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Test methods for water vapour
permeability of textiles

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Textile Evaluation Technology Council (JTETC)/Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act. This edition replaces the previous edition (**JIS L 1099** : 2012), which has been technically revised.

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Test methods for water vapour permeability of textiles

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 11092** : 2014, Edition 2 and **ISO 15496** : 2018, Edition 2, with some modifications of the technical contents in order to reflect the actual use situation in Japan.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies the test methods for water vapour permeability of textiles.

These test methods are not appropriate for highly air-permeable textiles such as extremely thin textiles (e.g. lawn) and textiles with extremely low density (e.g. organdie).

NOTE The International Standards corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 11092 : 2014 *Textiles — Physiological effects — Measurement of thermal and water-vapour resistance under steady-state conditions (sweating guarded-hotplate test)*

ISO 15496 : 2018 *Textiles — Measurement of water vapour permeability of textiles for the purpose of quality control* (overall evaluation : MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

Part or all of the provisions of the following standards, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS K 0050	<i>General rules for chemical analysis</i>
JIS K 8125	<i>Calcium chloride (for U-tube) (Reagent)</i>
JIS K 8363	<i>Potassium acetate (Reagent)</i>
JIS L 0105	<i>General principles of physical testing methods for textiles</i>
JIS Z 8401	<i>Rounding of numbers</i>

3 Terms and definitions

For the purpose of this Standard, the following terms and definitions apply.

3.1

water-vapour permeability, P_A , P_B

mass of water vapour, in grammes, that has permeated a textile at a specified temperature and under a specified humidity, which is converted to the value per square metre of its textile and per hour

Note 1 to entry This term is used in Method A and Method B.

3.2

thermal resistance, R_{ct}

temperature difference between the two faces of a material divided by the resultant heat flux per unit area in the direction of the gradient

Note 1 to entry The dry heat flux may consist of one or more conductive, convective and radiant components. It is a quantity specific to textile materials or composites which determines the dry heat flux across a given area in response to a steady applied temperature gradient.

Note 2 to entry Thermal resistance is expressed in square metres kelvin per watt ($m^2 \cdot K/W$).

Note 3 to entry This term is used in Method C (sweating guarded-hotplate method).

3.3

water-vapour resistance, R_{et}

water-vapour pressure difference between the two faces of a material divided by the resultant evaporative heat flux per unit area in the direction of the gradient

Note 1 to entry It is a quantity specific to textile materials or composites which determines the “latent” evaporative heat flux across a given area in response to a steady applied water-vapour pressure gradient.

Note 2 to entry Water-vapour resistance is expressed in square metres pascal per watt ($m^2 \cdot Pa/W$).

Note 3 to entry This term is used in Method C (sweating guarded-hotplate method).

3.4

water-vapour permeability index, i_{mt}

ratio of thermal and water-vapour resistances in accordance with the following formula :

$$i_{mt} = S \cdot \frac{R_{ct}}{R_{et}}$$

where, i_{mt} : water-vapour permeability index

S : 60 (Pa/K)
 R_{ct} : thermal resistance ($m^2 \cdot K/W$)
 R_{et} : water-vapour resistance ($m^2 \cdot Pa/W$)

Note 1 to entry The water-vapour permeability index is dimensionless, and has values between 0 and 1. A value of 0 implies that the material is water-vapour impermeable, that is, it has infinite water-vapour resistance, and a material with a value of 1 has both the thermal resistance and water-vapour resistance of an air layer of the same thickness.

Note 2 to entry This term is used in Method C (sweating guarded-hotplate method).

3.5

water-vapour permeability, W_d

characteristic of a textile material or composite obtained in accordance with the following formula :

$$W_d = \frac{1}{R_{et} \cdot \phi T_m}$$

where, W_d : water-vapour permeability ($g/m^2 \cdot h \cdot Pa$)
 R_{et} : water-vapour resistance ($m^2 \cdot Pa/W$)
 ϕT_m : latent heat at a measuring temperature ($W \cdot h/g$)

Note 1 to entry ϕT_m is the latent heat of vaporization of water at the temperature T_m of the measuring unit, equals, for example, $0.672 W \cdot h/g$ at $T_m = 35^\circ C$.

Note 2 to entry Water-vapour permeability depends on water-vapour resistance and temperature.

Note 3 to entry This term is used in Method C (sweating guarded-hotplate method).

