


**KeenSen®**


**RO and NF Membrane Element  
Products Manual  
(2017)**

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روبروی پالایشگاه نفت پارس، پلاک ۱۲

HUNAN KEENSEN TECHNOLOGY CO., LTD.  
[www.keensen.com](http://www.keensen.com)



## History



2011 Casting and coating lines installed.



2008 Hunan Keensan Technology Co., Ltd. was founded.



2012 Achieved the ISO9001 quality management system certificate.



2013 Achieved the wading health and safety license.



2015 Achieved USA National Sanitation Foundation "NSF" certificate in July, and identified as "New and High-tech Enterprise" in October.



2014 Passed safety standard in September, and it was identified as Hunan famous trademark in December.



2016 Keensan was awarded the second prize of technology by China Membrane Industry Association in April, and achieved "AAA Grade Evaluation for Enterprise Credit" in June.



2016 Reverse osmosis membrane joint R&D base was founded.



## Enterprise Qualification



NSF/ANSI 58(National Sanitation Foundation)



ISO9001:2008-English Version



Sanitary Permit of Nanofiltration Membrane Elements



Sanitary Permit of Reverse Osmosis Membrane Elements



Member of MIAC



Hi-tech Energy Conservation and Environmental Protection Certificate



Member of Drinking water Products Committee



Advanced Environmental Protection Unit



Member Institution



Work Safety Standardization Certificate



Independent Brand Award



AAA Grade Evaluation for Enterprise Credit



High-tech Enterprise



Reverse Osmosis Membrane Joint R&D Base



Famous Brand of Hunan Province



Science and Technology Awards Honored by Membrane Industry Association of China



Member of HPECEPA



Member of CDA

## Patent Certificate



Invention Patent—A High Rejection Rate, High Flux, Controllable and Composite RO Membrane Elements & Making Process



Invention Patent—Control Method and System for Spacer Welding Machine



Invention Patent—Spacer Welding Machine



Invention Patent—A Method for Improving Oxidation Discoloration of RO Membrane Elements



Invention Patent—A Cleaning Method and Fluid for RO Membrane Elements



Utility New Model Patent—A Performance Test Equipment of RO Membrane Elements



Utility New Model Patent—A Dyeing Test Device of Reverse Osmosis Membrane



Utility New Model Patent—A Dedicated Cutting Device of Reverse Osmosis Membrane Housing



Utility New Model Patent—A Membrane Housing End Plugging Device Used for Membrane Testing System



Utility New Model Patent—A Stereo Storage Rack for Reverse Osmosis Membrane



Utility New Model Patent—A Dyeing Test Device to Analyze the Glue Lines of RO Membrane Elements



Utility New Model Patent—A Solvent Drum Seal Cap

Keensen has declared thirty kinds of patents which included ten invention patents and eighteen utility model patents by keeping innovating. It has been authorized eight invention patents and fifteen utility model patents at present.



## Models and Applications of Membrane Elements

### Models

- Reverse osmosis (RO) and nanofiltration (NF) membrane elements can be divided into "industrial", "commercial", "residential" three series according to the application field.
- RO membrane has brackish water (BW), ultra-low pressure (ULP), extreme low pressure (XLP), fouling resistant (FR), sea water desalination model (SW) etc. according to its performance.
- NF membrane has high flux (NF2), high rejection (NF1), material separation model (NF-F) etc. according to its performance.
- Flat sheet membrane types: brackish water (BW), high rejection(ULP-HR), high flux(ULP), extreme low pressure (XLP), high rejection (NF1), high flux (NF2).

### Application Fields

Keensan RO and NF membrane elements can be widely used in municipal drinking water supply, surface water reuse, sea water desalination, landfill leachate treatment, coal chemical industry, power generation, pharmaceuticals, wine, process water of food industry, textile printing and dyeing, electroplating industry, and aviation aerospace field, etc.

No.	Membrane Series	Membrane Type	Model	Application Field
1	Industrial Series	XLP	XLP-8040/4040	Municipal Water Pure Preparation (TDS<1000ppm)
2		ULP	ULP-8040/4040/4040HR/4040MR	Municipal and Underground Water Preparation (TDS<1500ppm)
3		BW	BW-8040/4040	Desalination Processing for Brackish and Surface Water (TDS 2000-8000ppm)
4			BW-8040FR/4040FR	Reuse of Recycled Water and Waste Water Treatment
5		NF1/NF2	NF1-8040/4040	Direct Drinking Water, Spring Water and Low Pressure Boiler Softened Water Preparation
6			NF2-8040/4040	
7		NF-F	NF1-8040F/4040F	Concentration and Separation, Sea Water Concentration and Separation for Salt Making, Reuse of Recycled Water
8			NF2-8040F/4040F	
9		SW	SW-8040/4040/2540	Desalination Processing
10	Commercial Series	ULP	ULP-4021/2521/2540	Automatic Water Dispenser, Pure Water Machine in Medical Laboratory, Direct Drinking Equipment in Office
11		XLP	XLP-4021	
12	NF	NF-4021/2540/2521	Mineral Water Machine, Energy Machine	
13	Residential Series	RO	RO-1512/1812/2012/2812/3012/3013/3020	Household Direct Drinking Water
14		NF	NF-1812/2012/2812/3012	

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## Performance of Common Industrial Membrane Element



## Performance of Common Commercial and Residential Membrane Element

No.	Membrane Series	Membrane Model	Model	Active Membrane Area ft <sup>2</sup> (m <sup>2</sup> )	Permeate Flow GPD(T/D)	Stable Rejection Rate (%)	Concentration of Solution (ppm) (NaCl / MgSO <sub>4</sub> )	Operating Pressure psi(MPa)	Recovery Rate (%)	
1	Industrial Series	XLP	XLP-4040	85(7.9)	2000(7.6)	99.0	NaCl:500	100(0.69)	15	
2			XLP-8040	400(37.2)	9000(34.1)					
3		ULP	ULP-4040HR	85(7.9)	1800(6.8)	99.5	NaCl:1500	150(1.03)		
4			ULP-4040MR	85(7.9)	2200(8.3)	99.3				
5			ULP-4040	85(7.9)	2600(9.8)	99.0				
6			ULP-8040	400(37.2)	10000(37.8)	99.5				
7		BW	BW-8040	400(37.2)	10000(37.8)	99.6	NaCl:2000	225(1.55)		
8			BW-4040	85(7.9)	2400(9.1)					
9			BW-8040FR	365(34.0)	9500(35.9)					
10			BW-4040FR	78(7.2)	2200(8.3)					
11		NF1 NF2	NF1-8040 NF1-4040	NF1-8040	400(37.2)	10000(37.8)	50-70(NaCl) 96(MgSO <sub>4</sub> )	NaCl:500 MgSO <sub>4</sub> :2000		70(0.48)
12				NF1-4040	85(7.9)	2000(7.6)				
13			NF2-8040 NF2-4040	NF2-8040	400(37.2)	12000(45.4)	30-50(NaCl) 96(MgSO <sub>4</sub> )			
14				NF2-4040	85(7.9)	2400(9.1)				
15		NF1-F NF2-F	NF1-8040F NF1-4040F NF2-8040F NF2-4040F	NF1-8040F	400(37.2)	10500(39.7)	98.0	MgSO <sub>4</sub> :2000		70(0.48)
16				NF1-4040F	78(7.2)	2000(7.6)	96.0			
17				NF2-8040F	400(37.2)	12000(45.4)				
18				NF2-4040F	78(7.2)	2200(8.3)				
19		SW	SW-8040 SW-4040 SW-2540	SW-8040	400(37.2)	7500(28.3)		99.7		NaCl:32000
20				SW-4040	78(7.2)	1600(6.1)				
21				SW-2540	27 ( 2.5 )	600 ( 2.3 )				

