EPRO SMALL RO SERIES
OPERATION & MAINTENANCE MANUAL

1 x 440E

2 x 440E

1 x 240

2 x 440

5 x 440

3 x 440

Explosion Proof

3 x 440 Wall Mount

Water Purification Technologies

EPRO 600-10000 OPERATION & MAINTENANCE MANUAL (REVISED 2/14)

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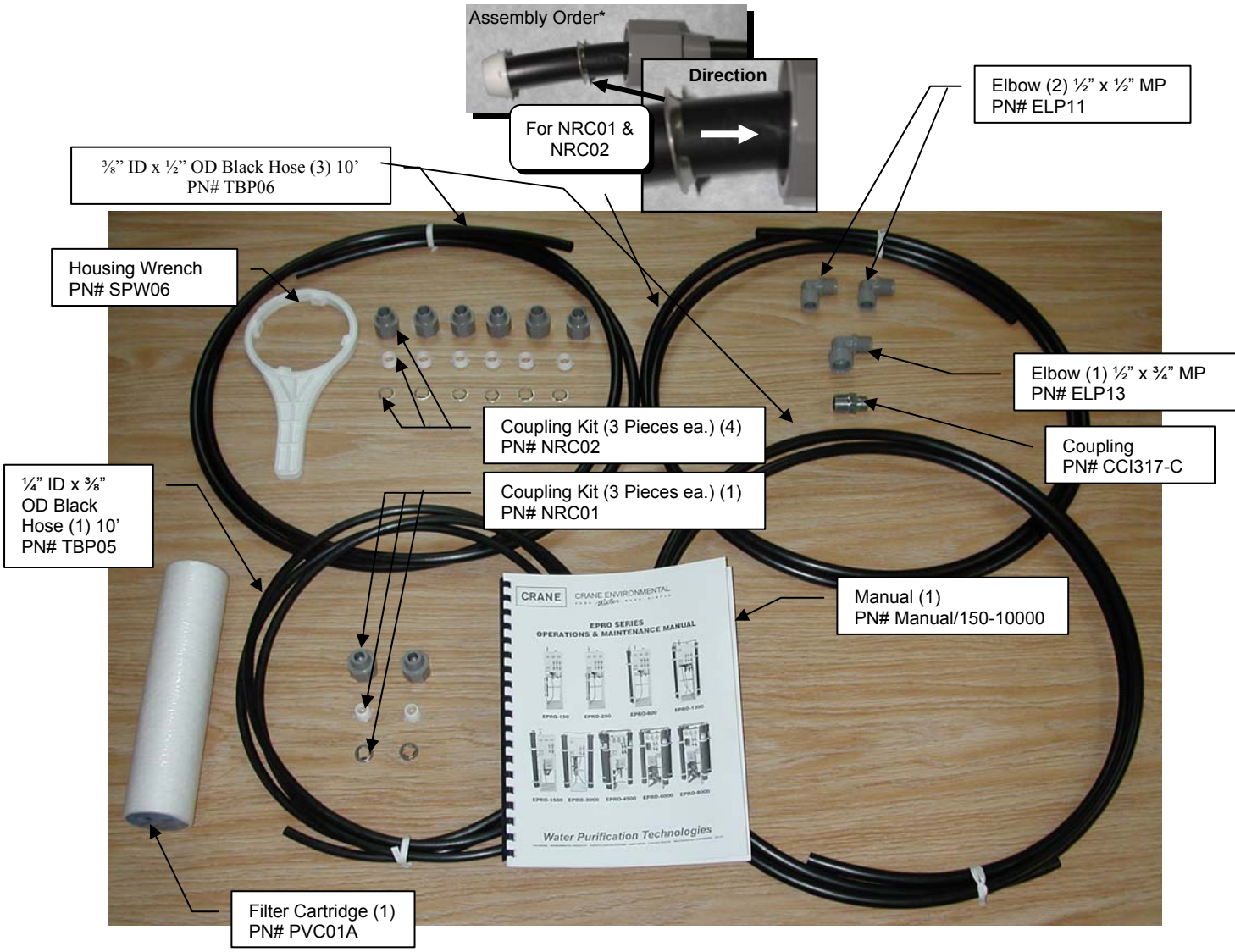
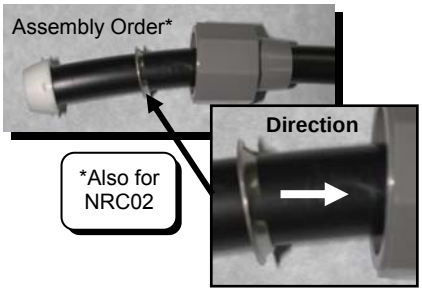
Accessory Kit for EPRO600-1200 (PN#AK600-1200)

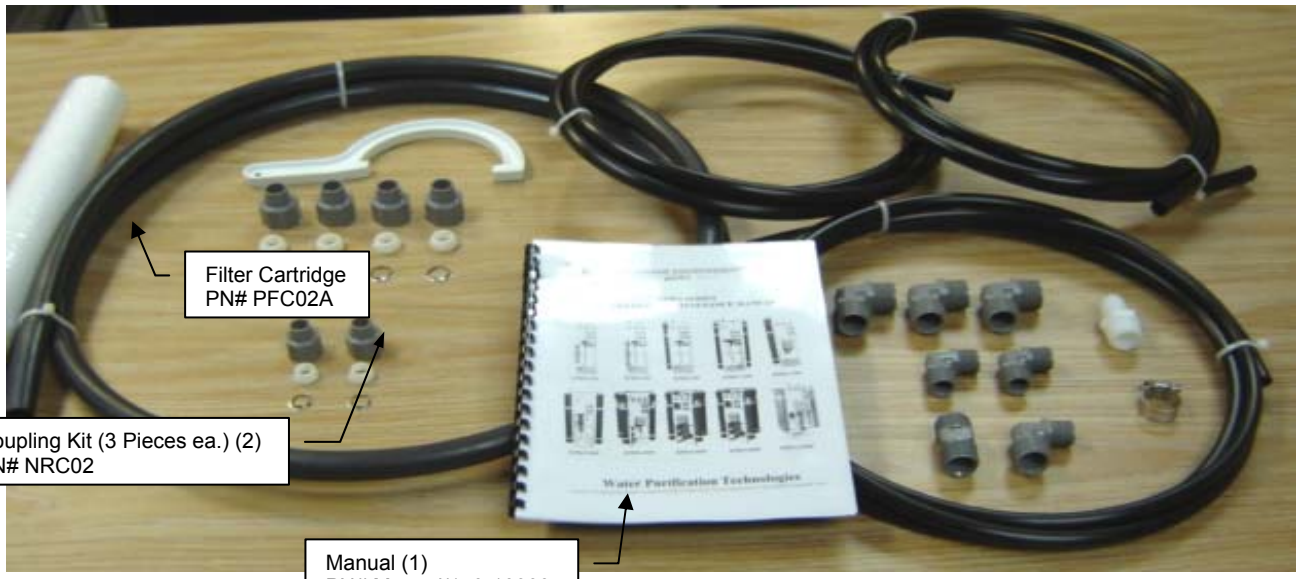


Part Number	Description	Qty. Included	Qty. to Order
TBP06	⅜" ID x ½" OD Black Hose 10'	(3)	
TBP05	¼" ID x ⅜" OD Black Hose 10'	(1)	
NRC01	Coupling Kit (3 Pieces ea.)	(2)	
NRC02	Coupling Kit (3 Pieces ea.)	(6)	
ELP13	Elbow ½" x ¾" MP	(1)	
ELP11	Elbow ½" x ½" MP	(2)	
CCI317-C	Coupling 3/8" x ½" MP	(1)	
PVC01A	Filter Cartridge	(1)	

SPW06	Housing Wrench	(1)	
Manual	Manual/150-8000	(1)	

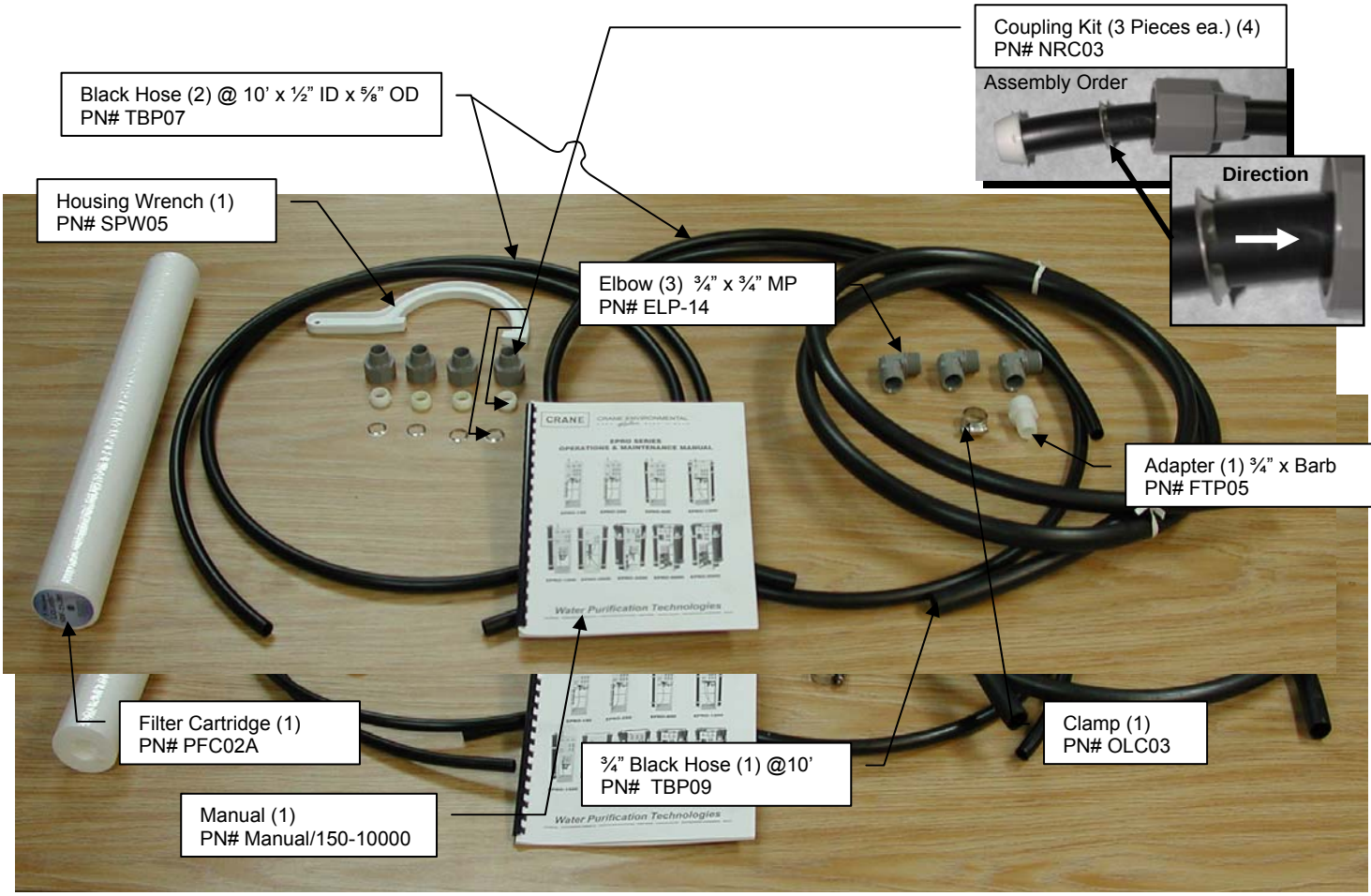
Accessory Kit for EPRO1500-6000 (PN#AK1500-6000)





Part Number	Description	Qty. Included	Qty. to Order
PFC02A	Pre-Filter Cartridge	(1)	
TBP06	Hose, Black 3/8"-ID X 1/2"-OD, 10' length	(1)	
NRC02	Coupling Kit (3 Pieces ea.)	(2)	
TBP07	Hose, Black 1/2"-ID X 5/8"-OD, 10' length	(2)	
NRC03	Coupling Kit (3 Pieces ea.)	(4)	
ELP11	Elbow, 1/2" X 1/2" MP	(2)	
ELP14	Elbow, 3/4" X 3/4" MP	(3)	
ELP13	Elbow, 3/4" X 1/2" MP	(1)	
TBP09	Hose, Black 3/4", 10' length	(1)	
FTP05	Adapter 3/4" MP X Barb	(1)	
OCL03	Clamp	(1)	
CLG07	Nipple, 3/4" MP	(1)	
SPW05	Pre-Filter Housing Wrench	(1)	
Manual/150-10000	Manual	(1)	

Accessory Kit for EPRO8000-10000 (PN#AK8000-10000)



