Unit of Measure Conversion Chart

FLOW RATE

Unit A	Unit B	Multiplier to Convert A to B	Multiplier to Convert B to A
gpm	L/min	3.785	0.2642
gpm	m^3/hr	0.227	4.405
ft^3/min	L/min	28.32	0.0353
ft^3/min	gpm	7.481	0.1337

LENGTH

Unit A	Unit B	Multiplier to Convert A to B	Multiplier to Convert B to A
in.	mm	25.4	0.03937
in.	cm	2.54	0.3937
in.	m	0.0254	39.37
ft.	m	0.3048	3.281
yards	m	0.9144	1.0936
yards	km	0.0009	1093.6
miles	km	1.609	0.6214

AREA/SURFACE

Unit A	Unit B	Multiplier to Convert A to B	Multiplier to Convert B to A
in^2	cm^2	6.452	0.155
ft^2	cm^2	929.03	0.00108
ft^2	m^2	0.0929	10.764
in^2	ft^2	0.00694	144
sq. yards	m^2	0.8361	1.196
sq. miles	km^2	2.59	0.3861
acres	hectares	0.4047	2.471

VOLUME/LIQUID

Unit A	Unit B	Multiplier to Convert A to B	Multiplier to Convert B to A
gal (US)	L	3.785	0.2642
gal (US)	ft^3	0.1337	7.481
gal (US)	m^3	0.003785	264.2
gal (US)	fl. oz.	128	0.0078
gal (US)	imperial gal	0.833	1.2
gal (US)	quart	4	0.25
in^3	cm^3	16.387	0.06102
in^3	liters	0.016387	61.023
ft^3	m^3	0.028317	35.314
ft^3	L	28.317	0.03531
fl. oz.	cm^3	29.57	0.03381
fl. oz.	ml	29.57	0.03381
lb	gal (US)	0.12	8.337
metric ton	gal (US)	264.2	0.003785

MASS/WEIGHT

Unit A	Unit B	Multiplier to Convert A to B	Multiplier to Convert B to A
lb	g	453.6	0.0022
lb	kg	0.4536	2.205
grains	g	0.0648	15.432
oz	g	28.35	0.03527
oz	kg	0.02835	35.27
metric ton	kg	1000	0.001
ton, long UK	kg	1016	0.00098
ton, short US	kg	907.2	0.0011

TEMPERATURE

Unit A	Unit B	Formula to Convert A to B	Formula to Convert B to A
Fahrenheit(°F)	Celsius (°C)	(°F-32)×0.556	(1.8×°C)+32

PRESSURE

Unit A	Unit B	Multiplier to Convert A to B	Multiplier to Convert B to A
psi	bar	0.069	14.504
psi	kg/cm^2	0.0703	14.22
psi	kPa	6.895	0.145
psi	ft. H_2O	2.307	0.4335

CONCENTRATION

Unit A	Unit B	Multiplier to Convert A to B	Multiplier to Convert B to A
ppm	mg/L	1	1
ppm	gpg	0.585	17.1
ppm	lb/1000 gal	0.0083	120.5
ppm	microSiemen	1.5	0.667
micromho	microSiemen	1	1
%	mg/L	10,000	0.0001
%	g/L	10	0.1

VELOCITY

Unit A	Unit B	Multiplier to Convert A to B	Multiplier to Convert B to A
ft/min	cm/sec	0.508	1.969
ft/sec	cm/sec	30.48	0.0328
ft/min	gpm/ft^2	7.481	0.1337
ft/sec	gpm/ft^2	448.9	0.00223
cm/sec	gpm/ft^2	14.73	0.0679

OTHER

TDS = Conductivity ÷ 1.5

HP = [Flow (gpm) × Press (psi) × 2.31] ÷ [3960 × 0.5 (eff.)]

Power Consumption KW = [Feed flow(GPM) × Feed pressure(PSI)] ÷ 1611

1,000,000 Ω resistivity = 1.00 µS conductivity = 0.500 ppm TDS

% Recovery = (Feed ÷ Permeate) × 100%

KEY

in = inches	mg = milligram
ft = feet	g = gram
mm = millimeter	gpg = grains per gallon
cm = centimeter	kg = kilogram
m = meter	psi = pounds per square inch
km = kilometer	kPa = kiloPascals
gal = gallon	gpm = gallons per minute
fl. oz. = fluid ounce	hr = hour
L = liter	min = minute
ml = milliliter	sec = second
lb = pound	TDS = total dissolved solids
KW = kilowatts	µS = microSiemen
Ω = mho	eff. = efficiency
HP = horsepower	

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Temperature Correction

Temperature of the feed water and the net driving pressure across the element must be taken into account before comparing or evaluating the performance of a membrane element or a reverse osmosis system.

Temperature Correction Factor

The water temperature is one of the key factors in the performance of the reverse osmosis membrane element. The higher the temperature, the more the product flow, and vice versa.
All reverse osmosis membrane elements and systems are rated at 77º Fahrenheit (25º Celsius).
To find the membrane permeate rate at a different temperature, follow these steps:

Find the temperature correction factor (TCF) from the below table. Divide the rated permeate flow at 77º Fahrenheit by the temperature correction factor. The result is the permeate flow at the desired temperature.