No.	Membrane Series	Membrane Model	Model	Active Membrane Area ft <sup>2</sup> (m <sup>2</sup> )	Permeate Flow GPD(T/D)	Stable Rejection Rate (%)	Concentration of Solution (ppm) (NaCl / MgSO <sub>4</sub> )	Operating Pressure psi(MPa)	Recovery Rate (%)
1	Commercial Series	ULP	ULP-4021	36(3.4)	950(3.6)	99.3	NaCl: 1500	150(1.03)	8
2			ULP-2521	14(1.3)	300(1.13)				15
3			ULP-2540	27(2.5)	750(2.84)				
4		XLP	XLP-4021	36(3.4)	800(3.04)	99.0	NaCl: 500	100(0.69)	8
5		NF	NF-4021	36(3.4)	1100(4.2)	30-50(NaCl) 96(MgSO <sub>4</sub> )	NaCl: 250 MgSO <sub>4</sub> : 250	70 ( 0.48 )	
6			NF-2521	14(1.3)	350(1.3)				
7	NF-2540		27(2.5)	850(3.2)					
8	Residential Series	RO	RO-1512-50	2 ( 0.19 )	50 ( 0.19 )	96.0	NaCl: 250	60 ( 0.41 )	15
9			RO-1812-50	4 ( 0.37 )	50 ( 0.19 )	98.0			
10			RO-1812-75	4 ( 0.37 )	75 ( 0.28 )				
11			RO-2012-100	6 ( 0.56 )	100 ( 0.38 )				
12			RO-2012-150	6 ( 0.56 )	150 ( 0.57 )				
13			RO-2812-200	10 ( 0.93 )	200 ( 0.76 )				
14			RO-3012-300	14 ( 1.30 )	300 ( 1.14 )	97.0			
15			RO-3012-400	14 ( 1.30 )	500 ( 1.89 )				
16			RO-3013-400	17 ( 1.58 )	600 ( 2.27 )				
17			RO-3020-600	27 ( 2.51 )	700 ( 2.64 )				
18	NF	NF-1812 NF-2012 NF-2812 NF-3012	NF-1812	4 ( 0.37 )	120 ( 0.45 )	30-50(NaCl) 96(MgSO <sub>4</sub> )	NaCl: 250 MgSO <sub>4</sub> : 250	60 ( 0.41 )	
19			NF-2012	6 ( 0.56 )	150 ( 0.57 )				
20			NF-2812	10 ( 0.93 )	300 ( 1.14 )				
21			NF-3012	14 ( 1.30 )	400 ( 1.51 )				

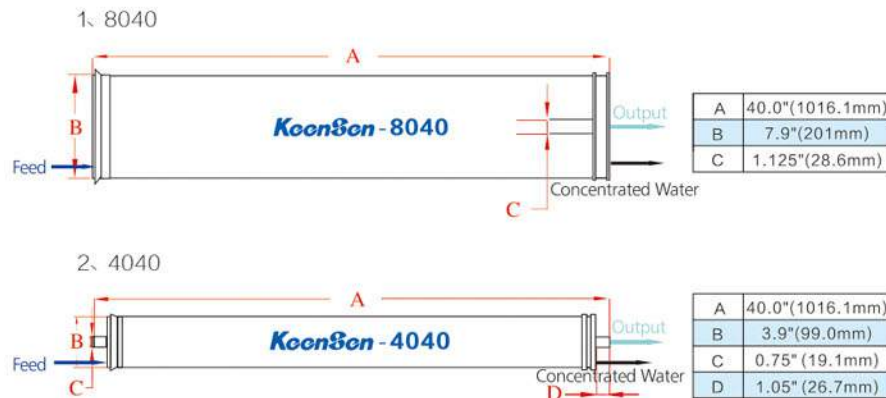


## Performance of Common Flat Sheet Membrane

No.	Project Model	Membrane Model	Min. Rejection Rate (%)	Permeate Flow (GFD)	Test Condition				
					Temperature	pH Value	Concentration of Feed Water	Operating Pressure (psi/MPa)	Concentration Flow
1	RO	BW	99.6	≥35	25°C	7.5-8.0	2000ppm (NaCl)	225psi (1.55MPa)	1.1GPM
2		ULP-HR	99.6	≥30			1500ppm (NaCl)	150psi (1.03MPa)	
3		ULP	99.4	≥45			500ppm (NaCl)	70psi (0.48MPa)	
4	NF1	60-80(NaCl) >99(MgSO <sub>4</sub> )	≥40(NaCl) ≥35(MgSO <sub>4</sub> )	500ppm (NaCl)			2000ppm (MgSO <sub>4</sub> )		
5	NF2	30-50(NaCl) >97(MgSO <sub>4</sub> )	≥45(NaCl) ≥40(MgSO <sub>4</sub> )	2000ppm (MgSO <sub>4</sub> )					

## Industrial Series

### Membrane Element Size



## Industrial Series

### Extreme Low Pressure RO Membrane Element

Model No.: XLP-4040/8040

Usage: It is applicable to the desalination of municipal water, groundwater with salt concentration less than 1000ppm. It can be widely used in pure water preparation and related industries.

Features: It can save energy and increase economic efficiency with its advantage of extreme low working pressure.

Specifications and Parameters:

Model	Active Membrane Area (ft <sup>2</sup> )	Permeate Flow GPD(T/D)	Stable Rejection Rate (%)	Min. Rejection Rate (%)
XLP-4040	85(7.9)	2000(7.6)	99.0	98.5
XLP-8040	400(37.2)	9000(34.1)	99.0	98.5

Standard Test Condition:

Concentration of Solution (NaCl)	Temperature (°C)	pH Value	Operating Pressure (psi/MPa)	Recovery Rate (%)
500ppm	25	7.5-8	100(0.69)	15

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 <sup>3</sup> /h (8040) , 3.6m <sup>3</sup> /h (4040)
Max. Feed Water SDI <sub>15</sub>	5.0
Free Chlorine Concentration of Feed Water	0.1mg/L
pH Range of Feed Water during Continuous Operation	3-10
pH Range of Feed Water during Chemical Cleaning	2-12
Max. Pressure Drop of Single Membrane Element	10psi(0.07Mpa)





## Industrial Series



## Industrial Series



### Ultra Low Pressure RO Membrane Element

Model No.: ULP-4040HR ( High Rejection )  
ULP-4040MR, ULP-8040/4040

Usage: It is applicable to the desalination of municipal water, groundwater with salt concentration less than 1500ppm. It can be widely used in residential dual water supplying system, pure water preparation plant, industry, food production and other fields etc..

Features: High rejection rate and low working pressure.

Specifications and Parameters:

Model	Active Membrane Area ft <sup>2</sup> (m <sup>2</sup> )	Permeate Flow GPD(T/D)	Stable Rejection Rate (%)	Min. Rejection Rate (%)
ULP-4040HR	85(7.9)	1800(6.8)	99.5	99.4
ULP-4040MR	85(7.9)	2200(8.3)	99.3	99.2
ULP-4040	85(7.9)	2600(9.8)	99.0	98.5
ULP-8040	400(37.2)	10000(37.8)	99.5	99.2

Standard Test Condition:

Concentration of Solution (NaCl)	Temperature ( °C )	pH Value	Operating Pressure psi(MPa)	Recovery Rate ( % )
1500ppm	25	7.5-8	150(1.03)	15

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 <sup>3</sup> /h ( 8040 ) , 3.6m <sup>3</sup> /h ( 4040 )
Max. Feed Water SDI <sub>15</sub>	5.0
Free Chlorine Concentration of Feed Water	0.1mg/L
pH Range of Feed Water during Continuous Operation	3-10
pH Range of Feed Water during Chemical Cleaning	2-12
Max. Pressure Drop of Single Membrane Element	10psi(0.07Mpa)



### Brackish Water and Fouling Resistant BW Membrane Element

Model No.: BW-8040/4040  
BW-8040FR/4040FR ( Fouling Resistant )

Usage: It is applicable to the desalination of surface water, groundwater and water treatment with salt concentration between 2000 and 8000ppm. It can be widely used in the medicine, chemical industry, beverage, electricity and other various industries etc.

Features: High rejection rate, large flux and excellent anti-fouling property.