Part Number	Description	Qty. Included	Qty. to Order
TBP07	Black Hose @ 10' x ½" ID x ⅝" OD	(2)	
NRC03	Coupling Kit (3 Pieces ea.)	(4)	
SPW05	Housing Wrench	(1)	
ELP-14	Elbow ¾" x ¾" MP	(3)	
PFC03A	Filter Cartridge	(1)	
Manual/150-8000	Manual	(1)	
TBP09	¾" Black Hose @ 10'	(1)	
OLC03	Clamp	(1)	

Introduction

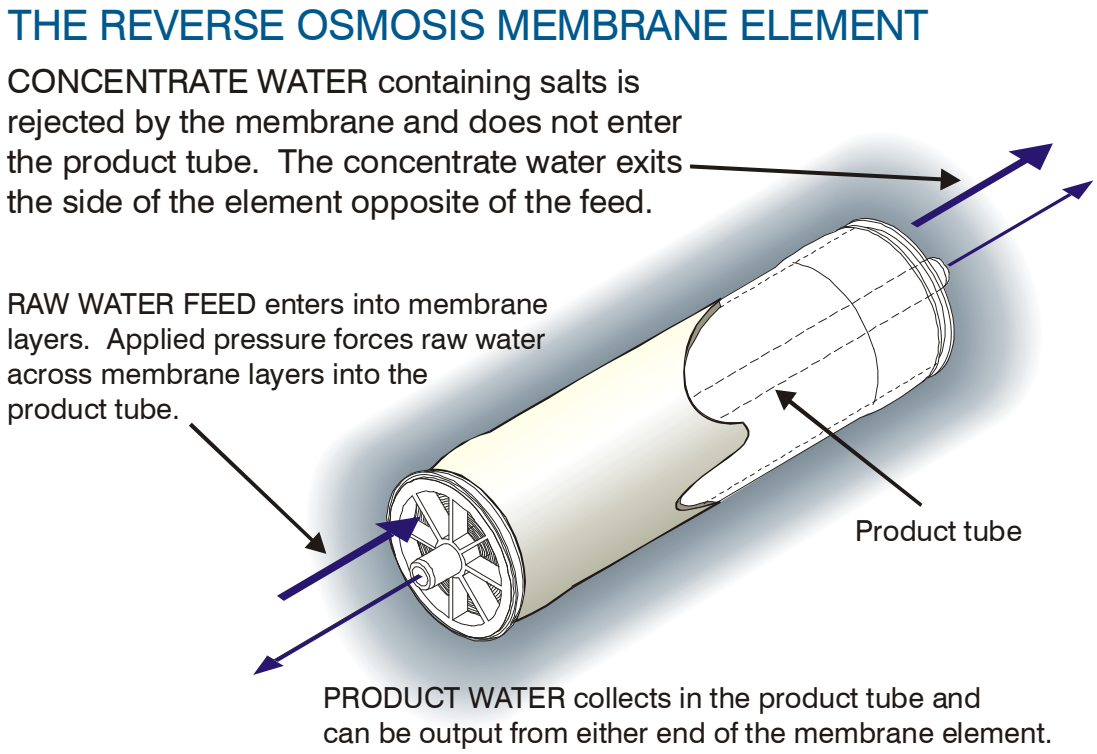
Reverse osmosis systems from Newterra produce high quality water from municipal and well water. The highest quality components and the latest technology are used in the production and design of our reverse osmosis systems.

What is reverse osmosis?

While ordinary filters use a screen to separate particles from water streams, a reverse osmosis system uses a semi-permeable membrane to separate a high percentage of dissolved molecules. Only certain types of molecules, like water, can pass through the membrane. Other molecules, like salts, do not pass through the membrane and are left behind.

What is a semi-permeable membrane?

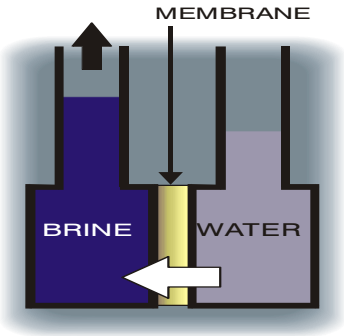
A semi-permeable membrane is very similar to your skin. The membrane is made of thin, multi-layered sheets with microscopic pores that let water pass through while acting as a barrier to stop dissolved particles like salt.



How does osmosis and reverse osmosis work?

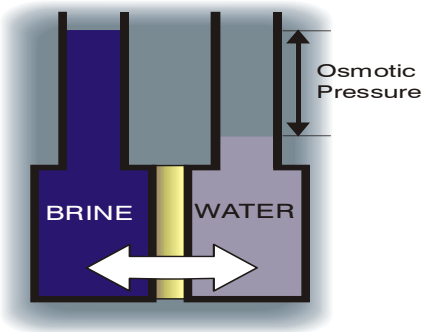
As shown in Figure 1A, under normal pressure water will pass from the side of the membrane with lower concentration to the side with the higher concentration to reach equilibrium, Fig. 1B.

Fig. 1A: OSMOSIS



Osmotic Pressure is the pressure required to stop water flow and reach equilibrium. When the applied pressure equals the osmotic pressure, the water flow stops. When applied pressure exceeds the osmotic pressure, reverse osmosis will take place. In reverse osmosis, water passes through the membrane to the dilute solution, leaving behind dissolved particles. This process purifies the water, often reducing total dissolved solids content by over 99%.

FIG. 1B: EQUILIBRIUM



Newterra systems use semi-permeable spiral wound, thin film composite membranes to separate and remove dissolved solids, organic material, pyrogens, submicron colloidal matter, viruses, and bacteria from water. Feed water is delivered under pressure to the membranes, where reverse osmosis takes place. Water permeates the minute pores of the membrane and is delivered as purified product water. The impurities in the water do not pass through the membrane, and are instead concentrated in the reject stream that is flushed to the drain.

FIG. 2A: REVERSE OSMOSIS

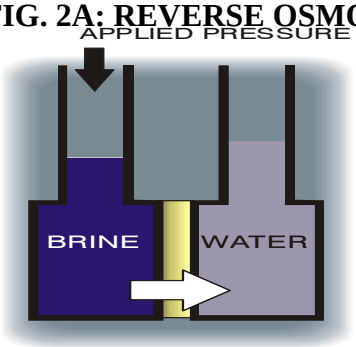
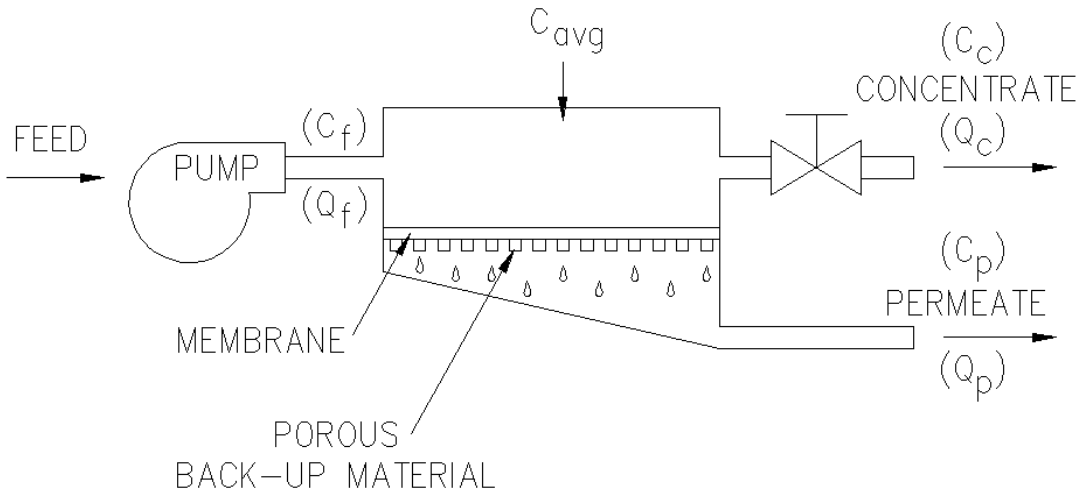


Fig. 2B: Reverse Osmosis System



Specifications

The basic EPRO / Force unit is designed to produce purified water at the capacities indicated by the suffix in the model number under the following conditions: water temp 77ºF (25ºC) and total dissolved solids (TDS) of 500 ppm or less. For example, the EPRO-1200 produces 1200 gallons per day (GPD) of purified water. In addition to the standard series the EPRO models are offered in the following configurations:

- The "P" series EPRO systems are reverse osmosis systems that are installed on a pressurized storage tank, (bladder tank). The product water (permeate) typically pressurizes the tank at 20-40 psi or 30-50 psi, and is distributed to the point of use with tank pressure.

- The "A" series EPRO systems are reverse osmosis systems that are installed on a 65 gallon atmospheric storage tank. The product water (permeate) feeds the atmospheric storage tank and is distributed from the tank by a small dispensing pump. This dispensing pump is designed to supply water to tap on the front of the "A" system. It is recommended that the "A" system be equipped with the optional re-pressurization system if the point of use is away from the "A" system. The standard dispensing pump is **not** recommended for distribution to points of use away from the "A" system.

- The "XP" series EPRO systems are modular, consisting of a reverse osmosis system, a 300-gallon atmospheric storage tank, two liquid level controls, and a re-pressurization system. A variety of storage tanks and re-pressurization systems are available.

- The "WM" series EPRO systems are reverse osmosis systems assembled on a wall-mount frame, and are designed for applications with limited floor space.

REJECTION AND RECOVERY

The amount of total dissolved solids (TDS) rejected by the membrane is expressed as a percentage. For example, a 96% rejection rate means that 96% of total dissolved solids do not pass through the membrane. To calculate the % rejection, use the following formula:

$$\% \text{ Rejection} = \frac{\text{Feed TDS} - \text{Product TDS}}{\text{Feed TDS}} \times 100$$

NOTE: All TDS figures must be expressed in the same units, usually parts per million (ppm) or milligrams per liter (mg/l).

The amount of purified water recovered for use is expressed as a percentage of the feed water, and is called % recovery. To calculate % recovery, use the following formula:

$$\% \text{ Recovery} = \frac{\text{Product Water Flow Rate}}{\text{Feed Water Flow Rate}} \times 100$$

Table 1, on page 10 lists the specifications for the EPRO-600 through 1200 models, Table 2 on page 11 lists specifications for the EPRO-1500 through 6000, and Table 3 on page 12 lists specifications for the EPRO–8000 through 10000 models.

TABLE 1

1x240 (EPRO-600) and 2x240 (EPRO-1200)

PART NUMBERS AND PART DESCRIPTIONS

	1x240 (EPRO-600)	2x240 (EPRO-1200)
Prefilter	PFC01P / 2.75” x 10.5”, 5 m	PFC01P / 2.75” x 10.5”, 5 m
Prefilter housing	HPO04S / 4”d x 12”h	HPO04S / 4”d x 12”h
Inlet Solenoid	GCV050B / .5” in/out, 115v GCV050C / .5” in/out, 220v	GCV050B / .5” in/out, 115v GCV050C / .5” in/out, 220v
Pump / Motor	DPO09F / DMO03A .33 hp	DPO11F / DMO04A .5hp
Pressure Vessel	HES20 / 2.5”x 40” SS (1) HEF70 / 2.5”x 40” FG (1)	HES20 / 2.5”x 40” SS (2) HEF70 / 2.5”x 40” FG (2)
Pressure Vessel Clamps (SS) Pressure Vessel Clamps (FG)	HEA43 / 2.5” (2) CH-6PW / 2.5” (2)	HEA43 / 2.5” (2) CH-6PW / 2.5” (4)
Membrane, Standard Membrane, Low Pressure *	ETT08F / 2.5”x 40” (1) ETT49 / 2.5” (1)	ETT08F / 2.5”x 40” (2) ETT49 / 2.5” (2)
Concentrate Control Valve	BLV14S / .5” in/out, SS	BLV14S / .5” in/out
Concentrate Pressure Gauge	DGO02S / 0-300 psi	DGO02S / 0-300 psi
Concentrate Recycle Valve *	BLV14S / .5” in/out, SS	BLV14S / .5” in/out, SS
Concentrate Flow Meter *	DFO04A / .2 – 2.0 gpm	DFO04A / .2 – 2.0 gpm
Permeate Flow Meter *	DFO03A / .1 – 1.0 gpm	DFO04A / .2 – 2.0 gpm
Recycle Flow Meter *	DFO03A / .1 – 1.0 gpm	DFO03A / .1 – 1.0 gpm

* **Designates optional equipment**

DESIGN SPECIFICAT1ONS

	1x240)	2x240
Permeate 18.5 Flux	.36 gpm (518 gpd)	.72 gpm (1036 gpd)
Rejection	99.0 %	99.0 %
Recovery (no R/C)	21.0 %	36.0 %
Feed Flow	1.7 gpm	2.0 gpm
Height	53” / 135 cm	53’ / 135 cm
Length	20” / 51 cm	24” / 61 cm
Width	17” / 43 cm	17” / 43 cm
Weight	80 lbs / 36 kg	90 lbs / 41 kg

