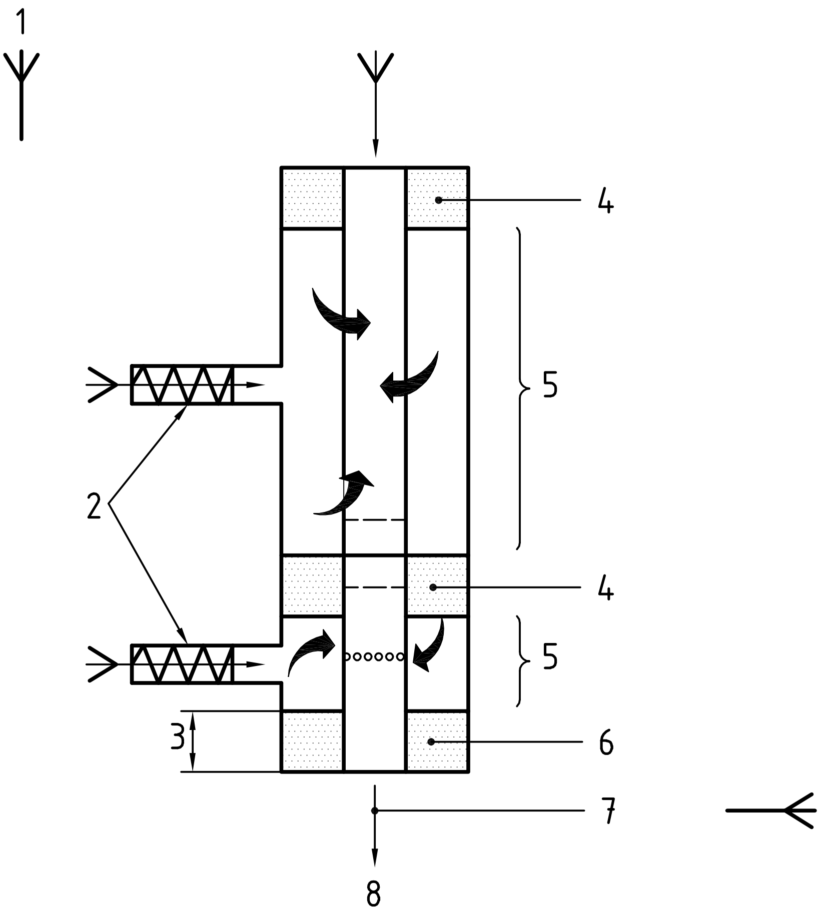
Degree of burnable tobacco rod ventilation, $V_R = \frac{Q_R}{Q} \times 100\ \%$

Degree of butt ventilation, $V_B = \frac{Q_B}{Q} \times 100\ \%$

Degree of cigarette paper ventilation, $V_C = \frac{Q_C}{Q} \times 100\ \%$

Degree of tipping paper ventilation, $V_M = \frac{Q_M}{Q} \times 100\ \%$

Figure 1 — Different degrees of ventilation



Key

1 Test atmosphere conforming to ISO 3402
2 Ventilation flow measurement devices
3 Encapsulation depth conforming to ISO 3308
4 Adjustable partitioning seals
5 Ventilation chamber
6 Fixed holding seal
7 Device to measure cigarette draw resistance
8 Total airflow

Figure 2 — Schematic for measurement of ventilation flows

7 Sampling

A sample shall be taken which is representative, on a statistical basis, of the population to be characterized.

Samples shall be free of visible defects and creases, which may impair measurement performance.

8 Checking of apparatus

The measurement device shall be calibrated in accordance with the manufacturer's recommendations, ensuring the device is leakfree prior to implementing or checking calibration.

9 Procedure

9.1 Conditioning of test cigarettes

Condition the cigarette sample selected for the test as specified in 5.1.

9.2 Calibration

Calibrate the measurement device using calibration standards and calibration procedure in accordance with annex B.

NOTE Any calibration needs to span the range of values expected from the test sample required on the products to be measured.

