MILLIPORE

Product Selection Guide

Microfiltration Membranes

Microfiltration Membranes for Filtration and Venting Applications

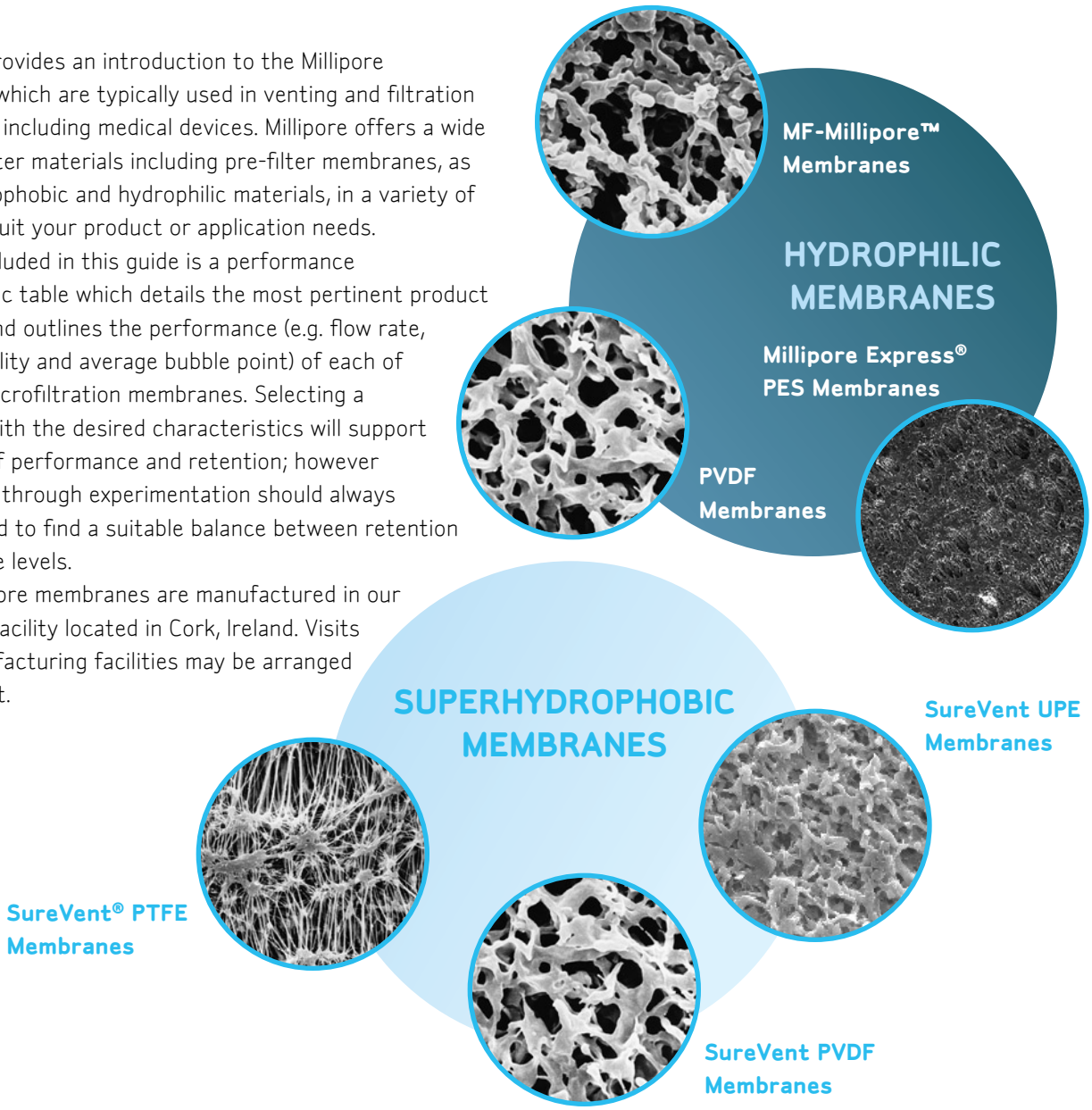
Microfiltration Membranes for Filtration and Venting

Microfiltration (MF) is the process of separating streams (i.e. air or liquid) from fluids. The primary basis for separation are particles ranging from 0.1 µm to 5 µm.

