Chapter One - Brief Introduction to the Company and Its Products Series

Section 1: Major Membrane Product Series

Section 2: Advantages of CANADIAN CLEAR Membrane Elements

Section 3: Complete Series of CANADIAN CLEAR Fouling Resistance Membrane Elements

Chapter Two- Products Manual of CANADIAN CLEAR Membrane Element

Section 1: Tables of Characteristics and Manuals for Selection of CANADIAN CLEAR Membrane Elements

Section 2 : Nomenclature

Section 3 : Specifications and Properties of CANADIAN CLEAR Membrane Elements

LP Series Membrane Elements

ULPSeries Elements

XLP Series Elements

SW Series Elements

FR Series Elements

ULP Small-Size Series Elements

SW Small-Size Series Elements

Section 4: Table of Temperature Correction Factors with Permeate flow Normalization

Chapter Three- Theory of Reverse Osmosis Technology and System Design

Section 1: Theory of Reverse Osmosis Technology

Chapter One - Brief Introduction to the Company and Its Products Series

Section 1: Major Membrane Product Series.

Section 2: Advantages of CANADIAN CLEAR Membrane Elements

Section 3: Complete Series of CANADIAN CLEAR Fouling Resistance Membrane Elements

Section 1: Major Membrane Product Series

- **XLP Series: Extra Low Pressure Composite RO Membrane Elements**

XLP series membrane can, under the conditions of extra low operating pressure, obtain as high permeate flow and rejection rate as the regular low-pressure membrane. Its operating pressure is approximately half that of the regular low pressure composite membrane, and it can reach the rejection rate as high as 99.0 percent.

- **ULP Series: Ultra Low Pressure Composite RO Membrane Elements**

ULP series membrane can, under the conditions of extra low operating pressure, obtain as high permeate flow and rejection rate as the regular low-pressure membrane. Its operating pressure is approximately 2/3 to the operating pressure of the regular low-pressure composite membrane, and it can reach the rejection rate as high as 99.0 percent.

- **LP Series: Low Pressure Composite RO Membrane Elements**

LP series is mainly applicable to brackish water desalination, and enjoys the characteristics of low-pressure operation; high permeate flow and excellent desalination property. Furthermore, with the excellent property of eliminating the soluble salts, TOC and SiO2, it is especially suitable for the preparation of high-purity water in electronic and electricity industries.

- **SW Series: Seawater Desalting Composite RO Membrane Elements**

Designed for seawater desalination, the SW series can increase the permeate flow by improving the structure of membrane elements, thus decreasing the consumption of membrane elements. It enjoys the characteristics of high rejection rate, stable function, low operation cost, and low investment in equipment, and can assure drinking water is obtained from seawater only through one-step RO. In connection with the considerably inferior conditions of feed water, such as wastewater recycling and sewage treatment, the company can provide the following:

- **FR Series: Fouling resistance composite RO Membrane Elements**

The FR series is mainly applicable to brackish water desalination, and is designed for the condition of fairly inferior water quality. By adopting special processing technology, the membrane surface is specially treated to change the electric charge and the

smoothness of membrane surface and to increase the hydrophilicity of membrane surface, thus reducing the adhesion of contaminant and microbes to the Membrane surface, increasing the contamination to membrane elements and therefore prolonging its service life.

Section 2: Advantages of CANADIAN CLEAR Membrane Elements

1. Being the largest manufacturer of polyamide composite RO membrane inside the country, we can
   supply to customers the RO elements with performance.
2. Complete series of fouling resistance membrane elements are available.
3. Perfect after service and overall technical support.
4. Products with complete range of specifications and models are available. The membrane products have the dimensions completely in conformity with industrial standards, and enjoy the excellent compatibility.

Section 3: Complete Series of CANADIAN CLEAR Fouling Resistance Membrane Elements

The greatest advantage of CANADIAN CLEAR membrane element series lies in the RO membrane with unique four-layer structure, in the exclusively owned complete series of fouling exclusive membrane elements, and in those characteristics such as excellent membrane properties, reasonable prices, perfect after service and overall technical support, etc.

After making plenty of investigation into the domestic RO systems, CANADIAN CLEAR found out that the service life of domestic RO membrane elements was generally lower than that of similar foreign membrane elements. Searching to the bottom, the reason was found to lie in the imperfect design and management of RO pretreatment, thus causing the membrane elements to suffer aggravated contamination, which decreased its service life.

The company has been concentrating on heightening the competitive power of native water industry and improving the mankind residential environment, and devoting itself to protecting the interests of customers and taking the lead of the industry in promoting the complete series of fouling resistance membrane elements.

While successfully bringing in the advanced RO technology, **CANADIAN CLEAR.** not only assimilated its advanced technology, but also developed independently the special low-fouling membrane, which adopted special technology to produce the world advanced low-fouling three-layer membrane. This membrane product not only retained such merits of regular composite membrane as low operating pressure, high rejection rate and great permeate flow, etc., but also enjoyed the excellent properties of stable fouling resistance and long service life. At present, this low-fouling coating technology has been applied to all series of RO membrane elements produced by **CANADIAN CLEAR**, which has led the company to be the first manufacturer capable of supplying the complete series of low-fouling membrane elements among the industry.

Surface Characteristics of Low-fouling Membrane

Low-fouling membrane is a special product originated from regular RO membrane upon the modification of its properties for the purpose of changing its surface electric charge smoothness.

Compared with regular RO membrane, the low-fouling membrane can effectively reduce the contamination on the membrane surface, prolong its service life, decrease the cleaning frequency, and lengthen the cleaning cycle.

The low-fouling membrane with uncharged surface (i.e. appearing to be electro neutral) can effectively reduce the contamination, and decrease the risk of organic contamination. The special-purpose low-fouling membrane with positive charge can not only reduce the contamination, but also carry out cleaning process by using the cationic surfactant, which is difficult for regular membrane to realize. The modification of surface properties includes the following two aspects:

1. Property of surface charge

The surfaces of XLP, ULP, LP and SW series membrane are free of charge, and appear to be electro neutral or slightly electronegative.

2. Surface smoothness

All series of CANADIAN CLEAR 's elements have the excellent surface smoothness with advantage over that of regular composite membranes.

Models of	Property of	Surface	Characteristics

Membrane	Surface Electric Charges	Smoothness	
XLP: Extra Low Pressure Series	Electro neutral or slightly electronegative	Smooth	Being capable of resisting effectively the most of those contaminants with negative charge, such as organic substance, colloid, and microbe, etc. Furthermore, the improved surface smoothness can effectively decrease the deposition with various contaminants including inorganic salt scale
ULP : Ultra Low Pressure Series			
LP : Low Pressure Series			
SW : Seawater Desalination Series			
FR : Fouling resistance Series	Electro neutral	Smooth	Being capable of reducing various contaminants with positive charge in the feed water, such as cationic polymer, etc.

Chapter Two - Products Manual of CANADIAN CLEAR Membrane Elements

Section l:Tables of Characteristics and Manuals for Selection of CANADIAN CLEAR Membrane Elements

Section 2: Nomenclature

Section 3: Specifications and Properties of CANADIAN CLEAR Membrane Elements

LP Series Membrane Elements

ULP Series Elements

XLP Series Elements

SW Series Elements

FR Series Elements

ULP Small-Size Series Elements

SW Small-Size Series Elements

Section 4: Table of Temperature Correction Factors with Permeate flow Normalization

Section I : Tables of Characteristics and Manuals for Selection of CANADIAN CLEAR Membrane Elements

1. Brief Table of Membrane Elements' Properties

Part Number	Operating Pressure and scope of applications	Average Desalting Ratio (%)	Water Output (m^3/d)	Testing		
				Testing Pressure psi (MPa)	Concentration of Tested Solution, NaCl (ppm)	Recovery Rate (%)
XLP11-4040	Operated under extra low pressure. Applicable to feed water with low salt concentration but low rejection rate	99	9.5	100 (0.69)	500	15
XLP11-8040		99	37.9			
XLP12-8040		99	41.6			
ULP11-4040	Operated under ultra low pressure. Applicable to feed water with fairly low salt concentration	98	11.3	150 (1.03)	1500	15
ULP11-8040		98	45.4			
ULP12-8040		98	49.9			
ULP21-4040		99	9.5			
ULP21-8040		99	41.6			
ULP22-8040		99	45.7			
ULP31-4040		99.4	7.2			
ULP31-8040		99.5	36.3			
ULP32-8040		99.5	39.7			
LP11-4040	Operated under low pressure. Applicable to brackish or high-concentration brackish water	99	10.6	225 (11.55)	2000	15
LP11-8040		99	39.7			
LP12-8040		99	43.5			
LP21-4040		99.5	9.1			
LP21-8040		99.5	36.3			
LP22-8040		99.5	39.7			
LP31-4040		99.7	8.3			
LP31-8040		99.7	34			

LP32-8040		99.7	37.4			
SW11-4040	Operated under high pressure. Applicable to seawater or quasi seawater	99.2	5.3	800 (5.5)	32800	8
SW11-8040		99.2	22.7			
SW12-8040		99.2	26.5			
SW21-4040		99.5	4.5			
SW21-8040		99.7	18.9			
SW22-8040		99.7	22.7			
FR11-4040	Operated under low pressure. Applicable to water resources with small quantity of contaminants (organic substance, colloid).	99	9.8	225 (1.55)	2000	15
FR11-8040		99	41.6			
FR11-8040		99	45.7			
FR11-4040		99.5	8.3			
FR11-8040		99.5	37.9			
FR11-8040		99.5	41.6			

2. Brief Table of Application Scope

Type of Elements	Operating Pressure and Scope of Applications	Applicable saltiness range (ppm)	Potable water; purified water	High-purity water; Ultra-purity water	Recycling of wastewater	Seawater Desalination
			Food staff industry; Pharmaceutical industry	Electronic industry; electric industry; metallurgical industry	Recycled water consumption; municipal sewage; industry wastewater	
XLP: Extra Low pressure series	Operated under extra low pressure. Applicable to feed water with low salt concentration and not required for high rejection rate	0 ~ 1000	Highly applicable	Applicable	Applicable	
ULP: Ultra Low pressure series	Operated under ultra low pressure. Applicable to feed water with fairly low salt concentration	0 ~ 2000	Highly applicable	Applicable	Applicable	
LP: Low pressure series	Operated under low pressure. Applicable to brackish or high-concentration brackish water.	0 ~ 8000	Highly Applicable	Highly Applicable	Applicable	
SW : Seawater Desalti	Operated under high pressure. Applicable to	20000~ 40000				Highly Applicable

ng Series	sea water or quasi seawater					
FR : Fouling Resistance Series	Operated under low pressure. Applicable to water resources with small quantity of contaminants (Organic substance, colloid)	0 ~ 5000	Applicable	Applicable	Highly Applicable	

Note:

1. The properties listed in "Brief Table of Membrane Elements' Properties" are based upon testing values, and may vary from practical application. For specific testing conditions, please refer to relevant chapters of this Manual.
2. Values listed in "Brief Table of Application Scope" are only for information. For practical application, please consult our company or professional personnel.
3. Owing to improvement on technologies and renewal of products, all materials are subject to change without prior notice. Please keep you access to the latest technology manual of the company and to the website of the company: www.canadianclear.com.