9.3 Measurement

Ensure that the measurement apparatus has been adjusted to suit the dimensions of the cigarette to be tested.

Insert the cigarette samples to be tested into the measurement head and use the apparatus in accordance with the manufacturer's instructions.

Record the ventilation measurement parameters.

10 Expression of results

The reported value of any ventilation measurements shall be the mean value of individual measurements, expressed as a percentage of total airflow.

The results shall be expressed as follows:

a) individual values shall be expressed to at least one decimal place;

b) mean values shall be expressed to the first decimal place (0,05 is rounded to 0,1);

c) the standard deviation shall be expressed to the first decimal place (0,05 is rounded to 0,1).

11 Precision

The precision of the method has been estimated by selecting five cigarette product types having nominal filter ventilation values which span the normal range of measurement. The results are given in annex E.

12 Test report

The test report shall include the number of cigarette samples and all necessary information for the complete identification of the samples.

The test report shall specify the method used, the result(s) obtained and any outlying cases. It shall also mention any operating details not specified in this International Standard or regarded as optional, together with details of any deviations from this International Standard.

In the test report, some additional information such as name of the laboratory in which the test has been performed, the name of the operator and the date of the test should be given.

Annex A
(normative)

Calibration of ventilation standards

A.1 Calibration of ventilation standards

Ventilation standards are used to calibrate measuring instruments for the determination of the components of the total ventilation of cigarettes.

Ventilation standards have ventilation values allowing calibration of the measurement apparatus in the mid-range measurements.

Ventilation standards have defined pressure drop values, which may be used to calibrate measurement instruments for the draw resistance of cigarettes within the target range of measurement.

A.2 Essential properties of ventilation standards

A.2.1 Ventilation standards should be made of an inert material which is unaffected by use or ageing.

A.2.2 Standards should closely resemble the physical size and shape of a cigarette.

A.2.3 Ventilation standards shall have defined and repeatable values of

— tipping ventilation, and

— pressure drop with tipping ventilation zones open (ΔP_o),

when a suction source, having a total airflow of 17,5 ml/s is applied to the outlet of the standard.

A.2.4 The following parameters may be added:

— paper ventilation;

— pressure drop with tipping ventilation zones closed (ΔP_c);

— pressure drop with tipping and paper ventilation zones closed (ΔP_e).

A.2.5 The airflow through the ventilation standard shall be laminar. The ventilation standard shall have repeatable measurement characteristics and shall be largely unaffected by changing atmospheric conditions.

A.2.6 Ventilation standards shall be inscribed with a unique ID having a certificate of calibration giving traceable values of tipping ventilation and pressure drop with tipping ventilation zones open. Additional parameters may be included.

The level of uncertainty of calibration of the ventilation standards shall not exceed 1,5 % absolute.

A.2.7 The certificate of calibration shall state the actual atmospheric pressure, temperature and relative humidity of the laboratory testing atmosphere during calibration.

A.3 Procedure

A.3.1 Requirements for apparatus

To determine the characteristics of the ventilation standard, it shall be held in a calibration apparatus, the mechanical arrangement of which shall not modify the characteristics of the standard nor create any systematic influences on the measurement. Measurements shall be conducted in a testing atmosphere in accordance with ISO 3402.

The calibration apparatus shall allow measurement and calibration of pressure drop of the ventilation standard. See Figure A.1.

The calibration apparatus should have a generator for constant total airflow (Q) of (17,5 ± 0,3) ml/s at the outlet end of the ventilation standard.

NOTE A critical flow orifice (CFO) is normally used to establish a constant total airflow for suction-based measurement systems.

An alternative method of calibration may be used to establish flow and pressure drop measurements either side of the 17,5 ml/s calibration point, which is subsequently calculated by interpolation.

A.3.2 Volumetric flow measurement

A volumetric flow measurement device that does not generate any systematic influence on flow measurement shall be used to check the total airflow that is applied to the outlet of the ventilation standard when inserted into the calibration apparatus.