This guide provides an introduction to the Millipore membranes which are typically used in venting and filtration applications, including medical devices. Millipore offers a wide variety of filter materials including pre-filter membranes, as well as hydrophobic and hydrophilic materials, in a variety of formats to suit your product or application needs.

Also, included in this guide is a performance characteristic table which details the most pertinent product attributes and outlines the performance (e.g. flow rate, biocompatibility and average bubble point) of each of Millipore's microfiltration membranes. Selecting a membrane with the desired characteristics will support high levels of performance and retention; however optimization through experimentation should always be conducted to find a suitable balance between retention and flow rate levels.

All Millipore membranes are manufactured in our world class facility located in Cork, Ireland. Visits to our manufacturing facilities may be arranged upon request.



HYDROPHILIC MEMBRANES

Typical medical filtration applications for hydrophilic membranes include:

- IV therapy
- Ophthalmic
- Drug preparation
- Blood, plasma
- Irrigation
- Clinical reagents

MF-Millipore Membrane

- Mixed esters of cellulose (MCE)
- Allows for high flow rate and effective retention of microorganisms.

PVDF Membrane

- Polyvinylidene fluoride (PVDF)
- Millipore's unique manufacturing process makes it the lowest protein binding membrane filter available.
- Available in hydrophilic, hydrophobic and cationic forms.

Millipore Express PES Membrane

- Surface-modified polyethersulfone (PES)
- Unique pore structures allow fast flow and less membrane clogging.
- Has higher flow and throughput than comparable membranes with the same pore size.

SUPERHYDROPHOBIC MEMBRANES

Typical medical device applications for hydrophobic membranes include:

- Bag and tubing vents
- Vial, pump and IV vents
- Transducer protection
- Vent caps
- Insufflation filters
- Anesthesia gas monitoring

SureVent PTFE Membrane

- Polytetrafluoro-ethylene
- Material is highly resistant to most chemicals.
- Available with polyethylene or polypropylene support material.

SureVent PVDF Membrane

- Super hydrophobic polyvinylidene fluoride (PVDF)
- Membrane is treated with a validated process that makes it one of the most phobic materials available.

SureVent UPE Membrane

- Ultrahigh molecular weight polyethylene
- SureVent UPE is highly resistant to most chemicals and seals well to low durometer plastics.

For a complete listing of our membrane products, please visit **www.millipore.com/oemproducts.**

PERFORMANCE CHARACTERISTICS

Mixed Cellulose Ester (MCE) Membranes (Hydrophilic)

Membrane Name	MF-Millipore	MF-Millipore	MF-Millipore	MF-Millipore	MF-Millipore
Pore Size	0.025 µm	0.05 µm	0.1 µm	0.22 µm	0.3 µm
Membrane Material	MCE	MCE	MCE	MCE	MCE
Support Material	None	None	None	None	None
Average Bubble Point	306 psi	255 psi	204 psi	51 psi	36 psi
Average Thickness	105 µm	105 µm	105 µm	150 µm	150 µm
Flow Time (at 10 psi)	0.15 µL/min/cm^2	0.74 µL/min/cm^2	1.5 µL/min/cm^2	18 µL/min/cm^2	32 µL/min/cm^2
Membrane Code	VSWP	VMWP	VCWP	GSWP	PHWP

PVDF, PES Membranes (Hydrophilic)