Specifications and Parameters:

Model	Active Membrane Area ft <sup>2</sup> (m <sup>2</sup> )	Permeate Flow GPD(T/D)	Stable Rejection Rate (%)	Min. Rejection Rate (%)
BW-8040	400(37.2)	10500(39.7)	99.6	99.4
BW-4040	85(7.9)	2400(9.1)	99.6	99.4
BW-8040FR	365(34.0)	9500(35.9)	99.6	99.4
BW-4040FR	78(7.2)	2200(8.3)	99.6	99.4

Standard Test Condition:

Concentration of Solution (NaCl)	Temperature ( °C )	pH Value	Operating Pressure psi(MPa)	Recovery Rate ( % )
2000ppm	25	7.5-8	225(1.55)	15

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 <sup>3</sup> /h ( 8040 ) , 3.6m <sup>3</sup> /h ( 4040 )
Max. Feed Water SDI <sub>15</sub>	5.0
Free Chlorine Concentration of Feed Water	0.1mg/L
pH Range of Feed Water during Continuous Operation	3-10
pH Range of Feed Water during Chemical Cleaning	2-12
Max. Pressure Drop of Single Membrane Element	10psi(0.07Mpa)



## Industrial Series

### High Rejection and High Flux Nanofiltration Membrane Element

Model No.: NF1-8040/4040 ( High Rejection )  
NF2-8040/4040 ( High Flux )

Usage: It is applicable to the desalination of direct drinking water, spring water, boiler water, also desalination and decolorization of wastewater with high salt concentration.

Features: It has the selective desalination mechanism for removal of high polyvalent ions and partial maintaining of monovalent ions with health benefits. Moreover, the equipment operating cost can be reduced effectively with the advantage of low working pressure.

Specifications and Parameters:

Model	Active Membrane Area ft <sup>2</sup> (m <sup>2</sup> )	Permeate Flow GPD(T/D)	Rejection Rate(%)	
			500ppm NaCl	2000ppm MgSO <sub>4</sub>
NF1-8040	400(37.2)	10000(37.8)	50-70	≥96
NF1-4040	85(7.9)	2000(7.6)	50-70	≥96
NF2-8040	400(37.2)	12000(45.4)	30-50	≥96
NF2-4040	85(7.9)	2400(9.1)	30-50	≥96

Standard Test Condition:

Concentration of Solution	Temperature (°C)	pH Value	Operating Pressure psi(MPa)	Recovery Rate (%)
500ppm(NaCl) 2000ppm(MgSO <sub>4</sub> )	25	7.5-8	70(0.48)	15

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 <sup>3</sup> /h (8040) , 3.6m <sup>3</sup> /h (4040)
Max. Feed Water SDI <sub>15</sub>	5.0
Free Chlorine Concentration of Feed Water	0.1mg/L
pH Range of Feed Water during Continuous Operation	3-10
pH Range of Feed Water during Chemical Cleaning	2-12
Max. Pressure Drop of Single Membrane Element	10psi(0.07Mpa)

## Industrial Series

### Material Separation Nanofiltration Membrane Element

Model No.: NF1-8040F/4040F ( High Rejection )  
NF2-8040F/4040F ( High Flux )

Usage: It is applicable for the removal or concentration of dye, removal of heavy metal and the concentration and desalination of whey protein. It will intercept divalent ions and higher ions preferentially, the interception of monovalent ions will be affected by the liquid concentration. This membrane model was widely applied to the desalination and decoloration treatment on the raw water, such as surface water, landfill leachate, dyeing wastewater, coking plant waste water, etc.

Features: Low working pressure and good restoration after cleaning.

Specifications and Parameters:

Model	Active Membrane Area ft <sup>2</sup> (m <sup>2</sup> )	Permeate Flow GPD(T/D)	Rejection Rate(%)
			2000ppm MgSO <sub>4</sub>
NF1-8040F	400(37.2)	10500(39.7)	98
NF1-4040F	78(7.2)	2000(7.6)	98
NF2-8040F	400(37.2)	12000(45.4)	96
NF2-4040F	78(7.2)	2200(8.3)	96

Standard Test Condition:

Concentration of Solution (MgSO <sub>4</sub> )	Temperature (°C)	pH Value	Operating Pressure psi(MPa)	Recovery Rate (%)
2000ppm	25	7.5-8	70(0.48)	15

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 <sup>3</sup> /h (8040) , 3.6m <sup>3</sup> /h (4040)
Max. Feed Water SDI <sub>15</sub>	5.0
Free Chlorine Concentration of Feed Water	0.1mg/L
pH Range of Feed Water during Continuous Operation	3-10
pH Range of Feed Water during Chemical Cleaning	2-12
Max. Pressure Drop of Single Membrane Element	10psi(0.07Mpa)





## Industrial Series

### Sea Water Desalination Membrane Element

Model No.: SW-8040/4040/2540

Usage: It is applicable to the desalination of raw water with salt concentration between 15000ppm and 40000ppm, and make removal for the boron is more than 90%. This membrane model was widely applied to the desalination of sea water and high concentration brackish water, concentration and recycle treatment for high salt wastewater.

Features: High rejection rate and large flux.

Specifications and Parameters:

Model	Active Membrane Area ft <sup>2</sup> (m <sup>2</sup> )	Permeate Flow GPD(T/D)	Stable Rejection Rate (%)	Min. Rejection Rate (%)
SW-8040	400(37.2)	7500(28.3)	99.7	99.5
SW-4040	85(7.9)	1600(6.1)	99.7	99.5
SW-2540	27(2.5)	600(2.3)	99.7	99.5

Standard Test Condition:

Concentration of Solution (NaCl)	Temperature (°C)	pH Value	Operating Pressure psi(MPa)	Recovery Rate (%)
32000ppm	25	7.5-8	800(5.5)	15

Notes: The permeate flow of single membrane element may vary with in ± 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 <sup>3</sup> /h (8040) , 3.6m <sup>3</sup> /h (4040) 1.4m <sup>3</sup> /h(2540)
Max. Feed Water SDI <sub>15</sub>	5.0
Free Chlorine Concentration of Feed Water	0.1mg/L
pH Range of Feed Water during Continuous Operation	3-10
pH Range of Feed Water during Chemical Cleaning	2-12
Max. Pressure Drop of Single Membrane Element	13psi(0.09Mpa)

## Commercial Series

### Membrane Element Size

1、2540



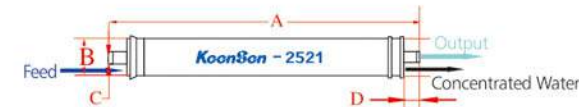
A	40" (1016mm)
B	2.4" (61.0mm)
C	0.75" (19.1mm)
D	1.05" (26.7mm)

2、4021



A	21" (533.4mm)
B	3.9" (99.0mm)
C	0.75" (19.1mm)
D	1.05" (26.7mm)

3、2521



A	21" (533.4mm)
B	2.4" (61.0mm)
C	0.75" (19.1mm)
D	1.10" (28.7mm)



### Ultra Low Pressure and Extreme Low Pressure RO Membrane Element

Model No.: ULP-4021/2540/2521, XLP-4021 (It is applicable to the desalination of raw water with salt concentration less than 1000ppm)

Usage: It is applicable to the desalination of raw water with salt concentration less than 1500ppm, and widely used for small pure water system, such as automatic water dispenser in residential area and school, direct drinking equipment in office, pure water machine in medical laboratory.

Features: High rejection rate and low working pressure.

Specifications and Parameters:

Model	Active Membrane Area ft <sup>2</sup> (m <sup>2</sup> )	Permeate Flow GPD(T/D)	Stable Rejection Rate (%)	Min. Rejection Rate (%)
ULP-4021	36(3.4)	950(3.6)	99.3	99.0
ULP-2540	27(2.5)	750(2.84)	99.3	99.0
ULP-2521	14(1.3)	300(1.13)	99.3	99.0
XLP-4021	36(3.4)	800(3.04)	99.0	98.5

Standard Test Condition:

Concentration of Solution (NaCl)	Temperature (°C)	pH Value	Operating Pressure psi(MPa)	Recovery Rate (%)
1500ppm (For ULP series) 500ppm (For XLP series)	25	7.5-8	ULP:150(1.03) XLP:100(0.69)	15(2540) 8 (4021/2521)

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	3.6m <sup>3</sup> /h (4021) 1.4m <sup>3</sup> /h (2540, 2521)
Max. Feed Water SDI <sub>15</sub>	5.0
Free Chlorine Concentration of Feed Water	0.1mg/L
pH Range of Feed Water during Continuous Operation	3-10
pH Range of Feed Water during Chemical Cleaning	2-12
Max. Pressure Drop of Single Membrane Element	10psi(0.07Mpa)

### Keensen Commercial Series NF Membrane Element

Model No.: NF-4021/2540/2521

Usage: It is applicable to the desalination of raw water with salt concentration 500ppm, and it was widely used for small household water purifier, mineral water machine and energy machine etc.

