International Standard ISO 5636/1

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Paper and board — Determination of air permeance (medium range) — Part 1 : General method

Papier et carton — Détermination de la perméabilité à l'air (valeur moyenne) — Partie 1 : Méthode générale

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 5636/1 was developed by Technical Committee ISO/TC 6, *Paper, board and pulps*, and was circulated to the member bodies in March 1983.

It has been approved by the member bodies of the following countries :

Australia	Hungary	South Africa, Rep. of
Austria	India	Spain
Belgium	Iran	Sweden
Bulgaria	Italy	Switzerland
Brazil	Kenya	Tanzania
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No member body expressed disapproval of the document.

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Paper and board — Determination of air permeance (medium range) — Part 1 : General method

0 Introduction

This International Standard specifies methods of measuring the rate of flow of air through unit area of a sheet of paper or board, under unit pressure difference. The measurements may be made with any apparatus which complies with the specifications given in this International Standard.

This part of ISO 5636 specifies basic requirements for the apparatus and general operating procedures. Other parts specify detailed requirements and operating procedures applicable to specific types of apparatus.

ISO 5636/2 describes the Schopper apparatus and operating procedures.[1)]

ISO 5636/3 describes the Bendtsen apparatus and operating procedures.[2)]

Other parts of this International Standard may be prepared later, provided that the apparatus complies with the specifications given in this part of ISO 5636.[3)]

1 Scope

This part of ISO 5636 specifies basic requirements for apparatus and general operating procedures for determining the air permeance of paper and board in the medium air permeance range.

2 Field of application

The method is applicable to papers and boards having air permeances between 1×10^{-2} and 1×10^{2} µm/(Pa·s). The method is unsuitable for rough surfaced papers and boards, such as creped and corrugated papers, which cannot be securely clamped to avoid leakage.

3 References

ISO 186, *Paper and board — Sampling for testing.*

ISO 187, *Paper and board — Conditioning of samples.*

4 Definition

For the purpose of this International Standard, the following definition applies.

air permeance : The mean flow of air through unit area under unit pressure difference in unit time, under specified conditions.

It is expressed in micrometres per pascal second [1 ml/(m²·Pa·s) = 1 µm/(Pa·s)].

5 Principle

Clamping a test piece between two circular gaskets or between a circular gasket and an annular flat surface, the dimensions being known in either case, with the absolute air pressure on one side of the test area of the test piece equivalent to atmospheric pressure and the difference in pressure between the two sides of the test piece maintained at a small but substantially constant value during the test. Determination of flow of air through the test area in a specified time.

NOTE — In the case of the Gurley tester, the applied pressure varies during the test due to the buoyancy effect of the cylinder, but such variation is reproducible.

6 Apparatus

The apparatus shall comply with the detailed requirements given in the appropriate parts of this International Standard. It is essential, however, that each type of apparatus meets the following general requirements :

a) the volume shall be measurable to an accuracy of ± 2 % of the measured value, and the time shall be measurable to an accuracy of ± 1 % of the measured value; or

b) the rate of flow shall be measurable to an accuracy of ± 5 % of the measured value.

1) ISO 5636/2, *Paper and board — Determination of air permeance (medium range) — Part 2 : Schopper method.*

2) ISO 5636/3, *Paper and board — Determination of air permeance (medium range) — Part 3 : Bendtsen method.*

3) Other instruments which may be considered include the Potts, Sheffield, Gurley and SCAN instruments.

The initial pressure difference[1] over the test piece shall be known to ± 2 % and shall not deviate by more than 5 % during the measurement. It shall lie between 0,7 and 3,0 kPa.

The test piece shall be clamped with an airtight gasket on the pressurized side of the test piece. This gasket shall not deform to such an extent that the test area of the test piece is changed by more than 1 %.

The test area of the test piece shall not be smaller than 6 cm^2. An area of 10 cm^2 is recommended. The area shall be known to within ± 2 %.

When water is used as the displacing medium, the air flow passing through the test piece shall be in such a direction as not to have been previously in contact with the water. The air leakage shall be checked by clamping a hard impermeable material, for example a metal foil, in the apparatus in place of the test piece. Any leakage shall be less than 0,025 times the minimum air permeance measurable with a particular instrument.

7 Sampling

Sampling shall be carried out in accordance with ISO 186.

8 Conditioning

Conditioning shall be carried out in accordance with ISO 187.

9 Preparation of test pieces

That part of the test piece which will become the test area shall not be handled during preparation or testing.

