

## MEMBRANE PRODUCTS SUMMARY

### High-Performance Membrane Products

Sepro manufactures and sells thirty-two different types of sheet ultrafiltration (UF), microfiltration (MF), nanofiltration (NF), and reverse osmosis (RO) membranes. These membranes display a range of performance characteristics for use in many applications. All are provided as rolls of dry membrane in the exact lengths, widths, and roll sizes best suited for customers.

Most UF and MF membranes are available on several backing materials, including those made with polyester and polypropylene. All of the membranes meet the U.S. FDA requirements for repeated-use food contact. Should an application of interest not be listed in the tables below, please contact Sepro for assistance.

### ULTRAFILTRATION AND MICROFILTRATION MEMBRANES

- In the tables below, membranes are characterized in terms of pure water flux (L/m<sup>2</sup>-h, or Lmh) per unit driving pressure (bar) at pH 7.5 and 25°C, or “normalized water flux”. Values can vary  $\pm$  15% for individual tests.
- Pore sizes for UF membranes are indirectly determined using “markers” having different molecular weights (Daltons) of poly(ethylene glycol) (PEG) or poly(vinyl alcohol) PVA at a concentration of 2 g/L in pure water, indicated below as “nominal marker rejection”.
- Pore sizes for membranes are also determined directly by the mercury intrusion method.
- Microfiltration membranes are defined as those with an average pore size > 0.10  $\mu$ m.
- Normal limits are 150 psi (10 bar), 50°C, and pH 2-10 for continuous operation, and pH 1.5-11.5 at 50°C for short term cleaning.

### Polysulfone (PS) Membranes

TYPE	APPLICATIONS	NORMALIZED WATER FLUX (Lmh/bar)	MW of MARKER (Dalton)	NOMINAL MARKER REJECTION (%)
PS-20	<ul style="list-style-type: none"> <li>• Process water treatment</li> <li>• Wastewater treatment</li> <li>• Clarification Process water treatment</li> <li>• Wastewater treatment</li> <li>• Clarification</li> </ul>	900	20K PEG	95
PS-30*		1,200	20K PEG	96
PS-35*		1,600	20K PEG	98

\* Indicates that these membranes are hydrophilic

### Poly(vinylidene fluoride) (PVDF) Membranes

TYPE	APPLICATIONS	NORMALIZED WATER FLUX (Lmh/bar)	MW of MARKER (Dalton)	NOMINAL MARKER REJECTION (%)
PVDF-200	<ul style="list-style-type: none"> <li>• Process water treatment</li> <li>• Electrocoat paint recovery</li> <li>• Wastewater treatment</li> <li>• Textile size recovery</li> <li>• Resource recovery</li> <li>• Clarification</li> </ul>	175	75K PVA	97
PVDF-350		300	75K PVA	96
PVDF-400		450	75K PVA	95
PVDF-700		650	75K PVA	93
PVDF-400B		1,000	75K PVA	96

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### Polyacrylonitrile (PAN) Membranes

TYPE	APPLICATIONS	NORMALIZED WATER FLUX (Lmh/bar)	MW of MARKER (Dalton)	NOMINAL MARKER REJECTION (%)
PAN-50	<ul style="list-style-type: none"> <li>Process water treatment</li> <li>Pervaporation substrates</li> <li>Wastewater treatment</li> <li>Oily feedwater treatment</li> <li>Wastewater membrane bioreactors</li> <li>Resource recovery</li> </ul>	140	20K PEG	85
PAN-200		300	20K PEG	80
PAN-350		800	20K PEG	80
PAN-400		900	20K PEG	75
PAN-400C/D		1,000	20K PEG	75
PAN-450		1,200	20K PEG	75