Features: It has the selective desalination mechanism for removal of high polyvalent ions (heavy metal ion) and partial maintaining of monovalent ions with health benefits. Moreover, it only needs low operating pressure.

Specifications and Parameters:

Model	Active Membrane Area ft <sup>2</sup> (m <sup>2</sup> )	Permeate Flow GPD(T/D)	Rejection Rate(%)	
			500ppm NaCl	2000ppm MgSO <sub>4</sub>
NF-4021	36(3.4)	1100(4.2)	30-50	96
NF-2540	27(2.5)	850(3.2)	30-50	96
NF-2521	14(1.3)	350(1.3)	30-50	96

Standard Test Condition:

Concentration of Solution	Temperature (°C)	pH Value	Operating Pressure psi(MPa)	Recovery Rate (%)
250ppm (NaCl) 250ppm (MgSO <sub>4</sub> )	25	7.5-8	60 (0.41)	15








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

Operating Limits and Conditions of Membrane Element:

Max. Working Pressure	600psi(4.14MPa)
Max. Feed Water Temperature	45 °C
Max. Feed Water Flow	3.6m <sup>3</sup> /h (4021) 1.4m <sup>3</sup> /h (2540, 2521)
Max. Feed Water SDI <sub>15</sub>	5.0
Free Chlorine Concentration of Feed Water	0.1mg/L
pH Range of Feed Water during Continuous Operation	3-10
pH Range of Feed Water during Chemical Cleaning	2-12
Max. Pressure Drop of Single Membrane Element	10psi(0.07Mpa)



Residential Series Membrane Element Size

1, 1512		<table border="1"> <tr><td>A</td><td>298 ± 0.5mm</td></tr> <tr><td>B</td><td>35 ± 1mm</td></tr> <tr><td>C</td><td>17 ± 0.5mm</td></tr> <tr><td>D</td><td>21.5 ± 0.5mm</td></tr> </table>	A	298 ± 0.5mm	B	35 ± 1mm	C	17 ± 0.5mm	D	21.5 ± 0.5mm		
A	298 ± 0.5mm											
B	35 ± 1mm											
C	17 ± 0.5mm											
D	21.5 ± 0.5mm											
2, 1812		<table border="1"> <tr><td>A</td><td>298 ± 0.5mm</td></tr> <tr><td>B</td><td>45 ± 1mm</td></tr> <tr><td>C</td><td>17 ± 0.5mm</td></tr> <tr><td>D</td><td>21.5 ± 0.5mm</td></tr> </table>	A	298 ± 0.5mm	B	45 ± 1mm	C	17 ± 0.5mm	D	21.5 ± 0.5mm		
A	298 ± 0.5mm											
B	45 ± 1mm											
C	17 ± 0.5mm											
D	21.5 ± 0.5mm											
3, 2012		<table border="1"> <tr><td>A</td><td>298 ± 0.5mm</td></tr> <tr><td>B</td><td>47 ± 1mm</td></tr> <tr><td>C</td><td>17 ± 0.5mm</td></tr> <tr><td>D</td><td>21.5 ± 0.5mm</td></tr> </table>	A	298 ± 0.5mm	B	47 ± 1mm	C	17 ± 0.5mm	D	21.5 ± 0.5mm		
A	298 ± 0.5mm											
B	47 ± 1mm											
C	17 ± 0.5mm											
D	21.5 ± 0.5mm											
4, 2812		<table border="1"> <tr><td>A</td><td>298 ± 0.5mm</td></tr> <tr><td>B</td><td>69 ± 1mm</td></tr> <tr><td>C</td><td>17 ± 0.5mm</td></tr> <tr><td>D</td><td>21.5 ± 0.5mm</td></tr> </table>	A	298 ± 0.5mm	B	69 ± 1mm	C	17 ± 0.5mm	D	21.5 ± 0.5mm		
A	298 ± 0.5mm											
B	69 ± 1mm											
C	17 ± 0.5mm											
D	21.5 ± 0.5mm											
5, 3012		<table border="1"> <tr><td>A</td><td>298 ± 0.5mm</td></tr> <tr><td>B</td><td>70 ± 1mm</td></tr> <tr><td>C</td><td>17 ± 0.5mm</td></tr> <tr><td>D</td><td>21.5 ± 0.5mm</td></tr> </table>	A	298 ± 0.5mm	B	70 ± 1mm	C	17 ± 0.5mm	D	21.5 ± 0.5mm		
A	298 ± 0.5mm											
B	70 ± 1mm											
C	17 ± 0.5mm											
D	21.5 ± 0.5mm											
6, 3013		<table border="1"> <tr><td>A</td><td>333 ± 0.5mm</td></tr> <tr><td>B</td><td>69 ± 1mm</td></tr> <tr><td>C</td><td>17 ± 0.5mm</td></tr> <tr><td>D</td><td>17.5 ± 0.5mm</td></tr> </table>	A	333 ± 0.5mm	B	69 ± 1mm	C	17 ± 0.5mm	D	17.5 ± 0.5mm		
A	333 ± 0.5mm											
B	69 ± 1mm											
C	17 ± 0.5mm											
D	17.5 ± 0.5mm											
7, 3020		<table border="1"> <tr><td>A</td><td>513 ± 0.5mm</td></tr> <tr><td>B</td><td>76 ± 1mm</td></tr> <tr><td>C</td><td>26 ± 0.5mm</td></tr> <tr><td>D1</td><td>26.5 ± 0.5mm</td></tr> <tr><td>D2</td><td>23.3 ± 0.5mm</td></tr> </table>	A	513 ± 0.5mm	B	76 ± 1mm	C	26 ± 0.5mm	D1	26.5 ± 0.5mm	D2	23.3 ± 0.5mm
A	513 ± 0.5mm											
B	76 ± 1mm											
C	26 ± 0.5mm											
D1	26.5 ± 0.5mm											
D2	23.3 ± 0.5mm											

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Residential Series

Keensen Residential Series RO Membrane Element

Model No.: RO-1512-50 ( Special Membrane Flat Sheet )  
RO-1812-50/75, RO-2012-100/150, RO-2812-200  
RO-3012-300/400, RO-3013-400, RO-3020-600

Usage: It is widely applicable to household water purification, direct drinking in building or office and other small water purification equipment etc.

Features: High rejection rate and low working pressure.

Specifications and Parameters:

Model	Active Membrane Area ft (m <sup>2</sup> )	Permeate Flow GPD(T/D)	Stable Rejection Rate (%)	Min. Rejection Rate (%)
RO-1512-50	2 (0.19)	50 (0.19)	97	96
RO-1812-50	4 (0.37)	50 (0.19)	98	97
RO-1812-75	4 (0.37)	75 (0.28)	98	97
RO-2012-100	6 (0.56)	100 (0.38)	97	96
RO-2012-150	6 (0.56)	150 (0.57)	97	96
RO-2812-200	10 (0.93)	200 (0.76)	97	96
RO-3012-300	14 (1.30)	300 (1.14)	97	96
RO-3012-400	14 (1.30)	500 (1.89)	97	96
RO-3013-400	17 (1.58)	600 (2.27)	97	96
RO-3020-600	27 (2.51)	700 (2.64)	97	96



Standard Test Condition:

Concentration of Solution (NaCl)	Temperature (°C)	pH Value	Operating Pressure psi(MPa)	Recovery Rate (%)
250ppm	25	7.5-8	60 (0.41) 400/600-100 (0.69)	15

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

Operating Limits and Conditions of Membrane Element:

Max. Working Pressure	300psi(2.07MPa)
Max. Feed Water Temperature	45 °C
Max. Feed Water SDI <sub>15</sub>	5.0
Free Chlorine Concentration of Feed Water	0.1mg/L
pH Range of Feed Water during Continuous Operation	3-10
pH Range of Feed Water during Chemical Cleaning	2-12
Max. Pressure Drop of Single Membrane Element	10psi(0.07Mpa)



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## Residential Series

### KeenSen Residential Series NF Membrane Element

Model No.: NF-1812/2012/2812/3012

Usage: It is applicable to the desalination of raw water with salt concentration less than 500ppm. It can be widely applied to various small size household water purification, mineral water machine and energy machine etc.