Membrane Name	Hydrophilic PVDF	Hydrophilic PVDF	Hydrophilic PVDF	Hydrophilic PVDF	Hydrophilic PVDF	Hydrophilic PVDF
Pore Size	0.1 µm	0.22 µm	0.45 µm	0.65 µm	1.0 µm	1.0 µm
Membrane Material	PVDF	PVDF	PVDF	PVDF	PVDF	PVDF
Support Material	None	None	None	None	None	None
Bacterial Retention	*B. diminuta* challenge with 10^7 org/cm^2	*B. diminuta* challenged with 10^7 org/cm^2	N/A	N/A	*B. diminuta* challenged with 10^7 org/cm^2	*B. diminuta* challenged with 10^7 org/cm^2
Average Bubble Point	80 psi	56 psi	25 psi	18 psi	11 psi	10.5 psi
Biocompatability	Passes the USP Biological test for plastics, Class VI	Passes the USP Biological test for plastics, Class VI	N/A	N/A	N/A	N/A
Average Thickness	102 µm	125 µm	115 µm	115 µm	115 µm	115 µm
Flow Time (at 13 psi)	≤ 2.5 mL/min/cm^2	7.2 mL/min/cm^2	29 mL/min/cm^2	69 mL/min/cm^2	91 mL/min/cm^2	87 mL/min/cm^2
Membrane Code	VVPP	GVPP	HVPP	DVPP	CVPP	BVPP

PVDF Membranes (Hydrophobic and SuperHydrophobic)

Membrane Name	Hydrophobic PVDF	Hydrophobic PVDF	Hydrophobic PVDF	Hydrophobic PVDF
Pore Size	0.1 µm	0.22 µm	0.45 µm	0.65 µm
Membrane Material	PVDF	PVDF	PVDF	PVDF
Support Material	None	None	None	None
Average Bubble Point	28 psi (methanol)	21 psi (methanol)	10 psi (methanol)	6 psi (methanol)
Average Thickness	107 µm	125 µm	115 µm	115 µm
Water Intrusion Pressure	≥ 50 psi	≥ 30 psi	≥ 15 psi	≥ 8 psi
Air Flow	≤ 3.5 mL/min/cm^2 at 13 psi	≤ 6.4 mL/min/cm^2 at 13 psi	15.1 mL/min/cm^2 at 13 psi	68 mL/min/cm^2 at 13 psi
Phobicity	Hydrophobic	Hydrophobic	Hydrophobic	Hydrophobic
Membrane Code	VVHP	GVHP	HVHP	DVHP

PTFE Membranes (Hydrophobic)

Membrane Name	SureVent PTFE	SureVent PTFE	SureVent PTFE	SureVent PTFE	SureVent PTFE	SureVent PTFE
Pore Size	0.22 µm	0.22 µm	0.45 µm	0.45 µm	1.0 µm	1.0 µm
Membrane Material	PTFE	PTFE	PTFE	PTFE	PTFE	PTFE
Support Material	Polypropylene	Polyester	Polypropylene	Polyester	Polypropylene	Polyester
Average Bubble Point	≥ 32 psi (100% IPA)	≥ 32 psi (100% IPA)	19 psi (100% IPA)	19 psi (100% IPA)	≥ 6 psi (100% IPA)	≥ 6 psi (100% IPA)
Average Thickness	275 µm	150 µm	254 µm	127 µm	275 µm	127 µm
Water Intrusion Pressure	≥ 60 psi	≥ 60 psi	> 40 psi	> 40 psi	≥ 10 psi	≥ 10 psi
Air Flow	5 L/ min/cm^2	5 L/min/cm^2	10 L/min/cm^2	10 L/min/cm^2	15 L/min/cm^2	15 L/min/cm^2
Phobicity	Hydrophobic	Hydrophobic	Hydrophobic	Hydrophobic	Hydrophobic	Hydrophobic
Flow Time (at 10 psi)	11 mL/min/cm^2	11 mL/min/cm^2	25 mL/min/cm^2	25 mL/min/cm^2	50 mL/min/cm^2	50 mL/min/cm^2
Membrane Code	GPTFEPP	GPTFEPE	HPTFEPP	HPTFEPE	BPTFEPP	BPTFEPE