Rated Permeate Flow ÷ TCF = Temperature Correct Flow

Example

QUESTION: For a thin-film membrane permeate rated at 1800 gallons per day at 77º Fahrenheit, what is the actual permeate rate at 59º Fahrenheit?

ANSWER: Temperature correction factor (from below table) for 59ºF = 1.422
Permeate flow at 59 degrees Fahrenheit = 1800 ÷ 1.422 = 1266 gallons/day

Feed Water Temperature		TCF for
ºC	ºF	Thin Film
10.0	50	1.711
10.5	50.9	1.679
11.0	51.8	1.648
11.5	52.7	1.618
12.0	53.6	1.588
12.5	54.5	1.558
13.0	55.4	1.530
13.5	56.3	1.502
14.0	57.2	1.475
14.5	58.1	1.448
15.0	59	1.422
15.5	59.9	1.396
16.0	60.8	1.371
16.5	61.7	1.347
17.0	62.6	1.323
17.5	63.5	1.299
18.0	64.4	1.276
18.5	65.3	1.254
19.0	66.2	1.232
19.5	67.1	1.210

Feed Water Temperature		TCF for
ºC	ºF	Thin Film
20	68	1.189
20.5	68.9	1.168
21.0	69.8	1.148
21.5	70.7	1.128
22.0	71.6	1.109
22.5	72.5	1.090
23.0	73.4	1.071
23.5	74.3	1.053
24.0	75.2	1.035
24.5	76.1	1.017
25.0	77	1.000
25.5	77.9	0.985
26.0	78.8	0.971
26.5	79.7	0.957
27.0	80.6	0.943
27.5	81.5	0.929
28.0	82.4	0.915
28.5	83.3	0.902
29.0	84.2	0.889
29.5	85.1	0.877

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Net Pressure Correction

Net Pressure Correction

The higher the net pressure on a membrane element, the higher the permeate rate. A rough value of osmotic pressure of water can be calculated roughly by the following rule:

Osmotic pressure (PSI) = Total Dissolved Solids ÷ 100

To estimate the effect of net pressure, follow these steps:

1. Calculate the net pressure under operating conditions (P_{op})
   P_{op} = Average applied pressure - Average osmotic pressure of the feed water

2. Calculate the net pressure at which the membrane element is rated (P_r)
   P_r = Rated pressure - Osmotic pressure of test solution

3. Expected permeate flow at operating conditions = **Rated permeate flow × P_{op} / (P_r)**

Example

QUESTION:
For a thin-film 4 × 40" membrane element, using a 2000 ppm, sodium chloride solution at 225 psi and 77 degrees Fahrenheit, the permeate rate is 1800 gallons/day. What is the permeate rate at 150 psi, feed water with 1000 TDS and temperature of 59 degrees Fahrenheit?

ANSWER:
Follow the below steps to come to your answer:

1. Temperature correction: Using the Temperature correction factor for 59°F (1.422) from the table:
   1800 gpd Rated Flow ÷ 1.422 = **1266 gpd**

2. Osmotic Pressure: TDS of 1,000 ÷ 100 = **10 psi**

3. Applied Net Pressure: 150 psi feed pressure – 10 psi osmotic pressure = **140 net pressure (P_{op})**

4. Rated net Pressure:
   a. Osmotic pressure of the membrane pressure is 2000 ÷ 100 = **20**
   b. 225 psi feed pressure – 20 psi osmotic pressure = **205 psi rated net pressure (P^r)**

Using the numbers found in the 4 steps above, our calculation [Rated permeate flow × P_{op} / (P_r)] will be:

1266 × 140 ÷ 205 = **865 gpd**

Note:
When designing a system additional detailed calculations are necessary to take into account the effect of pressure drop and variation in total dissolved solids (TDS) throughout the system. Please contact us if you require further information.

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Membrane Rejection Characteristics

Nominal Rejection Characteristics of Thin Film Composite Reverse Osmosis Membranes

ION	% REJECTION
Calcium	93-98
Sodium	92-98
Magnesium	93-98
Potassium	92-96
Manganese	96-98
Iron	96-98
Aluminum	96-98
Copper	96-98
Nickel	96-98
Cadmium	93-97
Silver	93-96
Zinc	96-98
Mercury	94-97
Hardness Ca & Mg	93-97
Radioactivity	93-97
Chloride	92-95
Ammonium	80-90

ION	% REJECTION
Bromide	90-95
Phosphate	95-98
Chromate	85-95
Cyanide	85-95
Sulfate	96-98
Thiosulfate	96-98
Silicate	92-95
Silica	80-90
Nitrate	90-95
Boron	50-70
Borate	30-50
Fluoride	92-95
Polyphosphate	96-98
Orthophosphate	96-98
Chromate	85-95
Bacteria	99 +
Lead	95-98

Nominal Rejection Characteristics of Cellulose Triacetate Reverse Osmosis Membranes

