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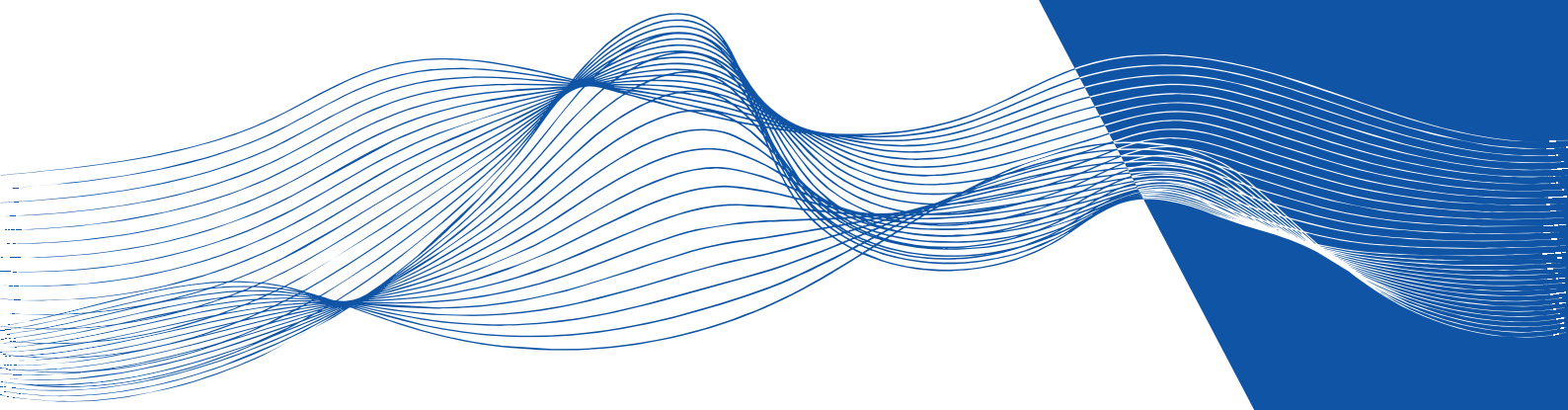
RO MEMBRANE

RO MEMBRANE

ADVANCE MEMBRANE TECHNOLOGY



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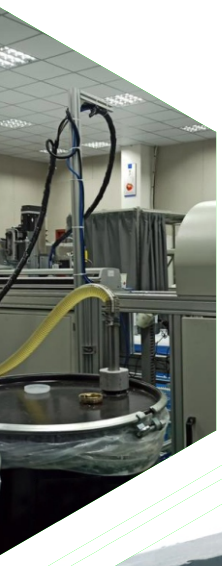


▶ Models and Parameters of Domestic, Industrial & Nanofiltration Membrane

No.	Membrane Type	Membrane Model	Stable Rejection Rate (%)	Concentration of testing Solution (ppm)	Operating Pressure psi(MPa)
1	Domestic Ro	TW 30-50	95-97	NaCl: 450	65(0.45)
2		TW 30-75	95-97		
3		TW 30-80	95-97		
4		TW 30-100	95-97		

Membrane Type	Model	Active Membrane Area $ft^2(m^2)$	Permeate Flow GPD(m^3/d)	Stable Rejection Rate (%)	Concentration of Solution (ppm) NaCl、$MgSO_4$	Operating Pressure psi(MPa)
LP	LP-4040	90(8.33)	2600(9.8)	99.2	NaCL: 1500	150(1.03)
XLP	XLP-8040	400(37.2)	9000(34)	98.5	NaCL: 1500	100(0.69)
	XLP-4040	90(8.33)	2300(8.7)	98.5		
ULP	ULP-8040	400(37.2)	12000(45.4)	99.2	NaCL: 1500	150 (1.03)
	ULP-4040	90(8.33)	2600(9.8)	99.2		
	ULP-8040HR	400(37.2)	10500(39.7)	99.4		
	ULP-4040HR	90(8.33)	2400(9.1)	99.4		
XFR	BWXFR-8040	400(37.2)	9500(35.9)	99.5	NaCL: 2000	225 (1.55)
	BWXFR-4040	90(8.33)	2300(8.7)	99.5		
BW	BW-4040	90(8.33)	2500(9.4)	99.5		
	BW-400	400(37.2)	10500(39.7)	99.5		
ULP Eco	ULP-4040	75(7.0)	2400(9.3)	99	NaCL: 1500	150(1.03)
	ULP-8040	370(34.5)	10000(37.7)	99		
Plus	LP-4040	90(8.33)	2600(9.8)	99.2	NaCL: 2000	150(1.03)
	ULP-8040	400(37.2)	12000(45.4)	99.2		
HSRO	HSRO-4040	90(8.33)	2650(10.0)	99.5	NaCL: 2000	150(1.03)
	HSRO-8040	400(37.2)	6500(24.6)	99.5		
SW	SW-8040HR	400(37.2)	6500(24.6)	99.8	NaCL: 32000	800(5.5)
	SW-8040MR	400(37.2)	7500(28.3)	99.75		
	SW-4040HR	85(7.9)	1500(5.7)	99.75		
	SW-4040MR	85(7.9)	1800(6.8)	99.7		
NF	NF30-8040	400(37.2)	14000(52.9)	≤30(NaCl) ≥97($MgSO_4$)	MgSO4: 2000 NaCl: 500	100(0.69)
	NF30-4040	85(7.9)	3200(12.1)			
	NF90-8040	400(37.2)	14500(54.8)	85-95(NaCl) ≥98($MgSO_4$)		
	NF90-4040	85(7.9)	3500(13.2)			

ⓘ **Note:** the temperature of Testing solution is 25 ±2.C, pH = 7-8, cross-flow rate is 0.45-0.50 m/s.

