



Glossary of membrane terms

AIRFLOW

The amount of air that can flow through a filter is affected by the pressure applied, the porosity of the filter, the filter area and the amount of contamination in the sample.

Millipore expresses airflow rate as liters per minute at a given pressure.

BUBBLE POINT

A simple, non destructive integrity test in which air is forced through the pores of a wet filter. Liquid is held within the pores by surface tension. The minimum pressure required to force air out of the pores is a measure of the capillary diameter. A bubble point significantly lower than the manufacturer's specification indicates damage to the membrane, ineffective seals, a system leak or the presence of residual fluid on the membrane with a surface tension lower than water.

DEPTH FILTER

Random matrix of fibers bonded to form a complex maze of flow channels. Removes contaminants by entrapment in, or adsorption to, the filter matrix. The irregular, poorly defined structure makes it impossible to quantify retention characteristics (i.e., the pore size). Instead, depth filters are given nominal ratings after fabrication. As a rule, a depth filter will retain 98% of all particles larger than its nominal rating. Contrast to *Screen Filter*.

EXTRACTABLES

In some cases, the surfactants, binders, or other substances used to manufacture filter materials can leach into a fluid as it is being filtered, thereby contaminating the fluid. If extractables are a concern, the filter might be rinsed prior to filtration.

GURLEY NUMBER

It is the volume flow rate of air at a fixed pressure difference through a fixed area of sample, and thus indicates the resistance to gas flow

HYDROPHILIC

Hydrophilic filters can be wet with water or almost any other liquid. Contrast with Hydrophobic.

HYDROPHOBIC

Hydrophobic filters repel water. They cannot be wet by aqueous solutions without high pressure or first wetting them with alcohol or another liquid with a low surface tension. Hydrophobic filters are used for venting and gas filtration. Contrast with hydrophilic.

INTEGRITY TESTS

Tests that confirm the integrity of a membrane filter or filter unit, especially sterilizing-grade filters. Can be performed before or after filtration. See *Bubble Point*.

PYROGENICITY

Pyrogens are the substances that cause fever in humans. Materials used to filter injectable drugs must be non-pyrogenic as determined by tests such as the Limulus Amoebocyte Lysate (LAL) test.

SCREEN FILTER

Screen (membrane) filters retain particles on their surface. Their structure is typically uniform and continuous with a pore size that has been precisely defined during manufacture. Screen filters have quantitative, or absolute, retention ratings. Contrast with Depth Filter.

THROUGHPUT

As material is trapped by a membrane filter, its pores begin to plug and flow rate decreases. A membrane with high through-put will have less flow rate decay over time than a low throughput filter.

WATER BREAKTHROUGH (INTRUSION)

The amount of pressure needed to force water through a hydrophobic filter. An indication of a membrane's effectiveness as an aqueous barrier.

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BED VOLUME

Bed volume is determined by measuring the water holding capacity of a membrane. A piece of membrane of a defined area is weighed and then wet with water, either by immersion or by allowing the water to wick through it. The membrane's dry weight is subtracted from its wet weight to determine the weight of the water in the membrane and that weight is converted to $\mu\text{L}/\text{cm}^2$.

CAPILLARY (LATERAL) FLOW TIME

Capillary flow time is the number of seconds it takes for water to travel a given distance along a membrane. This is measured by cutting a membrane strip to a defined length. The width of the membrane is unimportant for this test.

PORE SIZE

Pore size refers to the diameter of a membrane's largest pore, which corresponds to the largest particle that can be expected to pass through the membrane. Although pore size can be measured using a bubble point test, this test does not indicate the distribution or orientation of the pores.

SURFACE AREA

There are two complementary ways to measure the surface area of a membrane. The internal surface area (BET surface area) of a membrane is measured using the method of Brunauer, Emmett and Teller (J. Am. Chem. Soc. 60, 309, 1938). This method determines the total surface area (m^2) per gram of material by coating the membrane with nitrogen and desorbing it. This BET surface area ($\text{m}^2/\text{total}/\text{g}$) can then be multiplied by the basis weight of the membrane ($\text{g}/\text{m}^2/\text{frontal}$) to determine the surface area ratio (SAR; $\text{m}^2/\text{total}/\text{m}^2/\text{frontal}$). The SAR is a measure of the amount of total surface area per unit of frontal area of membrane (for example, how much total surface area is contained in a square centimeter of membrane).

PROTEIN (IgG) BINDING CAPACITY

To determine IgG binding capacity, membrane discs with a known diameter are immersed in a solution of 1 mg/mL goat- γ -globulin, 0.1 $\mu\text{Ci}/\text{mL}$ 125 I-goat IgG in phosphate-buffered saline (PBS) for 2 hours with agitation. The discs are then washed three times in PBS, and radioactivity remaining on the membranes is determined and converted to $\mu\text{g}/\text{cm}^2$.

SURFACE QUALITY

Surface quality encompasses many visual characteristics, such as scratches, particles, pinholes, and nitrocellulose powder on the membrane surface. "Stucco" is a term used to describe a surface that is rough like stucco or sandpaper. Depending on the severity of these characteristics, they can detrimentally affect an assay's performance. It's important for membrane manufacturers and assay developers to develop specification limits for surface quality characteristics.

TENSILE STRENGTH AND ELONGATION

These measurements are determined by applying force to a piece of membrane of defined size and determining the change in length at the point of breakage (elongation) and the force required to break the membrane (tensile strength).

WATER FLOW TIME

Water flow time is the number of seconds it takes for a specified volume to flow through a membrane. A membrane disc (i.e., 47 mm) is placed in a holder and water (i.e., 500 mL) is filtered through the disc. The time for the entire volume of water to filter through is recorded. For hydrophobic membranes, a low surface tension solvent, typically methanol, is used in place of water.

WETTABILITY

Wettability refers to the time it takes for a membrane filter to become completely wet when applied to the surface of the testing solution.