ION	% REJECTION
Sodium	90-95
Calcium	92-95
Magnesium	94-97
Potassium	85-95
Iron	92-96
Manganese	92-96
Aluminum	95-98
Ammonium	85-90
Copper	96-98
Nickel	96-98
Zinc	96-98
Strontium	95-97
Cadmium	95-97
Silver	90-95
Mercury	94-96
Barium	94-96
Chromium	94-96

ION	% REJECTION
Lead	94-96
Chloride	90-95
Bicarbonate	85-95
Nitrate	50-70
Fluoride	85-90
Silicate	80-90
Phosphate	95-97
Chromate	80-90
Cyanide	80-90
Sulfite	94-96
Thiosulfate	94-97
Ferrocyanide	96-98
Bromide	85-90
Borate	25-50
Sulfate	96-98
Arsenic	90-95
Selenium	90-95

**The above percent rejection is for reference only. The above listing is for the most common impurities found in water. Thin Film Composite RO membranes may also remove other less common impurities found in water (i.e. Uranium, Arsenic, etc.) Actual rejection will depend heavily on the exact chemistry, temperature, pressure, and TDS content of the feed water. If you have any questions, please contact us.*

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Comparison of Membrane Processes

Process	RO / NF		UF	MF	CF	
Examples of Common Constituents In Water	Metal Ions	Sugar	Virus, Pyrogen, Colloidal Silica	Carbon Fines	Bacteria	
Approx. Molecular Weight Cut-Off*	100	200	20,000	100,000	500,000	
Microns	0.0001	0.001	0.01	0.1	1.0	10.0

RO: Reverse Osmosis

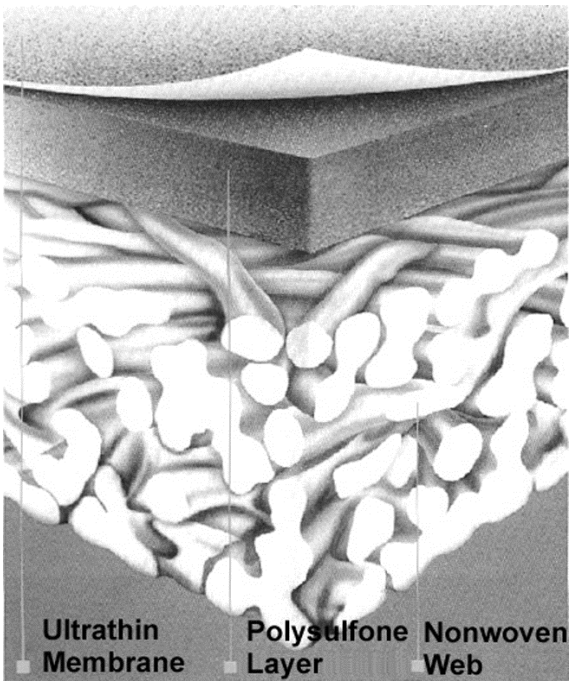
NF: Nanofiltration

UF: Ultrafiltration

MF: Microfiltration

CF: Conventional Filtration

* Used for sizing organics



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Membrane Cleaning Guidelines

When To Clean Membranes

In normal operation, the membrane in reverse osmosis elements can become fouled by suspended solids, microorganisms, and mineral scale. These deposits build up during operation and cause loss in water output or salt rejection, or both.

Elements should be cleaned whenever the normalized permeate water output rate drops by 10% from its initial flow rate (the flow rate established during the first 24 to 48 hours of operation), when salt passage in the product water increases over 5-10%, or when normalized pressure drop across the membrane increases by 10-15%.

It should be noted that the water output rate will drop if feed water temperature decreases (see Temperature Correction, page 11-2). This is normal and does not indicate membrane fouling.

Common Foulants and Their Associated Symptoms

Foulant	Symptoms	Solution per Membrane Type
Biological Growth	Element may have strong odor, possible mold growth on scroll end. Element will likely exhibit low permeate flow, but salt rejection will usually be as good if not better than original test.	TF: AM-22 CA: AM-33
Carbonate Scale	Usually on tap water or brackish water elements only. The element may be noticeably heavier than normal. Element will exhibit low permeate flow and poor salt rejection.	TF: AM-11 CA: AM-44
Iron Fouling	Rust coloring seen on end of scroll. Possibly some large rust flakes from iron plumbing. Element will exhibit low permeate flow and poor salt rejection. Rust colored reject water may be seen on start of baseline test	TF: AM-11 CA: AM-44
Silt or Carbon Fines	Brown or black material on scroll end. Low Flow, good rejection in early stages. High flow and very poor rejection in later stages due to the abrasive effects of the material on the membrane.	AM-55

Cleaning Sequence

Whether the system needs acid or alkaline cleaning will depend on the type of foulant suspected. If $CaCO_3$ is the known scalant, acid cleaning alone may be sufficient. Otherwise both kinds of cleaning are needed and it is recommended to start with the alkaline cleaning then follow with the acid cleaning after the system has been flushed.

1. ALKALINE CLEANING (if required)
2. FLUSH
3. ACID CLEANING
4. FLUSH

Note: Acid cleaning may be performed alone, but alkaline cleanings should always be followed by an acid cleaning after the system has been flushed.

