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

Part 1: Humidity detection sensor method

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

Partie 1: Méthode utilisant un détecteur d'humidité

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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.

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 15106-1 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 1: Humidity 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 a humidity 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 a humidity sensor capable of providing an electrical output signal which is a measure of the relative humidity in the dry chamber. The time taken for the humidity to increase by a given amount 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

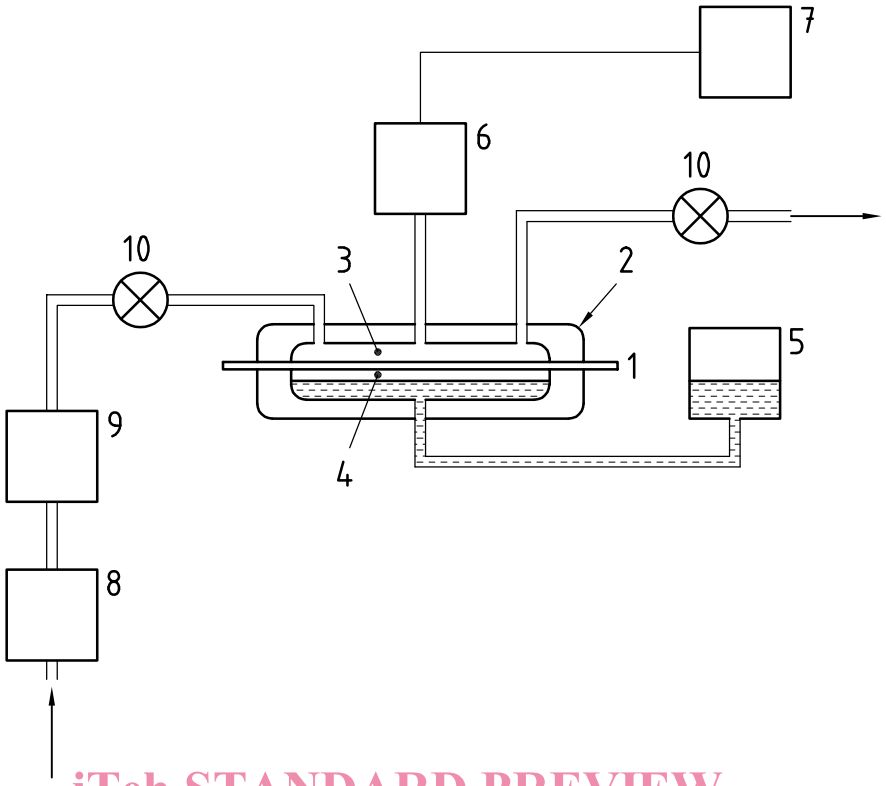
7.1 An example of a suitable apparatus is shown in Figure 1. The apparatus includes a transmission cell with two chambers, a lower (high-humidity) chamber and an upper (low-humidity) chamber between which a specimen is mounted, a humidity sensor for determining the relative humidity in the upper chamber,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

7.2 The lower chamber is connected directly to the water reservoir. The upper chamber is designed to collect the water vapour which passes through the specimen from the high-humidity side, and the humidity sensor is mounted over this chamber. The transmission area shall be between 5 cm^2 and 100 cm^2. 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 humidity sensor shall be capable of detecting humidity changes of 0,05 % RH, and its response speed shall be no longer than 1 s.

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

7.4 The water reservoir shall contain distilled or deionized water.



Key

1	Specimen	6	Humidity sensor
2	Transmission cell	7	Recorder
3	Upper chamber	8	Pump
4	Lower chamber	9	Drying tube
5	Water reservoir	10	Stop valve

Figure 1 — Example of water vapour transmission rate measuring apparatus with humidity 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 conditions	Temperature °C	Desired RH differential %	RH of upper chamber %	RH of lower chamber %
1	25 ± 0,5	90	10	100
2	38 ± 0,5	90	10	100
3	40 ± 0,5	90	10	100
4	23 ± 0,5	85	15	100
5	25 ± 0,5	75	25	100

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 9.6.

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 Introduce sufficient distilled or deionized water into the lower chamber so that, when the specimen is mounted in place, a 5 mm air layer will be left between the water surface and the specimen.

9.3 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.

9.4 Open the two valves (10) to introduce dry air in order to reduce the humidity in the upper chamber to a level e.g. 1 % or 2 % lower than that required to achieve the desired relative-humidity differential (see Table 1). Close the valves and begin recording the humidity.

9.5 Using the humidity sensor, monitor the increase in relative humidity in the upper chamber due to the water vapour passing through the specimen. Record the time taken for the humidity to increase to a level e.g. 1 % or 2 % higher than that corresponding to the desired relative-humidity differential.

9.6 Repeat the operations described in 9.4 and 9.5 until two consecutive times are recorded which are within ± 5 %.

If this condition cannot be met, this shall be indicated in the test report.

10 Calculation

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

$$\mathrm{WVTR} = \frac{S \times T_\mathrm{R}}{T_\mathrm{S}} \times \frac{A_\mathrm{R}}{A_\mathrm{S}}$$

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)];

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

T_R is the time, in seconds, taken for the relative humidity in the upper chamber to increase from its initial level (1 % or 2 % below the level given in Table 1) to its final level (1 % or 2 % above the level given in Table 1) with the reference specimen;

T_S is the time, in seconds, taken for the relative humidity in the upper chamber to increase from its initial level (1 % or 2 % below the level given in Table 1) to its final level (1 % or 2 % above the level given in Table 1) 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.

12 Precision

The precision of this test method is not known because inter-laboratory data are not available. When inter-laboratory data are obtained, a precision statement will be added at the following revision.

13 Test report

The test report shall include the following information:

a) a reference to this part of ISO 15106;

b) the test conditions;

c) details of the reference specimen used;

d) all details necessary for identification of the sample tested;

e) the method of preparation of the test specimens;

f) the side of the test specimen which faced the supply of water vapour;

g) the transmission area of the test specimen;

h) the mean thickness of the test specimen;

i) the number of specimens tested;

j) details of specimen conditioning;

k) if applicable to one or more specimens, a statement that it was not possible to record two consecutive times within ± 5 % (see 9.6);

l) the test result;

m) the date of the test.