NOTE It has been customary practice in the past to measure volumetric airflows by means of a soap bubble flow meter. This creates measurement errors in pressure drop calibration due to the saturation of the measurement air by the soap bubble flow meter, which causes the volumetric flow to increase artificially and the viscosity to decrease.

A.3.3 Pressure drop measurement

The pressure drop characteristics of the ventilation standard shall be measured in accordance with ISO 6565.

A.3.4 Flow measurement pressure drop compensation

The ventilation flow is expressed relative to the pressure at the outlet of the ventilation standard, created by the pressure drop of the ventilation standard when contained in a calibration apparatus.

The measured values for filter and paper ventilation flows shall be modified as follows to provide correct comparison with the total flow as measured at the exit of the standard.

The paper ventilation flow rate, Q_P, is

$$Q_\mathrm{P} = Q_\mathrm{C} \times \frac{P_\mathrm{atm}}{P_\mathrm{atm} - \Delta P_\mathrm{Z}}$$

The filter ventilation flow rate, Q_F, is

$$Q_\mathrm{F} = Q_\mathrm{M} \times \frac{P_\mathrm{atm}}{P_\mathrm{atm} - \Delta P_\mathrm{Z}}$$

where

P_{atm} is the actual atmospheric pressure, expressed in pascals; if the atmospheric pressure is not measured, it can be approximated to the normal value of 101 325 Pa;

ΔP_Z is the pressure drop of the ventilation standard with the ventilation zones open, expressed in pascals;

Q_C is the measured paper ventilation flow rate, expressed in millilitres per second;

Q_M is the measured filter ventilation flow rate, expressed in millilitres per second;

Q_P is the corrected paper ventilation flow rate, expressed in millilitres per second;

Q_F is the corrected filter ventilation flow rate, expressed in millilitres per second.

A.3.5 Calculation of the degree of ventilation

The degree of ventilation for the paper ventilation region, V_P, is expressed as follows:

$$V_P = \frac{Q_P}{Q} \times 100\ \%$$

The degree of ventilation for the filter ventilation region, V_F, is expressed as follows:

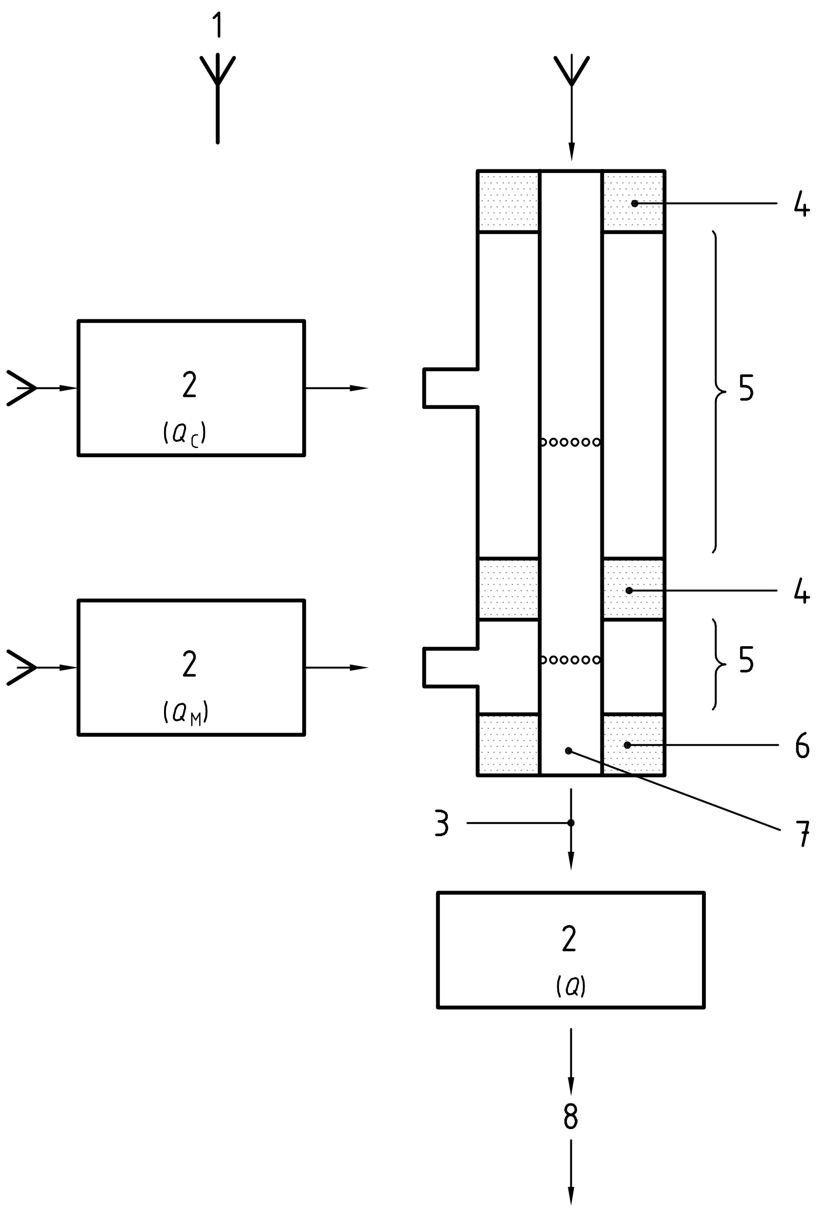
$$V_F = \frac{Q_F}{Q} \times 100\ \%$$

where

Q is the total airflow, expressed in millilitres per second;

V_P is the degree of paper ventilation, expressed as a percentage;

V_F is the degree of filter ventilation, expressed as a percentage.



Key

1 Atmosphere conforming to ISO 3402

2 Volumetric flow measurement device

3 Pressure drop (ΔP_Z)

4 Partitioning seal

5 Ventilation chamber

6 Fixed holding seal

7 Outlet end of ventilation standard

8 Total flow of drawn air

Figure A.1 — Calibration apparatus

Annex B
(normative)

Calibration of ventilation measurement instruments using ventilation and pressure drop standards

B.1 Calibration of instruments

The calibration and performance testing of instruments for measuring the ventilation of cigarettes shall be conducted in accordance with the manufacturer's instructions.

B.2 Principle

For the best accuracy of interpolated measurements, the instrument is calibrated as closely as possible to full scale or at the extreme end of the measurement range of products to be tested.

The instrument's measurement system is tested to ensure that a valid zero ventilation measurement can be established. The measurement system is then checked for leakage and linearity using at least one ventilation standard having an intermediate value.

B.3 Method

B.3.1 The instrument's measurement system should be checked for leaks, in accordance with the manufacturer's instructions, before undertaking calibration.

NOTE An example of leak testing is given in annex D.

B.3.2 The ventilation standard should be inserted into the measuring head, in accordance with the manufacturer's instructions, and allowed to equilibrate to the temperature of the measuring air. When the instrument reading is stable, calibration should be completed.

B.3.3 The linearity of the established calibration should be checked. At least one intermediate value ventilation standard should be used to check a mid-range value.

B.3.4 Ventilation measurement instruments with the additional capabilities to measure draw resistance of cigarettes and apply draw resistance compensation to the ventilation measurements shall have their pressure drop measurement systems calibrated in line with ISO 6565.

NOTE If only the ventilation value is measured and the equipment does not compensate the effect of pressure drop, then this value can be corrected to the compensated value according to the method given in informative annex C.

B.3.5 A preferred method of calibrating cigarette ventilation and pressure drop measuring instruments is to use multiple parameter calibration standards that have certificated traceable values for the following parameters:

- tipping ventilation;
- paper ventilation;
- pressure drop with tipping ventilation zones open (ΔP_o);

— pressure drop with tipping ventilation zones closed (ΔP_c);

— pressure drop with tipping and paper ventilation zones closed (ΔP_e).

B.3.6 The use of a single standard reduces the number of calibration pieces required, reduces the risk of operator error and effects due to handling, and reduces the time taken to accomplish a calibration sequence.

The three-stage pressure drop calibration and calibration check which can be achieved with measurements ΔP_e, ΔP_c and ΔP_o, respectively, also provides a valid leakage and linearity check.