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Membrane Cleaning Procedure

Use RO permeate water if possible, preferred. Whether the system needs acid (AM-11) or alkaline (AM-22) cleaning will depend on the type of foulant suspected. If both kinds of cleaning are desired, we recommend starting with the alkaline cleaning, then cleaning with the acid.

Note: If $CaCO_3$ is the known scalant, acid cleaning alone may be sufficient.

Cleaning System

Connect cleaning tank and pump system to the membrane system. It may be necessary to clean one tube at a time (see flow requirements, page 11-8). Pump pressure must not exceed 60 psi. Permeate and concentrate lines must return to the cleaning tank. Include a 10 micron filter in the feed line to the membrane.

Cleaning Procedure

Preparation of Solution

Add the cleaner slowly (for the proper amounts, check the detailed procedure for that cleaner) to cleaning tank water, and mix well.

CAUTION: *Mix with care and wear protective clothing.*

Cleaning Procedure

CAUTION: *Do not allow the cleaning solution temperature to exceed 120 degrees F. Do not allow the flows to exceed 4 gpm for 2½" elements, 12 gpm for 4" elements, or 40 gpm for 8" elements. Recirculate solution.*

- Operate system at 50 psi for 10 minutes. During this first 10 minutes of the cleaning cycle, the flow rate should be maintained at less than 1 gpm for 2½" elements, and less than 3 gpm for 4" elements, and less than 12 gpm for 8" elements to allow the foulants to loosen. The flow rate should then be increased to 3 gpm for 2½" elements, 9 gpm for 4" elements, and 35 gpm for 8" elements for 20 minutes to clear foulants from the system.
- Do not let the tank run dry. Add more water and cleaner if necessary.
- Discard cleaning solution to drain, diluting with copious amounts of water, then rinse tank well.
- Fill tank with clean water and flush system to drain for 10 to 15 minutes. Add clean water as necessary. Rinse the system until the concentrate pH is almost the same as the clean water pH.

CAUTION: *Flush thoroughly before cleaning with other cleaners. Cleaning chemicals may react with one another or with foulants to produce additional fouling on the membrane.*

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Membrane Cleaning Guidelines

Cleaning Flow Rates for Spiral Wound Membranes

Type	Volume (Gallons)	Medium Flow (GPM)	High Flow (GPM)
4” × 40”	2.5	4	10
4” Magnum	3.5	4	10
6” × 40”	4.0	12	20
8” × 40”	6.0	25	35
8” Magnum	8.5	25	35

Estimate of Cleaning Solution Volume

V = El × Vol × 5

El = Number of Elements
Vol = Volume of one element from Flow Tables

Estimate of Total Flow Required

HTF = NV × HF
MTF = NV × MF

HTF = High Total Flow
MTF = Medium Total Flow
NV= Number of Vessels in Parallel
HF = High Flow from Flow Table
MF = Medium Flow from Flow Table

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Membrane & System Preservation Process

Preserving Membranes and System with AM-88

The interior of a spiral membrane element is dark, moist and therefore an excellent breeding ground for microorganisms. When spiral elements are used, tested, or operated intermittently, they will probably be exposed to bacteria. During shutdown or storage periods of more than a few days, spiral elements should be disinfected or sterilized by filling the system with a biocidal solution. Up to 40% flux loss can occur from biological fouling in elements and modules that have been tested on non-sterile water, then stored on the shelf or in non-operating units for long periods.

To prevent biological growth during storage, shipping, or system shutdowns, it is recommended that RO systems and membranes be immersed in a solution of AM-88. This solution will not adversely affect membrane flux or performance.

System and Membrane Preservation Procedure

1. Make a water solution containing 2% by weight of AM-88. Add 75 grams of AM-88 for each gallon of water (use RO permeate if possible).
2. Flush and fill the system with this solution.
3. Drain the system as much as possible.
4. Seal the system.

Long Term Storage Procedure (Membranes Only)

1. Make a water solution containing 2% by weight of AM-88 and 20% by weight glycerin (99%, USP).
2. Drain and seal the membrane in a plastic bag.

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Membrane & System Disinfection Process

Disinfecting Membranes and System with PS-77

Hydrogen peroxide or a mixture of hydrogen peroxide and peracetic acid is used for disinfecting reverse osmosis systems and Thin-Film Composite membranes. Two factors greatly influence the rate of hydrogen peroxide attack on the membrane: Temperature and Iron.

Temperature:
The disinfecting solution should not exceed 77 degrees F (25 degrees C). Thin-Film Composite membranes tested at temperatures higher than 77 degrees F showed decreased salt rejection over a period of time. The higher the temperature, the faster the decrease occurs.

Iron:
The presence of iron or other transition metals in association with hydrogen peroxide will catalyze membrane degradation.

Disinfecting Procedure for Systems

1. Clean the system with AM-22 or AM-23. AM-22 or AM-23 will remove deposits in the system which harbors microorganisms. After cleaning, flush the system with RO permeate.

2. Clean the system with AM-11 to remove iron and other transition metals. After cleaning, flush the system with RO permeate.

