INTERNATIONAL STANDARD

ISO 6565

Second edition
1999-09-01

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

Tabac et produits du tabac — Résistance au tirage des cigarettes et perte de charge des bâtonnets-filtres — Conditions normalisées et mesurage

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

Reference number
ISO 6565:1999(E)

Contents

Page

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

© ISO 1999

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

Printed in Switzerland

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.

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

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 6565 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 6565:1983) of which it constitutes a technical revision.

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

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

Introduction

The draw resistance of cigarettes or the pressure drop of filter rods is a widespread and important concept both for product quality specifications and for analytical determinations by mechanical smoking.

Different procedures and apparatus are currently available for this determination. It has so far not been possible to standardize the complete description of the equipment to be used and the detailed procedure. Nevertheless, it has been possible to obtain broad consensus on the definitions to be adopted and the conditions that allow comparable determinations of this characteristic to be made. In order to achieve this, one of the main requirements is the use of transfer standards for the calibration of instruments (see annexes A and B).

In this International Standard, the results are given in pascals (Pa). For information, they are also given in millimetres of water (mmH_2O).

The values given previously in millimetres of water are converted into pascals (Pa) using the following correction factor:

1 mmH_2O = 9,806 7 Pa

For practical use, the values have been rounded.

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

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

1 Scope

This International Standard describes a method for the measurement of the draw resistance of cigarettes and pressure drop of filter rods, and specifies the standard conditions applicable to such measurements.

It is applicable to cigarettes, filter rods and, by extension, to cylindrical tobacco products similar 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 edition of the normative document 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 3402, *Tobacco and tobacco products — Atmosphere for conditioning and testing*.

ISO 10185, *Tobacco and tobacco products — Vocabulary*.

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 10185 and the following apply.

3.1
pressure drop
difference in static pressure between the two ends of the test piece when it is traversed by an air flow under steady conditions in which the measured volumetric flow, under standard conditions, at the output end is 17,5 ml/s

3.2
draw resistance
pressure drop obtained when the flow is the result of an aspiration

NOTE This term is generally used for the mechanical smoking of cigarettes.

3.3
input end
that end of the test piece intended to be lit in the case of a cigarette

3.4
output end
that end opposite from the input end

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

3.5
standard direction of flow
direction from the input end to the output end

NOTE In the case of a filter rod, the input end and the output end are defined by the direction of flow.

4 Test conditions

4.1 Test conditions common to cigarettes and filter rods

4.1.1 General

The test conditions shall be constant and in agreement with the conditions under which the calibration was performed (see clause 5).

4.1.2 Air flow

The air flow shall be from the input end in the standard direction of flow (see 3.5).

4.1.3 Position

The position of the test piece may be either horizontal or vertical, but products with cavities containing loose-fill material shall be positioned vertically.

4.2 Conditions particular to cigarettes: Insertion of the test piece

The output end of the test piece shall be inserted into a measurement device encapsulated to a depth of 9 mm.

NOTE The products should be handled with care particularly if they are to be smoked afterwards.

4.3 Conditions particular to filter rods: Encapsulation

The test piece shall be completely encapsulated in a measuring device so that no air can pass through the filter rod wrapping.

5 Instrument calibration

The instrument shall be calibrated before normal testing using transfer standards. This shall be done at least once per day. The calibration shall be carried out in accordance with annex A. The instrument shall be recalibrated if the atmospheric conditions change by more than 2 °C for temperature and/or 5 % for relative humidity.

Each calibration of the instrument shall be recorded for later reference.

6 Procedure

6.1 Conditions common to vacuum and pressure instruments

Insert the test piece (either manually or automatically) into the measuring device of the instrument. Read the value of the draw resistance or pressure drop and record it.

6.2 Conditions particular to vacuum instruments

Before reading the draw resistance or pressure drop, leave the test piece in the measuring device until the reading is steady.

NOTE Practice has shown that a settling time of 4 s to 6 s is normally sufficient.

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

6.3 Conditions particular to pressure instruments (for filter rods only)

Determine the required settling time depending on the draw resistance of the test piece and the type of instrument. The reading for pressure drop shall be recorded at a constant time after the insertion of the test piece.