Annex C
(informative)

Measurement of ventilation airflows of cigarettes

C.1 Theoretical considerations

The degree of ventilation is determined by measuring the volumetric airflow entering defined regions of the cigarette.

These measurements are made on the atmosphere side of the cigarette and are then compared with the total flow exiting the cigarette at a reduced pressure; i.e. atmospheric pressure less the “draw resistance” value of the cigarette.

The measurement of volumetric flow, in a pneumatic circuit, is dependent upon the air density at the point of measurement.

To compare volumetric flows, the measurements have to be standardized to the same atmospheric conditions.

C.2 Generation of measurement errors: The need to compensate for draw resistance

Consider the measurement of the ventilation airflow of a cigarette having a zero pressure drop between its ventilation holes and outlet end.

The measured volumetric flow into the ventilation region would be the same as if it were measured at the outlet end. This is due to the artificial situation of the cigarette not having a pressure drop; i.e. the volumetric airflows would not be modified by different gas densities. If the cigarette had a draw resistance of 981 Pa (100 mmWG), the gas pressure at the outlet end would be 981 Pa (100 mmWG) below the one existing in the ventilation region of the cigarette.

Since the volumetric exit flow (Q) is constant at 17,5 ml/s regardless of the sample draw resistance, the respective volumetric flow measurements can be compared if the effect of draw resistance on the ventilation flow is quantified.

Boyle’s Law is used to determine the actual ventilation volumetric flow as measured at the input of the tipping region, as follows:

$$Q_1 \times P_1 = Q_2 \times P_2$$

where

Q_1 is the volumetric flow into the tipping ventilation region, in millilitres per second;

P_1 is the atmospheric pressure at the input of the filter region, in pascals;

Q_2 is the total airflow in millilitres per second (= 17,5);

P_2 is the pressure at the outlet end (i.e. P_1 minus the draw resistance), in pascals.

If P_1 is the normal atmospheric pressure (i.e. 101 325 Pa), then for a draw resistance of 100 mmWG the value of P_2 will be

$$P_1 - (100 \times 9{,}806\ 7) = 100\ 344\ \text{Pa}$$

and hence:

$$Q_1 = \frac{Q_2 \times P_2}{P_1} = \frac{17{,}5 \times 100\ 344}{101\ 325} = 17{,}33\ \text{ml/s}$$

NOTE In this method the values given previously in mmWG are converted into pascals (Pa) using the following correction factor:

1 mmWG = 9,806 7 Pa

This shows that the ventilation airflow of a cigarette having a draw resistance of 981 Pa (100 mmWG) is reduced and would measure 0,97 % lower when compared to the constant exit flow of 17,5 ml/s from the mouth end.

Measuring cigarettes having a draw resistance in the region of 981 Pa to 2 452 Pa (100 mmWG to 250 mmWG) will result in an error of 1 % to 2,5 % absolute if the ventilation flow is not compensated for the draw resistance value of the cigarette.

Annex D
(informative)

Determination of the leakage of the ventilation measurement system

D.1 General

This principle of leakage testing can be applied to the range of ventilation measurement instruments used within the industry and is given as an example.

For system-specific techniques and recommended test and inspection regimes, reference should be made to the manufacturer's instructions.

D.2 Principle

D.2.1 Leakage testing is carried out to identify defective adjustable seals and to check the sealing integrity of ventilation (measurement) chambers. The usual sources of leaks can normally be detected by the use of intermediate ventilation and pressure drop calibration standards to check the accuracy of mid-range measurements following a full-scale calibration.

Normally a 100 % standard, made from a non-permeable material, is used to calibrate the full-scale limit of the paper and filter ventilation measurement systems. The measurement system can also be tested for a valid zero % ventilation measurement by initiating a ventilation measurement on a non-ventilated and non-permeable rod-shaped test piece.

D.2.2 Other leaks can be encountered which may not be evident when testing and/or calibrating with a 100 % standard. This is due to the fact that the standard is impervious to airflow leakage with the exception of the purposely manufactured ventilation region(s).