TABLE 2

1x440 (EPRO-1500) THROUGH 4x440 (EPRO-6000)

PART NUMBERS AND PART DESCRIPTIONS

	1x440 (EPRO-1500)	2x440 (EPRO-3000)
Prefilter	PFC02P / 2.75” x 20”, 5 m	PFC02P / 2.75” x 20”, 5 m
Prefilter housing	HPO01S / 5”d x 23”h	HPO01S / 5”d x 23”h
Inlet Solenoid 115v Inlet Solenoid 220v	GCV075B / .75” in/out GCV075C / .75” in/out	GCV075B / .75” in/out GCV075C / .75” in/out
Pump / Motor Assembly	DPM16 / 1.5 hp	DPM16 / 1.5 hp
Pump Throttle Valve	VGS01 / .75” in/out, SS	VGS01 / .75” in/out, SS
Pressure Vessel, Stainless Pressure Vessel, Fiberglass	HES19 / 4”x 40” (1) HEF64WC / 4”x 40” (1)	HES19 / 4”x 40” (2) HEF64WC / 4”x 40” (2)
Pressure Vessel Clamps (SS) Pressure Vessel Clamps (FG)	HEA40 / 3.5” (2) CH-9PW / 4” (2)	HEA40 / 3.5” (4) CH-9PW / 4” (4)
Membrane, Standard Membrane, Low Pressure	ETT11 / 4”x 40” (1) ETT74 / 4”x 40” (1)	ETT11 / 4”x 40” (2) ETT74 / 4”x 40” (2)
Concentrate Control Valve	VGS01 / .75” in/out, SS	VGS01 / .75” in/out
Concentrate Pressure Gauge	DGO02S / 0-300 psi	DGO02S / 0-300 psi
Concentrate Recycle Valve *	BLV14S / .5” in/out, SS	BLV14S / .5” in/out, SS
Concentrate Flow Meter *	DFO06A / 1.0 – 10.0 gpm	DFO06A / 1.0 – 10.0 gpm
Permeate Flow Meter *	DFO05A / .5 – 5.0 gpm	DFO05A / .5 – 5.0 gpm
Recycle Flow Meter *	DFO05A / .5 – 5.0 gpm	DFO05A / .5 – 5.0 gpm

*** Designates optional equipment**

PART NUMBERS AND PART DESCRIPTIONS

	3x440 (EPRO-4500)	4x440 (EPRO-6000)
Prefilter	PFC02P / 2.75” x 20”, 5 m	PFC02P / 2.75” x 20”, 5 m
Prefilter housing	HPO01S / 5”d x 23”h	HPO01S / 5”d x 23”h
Inlet Solenoid 115v Inlet Solenoid 220v	GCV075B / .75” in/out GCV075C / .75” in/out	GCV075B / .75” in/out GCV075C / .75” in/out
Pump / Motor Assembly	DPM16 / 1.5 hp	DPM16 / 1.5 hp
Pump Throttle Valve	VGS01 / .75” in/out, SS	VGS01 / .75” in/out, SS
Pressure Vessel, Stainless Pressure Vessel, Fiberglass	HES19 / 4”x 40” (3) HEF64WC / 4”x 40” (3)	HES19 / 4”x 40” (4) HEF64WC / 4”x 40” (4)
Pressure Vessel Clamps (SS) Pressure Vessel Clamps (FG)	HEA40 / 3.5” (6) CH-9PW / 4” (6)	HEA40 / 3.5” (8) CH-9PW / 4” (8)
Membrane, Standard Membrane, Low Pressure	ETT11 / 4”x 40” (3) ETT74 / 4”x 40” (3)	ETT11 / 4”x 40” (4) ETT74 / 4”x 40” (4)
Concentrate Control Valve	VGS01 / .75” in/out, SS	VGS01 / .75” in/out
Concentrate Pressure Gauge	DGO02S / 0-300 psi	DGO02S / 0-300 psi
Concentrate Recycle Valve *	BLV14S / .5” in/out, SS	BLV14S / .5” in/out, SS
Concentrate Flow Meter *	DFO06A / 1.0 – 10.0 gpm	DFO06A / 1.0 – 10.0 gpm
Permeate Flow Meter *	DFO06A / 1.0 – 10.0 gpm	DFO06A / 1.0 – 10.0 gpm
Recycle Flow Meter *	DFO05A / .5 – 5.0 gpm	DFO05A / .5 – 5.0 gpm

*** Designates optional equipment**

DESIGN SPECIFICAT1ONS

	1x440)	2x440	3x440	4x440
Permeate 18.5 Flux	1 gpm (1440 gpd)	2 gpm (2880 gpd)	3 gpm (4320 gpd)	4 gpm (5760 gpd)
Rejection	99.0 %	99.0 %	99.0 %	99.0 %
Recovery (no R/C)	20.0 %	28.6.0 %	37.5 %	44.4 %
Feed Flow	6 gpm	7 gpm	8 gpm	9 gpm
Height	53” / 135 cm	53’ / 135 cm	53’ / 135 cm	53’ / 135 cm
Length	20” / 51 cm	24” / 61 cm	24” / 61 cm	24” / 61 cm
Width	20” / 51 cm	20” / 51 cm	20” / 51 cm	20” / 51 cm
Weight	135 lbs / 36 kg	150 lbs / 41 kg	165 lbs / 41 kg	180 lbs / 41 kg

TABLE 3:

5x440 (EPRO-8000) and 6x440 (EPRO-10000V)

PART NUMBERS AND PART DESCRIPTIONS

	5x440 (EPRO-8000)	6x440 (EPRO-10000V)
Prefilter	PFC03 / 4.5” x 10”, 5 m	PFC03 / 4.5” x 10”, 5 m
Prefilter housing	HPO05 / 7.25”d x 12.75”h	HPO05 / 7.25”d x 12.75”h
Inlet Solenoid 220v	GCV100C / 1.0” in/out	GCV100C / 1.0” in/out
Pump / Motor Assembly	DPM120 / 3.0 hp	DPM120 / 3.0 hp
Pump Throttle Valve	VGS03 / 1.0” in/out, SS	VGS03 / 1.0” in/out, SS
Pressure Vessel, Stainless Pressure Vessel, Fiberglass	HES19 / 4”x 40” (5) HEF64WC / 4”x 40” (5)	HES19 / 4”x 40” (6) HEF64WC / 4”x 40” (6)
Pressure Vessel Clamps (SS) Pressure Vessel Clamps (FG)	HEA40 / 3.5” (10) CH-9PW / 4” (10)	HEA40 / 3.5” (12) CH-9PW / 4” (12)
Membrane, Standard Membrane, Low Pressure	ETT11 / 4”x 40” (5) ETT74 / 4”x 40” (5)	ETT11 / 4”x 40” (6) ETT74 / 4”x 40” (6)
Concentrate Control Valve	VGS01 / .75” in/out, SS	VGS01 / .75” in/out
Concentrate Pressure Gauge	DGO02S / 0-300 psi	DGO02S / 0-300 psi
Concentrate Recycle Valve *	BLV12S / .75” in/out, SS	BLV12S / .75” in/out, SS
Concentrate Flow Meter *	DFO06A / 1.0 – 10.0 gpm	DFO06A / 1.0 – 10.0 gpm
Permeate Flow Meter *	DFO06A / 1.0 – 10.0 gpm	DFO06A / 1.0 – 10.0 gpm
Recycle Flow Meter *	DFO05A / .5 – 5.0 gpm	DFO05A / .5 – 5.0 gpm

*** Designates optional equipment**

DESIGN SPECIFICAT1ONS

	5x440)	6x440
Permeate 18.5 Flux	5 gpm (7200 gpd)	6 gpm (8640 gpd)
Rejection	99.0 %	99.0 %
Recovery (no R/C)	41.7 %	42.9 %
Feed Flow	12 gpm	14 gpm
Height	60” / 152 cm	60” / 152 cm
Length	32” / 81 cm	32” / 81 cm
Width	32” / 81 cm	32” / 81 cm
Weight	305 lbs / 138 kg	325 lbs / 148 kg

System Requirements & Operation Guidelines

PLUMBING

The membranes and high-pressure pumps used on the EPRO systems require a continuous, non-turbulent flow of water to the unit. Minimum feed pressure is 20 PSI. See the tables on pages 10 through 12 to determine your systems required flow.

The tubing or piping used for discharge of the concentrate should be run to an open drain, in a free and unrestricted manner, **through an air gap**.

Any restrictions or blockage in the drain can cause backpressure, which will increase the system's operating pressure. This can result in damage to system components.

Temperature of the feed water must not exceed 113º F (45º C).

ELECTRICAL

All standard motors on the EPRO-600 through 1200 systems are single-phase, open drip type. The standard motors are 60 Hz and 50 Hz. The voltage will be either 115VAC or 230VAC for the 60 Hz motors, or 220VAC for the 50 Hz motors.

The standard motors on the EPRO-1500 through the 10000 are pump/motor combinations. They are available as single-phase: 115VAC or 230VAC at 60 Hz or 220VAC at 50 Hz. The three phase pump/ motors are available in 208-230-460VAC at 60 Hz or 220-380-415VAC at 50 Hz.

ALWAYS VERIFY THE CORRECT ROTATION OF THREE PHASE MOTORS
This must be performed on site during initial installation. Reversal of any two input power leads will result in reversing the rotation of the motor.

Ensure that the electrical circuit supplying the system is compatible with the requirements of the specific EPRO model.

Note: We recommend that a licensed electrician install your unit in accordance with local and national electrical codes.

Each EPRO system, excluding three-phase units, is equipped with a 10 foot electrical cord. Typically units do not require any additional wiring for installation. 50 Hz models may require replacement of the standard plug to fit certain receptacles.

PRE-FILTRATION

EPRO systems are supplied with a particulate pre-filter that filters out most particles over 5 microns in size before the water is pumped through the reverse osmosis membrane. Change the cartridge at least every month or whenever there is a pressure difference of 10% or more between the pressure readings before and after the filter, if pre-filter pressure gauges are installed.

CAUTION: If the pre-filter becomes clogged and the water flow to the pump is reduced or interrupted, cavitation will occur. This will damage the pump.

PUMP

The standard pumps supplied with EPRO-600 to 1200 systems are positive displacement, rotary vane type. The standard pumps supplied with the EPRO-1500 to 10000 systems are multi-stage, centrifugal pumps.

Please refer to Appendix C for information and specifications on the multi stage centrifugal booster pumps.

Follow these guidelines for proper operation of both types of pumps:

- The pump must NEVER be run dry. The standard multi stage centrifugal pump requires a minimum of 1.5 gpm of flow to prevent impeller damage.

- ALWAYS feed the pump with filtered water. The rotary vane type pump is especially susceptible to damage from sediment and debris.

- Never close the throttle valve or concentrate control valve completely.

- Low flow protection is recommended for all RO systems. Low flow protection will significantly reduce the possibility of pump damage due to low flow through the RO system. Low flow conditions can be caused by low flow to the RO system, a restricted prefilter, a failed inlet solenoid, a completely closed throttle valve, blocked membranes due to scaling or fouling, a completely closed concentrate control valve, or a restricted drain line.

LOW FLOW PROTECTION

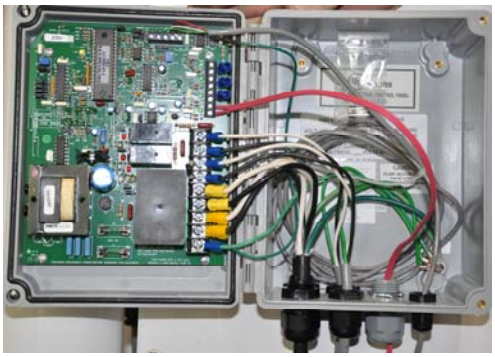
- There are four low flow control options available; The Low Flow Reverse Action Switch, the Economy Low Flow Control, the CE1 Electronic Control, and the CE2 Electronic Control. All three low flow control options utilize the same flow switch. The flow switch provides an on/off signal to the appropriate control, determined by the actual concentrate flow. The flow switch is located in the drain line after the concentrate control valve. If the system is equipped with a concentrate flow meter, the

flow switch is located at the feed (bottom) of the concentrate flow meter. (See Figure 3 on page 15)

Figure 3

Flow Control Switch

Economy Flow Control Box (showing red lead from flow switch)



CE 1 Electronic Control Box (showing red lead from flow switch)

Low Flow Reverse Action Switch

The Reverse Action Switch shuts off the EPRO system when the feed water pressure drops too low for the system to function properly. This helps prevents damage to the pump. The system restarts automatically when pressure is restored. If you notice the pressure fluctuating, and the system cycling off and on repeatedly, turn the system off and ensure that proper feed flow and pressure are available to the system.

