GB

NATIONAL STANDARD

OF THE PEOPLE'S REPUBLIC OF CHINA

ICS 85-010

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GB/T 458-2008

Replacing GB/T 5402-2003, GB/T 2679.13-1996, GB/T 458-2002

Paper and board - Measurement of air permeance

[ISO 5636-2:1984, Paper and board - Measurement of air permeance (medium range) - Part 2: Schopper method; ISO 5636-3:1992, Paper and board - Measurement of air permeance (medium range) - Part 3: Bendtsen method; ISO 5636-5:2003, Paper and board - Measurement of air permeance and air resistance (medium range) - Part 5: Gurley method, MOD]

Issued on: August 19, 2008 **Implemented on: May 01, 2009**

Issued by: General Administration of Quality Supervision, Inspection and Quarantine;

Standardization Administration of PRC.

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Foreword

This standard, through modification, adopts ISO 5636-2:1984, Paper and board - Measurement of air permeance (medium range) - Part 2: Schopper method; ISO 5636-5:2003, Paper and board - Measurement of air permeance and air resistance (medium range) - Part 5: Gurley method; AND ISO 5636-3:1992, Paper and board - Measurement of air permeance (medium range) - Part 3: Bendtsen method.

As compared with ISO 5636-2:1984, ISO 5636-3:1992 and ISO 5636-5:2003, the main differences are as follows:

- DELETE the introduction from international standards;

- CONSOLIDATE the scope of international standards;

- MOVE the instrument description in this standard into Appendix.

This standard the integration and modification of GB/T 458-2002 “Paper and board - Measurement of air permeance (Schopper method)”, GB/T 2679.13-1996 “Paper and board - Measurement of air permeance (medium range) - Bendtsen method” and GB/T 5402-2003 “Paper and board - Measurement of air permeance and air resistance (medium range) - Gurley method”, AND it replaces the above three standards.

Compared with GB/T 458-2002, GB/T 2679.13-1996 and GB/T 5402-2003, this standard has the following changes:

- INTRODUCE the instrument structure and working principle in the form of an appendix, in order to facilitate the rationality of the main contents of this standard;

- In the Gurley method, DELETE the splint above type instrument because it is out of date, and DELETE accordingly the relevant standard contents; so the party using this standard please pay attention to the relevant changes.

Appendix A, Appendix B and Appendix C of this Standard are normative appendixes.

This standard was proposed by China Light Industry Association.

This standard shall be under the jurisdiction of the National Paper Industry Standardization Technical Committee.

Paper and board - Measurement of air permeance

1 Scope

This standard specifies three methods for the measurement of air permeance of paper and board: Gurley method, Schopper method, and Bendtsen method.

This standard is applicable to paper and board with air permeance between 1 × 10^{-2}μm / (Pa • s) ~ 1 × 10^{2}μm / (Pa • s).

This standard does not apply to paper and board with a large surface roughness which cannot be firmly clamped, such as crepe paper or corrugated paperboard.

2 Normative references

The provisions in following documents become the provisions of this standard through reference in this Standard. For the dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this standard; however, parties who reach an agreement based on this standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest edition of the referenced document applies.

GB/T 450 Paper and board - Sampling for testing and identification of machine and cross direction wire side and felt side (GB/T 450-2008, ISO 186:2002, MOD)

GB/T 10739 Paper, board and pulps - Standard atmosphere for conditioning and testing (GB/T 10739-2002, eqv ISO 187:1990)

3 Terms and definitions

The following terms and definitions apply to this standard.

3.1

Air permeance

It refers to, based on the specified conditions at the unit time and unit pressure difference, the mean air flow passing through the unit area paper or board, expressed in microns per Pascal seconds [1 μm / (Pa • s) = 1 mL / (m^2 • Pa • s)].

4 Measurement procedures of Gurley method

4.1 Preparation of test specimens

4.1.1 The sample shall be taken in accordance with GB/T 450.

4.1.2 The temperature and humidity treatment for sample shall be conducted in accordance with the provisions of GB/T 10739.

4.1.3 From 10 samples, respectively CUT one specimen of the size 50 mm × 50 mm.

Note: The measurement surface shall not have wrinkles, cracks, holes or other appearance defects.

4.2 Measurement

4.2.1 The measurement shall be conducted under the same atmospheric conditions as those used in the temperature and humidity treatment.

4.2.2 ADJUST the instrument to the horizontal position so that the two cylinders are in a vertical position; and then CLAMP the smooth, hard, dense, and impermeable metal or plastic sheet in between the two pore plates, to check the tightness of the instrument. In accordance with 4.2.3, CONDUCT inspection; after measurement for 5 h, the leaked air shall not be greater than 50 mL.