D.2.3 Ventilation measurement systems that include measurement of cigarette draw resistance with filter ventilation zone open (ΔP_o) and closed (ΔP_c) use electrovalves to isolate the ventilation measurement regions from the atmosphere and the ventilation airflow measurement devices.

With these systems, it is possible to incur leaks that are not evident when conducting a 100 % calibration or checking with an intermediate standard but which invalidate measurements performed upon cigarettes. This is discussed in the following clauses of this annex.

D.3 Example of a method

D.3.1 A 100 % ventilation standard is used, in the normal manner, to calibrate the full-scale limit of the paper and filter ventilation measurement systems. This ensures that during the time of calibration the total airflow (Q) is directed from the atmosphere through the chosen ventilation chamber to exit at the outlet end of the ventilation standard.

D.3.2 Directly following calibration, any ventilation measurement chambers that can be isolated from the atmosphere to achieve pressure drop measurement or any other associated measurement, should be tested for leakage.

D.3.3 To perform a leakage test on isolated ventilation measurement chambers, the following items are required:

— a pressure drop (PD) standard, having a nominal value of not less than 2 942 Pa (300 mmWG);

— a PD extender tube;

— a filter ventilation chamber leak test tube;

— a paper ventilation chamber leak test tube.

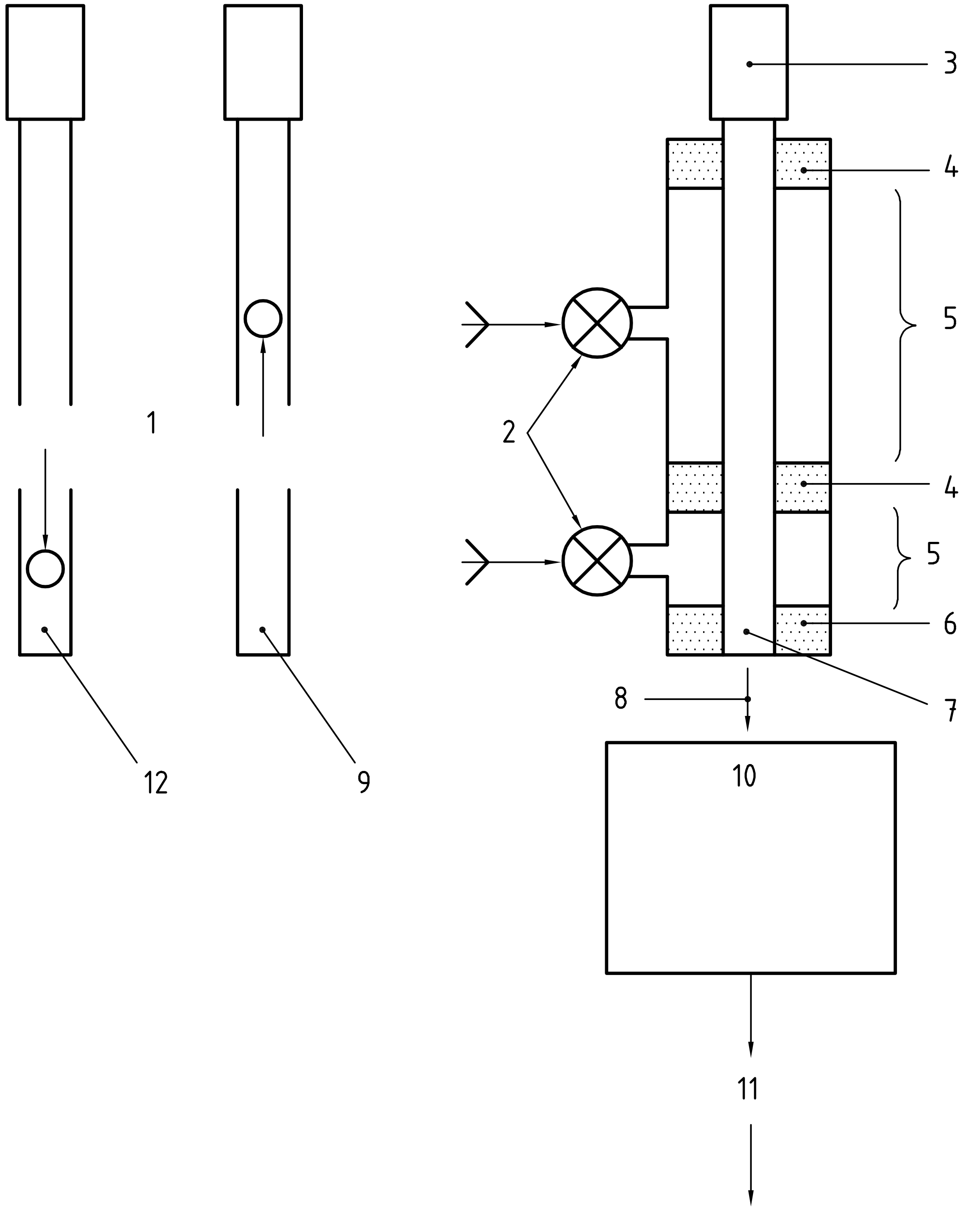
D.3.4 The pressure drop standard should be installed into an extender tube and inserted into the measurement head as illustrated in Figure D.1 and Figure D.2a). The value measured on the pressure drop standard should be noted.