Economy Low Flow Control

The two leads from the flow switch are connected to the terminals marked "Flow Switch", inside the Economy Low Flow Control. (see Figure 3 on page 15)
During normal operation, when there is a demand for product water, the inlet solenoid will open allowing water flow through the system. When the concentrate flow exceeds the minimum 1.5 gpm the flow switch will close which will signal the control to introduce electrical power to the pump/motor assembly, and the system will start. If the concentrate flow drops below 1.5 gpm, the flow switch will open signaling the control to interrupt the electrical power to the pump/motor assembly, and the system will shut down. The inlet solenoid will remain open as long as the demand for product water is not satisfied, allowing water flow through the system to continue. The flow switch will close when the concentrate flow exceeds the required 1.5 gpm, which will signal the control to apply electrical power to the pump/motor assembly, and the system will restart.

CE1 or CE2 Electronic Control

The two leads from the flow switch are connected to the low flow pair of control contacts (fourth pair from top) on the upper right, side of the PC board located inside the CE1 or CE2 Electronic Control. (see Figure 3 on page 15)
During normal operation, when there is a demand for product water, the inlet solenoid will open allowing water flow through the system. When the concentrate flow exceeds the minimum 1.5 gpm the flow switch will close which will signal the control to introduce electrical power to the pump/motor assembly. The control provides an

eight second delay before electrical power is applied to the pump/motor. After the delay the system will start. If the concentrate flow drops below 1.5 gpm, the flow switch will open signaling the control to interrupt the electrical power to the pump/motor assembly, the system will shut down and the inlet solenoid will close. The control will automatically open the solenoid every five minutes as long as the demand for product water is not satisfied, allowing water flow through the system. The flow switch will close when the concentrate flow exceeds the required 1.5 gpm, which will signal the control to apply electrical power to the pump/motor assembly. After the preset pump/motor delay the system will restart.

Feed Water Requirements

Nothing has a greater effect on a reverse osmosis system than feed water quality. For lasting performance it is important to supply the reverse osmosis system with the feed water quality shown below on Table 4. It is also important to feed the system the required amount of feed water, shown on Table 1 on page 10, Table 2 on page 11 and Table 3 on page 12.

Table 4: Recommended Feed Water Quality

Hardness	<1 grain	Hydrogen Sulfide	0 ppm
Free Chlorine	0 ppm	Manganese	<0.05 ppm
T.D.S.	<1000 ppm	Organics	<1 ppm
Turbidity SDI	<5	Temperature	40°F - 80°F
Ph	3-11		*8°C - 27°C*
Iron	<0.01 ppm	Pressure	20 - 60 psi
Silica	<1 ppm		

Notes:

- The EPRO Tap Water Systems' projected output is based on feed water with a TDS of 1000 ppm or less and 77°F. Higher TDS and/or lower temperature will reduce system production. When feed water is colder than 77º, the projected output can usually be reached by configuring the system with cold water membranes.

- It is very important to meet feed water requirements. Failure to do so will cause membranes to foul or scale..

- Providing the proper pre-treatment, and setting up the system correctly will extend the life of the membrane(s).

Fouled or scaled membranes are not covered by warranty

RO System Start-Up

Unless otherwise indicated, these instructions cover the basic EPRO-600 to 10000 systems as well as the "P", the "XP", the "A", and the "WM" configuration. Please refer to the appropriate pictures depicting your EPRO system.

- The Diagram of the EPRO-600 to 1200 is FIG. 3 on page 21.
- The Diagram of the EPRO-1500 to 10000 is FIG. 4 on page 22.
- The Diagram of the "XP" Series is FIG. 5 on page 25.
- The picture of the "A" Series is FIG. 6 on page 26.
- The picture of the "P" Series is FIG. 7 on page 26.
- The picture of the "WM" Series is FIG. 8 on page 27.
- The Picture of the "XP" Series is FIG. 9 on page 27.

INSTALLATION

The EPRO reverse osmosis systems, with the exception of the wall-mounted units, are free standing and require no special installation; however, if placed on an uneven floor, the system may vibrate. If this occurs, place the system on a rubber mat to reduce the vibrations. For wall-mounted units, attach the system to the wall securely (hardware not provided). Additional instructions for "XP" series installation are provided on page 23 and 24.

***An Installation kit is supplied with all EPRO-600 through 10000 RO systems.**

Carefully inspect your system before start-up. Check all plumbing and electrical connections. Connections may have loosened during shipment.

START-UP

The 5-micron filter cartridge is shipped separate from its housing. Steps 1-6 cover installation of this filter.

1. Locate the 5-micron pre-filter housing on the picture or diagram of your EPRO system, (FIG. 3, page 21, or Fig. 4 page 22). Unscrew the filter housing. If necessary, use the spanner wrench provided in the accessory kit.

Note: Water may spill from the unit when the housing is removed. Place a bucket below the housing to catch the water.

2. Remove the rubber O-ring from the groove located below the threaded part of the housing. Remove any dirt and old lubricant with a clean rag.

3. Inspect the inside of the housing for debris and rinse with water, if necessary.

4. Lubricate the rubber O-ring with a food grade O-ring lubricant and place in the groove of the housing.

5. Locate the 5 micron pre-filter cartridge provided in the accessory kit. Remove the wrapping from the cartridge and insert it into the housing. Screw the housing onto the cap hand tight.

6. Locate the feed water inlet on the pre-filter housing.

7. Attach the fitting and inlet hose provided in the accessory kit, to the feed water inlet, or permanently plumb the feed water piping or tubing to the inlet. Turn feed water on after all connections are completed. Prime the pre-filter housing by depressing and holding the red button on top of pre-filter until water flows from button.

ALWAYS maintain a smooth and sufficient flow of feed water during operation.

8. Locate the permeate outlet (See Fig. 3 pg 21, or Fig. 4 pg 22)
   a) Top of permeate flow meter, if equipped with a permeate flow meter.
   b) Output of permeate manifold, if not equipped with permeate flow meter.

9. Attach the permeate hose, provided in the accessory kit, to the permeate outlet. (Note: the "P" series systems have a check valve installed in the permeate line between the membrane and the bladder tank). Make sure that permeate water can flow freely and that there is no backpressure.

Excessive backpressure can cause damage to the membrane. **An air gap is required.**

CAUTION: **The plumbing in the permeate line can contaminate the high quality water produced by the EPRO system; ensure that the components are compatible with the application. The pH of the RO permeate will normally be 1-2 points lower than the feed water pH. A pH below 7.0 can be very aggressive to some plumbing materials, such as copper piping.**

10. Locate the **concentrate outlet**. For the "P" series systems: The concentrate outlet is located behind the control panel. Unscrew the top panel. Locate the concentrate outlet on the drain side of the concentrate control valve (see Fig. 3 pg 21, or Fig. 4 pg 22).
    a) Top of concentrate flow meter, if equipped with a concentrate flow meter.
    b) Discharge side of concentrate control valve, if not equipped with a concentrate flow meter.

11. Attach the drain hose, provided in the accessory kit, to the concentrate outlet.

12. Run the concentrate line to drain. Water must be allowed to run freely, without any restrictions or blockage in the drain line.

Limit backpressure on the concentrate line. **An air gap is required.**

13. Ensure that the electrical power source matches the electrical power requirements of the EPRO system.

CAUTION: **Consult a qualified electrician for proper start-up of your three-phase motor. When connecting a three-phase motor, always check for proper direction of rotation. Incorrect rotation will damage the pump and void the warranty.**

14. EPRO systems are typically controlled with a liquid level control installed in the storage tank. The liquid level control turns the EPRO system on when the water level in the tank drops, and off when the tank is full. If your RO system is equipped with an electronic control box, the level control is connected to the level control connections in the control box (see optional electronic control box CE-1 Appendix A, or CE-2 Appendix B, provided in this manual). If your RO system is not equipped with a control box, plug the level control into your power outlet, then plug the RO power cord into the level control. Some installations may require modification of the receptacles to complete the connection. EPRO-P systems are controlled by a pressure switch.

DO NOT exceed the power rating of the level control.

Liquid level controls can be obtained from Newterra or a plumbing supplier. Two liquid level controls are standard with the "XP" system.

If a liquid level control is to be used, install it at this time and turn the power to the EPRO system on. Otherwise, turn the system on by plugging in the power cord. Allow the system to run for about thirty minutes with the concentrate control valve fully open to flush preservative to drain and to purge air from the system.

15. ***IMPORTANT:*** The EPRO machine contains a preservative solution that can be harmful if digested. Discard the product and concentrate water from the first one (1) hour of operation.

16. Check for leaks. All Newterra reverse osmosis systems are fully tested prior to shipment, but leaks may occur due to shipping and handling. If leaks are discovered at fitting connections, it is recommended to remove, re-tape and reinstall the fittings.

Note: Over tightening fittings in the pressure vessel end caps will result in cracking the end caps.

17. **AFTER** the preservative solution has been flushed out of the system, connect the permeate line to the point-of-use. Make sure no backpressure exists on the permeate line. A check valve must be installed in the permeate line if backpressure is present.

18. Locate the concentrate control valve, the concentrate pressure gauge, and the permeate flow meter if equipped, (see Fig. 3, page 21 or Fig. 4, page 22).

19. Turn the concentrate control valve until the designated permeate flow is acquired. For example an EPRO-1500 should be adjusted until it produces about 1500GPD or 1.0 GPM of permeate flow. The concentrate pressure will increase as the concentrate control valve is closed. **The exact operating pressure will vary depending on the type of membrane(s) installed, and the temperature and the TDS of your feed water.** It may be necessary to re-adjust the system if there is a major change in feed water temperature and/or TDS.
An RO system is adjusted for permeate flow, not pressure. The operating pressure is the result of the adjustment.

NEVER CLOSE THE CONCENTRATE VALVE COMPLETELY

$$GPM = \frac{GPD}{1440}$$

WARNING: Never exceed the maximum pressure rating of your membrane(s) or pressure vessel(s).

The EPRO 1500-10000 reverse osmosis systems are equipped with a pump discharge throttle valve. This valve is used to compensate for differences in feed water temperature and TDS, and to adjust the reverse osmosis system to the desired recovery. For information about the pump throttle valve, refer to page 31.

NEVER CLOSE THE THROTTLE VALVE COMPLETELY

Feed water enters the system through an automatic shut-off valve (inlet solenoid). Ensure that the solenoid opens when the system turns on, allowing water flow through the system and that it closes when the system turns off, stopping water flow through the system. This will save water and prevent premature fouling of the reverse osmosis membrane.

Complete Table 5, Operation Log on page 20 with your Start-Up data and return to Newterra to validate your reverse osmosis system's warranty. Save a copy of your start-up information for your records. We recommend that you maintain your Operation Log for your system.

Log data is extremely useful when troubleshooting your RO system.

NOTE: ALL Newterra reverse osmosis systems are tested at this facility for leaks, workmanship, and proper operation; however, it is likely that leaks will develop during shipment.