MF-Millipore	MF-Millipore	MF-Millipore	MF-Millipore	MF-Millipore	MF-Millipore	MF-Millipore
0.45 µm	0.65 µm	0.8 µm	1.2 µm	3 µm	5 µm	8 µm
MCE	MCE	MCE	MCE	MCE	MCE	MCE
None	None	None	None	None	None	None
31 psi	17 psi	14 psi	11 psi	10 psi	8 psi	6 psi
150 µm	150 µm	150 µm	150 µm	150 µm	135 µm	135 µm
60 µL/min/cm^2	140 µL/min/cm^2	190 µL/min/cm^2	270 µL/min/cm^2	320 µL/min/cm^2	580 µL/min/cm^2	640 µL/min/cm^2
HAWP	DAWP	AAWP	RAWP	SSWP	SMWP	SCWP

Hydrophilic PVDF	Hydrophilic PVDF	Millipore Express PLUS	Millipore Express PLUS	Millipore Express	Millipore Express PLUS
5 µm	0.22 µm (positively charged)	0.1 µm	0.22 µm	0.22 µm	0.45 µm
PVDF	PVDF	Modified PES	Modified PES	Modified PES	Modified PES
Polyester web	None	None	None	None	None
N/A	N/A	*B. diminuta* challenged with 10^7 org/cm^2	*B. diminuta* challenged with 10^7 org/cm^2	*B. diminuta* challenged with 10^7 org/cm^2	N/A
4.5 psi	52 psi	≥ 40 psi	≤ 56.6 psi	55 psi	16.0 psi
Passes the USP Biological test for plastics, Class VI	Passes the USP Biological test for plastics, Class VI	Passes the USP Biological test for plastics, Class VI	Passes the USP Biological test for plastics, Class VI	Passes the USP Biological test for plastics, Class VI	Passes the USP Biological test for plastics, Class VI
120 µm	125 µm	110 µm	150 µm	160 µm	142 µm
193 mL/min/cm^2	5.8 mL/min/cm^2	5.6 mL/min/cm^2	15 mL/min/cm^2	12.5 mL/min/cm^2	24 mL/min/cm^2
SVPP	GVCP	VEPP	EIMF	TCMFE	HEMF

SureVent PVDF	SureVent PVDF	SureVent PVDF	SureVent PVDF	SureVent PVDF	SureVent PVDF
0.1 µm	0.22 µm	0.45 µm	0.65 µm	1.0 µm	5.0 µm
Modified PVDF	Modified PVDF	Modified PVDF	Modified PVDF	Modified PVDF	Modified PVDF
None	None	None	None	None	Polyester Nonwoven
N/A	N/A	N/A	N/A	N/A	N/A
115 µm	125 µm	115 µm	115 µm	115 µm	115 µm
≥ 73 psi	≥ 45 psi	≥ 25 psi	≥ 15 psi	≥ 7 psi	> 2 psi
≥ 0.3 slpm at 5 psi	> 0.4 slpm at 1 psi	≥ 1.1 slpm at 1 psi	≥ 0.6 slpm/cm^2 at 1 psi	≥ 5.0 slpm at 1 psi	N/A
SuperHydrophobic/ oleophobic	SuperHydrophobic/ oleophobic	SuperHydrophobic/ oleophobic	SuperHydrophobic/ oleophobic	SuperHydrophobic/ oleophobic	SuperHydrophobic/ oleophobic
VVSP	GVSP	HVSP	DVSP	BVSP	SVSP

UPE Membranes (Hydrophobic)

Membrane Name	SureVent UPE	SureVent UPE	SureVent UPE	SureVent UPE	SureVent UPE	SureVent UPE
Pore Size	0.05 µm	0.1 µm	0.2 µm	0.45 µm	0.65 µm	1.0 µm
Membrane Material	Ultra-high molecular weight polyethylene	Ultra-high molecular weight polyethylene	Ultra-high molecular weight polyethylene	Ultra-high molecular weight polyethylene	Ultra-high molecular weight polyethylene	Ultra-high molecular weight polyethylene
Support Material	None	None	None	None	None	None
Average Bubble Point	56 psi (100% IPA)	43 psi (100% IPA)	28 psi (100% IPA)	18 psi (100% IPA)	9 psi (100% IPA)	5 psi (100% IPA)
Average Thickness	67 µm	75 µm	75 µm	148 µm	110 µm	100 µm
Phobicity	Hydrophobic	Hydrophobic	Hydrophobic	Hydrophobic	Hydrophobic	Hydrophobic
Flow Time	1700 sec/ 500 mL IPA	1050 sec/ 500 mL IPA	450 sec/ 500 mL IPA	225 sec/ 500 mL IPA	95 sec/ 500 mL IPA	50 sec/ 500 mL IPA
Membrane Code	UPZP	UPVP	UPGP	UPHP	D0HP	UPBP