### Polyethersulfone (PES) Membranes

TYPE	APPLICATIONS	NORMALIZED WATER FLUX (Lmh/bar)	MW of MARKER (Dalton)	NOMINAL MARKER REJECTION (%)
PES-2	Recovery of <ul style="list-style-type: none"> <li>Proteins</li> <li>Gelatin</li> <li>Enzymes</li> <li>Whey protein</li> </ul>	30	6K PEG	98
PES-5		60	6K PEG	93
PES-10		90	10K PEG	93
PES-20		300	20K PEG	98
PES-900C/D		<ul style="list-style-type: none"> <li>Wastewater membrane bioreactors</li> </ul>	1,000	20K PEG

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### ULTRAFILTRATION AND MICROFILTRATION MEMBRANES

#### Microfiltration (MF) Membranes

TYPE	APPLICATIONS	NORMALIZED WATER FLUX (Lmh/bar)	PORE SIZE (µm)
PVDF-MFB	<ul style="list-style-type: none"> <li>Process water treatment</li> <li>Wastewater treatment</li> <li>Clarification</li> </ul>	1,800	0.2-0.4
PVDF-MF	<ul style="list-style-type: none"> <li>Suspended solids removal</li> <li>RO pretreatment</li> </ul>	10,000	0.5-0.7

#### Membrane Bioreactor (MBR) Membranes\*

TYPE	APPLICATIONS	NORMALIZED WATER FLUX (Lmh at 0.1bar)	MW of MARKER (Dalton)	NOMINAL MARKER REJECTION (%)
PAN-400C/D	<ul style="list-style-type: none"> <li>Wastewater membrane bioreactors</li> </ul>	200	20K PEG	75
PES-900C/D		100	20K PEG	98
MBR-100		1,900	Pore Size: 0.7-0.9 µm	
MBR-200		200	20K PEG	96

\* Municipal wastewater process flux ranges from 20-40 Lmh (12-24 gfd) at 0.1-0.3 bar for all four membranes.

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### High-Performance Membrane Products

#### NANOFILTRATION (NF) and REVERSE OSMOSIS (RO) MEMBRANES

- All are polyamide, thin-film composite membranes on a polyester backing with a polysulfone substrate.
- Membranes are characterized in terms of water flux (Lmh and gal/ft<sup>2</sup>-d or gfd) and rejection of salt solutes at the specified pressures.
- Membrane properties are normalized to 25°C (77°F) and pH 7.5.
- Normal operation limits of 1,200 psi (83 bar), 50°C (122°F) and pH 3-10; cleaning pH range at 50°C of pH 2-11.

#### Nanofiltration (NF) Membranes

TYPE	APPLICATIONS	TEST PRESSURE (psi/bar)	SOLUTE CONCENTRATION (mg/L)	SOLUTE	WATER FLUX (gfd/Lmh)	SOLUTE REJECTION (%)
NF-1	High multi-valent ion rejection	150/10.3	2,000	MgSO <sub>4</sub> NaCl	65/110	99.5 90.0
NF-2	High water flux Selective solute separation	150/10.3	2,000	MgSO <sub>4</sub> NaCl	80/135	97.0 50.0
NF-3	Selective solute separation High multi-valent ion rejection	150/10.3	2,000	MgSO <sub>4</sub> NaCl	25/42	99.0 60.0
NF-5	Selective solute separation High multi-valent ion rejection	150/10.3	2,000	MgSO <sub>4</sub> NaCl	52/88	99.9 46.0

#### Reverse Osmosis (RO) Membranes

TYPE	APPLICATIONS	TEST PRESSURE (psi/bar)	SOLUTE CONCENTRATION (mg/L)	SOLUTE	WATER FLUX (gfd/Lmh)	SOLUTE REJECTION (%)
RO-1	Low pressure	125/8.6	2,000	NaCl	30/50	98.0
RO-2	Medium pressure High water flux	225/15.5	2,000	NaCl	35/60	99.0
RO-3	Medium pressure	225/15.5	2,000	NaCl	25/42	99.0
RO-4	High pressure High solute rejection	800/55.2	32,800	NaCl	20/34	99.5
RO-6	High pressure Very high solute rejection	800/55.2	32,800	NaCl	17/29	99.8

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