Section 2: Nomenclature

1. Nomenclature of 2.5-inch, 4.0-inch and 8.0-inch membrane elements

ULP 1 2 - 8040

Dimensions of Membrane Elements

8040: 8-inch diameter and 40-inch length

4040: 4-inch diameter and 40-inch length

4021: 4-inch diameter and 21-inch length

4014: 4-inch diameter and 14-inch length

2540: 2.5-inch diameter and 40-inch length

2521: 2.5-inch diameter and 21-inch length

2514: 2.5-inch diameter and 14-inch length

Active Membrane Area
1: 80 ft^2 (4040 Membrane Element) 365ft^2 (8040 Membrane Element)
2: 400 ft^2 (8040 Membrane Element)

Rejection Rate
The sequence from 1 to 3 implies the gradual increase of rejection rate

Series of Membrane Elements
XLP: Extra low pressure series
ULP: Ultra low pressure series
LP: Low pressure series
SW: Seawater desalting series
FR: Fouling resistance series

2. Nomenclature of 1812 and 2012-type Membrane Element

ULP 1812 (2012) - 50

Water Permeate flow
50: 50GPD
75: 75GPD
100: 100GPD

Dimensions of Membrane Element
1812: 1.8-inch diameter and 12-inch length
2012: 2.0-inch diameter and 12-inch length

Section 3: Specifications and Properties of CANADIAN CLEAR Membrane Elements

LP Series Membrane Elements: 4040

1. Brief Introduction

LP (Low Pressure) series are the aromatic composite membrane elements developed by **CANADIAN CLEAR**. applicable to brackish water desalination. It enjoys the properties of low-pressure operation; high permeate flow and excellent desalination. Furthermore, it enjoys the high properties of eliminating the soluble salt, TOC and S1O2, and is especially applicable to the manufacture of high-purity water for electronic industry and electric power industry.

Being suitable for the desalination treatment of those water resources with salt concentration lower than 8000 ppm, such as surface water, underground water and municipal water, etc., LP series membrane elements are mainly applicable to various industrial water, such as industry-purpose pure water, boiler water replenishment in power plant, and can also applied to such brackish water applications as treatment of high-concentration salty wastewater and production of beverage-purpose water.

2. **Specifications and Properties of Membrane Element**

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
LP11-4040	99.0	2800(10.6)	85(7.9)

LP21-4040	99.5	2400(9.1)	85(7.9)
LP31-4040	99.7	2200(8.3)	85(7.9)

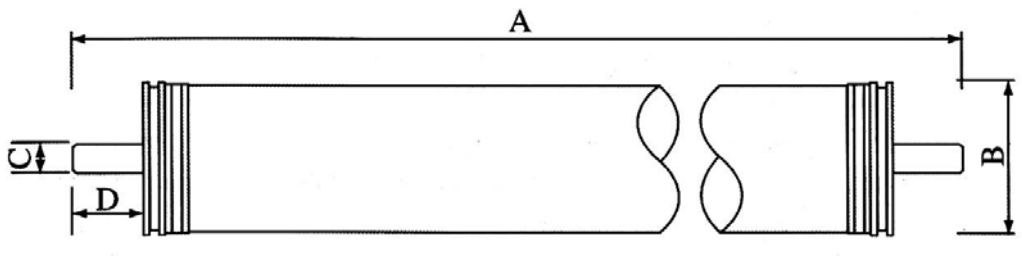
Testing Conditions : Testing Pressure 225psi (1.55Mpa)
Temperature of Testing Solution ..... 25 °C
Concentration of Testing Solution (NaCl) ..... 2000 ppm
PH Value of Testing Solution 7.5
Recovery Rate of Single Membrane Element 15%

3. Extreme operation Conditions

Max. Operating Pressure	600psi (4.14Mpa)
Max. Feed water Flow	16gpm (3.6 m^3/h)
Max. Temperature of Feed water	45 °C
Max. SDI of Feed water	5
Free Chlorine Concentration of Feed water	< 0. lppm
PH Value Range of Feed water as Continuous Operation	3 — 10
PH Value Range of Feed water as Chemical Cleaning	2-11
Max. Pressure difference of Single Membrane Element	15psi(0. IMpa)

4. Dimensions of the Element

All dimensions are in millimeter (inch).



Model	A	B	C	D
4040	1016.0 (40.00)	99 (3.9)	19.1 (0.75)	26.7 (1.05)

5. Important Information

1. For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR,** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR.** Will assumes no liability for all results.

2. The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ±15%.

3. Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogen sulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogen sulfite (foodstuff-purpose).

4. Discard RO product water produced during the first one hour after system start-up.

5. During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements, In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice :

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR**. We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR**, Ltd. assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of CANADIAN CLEAR's products and their applicability to customer's specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to CANADIAN CLEAR 's latest products information.

LP Series Membrane Elements: 8040

1. Brief Introduction

LP (Low Pressure) series are the aromatic composite membrane elements developed by **CANADIAN CLEAR** applicable to brackish water desalination. It enjoys the properties of low-pressure operation; high permeate flow and excellent desalination. Furthermore, it enjoys the high properties of eliminating the soluble salt, TOC and SiC>2, and is especially applicable to the manufacture of high-purity water for electronic industry and electric power industry.

Being suitable for the desalination treatment of those water resources with salt concentration lower than 8000 ppm, such as surface water, underground water, tap water and municipal water, etc., LP series membrane elements are mainly applicable to numerous applications of various scales, such as pure water, boiler water replenishment, foodstuff processing, and pharmaceutical production, etc.

2. Specifications and Main Properties of Membrane Elements

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
LP11-8040	99.0	10500(39.7)	365(33.9)
LP21-8040	99.5	9600(36.3)	365(33.9)
LP31-8040	99.7	9000(34.0)	365(33.9)

Testing Conditions: Testing Pressure	225psi (1.55Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	2000 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	15%

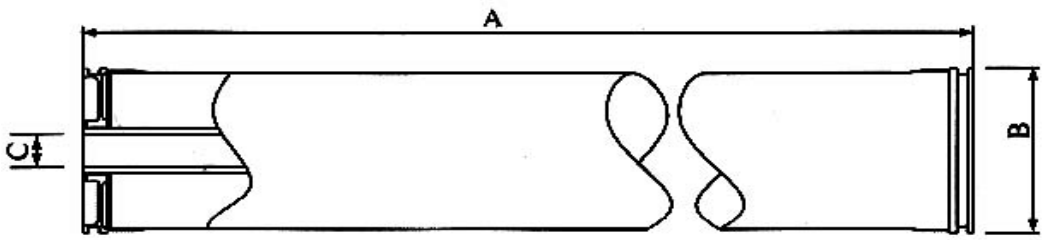
3. Extreme operation Conditions

Max. Operating Pressure	600psi (4.14Mpa)

Max. Feedwater Flow Flow	75gpm (3.6 m^3/h)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0. lppm
PH Value Range of Feedwater as Continuous Operation	3 —10
PH Value Range of Feedwater as Chemical Cleaning	2-11
Max. Pressure Difference of Single Membrane Element	15psi(0. IMpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C
8040	1016.0 (40.00)	201.9 (7.95)	28.6 (1.125)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR**, or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR**. will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ±15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogen

sulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogen sulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR** we believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR**. assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of CANADIAN CLEAR 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to CANADIAN CLEAR 's latest products information.

LP Series Membrane Elements: 8040 High Permeate

1. Brief Introduction

LP (Low Pressure) series are the aromatic composite membrane elements developed by **CANADIAN CLEAR**. applicable to brackish water desalination. It enjoys the properties of low-pressure operation; high permeate flow and excellent desalination. Furthermore, it enjoys the high properties of eliminating the soluble salt, TOC and SKD2, and is

especially applicable to the manufacture of high-purity water for electronic industry and electric power industry.

Being suitable for the desalination treatment of those water resources with salt concentration lower than 8000 ppm, such as surface water, underground water, tap water and municipal water, etc., LP series membrane elements are mainly applicable to numerous applications of various scales, such as pure water, boiler water replenishment, foodstuff processing, and pharmaceutical production, etc.

2. Specifications and Main Properties of Membrane Elements

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
LP12-8040	99.0	11500(43.5)	400(37.0)
LP22-8040	99.5	10500(39.7)	400(37.0)
LP32-8040	99.7	9900(37.4)	400(37.0)

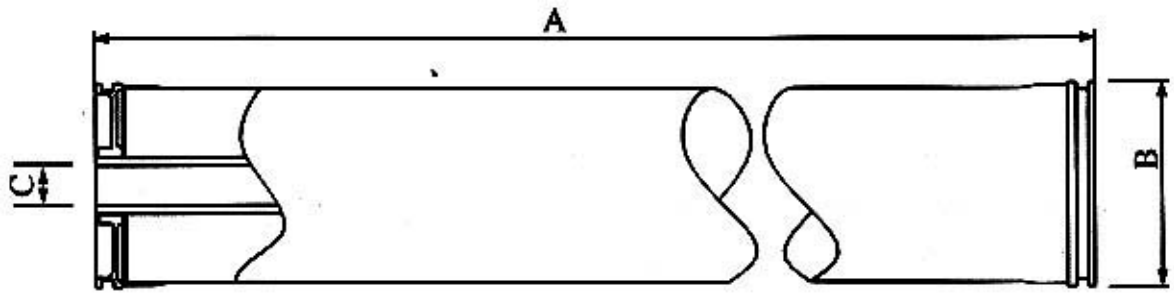
Testing Conditions: Testing Pressure	225psi (1.55Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	2000 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	15%

3. Extreme operation Conditions

Max. Operating Pressure	600psi (4.14Mpa)
Max. Feedwater Flow	75gpm (3.6 m^3/h)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0. lppm
PH Value Range of Feedwater as Continuous Operation	3 —**10**
PH Value Range of Feedwater as Chemical Cleaning	2-11
Max. Pressure Difference of Single Membrane Element	15psi(0. IMpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C
8040	1016.0 (40.00)	201.9 (7.95)	28.6 (1.125)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** Ltd. will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ±15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogen sulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogen sulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR**. assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR**. We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

ULP Series Elements: 4040

1. Brief Introduction

ULP (Ultra Low Pressure) series are the ultra low-pressure aromatic composite membrane elements developed by **CANADIAN CLEAR** applicable to desalination of surface water and underground water. It can work under ultra low pressure to reach as high permeate flow and salt rejection as regular low-pressure membrane element can. It operates under approximately 2 thirds of the operating pressure of regular low-pressure composite membrane, and achieves a salt rejection rate of up to 99.5%, which can decrease the investment costs for such relevant facilities as pump, piping, and container, etc. and the operating cost for the RO system, thus increasing the economic efficiency.

Being suitable for the desalination treatment of those water resources with salt concentration lower than 2000 ppm, such as surface water, underground water, tap water and municipal water, etc., ULP series membrane elements are mainly applicable to numerous applications of various scales, such as pure water, boiler water replenishment, foodstuff processing, and pharmaceutical production, etc.

2. Specifications and Main Properties of Membrane Element

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)

ULP11-4040	98.0	3000(11.3)	85(7.9)
ULP21-4040	99.0	2500(9.5)	85(7.9)
ULP31-4040	99.4	1900(7.2)	85(7.9)

Testing Conditions:

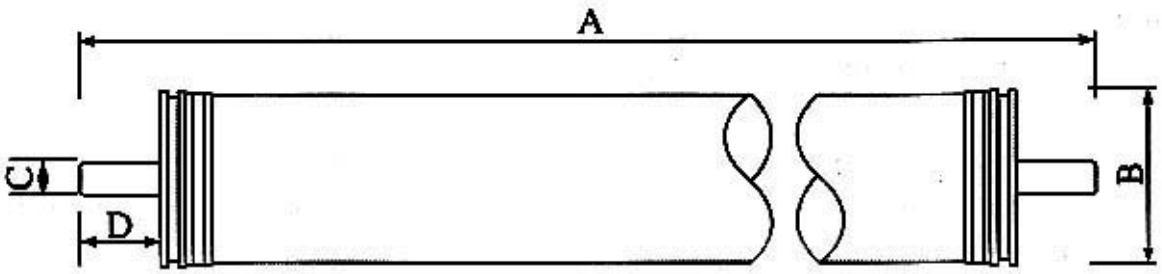
Testing Pressure	150psi (1.03Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	1500 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	15%

3. Extreme operation Conditions

Max. Operating Pressure	600psi (4.14Mpa)
Max. Feedwater Flow	16gpm (3.6 m^3/h)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0. lppm
PH Value Range of Feedwater as Continuous Operation	3-10
PH Value Range of Feedwater as Chemical Cleaning	2-11
Max. Pressure Difference of Single Membrane Element	15psi(0.1Mpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C	D
4040	1016.0 (40.00)	99 (3.9)	19.1 (0.75)	26.7 (1.05)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ±15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any

violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR .**We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

ULP Series Elements: 8040

1. Brief Introduction

ULP (Ultra Low Pressure) series are the ultra low-pressure aromatic composite membrane elements developed by **CANADIAN CLEAR** applicable to desalination of surface water and underground water. It can work under ultra low pressure to reach as high permeate flow and salt rejection as regular low-pressure membrane can. It operates under approximately 2 thirds of the operating pressure of regular low-pressure composite membrane, and enjoys a salt rejection rate of up to 99.5%, which can decrease the investment costs for such relevant facilities as pump, piping, and container, etc. and the operating cost for the RO system, thus increasing the economic efficiency.

