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Paper and board — Determination of water vapour transmission rate of sheet materials — Dynamic sweep and static gas methods

Papier et carton — Détermination du coefficient de transmission de la vapeur d'eau des matériaux en feuille — Méthode dynamique par balayage de gaz et méthode statique

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 6, *Paper, board and pulps*, Subcommittee SC 2, *Test methods and quality specifications for paper and board*.

This second edition cancels and replaces the first edition (ISO 9932:1990), of which it constitutes a minor revision. The changes compared to the previous edition are as follows:

— update of the normative references;

— removal of footnotes listing instruments in Clauses 4 and 5;

— addition of a general statement of the precision.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The rate of water vapour penetration through a barrier is an important property in many applications, for example, in building and in packaging. ISO 2528 describes a dish method for the determination of the transmission rate and this method has wide acceptance. It does, however, have three disadvantages. Results take several days to obtain, it is not suitable for transmission rates less than 1 g/(m^2·d) and it is not recommended for materials thicker than 3 mm.

The methods described in this document can, depending on the material being tested, produce results in a matter of hours and are suitable for materials with transmission rates considerably less than 1 g/(m^2·d). Depending on the specific apparatus, they are also suitable for materials up to 38 mm thick.

Paper and board — Determination of water vapour transmission rate of sheet materials — Dynamic sweep and static gas methods

1 Scope

This document describes general test methods for determining the water vapour transmission rate of sheet materials by means of a dynamic gas method or a static gas method. Depending on the method and specific apparatus employed, materials up to 38 mm thick and with water vapour transmission rates in the range from 0,05 g/(m^2·d) to 65 g/(m^2·d) can be tested. The basis of the function of the instrumental techniques is briefly described. Advice on calibration is given in Annex B.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 186:2002, *Paper and board — Sampling to determine average quality*

ISO 2528:2017, *Sheet materials — Determination of water vapour transmission rate (WVTR) — Gravimetric (dish) method*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
water vapour transmission rate
mass of water vapour transmitted through unit area in unit time under specified conditions of temperature and humidity. It is expressed in grams per square metre per 24 h [g/(m^2·d)]

3.2
dry side
side of the test cell which is exposed to low humidity

3.3
wet side
side of the test cell which is exposed to high humidity

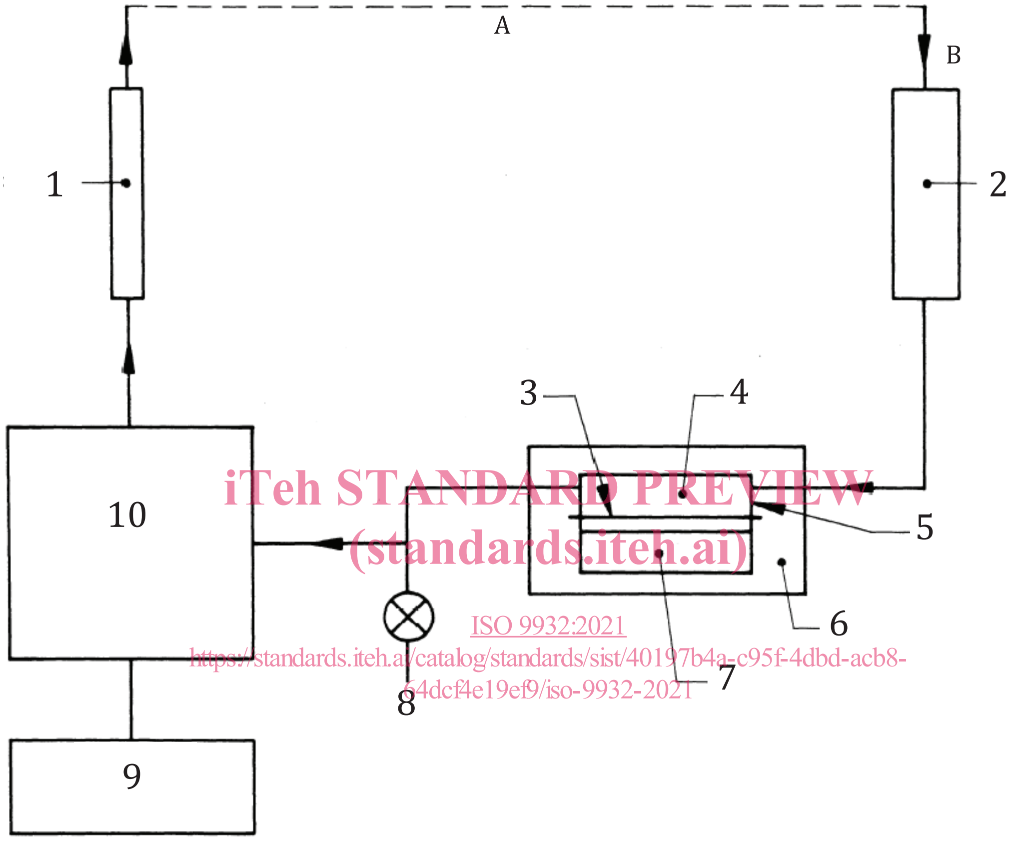
4 Method A: Dynamic sweep gas method

4.1 Principle

The test piece is mounted between two chambers. One at a known relative humidity and the other swept by a dry gas. The amount of water vapour picked up by the dry gas stream is detected by an electrical sensor and converted to a reading which directly, or after calculation, is a measure of the rate of water vapour transmission through the test piece.

4.2 Apparatus

4.2.1 Test cell, designed to clamp a test piece having a defined area, between two chambers, one swept by a dry gas (the dry side) and the other containing an atmosphere of high relative humidity (the wet side) (see Figure 1).