NOTE 1 For the particular conditions described in 6.2 and 6.3, practice has shown that for low draw resistance or pressure drop, i.e. below 2 000 Pa (or about 200 mmH_2O), a settling time of 2 s to 3 s is sufficient, while for higher draw resistances or pressure drop, i.e. above 4 000 Pa (or about 400 mmH_2O), a settling time of 4 s to 6 s is required.

NOTE 2 The settling time should be recorded in the test report.

7 Expression of results

The expression of the laboratory results depends on the purpose for which the data are required and the level of laboratory precision.

Express the results as follows:

— average draw resistance or pressure drop: in pascals to the nearest 10 Pa (in mmH_2O to the nearest 1 mmH_2O);

— standard deviation of the draw resistance or pressure drop of the test piece: in pascals to the nearest 1 Pa (in mmH_2O to the nearest 0,1 mmH_2O).

8 Precision

8.1 Interlaboratory test

Details of an interlaboratory test on the precision of the method are summarized in annex C. The values derived from this interlaboratory test may not be applicable to values and matrices other than those given.

8.2 Repeatability, r

The absolute difference between two independent single results obtained using the same method on identical test material in the same laboratory by the same operator using the same equipment within a short interval of time, will not in more than 5 % of cases be greater than the values given in Table 1 for cigarettes and Table 2 for filter rods.

Table 1 — Cigarettes

Repeatability limit	
Pa	mmH_2O
$r = 23$	$r = 2,3$

Table 2 — Filter rods

Repeatability limit	
Pa	mmH_2O
$r = 0,007 \times m$	$r = 0,007 \times m$
NOTE m is the mean value of the pressure drop in pascals (Pa) (or in mmH_2O).	

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

8.3 Reproducibility, R

The absolute difference between two single test results, obtained using the same method on identical test material in different laboratories with different operators using different equipment will not in more than 5 % of cases be greater than the values given in Table 3 for cigarettes and Table 4 for filter rods.

Table 3 — Cigarettes

Reproducibility limit	
Pa	mmH_2O
R = 57	R = 5,8

Table 4 — Filter rods

Reproducibility limit	
Pa	mmH_2O
$R = 0{,}023 \times m$	$R = 0{,}023 \times m$
NOTE m is the mean value of pressure drop in pascals (Pa) (or in mmH_2O).	

9 Test report

The test report shall show the method used and the results obtained. It shall also mention any operating conditions not specified in this International Standard or regarded as optional, as well as any circumstances that may have influenced the results.

The test report shall include all details required for the complete identification of the sample.

It shall mention, in particular, the following information:

— product name or identification;

— date of sampling;

— date of test;

— type of instrument used and, if possible, settling time;

— total number of test pieces tested;

— room temperature in degrees Celsius (°C) during testing;

— relative humidity in percentage (RH %) during testing.

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

Annex A
(normative)

Calibration of draw resistance or pressure drop instruments using pressure drop transfer standards

A.1 Calibration of instruments

Carry out the calibration and the performance test of instruments for measuring the draw resistance of cigarettes or pressure drop of filter rods in accordance with the manufacturer's instructions.

To obtain the best accuracy, calibrate the instrument as close as possible to its full-scale deflection or at the maximum point of the range of values of the products to be tested.

To check for air leaks that might have occurred during the calibration and/or the linearity of the measuring system, at least one intermediate value pressure drop standard should be used in order to obtain a mid-scale value.

In addition to the mid-point value, a calibration check can be made with a pressure drop standard having a nominal pressure drop value close to the draw resistance or pressure drop of the test pieces to be measured.

A.2 Procedure

Before use, bring the temperature of the transfer standard into equilibrium with that of the ambient air. Insert the transfer standard into the measuring head in accordance with the manufacturer's instructions. When the reading becomes steady, continue the calibration procedure as follows.

a) In the case of vacuum (sucking) based instruments with a volumetric flow rate of 17,5 ml/s, established by a critical flow orifice (CFO), it is not possible to adjust the flow rate. In this case, adjust the electronic display to show the value inscribed on the transfer standard.

b) In the case of pressure (blowing) instruments incorporating a flow controller, couple an external manometer to the pneumatic measuring circuit and adjust the flow controller until the manometer registers the value inscribed on the transfer standard.