Being suitable for the desalination treatment of those water resources with salt concentration lower than 2000 ppm, such as surface water, underground water, tap water and municipal water, etc., ULP series membrane elements are mainly applicable to numerous applications of various scales, such as pure water, boiler water replenishment, foodstuff processing, and pharmaceutical production, etc.

2. Specifications and Main Properties of Membrane Element

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
ULP12-8040	98.0	12000(45.4)	365(33.9)
ULP22-8040	99.0	2100(41.6)	365(33.9)
ULP32-8040	99.5	10500(36.3)	365(33.9)

Testing Conditions:

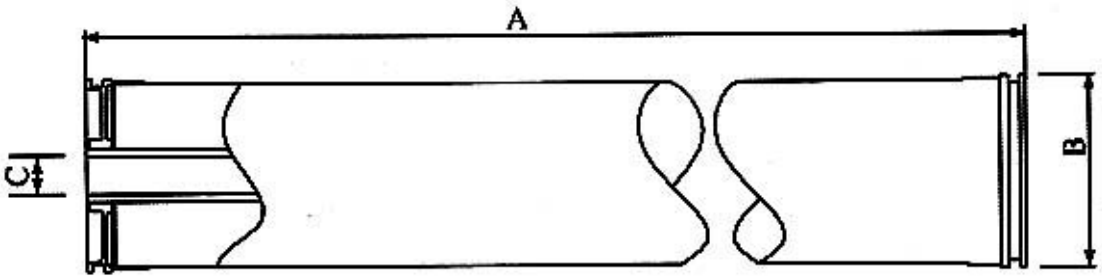
Testing Pressure	150psi(1.03Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	1500 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	15%

3, Extreme operation Conditions

Max. Operating Pressure	600psi (4.14Mpa)
Max. Feedwater Flow	75gpm (17.0 m /h)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater 5	
Free Chlorine Concentration of Feedwater	< 0. lppm
PH Value Range of Feedwater as Continuous Operation	3 —10
PH Value Range of Feedwater as Chemical Cleaning	2-11
Max. Pressure Difference of Single Membrane Element	15psi(0.1Mpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C
8040	1016.0 (40.00)	201.9 (7.95)	28.6 (1.125)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ± 15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogen sulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogen sulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR**. assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR .**We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR.** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers* specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

ULP Series Elements: 8040 High Permeate

1. Brief Introduction

ULP (Ultra Low Pressure) series are the ultra low-pressure aromatic composite membrane elements developed by **CANADIAN CLEAR** applicable to desalination of surface water and underground water. It can work under ultra low pressure to reach as high permeate flow and salt rejection as regular low-pressure membrane can. It operates under approximately 2 thirds of the operating pressure of regular low-pressure composite membrane, and enjoys a salt rejection rate of up to 99.5%, which can decrease the investment costs for such relevant facilities as pump, piping, and container, etc. and the e for the RO system, thus increasing the economic efficiency.

Being suitable for the desalination treatment of those water resources with salt concentration lower than 2000 ppm, such as surface water, underground water, tap water and municipal water, etc., ULP series membrane elements are mainly applicable to numerous applications of various scales, such as pure water, boiler water replenishment, foodstuff processing, and pharmaceutical production, etc.

2. Specifications and Main Properties of Membrane Element

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)

ULP12-8040	98.0	13200(49.9)	400(37.0)
ULP22-8040	99.0	2100(45.7)	400(37.0)
ULP32-8040	99.4	10500(39.7)	400(37.0)

Testing Conditions:

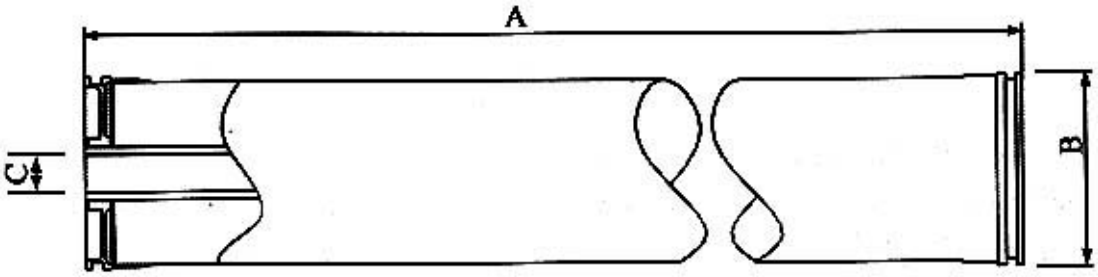
Testing Pressure	150psi (1.03Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	1500 ppm
PH Value of Testing Solution	*15*
Recovery Rate of Single Membrane Element	15%

3. Extreme operation Conditions

Max. Operating Pressure	600psi (4.14Mpa)
Max. Feed water Flow	75gpm (17.0 m^3/h)
Max. Temperature of Feed water	45 °C
Max. SDI of Feed water	5
Free Chlorine Concentration of Feed water	< 0.1 ppm
PH Value Range of Feed water as Continuous Operation	3 — 10
PH Value Range of Feed water as Chemical Cleaning	2-11
Max. Pressure Difference of Single Membrane Element	15psi(0. IMpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C
8040	1016.0 (40.00)	201.9 (7.95)	28.6 (1.125)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ± 15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogen sulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogen sulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR**. assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR**. We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

XLP Series Elements: 4040 1. Brief Introduction

XLP (Extra Low Pressure) series are the extra low-pressure aromatic composite membrane elements developed by **CANADIAN CLEAR** applicable to desalination of surface water and underground water. It can work under extra low pressure to reach as high permeate flow and salt rejection as regular low-pressure membrane can. It operates under approximately half of the operating pressure of regular low-pressure composite membrane, and enjoys a salt rejection rate of up to 99.0%, which can decrease the* investment costs for such relevant facilities as pump, piping, and container, etc. and the operating cost for the RO system, thus increasing the economic efficiency.

Being suitable for the desalination treatment of those low salt-content water resources not requiring high salt rejection, such as surface water, underground water, tap water and municipal water, etc. which have a salt concentration lower than 1000 ppm, XLP series membrane elements are especially applicable to the second-stage desalination with two-stage RO, and are mainly applied to numerous applications of various scales, such as pure water, boiler water replenishment, foodstuff processing, and pharmaceutical production, etc.

2 Specifications and Main Properties of Membrane Elements

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
XLP11-4040	99.0	2500(9.5)	85(7.9)

Testing Conditions:

Testing Pressure	lOOpsi (0.69Mpa)
Temperature of Testing Solution ..... 25 °C	
Concentration of Testing Solution (NaCl)	1500 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	15%

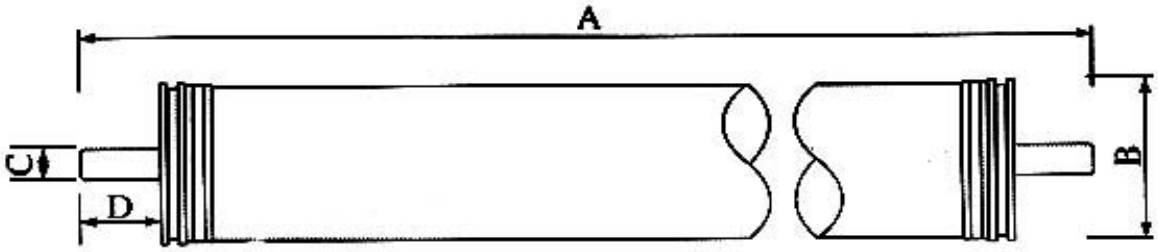
3. Extreme operation Conditions

Max. Operating Pressure	600psi (4.14Mpa)

Max. Feedwater Flow	75gpm (17.0 m^3/h)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0.1 ppm
PH Value Range of Feedwater as Continuous Operation	3 — 10
PH Value Range of Feedwater as Chemical Cleaning	2 ~ 11
Max. Pressure Difference of Single Membrane Element	15psi(0. IMpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C	D
4040	1016.0 (40.00)	99 (3.9)	19.1 (0.75)	26.7 (1.05)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR**. will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ±15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogen sulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective

solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR .**We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

XLP Series Elements: 8040

1. Brief Introduction

XLP (Extra Low Pressure) series are the extra low-pressure aromatic composite membrane elements developed by **CANADIAN CLEAR**. applicable to desalination of surface water and underground water. It can work under extra low pressure to reach as high permeate flow and salt rejection as regular low-pressure membrane can. It operates under approximately half of the operating pressure of regular low-pressure composite membrane, and enjoys a salt rejection rate of up to 99.0%, which can decrease the investment costs for such relevant facilities as pump, piping, and container, etc. and the operating cost for the RO system, thus increasing the economic efficiency.

Being suitable for the desalination treatment of those low salt-content water resources not requiring high salt rejection, such as surface water, underground water, tap water and municipal water, etc. which have a salt concentration lower than 1000 ppm, XLP series membrane elements are especially applicable to the second-stage desalination with two-stage RO, and are mainly applied to numerous applications of various scales, such as pure water, boiler water replenishment, foodstuff processing, and pharmaceutical production, etc.

2. Specifications and Main Properties of Membrane Elements

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
XLP11-8040	99.0	10000(37.9)	365(33.9)

Testing Conditions:

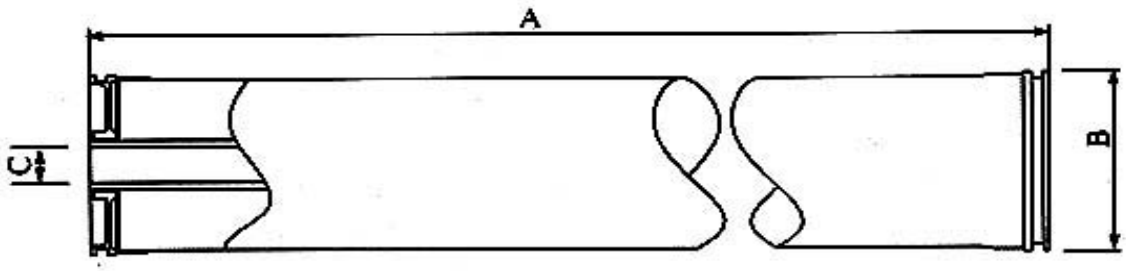
Testing Pressure	1 OOpsi (0.69Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	500 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	15%

3. Extreme operation Conditions

Max. Operating Pressure	600psi (4.14Mpa)
Max. Feedwater Flow..... 75gpm (17.0 m^3/h)	
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0. lppm
PH Value Range of Feedwater as Continuous Operation	3 - 10
PH Value Range of Feedwater as Chemical Cleaning	2-11
Max. Pressure Difference of Single Membrane Element	15psi(0. IMpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C
8040	1016.0 (40.00)	201.9 (7.95)	28.6 (1.125)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane elements is with a tolerance of ± 15%.