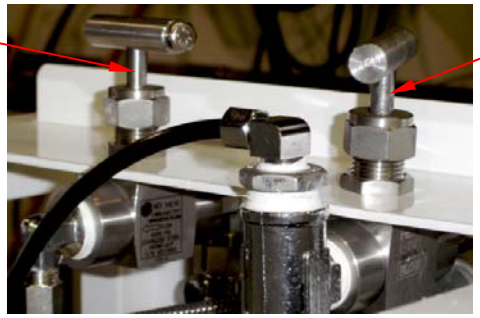
Table 5: Operation Log

COMPANY:	_____	DATE OF START-UP	_____
LOCATION:	_____	DATE OF LAST CLEANING:	_____
WEEK OF:	_____	CLEANING FORMULATION:	_____
MACHINE SERIAL #:			

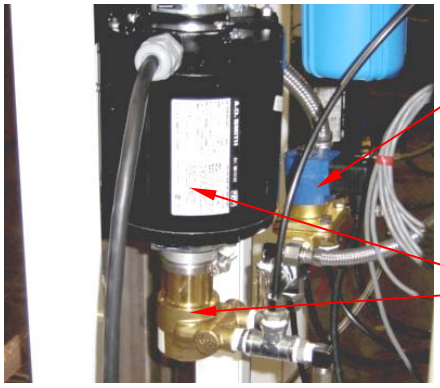
DATE						
TIME						
HOURS OF OPERATION						
CARTRIDGE FILTER INLET PRESSURE (psi)						
DIFFERENTIAL PRESSURE (psi)						
PERMEATE PRESSURE (psi)						
FEED PRESSURE (psi)						
CONCENTRATE PRESSURE (psi)						
DIFFERENTIAL PRESSURE (psi)						
PUMP DISCHARGE PRESSURE (psi)						
PERMEATE FLOW (GPM)						
CONCENTRATE FLOW (GPM)						
FEED FLOW (GPM)						
RECOVERY (%)						
FEED TEMPERATURE (^{o}F)						
FEED CONDUCTIVITY (mg/L)						
PERMEATE CONDUCTIVITY (mg/L)						
REJECTION (%)						
FEED pH						
PERMEATE pH						
SCALE INHIBITOR FEED (PPM)						
ACID FEED (PPM)						
SODIUM BISULFITE FEED (PPM)						
FEED WATER: IRON (mg/L)						
FREE CHLORINE (mg/L)						
HARDNESS (PPM CaCO3)						
TURBIDITY (NTU)						

FIG. 4:

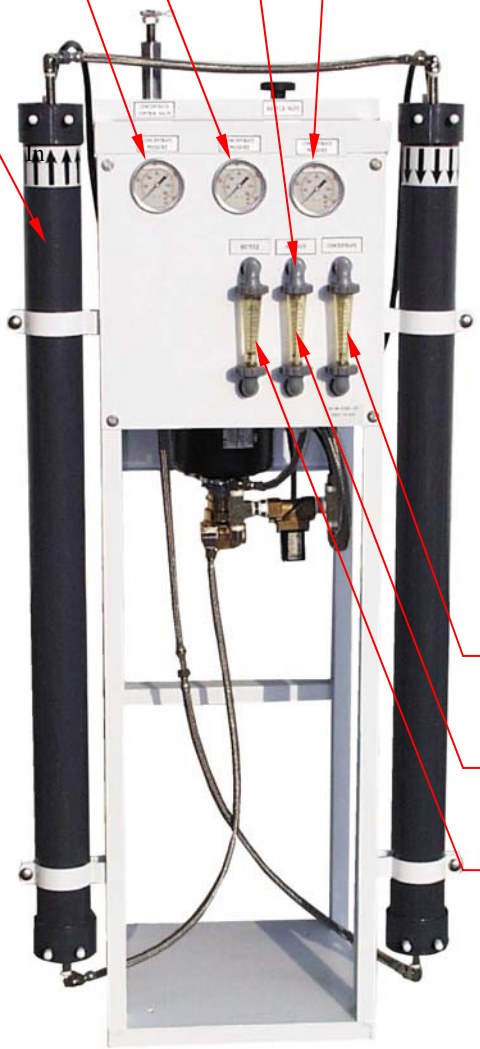
EPRO-600 to 1200 SERIES RO SYSTEM COMPONENT REFERENCE



REAR VIEW
Concentrate & Recycle Control Valves



LEFT SIDE VIEW
Pump, Motor & Inlet Solenoid Valve



FRONT VIEW
EPRO RO System
(See notes below)

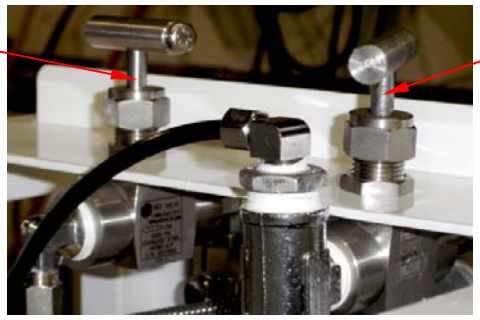
RIGHT SIDE VIEW
Pre-filter Cartridge

Note(s):

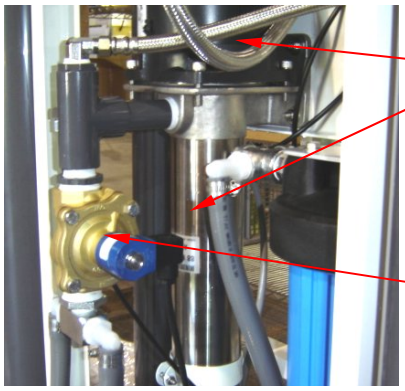
- The size and number of pressure vessels vary according to EPRO model.
- Stainless Steel Pressure Vessels or Fiberglass Pressure Vessels are standard.

FIG. 5:

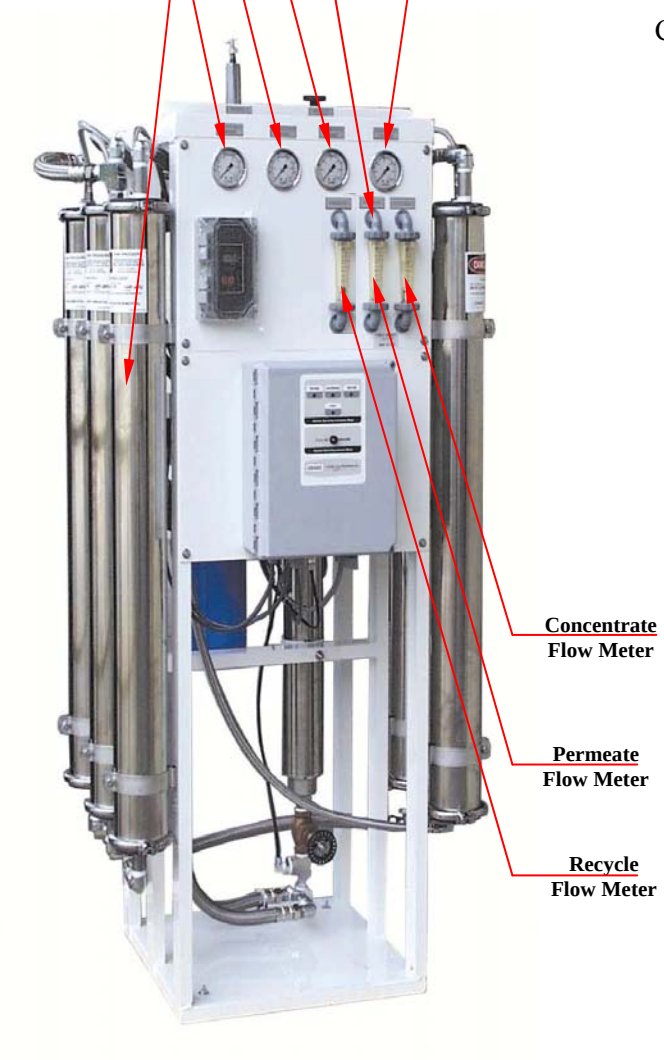
EPRO-1500 to 10000 SERIES RO SYSTEM COMPONENT REFERENCE GUIDE



REAR VIEW
Concentrate & Recycle Control Valves



LEFT SIDE VIEW
Pump, Motor & Inlet Solenoid Valve



FRONT VIEW
EPRO RO System
(See notes below)

RIGHT SIDE VIEW
Pre-filter Cartridge

Note(s):

- The size and number of pressure vessels vary according to EPRO model.
- Stainless Steel Pressure Vessels or Fiberglass Pressure Vessels are standard.

Additional Instructions for "XP" Installation

"XP" SYSTEM COMPONENT CHECKLIST:

1) RO system
2) Atmospheric Tank
3) Re-pressurization System
4) Accessory Kit
5) (2) Liquid Level Controls (Float Switch)
6) (2) Pivot Weights
7) (2) Strain reliefs
8) Plumbing Kit

1. Storage Tank Preparation:
Plumb the RO permeate line to the storage tank. Attach the permeate line to the **permeate out** on the RO machine, (see Figure 3, page 21 or Figure 4, page 22). Attach the other end of the permeate line to the top bulkhead fitting on the storage tank.

2. Connect the atmospheric storage tank to the repressurization system:
Use the plumbing kit supplied (the required pipe and fittings are provided in this kit.) Thread the male adaptor into the bulkhead fitting at the bottom of the storage tank. Use Teflon tape to prevent leaking. Plumb from the storage tank suction tube to the inlet (nose cone) on the re-pressurization pump. Make sure that the check valve is pointing in the direction of the water flow.

3. Connect the line from the repressurization system to the point of use:
This will be from the cross fitting on the bottom of the pressure tank piping.

4. Liquid Level Control (Solo Float, standard): Two liquid level controls are supplied with the "XP" system.

1) Red level control, (on when down), to control the reverse osmosis system.
2) Blue level control, (on when up), to protect the repressurization pump.

The level controls are installed in the tank with pivot weights attached, and the cords are secured through strain reliefs near the top of the tank. To adjust the differential between on and off, lengthen or shorten the distance from the weight to the float. To adjust the pivot point, lengthen or shorten the distance between the weight and the strain relief.

5a. Electrical Connections (Red level control to the Reverse Osmosis System): <u>All electrical connections should be made by a licensed electrician.</u> Make sure water is available to the reverse osmosis system before making this connection.

1) **Systems equipped with electronic control:** Remove the jumper, (if installed), from the "Tank Full High" contacts in the electronic control. Connect the two wires from the red level control to the "Tank Full High" contacts in the electronic control. Refer to the "Optional Electronic Control Box CE-1, or CE-2", Appendix A or B, located in this manual.
2) **Systems equipped with an Economy Flow Control:** Remove the jumper from the contacts on the flow control box, and connect the red level control wires to the open contacts.

3) **Systems not equipped with low flow protection:** Remove one wire of the "power in" cable from one of the input terminals on the RO motor. Wire nut that wire to one wire from the level control. Connect the other level control wire to the vacated input terminal on the RO motor, (the level control is connected in series with one input leg).

Note: In this configuration, the red level control must interrupt power to the pump motor and the inlet solenoid.

5b. Electrical Connections (Blue level control to Repressurization System): Remove one wire of the "power in" cable from one of the "line" terminals on the pressure switch. Wire nut that wire to one of the wire from the level control. Connect the other level control wire to the vacated "line" terminal on the pressure switch, (the level control is connected in series).

NOTE: Male plugs are supplied with 10' of lead. Extension cords are not recommended. If a longer wire run is required, **we recommend retaining a qualified electrician.**

6. Repressurization System Start-Up:
With an air pressure gauge, insure that the bladder tank pre-charge is set 2 psi below the cut in pressure (see example below).

Example**:**

Operating Pressure Range	20-40 PSI	30-50 PSI
Bladder Tank Pre-charge	18 PSI	28 PSI

7. Priming:
After the atmospheric storage tank is filled, the re-pressurization system must be primed and started. Prime the pump by removing the pressure gauge and pouring water into the pump. Reinstall the pressure gauge. Connect power to the repressurization system. The pump will start, and it will run until the bladder tank pressure reaches the "cut out" pressure set on the pressure switch. Open the drain valve slightly to allow air to escape during start up. This valve is located at the bottom of the pressure tank. Close the drain valve after the air is bled from the bladder tank. If the pump does not start to build pressure within 20 seconds, repeat the priming sequence. Failure to properly prime the pump can cause damage that is not covered under the warranty. Operation from this point on is automatic. The repressurization pump should start at the "cut in" pressure and stop at the "cut out" pressure.