Membrane Sealing Methods

This section provides an overview of membrane sealing methods and key considerations when designing a sealing process.

HEAT SEALING

Heat is transferred through a die that is applied directly onto the materials being sealed. As the heat melts the substrate plastic, the pressure forces the softened plastic into the pore structure of the membrane and forms a bond between the materials. The sealing parameters of temperature, pressure and dwell time must be optimized for each process and material combination.

- Apply a low surface-energy coating to the heater head to minimize plastic build-up
- A transparent seal area generally indicates a complete seal
- Simple geometries such as a round seal area yield better results
- Seal membranes to substrate materials with similar or lower melting points
- A minimum seal width of 0.05″ (1.25 mm) is recommended
- Seal integrity can be tested using low air or water pressure in the reverse flow direction

MEMBRANE SEALING PROPERTIES*

PVDF MEMBRANE

HEAT SEALING

Housing Material	Temperature Range	Pressure	Dwell Time
Acrylic	390 °F – 440 °F	35 psi	4 sec
Co-polyester	390 °F – 450 °F	35 psi	4 sec
Polyethylene	420 °F – 435 °F	35 psi	3 sec
Polypropylene	420 °F – 440 °F	35 psi	3 sec
PVC	375 °F – 475 °F	35 psi	3 sec

ULTRASONIC WELDING

Can be sealed to a variety of plastics, including co-polyester, PVC, polyethylene and polypropylene. Ultrasonic welding to acrylic is not recommended.

SUREVENT PTFE MEMBRANE

HEAT SEALING

Housing Material	Temperature Range	Pressure	Dwell Time
Acrylic	435 °F – 500 °F	40 psi	3 sec
Co-polyester	435 °F – 500 °F	40 psi	3 sec
Polyethylene	430 °F – 470 °F	35 psi	2 sec
Polypropylene	430 °F – 470 °F	35 psi	2 sec
PVC	390 °F – 500 °F	45 psi	4 sec

ULTRASONIC WELDING

Recommended with co-polyester, PVC, polyethylene, and polypropylene. Can also be sealed to acrylic if membrane has polyester backing. Should not be ultrasonically sealed to acrylic if membrane has a polypropylene backing.

A superior seal is formed when the PTFE laminates are sealed between two pieces of plastic, rather than when the horn comes in direct contact with the membrane.

* The parameters presented are guidelines only.

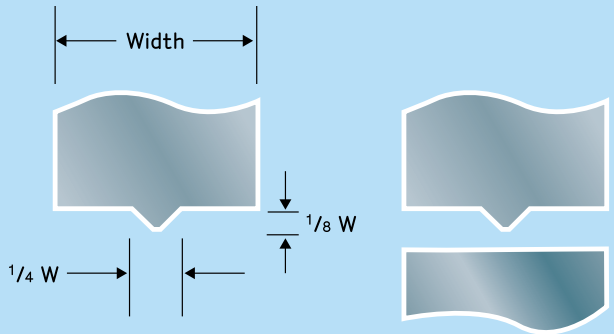
ULTRASONIC WELDING

Ultrasonic welding is the joining of thermoplastics through the use of heat generated from high frequency mechanical motion or vibrations. The vibrations are created in a vertical direction; the heat is generated from the repeated collision of the materials.