   Then adjust the electronic display to show the value inscribed on the transfer standard.

c) In the case of liquid column (blowing) instruments, first adjust the liquid level to the zero mark on the scale and then insert the transfer standard into the measuring head. When the liquid column is steady, adjust the flow controller until the manometer indicates the value inscribed on the transfer standard.

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

Annex B
(normative)

Calibration of pressure drop transfer standards

B.1 Essential properties of calibration standards

The pressure drop transfer standard is used to calibrate measuring instruments for the determination of draw resistance of cigarettes and pressure drop of cigarette filter rods.

Pressure drop transfer standards should be made of an inert material which is unaffected by use or ageing.

The standards:

— should closely resemble the physical size and shape of a typical cigarette;

— shall have a repeatable value of draw resistance or pressure drop; and

— shall exhibit a high tolerance to changing atmospheric conditions.

The air flow through the pressure drop standard shall be laminar.

B.2 Procedure

The laboratory testing atmosphere shall be controlled to (22 ± 2)°C and (60 ± 5) % RH in conformity with ISO 3402. The atmospheric pressure has no influence on the volumetric flow.

A suction source capable of drawing a constant volumetric air flow shall be applied to the output end of the standard. A volumetric flow of (17,5 ± 0,3) ml/s at the output end of the standard shall be established using a gas calibrator that does not generate a systematic influence on the flow measurement. The air should be allowed to flow until the system reaches thermal equilibrium.

The static pressure difference between the exit end of the standard and atmosphere, while it is traversed by the controlled air flow under steady conditions, shall be measured and the pressure drop value in pascals (or in mmH_2O) inscribed on the transfer standard. A reference number shall also be inscribed on the transfer standard to provide traceability of calibration.

This arrangement is illustrated in Figure B.1.

Key

1 ISO 3402 testing atmosphere
2 Transfer standard
3 Connecting piece
4 Volumetric air flow
5 Suction source (17,5 ± 0,3) ml/s
6 Pressure transducer

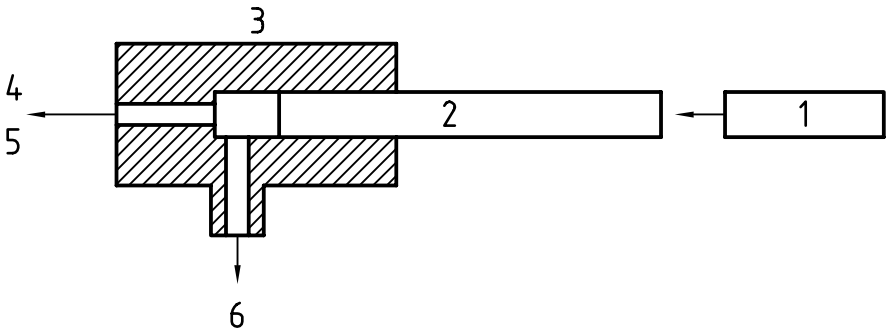

Figure B.1 — Calibration device

IMPORTANT: Soap bubble flow meters shall not be used for the calibration of pressure drop transfer standards. These devices increase the moisture content of the measurement air, causing increased volumetric flow and decreased velocity.

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

Annex C
(informative)

Results of an interlaboratory trial

C.1 Number of laboratories and test samples

An international collaborative test involving 21 laboratories which tested six different types (levels) of cigarettes and six different types (levels) of filter rods was carried out in 1994 by CORESTA, and the results obtained were subjected to statistical analysis in accordance with ISO 5725 [3][1)] to give the precision data shown in Tables C.3 and C.4.

Procedures used in this study and results are described below:

C.2 Selection of samples

The cigarette samples used were supplied to the participants by different cigarette manufacturers. Some samples were taken straight from production without any special pre-selection, some were selected for total mass, and one sample was selected for mass and for draw resistance.

The values obtained for repeatability and reproducibility will in the case of cigarettes therefore not only reflect the variability in the measuring procedure but also the variability of the product.

The cigarette filter samples were all carefully selected for pressure drop. Each individual test piece was allowed to differ by a maximum of ±1,5 % from the total mean value for each level. The results for repeatability and reproducibility will therefore mainly reflect the variability of the measuring procedure.