3. Circulate a solution of PS-77 or hydrogen peroxide through the system in a ratio of 1:100 with RO permeate for 30 minutes, at a temperature not to exceed 77 degrees F.
   CAUTION: Do NOT exceed this concentration or the membranes will be damaged.

4. Allow the system to soak in the disinfecting solution for 2-12 hours. A soak-time of 2 hours will kill more than 90% of the bacteria, whereas a soak time of 12 hours will kill 99% of the bacteria. After disinfecting, flush the system with RO permeate.

Disinfecting Procedure for Membranes

1. Clean the membrane with AM-22 or AM-23. AM-22 or AM-23 will remove deposits in the membrane which harbor microorganisms. After cleaning, flush the membrane with RO permeate.

2. Clean the membrane with AM-11 to remove iron and other transition metals. After cleaning, flush the membrane with RO permeate.

3. Circulate a solution of PS-77 or hydrogen peroxide through the membrane in a ratio of 1:100 with RO permeate for 30 minutes, at a temperature not to exceed 77 degrees F.
   CAUTION: Do NOT exceed this concentration or the membranes will be damaged.

4. Allow the membrane to soak in the disinfecting solution for 30 minutes. After disinfecting, flush the membrane with RO permeate.

   CAUTION: PS-77 or hydrogen peroxide is not recommended in contact with brass, copper, or iron parts and fittings of an RO system. Handle all chemicals with care. Wear protective clothing and eye protection.

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Membrane Storage, Shipping & System Shut-Down

Membrane Storage:

- Store Membranes in a cool area out of direct sunlight. Membrane storage temperature limits are 22°F-113°F. Dry (new) elements can go below 22°F.
- Preserve in a solution of 2% AM-88 and 20% AM-225. This will not prevent freezing below 32°F, but the crystals are soft and the membrane is not damaged.
- Keep new elements in their original packaging.
- Examine the preservative in preserved elements every 3 months. If preservative color is not clear, remove and re-preserve the element. The pH of the preservative should not drop below 3.
- Storage time of dry elements is unlimited.

Membrane Shipping:

- Preserve the element in the plastic bag using the recommended procedure. Make sure the plastic bag does not leak and the element is properly identified.
- Make sure the preservative solution is correctly labeled.
- Protect the element package from physical damage.

System Shut-Down:

- Clean the membranes in the system using the cleaning procedure.
- Circulate the preservative solution.
- Shut down the system and close valves to avoid air entering the system.
- Check preservative once a month.

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Silt Density Index Test Method

Open kit and check that all items are present:

- Tubing for Feed
- Graduated Cylinder
- Filter Holder (with tubing connected)
- Tweezers
- Thermometer
- Sample SDI Membrane Filters

Connect the tubing to the feed port labeled “IN” by inserting the tubing into the fitting and pushing to the pipe-stop. Pull lightly on the tubing to check that it is secure.

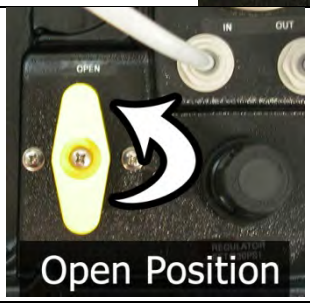
(To remove the tubing when you are done testing: Push in the collet against the face of the fitting. With the collet held in this position the tube can be removed.)

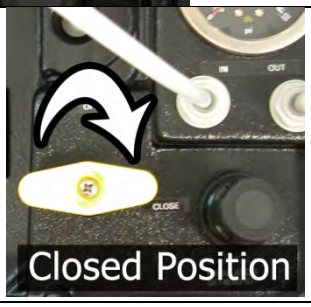
Connect the elbow at the end of tubing attached to the filter holder by inserting the stem into the outlet labeled “OUT” and pushing to the pipe stop. Pull lightly on the elbow to check that it is secure.

(To remove the elbow when you are done testing: Push in the collet against the face of the outlet fitting. With the collet held in this position the elbow can be removed.)

Once all connections are made, turn the feed water on by turning the control valve handle counter-clockwise to the open position. Purge air and adjust the pressure regulator to 30psi.

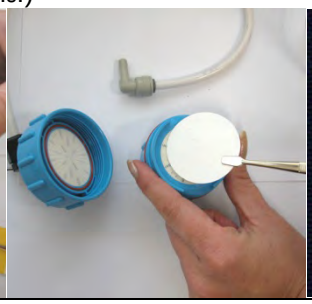
Return the valve to the closed position by twisting the handle clockwise.

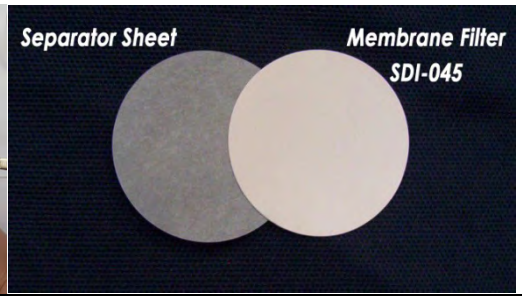




Open the filter holder by twisting the cap, and place the membrane filter into the holder. Use the tweezers to handle the membrane filter – do not touch this with your hands. Note that the filters are packaged with blue separator sheets between them – these should be discarded.

