INTERNATIONAL STANDARD

ISO 15106-2

First edition
2003-01-15

Plastics — Film and sheeting — Determination of water vapour transmission rate —

Part 2: Infrared detection sensor method

Plastiques — Film et feuille — Détermination du coefficient de transmission de vapeur d'eau —

Partie 2: Méthode utilisant un détecteur infrarouge

Reference number
ISO 15106-2:2003(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword iv
1 Scope 1
2 Normative references 1
3 Terms and definitions 1
4 Principle 2
5 Test specimens 2
6 Conditioning 2
7 Apparatus 2
8 Test conditions 3
9 Procedure 4
10 Calculation 4
11 Test result 4
12 Precision 5
13 Test report 5

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 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 15106-2 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

ISO 15106 consists of the following parts, under the general title *Plastics — Film and sheeting — Determination of water vapour transmission rate*:

— *Part 1: Humidity detection sensor method*

— *Part 2: Infrared detection sensor method*

— *Part 3: Electrolytic detection sensor method*

Plastics — Film and sheeting — Determination of water vapour transmission rate —

Part 2:
Infrared detection sensor method

1 Scope

This part of ISO 15106 specifies an instrumental method for determining the water vapour transmission rate of plastic film, plastic sheeting and multi-layer structures including plastics, using an infrared detection sensor.

NOTE The method provides rapid measurement over a wide range of water vapour transmission rates.

2 Normative references

The following referenced documents are indispensable for the application 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 2528:1995, *Sheet materials — Determination of water vapour transmission rate — Gravimetric (dish) method*

ISO 4593:1993, *Plastics — Film and sheeting — Determination of thickness by mechanical scanning*

3 Terms and definitions

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

3.1
water vapour transmission rate
the amount of water vapour transmitted through unit area of test specimen per unit time under specified conditions

NOTE Water vapour transmission rate is expressed in grams per square metre 24 hours [g/(m^2·24 h)].

3.2
reference test specimen
a test specimen whose water vapour transmission rate is known, or one for which the water vapour transmission rate has been determined in accordance with ISO 2528

4 Principle

A dry chamber, at a specified relative humidity, is separated from a wet chamber, in which the atmosphere is saturated with water vapour at a known temperature, by a sheet of the material to be tested. The change in humidity brought about by water vapour transmitted through the specimen is detected by an infrared sensor capable of providing an electrical output signal which is a measure of the relative humidity in the dry chamber. The time taken to reach a steady state is measured and converted into a water vapour transmission rate.

5 Test specimens

5.1 The specimens shall be representative of the material, be free from wrinkles, creases and pinholes, and have uniform thickness. Each specimen shall have a larger area than the transmission area of the cell used for the test, and shall be hermetically mounted.

5.2 Three specimens shall be used unless otherwise specified or agreed between the interested parties.

NOTE For some products, testing more than three specimens gives a more representative result.

5.3 Unless otherwise specified, determine the thickness of each specimen in accordance with ISO 4593 at three points that are equally spaced.

6 Conditioning

Condition the specimens at 23 °C ± 2 °C and a relative humidity of (50 ± 10) %. The period of conditioning shall be as stated in the relevant specification for the material.

7 Apparatus

7.1 An example of a suitable apparatus is shown in Figure 1. The apparatus includes a transmission cell with two chambers, a lower (high-humidity) chamber and an upper (low-humidity) chamber between which a specimen is mounted, an infrared sensor for determining the relative humidity in the upper chamber, a pump for circulating the air in the upper chamber through the sensor, a flow meter, a drying tube and switch valves.