C.3 Conditions used for the test

Before measuring, the samples were conditioned for at least 24 h under the following conditions:

— temperature: (22 ± 2) °C;

— relative humidity: (60 ± 5) %.

For each measurement, 30 readings were taken, i.e. 30 randomly selected test pieces were tested. A repetition of the test using 30 different test pieces from the same sample was carried out after a short period of time. In all cases this was done on the same day.

Although the individual samples could have been tested on different days, most laboratories carried out the tests on the same day.

C.4 Conditioning of the samples

As mentioned above, the laboratories were asked to condition the samples at (22 ± 2) °C and (60 ± 5) % RH for at least 24 h before measurements. This is certainly not production floor practice but it has been found to be necessary to reduce the variation of the samples.

---

1) ISO 5275:1986 (now withdrawn) was used to obtain the precision data.

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

The actual conditions reported by the laboratories ranged from 21 °C to 23,5 °C and from 59 % RH to 66 % RH for cigarettes. Only one laboratory exceeded slightly the maximum value for relative humidity, but not to the extent that the results of this laboratory were affected in any way.

For filter rods the conditions ranged from 20 °C to 23,5 °C and 57 % RH to 63 % RH.

C.5 Conditions during measurements

No specific requirements were made in the test protocol for the ambient conditions during the measurement of the samples.

The actual ambient conditions observed and reported are given in Table C.1.

Table C.1 — Actual conditions observed

	Temperature °C	Relative humidity %	Atmospheric pressure hPa
Cigarettes	21,5 to 26,5	42 to 64	847 to 1 019
Filter rods	21,5 to 24,5	42,5 to 62	847 to 1 025

The atmospheric pressures correspond approximately to locations from sea level to 1 800 metres above sea level.

C.6 Repeatability and reproducibility for the testing of cigarettes

The values for m (mean draw resistance), r (repeatability limit), and R (reproducibility limit) are given in pascals (Pa) (and in mmH_2O) in Table C.3.

They were calculated as described in ISO 5725:1986, subclause 14.7 [3].

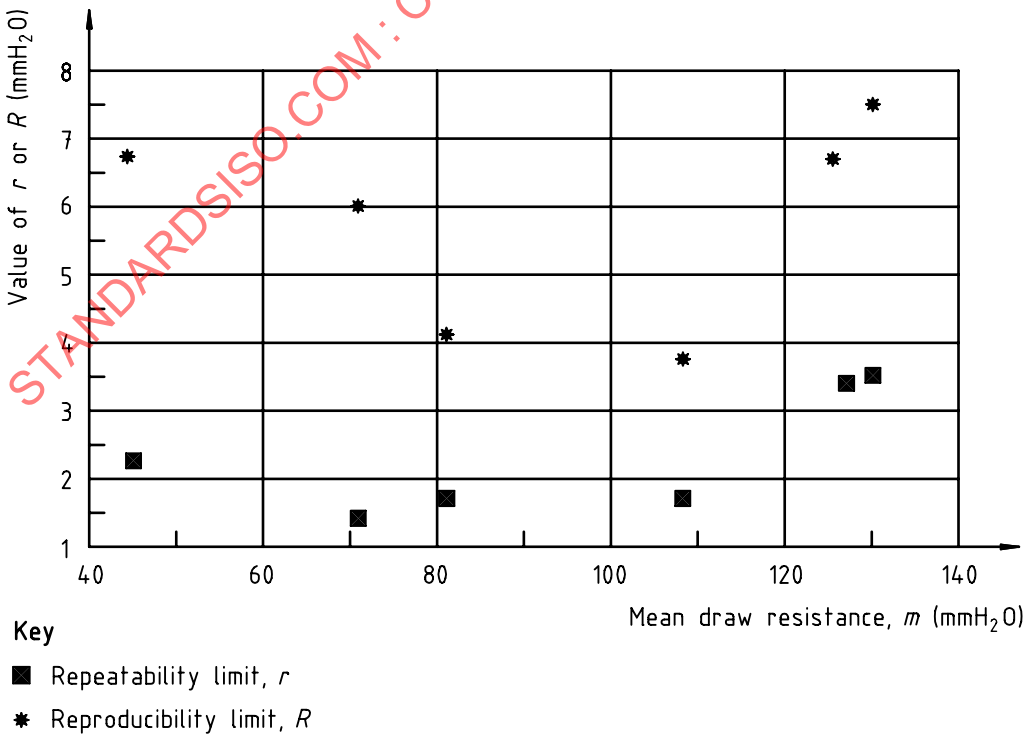

Figure C.1 — Relationship between r or R and m (for cigarettes)

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

Figure C.1 shows that there is no evident correlation between the values for r and R and the mean levels m.