Features: It has the selective desalination mechanism for removal of high polyvalent ions and partial maintaining of monovalent ions with health benefits. Moreover, it has the advantage of ultra-low operating pressure.

Specifications and Parameters:

Model	Active Membrane Area ft (m <sup>2</sup> )	Permeate Flow GPD(T/D)	Rejection Rate(%)	
			250ppm NaCl	250ppm MgSO <sub>4</sub>
NF-1812	4 (0.37)	120 (0.45)	30-50	96
NF-2012	6 (0.56)	150 (0.57)	30-50	96
NF-2812	10 (0.93)	300 (1.14)	30-50	96
NF-3012	14 (1.30)	400 (1.51)	30-50	96

Standard Test Condition:

Concentration of Solution	Temperature (°C)	pH Value	Operating Pressure psi(MPa)	Recovery Rate (%)
250ppm(NaCl) 250ppm(MgSO <sub>4</sub> )	25	7.5-8	60 (0.41)	15

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

Operating Limits and Conditions of Membrane Element:

Max. Working Pressure	300psi(2.07MPa)
Max. Feed Water Temperature	45 °C
Max. Feed Water SDI <sub>15</sub>	5.0
Free Chlorine Concentration of Feed Water	0.1mg/L
pH Range of Feed Water during Continuous Operation	3-10
pH Range of Feed Water during Chemical Cleaning	2-12
Max. Pressure Drop of Single Membrane Element	10psi(0.07Mpa)



### 1、 Customized Membrane Sheet

Special membrane sheet what is according to the customers' flux and rejection rate requirement.

### 2、 Customized Membrane Element

Special size and performance of membrane element what is according to the customers' requirement.

### 3、 Customized Requirement

Customers should provide the technical specification document for customized product to KeenSen's sales manager or application engineer (AE).





## Purchase Confirmation of Membrane Sheets' Technical Specification

Quality Requirement	<input type="checkbox"/> According to the KeenSen's standard <input type="checkbox"/> According to the customer's requirement	Usage	
Information Customer Provided	<input type="checkbox"/> Design drawing (including product size and logo) <input type="checkbox"/> Purchasing technical specification <input type="checkbox"/> Packaged sample		
Special Specifications	Membrane Sheets Types	Membrane Sheets Series	Quantity ( Roll ) Remark 1
	<input type="checkbox"/> RO <input type="checkbox"/> NF Membrane Filtration Flux GFD ( NaCl )	<input type="checkbox"/> BW <input type="checkbox"/> ULP-HR <input type="checkbox"/> ULP <input type="checkbox"/> NF1 <input type="checkbox"/> NF2	<input type="checkbox"/> 500m/roll <input type="checkbox"/> 1000m/roll
Special Specifications and Parameters	Rejection Rate (%)	Membrane Flux GFD ( NaCl )	Time for Stable Performance(h)
	<input type="checkbox"/> NaCl <input type="checkbox"/> MgSO <sub>4</sub>		
Test Condition	Temperature	pH Value	Concentrate Flow
	25°C	7.5-8.0	1.1GPM
	Concentration of Feed Water	Operating Pressure	Remark 2 (optional)
	NaCl <input type="checkbox"/> 500ppm <input type="checkbox"/> 1500ppm <input type="checkbox"/> 2000ppm MgSO <sub>4</sub> <input type="checkbox"/> 2000ppm	<input type="checkbox"/> 225psi (1.55MPa) <input type="checkbox"/> 150psi (1.03MPa) <input type="checkbox"/> 70psi (0.48MPa)	
Approved	Approved by Customer		Approved by Engineer
	Signature: _____ Date: _____	Signature: _____ Date: _____	

## Purchase Confirmation of Membrane Elements' Technical Specification

Quality Requirement	<input type="checkbox"/> According to the KeenSen's standard <input type="checkbox"/> According to the customer's requirement	Usage	
Information Customer Provided	<input type="checkbox"/> Design drawing (including product size and logo) <input type="checkbox"/> Purchasing technical specification <input type="checkbox"/> Packaged sample		
Special Specifications	Membrane Elements Types	Membrane Sheets Series	Quantity Remark 1(optional)
	<input type="checkbox"/> RO <input type="checkbox"/> NF		
Special Specifications and Parameters	Rejection Rate (%)	Membrane Flux GFD ( NaCl )	Time for Stable Performance(h)
	<input type="checkbox"/> NaCl <input type="checkbox"/> MgSO <sub>4</sub>	( ± 15% )	Dry: Wet:
Test Condition	Temperature	pH Value	Recovery Rate
	25°C	7.5-8.0	
	Concentration of Feed Water	Operating Pressure	Remark 2 (optional)
	NaCl <input type="checkbox"/> 500ppm <input type="checkbox"/> 1500ppm <input type="checkbox"/> 2000ppm MgSO <sub>4</sub> <input type="checkbox"/> 2000ppm	<input type="checkbox"/> 225psi (1.55MPa) <input type="checkbox"/> 150psi (1.03MPa) <input type="checkbox"/> 100psi (0.69MPa) <input type="checkbox"/> 70psi (0.48MPa) <input type="checkbox"/> 60psi (0.41MPa)	
Approved	Approved by Customer		Approved by Engineer
	Signature: _____ Date: _____	Signature: _____ Date: _____	



## Guide to Design of RO and NF System

According to the water quality of feed and requirements of output, users need to design the membrane system with reasonable recovery rate and permeate flow in unit membrane area by applying suitable model membranes to achieve the high efficiency.

If the designed permeate flow of unit area is much higher than the reasonable value, it will greatly rises the membrane fouling rate and reduces the permeate flow, meanwhile, the membrane system will need much more extra cost for maintaining. To extend membranes service life, the recovery rate should be designed with 15%. However, some users need to design the higher recovery rate (more than 18%) to improve the system efficiency. Therefore, it is necessary to choose the reasonable array about membrane system to achieve the higher system recovery rate. Such as series or parallel design which can extend the membranes service life and also save the energy.

Detailed design advice:

1. As for the single membrane system, the system recovery rate can be improved to 50% by adjusting the backflow device of concentrated water; if the membrane system designed recovery rate is higher than 18% without concentrated water backflow device, 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 core pressure vessels, recovery rate of membrane system can achieve to 40-60% by using three stage arrays (4:2:1)

For 3-5 core pressure vessels, 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 core pressure vessels, 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 contamination under the correct working condition, which will decrease the permeate flow.

## Feed Quality Requirements of RO and NF Membrane System

As a kind of new type physical desalination technology, membranes have special structure, material and desalination mechanism. So quality of feed water has strict requirements, which is crucial to maintaining the good separation performance, extending the working life and economize the operating cost.

Items		Permissible Value	Probably Consequence of Excessive Standard	Improvement Suggestions
Suspended Solids	Turbidity	<1.0NTU	Sludge, Colloid Pollution	Flocculation and Filtration
	SDI <sub>15</sub>	<5		
Metal Oxides	Fe(mg/L)	<0.05	Iron Pollution	Oxidation, Precipitation/ Filtration Application of Dispersing Agents
	Mn(mg/L)	<0.05	Manganese Contamination	
Scale Forming Matter	CaCO <sub>3</sub>	LSI<0	Concentrated Water Side does not Permit Scaling	Decrease Recovery Rate, pH Value, or Add Scale Inhibitor
	Other Insoluble Salt	/		
Organics	Oil	0	Organics and Oil Pollution	Air Flotation, Absorption
	TOC (mg/L)	<10		
	COD <sub>cr</sub> (mg/L)	<10	Organics Pollution	Activated Carbon Absorption, Filtration
	BOD <sub>5</sub> (mg/L)	<5		
Si (mg/L)		<20	Colloid Pollution	
pH		3-10	Too Low or too High pH will Accelerate the Aging Speed of Membrane	Regulation 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 Others	0		

### Note:

1. Membrane has a certain residual chlorine resistance capability (200-1000ppm HR), and when it's in the different temperature, pH value and other conditions, the damage speed of residual



chlorine is different to aromatic polyamide membrane. Hence, it must keep the residual chlorine of feed water under 0.1mg/L;

2. Iron and manganese in feed water cannot be higher than 0.05mg/L. They usually dissolved in water with bivalent or present with insoluble trivalent hydroxide. If the concentration of iron and manganese are higher than 0.05mg/L, and they are oxidized by air to form the  $Fe(OH)_3$  and  $Mn(OH)_2$ , precipitate will be existed in the membrane system when the pH value is higher than standard level.

