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Cigarettes and filters — Determination of nominal diameter — Pneumatic method

Cigarettes et filtres — Détermination du diamètre nominal — Méthode pneumatique

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Reference number
ISO 2971 : 1987 (E)

Foreword

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International Standard ISO 2971 was prepared by Technical Committee ISO/TC 126, *Tobacco and tobacco products.*

This second edition cancels and replaces the first edition (ISO 2971 : 1976), of which it constitutes a technical revision.

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Cigarettes and filters — Determination of nominal diameter — Pneumatic method

0 Introduction

The determination of the diameter of cigarettes and filters is difficult to achieve with sufficient accuracy by usual metrology using a sliding caliper or a micrometer gauge, particularly because of:

— possible distortion during measurement,

— a slight ovality in practice of the cigarettes and filters.

It is therefore necessary to use a method overcoming these difficulties, as with the use of a pneumatic instrument.

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1 Scope

This International Standard specifies a method for determining the nominal diameter of cigarettes and filters by the pneumatic measuring head process.

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2 Field of application

The method is generally applicable to cylindrically shaped cigarettes and filters, enclosed in a wrapper having a permeability to air less than 200 $cm^3/(min \cdot cm^2 \cdot kPa)$.

3 References

ISO 2965, *Material used as cigarette papers — Determination of air permeability.*

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

4 Definitions

For the purpose of this International Standard, the following definitions apply.

4.1 nominal diameter of a cigarette or filter: The diameter in millimetres of a cylindrical metal measuring rod ground to an accuracy of ± 0,005 mm giving in the same measuring head the same pressure reading (water height h) as the cigarette or filter submitted to the measurement.

NOTE — By convention, it is accepted that the results obtained define the nominal diameter of cigarettes or filters which may possibly not be perfectly circular.

4.2 nominal diameter of a measuring head (D_n): The diameter in millimetres of the metal measuring rod ground to an accuracy of ± 0,005 mm with which the reading is situated in the centre of the measuring range, this position corresponding to maximum sensitivity.

5 Principle

Introduction of the test piece into a measuring head having a slightly larger circular cross-section through which compressed air is applied to the test piece, and determination of the average loss of pressure, which is directly related to the diameter of the test piece.

6 Apparatus

6.1 Conditioning chamber, regulated in accordance with the requirements of ISO 3402.

6.2 Pneumatic micrometer, giving one reading, based on the principle shown schematically in figure 1.

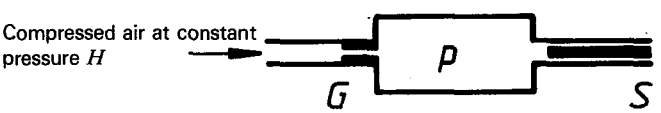

Figure 1 — Principle of a pneumatic micrometer

Two apertures with cross-section G and S are placed in series in an air circuit at constant pressure H. The pressure p which exists between the two apertures depends directly on the ratio of cross-sections of these apertures. It is shown that

$$p = \frac{H}{1 + k\,(S/G)^2}$$

G being the fixed cross-section of the main jet, the pressure p depends solely on S and the variations in p reflect the variations in S. In addition, if G is small, it is seen that slight variations in S bring about large variations in p.

k is a constant for the pneumatic micrometer used.

S is the outflow cross-section between the measuring head used and the test piece. The outflow at this aperture decreases as the diameter of the test piece increases. A given outlet section, and thus a certain pressure, corresponds to a given diameter. The scale of pressures can therefore be graduated directly in diameters on the water column (in practice $H - p$ is measured); it is sufficient to calibrate the apparatus beforehand.

6.3 Measuring head (see annex B)

— inside diameter of the internal rings: nominal dimension + 0,30 mm;

— inside diameter of the external rings: nominal dimension + 0,25 mm.

NOTES

1 The external rings are used only as a centering device and as a protection for the internal rings; there is no risk of inadvertently inserting a test piece with too great a diameter.

2 The theoretical scale of measurement of a measuring head extends from 0 to (D_n + 0,25 mm), the upper limit corresponding to a mechanical impossibility.

The practical scale of measurement of a measuring head is limited to smaller values by the decreasing sensitivity ($\Delta h/\Delta D_n$) of the determination when the diameter of the test piece is smaller than the nominal diameter of a measuring head (D_n) (see in annex A the characteristic calibration curve of a measuring head).

Therefore the graduations on a scale should only be used within the approximate range of:

(D_n − 0,30 mm) to (D_n + 0,20 mm)

The useful range of nominal diameters of measuring heads, D_n, varies from 7 to 10,5 mm, but a certain overlapping of the scales of measurement of the different measuring heads is provided, with the result that it is always possible to operate other than at the limit of the scale on at least one measuring head.

6.4 Set of cylindrical metal measuring rods, ground to an accuracy of ± 0,005 mm, graduated in diameter steps of 0,05 mm.