Table C.2 — Determined final values for r and R

Final values	
Pa	mmH_2O
r = 23	r = 2,3
R = 57	R = 5,8
These values are valid for a draw resistance range of 400 Pa (40 mmH_2O) to 1 300 Pa (130 mmH_2O).	

Table C.3 — Computed rounded values for mean pressure drop (m), repeatability (r) and reproducibility (R) for cigarettes

Level	Number of laboratories	m		s_r^2		r		s_R^2		R	
		Pa	mmH_2O	Pa	mmH_2O	Pa	mmH_2O	Pa	mmH_2O	Pa	mmH_2O
1	19	440,81	44,95	6,57	0,67	22,45	2,29	56,89	5,80	66,10	6,74
2	17	696,56	71,03	2,65	0,27	14,21	1,45	43,75	4,46	57,96	5,91
3	17	792,57	80,82	3,64	0,37	16,76	1,71	21,53	2,20	40,70	4,15
4	18	1 059,51	108,04	3,08	0,31	15,39	1,57	17,98	1,83	37,17	3,79
5	19	1 244,66	126,92	13,67	1,39	32,46	3,31	55,16	5,62	65,12	6,64
6	19	1 276,93	130,21	15,69	1,60	34,72	3,54	70,20	7,160	73,45	7,49

C.7 Repeatability and reproducibility for the testing of filter rods

The values for m (mean pressure drop), r (repeatability) and R (reproducibility) are given in Table C.4.

They were calculated as described in ISO 5725:1986, subclause 14.7 [3].

From Table C.4 it seems clear that both r and R tend to increase linearly with higher values of m.

Figure C.2 confirms this linear dependence. The dependence can be expressed by a straight line through the origin:

$$r = b_r \times m$$

$$R = b_R \times m$$

where b is the slope.

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

Table C.4 — Computed rounded values for mean pressure drop (m), repeatability (r) and reproducibility (R) for filter rods

Level	Number of laboratories	m		s_r^2		r		s_R^2		R	
		Pa	mmH_2O	Pa	mmH_2O	Pa	mmH_2O	Pa	mmH_2O	Pa	mmH_2O
1	20	1 965,94	200,47	1,85	0,19	11,96	1,22	26,83	2,74	45,41	4,63
2	20	2 975,15	303,38	5,62	0,57	20,79	2,12	57,40	5,85	66,39	6,77
3	20	4 019,47	409,87	11,24	1,15	29,42	3,00	109,53	11,17	91,79	9,36
4	20	5 105,76	520,64	28,79	2,94	47,07	4,80	188,92	19,27	120,52	12,29
5	20	5 945,80	606,30	26,90	2,74	45,50	4,64	244,08	24,89	137,00	13,97
6	20	7 014,73	715,30	24,17	2,46	43,14	4,40	322,98	32,93	157,59	16,07