FIGURE 6: EPRO XP SERIES

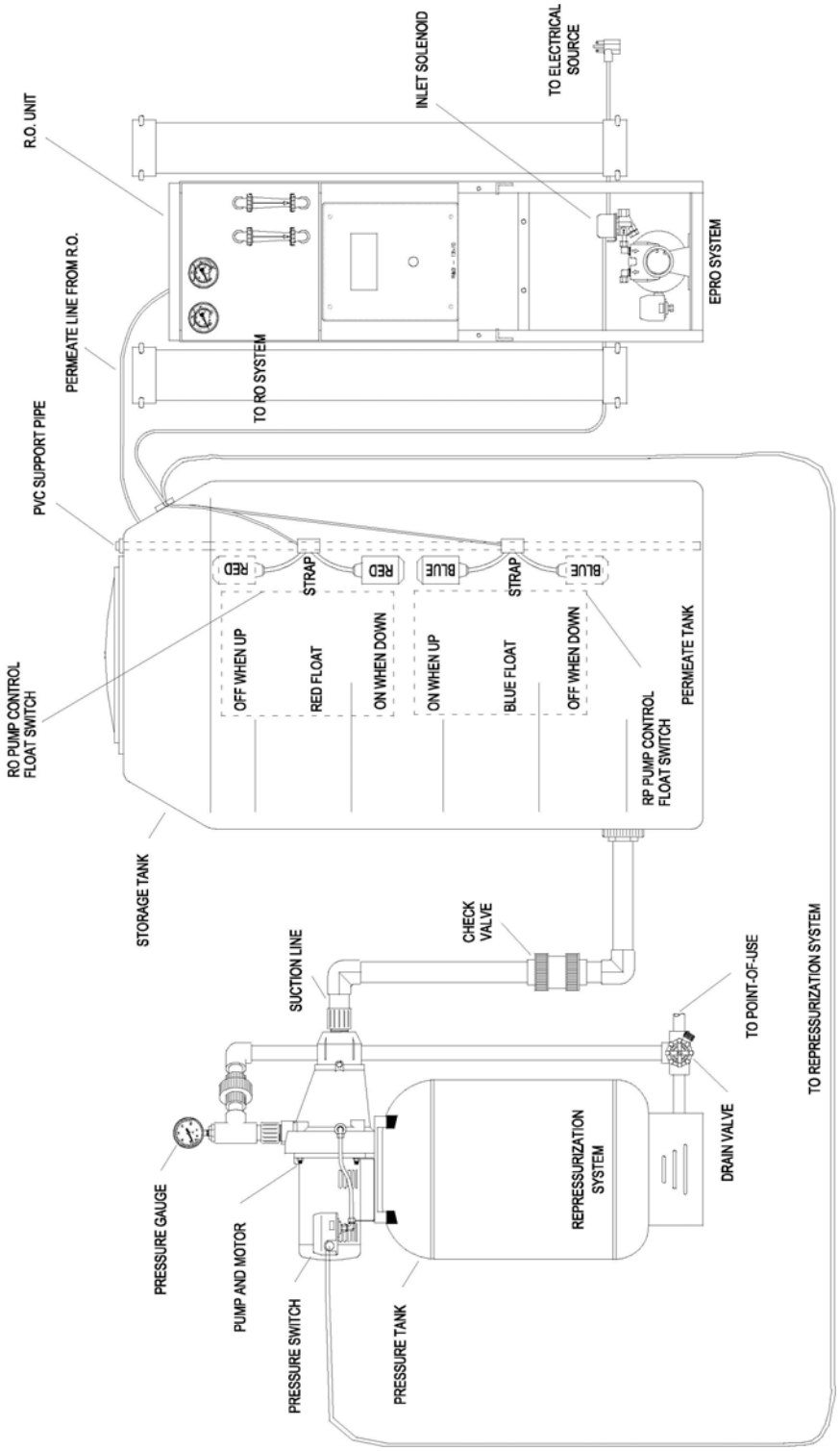


Fig. 7: EPRO “A” Series

Fig. 8: EPRO “P” Series

Fig. 9: EPRO “WM” Series

Fig. 10: EPRO “XP” Series

Operation & Maintenance

Reverse osmosis causes the concentration of impurities in the concentrate stream to increase. The impurities may precipitate (come out of solution) when their concentration reaches saturation levels. **Precipitation can scale or foul membranes and must be prevented.** Check your feed water chemistry. Pre-treat the water and/or reduce the system recovery as required. If necessary, consult with a Newterra service representative for pre-treatment recommendations.

OPERATION OF OPTIONAL FEATURES

- **Pre-filter Pressure Gauges:**

These gauges measure the feed water pressure when it enters and exits the pre-filter housing. A pressure differential of 10% or more on the two pressure readings indicates that the pre-filter needs to be replaced. For example, if inlet pressure is 40 psi, the filter should be changed when the outlet pressure is 36 psi or below.

- **Product Water (Permeate) Flow Meter and Waste Water (Concentrate) Flow Meter:**

These flow meters indicate the flow rates of permeate and concentrate water. The measurements, when added together, also indicate the feed water flow rate, if the system is not equipped with waste recycle.

- **Waste Recycle Valve:**

This valve allows you to recycle some of the concentrate water back to the feed of the pump. This will increase the recovery of the EPRO system. An optional waste recycle flow meter allows you to measure how much concentrate is recycled.

THE AMOUNT OF WASTE WATER RECYCLED IS LIMITED BY THE TDS OF THE FEED WATER AND THE PRETREATMENT INSTALLED.

CAUTION: Excessive recycling may cause premature fouling or scaling of the membrane.

- **Optional Economy Low Flow Control:**

The Economy Low Flow Control shuts off the EPRO system when the flow through the RO system is too low for the system to function properly. This prevents damage to the pump. The system restarts automatically when required flow is restored. If you notice the pressure fluctuating, and the system cycling off and on repeatedly, turn the system off and ensure that proper feed flow and pressure are available to the system.

- **Optional CE1 or CE2 Electronic Control (See Appendices A & B)**

These options consist of a UL listed electronic control box with low flow protection, and dry contacts for liquid level control and pre-treatment lockout, function LED's, and an on/off switch. The low flow control can be switched on site to reset manually or automatically by moving a jumper in the control box.

- **Optional Automatic Fast Flush, (upgrade of the CE1 or CE2 Electronic Control)**

The automatic fast flush option bypasses the concentrate control valve, reducing the concentrate pressure and increasing the flow of feed water across the membranes. The fast flush removes foulants that may have attached to the surface of the membranes. Removing these foulants before they crystallize on the surface of the membranes, allows the system to operate longer without cleaning and/or replacing membranes. During fast flush operation the water flushes across the membrane in the same direction as water flows in normal operation; this is not a "backwash" flow.

- **Optional Automatic Permeate Flush, (upgrade of the CE1 or CE2 Electronic Control)**

The automatic permeate flush option provides permeate water to flush the membranes on each RO shut down. This option requires a customer supplied source of pressurized permeate water be connected to the flush solenoid.

The permeate flush installation must include a carbon filter if an oxidizing agent is present in the permeate stream.

Newterra recommends the use of an automatic flush in several instances:

1. When injecting anti-scalant chemicals. These chemicals keep scaling ions in solution up to a higher concentration so the ions do not precipitate, and scale the membrane. If the solubility concentration is exceeded, the ions may precipitate and scale the membrane.

2. For feed water with a high scaling potential (hard water) in addition to an automatic flush, pre-treat the water with an anti-scalant or a softener. Do not use the automatic flush instead of pre-treatment.

3. Where minimal maintenance is important, an automatic flush can increase the time between membrane cleaning.

4. For high TDS (total dissolved solids) applications where the TDS exceeds 2000 ppm, consider installing an automatic flush.

5. For high recovery applications (use of a recycle valve), consider using auto flush.

6. For systems that may remain inoperative for long periods of time, an **automatic fast flush** should be installed. This will cause the system to operate daily. The automatic fast flush will not operate if the electrical power is removed from the system.

NOTE: Some permeate may be produced during the automatic fast flush; therefore, an overflow for the permeate storage tank is recommended.

- **Optional Water Quality Meter (Included on the CE2 Electronic Control):**

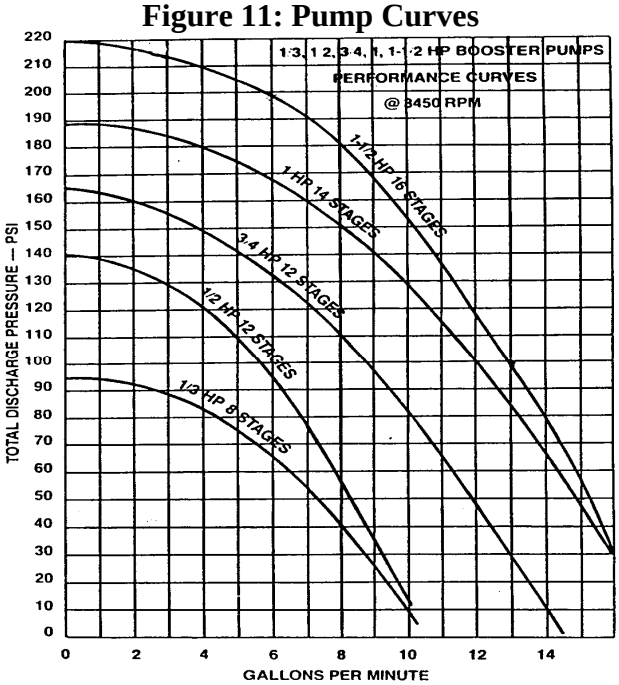
This option provides a continuous digital readout of the permeate water quality, in Total Dissolved Solids (TDS). One of two available TDS ranges can be selected on site, by moving a jumper in the CE2 electronic control box. Also, a visual high TDS alarm or high TDS shut down can be selected on site.

Pump Throttle Valve

This valve is installed as a standard feature on all systems equipped with a multi-stage centrifugal pump (except the Economy Series), normally the EPRO–1500 through EPRO–10000 reverse osmosis systems. It provides an adjustment for pump flow, which will vary as the required operating pressure changes. To understand this concept, please refer to the pump curves in figure 10. Note that with a centrifugal pump, the pump flow decreases as the operating pressure increases. See the example below.

PRESSURE	1 HP	1.5 HP
120 psi	10.5 gpm	12 gpm
150 psi	8 gpm	10.5 gpm
180 psi	4 gpm	8 gpm

Figure 11: Pump Curves



As the feed water temperature decreases, and/or the feed water TDS increases, the system will require a higher operating pressure to produce the specified permeate flow. An EPRO-1500 installed in Florida may provide the specified permeate flow of 1 gpm at 130 psi; however, the same EPRO-1500 installed in Maine – much colder feed water – may require 190 psi to produce this same amount of permeate. The Florida system would have higher concentrate flow to drain because of the lower operating pressure, which would result in poor system recovery.

$$\% \text{ Rejection} = \frac{\text{Feed TDS - Product TDS}}{\text{Feed TDS}} \times 100$$

The pump throttle valve can be adjusted to the desired system recovery for applications that fit the system specifications.

NOTE: NEVER CLOSE THE THROTTLE VALVE COMPLETELY

Membrane Cleaning

Periodic cleaning of the membrane(s) can improve system performance. In normal operation, mineral scale, biological matter, colloidal particles, and organic substances can foul the membranes.

WARNING: Cleaning chemicals are dangerous and can cause injury, and damage to the environment. Read and comply with all safety and disposal precautions listed on the Material Safety Data Sheets (MSDS's). It is the user's responsibility to comply with all applicable federal, state, and local regulations.

Newterra manufactures a complete line of membrane cleaning stations that can be used to clean membranes; however, if a cleaning station is not available, the membrane can be cleaned using the EPRO system.

INORGANIC FOULANT CLEANING

Use an acid cleaning solution to remove inorganic salts such as $CaCO_3$, $CaSO_4$, $BaSO_4$ and metal oxides (i.e., iron) from reverse osmosis membranes. Do not use sulfuric acid because it may cause calcium sulfate to precipitate on the membrane(s).

Acceptable cleaning solutions (all compositions given by weight):

- Newterra Cleaning Solution, COO03, (low pH cleaner)
- A solution of 0.2% hydrochloric acid (HCl),
- A solution of 0.5% phosphoric acid (H_3PO_4),
- A solution of 0.2% sulfamic acid (NH_2SO_3H), or
- A solution of 1.0% sodium hydrosulfite (Na_2S_2O4)

The solution will be most effective if maintained at 95°F (35°C). The pH of the solution should be around 2 - 3 pH.

ORGANIC FOULANT CLEANING

Use an alkaline cleaning solution to remove silica, biofilms, and organics from reverse osmosis membranes.

Acceptable cleaning solutions (all composition given by weight):

- Newterra Cleaning Solution, COO02, (high pH cleaner)
- A solution of 0.1% sodium hydroxide (NaOH) and 0.1% of tetra-sodium salt of ethylenediamine tetraacetic acid (Na-EDTA),

- A solution of 0.1% sodium hydroxide (NaOH) and 0.05% sodium salt of dodecyl-sulfate (Na-DDS),

- A solution of 1.0% sodium triphosphate (STP) and 1.0% trisodium phosphate (TSP) and 1.0% Na-EDTA.

The pH of the solution should be approximately 11 - 12. The temperature of the solution should not exceed 86°F (30°C).

MEMBRANE CLEANING DIRECTIONS

These directions describe how the membranes can be cleaned using the EPRO system. If a cleaning station is used, please follow the directions in the cleaning station Operating and Maintenance Manual.

1. Record the quantity and quality of the permeate with the system set at the normal operating pressure, (refer to your system log sheet).

2. Prepare the inorganic cleaning solution (approximate pH of 2 - 3) in a polypropylene or fiberglass reinforced plastic tank with a removable cover. The amount of solution required will be approximately two times the capacity of the system. Use RO water if possible.

3. Connect a hose from the cleaning solution tank to the inlet of the pre-filter (FIG. 3, page 21 or FIG.4, page 22) from the cleaning solution tank. Ensure a flooded inlet to the pump or positive feed pressure. A supply pump may be required.

4. Feed the permeate and the drain tubes back to the cleaning solution tank so that the solution will re-circulate during cleaning.

5. Turn on the reverse osmosis pump. Open the concentrate control valve (drain restrictor) and pump throttle valve (FIG. 3, page 21, or FIG. 4, page 22) to reduce the concentrate pressure to the prefilter pressure. Run the system for approximately 30 minutes.

6. Turn the machine off and return the RO system to the original configuration.

7. Turn the machine on and flush at 50 psi for approximately 30 minutes. Discard all of the permeate and concentrate water.