- Use a welder with high frequency and low amplitude (40 KHz) to reduce damage to delicate materials such as membranes
- Avoid excess vibration
- Proper horn, nest, and part design are crucial to achieve a good seal
- Use energy directors to reduce the required weld energy
- Cutting and sealing can occur with one pass of the welder

ASSEMBLY AND JOINING

Ultrasonic Bonding



Recomended proportional ratios for energy director design.

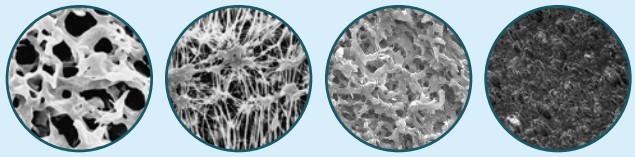
SUREVENT UPE MEMBRANE

HEAT SEALING

Housing Material	Temperature Range	Pressure	Dwell Time
Acrylic	Not recommended		
Co-polyester	380 °F – 400 °F	35 psi	3 sec
Polyethylene	360 °F – 380 °F	35 psi	2 sec
Polypropylene	360 °F – 380 °F	35 psi	2 sec
PVC	320 °F – 380 °F	45 psi	4 sec

ULTRASONIC WELDING

Recommended with polyethylene and polypropylene. The membrane does not readily seal to acrylic, co-polyester, or PVC, but UPE can still be incorporated into devices assembled with these plastics using the proper mechanical bonding techniques. A list of techniques for bonding chemically incompatible materials is available from welding equipment manufacturers.



PVDF PTFE UPE PES

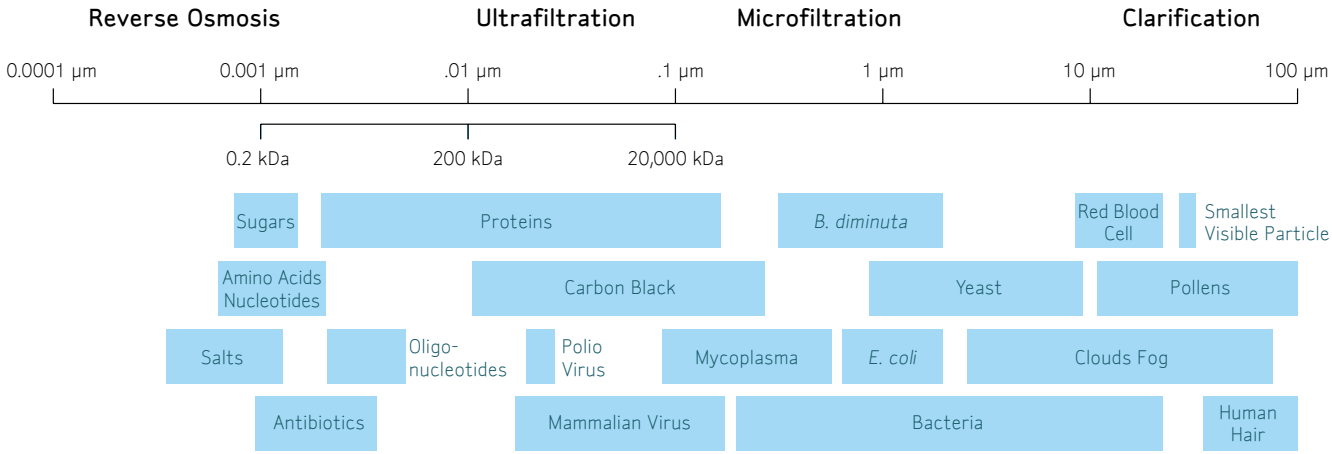
STERILIZATION COMPATIBILITY

	Autoclave	Ethylene Oxide	Gamma Irradiation
PVDF	●	●	●
PTFE	○	●	○
UPE	○	●	●
PES	●	●	●

● = Recommended
○ = Not Recommended

COMPARISON OF MICROFILTRATION WITH OTHER COMMONLY USED MEMBRANE SEPARATION TECHNIQUES

This table is an overview of common filtrates and particles with the recommended filtration/separation technology based on the size and/or type of filtrate or particle. Millipore offers a wide array of membrane products to support both your microfiltration and ultrafiltration needs.



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