3) Before leaving the factory, all membrane elements will have been strictly tested; and have been treated for storage with the solution of 1.0% sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent

the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR**. We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

XLP Series Elements: 8040 High Permeate

1. Brief Introduction

XLP (Extra Low Pressure) series are the extra low-pressure aromatic composite membrane elements developed by **CANADIAN CLEAR** applicable to desalination of surface water and underground water. It can work under extra low pressure to reach as high permeate flow and salt rejection as regular low-pressure membrane can. It operates under approximately half of the operating pressure of regular low-pressure composite membrane, and enjoys a salt rejection rate of up to 99.0%, which can decrease the

investment costs for such relevant facilities as pump, piping, and container, etc. and the operating cost for the RO system, thus increasing the economic efficiency.

Being suitable for the desalination treatment of those low salt-content water resources not requiring high salt rejection, such as surface water, underground water, tap water and municipal water, etc. which have a salt concentration lower than lOOO ppm, XLP series membrane elements are especially applicable to the second-stage desalination with two-stage RO, and are mainly applied to numerous applications of various scales, such as pure water, boiler water replenishment, foodstuff processing, and pharmaceutical production, etc.

2. Specifications and Main Properties of Membrane Elements

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
XLP12-8040	99.0	11000(41.6)	400(37.0)

Testing Conditions:

Testing Pressure (0.69Mpa)	100psi
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	500 ppm
PH Value of Testing Solution	7,5
Recovery Rate of Single Membrane Element	15%

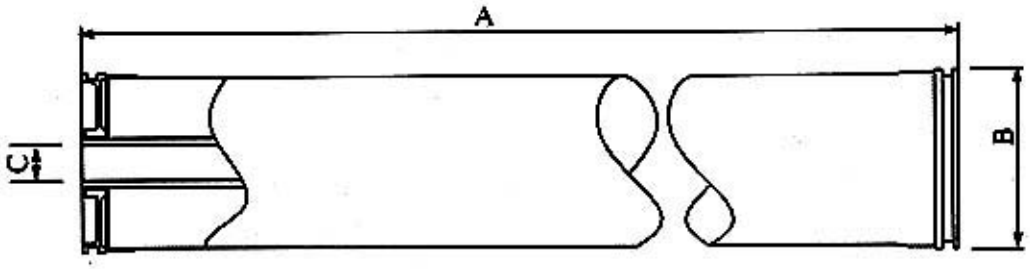
3. Extreme operation Conditions

Max. Operating Pressure (4.14Mpa)	600psi
Max. Feedwater Flow m^3/h)	75gpm (17.0
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0. lppm
PH Value Range of Feedwater as Continuous Operation	3 —10
PH Value Range of Feedwater as Chemical Cleaning	2-11

Max. Pressure Difference of Single Membrane Element 15psi(0.1Mpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C
8040	1016.0 (40.00)	201.9 (7.95)	28.6 (1.125)

Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR**, or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane elements is with a tolerance of ± 15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any

violation in using this kind of chemical medicament, **CANADIAN CLEAR**. assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR.** We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

SW Series Elements: 4040

1. Brief Introduction

The SW (Seawater) series are aromatic polyamide RO membrane elements, which are newly developed by **CANADIAN CLEAR** and are applicable to seawater desalination. By optimizing the structure of membrane elements, the SW series increases the permeate flow, and requires fewer elements for same permeate flow. It is characterized by low operating pressure, small equipment investment, excellent rejection rate and reliable performance, and its high salt rejection can ensure producing the drinking water from seawater simply through one-stage RO system. The SW series are applicable to the treatment of seawater and high-concentration brackish water. SW4040 membrane elements are designed for seawater desalting, brackish water desalting and boiler water replenishment of power plant, as well as various applications, such as recycling of wastewater, concentrating and reclamation of such high additional value substances as foodstuff and medicine, etc.

2 Specifications and Main Properties of Membrane Elements

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)

SW11-4040	99.2	1400(5.3)	80(7.4)
SW21-4040	99.5	1200(4.5)	80(7.4)

Testing Conditions:

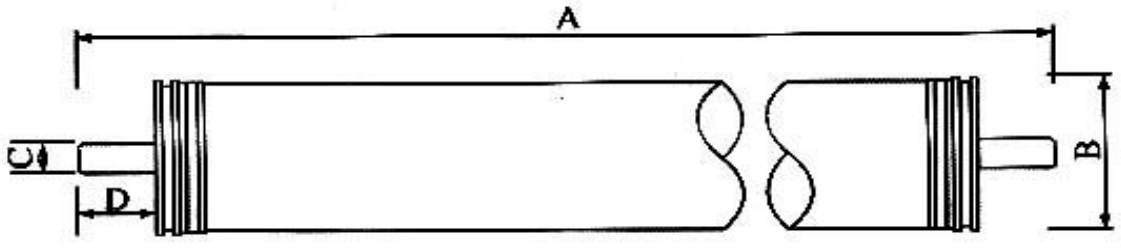
Testing Pressure	800psi (8.5Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	32800 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	8%

3. Extreme operation Conditions

Max, Operating Pressure	1 OOOpsi (6.9Mpa)
Max. Feedwater Flow	16gpm (3.6 m^3/h)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0. Ippm
PH Value Range of Feedwater as Continuous Operation	
PH Value Range of Feedwater as Chemical Cleaning	2
Max. Pressure Difference of Single Membrane Element	15psi(0.1Mpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C	D
4040	1016.0 (40.00)	99 (3.9)	19.1 (0.75)	26.7 (1.05)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR**. will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ±15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up,

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR**. We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR**. assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

SW Series Elements: 8040

1. Brief Introduction

The SW (Seawater) series are aromatic polyamide RO membrane elements, which are newly developed by **CANADIAN CLEAR**, and are applicable to seawater desalination. By optimizing the structure of membrane elements, the SW series increases the permeate flow, and requires fewer elements for it permeate flow. It is characterized by low operating pressure, small equipment investment, excellent rejection rate and reliable performance, and its high salt rejection can ensure producing the drinking water from seawater simply through one-stage RO system. The SW series are applicable, to the treatment of seawater and high-concentration brackish water. SW8040 membrane elements are designed for seawater desalting, brackish water desalting and boiler water replenishment of power plant, as well as various applications, such as recycling of wastewater, concentrating and reclamation of such high additional value substances as foodstuff and medicine, etc.

2. Specifications and Main Properties of Membrane Elements

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
SW11-8040	99.2	6000(22.7)	330(30.6)
SW21-8040	99.7	5000(18.9)	330(30.6)

Testing Conditions:

Testing Pressure	800psi (8.5Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	32800 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	8%

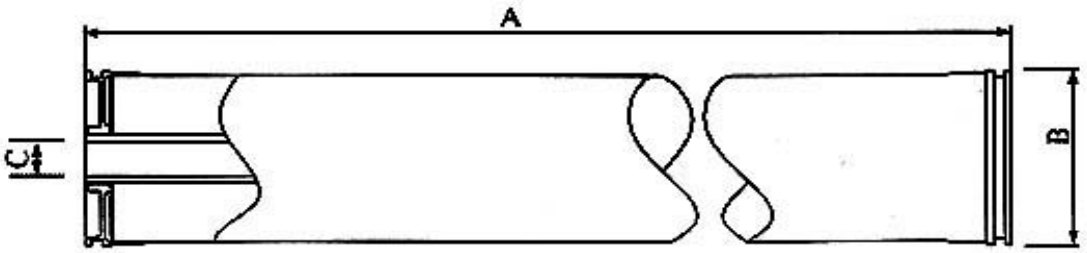
3. Extreme operation Conditions

Max. Operating Pressure	1000 psi (6.9Mpa)

Max. Feedwater Flow	75gpm (17 m^3/h)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0. 1 ppm
PH Value Range of Feedwater as Continuous Operation	3 ~ 10
PH Value Range of Feedwater as Chemical Cleaning	2-11
Max. Pressure Difference of Single Membrane Element	15psi(0.1Mpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C
8040	1016.0 (40.00)	201.9 (7.95)	28.6 (1.125)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ±15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any

violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR**. We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information

SW Series Elements: 8040 High-Permeate

1. Brief Introduction

The SW (Seawater) series are aromatic polyamide RO membrane elements, which are newly developed by **CANADIAN CLEAR** and are applicable to seawater desalination. By optimizing the structure of membrane elements, the SW series increases the permeate flow, and requires fewer elements for it permeate flow. It is characterized by low operating pressure, small equipment investment, excellent rejection rate and reliable performance, and its high salt rejection can ensure producing the drinking water from seawater simply through one-stage RO system. The SW series are applicable to the treatment of seawater and high-concentration brackish water. SW8040 membrane elements are designed for seawater desalting, brackish water desalting and boiler water replenishment of power plant, as well as various applications, such as recycling of wastewater, concentrating and reclamation of such high additional value substances as foodstuff and medicine, etc.

2. Specifications and Main Properties of Membrane Elements

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
SW12-8040	99.2	7000(26.5)	380(35.2)

SW22-8040	99.7	6000(22.7)	380(35.2)

Testing Conditions:

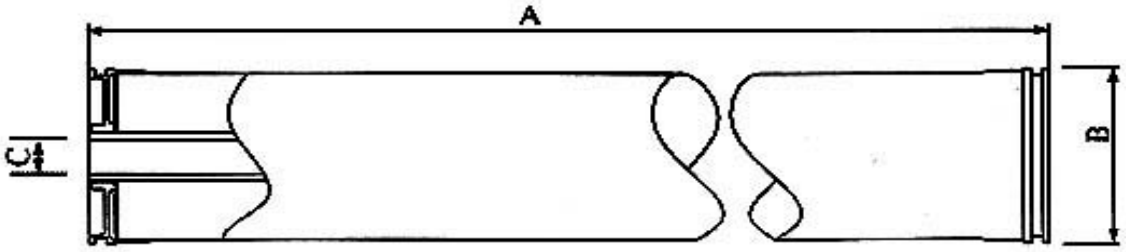
Testing Pressure	800psi (8.5Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	32800 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	8%

3, Extreme operation Conditions

Max. Operating Pressure	l000psi (6.9Mpa)
Max. Feedwater Flow	75gpm (17 m^3/h)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0.1 ppm
PH Value Range of Feedwater as Continuous Operation	3-10
PH Value Range of Feedwater as Chemical Cleaning	2-11
Max. Pressure Difference of Single Membrane Element	**1**5psi(0.1Mpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C
8040	1016.0 (40.00)	201.9 (7.95)	28.6 (1.125)

Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow

the operating conditions as specified in this manual, **CANADIAN CLEAR**. will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ± 15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), and then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR**. assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR** .We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

FR Series Elements: 4040

1. Brief Introduction

The FR series are aromatic polyamide RO membrane elements, which are newly developed by **CANADIAN CLEAR** and can be used in desalination of brackish water. It is characterized by ultra low-pressure operation, higher water productivity and excellent desalting property. Moreover, we make special treatment to the surface of membrane with unique technology to change its electrical charge and smoothness, increasing the hydropihicity of membrane surface, thus decreasing the adhesion of contamination and microbe so as to lessen the pollution and extend the service life of elements.

The FR series are applicable to the desalinating treatment of those water resources with salt concentration less than 5000ppm, such as surface water, underground water, tap water and municipal water. They are mainly used for treatment of various industrial water, such as various scales of industrial intermediate-stage water reclamation, boiler water replenishment in power plant, and are especially applicable to the treatment of that water with slight organic pollutants, such as industrial wastewater, municipal sewage and other slightly contaminated water.