7 Procedure

7.1 Conditioning of the test pieces

Introduce the test pieces into the conditioning chamber (6.1) and keep them there until equilibrium is attained (see ISO 3402). For newly manufactured cigarettes, conditioning is not necessary.

7.2 Calibration

For each measuring head (6.3) calibrate the apparatus using a set of metal measuring rods (6.4).

Transfer to the graduated scale corresponding to each measuring head the value of the diameter D of the metal measuring rod corresponding to the water height h obtained.

If necessary, "smooth out" the calibration curve (see annex A) in order to reduce the slight experimental deviations noted.

After calibration, the water column may be directly graduated "in diameters": to each height h of the water column corresponds a value D of the diameter.

7.3 Determination

Introduce the test piece so that its central third is in the middle of the measuring head (6.3) with appropriate nominal diameter D_n.

Read the result on the water column.

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8 Expression of results

Express the results in millimetres to the nearest 0,01 mm.

9 Test report

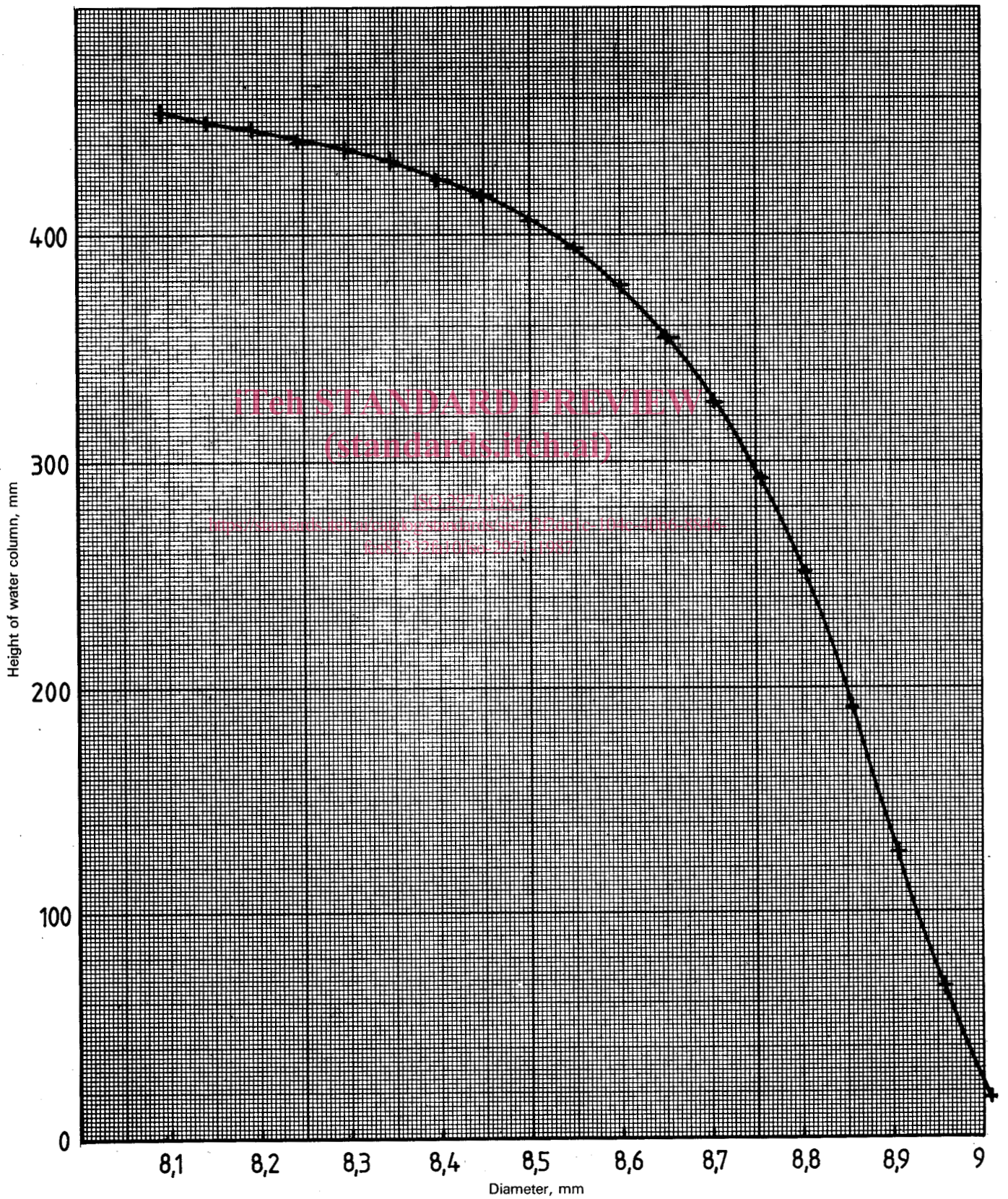
The test report shall indicate the method used and the results obtained. It shall, in addition, mention all the operational details not provided for in this International Standard or which are optional, as well as any incidents which may have influenced the results.

The conditioning atmosphere adopted shall be mentioned, as well as all the information necessary for the complete identification of the sample.