Domestic Membrane

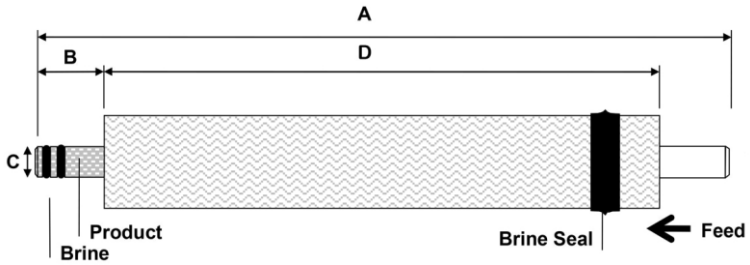
Features

POLYMEX reverse osmosis (RO) membranes for home drinking water treatment units are some of the most reliable and consistent elements in the industry. Advanced membrane technology and automated fabrication allow Polymex to precisely produce each and every element to tight, predefined specifications. Polymex's advanced and consistent RO element quality helps customers develop, and maintain brand recognition along with a reputation for building systems that reliably provide low impurity drinking water POLYMEX elements are shipped dry for convenient handling and long shelf-life.

Specifications and Parameters:

Model	Applied Pressure psig (bar)	Permeate Flow Rate GPD (l/h)	Stabilized Salt Rejection (%)
Polymex-50	50(3.4)	50(7.9)	95-97%
Polymex-75	50(3.4)	75(12)	95-97%
Polymex-80	50(3.4)	80(13)	95-97%
Polymex-100	50(3.4)	100(15.5)	95-97%

1. Permeate flow and salt rejection based on the following test conditions: 250 ppm softened tap water, 77°F (25°C), 15% recovery and the specified applied pressure.
2. Minimum salt rejection is 96.0%.
3. Permeate flows for individual elements may vary +/-20%



Dimensions – Inches (mm)	A	B	C	D
	11.74 (298)	1.17 (30)	0.68 (17)	9.4 (239)

Operating Limits and Conditions of Membrane Element:

Membrane Type	Polyamide Thin-Film Composite
Max. Feed Water Temperature	113° F (45°C)
Max. Operating Pressure	150 psig (10 bar)
Max. Feed Flow Rate	2.0 gpm (7.6 lpm)
pH Range, Continuous Operationa	2 – 11
Max. Feed Silt Density Index (SDI)	5
Free Chlorine Tolerance	< 0.1 ppm

○ Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty,

Low Pressure

▸ Membrane sheet:

The module was fabricated by ultra-low pressure polyamide membrane sheet, which is suitable for the feed solution below 3000 mg/L. The features of ULP elements are high rejection rate, low working pressure and high permeate flux, which is applicable to the municipal water and groundwater, residential drinking water, water supply in food and beverage, etc.

▸ Specifications and Parameters:

Model	Active Membrane Area $ft^2(m^2)$	Permeate Flow GPD (m3/d)	Stable Rejection Rate (%)	Min. Rejection Rate (%)
LP-4040	90(8.4)	2600(9.8)	99.2	99.0

▸ Standard Test Condition:

Concentration of Solution	Temperature (.C)	pH Value	Operating Pressure psi (MPa)	Recovery Rate(%)
1500ppm NaCl	25±2	7.5-8.0	150(1.03)	15±1

Notes: The permeate flow of single membrane element may vary with in±15%.

▸ Operating Limits and Conditions of Membrane Element:

Max. Working Pressure	600 psi (4.14MPa)
Max. Feed Water Temperature	45 °C
Max. Feed Water Flow	17.0m^3/h(8040), 3.6m^3/h(4040)
Max. Feed Water SDI_{15}	5.0
pH Range of Feed Water during Continuous Operation	2-11
pH Range of Feed Water during Chemical Cleaning	1-13
Max. Pressure Drop of Single Membrane Element	15psi(0.1Mpa)
Free Chlorine Tolerance	< 0.1mg/L

○ Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty,

Extra-low Pressure

▸ Membrane sheet:

The module was fabricated by extra-low pressure polyamide membrane sheet, which is suitable for the feed solution below 1500 mg/L. The features of XLP elements are high rejection rate, low working pressure and high permeate flux, which is applicable to the municipal water and groundwater, residential drinking water, water supply in food and beverage, etc.

▸ Specifications and Parameters:

Model	Active Membrane Area $ft^2(m^2)$	Permeate Flow GPD (m3/d)	Stable Rejection Rate (%)	Min. Rejection Rate (%)
XLP-8040	400(37.2)	9000 (34)	98.5	98.0
XLP-4040	90(8.33)	2300 (8.7)	98.5	98.0

▸ Standard Test Condition:

Concentration of Solution	Temperature (.C)	pH Value	Operating Pressure psi (MPa)	Recovery Rate(%)
1500ppm NaCl	25±2	7.0-8.0	100(0.69)	15±1

Notes: The permeate flow of single membrane element may vary with in±15%.