2. Specifications and Main Properties of Membrane Elements

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
FR11-4040	99.0	2600(9.8)	85(7.9)
FR21-4040	99.5	2200(8.3)	85(7.9)

Testing Conditions:

Testing Pressure	225psi (1.55Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	2000 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	15%

3. Extreme operation Conditions

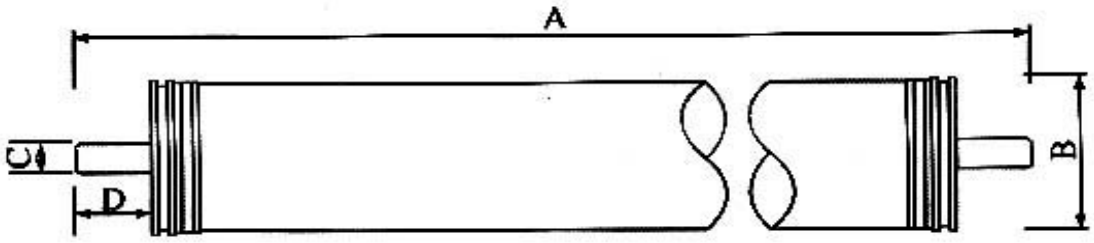
Max. Operating Pressure 600psi (4.14Mpa)

Max. Feedwater Flow 16gpm (3.6 m^3/h)

Max, Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0. lppm
PH Value Range of Feedwater as Continuous Operation	3 — 10
PH Value Range of Feedwater as Chemical Cleaning	2-11
Max. Pressure Difference of Single Membrane Element	15psi(0. IMpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C	D
4040	1016.0 (40.00)	99 (3.9)	19.1 (0.75)	26.7 (1.05)

5, Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ± 15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any

violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR**. We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.'

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

FR Series Elements: 8040

1. Brief Introduction

The FR series are aromatic polyamide RO membrane elements, which are newly developed by **CANADIAN CLEAR** and can be used in desalination of brackish water. It is characterized by ultra low-pressure operation, higher water productivity and excellent desalting property. Moreover, we make special treatment to the surface of membrane with unique technology to change its electrical charge and smoothness, increasing the hydrophilicity of membrane surface, thus decreasing the adhesion of contamination and microbe so as to lessen the pollution and extend the service life of elements.

The FR series are applicable to the desalinating treatment of those water resources with salt concentration less than 5000 ppm, such as surface water, underground water, tap water and municipal water. They are mainly used for treatment of various industrial water, such as various scales of industrial intermediate-stage water reclamation, boiler water replenishment in power plant, and are especially applicable to the treatment of that water with slight organic pollutants, such as industrial wastewater, municipal sewage and other slightly contaminated water.

2. Specifications and Main Properties of Membrane Elements

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
FR11-8040	99.0	11000(41.6)	365(33.9)
FR21-8040	99.5	10000(37.6)	365(33.9)

Testing Conditions:

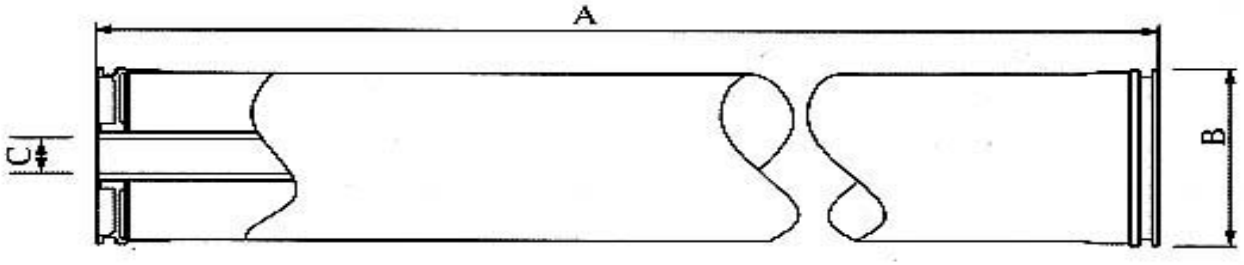
Testing Pressure	225psi (1.55Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	2000 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	*15%*

3* Extreme operation Conditions

Max. Operating Pressure	600psi (4.14Mpa)
Max. Feedwater Flow	75gpm (17 m^3/h)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0.1 ppm
PH Value Range of Feedwater as Continuous Operation	3-—'10
PH Value Range of Feedwater as Chemical Cleaning	2-11
Max. Pressure Difference of Single Membrane Element	15psi(0.1 Mpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C
8040	1016.0 (40.00)	201.9 (7.95)	28.6 (1.125)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ± 15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. CANADIAN CLEAR has obtained all data and information provided in this manual from long-time experiment. We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or

working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

FR Series: 8040 High Permeate

1. Brief Introduction

The FR series are aromatic polyamide RO membrane elements, which are newly developed by **CANADIAN CLEAR** and can be used in desalination of brackish water. It is characterized by ultra low-pressure operation, higher water productivity and excellent desalting property. Moreover, we make special treatment to the surface of membrane with unique technology to change its electrical charge and smoothness, increasing the hydrophilicity of membrane surface, thus decreasing the adhesion of contamination and microbe so as to lessen the pollution and extend the service life of elements.

The FR series are applicable to the desalinating treatment of those water resources with salt concentration less than 5000ppm, such as surface water, underground water, tap water and municipal water. They are mainly used for treatment of various industrial water, such as various scales of industrial intermediate-stage water reclamation, boiler water replenishment in power plant, and are especially applicable to the treatment of those water with slight organic pollutants, such as industrial wastewater, municipal sewage and other slightly contaminated water.

2. Specifications and Main Properties of Membrane Elements

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
FR11-8040	99.0	12100(45.7)	400(37.0)
FR22-8040	99.5	11000(41.6)	400(37.0)

Testing Conditions:

Testing Pressure	225psi (L55Mpa)
Temperature of Testing Solution	25 °C

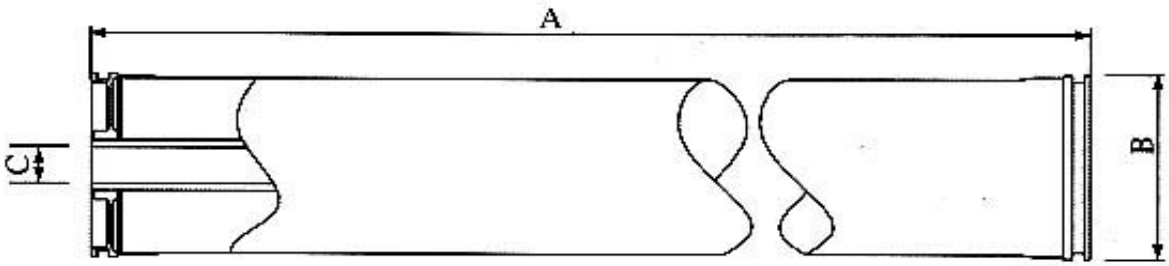
Concentration of Testing Solution (NaCl)	2000 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	15%

3. Extreme operation Conditions

Max. Operating Pressure	600psi (4.14Mpa)
Max. Feedwater Flow	75gpm (17 m^3/h)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater ..... 5 ___	
Free Chlorine Concentration of Feedwater	< 0. lppm
PH Value Range of Feedwater as Continuous Operation	3-^-10
PH Value Range of Feedwater as Chemical Cleaning	2 ~ 11
Max. Pressure Difference of Single Membrane Element	15psi(0. IMpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C
8040	1016.0 (40.00)	201.9 (7.95)	28.6 (1.125)

Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ±15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent

the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR** .We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2, Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

Household Series Elements

1. Brief Introduction

The ULP (Ultra Low Pressure) series are the ultra low-pressure aromatic composite membrane elements developed by **CANADIAN CLEAR** applicable to desalination of surface water and underground water. It can work under ultra low pressure to reach as high permeate flow and salt rejection as regular low-pressure membrane can. It operates under approximately 2 thirds of the operating pressure of regular low-pressure

composite membrane, and achieves a salt rejection rate of up to 99.0%, which can decrease the investment costs for such relevant facilities as pump, piping, and container, etc. and the operating cost for the RO system, thus increasing the economic efficiency.

Being suitable for the desalination treatment of those water resources with salt concentration lower than 2000ppm, such as surface water, underground water, tap water and municipal water, etc., ULP series membrane elements are mainly applicable to numerous applications of various scales, such as pure water, boiler water replenishment, foodstuff processing, and pharmaceutical production, etc. 1812 membrane elements are mainly applicable to various small-sized systems, such as household water purifying machine, and other water purifying devices in hospital and laboratory.

2. Specifications and Main Properties of Membrane Element

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
ULP1812-50	97.5	50(0.19)	4.8 (0.45)
ULP1812-75	97.5	75(0.28)	4.8(0.45)
ULP2012-100	95.0	100(0.38)	4.8(0.45)

Testing Conditions:

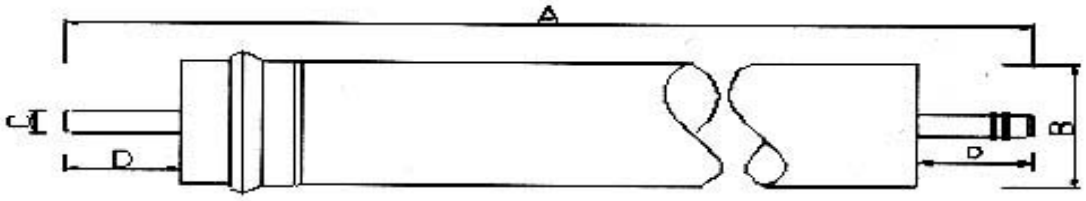
Testing Pressure	60psi (0.41 Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	250 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	15%

3. Extreme operation Conditions

Max. Operating Pressure	300psi (2.07Mpa)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0. lppm
PH Value Range of Feedwater as Continuous Operation	3 —10
PH Value Range of Feedwater as Chemical Cleaning	2 ~ 11
Max. Pressure Difference of Single Membrane Element	10psi(0.07Mpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C	D
1812	298.0(11.7)	44.5(1.75)	17.0(0.67)	21.0(0.83)
2012	298.0(11.7)	48.2(1.9)	17.0(0.67)	21.0(0.83)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR**, or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ±20%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR**.We believe the data and information contained herein to be accurate and effective., However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific *end* uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

ULP Series Elements: 2.5-inch

1. Brief Introduction

The ULP (Ultra Low Pressure) series are the ultra low-pressure aromatic composite membrane elements newly developed by **CANADIAN CLEAR** applicable to desalination of surface water and underground water. It can work under ultra low pressure to reach as high permeate flow and salt rejection as regular low-pressure membrane can. It operates under approximately 2 thirds of the operating pressure of regular low-pressure composite membrane, and achieves a salt rejection rate of up to 99.0%, which can decrease the investment costs for such relevant facilities as pump, piping, and container, etc. and the operating cost for the RO system, thus increasing the economic efficiency.

Being suitable for the desalination treatment of those water resources with salt concentration lower than 2000ppm, such as surface water, underground water, tap water and municipal water, etc., ULP series membrane elements are mainly applicable to numerous applications of various scales, such as pure water, boiler water replenishment, foodstuff processing, and pharmaceutical production, etc. The 2.5-inch membrane elements are mainly applicable to various small-sized systems, such as household water purifying machine, and other water purifying devices in hospital and laboratory.