(Begin testing as per instructions.)





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(760) 727-3711• FX: (760) 727-4427
sales@appliedmembranes.com

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SDI Test Method & Calculation

Preparation

1. Assemble the measuring equipment per setup instructions.
2. Install Filter Holder
3. Attach input hose to source. Note: source must be at a pressure greater than 30 psi to give a proper test.
4. Open ball valve and adjust pressure regulator to 30 psi. This is the proper pressure for the test and should be maintained at all times.
5. Once the pressure regulator is adjusted, close the ball valve. The equipment is ready to begin testing.

Testing and Calculation

1. Install new filter in the filter holder. The filter disk goes below the o-ring laying flat against the perforated screen.
2. Direct the output from the filter holder to the 500 ml container. Open the ball valve and begin timing. T_0 is the time it takes to fill the 500 ml container starting when the valve is first opened.
3. Let the water run through the filter at the constant pressure of 30 psi for 15 minutes. Take another reading for the time it takes to fill the 500 ml container. This is T_{15}.
4. After the time to fill the 500 ml container starting at 15 minutes (T_{15}) is recorded, the test may be discontinued.
5. Using the values of T_0 and T_{15}, calculate the value of SDI from the formula below. This is called the standard SDI, and is referred to as SDI_{15}.
6. It is possible that the filter may get completely plugged or it may take too long to collect the 500 ml sample after 15 minutes. In that case, starting with a new filter, repeat the process at 5 minutes, instead of 15 minutes. The SDI calculated using this information is called SDI_5. If possible, starting with a new filter, you may also determine SDI_{10} (at 10 minutes).
7. The formula for calculating the Silt Density Index is as follows:

   $S.D.I. = [(1-T_0/T_t) \times 100] \div t$

   Small t = the time elapsed between the first timed test and the second timed test, and is usually 15 minutes as stated in 3 above unless plugging occurs and the process needs to be repeated at a 5 minute interval. A typical calculation (using 15 minutes) is as follows:

   $S.D.I. = [(1-30/90) \times 100] \div 15 = 4.4$

   Where T_0 = 30 seconds, T_{15} = 90 seconds, and t = 15 minutes.
8. The test may, of course, be repeated (using a new filter each time) at the same interval, and an average of the SDI readings may be used for analysis.

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System Design & Feed Analysis Worksheet

RO System Design Questionnaire

Date: _____

1. COMPANY: _____
2. CONTACT: _____
   _____
3. Please provide a copy of any job specifications.

FEED WATER	
Source	
Flow	
Flow Limit?	
Temp. range*	
Pressure	
Quality Fluctuations?	
Feed Analysis (Complete below or attach a copy)	
Units are as: PPM Ion _____ PPM Calcium Carbonate_____	
pH	
Calcium	
Sulfate	
Potassium	
Silica	
Bicarbonate	
Sodium	
Nitrate	
Magnesium	
Chloride	
Iron	
Other	
TDS (PPM)	
Conductivity (µMHOS/CM)	
Turbidity	
Color	
BOD/COD	
TOC	
Suspended solids	

FACILITIES	
Space	
Length	
Width	
Height	
Access Door	
Power	
Volts	
Phase	
Cycles (HZ)	
Max. Amps	
Location	
Indoor	
Outdoor	
Ambient Temperature	
Max. Temp.	
Min. Temp.	
Altitude	

PRODUCT WATER	
Flow Required	
In Hours/day	
Quality Required (In TDS, Conductivity or Resistivity)	
TDS	
Conductivity	
Resistivity	
pH	
Application	

Additional Information:

_____

_____

_____

_____

** Temperature range accuracy is important to minimize equipment cost.*

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Order Form

Bill To:	Ship To:
Company: _____	Company: _____
_____	P.O. # _____
Attention: _____	Attention: _____
Address: _____	Address: _____
_____	_____
Phone: _____	Phone: _____
-Or-	
Account # (If known) _____	Fax: _____

Payment (check one)

☐ **Bill to my account:**
- ☐ **I have an existing account with terms**
- ☐ **I have enclosed a credit application (approval may take 7-10 business days)**

☐ **Prepayment (please see banking information)**

☐ **Credit Card (Visa, Mastercard, American Express, & Discover):**

_____ **Exp.** _____

Ship via: _____

☐ **Prepaid**
☐ **Collect: Carrier Acct #** _____

Qty.	Item Number	Description	Unit Price	Extended Price

Special Instructions:

_____

_____

Total Sales Amount:	$

*Sales Tax Charges may apply for California Residents. Please fax a copy of your re-sale certificate for California tax exemption.
*Pricing is Ex-Works, Vista, CA and in US Dollars.

Please Complete and Fax to: 760-727-4427

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Credit Application

Company _____

Address _____

City _____ State _____ Zip _____ Phone (_____)_____

E-mail _____ Fax (_____)_____

DBA _____ Affiliated Companies _____

Proprietor _____ Partnership _____ Corporation _____

Incorporated: State _____ Year _____

Owner(s) Name/SSN ***Home Address, Zip*** ***Phone #***

_____

_____

_____

*Attach copies of credit references

Have you been a party to a suit within the last 5 years, have any outstanding judgments against you, or have gone through foreclosure _____

I do hereby authorize my bank to disclose information concerning my accounts.