Annex A

Example of a calibration curve for a measuring head of nominal diameter D_n = 8,80 mm

(This annex does not form an integral part of the Standard.)



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Annex B

Examples of measuring heads and micrometers

(This annex does not form an integral part of the Standard.)

B.1 Example of the possible scale ranges for measuring heads

Nominal diameter (D_n)	Range in normal use (high accuracy of measurement)
mm	mm
Continuous range of values (with overlapping of individual ranges)	
7,2	6,80 to 7,30
7,5	7,20 to 7,65
7,8	7,50 to 7,95
8,0	7,90 to 8,20
8,2	8,10 to 8,40
8,4	8,30 to 8,60
8,65	8,45 to 8,75
8,80	8,60 to 8,90
9,0	8,70 to 9,20
Example of isolated values out of the normal range	
9,5	9,25 to 9,70
10,5	10,30 to 10,70

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B.2 Diagram showing a typical pneumatic micrometer and measuring head assembly

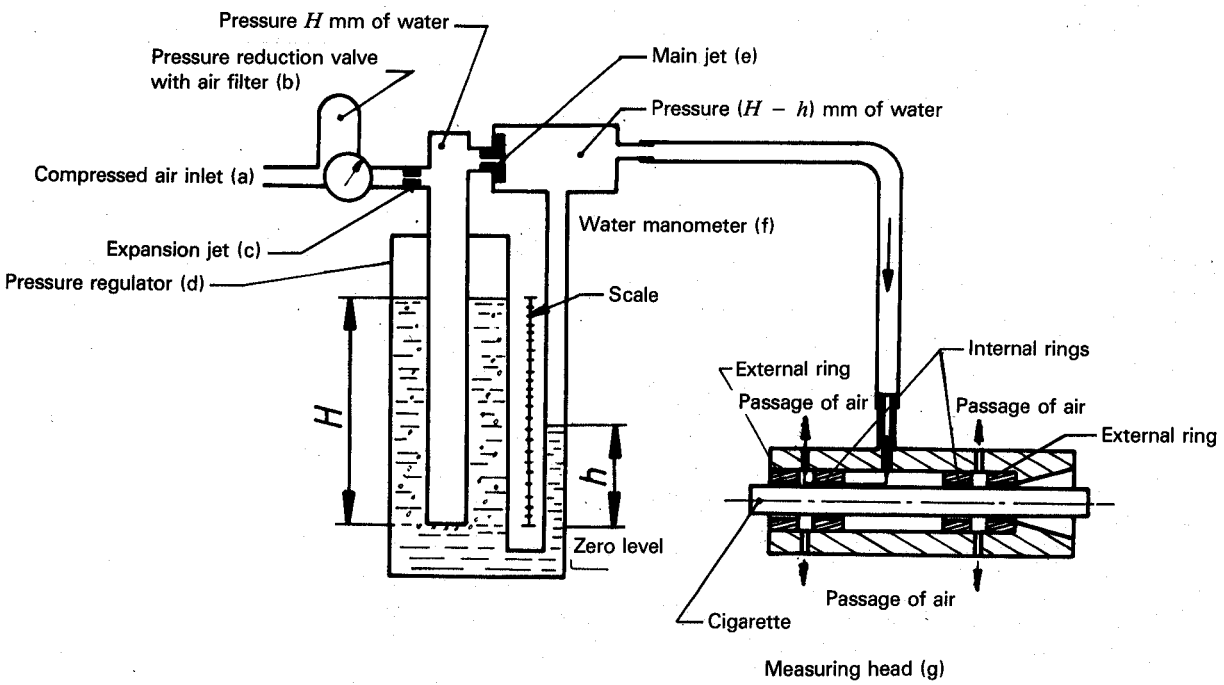

Figure 2 — Diagram of a typical instrument

A diagram of a typical instrument based on the principles described in clause 6.2 is shown in figure 2. This uses an expansion jet to attenuate sharp variations in the supply pressure and a main jet and a water column to provide air at a controlled pressure through a main jet to the measuring head. The pressure loss due to leakage of air between the test piece and the measuring rings is indicated on an integral water manometer.

However, any apparatus that is capable of supplying air at a controlled pressure through the main jet to the measuring head (for example by precision pressure regulators) may be used. The differential pressure between the air downstream of the main jet and that downstream of the measuring head may be measured by a separate manometer.

For the apparatus shown in figure 2, the following items are required:

a) compressed air inlet;

b) pressure reduction valve with air filter (clean air at low pressure);

c) expansion jet;

d) pressure regulator;

e) main jet;

f) water manometer;

g) measuring head as described in 6.3.

On other types of apparatus, all of the parts except the main jet and measuring head may be replaced by alternative parts capable of providing the same accuracy of measurement.

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B.3 Note concerning the main jet

For a given pressure H, the flow rate supplied should lie within a certain range which is compatible, in particular, with the desired range of the measuring scale and the required precision of the reading. This determines the choice of main jet.

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