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**Nonwovens - Test method for porosity**

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### 1 Scope

GB/T 42697-2023 measures the porosity of nonwoven fabric - the fraction of its volume that is air rather than fibre. It is the property that governs what a nonwoven is for. Filtration media, surgical gowns and masks, geotextiles, wipes, absorbent cores and battery separators are all selected on how much they let through and how much they hold, and both follow from porosity. Because a nonwoven has no regular structure, unlike a woven fabric where the geometry is known, porosity cannot be calculated from construction data and has to be measured. This document describes a test method for the porosity of nonwovens by two routes: the mass-density method, which compares the fabric's bulk density with the density of the fibre it is made from, and the true volume method, which measures the solid volume directly. Having both matters because they are sensitive to different things, and a composite or coated material may need the second. It applies to all types of nonwovens except lofty or bulky ones, where the thickness measurement the calculation rests on is not reliable. It is written for nonwoven manufacturers, for the filtration, medical and geotextile industries that specify porosity, and for testing laboratories.

This document describes a test method for testing the porosity of nonwoven fabrics by using the mass-density method and the true volume method. This document applies to all types of nonwovens except fluffy nonwovens.

### 2 Normative references

The following documents contain the provisions which, through normative reference in this document, constitute the essential provisions of this document. For the dated referenced

documents, only the versions with the indicated dates are applicable to this document; for the undated referenced documents, only the latest version (including all the amendments) is applicable to this document.

GB/T 6529 Textiles - Standard atmospheres for conditioning and testing

GB/T 24218.1 Textiles - Test methods for nonwovens - Part 1: Determination of mass per unit area

GB/T 24218.2-2009 Textiles - Test methods for nonwovens - Part 2: Determination of thickness

### 3 Terms and definitions

The following terms and definitions apply to this document.

3.1 true volume The absolute volume after all internal void is removed.

3.2 apparent volume The volume obtained by multiplying the thickness and area of the sample.

3.3 porosity The percentage of nonwoven pore volume to apparent volume.

### 4 Principles

Method A (mass-density method): For single-component nonwoven fabrics with known fiber density, or multicomponent nonwoven fabrics with known density and content of each fiber, the true volume of the sample is calculated by the measured sample mass and the known fiber density; at the same time, the thickness of the sample is measured under a specified pressure and its apparent volume is calculated; then, the porosity of the sample is calculated by the true volume and apparent volume. Method B (true volume method): For nonwoven fabrics with unknown fiber density or content, according to the ideal gas law ( $PV=nRT$ ) of small molecule inert gases under certain conditions, the true volume of the sample can be determined by the measurement of the change in gas volume before and after the sample is placed in the sample chamber; then, the apparent volume is calculated by the thickness of the sample measured under the specified pressure, and finally the true density and porosity of the sample are obtained.

### 5 Instruments and equipment

5.1 Thickness tester It shall comply with the requirements of

5.1 in GB/T 24218.2-2009.

5.2 True volume tester The schematic diagram of the true volume tester is shown in Figure 1, which meets the following requirements:

- a) High-purity compressed nitrogen source: It can provide stable high-purity nitrogen (purity reaches 99.999%), and the pressure can be adjusted according to test needs;
- b) Sample chamber: It has good air tightness and the volume VC is  $3 \times 10^4 \text{ mm}^3 \sim 1.5 \times 10^6 \text{ mm}^3$ , accurate to  $100 \text{ mm}^3$ ;
- c) Air pressure sensor: It is connected to the sample chamber and has an accuracy of  $0.01 \text{ psi}$ ;
- d) Additional chamber: Its volume VA is provided by the instrument manufacturer and accurate to  $100 \text{ mm}^3$ ; it can be connected to each other through solenoid valves, and be connected to the sample chamber through a solenoid valve;
- e) Solenoid valve: It has good air tightness; its opening/closing can be controlled 1) psi is a non-statutory unit of measurement,  $1 \text{ psi} \sim$

$6.89 \text{ kPa}$ . The sample shall be cut at least  $100 \text{ mm}$  away from the edge of the cloth; smooth the cloth gently and then take the sample at a uniform area; avoid deforming the sample due to forceful stretching.

7 Conditioning and testing environment The standard atmosphere for conditioning and testing shall be in accordance with the provisions of GB/T 6529.

## 8 Test steps

8.1 Thickness test For conventional nonwoven fabrics, carry out the test according to Method A in GB/T 24218.2-2009. The test pressure is

$0.1 \text{ kPa}$ . Use a thickness tester to measure the thickness  $t$ , accurate to

$0.01 \text{ mm}$ . After negotiation between the relevant parties, the thickness can be measured directly with a ruler or measured through other pressure, and the specific methods and parameters shall be noted in the report.

8.2 Method A (mass-density method) Determine the mass  $w$  per unit area of the sample according to GB/T 24218.1. According to the fiber density and content of each component in the sample, calculate the porosity of the sample according to 9.1.

### 8.3 Method B (true volume method)

8.3.1 Measure the transverse length and longitudinal length of each sample separately, accurate to  $1 \text{ mm}$ .

8.3.2 Roll the sample into a roll and put it into the sample chamber, close the sample chamber, and open the solenoid valve 2# and the solenoid valve 3# shown in Figure 1; open the nitrogen source and the solenoid valve 1# to allow nitrogen to enter and clean the sample chamber and the additional chamber, and the cleaning time is at least 2 minutes.

8.3.3 Close the solenoid valve 1# and set the air pressure in the sample chamber and additional chamber to zero point.

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