3. Silicon usually exists in most of nature water with 1-100mg/L concentration. When the pH value is lower than 9.0, Silicon will be exist in  $Si(OH)_4$ . When the pH value is too low, it will form colloidal silica. When the pH value is higher than 9.0, it will exist in  $SiO_3^{2-}$  or form hydrate precipitation through combine with calcium, magnesium, iron, or plumbum.

4. Water alkalinity is mainly formed by  $HCO_3^-$ . When the pH Value is higher than 8.3,  $HCO_3^-$  will transfer to be  $CO_3^{2-}$ . Raw water will be concentrated in the process of RO and NF system, so  $CaCO_3$  is easy to form the scaling matter in the system.

5. If one or more above indicators in non-compliance, which may have following influence for membranes or permanent damage.

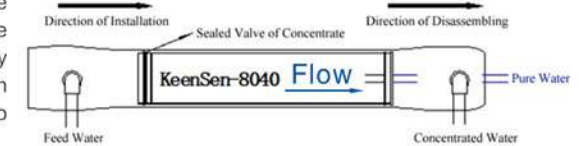
- Membrane elements are oxidized by residual chloride or contaminated by metal oxide.
- Suspended solid may plug the membrane elements, even following with serious colloidal contamination.
- An increasing output of CODcr may occur as a result of organic and microbiological contamination.

## Membrane Installation and System Operating Maintenance

—To Improve the Utilization Efficiency and Extend the Working Life

### 1. Installation and Disassembling of Membrane Element ( Please see the below image )

**Installation:** The concentrated water V-groove seal on the inlet side is opposite to the feed water inlet direction. Membrane element force direction is same as feed water, and please kindly use the professional tool to push the membrane element into housing.



**Disassembling:** When users remove the membrane element, the direction should be consistent with install process. Installer need to stably push the membrane element from the side of inflow. Please notice the connection of central connector, adapter and central tube of element. Avoid installing or disassembling forcefully. Make sure to use the water or glycerin as lubricant.

The inner length of membrane element's pressure vessel has a little surplus size, which enables membrane element length to change in a small range. However, the surplus size may result in a gap between the adapter and membrane element after installation. Membrane element will slide back and forth in the pressure vessels during the process of boot and shut down the system because of the gap, which will accelerate the damage of sealing element. Besides, pressure vessels will extend when pressure rises. In extreme condition, the component closer to inflow water side and concentrated water maybe drop from end-plate, which will cause more serious leakage. Installers should adjust membrane axial clearance of membrane element in pressure vessels to decrease the axis motion, thus to ensure the firm seal between the inner joint and the front and the elements ends.

### 2. Initial Operation Notice of Membrane Element System

(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 membrane element, check the effluent SDI15 value of pre-treatment, residual chlorine of inflow water should be lower than 0.1mg/L, inflow water cannot have oxidizer, etc.

(2). Operator should fully ensure all the setting of valves is correct after careful 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 flushing 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,

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تهران، کیلومتر ۲۱ بزرگراه لشکری (جاده مخصوص کرج)

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/30/



(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 be lower than 0.7bar 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.

### 3. Notice of Membrane System Halt

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.

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°C, bactericide needs to change per each 15 days. When the membrane system start 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.

### 4. The Cleaning of Membrane System

#### (1). 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 appears:

- 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%. (RO series is subject to NaCl solution, NF series is subject to MgSO4 solution)

The choosing of cleaning agents will be determined by quality of raw water. The high hardness of water is easy to scale, which usually need to clean through acidic cleaning agents. However, the high content of organic can cause contamination of organic, membrane element need to clean through alkaline cleaning agents. When the membrane system mainly contaminated by the salt scaling, it needs acid pickling first, then alkali washing. When the membrane system is mainly caused by organic pollution, following recommendation is necessary: alkali cleaning first,

then acid pickling, alkali washing again.

#### (2). Process of Cleaning

Related cleaning solution should be prepared with permeated flow. Firstly, open or close relevant pipes to form a recycle cleaning pipe. Then, operate the cleaning pump, pour the cleaning solution into pressure vessel of membrane element. The circulation cleaning starts to work. It usually takes 1-2 hours for once cleaning. Membrane systems can also be soaking first then cleaning, if it is contaminated terribly. Please notice the flow changes of permeated flow and concentration.

When the pH value changes 0.5, operator should add cleaning agents. Membrane system should be washed with permeated flow after first cleaning. Then re-clean with another kind of cleaning agent. After these processes, membrane system need to be washed with low pressure water first, then gradually exhausting to boost the pressure until the permeated flow is qualified.

If membrane element blocked up in a serious condition or it doesn't have obvious recovery for flow after cleaning, pour the cleaning agent again to the pressure vessels of membrane element and then soaking the membrane element for 6 to 12 hours. Then membrane system can be cleaned again.

#### (3). 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.

#### (4). Note:

Membrane system should be cleaned with low pressure and high flux water. At the initial five minutes, circulation cleaning should be controlled with 1/3 of deigned flow rate. Then the flux should be adjusted the 2/3 of designed flux to full value in each ten minutes. Usually it needs at least one hour circulation cleaning.

#### (5). Cleaning Limit of pH

Scaling, organic compounds and biological film can be cleaned with high efficiency, when the cleaning solution pH at 1 or 13. The cleaning solution temperature must be controlled to avoid damage for membrane elements. If the limit cleaning is necessary, contact the technical support of manufacturer for the guidance.

#### (6). Cleaning Limit of Temperature

The regular chemical cleaning solution temperature should be controlled between 30 to 35 °C. If limit cleaning is necessary, the solution temperature should be controlled within 25 °C. The membranes system needs to avoid limit cleaning under too low temperature. The suggested cleaning temperature is between 20 to 25 °C to increase the cleaning efficiency.





## Packing and Storage of Keenssen Membrane Element

1. Majority of Keenssen 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 degrees celsius, the wet membranes also need to be protected 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

(1). The membrane elements shall be stored in a shadow place (within 5–35°C) out of direct sunlight.

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

(3). Avoid the membrane element remain in upright for a long period.

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

(5). 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.



## Major Project Case

### Case 1. Groundwater Treatment—Water Supply Workshop of Shougang Group Power Plant

Shougang Power Plant mainly provides power of water, gas, steam and compressed air etc. The water supply workshop mainly provides living water for the group.

The raw water of desalination system in this workshop is ground water with the characteristic of high hardness. The system adopting Keenssen RO series "BW-8040" membrane element with "disc filter + UF + RO" treatment processes, it's running since April 2016, the stable rejection rate is 98.5%, permeate water is stable as well.

#### System Parameters:

Model	Output/Set	Membrane Flux	Recovery Rate	Operating Pressure	Rejection Rate	Array
BW-8040	4000m <sup>3</sup> /d	27.0LMH	75%	1.2MPa	>98.5%	11:5



### Case 2. Surface Water Treatment—Hang Feng Tap Water Plant in Cixi, Ningbo

Cixi is located at coast of East China Sea, south coast of Hangzhou bay. Reservoir water is the main sources of the Cixi citizen. Hang Feng Tap Water Plant is the earliest and largest running water supplier with advanced "UF+RO" double membrane" treatment technology. Its daily treatment capability reaches to 50,000 tons. Dow membranes have been applied over the past decade.



In May, 2013, Keenssen BW-8040 membrane elements replaced the old membrane of Hang Feng Tap Water Plant. Now the system remains stable rejection rate at 98.9%–99.3%, which can fully meet the customer requirements with high permeate flow. The regeneration performance of membrane element is also praised by the owner. This project not only improved municipal tap water quality but also greatly reduced the production cost by using Keenssen reverse osmosis membranes elements.