2. Specifications and Main Properties of Membrane Element

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
ULP21-2514	99.0	150(0.57)	6.5(0.6)
ULP21-2521	99.0	300(1.13)	12(1.1)
ULP21-2540	99.0	750(2.84)	28(2.6)

Testing Conditions:

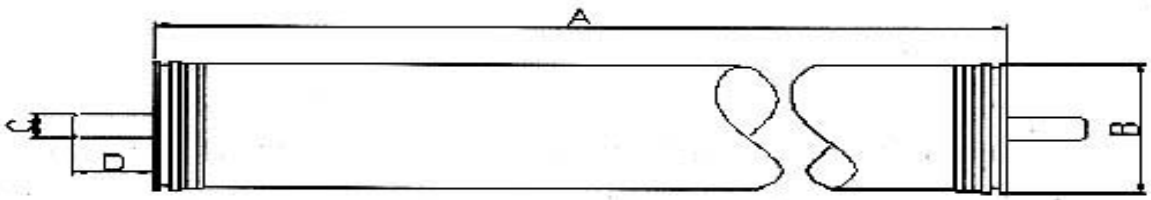
Testing Pressure	150psi (1.03Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	1500 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	15%

3. Extreme operation Conditions

Max. Operating Pressure	600psi (4.14Mpa)
Max. Feedwater Flow	6.0gpm(1.4 m^3/h)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0. l ppm
PH Value Range of Feedwater as Continuous Operation	3 — 10
PH Value Range of Feedwater as Chemical Cleaning	2-11
Max. Pressure Difference of Single Membrane Element	15psi(0.07Mpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C	D
2514	355.6(14.0)	61.0(2.4)	19.1(0.75)	28.6(1.1)
2521	533.4(21.0)	61.0(2.4)	19.1(0.75)	28.6(1.1)
2540	1016.0(40.0)	61.0(2.4)	19.1(0.75)	28.6(1.1)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ± 15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR**. We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

ULP Series Elements: 4021

1. Brief Introduction

The ULP (Ultra Low Pressure) series are the ultra low-pressure aromatic composite membrane elements developed by **CANADIAN CLEAR** applicable to desalination of surface water and underground water. It can work under ultra low pressure to reach as high permeate flow and salt rejection as regular low-pressure membrane can. It operates under approximately 2 thirds of the operating pressure of regular low-pressure composite membrane, and achieves a salt rejection rate of up to 99.0%, which can decrease the investment costs for such relevant facilities as pump, piping, and container, etc. and the operating cost for the RO system, thus increasing the economic efficiency.

Being suitable for the desalination treatment of those water resources with salt concentration lower than 2000ppm, such as surface water, underground water, tap water and municipal water, etc., ULP series membrane elements are mainly applicable to numerous applications of various scales, such as pure water, boiler water replenishment, foodstuff processing, and pharmaceutical production, etc. 4021 membrane elements are mainly applicable to various small-sized systems, such as household water purifying machine, and other water purifying devices in hospital and laboratory.

2. Specifications and Main Properties of Membrane Element

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
ULP11-4021	98.0	1000(3.78)	36(3.3)
ULP21-4021	99.0	950(3.6)	36(3.3)

Testing Conditions:

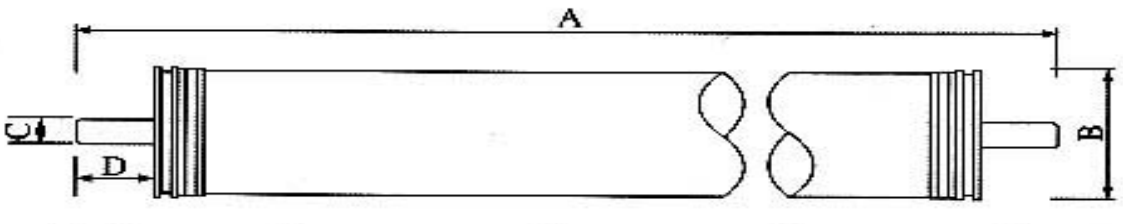
Testing Pressure	150psi (1.03Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	1500 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	15%

3. Extreme operation Conditions

Max. Operating Pressure	600psi (4.14Mpa)
Max. Feedwater Flow	16gpm(3.6 m^3/h)
Max. Temperature of Feedwater	45 °C
Max. SD1 of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0. Ippm
PH Value Range of Feedwater as Continuous Operation	3-10
PH Value Range of Feedwater as Chemical Cleaning	2 ~ 11
Max. Pressure Difference of Single Membrane Element	10psi(0.07Mpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C	D
4021	553 (21.00)	99 (3.9)	19.1 (0.75)	26.7 (1.05)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ± 15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0%. sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR**. We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

SW Series Elements: 2.5-inch

1. Brief Introduction

The SW (Seawater) series are aromatic polyamide RO membrane elements, which are newly developed by **CANADIAN CLEAR** and are applicable to seawater desalination. By optimizing the structure of membrane elements, the SW series increases the permeate flow, and requires fewer elements for it permeate flow. It is characterized by low operating pressure, small equipment investment, excellent rejection rate and reliable performance, and its high salt rejection can ensure producing the drinking water from seawater simply through one-stage RO system.

The SW series are applicable to the treatment of seawater and high-concentration brackish water. SW4040 membrane elements are designed for seawater desalting, brackish water desalting and boiler water replenishment of power plant, as well as various applications, such as recycling of wastewater, concentrating and reclamation of such high additional value substances as foodstuff and medicine, etc.

The 2.5-inch membrane elements are applicable to those small-sized systems for seawater desalination or high-concentration brackish water desalting, such as military ships, ocean vessels, and laboratory, etc.

2. Specifications and Main Properties of Membrane Elements

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area ft^2 (m^2)
SW11-2514	99.2	130(0.49)	6.5(0.6)
SW11-2521	99.2	280(1.06)	12(1.1)
SW11-2540	99.2	700(2.65	28(2.6)

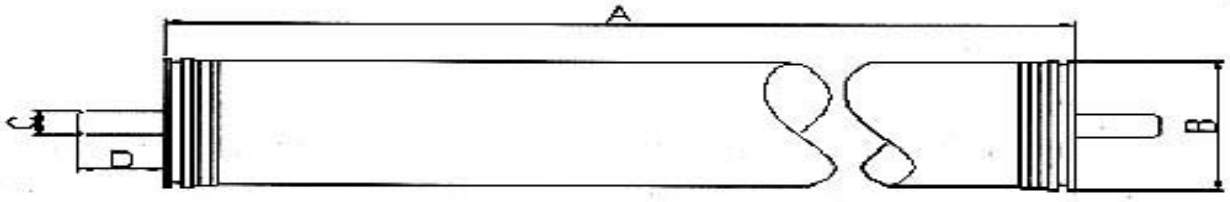
Testing Conditions: Testing Pressure	800psi (5.5Mpa)
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	32800 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	8%

3. Extreme operation Conditions

Max. Operating Pressure	lOOOpsi (6.9Mpa)
Max. Feedwater Flow	6.0gpm (1.4 m^3/h)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0. lppm
PH Value Range of Feedwater as Continuous Operation	3-10
PH Value Range of Feedwater as Chemical Cleaning	2 ~ 11
Max. Pressure Difference of Single Membrane Element	15psi(0.1 Mpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C	D
2514	355.6(14.0)	61.0(2.4)	19.1(0.75)	28.6(1.1)
2521	533.4(21.0)	61.0(2.4)	19.1(0.75)	28.6(1.1)
2540	1016.0(40.0)	61.0(2.4)	19.1(0.75)	28.6(1.1)

5. **Important Information**

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR** or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual, **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ±15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), and then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR** .We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or

working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information.

SW Series Elements: 4021

1. Brief Introduction

The SW (Seawater) series are aromatic polyamide RO membrane elements, which are newly developed by **CANADIAN CLEAR** and are applicable to seawater desalination. By optimizing the structure, of membrane elements, the SW series increases the permeate flow, and requires fewer elements for it permeate flow. It is characterized by low operating pressure, small equipment investment,' excellent rejection rate and reliable performance, and its high salt rejection can ensure producing the drinking water from seawater simply through one-stage RO system.

The SW series are applicable to the treatment of seawater and high-concentration brackish water. SW4040 membrane elements are designed for seawater desalting, brackish water desalting and boiler water replenishment of power plant, as well as various applications, such as recycling of wastewater, concentrating and reclamation of such high additional value substances as foodstuff and medicine, etc.

The 2.5-inch membrane elements are applicable to those small-sized systems for seawater desalination or high-concentration brackish water desalting, such as military ships, ocean vessels, and laboratory, etc.

2. Specifications and Main Properties of Membrane Elements

Part No.	Average Salt Rejection Rate %	Average Permeate flow GPD (m^3/d)	Active Membrane Area $ft^2(m^2)$
SW 11-4021	99.2	750(2.8)	33(3.1)

Testing Conditions:
Testing Pressure 800psi (5.5Mpa)

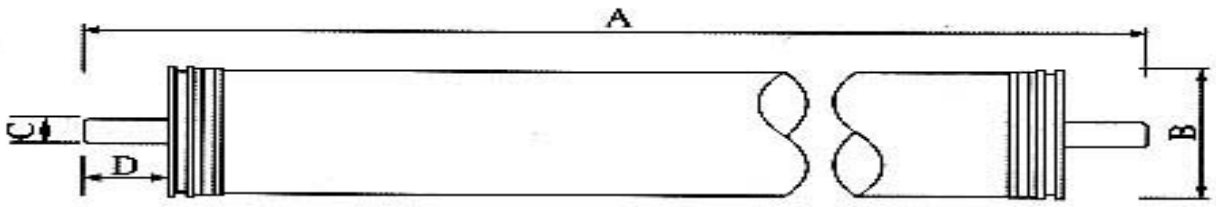
Temperature of Testing Solution	25 °C
Concentration of Testing Solution (NaCl)	32800 ppm
PH Value of Testing Solution	7.5
Recovery Rate of Single Membrane Element	8%

3. Extreme operation Conditions

Max. Operating Pressure	lOOOpsi (6.9Mpa)
Max. Feedwater Flow	4.5gpm (1.0 m^3/h)
Max. Temperature of Feedwater	45 °C
Max. SDI of Feedwater	5
Free Chlorine Concentration of Feedwater	< 0. Ippm
PH Value Range of Feedwater as Continuous Operation	3^10
PH Value Range of Feedwater as Chemical Cleaning	2-11
Max. Pressure Difference of Single Membrane Element	15psi(0. IMpa)

4. Dimensions of Membrane Element

All dimensions are in millimeter (inch).



Model	A	B	C	D
4021	553 (21.00)	99 (3.9)	19.1 (0.75)	26.7 (1.05)

5. Important Information

1) For any recommended design scope, please refer to the latest edition of technology manual and design guide prepared by **CANADIAN CLEAR**, or consult experts proficient in membrane technology. In case the customer fails to follow the operating conditions as specified in this manual **CANADIAN CLEAR** will assumes no liability for all results.

2) The permeate flow listed in the table is the average value. The permeate flow of single membrane element is with a tolerance of ±15%.

3) Before leaving the factory, all membrane elements will have been strictly tested, and have been treated for storage with the solution of 1.0% sodium hydrogensulfite (an antifreeze solution of 10% propanediol will further added in winter), then packed in vacuum, and outer packing is carton. In order to prevent the breeding of microbes during short-time storage, transportation and

system standby, we recommend you to soak the membrane elements with the protective solution (prepared with RO permeate water) containing 1.0% sodium hydrogensulfite (foodstuff-purpose).

4) Discard RO product water produced during the first one hour after system start-up.

5) During storage time and run time, it is strictly prohibited to add any chemical medicament, which may be harmful to membrane elements. In case of any violation in using this kind of chemical medicament, **CANADIAN CLEAR** assumes no liability for all results.

Notice:

1. All data and information provided in this manual have been obtained from long-time experiment by **CANADIAN CLEAR**. We believe the data and information contained herein to be accurate and effective. However, since the conditions and methods for use of our products are beyond our control, **CANADIAN CLEAR** assumes no liability for all results obtained or damages incurred through the application of the presented data and information. Regardless of separate use or working with other products, it is strongly recommended that the users shall carry out experiment to determine the safety of **CANADIAN CLEAR** 's products and their applicability to customers' specific end uses.