Key

1 flowmeter
2 desiccant column or electrolytic cell
3 test piece
4 dry side
5 test cell
6 enclosure maintained at required temperature
7 water or saline solution
8 by-pass
9 recorder or display
10 sensor (infra-red, electrolytic cell or electrical resistance element)
A gas recirculation in some systems
B dry gas in

Figure 1 — Schematic diagram of dynamic system

4.2.2 Clamping arrangements, to allow rapid insertion and removal of the test piece, equipped with suitable gaskets against which the test piece is sealed by the clamping force.

4.2.3 Provision for maintaining humidity on the wet side at the desired level. The required level of relative humidity may be obtained with saturated saline solutions containing a solid phase as described in Annex A or by distilled water if 100 % relative humidity is required.

4.2.4 Inert dry gas (as required by the specific apparatus to be used), for purging on the dry side.

NOTE The gas is normally desiccated air or dry nitrogen.

4.2.5 Sensor, with rapid response and high sensitivity capable of detecting levels in the moisture content of the sweep gas equivalent to 0,05 % relative humidity or less. The sensor may take a number of forms: an electrical resistance element, an electrolytic cell, or an infrared detector.

4.2.6 Means to convert the output from the sensor into a signal that can be used to calculate the amount of moisture passing through the test piece being tested in unit time.

4.2.7 Means of maintaining the test chamber and the sweep gas and the sensor at the required temperature.

NOTE The normal test temperature is either 23 °C ± 1 °C or 38 °C ± 1 °C, but other temperatures can be used.

4.2.8 Specimen of stated water vapour transmission rate supplied by the instrument manufacturer for standardization of the test cell.

5 Method B: Static gas method

5.1 Principle

The test piece is mounted in a cell containing an electrolytic element and the cell placed in a humidity cabinet at the required temperature and relative humidity. The water vapour penetrating the cell is electrolyzed and consequently the relative humidity within the cell remains very low (<1 %). After equilibrium, the electric current is a direct measure of the rate of electrolysis (according to Faraday's law of electrolysis) and the water vapour transmission rate.

5.2 Apparatus

5.2.1 Control box, containing

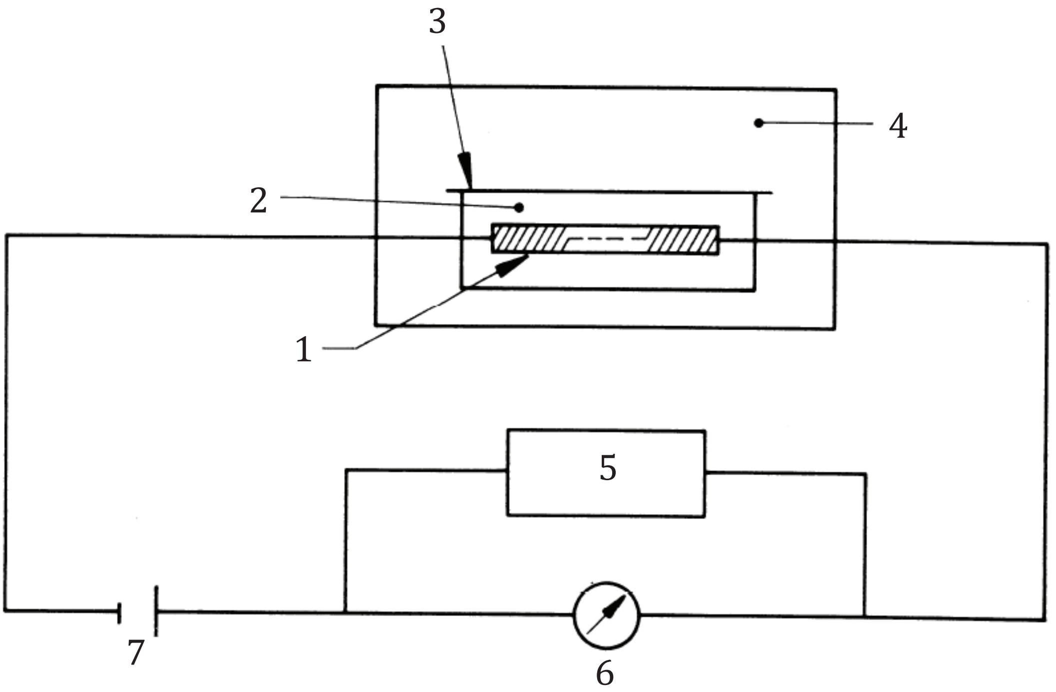
a) an electric power supply;

b) a microammeter, graduated directly in grams per square metre per 24 h [g/(m^2·d)];

c) selector and range switches;

d) connection points for cells and, if desired, a recorder.

See Figure 2.



Key

1 electrolytic element
2 dry side
3 test piece
4 enclosure maintained at required temperature and relative humidity
5 recorder
6 microammeter
7 power supply

Figure 2 — Schematic diagram of static system

5.2.2 Humidity cabinet, for storing the cells at the required conditions and having a fan for air circulation and small openings for entry of the plugs and cables of the cells. The required level of relative humidity may be obtained as prescribed in 4.2.3.

5.2.3 Stainless steel test cells, designed to clamp a defined area of a test piece and containing an electrolytic element which can be connected to the control box by means of a cable and plug.

5.2.4 Electrolytic element, consisting of two platinum wires wound at constant pitch round an inert former (glass and polytetrafluorethylene are suitable materials). A film of phosphorus pentoxide is deposited over the surface or the wires and former.

5.2.5 Means of drilling holes in test pieces.

5.2.6 Specimen of stated water vapour transmission rate.

6 Sampling

Select samples in accordance with ISO 186.