D.3.5 The pressure drop standard should then be installed into the filter ventilation chamber leak test tube and inserted into the measurement head as illustrated in Figure D.2b). A second measurement should be performed on the pressure drop standard and its value should be noted.

The two pressure drop values should be the same within the known repeatability of the measurement system under test.

If the two measured values are not the same to within the tolerance allowed (± 1 %), then a leak is present.

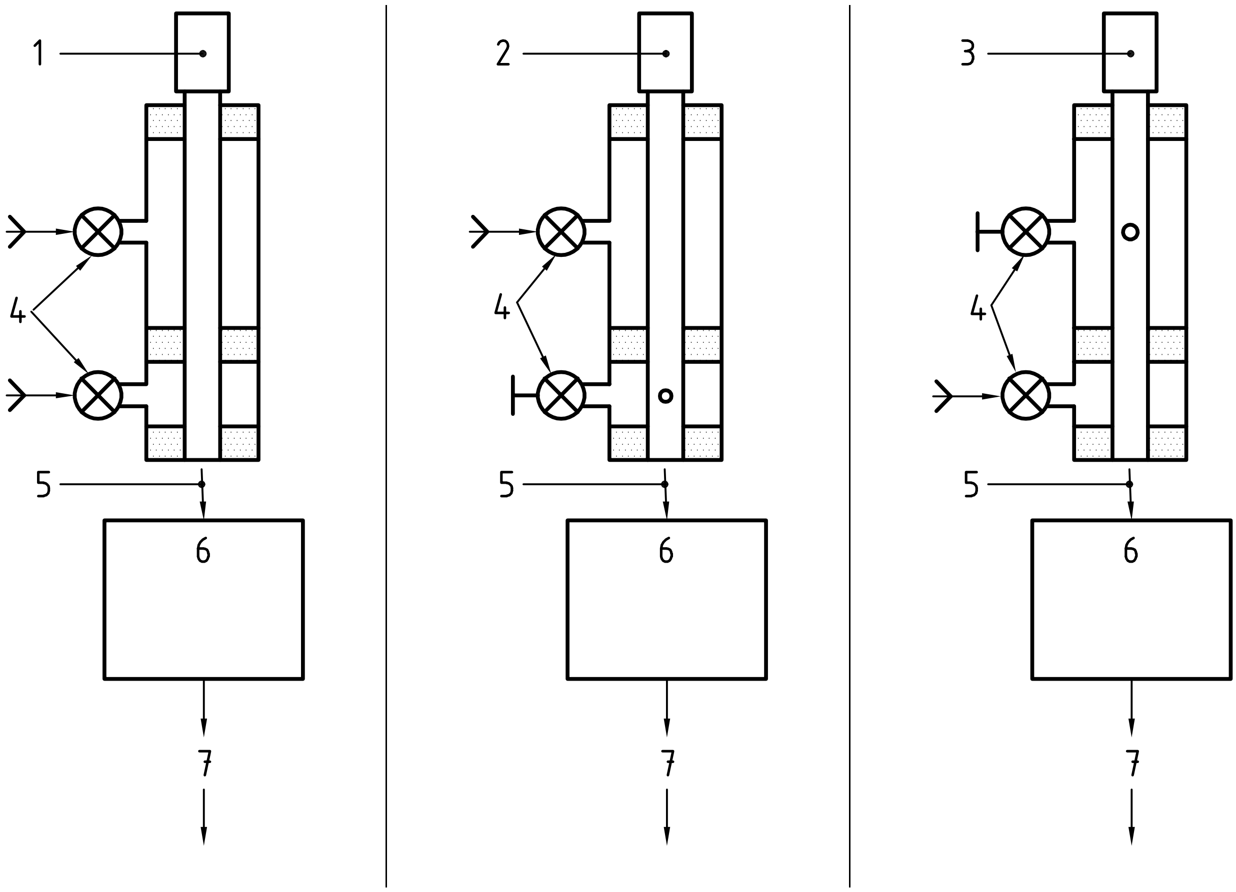
D.3.6 Repeat steps D.3.4 and D.3.5 using the paper ventilation chamber leak test tube, as illustrated in Figure D.2c), to test the leakage integrity of the paper ventilation chamber.