8. Adjust the system to normal operating pressure and check the quantity and quality of the permeate water after the low pH cleaning to assess any improvements in the system's performance.

9. Repeat this procedure for the organic cleaning solution (approximate pH of 11 to 12).

10. Readjust the concentrate pressure to original operating pressure for normal operation after the cleaning procedure is complete. Check the quantity and quality of the permeate to evaluate the effectiveness of the cleaning process.

MEMBRANE REMOVAL AND REPLACEMENT

Changing membranes in pressure vessels is relatively easy with the proper tools. The pressure vessel should be removed from the system. Please refer to Figure 11 and 12 on page 34 when following these instructions. Note: During this process, lubricate the o-rings, brine seals and the inner wall of the pressure vessels with a food grade water based lubricant. Do not use a petroleum based lubricant or silicone.

1. Remove the hoses and fittings from both ends of the pressure vessel.
2. Remove the pins holding the end plugs in the PVC vessel. Note: Some fiberglass pressure vessels use a snap ring, a spiral lock, or wedges to hold the plug in place. Use properly sized snap ring pliers to safely remove the snap rings.
3. Thread a nipple and tee into the feed or concentrate port. The nipple must extend past the end of the pressure vessel.
4. Pry off both end plugs using a pry bar. WARNING: Do not pry directly on the edge of the pressure vessel; damage may occur. We recommend using either a ball joint separator, also called a "pickle fork," which is an automotive tool, or a slide hammer (see page 34 for examples of these tools). Remove any fittings used to extract the end plugs.
5. Remove the membrane from the pressure vessel, noting which end the brine seal is on.

Note: ALWAYS remove and replace the membrane in the direction of the feed flow. This protects the brine seal from folding over. The brine seal should ALWAYS be installed on the feed end of your membrane.

Do not pull the membrane out using the permeate tube, as this may cause damage.

6. Replace the membrane. Always feed the new membrane into the feed end of the pressure vessel. Feed the membrane in the direction of water flow. Failure to do so may cause damage to the brine seal. Make sure the brine seal is on the feed end of the pressure vessel.
7. Replace any damaged O-rings. Lubricate the O-rings, brine seal and inner wall of the pressure vessel with a food grade water based lubricant.

Do not use a petroleum based lubricant or silicone.

8. Tap the plug securely into place using a piece of soft wood or a rubber mallet.
9. Ensure that the backing plates on fiberglass pressure vessels, when equipped, are installed between the end plugs and the snap rings.
10. Replace the retaining pins on the PVC pressure vessels. On fiberglass pressure vessels that use snap rings, insert the snap ring back into its groove.
11. Reattach the fittings into each plug.

Note: Be sure to apply Teflon tape to all threaded plumbing fittings removed for the above process. **Do not over tighten fittings. Over tightening fittings will cause the end caps to crack.**

CAUTION: New or factory cleaned membranes are shipped in a preservative solution. With a new membrane, flush the system at 50 psi for at least 1 hour to remove the preservative from the membrane. **Discard all permeate and concentrate produced during the flush.**

Fig. 12: Membrane Removal Tools for Pressure Vessels

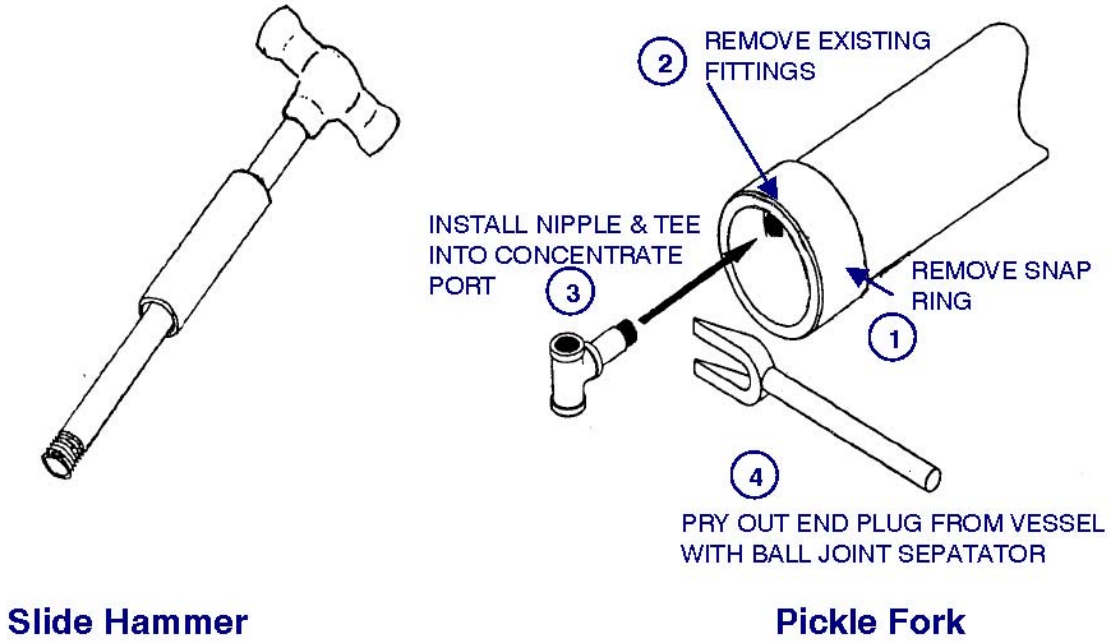
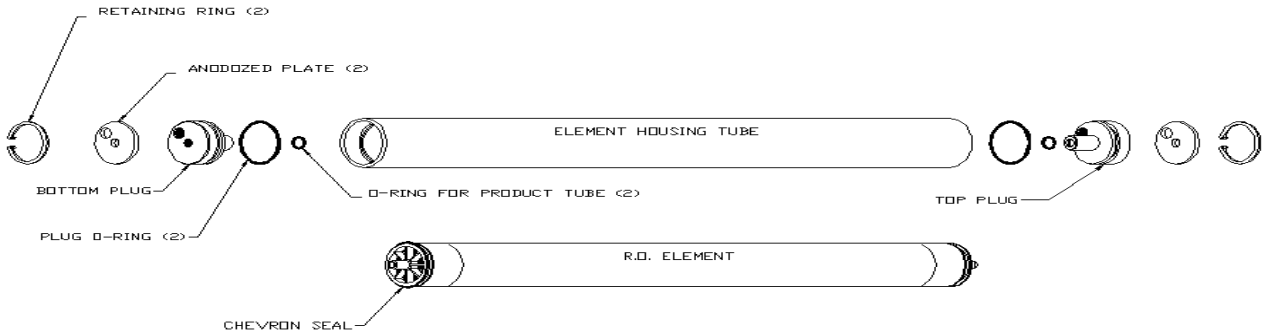


Fig. 13: Pressure Vessel Housing & Membrane



RO System Troubleshooting

If the system production declines or the unit stops working, check the mechanical components for any visual problems. Listed below are two of the most commonly encountered problem conditions that may occur: LOW or NO SYSTEM FLOW, and ABNORMAL PERMEATE FLOW.

LOW or NO SYSTEM FLOW:
Some causes of low or no system flow are incorrect adjustment of the RO system, insufficient feed flow, restricted prefilter, inoperative inlet solenoid, booster pump failure, pump throttle valve closed, membranes fouled or scaled, concentrate control valve closed, and/or drain line restricted.
Note: Three options are available to protect the RO system components from low system flow; the Economy Low Flow Control, the CE1 Electronic Control, and the CE2 Electronic Control. All three options employ a flow switch located after the concentrate control valve. When the concentrate flow drops below 1.5gpm, the system will turn off. All three options have provisions for automatic reset when the proper flow returns.

ABNORMAL PERMEATE FLOW
Permeate flow should be within 15% of the rated production (see Tables 1, 2, and 3 on pages 10, 11, and 12). Also, refer to the Temperature Correction Table, Table 7 on page 39, when using standard membranes with feed water temperatures below 77° F. Check your permeate flow meter to determine the permeate flow rate. If the system does not have a permeate flow meter, measure the time it takes to fill a one-gallon container and then calculate the permeate flow rate at gallons per minute or gallons per day.

Causes of Low Permeate Flow:
1) Improper adjustment
2) Cold feed water
3) High feed water TDS
4) Defective membrane brine seal
5) Fouled or scaled membrane

Causes of High Permeate Flow:
1) Improper adjustment
2) Defective product tube O-ring
3) Ruptured or oxidized membrane

Causes of Poor Permeate Quality:
1) Fouled or scaled membrane
2) Defective product tube O-ring
3) Ruptured or oxidized membrane
4) Low operating pressure

BOOSTER PUMP:
Isolate the pump and determine how much pressure can be achieved. This can be determined by checking the pump discharge pressure gauge. If the system is not equipped with this gauge, replace the hose that runs from the pump to the first pressure vessel with a hose to drain. Visually monitor the pump discharge for high pressure.

PRE-FILTER:
Check the differential of the pre-filter pressure gauges to determine if the filter needs to be replaced. If the system is not equipped with these gauges, examine the pre-filter cartridge to make sure that it is not clogged and does not restrict feed flow to the pump.

INLET SOLENOID VALVE: (see system diagrams on pages 22 and 23):
Feed water enters the system through an automatic solenoid shut-off valve, which is normally closed. Ensure that the solenoid opens when there is a demand for permeate water. The system can be operated without the solenoid for troubleshooting. Bypass the solenoid to see if it is contributing to the problem. Reinstall the solenoid after the test.

PRESSURE GAUGE:
Check for foreign matter in the gauge fitting or signal tubing. Remove any visible matter and reinstall the fitting and tubing. Verify that the tubing is not pushed too far inside the fitting. This could restrict flow and cause an inaccurate display. If the fitting and tubing are fine and the pressure gauge is still malfunctioning, the gauge should be replaced.

CONCENTRATE CONTROL VALVE:
Ensure that adjustment of the valve produces changes in the system flows and pressures.

ELECTRIC:
Use a voltmeter to verify that the correct voltage is being supplied to the system These measurements must be performed under load. Check to ensure that there are no electrical circuit breakers tripped or fuses blown, and that all electrical connections are secure.

MOTOR:
Verify that the motor is tuning. The motor may not be drawing the correct current. Use a clamp-on ammeter to check the current draw.

TABLE 6: TROUBLESHOOTING MATRIX

NO.	SYMPTOM	PROBABLE ROOT CAUSE	CORRECTIVE ACTION
1	SYSTEM FUNCTION LIGHTS DO NOT LITE (CE1 / CE2 CONTROL)	a) BLOWN FUSES b) NO POWER TO SYSTEM	a) REPLACE FUSES b) CHECK POWER DISTRIBUTION PANEL
2	SYSTEM ON, BUT MOTOR DOES NOT START	a) OVERLOAD RELAY TRIPPED (THREE PHASE ONLY) b) EXTERNAL CONTROL CONTACTS OPEN c) STORAGE TANK LEVEL CONTROL INOPERATIVE	a) RESET OVERLOAD RELAYS, CHECK CURRENT DRAW (THREE PHASE ONLY) b) CHECK EXTERNAL DEVICES AND REPAIR PER USERS MANUAL c) CHECK FLOAT SWITCHES AND REPLACE OR REPAIR
3	PUMP DISCHARGE PRESSURE WILL NOT ACHIEVE RECOMMENDED LEVEL	a) INSUFICIENT FEED b) PUMP/MTOR DAMAGED c) SYSTEM IMPROPERLY ADJUSTED	a) CORRECT FEED b) REPLACE PUMP/MOTOR c) ADJUST SYSTEM
4	CONCENTRATE PRESSURE WILL NOT ACHIEVE RECOMMENDED LEVEL	a) INSUFFICIENT FEED FLOW b) MEMBRANES FOULED c) PUMP/MOTOR DAMAGED	a) CORRECT FEED b) REPLACE MEMBRANES c) REPLACE PUMP/MOTOR
5	PUMP EXTREMELY NOISY WHEN PRESSURE INCREASED	a) INSUFFICIENT FEED FLOW b) PUMP DAMAGED	a) CORRECT FEED b) REPLACE PUMP
6	SYSTEM STOPS WITH LOW FLOW INDICATOR LIT (OPTIONAL)	a) INSUFFICIENT FEED FLOW b) INLET SOLENOID BAD c) IMPROPER ADJUSTMENT d) DRAIN LINE RESTRICTED	a) CORRECT FEED b) REPLACE SOLENOID c) READJUST SYSTEM d) CLEAR DRAIN
7	INSUFFICIENT PERMEATE PRODUCTION	a) FOULED MEMBRANES b) MEMBRANE BRINE SEAL DEFECTIVE c) SYSTEM IMPROPERLY ADJUSTED	a) REPLACE MEMBRANES b) REPLACE BRINE SEALS c) ADJUST SYSTEM
8	EXCESSIVE PERMEATE PRODUCTION AND POOR QUALITY PERMEATE	a) PRODUCT TUBE O-RINGS LEAKING OR MISSING b) DEFECTIVE MEMBRANE(S)	a) REPLACE PRODUCT TUBE O-RINGS b) REPLACE MEMBRANE(S)