▸ Operating Limits and Conditions of Membrane Element:

Max. Working Pressure	600 psi (4.14MPa)
Max. Feed Water Temperature	45 °C
Max. Feed Water Flow	17.0m^3/h(8040), 3.6m^3/h(4040)
Max. Feed Water SDI_{15}	5.0
pH Range of Feed Water during Continuous Operation	2-11
pH Range of Feed Water during Chemical Cleaning	1-13
Max. Pressure Drop of Single Membrane Element	15psi(0.1Mpa)
Free Chlorine Tolerance	< 0.1mg/L

○ Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty,

Ultra-low Pressure

▸ Membrane sheet:

The module was fabricated by ultra-low pressure polyamide membrane sheet, which is suitable for the feed solution below 3000 mg/L. The features of ULP elements are high rejection rate, low working pressure and high permeate flux, which is applicable to the municipal water and groundwater, residential drinking water, water supply in food and beverage, etc.

▸ Specifications and Parameters:

Model	Active Membrane Area $ft^2(m^2)$	Permeate Flow GPD (m^3/d)	Stable Rejection Rate (%)	Min. Rejection Rate (%)
ULP-8040	400(37.2)	12000(45.4)	99.2	99.0
ULP-4040	90(8.33)	2600(9.8)	99.2	99.0
ULP-8040HR	400(37.2)	10500(39.7)	99.4	99.2
ULP-4040HR	90(8.33)	2400(9.1)	99.4	99.2

▸ Standard Test Condition:

Concentration of Solution	Temperature (.C)	pH Value	Operating Pressure psi (MPa)	Recovery Rate(%)
1500ppm NaCl	25±2	7.5-8.0	150(1.03)	15±1

Notes: The permeate flow of single membrane element may vary with in±15%.

▸ Operating Limits and Conditions of Membrane Element:

Max. Working Pressure	600 psi (4.14MPa)
Max. Feed Water Temperature	45 °C
Max. Feed Water Flow	17.0m^3/h(8040), 3.6m^3/h(4040)
Max. Feed Water SDI_{15}	5.0
pH Range of Feed Water during Continuous Operation	2-11
pH Range of Feed Water during Chemical Cleaning	1-13
Max. Pressure Drop of Single Membrane Element	15psi(0.1Mpa)
Free Chlorine Tolerance	< 0.1mg/L

○ Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty,

BRACKISH WATER & Extra Fouling Resistant Membrane

▸ Membrane sheet:

The membrane elements are applicable to the desalination of the water with salt concentration less than 10000 mg/L, such as surface water, ground water, wastewater with high organic foulants or micropollutants. The features of BW elements are high fouling resistance and high stability under chemical cleaning via the modification of the membrane sheet.

▸ Specifications and Parameters:

Model	Active Membrane Area $ft^2(m^2)$	Permeate Flow GPD (m^3/d)	Stable Rejection Rate (%)	Min. Rejection Rate (%)
BWXFR-8040	400(37.2)	10500(39.7)	99.5	99.3
BWXFR-4040	90(8.33)	2500(9.4)	99.5	99.3
BW-4040	90(8.33)	2300(8.7)	99.5	99.3
BW-400	400(37.2)	10500(39.7)	99.5	99.3

▸ Standard Test Condition:

Concentration of Solution	Temperature (.C)	pH Value	Operating Pressure psi (MPa)	Recovery Rate(%)
2000ppm NaCl	25±2	7.5-8.0	225(1.55)	15±1

Notes: The permeate flow of single membrane element may vary with in±15%.

▸ Operating Limits and Conditions of Membrane Element:

Max. Working Pressure	600 psi (4.14MPa)
Max. Feed Water Temperature	45 °C
Max. Feed Water Flow	17.0m^3/h(8040), 3.6m^3/h(4040)
Max. Feed Water SDI_{15}	5.0
pH Range of Feed Water during Continuous Operation	2-11
pH Range of Feed Water during Chemical Cleaning	1-13
Max. Pressure Drop of Single Membrane Element	15psi(0.1Mpa)
Free Chlorine Tolerance	< 0.1mg/L

○ Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty,

Ultra-low Pressure Eco ULP-4040

▶ Specifications and Parameters:

Model	Effective Area $ft^2(m^2)$	Flow GPD (m^3/d)	Stable Rejection Rate (%)	Min. Rejection Rate (%)
ULP-4040	75(7.0)	2400	99	98.5

▶ Standard Test Condition:

Solution	Temperature (℃)	pH Value	Operating Pressure psi (MPa)	Recovery Rate(%)
1500ppm NaCl	25±2	7.5-8.0	150(1.03)	15±1

Notes: The permeate flow of single membrane element may vary with in±15%.

Ultra-low Pressure Eco ULP-8040

▶ Specifications and Parameters:

Model	Effective Area $ft^2(m^2)$	Flow GPD (m^3/d)	Stable Rejection Rate (%)	Min. Rejection Rate (%)
ULP-8040	370(34.5)	10000	99	98.5

▶ Standard Test Condition:

Solution	Temperature (℃)	pH Value	Operating Pressure psi (MPa)	Recovery Rate(%)
1500ppm NaCl	25±2	7.5-8.0	150(1.03)	15±1

Notes: The permeate flow of single membrane element may vary with in±15%.

