

Australian/New Zealand Standard™

Methods of test for pulp and paper

Method 440: Determination of air permeance (medium range)—Bendtsen method



AS/NZS 1301.440:2016

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee PK-019, Methods of Test for Pulp and Paper to supersede AS 1301.440s—1991, *Methods of test for pulp and paper*, Method 440s: *Bendtsen air permeance of paper and board*.

The objective of this Standard is to provide a method for determining the air permeance of paper and board by means of the Bendtsen air permeance instrument.

This Standard is identical with, and has been reproduced from ISO 5636-3:2013, *Paper and board—Determination of air permeance (medium range)*, Part 3: *Bendtsen method*.

As this Standard is reproduced from an International Standard, the following applies:

- (a) In the source text ‘this part of ISO 5636’ should read ‘this Australian/New Zealand Standard’.
- (b) A full point substitutes for a comma when referring to a decimal marker.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

<i>Reference to International Standard</i>		<i>Australian/New Zealand Standard</i>	
ISO		AS/NZS	
186	Paper and board—Sampling to determine average quality	1301	Method of test for pulp and paper
		1301.417s	Method 417s: Sampling to determine average quality

The normative reference ISO 187 has not been adopted as an Australian/New Zealand Standard.

In Australia and New Zealand the following Standards are generally used:

AS/NZS 1301.414s:2006, *Methods of test for pulp and paper*, Methods 414s: *Conditioning of paper for testing*.

AS/NZS 1301.415s:2008, *Methods of test for pulp and paper*, Methods 415s: *Standard atmosphere for testing paper and board and procedure for monitoring the atmosphere*.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the annex to which they apply. A ‘normative’ annex is an integral part of a Standard, whereas an ‘informative’ annex is only for information and guidance.

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AUSTRALIAN/NEW ZEALAND STANDARD

Methods of test for pulp and paper

Method 440:

Determination of air permeance (medium range)—Bendtsen method

1 Scope

This part of ISO 5636 specifies the Bendtsen method for determining the air permeance of paper and board using the Bendtsen apparatus.

It is applicable to papers and boards which have air permeances between 0,35 $\mu\text{m}/(\text{Pa}\cdot\text{s})$ and 15 $\mu\text{m}/(\text{Pa}\cdot\text{s})$ when tested with the Bendtsen apparatus.

It is unsuitable for rough-surfaced materials which cannot be securely clamped to avoid leakage.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 186, *Paper and board — Sampling to determine average quality*

ISO 187, *Paper, board and pulps — Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples*

3 Terms and definitions

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

3.1**air permeance**

mean air flow rate through unit area under unit pressure difference in unit time, under specified conditions

Note 1 to entry: Air permeance is expressed in micrometres per pascal second [$1 \text{ ml}/(\text{m}^2\cdot\text{Pa}\cdot\text{s}) = 1 \mu\text{m}/(\text{Pa}\cdot\text{s})$].

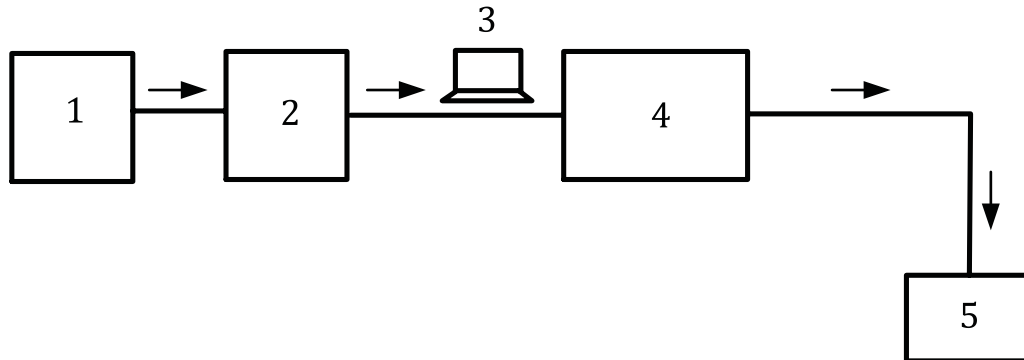
Note 2 to entry: This property is called air permeance, and not air permeability, because it is reported as a sheet property and is not standardized with respect to thickness to give a material property per unit thickness.

4 Principle

A test piece is clamped between a circular gasket and an annular flat surface of known dimensions. The absolute air pressure on one side of the test area of the test piece is equivalent to atmospheric pressure and the difference in pressure between the two sides of the test piece is maintained at a small, substantially constant, value during the test. Determination of the flow of air through the test area in a specified time.

5 Apparatus

Bendtsen apparatus, see [Figure 1](#), consisting of a compressor (see [5.1](#)) and a pressure stabilizing reservoir (see [5.2](#)) to supply air, a flowmeter (see [5.4](#)) with a pressure controlling device (see [5.3](#)) and a measuring head (see [5.5](#)).



Key

- 1 compressor
- 2 pressure stabilizing reservoir
- 3 pressure controlling device
- 4 flowmeter
- 5 sample clamping device and measuring head

Figure 1 — Flow diagram of the Bendtsen apparatus

5.1 Compressor, generating air at a pressure of about 127 kPa. If necessary, filters shall be provided to ensure that the air is clean and free of oil.

5.2 Pressure stabilizing reservoir, having a vessel volume of about 10 litres and installed between the compressor and the pressure controlling device, or some other means of providing a stable air flow.

NOTE The pressure stabilizing reservoir is not normally supplied with the apparatus. Its provision, or some other means of providing a stable air flow, is the responsibility of the user.

5.3 Pressure controlling device, to control the air pressure at the inlet of the flowmeter. This shall comprise a manostat weight, a pressure regulator or some other means of creating a steady nominal air pressure of $(1,47 \pm 0,02)$ kPa measured at the manostat.

NOTE Most Bendtsen apparatus are provided with three interchangeable manostat weights but only the 1,47 kPa manostat meets the requirement of this part of ISO 5636.

5.4 Variable-area flowmeters, to measure the flow rate in the following ranges: 5 ml/min to 150 ml/min, 50 ml/min to 500 ml/min and 300 ml/min to 3 000 ml/min. The resolution of these variable-area flowmeters shall be 2 ml/min, 5 ml/min and 20 ml/min respectively. The variable-area flowmeter may be replaced by an electronic air flowmeter having a measuring range suitable for the material measured that allows the air flow to be determined with an error of less than ± 5 ml/min or ± 5 % whichever is greater.

On some apparatus the available measuring ranges are 0 to 300 ml/min and 300 ml/min to 3 000 ml/min. The resolution of these variable area flowmeters shall be 1 % of the maximum reading scale.

5.5 Measuring head, consisting of a device in which the test piece is clamped between an annular flat surface and a circular rubber gasket. The annular ring and the gasket shall be of such dimensions that the