4 Testing location

The test shall be conducted in a laboratory maintained under the standard conditions specified in **JIS L 0105**. Where this is impractical, the conditions closest possible to those specified shall be employed, in which case the temperature and relative humidity employed at the test shall be reported in the test report given in Clause 8.

5 Sampling and preparation of samples and test specimens

Sampling and preparation of samples and test specimens shall be in accordance with **6.3 or 6.4 of JIS L 0105**.

6 Classification of tests

Classification of tests is as follows. An appropriate test method shall be selected by agreement with the test applicant.

a) Method A

1) **Method A-1 (calcium chloride method) (7.1.2)** This test method shall be applied

for the measurement of the water-vapour permeability of textiles under the wearing condition where the humidity inside the clothe is high in the dry environment.

- 2) **Method A-2 (water method) (7.1.3)** This test method shall be applied for the measurement of the water-vapour permeability of textiles under the wearing condition where the humidity inside the clothe is high.

b) **Method B**

- 1) **Method B-1 (potassium acetate method) (7.2.2)** This test method shall be applied to the measurement of the maximum water-vapour permeability of water-proof textiles.
- 2) **Method B-2 (alternative method to potassium acetate method) (7.2.3)** This test method shall be applied for the measurement of the maximum water-vapour permeability of non-waterproof textiles.

- c) **Method C (sweating guarded-hotplate method) (7.3)** As specified in Annex A.

7 Test methods

7.1 Method A

7.1.1 General

Method A is classified into Method A-1 (calcium chloride method) or Method A-2 (water method), either of which shall be selected and performed.

7.1.2 Method A-1 (calcium chloride method)

Method A-1 (calcium chloride method) shall be as follows.

a) **Apparatus and materials**

- 1) **Thermohygrostat**, capable of maintaining the temperature and humidity at the specified value, and circulating the air inside the apparatus.
- 2) **Wind speed indicator**, capable of measuring the velocity inside the thermohygrostat with the precision of 0.1 m/s.
- 3) **Chemical balance**, capable of determining the mass of the test assembly with the precision of 1 mg.
- 4) **Disk plate**, in a flat form, made of synthetic resin and 60 mm in diameter and 3 mm in thickness.
- 5) **Permeable cup**, as shown in Figure 1, which is of a material not allowing permeation of water vapour, and which is free from corrosion and change of permeated area when it is subjected to the test procedure.
- 6) **Desiccant**, as specified in JIS K 8125.