▶ Operating Limits and Conditions of Membrane Element:

Max. Working Pressure	600 psi (4.14MPa)
Max. Feed Water Temperature	45 °C
Max.Heat Disinfection Temperature (1.75 Bar)	85 °C
Max. Feed Water SDI_{15}	5.0
pH Range of Feed Water during Continuous Operation	2-11
pH Range of Feed Water during Chemical Cleaning	1-12
Max. Pressure Drop of Single Membrane Element	15psi(0.1Mpa)
Free Chlorine Tolerance	< 0.1mg/L

Ultra-low Pressure Plus ULP-8040

▸ Membrane sheet:

The module was fabricated by ultra-low pressure polyamide membrane sheet, which is suitable for the feed solution below 3000 mg/L. The features of ULP elements are high rejection rate, low working pressure and high permeate flux, which is applicable to the municipal water and groundwater, residential drinking water, water supply in food and beverage, etc.

▸ Specifications and Parameters:

Model	Effective Area $ft^2(m^2)$	Flow GPD (m^3/d)	Stable Rejection Rate (%)	Min. Rejection Rate (%)
LP-4040	90(8.4)	2600(9.8)	99.2	99
ULP-8040	400(37.2)	12000	99.2	99

▸ Standard Test Condition:

Solution	Temperature (℃)	pH Value	Operating Pressure psi (MPa)	Recovery Rate(%)
2000ppm NaCl	25±2	7.5-8.0	150(1.03)	15±1

Notes: The permeate flow of single membrane element may vary with in±15%.

▸ Operating Limits and Conditions of Membrane Element:

Max. Working Pressure	600 psi (4.14MPa)
Max. Feed Water Temperature	45 ℃
Max.Heat Disinfection Temperature (1.75 Bar)	85 ℃
Max. Feed Water SDI_{15}	5.0
pH Range of Feed Water during Continuous Operation	2-11
pH Range of Feed Water during Chemical Cleaning	1-12
Max. Pressure Drop of Single Membrane Element	15psi(0.1Mpa)
Free Chlorine Tolerance	< 0.1mg/L

SEA WATER MEMBRANE

▶ Applications

○ Seawater desalination
○ Industrial application for landfill leachate sewage wastewater treatment, high-salinity wastewater concentration etc.
○ Minimal or zero liquid discharge
○ Feed TDS above 10000mg/L

▶ Benefits

★ High Rejection and High Concentration Rate
★ Stability and Durability

▶ Specifications

Model	Active Area $ft^2(m^2)$	Permeete Flow Rate GPD(m^3/d)	Stabilized Salt Rejection(%)
SW-8040HR	400(37.2)	6500(24.6)	99.8
SW-8040MR	400(37.2)	7500(28.3)	99.75

▶ Standard Test Condition:

Solution	Operating Pressure psi(MPa)	Temperature (°C)	pH	Recovery Rate(%)
32000mg/L NaCl	800(5.5)	25	7.5-8.0	8

Individual flow rate may vary ±15%.

▶ Specifications

Model	Active Area $ft^2(m^2)$	Permeete Flow Rate GPD(m^3/d)	Stabilized Salt Rejection(%)
SW-4040HR	85(7.9)	1500(5.7)	99.75
SW-4040MR	85(7.9)	1800(6.8)	99.7

▶ Standard Test Condition:

Solution	Operating Pressure psi(MPa)	Temperature (°C)	pH	Recovery Rate(%)
32000mg/L NaCl	800(5.5)	25	7.5-8.0	8

Individual flow rate may vary ±15%.

▶ Operating Limits and Conditions of Membrane Element:

Max. Working Pressure	1200 psi (8.3MPa)
Max. Feed Water Temperature	45 °C
Max. Feed Water Flow	17.0m^3/h(8040), 3.6m^3/h(4040)
Max. Feed Water SDI_{15}	5.0
pH Range of Feed Water during Continuous Operation	2-11
pH Range of Feed Water during Chemical Cleaning	1-13
Max. Pressure Drop of Single Membrane Element	15psi(0.1Mpa)
Free Chlorine Tolerance	< 0.1mg/L

○ Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty,

HSRO Membrane

The HSRO-8040 elements are mainly used in the depth desalination treatment of water in the bio-medical field. It is able to withstand the disinfection treatment of hot water at 85 °C, which can fully meet the requirements of making pure water in the important processes, such as raw material production, separation and purification, end product preparation, washing process, cleaning process and disinfection process. The HSRO-8040 elements with ultra low electric charge have many characteristics, such as high fouling resistance, strong ability of recovery after cleaning and so on. The HSRO elements can be widely used in desalination of drinking water, purified water, high purity water and the water for injection.

▶ Specifications

Model	Effective Area $ft^2(m^2)$	Flow GPD(m^3/d)	Stable Rejection(%)	Mini Rejection(%)
HSRO-4040	90(8.36)	2560(10)	99.5	99.2
HSRO-8040	390(36)	9000(34)±20%	99.5	99.2

▶ Standard Test Condition:

Solution	Operating Pressure psi(MPa)	Temperature (°C)	pH	Recovery Rate(%)
2000ppm NaCl	150(1.03)	25±2	7.5-8.0	15±1

▶ Operating Limits and Conditions of Membrane Element:

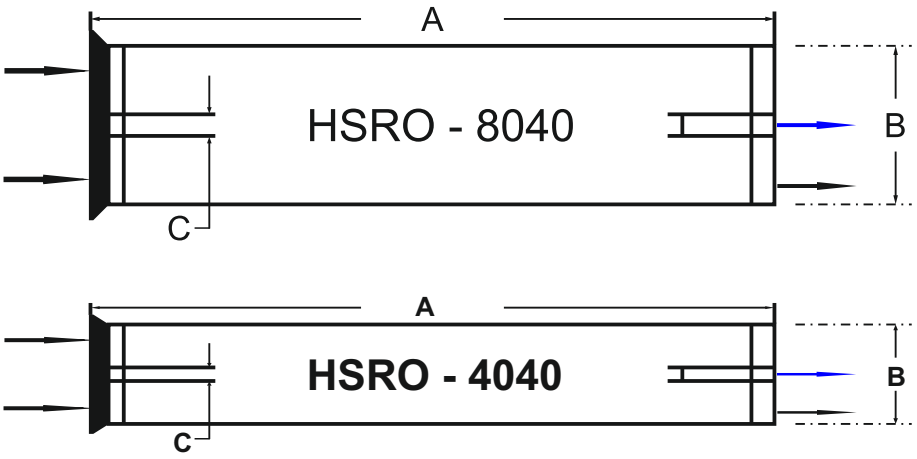
Max. Working Pressure	600 psi (4.14MPa)
Max. Feed Water Temperature	45 °C
Max. Heat Disinfection Temperature (1.75 Bar)	85 ℃
Max. Feed Water SDI_{15}	5.0
pH Range of Feed Water during Continuous Operation	2-11
pH Range of Feed Water during Chemical Cleaning	1-12
Max. Pressure Drop of Single Membrane Element	15psi(0.1Mpa)
Free Chlorine Tolerance	< 0.1mg/L

○ Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty,

HSRO Membrane

▶ Size Parameters

	A	B	C
HSRO-8040	40.0"(1016mm)	7.9"(201mm)	1.12" (28.5mm)
HSRO-4040	40.0"(1016mm)	3.9"(99mm)	0.75"(19mm)
	±1.0mm	±1.0mm	±1.0mm



▶ Important Operation Information

HSRO element should be handled with thermal stabilization by hot water at first use as follows.

- Under the conditions of low pressure and flow, flushing for 30mins by certainly RO produced water, Max. Pressure < 0.3MPa, and differential pressure between elements is below 0.17MPa.
- Under ultra low pressure, circulating with hot water for 45mins, temperature ≤ 45 °C, Max. Pressure < 0.3MPa, and differential pressure between elements is below 0.17MPa, back pressure is below 0.035MPa
- Adopting the way of circulation by gradually increasing the temperature until it is at 80 °C, heating rate < 3 °C/min. Max. Delivery pressure ≤ 0.3MPa and differential pressure between elements is below 0.17MPa. Back pressure is below 0.035MPa. Finally, making the reverse flow temperature reach to 80 °C, and ensuring the feed water of element inlet max. temperature ≤ 85 °C.
- Keeping the heat over 60mins.
- Adopting the way of circulation by gradually decreasing the temperature to below 45°C, cooling rate < 5 °C/min.
- When the water temperature is determined to be below 45°C, flushing by certainly RO produced water under ultra low pressure. Max. Pressure < 0.3MPa, and differential pressure between elements is below 0.17MPa.
- The thermal stabilization step of HSRO membrane element has been done. Please pay attention to this step should be finished as soon as possible once the RO system starts normally to avoid influencing the performance of element.

Nanofiltration Membrane

▶ Membrane sheet:

The features of NF membrane are high rejection against multi-valence ions and high selectivity with ultra-low applied pressure. The NF modules can be widely used in the field of sugars, amino acids and organic acids production, as well as the desalination and decolorization of surface water, landfill leachate, textile printing wastewater. Besides, the products also could be widely used in medicine extraction, and concentration.

▶ Specifications and Parameters:

Model	Active Membrane Area $ft^2(m^2)$	Permeate Flow GPD (m^3/d)	Stable Rejection Rate (%) - $MgSO_4$	Min. Rejection Rate (%) - NaCl
NF30-8040	400(37.2)	14000(52.9)	≥97	≤30
NF30-4040	85(7.9)	3200(12.1)	≥97	≤30
NF90-8040	400(37.2)	14500(54.8)	≥98	85-95
NF90-4040	85(7.9)	3500(13.2)	≥98	85-95

▶ Standard Test Condition:

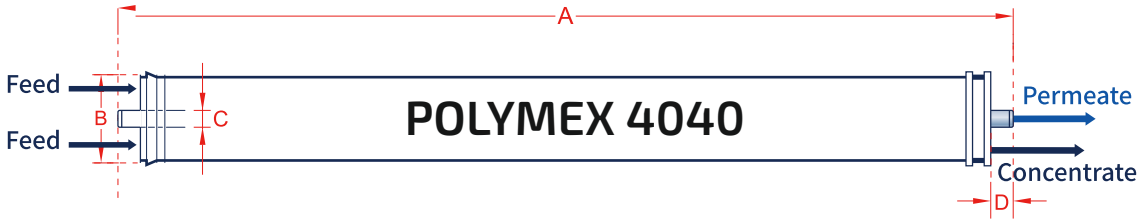
Concentration of Solution	Temperature (.C)	pH Value	Operating Pressure psi (MPa)	Recovery Rate(%)
2000ppm $MgSO_4$500ppmNaCl	25±2	7.5-8	100(0.69)	15±1