4.2.3 RAISE the inner cylinder so that its edge is on the support of the outer cylinder. CLAMP the specimen; REMOVE the supporting device, in order to lower down the inner cylinder to the position that can be floated.

When the inner cylinder is steadily lowered, START time keeping from the zero scale, and MEASURE the time required by the initial two 50 mL interval (i.e., the interval from 0 mL to 100 mL) to pass the outer cylinder edge.

≤ 60 s: accurate to 0.2 s;

> 60 s to ≤ 180 s: accurate to 1 s;

> 180 s: accurate to 5 s.

Δp - Pressure difference between the two sides of the sample, in kilopascal (kPa);

t - Measurement time, in seconds (s).

5.4 Precision

TAKE two specimens from the same sample; ARRANGE one operator to conduct measurement in the same lab; AND the deviation of the mean values of the two measurement results shall be within 10%.

6 Measurement procedures of Bendtsen method

6.1 Preparation of test specimens

6.1.1 The sample shall be taken in accordance with GB/T 450.

6.1.2 The temperature and humidity treatment for sample shall be conducted in accordance with the provisions of GB/T 10739.

6.1.3 From 10 samples, respectively CUT one specimen of the size 50 mm × 50 mm.

Note: The measurement surface shall not have wrinkles, cracks, holes or other appearance defects.

6.2 Measurement

6.2.1 The measurement shall be conducted under the same atmospheric conditions as those used in the temperature and humidity treatment.

6.2.2 PLACE the instrument on a stable workbench and ADJUST it level.

6.2.3 Based on the test sample, SELECT appropriate flow meter and working pressure (the pressure as specified in this standard is 1.47 kPa).

6.2.4 After completing the leakage inspection and flow rate calibration, CONNECT the flowmeter and measurement probe.

6.2.5 CLAMP the sample in between the annular plate and the gasket; and RECORD the flowmeter reading 5 s after clamping.

6.2.6 CONDUCT measurement on the front of 5 samples and back of another five samples. If there is a significant difference in the air permeance through the front side and the back side, AND meanwhile it is required to report such

APPENDIX A

(Normative)

Gurley air permeance tester

A.1 Instrument

The instrument consists of an outer cylinder and an inner cylinder. The outer cylinder contains a certain amount of sealing liquid, AND the inner cylinder is free to slide in the outer cylinder. The outer cylinder has a height of 254 mm and an inner diameter of 82.6 mm, in which 3 or 4 metal strips are arranged erectly on the inner wall at same interval. The length of the metal strip is between 190 mm and 245.5 mm, AND the cross section of the metal strip is square of edge length 2.4 mm OR circle of diameter 2.4 mm; the metal strip is used as the guide rail for the movement up and down of the inner cylinder. The inner cylinder has a height of 254 mm, an outer diameter of 76.2 mm, an inner diameter of 74.1 mm and a mass of (567 ± 0.5) g. The air pressure formed by the self-gravity of the inner cylinder is applied to a sample sandwiched between the plates having an aperture of (28.6 ± 0.1) mm.

The splint is located at the base, AND at the splint side with air pressure is attached with a rubber liner, in order to avoid air leakage between the sample surface and the splint. The liner is made from thin, resilient, oil resistant, and oxidation resistant materials, AND has smooth and flat surfaces. The thickness of the liner is 0.70 mm to 1.00 mm, and the hardness is 50 IRHD to 60 IRHD (International Rubber Hardness Scale), the inner diameter is (28.6 ± 0.1) mm (area: 6.42 cm^2) and the outer diameter is (34.9 ± 0.1) mm, AND the hole of the liner shall be aligned with the hole of the splint. During use, in order to align the hole of the liner and the hole of the splint AND protect the liner, it shall attach the liner into the positioning channel of the splint. This round groove shall be concentric with the corresponding splint hole, with the depth of (28.41 ± 0.04) mm, groove depth of (0.45 ± 0.05) mm, and the outside diameter of (35.2 ± 0.1) mm. The liner and the positioning groove shall match exactly.

Note: the board slot of some instruments has an inner diameter of 28.65 mm, AND it shall slightly tighten the fitting with liner.

The sealing liquid has a density of 860 kg/m^3 at 38 °C, a kinematic viscosity of 10 mm^2/s to 13 mm^2/s (equivalent to 60s Saybolt to 70s Saybolt), AND a flash point of not less than 135 °C.

APPENDIX B

(Normative)

Schopper air permeance tester

B.1 Instrument

The holding device of the instrument shall ensure that the test area of the specimen is (10.0 ± 0.2) cm^2.