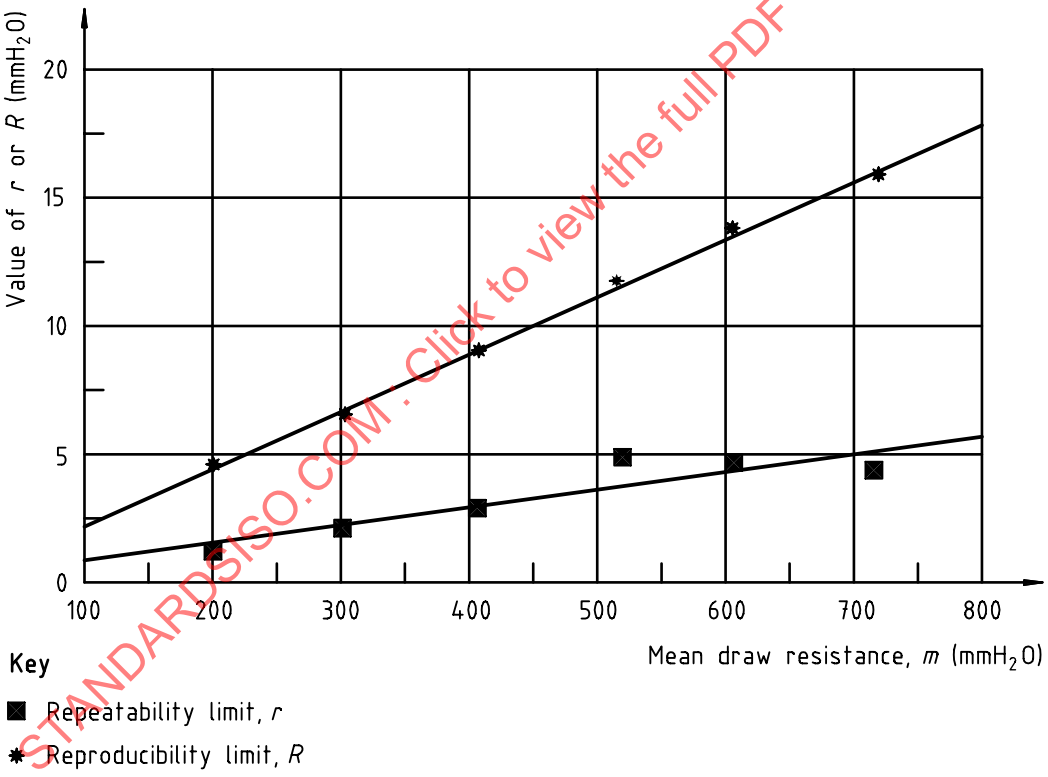

Figure C.2 — Relationship between r or R and m (for filter rods)

The final values of r and R can be expressed as linear equations.

The slopes of these lines, calculated as described in ISO 5725:1986, subclause 15.6 [2] are given in Table C.5.

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

Table C.5 — Relationship between r or R and m (filter rods)

Final values	
Pa	mmH_2O
$r = 0{,}007 \times m$	$r = 0{,}007 \times m$
$R = 0{,}023 \times m$	$R = 0{,}023 \times m$
NOTE 1 m is the mean value of pressure drop in pascals (Pa) (or in mmH_2O).	
NOTE 2 These values are valid for a pressure drop range of 2 000 Pa (200 mmH_2O) to 7 000 Pa (700 mmH_2O).	

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999

Annex D
(informative)

Comparison of draw resistance or pressure drop measurement: Critical flow orifice instruments vs. constant mass flow instruments

Due to different interpretations of the first edition of this International Standard (ISO 6565:1983), there are currently two types of instruments used for the measurement of draw resistance (or pressure drop). The two instruments described below both operate under vacuum.

The first type operates with a critical flow orifice (CFO) which is a constant volumetric flow device. These instruments maintain a constant volume of air at the exit of the test piece regardless of the pressure; the flow rate at the inlet end will fall with increasing pressure drop of the test piece. Thus, the mass flow rate through the test piece will be lower as the pressure drop of the test piece increases.

The second type operates with a constant mass flow device (CMF) which maintains a constant mass flow rate of air through all test pieces. These instruments maintain a constant mass flow rate of air by automatically compensating for changes in pressure at the exit of the test pieces. As a result the volumetric air flow rate at the inlet of the test piece remains constant. Since the flow rate through a CMF is always greater than the flow rate through a CFO on the same test piece, the pressure drop readings obtained with a CMF instrument are higher than with a CFO device.

This recommended method requires the use of instruments which maintain a constant volumetric flow at the exit of the test piece, e.g. instruments with a CFO device.

The relationship between the pressure drop readings obtained with a CFO device or with a CMF device can be expressed by the following equations:

$$PD_M = PD_O \frac{p_a}{p_a - PD_O}$$

$$PD_O = PD_M \frac{p_a}{p_a + PD_M}$$

where

PD_O is the pressure drop observed with a CFO device;

PD_M is the pressure drop observed with a CMF device;

p_a is the atmospheric (ambient) pressure.

Table D.1 gives an example.

STANDARDSISO.COM : Click to view the full PDF of ISO 6565:1999