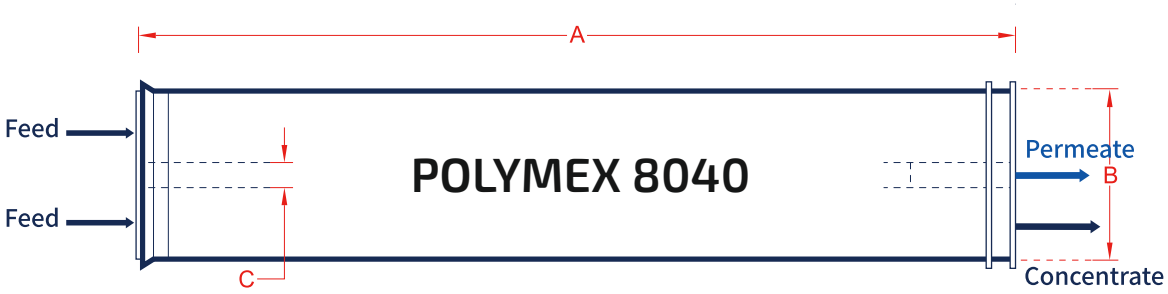
Notes: The permeate flow of single membrane element may vary with in±15%.

▶ Operating Limits and Conditions of Membrane Element:

Max. Working Pressure	600 psi (4.14MPa)
Max. Feed Water Temperature	45 °C
Max. Feed Water Flow	17.0m^3/h(8040), 3.6m^3/h(4040)
Max. Feed Water SDI_{15}	5.0
pH Range of Feed Water during Continuous Operation	2-11
pH Range of Feed Water during Chemical Cleaning	1-13
Max. Pressure Drop of Single Membrane Element	15psi(0.1Mpa)
Free Chlorine Tolerance	< 0.1mg/L

○ Under certain conditions, the presence of free chlorine and other oxidizing agents will cause premature membrane failure. Since oxidation damage is not covered under warranty,





Parameter	8040	4040	Standard deviation
A	40.0"(1016mm)	40.0"(1016)	1.0mm
B	7.9"(201mm)	3.9"(99mm)	1.0mm
C	1.12"(28.5)	0.75(19.1mm)	0.5mm
D	X X X X	1.04"(26.5mm)	0.5mm

Guide to Design of RO and NF System

To achieve high system efficiency, reasonable recovery and membrane flux should be selected according to the feed water quality and permeate water requirement. Very high flux cannot help to save cost due to faster fouling and more frequent maintenance. Normally, the recovery rate should be designed with 15% for each element. Optimized system design could help the system reach higher recovery, such as 18%-20% for each element.

▸ Detailed design advice:

1. As for the single membrane system, the system recovery rate can be improved to 50% by adjusting the recirculation of concentrated water; if the membrane system designed recovery rate is higher than 18% without concentrated water recirculation, the membranes cannot achieve the best performance and it will lead to fouling or damage for membrane.

2. As for single stage membrane system (single pressure vessel), it can adopt series design with two or more membranes to improve the membrane system recovery rate. But the system recovery rate should be higher than 50% (sea water should be higher than 45%).

3. As for multi-stage membrane system, it can achieve the high recovery rate by designing membrane housing in series, or first connected in parallel then connected in series.

▸ The detailed suggestion as below:

» For 1-2 elements per vessel, recovery rate of membrane system can achieve to 40-60% by using three stage arrays (4:2:1)

» For 3-5 elements per vessel, recovery rate of membrane system can achieve to 55-70% by using two stage arrays (2:1). For 6 core pressure vessels, recovery rate of membrane system can achieve to 75% by using two stage arrays (2:1).

» For 6 elements per vessel, recovery rate of membrane system can achieve to 85%-90% by using three stage arrays (4:2:1).

! Note:
It is normal that the membrane element will still have different degrees of fouling under the correct working condition, which will decrease the permeate flow.

Feed Quality Requirements of RO and NF Membrane System

RO/NF membranes have strict requirements of feed water quality, which is crucial to maintain the good separation performance, extend the service life, and save operating cost.

Items		Permissible Value	Probably Consequence of Excessive Standard	Improvement Suggestions
Suspended Solids	Turbidity	<1.0NTU	Sludge, Colloid Pollution	Flocculation and Filtration
	SDI_{15}	<5		
Metal Oxides	Fe(mg/L)	<0.05	Iron Pollution	Oxidation
	Mn(mg/L)	<0.05	Manganese Contamination	Application of
Scale Forming Matter	$CaCo_3$	LSI<0	Concentrated Water Side does not Permit Scaling	Decrease Recovery Rate, pH Value, or Add Scale Inhibitor
	Other Insoluble Salt	/		
Organics	Oli	0	Organics and Oli Pollution	Air Flotation
	TOC(mg/L)	<10	Organics Pollution	Activated Carbon Absorption, Filtration
	COD_{cr}(mg/L)	<20		
	BOD_5(mg/L)	<10		
Si (mg/L)		<20	Colloid Pollution	Add Silicon Retardant and Reduce Recovery
pH		3-10	Too Low or too High pH will Accelerate the Aging	Regular of Acid-Base
Temperature		5-45°C	Low Temperature will Easy Produce Scaling of Undissolved Salt High Temperature will Accelerate the Aging Speed of Membrane	Heat Exchanger
Oxidizer	Residual Chlorine (mg/L)	<0.1	Membrane System will be Oxidized	Reductant or Activated Carbon Absorption
	Ozone and Other	0		

Membrane Installation

1. The membrane element is usually stored in dry form or in a 1% sodium bisulfite solution. Before putting in service, the element needs thoroughly rinsing with pure water. The V-groove seal on the feed inlet is opposite to the direction of feed water. Make sure the O-ring is installed at the specified position of the connection fitting. Make sure th ere is no scratches or attachments of the O ring and the connector and make sure the O ring is not twisted during the installation,. The pure water, distilled water or glycerin can be applied to liberate the collection pipe and O ring in order to assemble smoothly.