Key

1 Leakage measurement holes
2 Ventilation chamber isolation valves
3 PD extender tube (insert PD standard)
4 Partitioning seal
5 Ventilation chamber
6 Fixed holding seal
7 Outlet end of standard
8 Pressure drop
9 Paper ventilation chamber leak test tube
10 Volumetric flow (Q) measurement device
11 Total flow of drawn air
12 Filter ventilation chamber leak test tube

Figure D.1 — Ventilation chamber leakage testing apparatus



a) b) c)

Key

1 PD extender tube (insert PD standard)
2 Filter ventilation leak test tube
3 Paper ventilation leak test tube
4 Ventilation chamber isolation valves
5 Pressure drop
6 Volumetric flow (Q) measurement device
7 Total flow of drawn air

Figure D.2 — Test apparatus

Annex E
(informative)

Results of interlaboratory test

Data sets from 17 laboratories that complied with the collaborative study testing protocol were used in the determination of repeatability limits, r, and reproducibilty limits, R, for this method.

For each of the product types shown in Table E.1, individual sample sets comprising 20 samples were tested daily for a period of 5 days.

Table E.1 — Ventilation values

Product type	Nominal filter ventilation value
1	0 %
2	22 %
3	41 %
4	58 %
5	81 %

Outlier analysis was performed in accordance with ISO 5725-2[1)] and any outliers have been removed for the determination of r and R.

Mean value ranges for r and R are given in Table E.2, where s_r^2 and s_R^2 are the repeatability and reproducibility variances, respectively (see ISO 5725-2:1994, 7.1.2).

Table E.2 — Ranges for mean (m), repeatability limit (r) and reproducibility limit (R) for tipping ventilation, paper ventilation and draw resistance

Parameter	m [a]	s_r^2	r	s_R^2	R	R/r
Tipping ventilation	22,2 to 80,6	0,10 to 0,47	0,86 to1,91	0,45 to 1,07	1,88 to 2,89	1,42 to 2,21
Paper ventilation	3,2 to 11,7	0,03 to 0,11	0,50 to 0,91	0,09 to 0,28	0,84 to 1,47	1,19 to 2,28
Draw resistance	70,3 to 128,1	0,44 to 2,39	1,86 to 4,33	2,03 to 8,85	3,99 to 8,33	1,19 to 2,15

[a] In calculating the conditions for r and R, the products having a ventilation value below 1,5 % are not included due to the fact that the normal application of confidence limits do not apply in these circumstances.

1) ISO 5725-2:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*.

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