#### System Parameters:

Model	Output/Set	Membrane Flux	Recovery Rate	Operating Pressure	Rejection Rate	Array
BW-8040	2000m <sup>3</sup> /d	21.0LMH	75%	0.9–1.2MPa	99.0%	16:8



## Major Project Case

### Case 3: Landfill Leachate Treatment--Changsha Solid Wastes Disposal Site in Hunan

Leachate is a kind of high concentration of toxic wastewater, containing large amounts of refractory organics, soluble salts and heavy metals. Changsha Solid Wastes Disposal Plant is one of large scale landfills site in China with 5,000 Tons of disposal capability per day. The Leachate Treatment Plant has adopted the international advanced membrane technology. Its leachate processing capacity up to 1,800 tons per day, the treated wastewater fully meets the national discharged standards, which regards as a demonstrative project for treatment of solid wastes disposal by the National Ministry of Housing and Urban-Rural Development.



The membrane system replaced with Keensan "NF1-8040" and "SW-8040" membrane element in April, 2013. So far, Keensan membranes are working with good performance. Moreover, low operating pressure and high flux of Keensan NF membrane greatly decreased the investment and running cost.

#### System Parameters:

Model	Output/Set	Membrane Flux	Recovery Rate	Operating Pressure	Rejection Rate	Array
NF1-8040	600m <sup>3</sup> /d	18.0LMH	85%	0.5MPa		2:2:2
SW-8040	417m <sup>3</sup> /d	12.0LMH	70%	2.5MPa		2:2:2

#### Some other examples of landfill leachate

- Landfill Site in Hei Mifeng, Changsha (2000m<sup>3</sup> / d, it's running since April, 2013)
- Landfill Site in Chongkou, Guilin (600m<sup>3</sup> / d, it's running since August, 2015)
- Landfill Site in Dapeng New District, Shenzhen (400m<sup>3</sup> / d, it's running since August, 2015)
- Landfill Site in Lingui County Pass (400m<sup>3</sup> / d, it's running since August, 2015)
- Landfill Site in Leiyang (300m<sup>3</sup> / d, it's running since June, 2015)

### Case 4. Groundwater Treatment--Sonid Zuoqi Mandula Waterworks ( Inner Mongolia)



The raw water of this project is groundwater, which has the characteristics of high TDS, high fluoride, and high hardness. The RO system adopts Keensan "BW-8040" membrane with "sand filter + manganese sand filter + self-cleaning filter + ultrafiltration." pretreatment process. Membrane system running since 2014, the system rejection rate is stable at 98.5% with stable permeates flow. It fully meets customer demands.

#### System Parameters:

Model	Output/Set	Membrane Flux	Recovery Rate	Operating Pressure	Rejection Rate	Array
BW-8040	3000m <sup>3</sup> /d	21.0LMH	75%	1.2MPa	98.5%	10:6

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### Case 5. Groundwater Treatment --Centralized Water Supply Plant in Baiqi area (Inner Mongolia)

As for the high hardness, manganese, fluoride of raw water, the project used the "manganese sand filtration + ultrafiltration + reverse osmosis" treatment process. Keensan "BW-8040" model used in the whole system, the supply water is disinfected the mixed permeate flow from RO and precision filter. The RO system working from 2015, the system rejection rate is stable at 98.5% with good permeate flow. The permeate flow quality is much higher than the national "drinking water standards".

#### System Parameters:

Model	Output/Set	Membrane Flux	Recovery Rate	Operating Pressure	Rejection Rate	Array
BW-8040	1000m <sup>3</sup> /d	22.0LMH	75%	1.1MPa	98.5%	4:2

### Case 6: Food Process Water--Manufacturing Base of Shanghai Bright Dairy & Food Co., Ltd



Dairy foods are necessary for human life. The production process requires a lot of pure water, which usually apply the large-scale of RO water treatment plant.

Bright Dairy & Food Co., Ltd is specializing in production of dairy food. The pure water system of Shanghai Production Base is applying the Keensan "ULP-8040" RO membrane element with 200 CBM per hour output from June, 2013. So far, membrane systems are working under a well condition. The stable membrane performance has gained recognition of their leader.

#### System Parameters:

Model	Output/Set	Membrane Flux	Recovery Rate	Operating Pressure	Rejection Rate	Array
ULP-8040	2500m <sup>3</sup> /d	25.0LMH	75%	1.0MPa	>98%	6:3

### Case 7: Surface Water Treatment --- Reuse of Recycled Water in Cixi Xingfa Electroplating Factory

The main projects of Cixi Xingfa Electroplating Factory are matte tin plating, gold plating, semi-gold nickel selective, semi-gold nickel, all nickel, all tin and iron plating etc. They are widely applied for computer connectors, hardware electrical switches, communications, home and electrical appliances etc.

The process water of electroplating production line is using municipal and industrial wastewater as raw water. The water treatment system adopt flocculation clarification and multi-media as pretreatment process, then RO process are using Keensan RO series "BW-8040FR" fouling resistant membrane element. The RO system is running stably since December, 2013. The flow rate and output quality both meet the water supply requirements.

#### System Parameters:

Model	Output/Set	Membrane Flux	Recovery Rate	Operating Pressure	Rejection Rate	Array
BW-8040FR	3600m <sup>3</sup> /d	24.0LMH	75%	1.5MPa	98.5%	12:6

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## Major Project Case

**Case 8: Leather Wastewater Treatment--Reuse of Leather Wastewater in Henan Xiangcheng Tannery.**

Leather wastewater is generated from the production process, has a high colority, high organic content, large flux fluctuations and high concentrations of suspended solids with serious pollution. A tanneries in Xiangcheng applying "Biochemical + NF + RO" process to recycle waste water. Keensen "NF1-8040" and "BW-8040FR" model are using in the NF and RO system since October, 2015. So far, it is operating with good performance.

System Parameters:

Model	Output/Set	Membrane Flux	Recovery Rate	Operating Pressure	Rejection Rate
NF1-8040	1000m <sup>3</sup> /d	27.0LMH	70%	0.7MPa	60%
BW-8040FR	800m <sup>3</sup> /d	27.0LMH	70%	1.5MPa	98%

**Case 9: Paper Mill Effluent Treatment--Reuse of Paper Mill Effluent in Lin'an, Hangzhou**

Paper-making wastewater is mainly from the production process of pulping and paper making. The pulp process causes the worst water pollution. It contains a lot of fiber, inorganic salts, organic matter, pigments and other pollutants.

The Lingnong Paper Co., Ltd., is located at Hangzhou, apply the traditional "neutralization + coagulating sedimentation + chemical decolorization + biological treatment" method as pretreatment process, introduce the advanced double membrane "UF+RO" treatment process to achieve the sustainable development of enterprises of energy conservation and emission reduction.

System Parameters:

Model	Output/Set	Membrane Flux	Recovery Rate	Operating Pressure	Rejection Rate
BW-8040FR	2000m <sup>3</sup> /d	23.0LMH	70%	1.5MPa	>97%

**Case 10: Salt Chemical Engineering of Sea Water--Chlor-Alkali Chemical Projects in North Korea**

Salt chemical industry is the use of salt or brine resources, processed into sodium chlorate, sodium carbonate, ammonium chloride, caustic soda, hydrochloric acid, chlorine, hydrogen, sodium metal, as well as the further processing and utilization of above material. A salt chemical project is located in North Korea, apply the Donnan and charge effect of Keensen nanofiltration membranes to remove the calcium, magnesium, sulfate. Other ions, sodium chloride allowed permeating. Keensen nanofiltration membranes "NF2-8040F" model have been applied to the membranes systems.

System Parameters:

Model	Output/Set	Membrane Flux	Recovery Rate	Operating Pressure
NF2-8040F(1st Stage)	1800m <sup>3</sup> /d	18.0LMH	50%	1.8MPa
NF2-8040F(2nd Stage)	1500m <sup>3</sup> /d	21.0LMH	50%	1.0MPa

**Case 11: Groundwater and Surface Water Treatment--Boiler Feed of Thermal Power Plant**

A large thermal power plant in famous Iron and Steel Enterprise of Shandong is mainly supplies electricity energy and heat. The outputs of reverse osmosis system supply the boiler demands. The raw water of RO system is mixture surface water and groundwater with high hardness and high organism. It combines the clarification and mechanical filtration pretreatments process, meanwhile, Keensen "BW-8040" brackish water series elements are applied for the RO system. The permeated quality and flow are working stable (Rejection rate> 98.5%).