One side of the holding device is in the standard atmosphere of the laboratory AND the other side is connected to the pressure stabilization part of the instrument, which will provide a small and stable pressure difference in the test zone AND accurately measure the volume or flow of the exhaust air. The holding ring shall use a special low-elastic rubber gasket, to prevent the test zone on the specimen produce significant deformation.

The pressure difference in the test zone of the instrument is adjustable, AND able to ensure that the following two pressure difference Δp maintain the specified accuracy.

$$\Delta p_1 = 1.00 \text{ kPa} \pm 0.01 \text{ kPa}$$

$$\Delta p_2 = 2.50 \text{ kPa} \pm 0.01 \text{ kPa}$$

The measurement accuracy of air flow through the test zone shall comply with the following requirements: if the air flow is 100 mL or less than 100 mL, the volume error shall be ± 1 mL; if the air flow is more than 100 mL, the volume error shall be ± 5 mL. The maximum flow rate that can be measured is 1000 mL.

B.2 Tightness calibration

B.2.1 ADJUST the instrument to level.

B.2.2 SANDWICH a piece of smooth, hard, and air-tight plastic foil or metal foil on the holder; ADJUST the constant pressure difference in the test zone to 1.0 kPa; and CLOSE the drain valve.

B.2.3 START timer for timekeeping; AND the air leakage per hour shall not exceed 1.0 mL.

The sealing gasket shall, if worn or deformed, be replaced in time. The measurement probe and the flowmeter are connected by rubber hose or plastic hose of the diameter 5 mm to 6 mm AND length not more than 600 mm.

C.2 Leakage inspection

SELECT 10 mL/min ~ 150 mL/min flowmeter; at the measurement probe, SANDWICH one piece of smooth and hard mon-metallic plate (standard plate) close to the sealing gasket, in order to check the air leakage conditions.

If the reading is not zero, it shall check whether the non-metallic plate (standard plate) is damaged or defective. It shall ensure the sealing gasket is in close contact with the non-metallic plate; CHECK whether the airflow line is tightened, in order to prevent leakage.

C.3 Flowmeter calibration

C.3.1 Flowmeter calibration by capillary

The rotor of the flowmeter is sensitive to wear. If the difference between the scale reading and the specified value of the connected capillary is more than 5%, it shall take the following procedures:

C.3.1.1 USE capillary to calibrate two adjacent flowmeters.

C.3.1.2 If both readings are relatively high, CHECK the cleanliness of the flowmeter and rotor; CLEAN them if necessary.

C.3.1.3 If both readings are relatively low, CHECK whether the system is clogged (such as hose distortion).

C.3.1.4 If the both readings are inconsistent, OR the fault cannot be determined based on C.3.1.2 and C.3.1.3, USE the 1.47 kPa pressure bubble meter or other devices to calibrate the flowmeter.

C.3.1.5. If it is judged based on 3.1.4 that the flowmeter or capillary is damaged, it shall be replaced.

C.3.2 Rotor flowmeter calibration by soap bubble meter

C.3.2.1 Soap bubble meter (Figure C.1) and related testing apparatus:

- Glass bottle of 1 L capacity;

- Volume meter, with 100 mL, 250 mL and 1500 mL scale; different scale range can be obtained through changing the volume meter;

two scales of the calibrated volume, expressed in second. The measurement range of the selected volume meter shall make the measurement time exceed 30 s; REPEAT measuring the airflows of 6 points, and RECORD the atmospheric pressure at that time.

C.3.2.3 Calculation

From each measurement time and measurement volume, CALCULATE the accurate air flow (in milliliters) per minute. CHECK whether the flowmeter reading is within 5% of this flow rate; if not, CHECK the flowmeter operation. If necessary, it may draw the calibration drawing. Based on each measurement time and measurement volume, USE the equation (C.1) to correct the air flow rate.

$$q = p \times V \times 60/102.8 \times t = 0.584 p \times V/t \qquad \cdots\cdots (C.1)$$

Where:

q - Air flow, in the unit of milliliters per minute (mL/min);

p - The sum of the actual atmospheric pressure (water column) and the pressure gauge, in kilopascals (kPa), calibrated to 102.8 kPa [the sum of the normal atmospheric pressure (101.3 kPa) and the operating pressure (1.47 kPa) at 23 °C];

V - Volume of the volume meter, in the unit of milliliters (mL);

t - The time required for the soap bubble to pass the two scales of the volume meter, in the unit of seconds (s).

C.3.3 Capillary calibration

Between the flowmeter outlet and the soap bubble meter's A point, CONNECT the capillary; REMOVE the hose from the top of the control valve and volume meter.

In accordance with C.3.2.2, MEASURE the time required for the soap bubbles to pass; in accordance with C.3.2.3, CALCULATE the air flow rate (new instruments are equipped with standard pore plates for the purpose of flow rate calibration).

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