2. Due to technology development and products renovation, products information will be subject to modification without prior notification. Please pay attention to **CANADIAN CLEAR** 's latest products information

Section 4: Table of Temperature Correction Factors with Permeate flow Normalization

Temp.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
5	2.160	2.151	2.142	2.134	2.125	2.117	2.108	2.100	2.091	2.083
6	2.075	2.066	2.058	2.050	2.042	2.034	2.025	2.017	2.009	2.001
7	1.993	1.986	1.978	1.970	1.962	1.954	1.946	1.939	1.931	1.923
8	1.916	1.908	1.901	1.893	1.886	1.878	1.871	1.863	1.856	1.849
9	1.841	1.834	1.827	1.820	1.813	1.805	1.798	1.791	1.784	1.777
10	1.770	1.763	1.756	1.750	1.743	1.736	1.729	1.722	1.716	1.709
11	1.702	1.696	1.689	1.682	1.676	1.669	1.663	1.656	1.650	10643
12	1.637	1.631	1.624	1.618	1.612	1.605	1.599	1.593	1.587	1.581
13	1.575	1.568	1.562	1.556	1.55	1.544	1.538	1.532	1.527	1.521
14	1.515	1.509	1.503	1.497	1.492	1.486	1,480	1.474	1.469	1.463
15	1.457	1.452	1.446	1.441	1.435	1.430	1.424	1.419	1.413	1.408
16	1.403	1.397	1.392	1.387	1.381	1.376	1.371	1.366	1.360	1.355
17	1.350	1.345	1.340	1.335	1.330	1.325	1.320	1.315	1.310	1.305
18	1.300	1.295	1.290	1.285	1.280	1.275	1.270	1.266	1.261	1.256
19	1.251	1.247	1.242	1.237	1.232	1.228	1.223	1.219	1.214	1.209
20	1.205	1.200	1.196	1.191	1.187	1.182	1.178	1.174	1.169	1.165
21	1.16	1.156	1.152	1.147	1.143	1.139	1.135	1.130	1.126	1.122
22	1.118	1.114	1.110	1.105	1.101	1.097	1.093	1.089	1.085	1.081
23	1.077	1.073	1.069	1.065	1.061	1.057	1.053	1.049	1.045	1.042
24	1.038	1.034	1.030	1.026	1.022	1.019	1.015	1.011	1.007	1.004
25	1.000	0.997	0.995	0.992	0.989	0.987	0.984	0.982	0.979	0.976
26	0.974	0.971	0.969	0.966	0.963	0.961	0.958	0.956	0.953	0.951
27	0.948	0.946	0.943	0,941	0.938	0.936	0.933	0.931	0.928	0.926
28	0.924	0.921	0.919	0.916	0.914	0.912	0.909	0.907	0.904	0.902
29	0.900	0.897	0.895	0.893	0.89	0.888	0.886	0.883	0.881	0.879
30	0.877	0.874	0.872	0.870	0.868	0.865	0.863	0.861	0.859	0.856
31	0.854	0.852	0.850	0.848	0.845	0.843	0.841	0.839	0.837	0.835
32	0.832	0.830	0.828	0.826	0.824	0.822	0.820	0.818	0.816	0.813
33	0.811	0.809	0.807	0.805	0.803	0.801	0.799	0.797	0.795	0.793
34	0.791	0.789	0.787	0.785	0.783	0.781	0.779	0.777	0.775	0.773
35	0.771	0.769	0.767	0.765	0.763	0.761	0.760	0.758	0.756	0.754
36	0.752	0.750	0.748	0.746	0.744	0.743	0.741	0.739	0.737	0.735
37	0.733	0.731	0.730	0.728	0.726	0.724	0.722	0.721	0.719	0.717
38	0.715	0.713	0.712	0.710	0.708	0.706	0.705	0.703	0.701	0.699

39	0.698	0.696	0.694	0.693	0.691	0.689	0.687	0.686	0.684	0.682
40	0,681	0.679	0.677	0.676	0.674	0.672	0.671	0.669	0.667	0.666

Permeate Flow normalization=Measured permeate flowX Normalization coefficient corresponding to feed water temperature (as stated in above table).

Chapter Three - Theory of Reverse Osmosis Technology and System Design

Section 1: Theory of Reverse Osmosis Technology

Section 2 :Technological Basis for Water Treatment and RO Pretreatment

Section 3 - Guide to Design of RO System

Section 1: Theory of Reverse Osmosis Technology

With the polymeric membrane as its representative, the technology of membrane separation came into being since 1950s along with the development of polymer chemistry, characterized by such advantages as high separation efficiency, low energy consumption and convenient operation, etc. Significant advancement has been achieved in this field, and membrane separation has become the major means of separation and purification. According to the differences in separation precision and driving force, the membrane separation can be classified into the following kinds:

Membrane Types	Membrane Functions	Driving Force for Separation.	Permeable Substances	Rejected Substances
Micro filtration membrane	Porous membrane for decorpuscle of solution	Pressure Difference	Water, Solvents and dissolved matters	Suspended matters, bacteria corpuscles, macromolecular organic matters
Ultra filtration membrane	Elimination of the colloid and various macro molecules in the solution	Pressure Difference	Solvents, ions and micro molecules	Protein, various enzymes, bacteria, virus, colloid, corpuscles
Reverse Osmosis and nano-filtration membrane	Elimination of sales and macro molecules in the solution	Pressure difference	Water or solvents	Inorganic salts, sugars, saccharides, amino acid, organic matters, etc.
Dialysis	Elimination of salts and macro molecules in the solution	Concentration difference	Ion, micro molecules, acid, alkali	Inorganic salts, sugars, saccharides, amino acid, organic matters, etc.
Electrodialysis	Elimination of ions in the solution	Potential difference	Ions	Inorganic and organic ions
Pervaporation membrane	Elimination of micro molecules in the solutions, separation of solvents	Pressure difference and concentration differences	Steam	Liquid, inorganic salts, and ethanol solution
Gas separation	Separation of gases	Concentration difference	Permeable gases	Impermeable gases

The above table shows various kinds of separating membranes classified by the principle of separation and the sizes of separated matters. It can be seen from this table that almost all of the separating technologies are applicable to all fields of separation, purification, and concentration. Reverse osmosis and nanofiltration membranes, as one of the major membranes for separating water and other liquids, holds an important position in the field of separating membranes.

Basis of Reverse Osmosis Technology - What is the RO Membrane?

Osmosis membrane has been existing in the nature for a long time, but the osmosis phenomenon was not discovered by the mankind until the year of 1748 when Nollet found that the water could naturally diffuse into the swine's urinary bladder containing alcohol solution.

In the course of natural osmosis, the solvent always penetrates from the lower-concentration area to the higher-concentration area, while reverse osmosis refers to the diffusion of solvent, which is originally in the high-concentration solution, into the thin solution through the membrane which is hence named as the reverse osmosis (RO) membrane for enjoying this kind of function.

Judging by the principle and model of mass transfer in the course of reverse osmosis, there are three kinds of doctrines as follows:

Phenomenology model

Solution-diffusion model

Preferential Absorption - Capillary Flow model

None of the above doctrines can independently give a perfect explanation on the principle of reverse osmosis phenomenon. Though the mankind hasn’t revealed the essence of reverse osmosis phenomenon, this has not presented any obstacle to the utilization of reverse osmosis phenomenon by mankind and to the development of the excellent reverse osmosis membrane for the benefit of mankind.

Another characteristic of the reverse osmosis membrane lies in the fact that we cannot produce perfect membrane, i.e. the one with 100% salt rejection rate, though it can

reach an above 98% rate for elimination of inorganic salts and organic matters with molecule weight of above 100. The best RO membrane presently available can reach the salt rejection rate of up to 99.9%.

Basis of Reverse Osmosis Technology - The Development History of RO Membrane

In the year of 1748 : Nollet discovered the phenomenon of reverse osmosis.

In the year of 1920 : Van't Hoff established the complete theory of thin solution.

In the year of 1953 : The acetyl cellulose was found to be with excellent semi-permeability.

In the year of 1960 : The acetyl cellulose RO membrane was innovatively produced.

In the year of 1970 : Dupont invented the aromatic polyamide doughnut RO device.

In the year of 1980 : The aromatic polyamide composite membrane and spiral wound elements came into being.

In the year of 1990 : The medium-pressure, low-pressure and ultra low-pressure, high-rejection polyamide composite membranes came out in the market, thus opening up a vast vista for the RO technology.

In the year of 1998 : The fouling-resist membrane was developed, thus further expanding the range of RO applications.

Theory of Reverse Osmosis Technology Main Parameters for Evaluating the RO Properties

1. Salt Rejection and salt permeability

Salt rejection: Percentage of the dissolved salts in the feed water rejected by RO membrane.

Salt Permeability: Percentage of dissolved salts in the feed water permeating through the membrane.

Salt Rejection = (l-salt concentration of permeation/salt concentration of feed water) X 100%

Salt Permeability = 100 % — Salt Rejection

The rejection rate of membrane element is determined at the time of its being manufactured. The rejection rate depends on the density of superficial ultra thin desalting layer of membrane. The higher the density is, the higher the rejection rate can be obtained and the less the water is yielded. The rejection rates to different substances when using reverse osmosis are determined by the structure and molecular weight of substances. The rejection rate may exceed 99% for high-valent ions and univalent ions with complicated structures, and, though slightly lower, exceeds 98% for eliminating those univalent ions as Na^+, K^+ and CF. It can also achieve the rejection rate of up to 98% for the organic matters with molecular weight greater than 100, but for those organic matters with molecular less than 100, its rejection rate is lower to some extent.

Table: Typical Rejection Rate of RO Membrane Element

Solute	Molecular Weight	Salt Rejection Rate (R)	Solute	Molecular Weight	Salt Rejection Rate (%)
NaF	42	99	NaCN	49	97
NaCl	58	99	SiO_2	60	98
$NaHCO_3$	84	99	$NaNO_3$	85	97
$MgCl_2$	95	99	$CaCl_2$	111	99
$MgSO_4$	160	>99	$NiSO_4$	155	>99
$CuSO_4$	160	>99	Formaldehyde	30	40
Carbinol	32	30	Ethanol	46	70
Isopropyl alcohol	60	90	Carbamide	60	70
Lactic acid, pH5	90	99	Glucose	180	98
Saccharose	342	99	Chlorinous pesticide		>99

2, Permeate Flow

Permeate Flow: it refers to the yield capacity of reverse osmosis system, i.e. the quantity of water permeating through the membrane in certain unit time, which is generally shown in ton/hour or gallon/day.

Permeate Flow Rate: Also being an important index indicating the water yield of RO membrane element, it refers to the flow rate of permeating liquid through certain unit area of membrane, which is generally shown in gallon/ft^2-day (GFD). Excessively high permeate flow rate will quicken the water current velocity vertical to membrane surface, thus aggravating the contamination to membrane.

Table: Permeate Flow Rate of Membrane Element in RO System

Type of Feed water	ROP permeate	Undergro und Water	Surface Water	Brackish Water	Sea Water
Typical Salt concentration (ppm)	Less than 500	300 ~ 1500	200 ~ 1500	1500 ~ 5000	32500
Max. Permeate	30	15	12	12	8

flow rate (GFD)					

3. Recovery Rate

It refers to the percentage of the permeate to the feed water in the RO system. The recovery rate of an RO system is determined by the feed water quality when it is being designed. The recovery rate is generally expected to be maximized for the purpose of increasing the economic efficiency, but should be limited to the extent that no deposition will be caused in the RO system due to excessive saturation of salts.