Declared bankruptcy within the last 10 years _____ Year _____
Bank Name _____ Account Number _____
Contact _____
Address _____ Phone (____)_____

Bank Name _____ Account Number _____
Contact _____
Address _____ Phone (____)_____

	Trade Creditor Street	**City**	**Zip**	**Phone**	**Fax**
1.					
2.					
3.					

Resale# _____ Fed Tax ID# _____

Payment Terms: To be received at Applied Membranes, Inc., Vista, California, within 30 days from invoice date.

The customer agrees to pay all service/late charges, reasonable attorney's fees, court costs, investigation costs, and expert witness fees incurred in the collection of the customer's past due account.

A service charge of 11/2% per month (18% annually) will be assessed on past due amounts.

Any disputes relating to the customer's account will be governed by California law, and shall be litigated only in the superior or municipal court for the county of San Diego, and no other.

Signed _____ Title_____ Date_____
Co. Officer

Please Complete and Fax to: 760-727-4427

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Product Warranty

- SELLER hereby warrants to CUSTOMER that the goods herein described will be free from any liens or encumbrances, that good title to said goods will be conveyed to CUSTOMER by sale of same.

- SELLER warrants materials of its own manufacture against defects in material and workmanship under normal conditions of usage and service for one year from whichever of the following events occur first:

    - First use in a system
    - Three (3) months following date of shipment from Vista.

Materials not manufactured by SELLER receive only such warranty, if any, of the manufacturer thereof and which are hereby assigned to CUSTOMER without recourse to SELLER.

SELLER'S obligation under this warranty is limited to and shall be fully discharged by repairing or replacing any defective part FOB its works. SELLER shall not be liable for repair or alterations made without SELLER'S prior written approval; for membrane elements becoming plugged by suspended matter, precipitates, or biological growth; or for failure to properly maintain the element. SELLER shall not be liable for damages or delay caused by defective material. Elements returned to SELLER for warranty examination must be shipped freight prepaid.

- **SELLER'S Liability.** SELLER SHALL NOT BE LIABLE FOR PROSPECTIVE PROFITS OR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, NOR SHALL RECOVERY OF ANY KIND AGAINST SELLER BE GREATER IN AMOUNT THAT THE PURCHASE PRICE OF THE SPECIFIC GOODS SOLD AND CAUSING THE ALLEGED DAMAGE, WHETHER SUCH CLAIM BE BASED ON CONTRACT OR TORT; provided, however, the aforesaid to the contrary notwithstanding, SELLER shall not be liable for any bodily injuries or property damage directly caused by its willful, wanton or negligent acts.

- **All Other Warranties and Damages.** THERE ARE NO WARRANTIES ESTABLISHED, EXPRESS OR IMPLIED OR STATUTORY, INCLUDING THE WARRANTY OF MERCHANTABILITY, EXCEPT THOSE SET FORTH ABOVE OR ANY PERFORMANCE WARRANTY WHICH IS ATTACHED TO THIS ORDER.

- **Permits, Ordinances and Code Compliance.** CUSTOMER has full responsibility for obtaining any licenses, permits and inspections required with respect to installation and use of the goods herein described.

- **Governing Law.** Any agreement based upon this Order and the obligations thereby imposed on SELLER and CUSTOMER shall be governed by and construed according to the laws of the State of California.

Membrane Warranty

Important Note: If a membrane performs as per specifications when first tested in the system (allowing for water temperature effect), then the membrane is good. Any performance decline after this has nothing to do with the membrane. The performance decline is due to one or more of the following:

- Chlorine Leakage
- Colloidal Particles or Suspended Solids
- Hardness, Iron or other fouling
- Microbiological Fouling
- Physical Abuse
- O-Ring Leak

The water quality and the way the system is operated may lead to premature failure. It sometimes takes only a few hours to damage the membrane. The membrane does not lose its performance unless it is subjected to poor operating conditions or improper pretreatment. Performance problems at startup should be reported immediately.

1. **Terms of Pro-rated Performance Warranty -** Subject to the conditions set forth in Sections 3 and 4 below, AMI warrants the performance of its elements for **one (1) year** from whichever of the following events occurs first: **a.** First use in system; **b.** Three (3) months following date of shipment from Vista, CA.

2. **Initial Performance -** AMI warrants the elements herein offered have the initial minimum permeate flow and initial minimum salt rejection as specified in the Technical Bulletin(s) when such elements are tested under standard conditions specified by AMI.
   a. Buyer is responsible for testing of each element to ensure element meets performance specified in the Technical Bulletin(s).
   b. Should any element not meet performance specifications, and Buyer notifies AMI of such deficiency within 10 days from date of testing of element(s) by Buyer, AMI will, upon confirmation of faulty performance, repair or replace the defective element(s) at no charge. Shipping costs, in such case, will be paid by AMI.

