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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 47684-2026

**Bioinspired liquid gating technology - Test method for
transmembrane pressure**

仿生液体门控技术 跨膜压强测试方法

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6 Test Conditions

Unless otherwise specified, the testing environment should be.

---Pressure. Complies with the standard atmospheric pressure of GB/T 45846;

---Temperature. $25^{\circ}\text{C}\pm 5^{\circ}\text{C}$;

---Relative humidity. $(50\pm 10)\%$.

7 Preparation of the liquid valve system

7.1 Porous Solid Membrane Materials The preparation process for porous solid membrane materials is as follows:

a) Select. 1) Thickness. Should be a flat film of $10\mu\text{m}\sim 1000\mu\text{m}$; 2) Material. It should be an inorganic material, an organic material, or a hybrid material. Commonly used membrane materials are listed in Table 1. 3) Aperture. should be $0.1\mu\text{m}\sim 100\mu\text{m}$; 4) Dimensions. should be consistent with the dimensions of the sealing elastomer, the contact surface should be flat and wrinkle-free, and the sample should be concentric with the sealing elastomer.

b) Cleaning. 1) The cleaning solution should be distilled water that meets or exceeds the laboratory grade III standard as required by GB/T 6682, with a purity of 95%. Organic reagents such as methanol, ethanol, acetone, n-hexane, petroleum ether, or mixtures thereof, and cleaning solutions. It should not chemically react with porous solid membrane materials and should not cause the porous solid membrane materials to swell; 2) Immerse the porous solid membrane material to be tested in the cleaning solution and clean the surface of the material using ultrasonic cleaning technology; 3) Wrap the cleaned porous solid membrane material in a clean, soft, lint-free cloth and let it air dry naturally in a clean bench, or use a clean, soft cloth to dry it. Dry air or inert gas is used to gently blow away any residual cleaning fluid from the surface and pores.

7.2 Functionally Gated Liquid Materials Based on the requirements of the experimental project, select or prepare a porous solid membrane material that exhibits flow characteristics under the test conditions and can fully wet and stabilize the membrane. The functional gated liquid material is used to fill the internal cavity. Commonly used functional

gated liquid material categories are shown in Table 2.

7.3 Transfer Fluid The transport fluid should be immiscible with the functionally gated liquid material, and the affinity between the transport fluid and the porous solid membrane material should be lower than that of the functionally gated liquid material. The affinity between gated liquids and porous solid membrane materials, and the types of transported fluids are as follows:

---Gas. Types include. air, nitrogen, argon, oxygen, carbon dioxide, sulfur dioxide, hydrogen sulfide, ammonia, formaldehyde, and mixtures thereof. According to the test requirements, obtain the gas and fill it into a syringe. Harmful gases should be tested in a well-ventilated environment. Released in accordance with GB 16297.

---Liquid. Commonly used fluid transfer materials are listed in Table

2. Obtain the liquid according to the experimental requirements and fill it into the syringe.

8 System stability assessment

8.1 Calculation Before conducting the transmembrane pressure test, the liquid gate system should be calculated and judged to determine whether it is in a thermodynamically stable state according to formulas (1) and (2).

8.2 Judgment Based on the principle of minimum energy, the thermodynamic stability of the liquid-valve system is determined as follows:

---When $\Delta E_1 \leq 0$ or $\Delta E_2 \leq 0$, it is a thermodynamically unstable state, and the functionally gated liquid material or porous solid membrane should be replaced. Material;

---When $\Delta E_1 > 0$ and $\Delta E_2 > 0$, it is a thermodynamically stable state, and transmembrane pressure testing can be performed.

9. Test Steps Follow these steps to perform the test.

a) Preparation of liquid-gated membranes. 1) Completely immerse the porous solid membrane material in the functionally gated liquid material for at least 2 minutes; 2) Remove the liquid-gated membrane and remove excess functionally gated liquid material from the surface of the porous solid membrane until there is no obvious liquid level on the surface. A protrusion.

b) Prepare the instruments and equipment and connect the pipelines according to the requirements of Chapter 5.

c) According to the device diagram of the clamping system in Appendix A, install the liquid gated membrane into the clamp and connect the membrane clamping system to the pipeline.

d) Connect the power cord, turn on the device switch, start the test software in the display

unit interface, and set the test parameters (sampling interval, test...). The sampling interval should be set to 1 second for parameters such as time and pressure supply system operating parameters (flow rate, etc.).

e) As the test progresses, the system is gradually pressurized, and transmembrane pressure tests are performed within the accuracy class of the pressure sensor until the current-time curve is obtained. The line reaches its peak value and stabilizes [stable state means that the fluctuation range of the current does not exceed $\pm(\text{accuracy class \%} \times \text{output current range})$]. Example. A pressure sensor with an output current of 4mA~20mA, a measuring range of 0kPa~100kPa, and an accuracy class of 0.5, exhibiting a current fluctuation range. $=\pm(0.5\% \times 16\text{mA})=\pm 0.08\text{mA}$.

g) Save and record the test data.

h) Turn off the instrument and equipment and disconnect the connecting pipelines.

10. Experimental Data Processing Convert the test current value into a pressure value according to formula (3).

11 Test Report The test report should include the following content; see Appendix D for a sample test report.