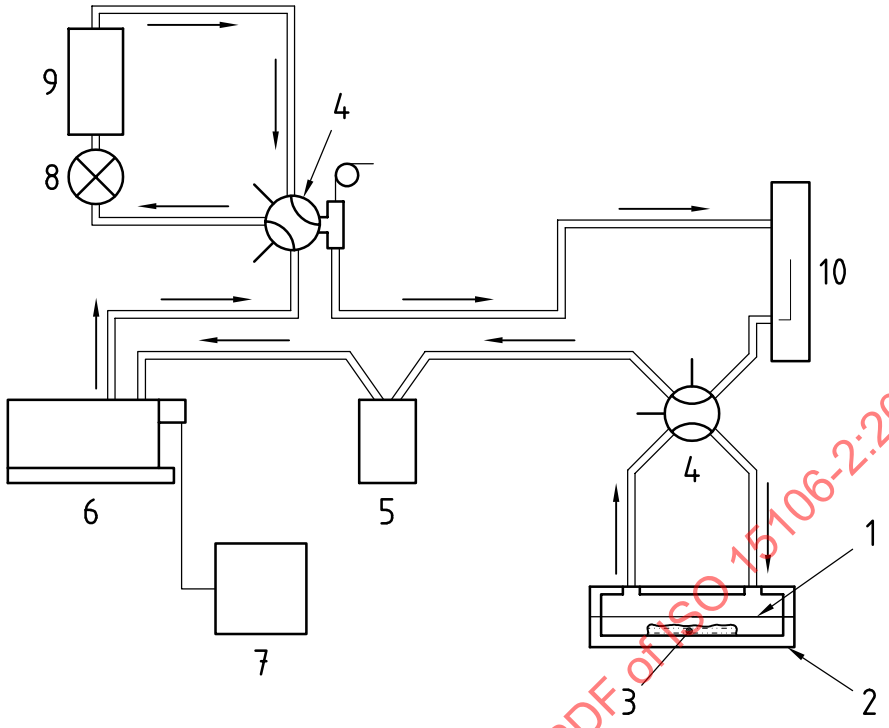
7.2 The transmission area shall be between 5 cm^2 and 100 cm^2. The specimen shall never be able to touch the upper or lower inside surface of the transmission cell. The temperature of the transmission cell shall be kept within ± 0,5 °C of the test temperature by means of a temperature controller.

7.3 The flow meter shall be capable of measuring flow rates from 5 ml to 100 ml per minute.

7.4 The infrared detection sensor shall be capable of detecting a change in water vapour content of either 1 µg per litre or 1 mm^3/dm^3 (1 ppm by volume).

For each type of humidity sensor, the appropriate maintenance and calibration procedures shall be followed as specified by the manufacturer.

7.5 The drying tube shall be capable of drying air down to the detection limit of the infrared sensor or lower.



Key

1	Specimen	6	Infrared sensor
2	Transmission cell	7	Recorder
3	Cotton wool soaked in suitable solution	8	Control valve
4	Switch valve	9	Flow meter
5	Pump	10	Drying tube

Figure 1 — Example of water vapour transmission rate measuring apparatus with infrared sensor

8 Test conditions

The test conditions should preferably be chosen from those given in Table 1.

Table 1 — Choice of test conditions

Set of test conditions	Temperature °C	RH %
1	25 ± 0,5	90 ± 2
2	38 ± 0,5	90 ± 2
3	40 ± 0,5	90 ± 2
4	23 ± 0,5	85 ± 2
5	25 ± 0,5	75 ± 2

Test conditions other than these shall be agreed upon by the interested parties.

9 Procedure

9.1 Measure the water vapour transmission rate of a reference specimen and then each test specimen as described in 9.2 to 9.5.

The water vapour transmission rate of the reference specimen shall be checked periodically, preferably once or twice a year.

Each laboratory or test site shall maintain and utilize their own reference specimens.

9.2 Measure the zero-level voltage of the apparatus using dried air.

9.3 Prepare a saturated solution suitable for maintaining the humidity at the required level, and introduce it into the lower chamber together with some cotton wool.

NOTE A relative humidity of (90 ± 2) % is produced by a saturated solution of either zinc sulfate or ammonium dihydrogen phosphate. A relative humidity of (85 ± 2) % is produced by a saturated solution of potassium chloride. A relative humidity of (75 ± 2) % is produced by a saturated solution of sodium chloride or sodium acetate.

9.4 Mount the reference specimen or test specimen hermetically between the upper and lower chambers, taking care that there are no wrinkles or slackness in the specimen.

9.5 Fit the transmission cell in the apparatus and then allow dry air to flow through the upper chamber at the specified flow rate. Monitor the output voltage from the infrared sensor until it reaches a steady state in which it is constant to within ± 5 %.

NOTE The flow rate should be specified by the manufacturer of the apparatus.

If the voltage is not constant to within ± 5 %, this shall be indicated in the test report.

10 Calculation

Calculate the water vapour transmission rate of each test specimen using the following equation:

$$\mathrm{WVTR} = \frac{S \times (E_S - E_0)}{(E_R - E_0)} \times \frac{A_R}{A_S}$$

where

WVTR is the water vapour transmission rate of the test specimen, expressed in grams per square metre 24 hours [g/(m^2·24 h)];

E_0 is the zero-level voltage, in volts, of the apparatus using dried air;

E_R is the steady-state voltage, in volts, measured with the reference specimen;

S is the water vapour transmission rate of the reference specimen, in g/(m^2·24 h);

E_S is the steady-state voltage, in volts, measured with the test specimen;

A_R is the transmission area, in square metres, of the reference specimen;

A_S is the transmission area, in square metres, of the test specimen.

11 Test result

Calculate the test result as the arithmetic mean of the results obtained for each test specimen, rounding to the second place of decimals if the value is less than one, and to two significant figures if the value is greater than one.