Unit: mm

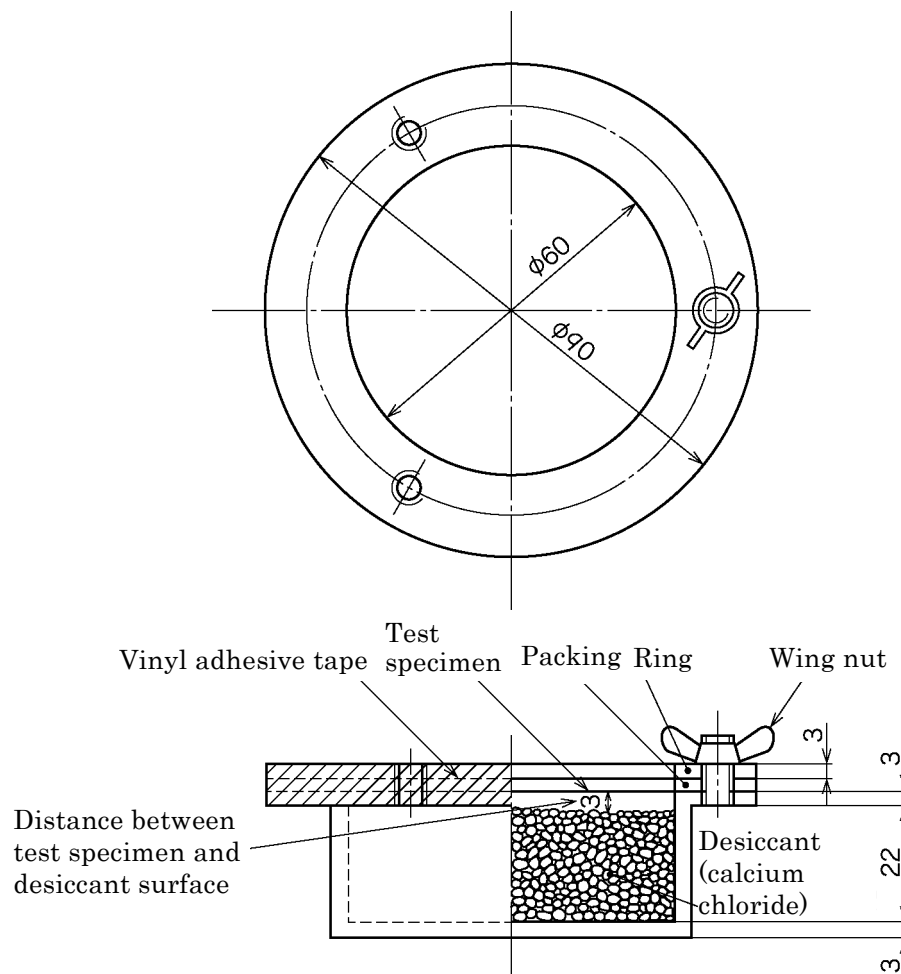


Figure 1 Example of permeable cup for Method A-1 (calcium chloride method)

- b) **Operation** Put desiccant in a permeable cup, make it uniform by vibrating the cup, and then smooth the surface by a medical spoon. Adjust the distance between the desiccant and the lower surface of the test specimen to 3 mm by using a disk plate.

Take three test specimens of about 70 mm in diameter from the sample specified in Clause 5, and as shown in Figure 1, place the test specimen on the cup in such a way that the front surface of the test specimen faces the desiccant and that it is concentric with the cup, and then put the packing and the ring in place and fix them with the wing nut. Seal the side periphery of the packing and the ring with vinyl adhesive tape and use this as a test assembly.

Place this test assembly in the position where the wind speed does not exceed 0.8 m/s at approximately 10 mm above the upper part of test specimen in a thermohygrostat maintained at $40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and under $(90 \pm 5)\text{ \%RH}^{1)}$.

Take out the test assembly after 1 h and immediately weigh its mass (a_1) to the nearest 1 mg. After the measurement, place the test assembly at the same position of the thermohygrostat. Take out the test assembly after 1 h and immediately

weigh its mass (a_2) to the nearest 1 mg.

Note ¹⁾ The temperature and humidity conditions may be changed as necessary. In any case, the temperature and relative humidity employed shall be reported in the test report given in Clause 8.

- c) **Calculation** The water-vapour permeability shall be calculated in accordance with Formula (1) and the test result shall be expressed by the mean value of three tests rounded to an integer according to Rule B of JIS Z 8401.

$$P_{A1} = \frac{a_2 - a_1}{S_{A1}} \dots\dots\dots(1)$$

where, P_{A1} : water-vapour permeability ($\text{g/m}^2 \cdot \text{h}$)
 $a_2 - a_1$: change of mass of test assembly per hour (g/h)
 S_{A1} : permeated area (m^2)

7.1.3 Method A-2 (water method)

Method A-2 (water method) shall be as follows.

a) Apparatus and materials

- 1) **Thermohygrostat**, specified in 7.1.2 a) 1).
- 2) **Wind speed indicator**, specified in 7.1.2 a) 2).
- 3) **Chemical balance**, specified in 7.1.2 a) 3).
- 4) **Permeable cup**, specified in 7.1.2 a) 5).

- b) **Operation** Pour 42 ml of water of approximately 40 °C in a permeable cup which has been warmed to approximately 40 °C beforehand, and adjust the distance between the water and the lower surface of the test specimen to 10 mm. The water used shall be the purified water as specified in Japanese Pharmacopoeia or water of A2 or better as specified in JIS K 0050.

Take three test specimens of about 70 mm in diameter from the sample specified in Clause 5, and place the test specimen on the cup in such a way that the back surface of the test specimen faces the water and that it is concentric with the cup, and then put the packing and the ring in place and fix them with the wing nut. Seal the side periphery of the packing and the ring with vinyl adhesive tape and use this as a test assembly.

Place this test assembly in the position where the wind speed does not exceed 0.8 m/s at approximately 10 mm above the upper part of test specimen in a thermohygrostat maintained at 40 °C $\pm$ 2 °C and under (50 $\pm$ 5) %RH ¹⁾.

Take out the test assembly after 1 h and immediately weigh its mass (a_3) to the nearest 1 mg. After the measurement, place the test assembly at the same position of the thermohygrostat. Take out the test assembly after 1 h and immediately weigh its mass (a_4) to the nearest 1 mg.

Care should be sufficiently taken in handling the test assembly so as not to wet the test specimen with water in permeable cup.