System Parameters:

Model	Output/Set	Membrane Flux	Recovery Rate	Operating Pressure	Rejection Rate
BW-8040	4800m <sup>3</sup> /d	25.0LMH	75%	1.0MPa	>98.5%

Some Parts of Other Thermal Power Projects

A Aluminum Power Plant in Binzhou, Shandong ( 2500 m<sup>3</sup>/d )

A Power Plant in Taian, Shandong ( 2000 m<sup>3</sup>/d )

A Power Plant in Linyi, Shandong ( 1000 m<sup>3</sup>/d )

**Case 12: Groundwater Treatment-- Production Water Supply for Joincare Pharmaceutical Group in Jiaozuo**

Jiaozuo Joincare Pharmaceutical Industry Co., Ltd is a subsidiary of Joincare Pharmaceutical Industry Group Co., Ltd (Factory of Taitai Oral Liquid). It's the important strategy for raw material self-sufficient. The pure process water supply system is using Keensen "BW-8040" series element. It is working from Sep, 2016, so far, the membrane system working stable and get the fully recognition of the owner.

System Parameters:

Model	Output/Set	Membrane Flux	Recovery Rate	Operating Pressure	Rejection Rate
BW-8040	2000m <sup>3</sup> /d	25.0LMH	75%	1.0MPa	98.5%

**Case 13: Heavy Metal Wastewater Treatment--Arsenic Wastewater Treatment by NF Technology**

A new material company in Hunan is specializing in manufacture and processing for antimony products. It occurs high arsenic concentrated wastewater during the production process. This project use "aerated sedimentation + MF" as the pretreatment process, and NF technology to achieve the output fully meet emission standard. Keensen "NF2-8040F" separation series elements are applied in this project for material separation.

System Parameters:

Model	Output/Set	Membrane Flux	Recovery Rate	Operating Pressure
NF2-8040F	500m <sup>3</sup> /d	23.0LMH	65%	0.5MPa

**Case 14: Other Applications**

Except above mentioned landfill leachate, coking wastewater, municipal water supply, process water of food and other industries, Keensen RO and NF membranes also have wide application for drinking water, food and beverage, industrial ultra-pure, boiler feed water, etc.



## KEENSEN Table of Temperature Correction Factor for RO Membrane Permeate Flow

## Analysis and Suggestion for Common Bug of Membrane System

Temperature °C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
5	2.014	2.007	2.000	1.993	1.986	1.979	1.972	1.965	1.958	1.951
6	1.944	1.938	1.931	1.924	1.917	1.911	1.904	1.897	1.891	1.884
7	1.878	1.871	1.865	1.858	1.852	1.845	1.839	1.832	1.826	1.819
8	1.813	1.807	1.800	1.794	1.788	1.782	1.775	1.769	1.763	1.757
9	1.751	1.745	1.738	1.732	1.726	1.720	1.714	1.708	1.702	1.696
10	1.690	1.685	1.679	1.673	1.667	1.661	1.655	1.650	1.644	1.638
11	1.632	1.627	1.621	1.615	1.610	1.604	1.598	1.593	1.587	1.582
12	1.576	1.571	1.565	1.560	1.554	1.549	1.543	1.538	1.533	1.527
13	1.522	1.517	1.511	1.506	1.501	1.496	1.490	1.485	1.480	1.475
14	1.470	1.464	1.459	1.454	1.449	1.444	1.439	1.434	1.429	1.424
15	1.419	1.414	1.409	1.404	1.399	1.394	1.390	1.385	1.380	1.375
16	1.370	1.365	1.361	1.356	1.351	1.346	1.342	1.337	1.332	1.328
17	1.323	1.319	1.314	1.309	1.305	1.300	1.296	1.291	1.287	1.282
18	1.278	1.273	1.269	1.264	1.260	1.255	1.251	1.247	1.242	1.238
19	1.234	1.229	1.225	1.221	1.217	1.212	1.208	1.204	1.200	1.195
20	1.191	1.187	1.183	1.179	1.175	1.171	1.166	1.162	1.158	1.154
21	1.150	1.146	1.142	1.138	1.134	1.130	1.126	1.122	1.119	1.115
22	1.111	1.107	1.103	1.099	1.095	1.091	1.088	1.084	1.080	1.076
23	1.073	1.069	1.065	1.061	1.058	1.054	1.050	1.047	1.043	1.039
24	1.036	1.032	1.028	1.025	1.021	1.018	1.014	1.011	1.007	1.004
25	1.000	0.997	0.993	0.990	0.986	0.983	0.979	0.976	0.972	0.969
26	0.966	0.962	0.959	0.956	0.952	0.949	0.946	0.942	0.939	0.936
27	0.932	0.929	0.926	0.923	0.919	0.916	0.913	0.910	0.907	0.903
28	0.900	0.897	0.894	0.891	0.888	0.885	0.882	0.879	0.875	0.872
29	0.869	0.866	0.863	0.860	0.857	0.854	0.851	0.848	0.845	0.842
30	0.839	0.837	0.834	0.831	0.828	0.825	0.822	0.819	0.816	0.813
31	0.811	0.808	0.805	0.802	0.799	0.797	0.794	0.791	0.788	0.785
32	0.783	0.780	0.777	0.775	0.772	0.769	0.766	0.764	0.761	0.758
33	0.756	0.753	0.751	0.748	0.745	0.743	0.740	0.737	0.735	0.732
34	0.730	0.727	0.725	0.722	0.720	0.717	0.715	0.712	0.710	0.707
35	0.705	0.702	0.700	0.697	0.695	0.692	0.690	0.688	0.685	0.683
36	0.680	0.678	0.676	0.673	0.671	0.669	0.666	0.664	0.662	0.659
37	0.657	0.655	0.652	0.650	0.648	0.646	0.643	0.641	0.639	0.637
38	0.634	0.632	0.630	0.628	0.626	0.623	0.621	0.619	0.617	0.615
39	0.613	0.610	0.608	0.606	0.604	0.602	0.600	0.598	0.596	0.594

### Analysis and Solution for Common Bug

No.	Permeate Flow	Rejection Rate	Pressure Difference	The Cause of Bug	Solution
1	Decline	Rise	Unchanged	Membrane Flat Sheet Densification by Water Hammer	Replace Membrane Element; Improving Membrane System
2	Decline	Keep	Unchanged	Organic Contamination	Chemical Cleaning Improving the Pretreatment
3	Decline	Keep	Rise	Microbial Contamination	Chemical Cleaning; Disinfection; Improving the Pretreatment
4	Decline	Decline	Rise	Scaling or Colloidal Contamination	Chemical Cleaning; Improving the Pretreatment
5	Rise	Decline	Unchanged	O-ring Leakage	Inspect or Replace the O-ring
6	Rise	Decline	Unchanged	Back Pressure or Oxidation	Replace Membrane Element

### Judgement for Common System Contamination

No.	Type of Contamination	Change of Feed Water Pressure	Change of Pressure Difference	Change of Rejection Rate	Possible Fouling Position
1	Inorganic Salt Scaling	Rise	Rise	Rise	The Membrane Element in the end of Final Stage
2	Organic Contamination	Rise	Keep	Decline or Keep	All the Membrane Element
3	Fouling by Metallic Oxides	Rise Quickly	Rise Quickly	Rise Quickly	The Membrane Element in the front of First Stage
4	Biological Contamination	Rise Quickly	Rise Quickly	Rise Slowly	Anyone of Membrane Element in the front of Stage
5	Colloidal Contamination	Rise Slowly	Rise Slowly	Rise Slowly	The Membrane Element in the front of First Stage
6	Scaling Contamination	Rise	Rise	Rise	The Membrane Element in the Second Stage
7	Polymerization Silicon Deposits	Rise	Rise	Rise	The Membrane Element in the end of Final Stage

Remark: [Corrected Permeate Flow] = [Standard Permeate Flow at 25°C] ÷ [Temperature Correction Factor corresponding to Feed Water Temperature]



## Sales Network

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