2. Then remove the end plate on both sides of the pressure vessel and install the membrane elements. Install the adapter on the concentrate side of the first membrane element, and then push the membrane element into the housing with the same direction of feed water flow. The next membrane element is ready to be pushed after the prior element is completely entered the housing. During the installation, any scratches should be avoided.

3. After installing the end plate of concentrate side, push the elements again from the feed side towards the concentrate side, to ensure correct connection. Then, the end plate of feed flow side can be installed. If there is a gap between the end plate of feed flow side and the adapter, please install several plastic (or other suitable material) pads with largerdiameter than the outer diameter of the adapter around 1/4-1/8 until the end plate canjust be fully installed.

4. During uninstallation, the direction should be consistent with install process. The membrane elements should be pushed out from the concentrate side piece by piece. Please avoid installing or disassembling forcefully.

5. After the elements have been installed, it may be necessary to add shims to reduce the space between the lead element and the adapter. This procedure helps prevent movement and hammering of elements when the system starts and shuts down.

Operation of Membrane Element System at the First Time

1. Before the system booting, operator should inspect all the notice in operation checklist in the situation that raw water did not enter the membrane element, which including completely wash the pre-treatment section to prevent the impurities and other contaminants from entering the high pressure pump and me brane element, check the effluent SDI15 value of pre-treatment, residual chlorine of inflow water should lower than 0.1mg/L, inflow water cannot have oxidizer, etc.

2. Operator should fully ensure all the setting of valves is correct after care ful inspection. Drain valve, inlet valve, concentrate valve of membrane system should be totally switched on. Pre-treatment system should use the low pressure and low flow expels the air in the membrane element and pressure vessel. The flusing pressure should control between 2.5 to 3 bars.

3. Five hours of cleaning in low working pressure or one to two hours of flush recommended, when the wet or dry type of new membranes installed. One to two hours of flush again recommended after soaking in 1-2 hours. The wet membrane system usually will reach the stable performance after 12 hours continuously working. The dry membrane system may need around 48 hours or longer time working to reach the stable performance.

4. Open the inlet valve slowly after started the high-pressure pump. Evenly raise the flux of concentrate to the designed value The rate of pressure rise should lower than 0.7 bar per second.

5. Inspect the quality of production water after one hour continuously operating of membrane system. Record the initial data of operating system. Then switch on the qualified water valve and switch off the drain off valve to deliver the water to following device.

Notice of Membrane System Halt

15-30 Days

Membrane system stop running for 15-30 days is short-term halt. Operator should wash the membrane system and completely release the air per each five days. Switch off the related inlet valves and drain valve after washing. If the raw water quality is bad, please use the permeated flow of RO or NF system cleans the membrane system.

more then 30 Days

If membrane system needs to halt more than 30 days and membrane element still have to remain in pressure vessel, membrane system must wash with chemical cleaning after its stop. Then recycle wash the membrane system with the 1% sodium bisulfite of disinfection and fill the membrane system to achieve the purpose of long-term storage. If water temperature is higher than 27℃, bactericide needs to change per each 15 days. When the membrane system starts to work next time, please use the low pressure and high flux permeated flow clean the membrane system at least one hour till the permeated flow is to be the standard of qualified water.

The Cleaning of Membrane System

Standard of Cleaning

The film of membrane element will be contaminated by inorganic salt, microbial, colloidal solid and not soluble organics after a period of running. These contaminants are deposited on the surface of membrane film, which cause the standard flux rate and salt rejection rate decline or even deteriorate. Membrane system needs to chemical clean when the following conditions occurrence:

» Standardization water production permeate flux is lowered than 10-15%.
» The difference of system pressure between inflow water and concentrated water reach the 1.5 times of initial value.
» Standard salt permeate rate increase more than 10-15%.

The types of cleaning agents will be determined by quality of feed water. The membrane system needs acid cleaning following by alkali cleaning as the system mainly contaminated by the inorganic scaling. On the other hand, the membrane system needs alkili-acid-alkali sequence cleaning process, as the system is mainly fouled by organic matters

The Use and Preparation of Cleaning Agent

Acid cleaner: 2% citric acid solution with pH ranges from 2-3 or 0.2% hydrochloric acid solution with pH ranges from 2-3.

Alkaline cleaner: 0.1% caustic soda solution and 0.025% Sodium Dodecyl Sulfonate (Na-SDS) with pH ranges from 11-12.

Cleaning methods

There are six steps in the cleaning process:

1. Flush the membrane element.Rinsing with the permeate water under low pressure and high flow velocity.

2. Preparation of cleaning solution Pump mixed, preheated the cleaning solution to the vessel at conditions of low flow rate.

3. Recycle. Membrane system should be cleaned with low pressure and high flux water. At the initial five minutes, circulation cleaing should be controlled with 1/3 of designed flow rate. Then the flux should be adjusted 2/3 of designed flux to full value in each ten minutes. The time of the recycle usually is 1 hour. Measure the pH of solution and difference of the pressure.