Not less than ten test pieces shall be cut and their two surfaces identified, for example top side and wire side. The minimum size of the test piece shall be such that the test piece protrudes noticeably in all directions from the clamping unit and provides the test area specified in clause 6. The test area shall be free from folds, wrinkles, holes, watermarks, or defects normally not inherent in the paper or board.

10 Procedure

10.1 Test atmosphere

Testing shall be carried out under the same atmospheric conditions used to condition the test pieces (see clause 8).

10.2 Details of measurement

The operations involved in the measurement of air permeance of each test piece shall be carried out in the manner described in the appropriate part of this International Standard. The details depend on the particular type of instrument used, but, in all cases, it is essential

a) to calibrate accurately the pressure difference to be applied across the test piece;

b) to ensure steady operation of the device controlling the flow of air immediately before and during the time the determinations are being made;

c) to ensure absence of vibration which could affect air displacement;

d) to ensure that the test piece is clamped uniformly without distortion;

e) to ensure that the measurements are made with the apparatus on a level surface;

f) to test half of the test pieces from one side and half from the other side.

11 Expression of results

11.1 Calculation

Convert the measured values (see the annex) to give the air permeance (P) of each test piece, in micrometres per pascal second [µm/(Pa·s)] by means of the formula

$$\frac{V}{1\,000 \times A\,\Delta p\,t}$$

where

V is the volume of air, expressed in millilitres, which passed through the test area;

A is the test area, in square metres;

Δp is the pressure difference, in kilopascals;

t is the test duration, in seconds.

11.2 Arithmetic mean

Calculate the arithmetic mean of the air permeance, in micrometres per pascal second, to three significant figures.

If there is evidence of a significant difference between the results for each direction of air flow through the test piece, calculate a separate arithmetic mean for each.

11.3 Standard deviation

Calculate the standard deviation or coefficient of variation of the air permeance for all replicate test results to two significant figures.

1) In the Gurley test, the pressure is specified in terms of the mass and dimensions of the cylinder and the quality and level of the oil.

12 Test report

The test report shall include the following information :

a) a reference to the appropriate part of ISO 5636;

b) the date and place of testing;

c) all the information necessary for the complete identification of the sample;

d) the type of instrument used;

e) the temperature and relative humidity during the test;

f) the number of test pieces tested;

g) the pressure difference used, in kilopascals;

h) the test duration, in seconds, or the flow meter range used;

j) the arithmetic mean or means (see 11.2);

k) the standard deviation or coefficient of variation (see 11.3);

m) any deviation from the procedure specified.

Annex

Conversion factors for different types of apparatus

A.0 Introduction

To obtain the air permeance of a test piece from readings obtained using a particular type of apparatus, the appropriate formulae given below should be used.

There are inherent differences between different types of apparatus, for example measuring head geometry, pressure difference etc. For this reason, the factors used in the formulae should not be used to convert readings made on one type of apparatus to equivalent readings on another. It is for this reason also that the type of apparatus used must always be reported.

A.1 Conversion factors (see also clause 11 for symbols)

A.1.1 Schopper apparatus

a) $\Delta p = 1{,}00$ kPa

$$P = \frac{V}{t}$$

b) $\Delta p = 2{,}50$ kPa

$$P = \frac{0{,}4\ V}{t}$$

A.1.2 Bendtsen apparatus

$\Delta p = 1{,}47$ kPa

$P = 0{,}011\ 3\ q$

where q is the rate of flow of air, expressed in millilitres per minute, passing through the test area.

A.1.3 Potts apparatus

$\Delta p = 0{,}98$ kPa

$P = 0{,}017\ 0\ q$

where q is the rate of flow of air, expressed in millilitres per minute, passing through the test area.

A.1.4 Sheffield apparatus

$\Delta p = 10{,}3$ kPa

$$P = 1{,}62 \times \frac{q}{A}$$

where q is the rate of flow of air, expressed in millilitres per minute, passing through the test area A, in square millimetres.

If the test area is 285 mm^2

$P = 0{,}005\ 68\ q$

A.1.5 Gurley apparatus

$$P = \frac{127}{t}$$

A.2 Equivalent values

The equivalent values on different apparatus of an air permeance of 1 µm/(Pa·s) are given in the table.

Apparatus	Values
Schopper	1 ml/s at 1 kPa
Schopper	2,5 ml/s at 2,5 kPa
Bendtsen	88 ml/min at 1,47 kPa
Potts	59 ml/min at 0,98 kPa
Sheffield	176 ml/min at 10,3 kPa and 285 mm^2
Gurley	127 s at 1,23 kPa*

* Inverse relationship.

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