3. **Performance During Three Year Warranty Period -** During the first year of operation on the element(s), AMI warrants that minimum permeate flow, when operated under standard conditions published by AMI, shall be at least 70 percent of the specified initial average flow. AMI further warrants that maximum salt passage, when element is operated under standard conditions published by AMI and pressure required to give the initial rated flow, will not exceed 1.35x the specified maximum value. AMI will, on confirmation of loss of performance during the warranty period, credit 1/12 of the original purchase price of the element for each unused month of the warranty period toward the purchase of a replacement element and the current prevailing price.

4. **Conditions of Warranty**
   The performance warranty described in section 3 above shall be null and void if any of the following conditions are not met:
   a. The feedwater to the element(s) shall have less than one (1) NTU turbidity and a silt density index at 15 mins. (SDI_{15}) of less than 5.0;
   b. The feedwater to the element(s) shall contain no oil, grease, or other organic or inorganic matter harmful to the membrane;
   c. The feedwater temperature shall not exceed 113°F (45°C). The element(s) shall not be exposed during operation, cleaning, or in shutdown periods, to pH outside the range given in specification sheet and adequate provisions against microbiological contamination shall be incorporated into the system and design, as well as into all operating and maintenance procedures. The element(s) shall not be exposed to pressure outside the limit in the specification sheet;
   d. Backpressure (where permeate static pressure exceeds reject static pressure) shall not exceed 5 psi at any time;
   e. The element(s) shall be operationally protected against hydraulic shock loading (water hammer);
   f. The element(s) shall be maintained in a clean condition, unfouled by particulate matter or precipitates or biological growth; *If scaling or fouling should occur, or normalized element flow decline 10%, cleaning procedures should be initialized;*
   g. The system array, recovery, and instrumentation, and the design parameters and components of the system in which the element(s) are employed, shall be consistent with sound engineering practice;
   h. Buyer is responsible for providing the user with the adequate system operating and maintenance manuals, operator and supervisor training, and ensuring user's ability to perform cleaning and other performance restoration and diagnostic procedures;
   i. Buyer shall ensure that frequent, adequate system and subsystem performance data are routinely logged, reviewed, and filed in a systematic format, such information to be available to AMI on a reasonable basis in the event a claim is made against AMI pursuant to this performance warranty.

5. **Repair of Replacement -** AMI's obligation under this warranty and Buyer's sole remedy for any breach of warranty is limited to and shall be fully discharged by AMI repairing any defective element or, at AMI's discretion, replacing same at the then selling price f.o.b. AMI's plant, plus a service and handling charge of thirty dollars ($30.00) per element, less a prorated rebate on the unrealized life of the warranty period. AMI reserves the right to test the alleged defective elements and the reverse osmosis systems on user's or Buyer's premises or to request Buyer to perform such inspections or tests and forward the results thereof to AMI. If the element failure is determined to be from cause other than breach of warranty as set forth above, Buyer shall pay to AMI a fee of $800 per day, plus direct travel expenses incurred by AMI's employees, in connection with any inspection and testing of such elements and systems on Buyer's premises. Elements shipped to AMI for warranty examination must be shipped freight prepaid. Elements examined as part of a warranty claim which are found to be performing as warranted will be returned to the Buyer freight collect and a handling charge will be levied against the Buyer, as described in the published Element Return Procedures

Reminders

- Permeate obtained from first hour of operation should be discharged.
- Elements must be in use for at least 6 hours before formaldehyde is used as a biocide. If the elements are exposed to formaldehyde before this period, a severe loss in flux may result.
- Neither nonionic nor cationic surfactants, nor any other chemical not approved by AMI, should be used for membrane cleaning or come in contact with AMI elements. The customer is fully responsible for the effects of unapproved chemicals on AMI elements; their use will void the warranty.
- Before returning any element(s) to AMI for warranty examination, see the Element Return Procedures technical bulletin.

6. **UF & MF Membranes & Systems for Non-Water Treatment Applications -** The performance of membranes for process and waste water applications is difficult to predict. Each situation is different in the liquid composition and can drastically change the performance of the membrane, its fouling and useful life. AMI makes no specific claims on the permeate flow, rejection or membrane life for these applications. This information must come from the customer either from prior experience or from pilot testing under actual process conditions. AMI can only provide flux information with non-fouling water. The molecular weight cut-off information is a guideline number and must be treated as such. Different compounds with similar molecular weight cut-offs can behave very differently in their rejection by a membrane. Also, different material membranes with the same MWCO may mean different rejections for the same compound. In short, for process and waste water applications the customer must take the responsibility of the membrane performance. AMI will honor warranty only if the initial non-fouling water permeate flow under the test conditions is lower or if there is an initial mechanical defect. No performance warranty is given or implied by anyone or any sales literature from AMI.

Warranty Notice - Failure or refusal to fully disclose to AMI the use and operating parameters of AMI membrane elements shall render all warranties other than that covering materials and workmanship null and void.*The warranty information above is Applied Membranes, Inc. membrane warranty, and pertains to membrane elements manufactured by Applied Membranes, Inc. For other manufacturers, their individual warranties will apply.

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