4. Soak and recycle. Slowly turn the circulation pump off and allow to soak the element. The soaking time is 1-12 hours depending on the situation of the contamination.

5. Rinse. Feed the clean solution into the membrane element and cleaning device. The rinsing time is about 20-60 minutes. Once the pH and conductivity of concentrated flow is similar with the feed flow, the rinsing process can be stopped.

6. ⑥Trail. After turning on the system, the permeate should be drained until the water quality meets the requirements.

When the pH value changes 0.5, operator should add cleaning agents. It is strongly recommended to clean the system separately by using one type of cleaning solution. Before alerting the cleaning agent, the membrane system should be thoroughly washed by permeate water. Usually, the period of acid cleaning is no more than 8h and of alkali cleaning is no more than 24-36h.

Common Problems, Causes & Solutions

If the system is beyond the operational range by viewing the operating conditions and data. You can take action according to the table below.

▶ Analysis and Solution for Common Bug

Phenomenon			The Possible Cause of Bug	Solution
Rejection Rate	Permeate Flow	Pressure Difference		
↓	↗	→	Oxidation: Oxidant of Residual Chlorine, etc.	Replacing Membrane Element，Improving the Pretreatment
↓	↗	→	Membrane Element Damage: Back Pressure, Water Hammer	Replacing Membrane Element
↓	↗	→	Connector not tightly sealed	Replacing Membrane Element
↘	↓	↗	Scaling or Colloidal Contamination	Improving the Pretreatment, Chemical Cleaning
↘	↓	↗	Scale Formation of CaCO3, SiO2, etc.	pH Value/Recovery Rate Adjustment，Chemical Clean
→	↓	↗	Microbial Contamination	Disinfection, Chemical Cleaning
→	↓	→	Attachment: Surfactant, Oil	Avoiding Mixing the Same Substance in Raw Water
→↘	↗↘	→	High Temperature	Adjust within the Allowable Range
→↘	↗↘	→	High Pressure	Adjust within the Allowable Range

▶ Membrane Element Analysis

If the membrane element is beyond the operational range by viewing the operating conditions and data. you can take action according to the table below.

▶ Judgment for Common System Contamination

Method	Deterioration	Scale Layer	Suction Layer	Blockage	Flow Blockage
Appearance of Membrane Element, Weight Test	×	√	×	√	√
Dyeing Test of Membrane Elements	√	×	×	×	×
Membrane Observation (visual, microscope)	√	√	Δ	√	√
Raw Water Survey, Analysis	√	√	√	×	×
Performance Check of Membrane Elements	√	Δ	Δ	√	√
Quantitative Analysis of Attachments	×	√	×	×	√
Scanning Electron Microscope, SEM	√	√	×	√	√
X-ray Analysis, XMA	×	√	×	√	√
X-ray Diffraction Analysis	×	√	×	√	√
Fourier Infrared Analysis, FT-IR	√	√	√	×	×
Chemical Cleaning Test	×	√	×	×	×

! **Note:** √ indicates applicable; Δ indicates basically applicable; × indicates not applicable.

▶ Appearance and Weight

It could be determined physically damaged or attached organic matter of membrane element by observing the appearance. However, it is only a rough indicator to get the amount of pollutants by measuring the weight of elements.

▶ Membrane Element Performance Check

We highly recommend preparing two parallel samples. One of them is used for performance check, and the other is used for anatomy. As the foulants are determined, however, after re-evaluation the membrane performance, the changes of pollutants will be happened and affects the analysis.

Performance testing of membrane elements includes the following items:

» Vacuum maintenance inspection and leaking inspection could be applied to determine the damage and damage of the flat membrane

» Evaluation of membrane elements by using standard test conditions. It can be determined the, membrane damage, membrane performance degradation, contamination, flow blockage, and poor contact of the connectors throughcomparison of the changes in salt rejection, water production, and differential pressure.

Compare the above performance test data with the factory data to confirm the performance change. A differential pressure tester is used in the measurement of the differential pressure, and an accuracy of 0.01 bar is required in the test.

▶ Staining Test

It is possible to determine whether the membrane properties are deteriorated or the location of the damage by the dyeing test. It is better to prepare another element to do the contaminant analysis to avoid the affecting of staining test affecting the accuracy of the contamination analysis.

▶ Chemical Cleaning Test

In order to identify the pollutants and determine the extent of membrane degradation, a chemical cleaning test could be applied on the flat sheet collected after module autopsy.

▶ Packing and Storage of Membrane Element

Majority of POLYMEX membrane element are dry type, wet type membranes also are available.

The wet membrane element should be stored in 1% food grade sodium bisulfite of standard protective liquid (When the temperatures lower than zero degree, the wet membranes also need to protect by 10% of propylene glycol antifreeze). It is protected from microorganism breeding and contamination and frozen in the process of storage and transportation.

2. Precautions for Storage and Transportation

» The membrane elements shall be stored in a shade place (within 5-35℃) out of direct sunlight.

» Forbidden the rough handing for membrane elements, such as throwing, dropping from high place, etc.

» Avoid the membrane element remain in upright for a long period.

» It is recommended to use the wet membrane elements within six months. When it is over than six months, the protection solution should be replaced.

» It is forbidden to add any of chemical agents has influence on membrane elements during storage and transportation process.

3. If users are against above rules, it probably does permanent damage to membrane elements.

▶ Quality Warranty of POLYMEX Membrane Flat Sheet

Dear user,

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POLYMEX

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