Recovery Rate = (permeate flow/ feed water flow) X 100%

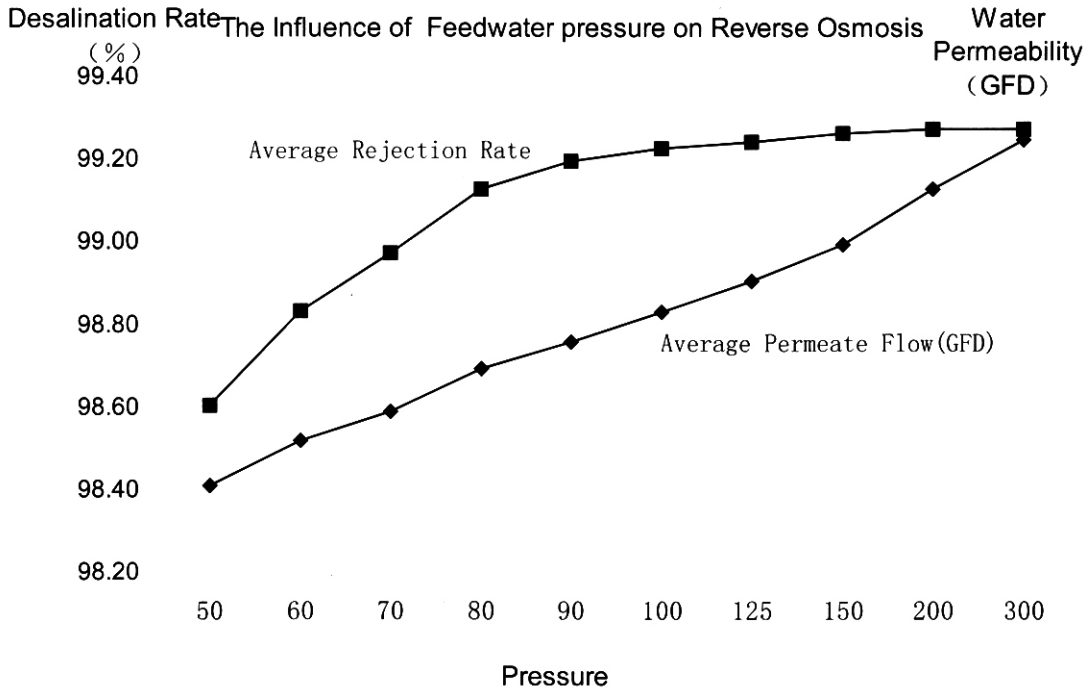
Table: Typical Recovery Rate of RO System

Type of Feed water	RO permeate	Underground and surface water	Brackish Water	Seawater	Recovery Concentrating
Typical Salt Concentration (ppm)	Less than 500	200 ~ 1500	1500 ~ 5000	32500	
Max. Recovery Rate (%)	90	75	75	50	≥90

Basis of Reverse Osmosis Technology
Factors Influencing the Properties of RO Membrane

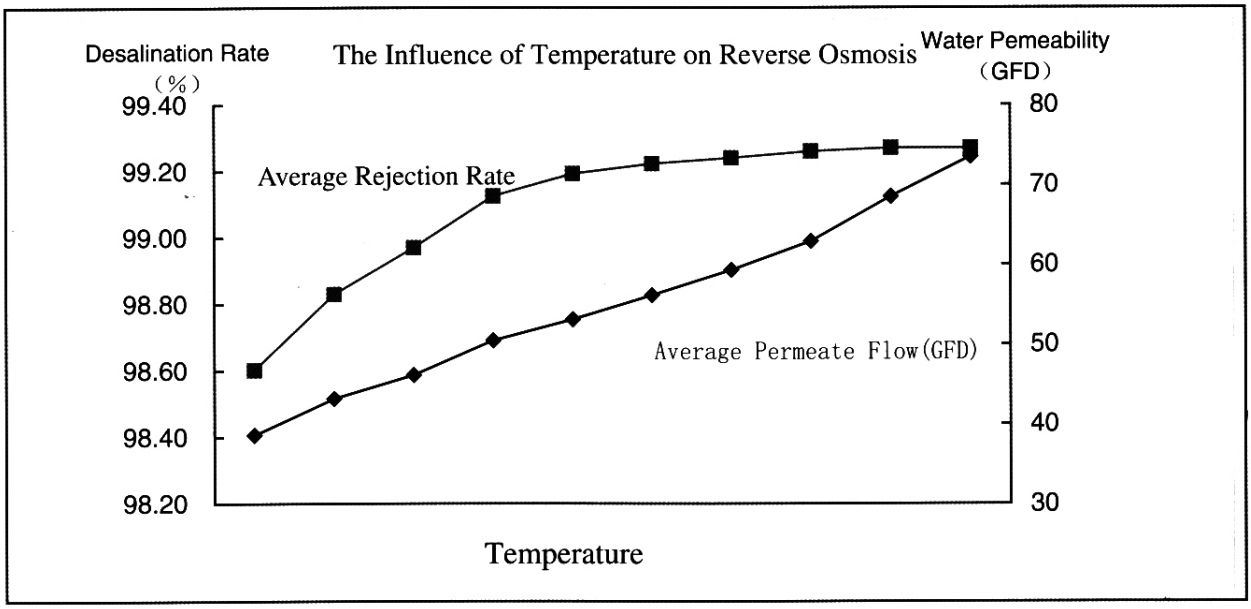
1. The influence of feed water pressure on RO membrane

The feed water pressure itself doesn't exert any influence on the quantity of permeating salt, but the increase of feed water pressure may heighten the net pressure driving the reverse osmosis, thus increasing the permeate flow while the quantity of permeating salt remains almost unchanged, then the enlarged permeate flow dilutes the saline matters permeating through the membrane, thus decreasing the salt permeability rate and increasing the rejection rate. When the feed water pressure exceeds a specific value, the excessively recovery rate increases the concentration polarization, and results in the increase of quantity of permeating salt, thus counteracting the enlarged permeate flow and causing the desalination not to be further increased, as shown in the following figure:



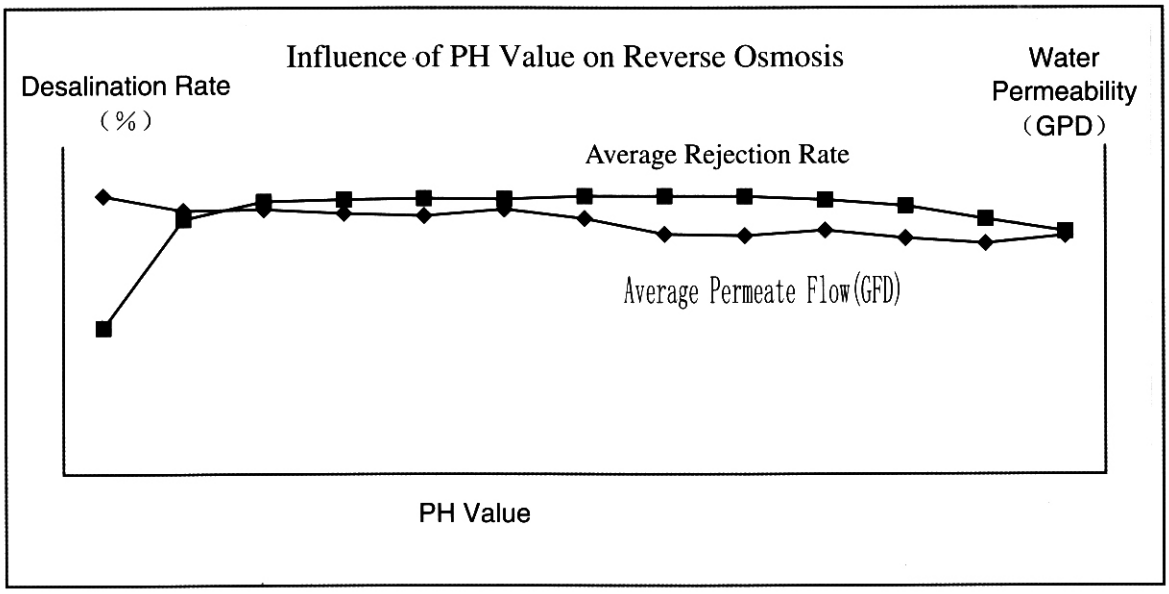
2. The influence of feed water temperature on RO membrane

The conductivity of the permeate is very sensitive to the change of water temperature. Along with the rise of water temperature, the permeate flow also increases linearly. Each 1 °C rise of feed water temperature will cause the permeate flow to be increased by 2.5% ~ 3.0%. The reason lies in that the viscosity of water molecules decreases, thus heightening their diffusivity. The increase of feed water temperature will also result in the increase of salt permeability and the decrease of rejection rate, and this is mainly because the diffusion of salts will be quickened along with the increase of water temperature, as shown in the following figure:



3. The influence of feed water PH value on the RO membrane

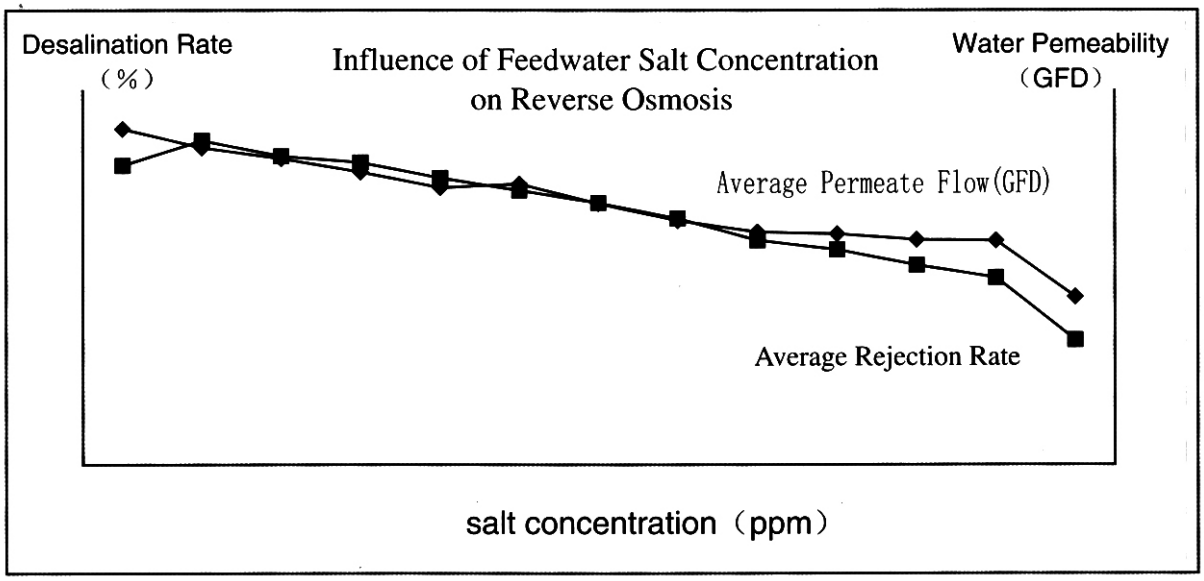
The pH value of feed water has almost no influence on permeate flow, but has a considerable influence on the rejection rate. Considerably influenced by PH value, the CO2 dissolved in water appears in gaseous state when the PH value is low, which can easily permeate the RO membrane, therefore low PH value results in low rejection rate. Along with the rise of PH value, the gaseous CO2 is converted into HCO3" and CO^" ions, then the rejection rate is going up gradually, and reaches the peak when the PH value is among 7.5-8.5. As shown in the following figure:



4. Influence of feed water salt concentration on RO membrane

Osmotic pressure is a function of the concentration of the salts or of organic matters in water. The rise of salt concentration will increase the osmotic pressure, and in case the feed water pressure remains unchanged, the net pressure will decrease and the permeate flow will drop down. Salt permeability is directly proportional to the difference of salt concentration between the both sides of membrane. The higher the salt concentration is in feed water, the bigger the difference of salt concentration is, and the salt permeability goes up, thus causing the decrease of rejection rate. As shown in following

figure:


Desalination Rate
（%）
Influence of Feedwater Salt Concentration
on Reverse Osmosis
Water Pemeability
（GFD）
Average Permeate Flow(GFD)
Average Rejection Rate
salt concentration（ppm）