TABLE 7:

Temperature Correction Factors

TEMPERATURE		CORRECTION FACTOR BY MEMBRANE MANUFACTURER				
°C	°F	FILMTEC	FLUID SYSTEMS TFCL	DESAL C.A.	DESAL N.F.	E.P. TRISEP HYDRANAUTCS
1	33.8	2.43	2.15	1.98	2.27	2.21
2	35.6	2.34	2.07	1.93	2.21	2.13
3	37.4	2.25	2.01	1.87	2.14	2.06
4	39.2	2.16	1.94	1.82	2.08	1.99
5	41.0	2.08	1.87	1.77	2.01	1.92
6	42.8	2.00	1.81	1.72	1.94	1.85
7	44.6	1.92	1.75	1.67	1.87	1.79
8	46.4	1.85	1.70	1.62	1.80	1.73
9	48.2	1.77	1.64	1.57	1.74	1.67
10	50.0	1.71	1.59	1.52	1.67	1.62
11	51.8	1.63	1.54	1.48	1.62	1.56
12	53.6	1.58	1.49	1.44	1.55	1.51
13	55.4	1.53	1.44	1.41	1.48	1.46
14	57.2	1.48	1.40	1.37	1.41	1.42
15	59.0	1.42	1.35	1.34	1.34	1.37
16	60.8	1.37	1.31	1.30	1.37	1.33
17	62.6	1.33	1.27	1.26	1.32	1.28
18	64.4	1.28	1.23	1.22	1.28	1.24
19	66.2	1.24	1.20	1.19	1.23	1.20
20	68.0	1.19	1.16	1.15	1.18	1.17
21	69.8	1.14	1.13	1.11	1.14	1.13
22	71.6	1.11	1.09	1.08	1.10	1.10
23	73.4	1.07	1.06	1.06	1.07	1.06
24	75.2	1.03	1.03	1.03	1.03	1.03
25	77.0	1.00	1.00	1.00	1.00	1.00
26	78.8	0.97	0.97	0.98	0.93	0.97
27	80.6	0.94	0.94	0.96	0.94	0.94
28	82.4	0.91	0.92	0.94	0.91	0.91
29	84.2	0.89	0.89	0.91	0.88	0.89
30	86.0	0.86	0.87	0.88	0.85	0.86
31	87.8		0.84	0.86	0.82	0.84
32	89.6		0.82	0.83	0.79	0.81
33	91.4		0.80			0.79
34	93.2		0.77			0.77
35	95.0		0.75			0.75
36	96.8		0.73			0.72
37	98.6		0.71			0.70
38	100.4		0.69			0.68
39	102.2		0.68			0.67
40	104.0		0.66			0.65
41	105.8		0.64			0.63
42	107.6		0.62			0.61
43	109.4		0.61			0.60
44	111.2		0.59			0.58
45	113.0		0.58			0.57
46	114.8		0.56			0.55
47	116.6		0.55			0.54
48	118.4		0.54			0.52
49	120.2		0.52			0.51
50	122.0		0.51			0.50

FLOW @ TEMPERATURE = FLOW @ 25 C (77° F) / CORRECTION FACTOR

Activated Carbon Filter

START-UP PROCEDURES (AUTOMATIC or MANUAL)

The Carbon Filter is shipped with **DRY** activated Carbon media that **MUST BE HYDRATED** with water for 24 hours (12 hours minimum) **BEFORE** placing the unit into service. Failure to properly **HYDRATE** the activated Carbon media and perform the following backwashing procedures may allow Carbon fines to enter into the RO system causing premature fouling of the RO membranes.

DAMAGE TO MEMBRANES DUE TO FOULING OR SCALING IS **NOT COVERED** UNDER WARRANTY FOR REPLACEMENT**.**

If the carbon filter has been shipped preloaded with activated carbon media, install the control valve head in accordance with (IAW) the manufacturer's instruction manual and proceed to step #1.

If the carbon filter has been shipped with loose activated carbon media, load the activated carbon media on site into the filter vessels IAW the manufacturer's instruction manual, install the controller valve head and proceed to step #1.

NOTE: FILL the filter vessel approximately 1/3 full with clean water before loading the under gravel or filter media to avoid possible breakage of the lower distributor.

1. Connect the feed water, backwash drain and service lines to the filter's control unit IAW the manufacturer's instruction manual included with the unit. Allow a 6-8" air gap on the drain line connection to the main drain.

2. Connect the proper electrical power connections for automatic units, IAW the manufacturer's instruction manual included with the unit.

3. Direct the service line from the carbon filter to drain during the initial startup backwashing procedures.

DO NOT ALLOW SERVICE WATER FROM THE NEW CARBON FILTER TO SUPPLY THE RO UNIT UNTIL THE CARBON FILTER BACKWASH PROCEDURES HAVE BEEN COMPLETED, AND CARBON FREE WATER HAS BEEN VERIFIED.

4. Place the controller valve into the backwash position and supply feed water slowly until all air has vented out of the carbon tank. After the air has been vented off and a steady flow of water is observed to the drain, you may open the feed water supply fully.

5. Allow the unit to backwash and sample the water with a clean WHITE cup. You may observe that the water is partially black with some carbon fines settling to the bottom of the cup. Continue backwashing until the water becomes clear as sampled with the WHITE cup. This may take 30 minutes or longer depending on the amount of carbon media.

CAUTION: IF EXCESSIVE AMOUNTS OF CARBON MEDIA CONTINUE TO DISCHARGE TO THE DRAIN DURING BACKWASH—***STOP!***

(1) The backwash flow controller orifice may not be installed properly;
(2) The flow during backwash is too high;
(3) The media maybe loaded improperly.
*Inspect and repair.

6. Place the unit into the RINSE / SETTLE position and allow the media to settle for the next 15 to 20 minutes.

7. Place the unit into the SERVICE position and observe the water out of the service line (disconnected from the RO supply). Perform the WHITE cup sample tests until the water is clear.

8. Stop the water flow into the Activated Carbon Filter and isolate the feed water and service lines. Allow the activated carbon media to HYDRATE for 24 hours (12 hours minimum).

9. After HYDRATION of the media, perform steps 1 through 7 at least 2-3 times to remove all loose carbon fines throughout the media bed.

10. Test for the presence of chlorine after the carbon filter and record the PPM level of Chlorine residual, (**MUST BE ZERO** for feed water supply to an RO system). Perform the **WHITE** cup test, the water should be clear with **NO** Carbon fines present.

If Chlorine is still present, check the installation of the control valve. The O-rings may not be seated properly or the distributor is too short. Verify proper flow design through the carbon filter to prevent channeling due to low flow or high flow conditions. It is possible that the chlorine level is too high for the design of the carbon filter media bed.

Should you have any problems or require additional assistance, please call our Manufacturer's Representative or Dealer that provided the equipment to you.

Are Carbon Fines Fouling Your Membrane(s)?

Now that you have them, how do you get rid of them?

Safety First! Wear gloves, goggles and if possible, an apron to protect your clothes. You will be using either citric or hydrochloric acid. In addition to these items, you will need a pH test kit and a new pre-filter**.**

1. Close feed water supply line to RO. Close the RO recycle valve if equipped.

2. Release pressure from pre-filter housing by pressing down on the red button on top of the housing.

3. Disconnect the Permeate line from any holding tank or point-of-use (POU).

   Note: During this cleaning process, Permeate is diverted to the drain.

4. Open Concentrate control valve about half way (50% or more).

5. Remove the pre-filter sediment bowl, discard the used pre-filter and clean the inside of the bowl.

6. Install a new pre-filter element into the bowl and add approx.1/3 clean water.

7. Fill the remaining 2/3 of the housing bowl with acid without overflowing, then attach the housing bowl back to the pre-filter inlet/outlet head.

8. Open feed water supply line to the RO slowly and press the red button, on top of the pre-filter head, down to vent any air out of the housing bowl.

9. Start the RO unit and allow it to run (15 to 30 seconds depending on size of RO,) adjust the Concentrate valve to maintain the RO pressure at 100 psi or lower without tripping the Low Pressure Cut-Out Switch. Sample the Concentrate until the pH indicates between 3-4 pH, and then shut down the RO.

10. Close the Concentrate control valve completely and trap the acidic water inside the membrane housing(s).

11. Tag the RO unit. **"DO NOT START- CONCENTRATE VALVE CLOSED."**

12. Allow the RO membrane(s) to soak in acidic water for 45 minutes to an hour.

NOTE: FOR RESTART OF RO:

13. Open Concentrate control valve to 50% and remove the "DO NOT START" tag.

14. Start the RO unit and adjust pressure to approx.100 psi. Flush for 5-10 min. Check the pH of the Concentrate until the acid is completely rinsed out.

    Note: The Concentrate pH should match closely to the Feed water pH supply.

15. Adjust the RO Concentrate control valve to bring operating pressure and flows within design projections for the system. Sample the Feed water and Permeate TDS to determine % Rejection. If RO membrane(s) are still not producing proper flow and % Rejection – repeat the above procedures.

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Limited Warranty

newterra warrants, for a period of twelve months from the date of shipment, that any equipment it manufactures shall be free of defects in material and workmanship, shall comply with the then-current product specifications and product literature, and if applicable, shall be fit for the purpose specified in the agreed upon quotation or proposal document, but only when said products are operated at all times in accordance with Seller's written instructions.

Products which are sold but not manufactured by newterra are subject to the warranty provided by the manufacturer of said products and not by newterra's warranty. Seller shall assign to Purchaser manufacturer's warranties of equipment or material purchased from others to the extent they are assignable, and Buyer's sole recourse shall be against the manufacturer. newterra will determine the applicability of any such third-party warranties.

This warranty applies only to the original purchaser. newterra's liability under this warranty shall be limited to repairing or replacing at newterra's option, without charge, F.O.B. newterra's factory, any product manufactured by newterra newterra will not be liable for any cost of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Buyer shall provide Seller with reasonable opportunity to make inspections, tests, and repairs using the most cost-effective methods available. If Seller is not responsible under the terms of this agreement, the Buyer shall pay the Seller for such inspections, tests, and repairs at the Seller's prevailing rates.

Repair or replacement shall be Buyer's sole and exclusive remedy, and the warranty period on any repaired or replacement equipment shall be 1 year from the original equipment ship date. In no event shall newterra's warranty obligations with respect to equipment exceed 100% of the total cost of the equipment supplied hereunder. No allowance will be made for repairs or alterations made without Seller's written consent or approval. newterra will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration, or repair, or if the product was not installed in accordance with newterra's printed installation and operating instructions.

newterra will not be liable for any incidental or consequential damages, losses, or expenses arising from installation, use, or any other causes. There are no express or implied warranties, including merchantability or fitness for a particular purpose, which extends beyond those warranties described or referred to above.

Returned of Defective Goods:

No equipment shall be returned to Seller without Seller's prior written authorization. To obtain specific performance under this warranty, the defective product must be returned to newterra together with proof of purchase, installation date, failure date, and supporting technical data including serial number of the item or the item's parent component. This information must be provided at the time a request is made for a Returned Material Authorization (RMA).

Any defective product to be returned to the factory or manufacturers service center must be authorized in advance and sent Freight Prepaid. The RMA number must be clearly marked on the return shipping documents and any Documentation supporting the warranty claim shall be attached. Contact your newterra sales engineer or customer service for details on obtaining an RMA number.

Services:

Any services newterra provides hereunder, whether directly or through subcontractors, shall be performed in accordance with the standard of care with which such services are normally provided in the industry. If the services fail to meet the applicable industry standard, newterra will, for a period of 1 year from the date of completion of said services, re-perform such services at no cost to Buyer. Re-performance of services shall be Buyer's sole and exclusive remedy, and in no event shall newterra's warranty obligations with respect to services exceed 100% of the total cost of services provided hereunder.

Limitations / Exclusions:

newterra warrants its pumps and membrane elements for one year from ship date, providing that loss of performance was not caused by fouling or neglect. newterra will, on confirmation of loss of performance during the warranty period, credit one-twelfth of the original invoice price of the pump or membrane element for each month remaining in the warranty period, toward the purchase of the replacement pump or membrane.

Components and materials of the type that need periodic replacement due to normal wear and tear, such as membranes, electrodes, frames, gaskets, o-rings, filters, pump seals, spray nozzles, trays and fuses, are warranted against defects only as of the shipment date, unless expressly stated otherwise.

The warranties herein shall not apply to, and newterra shall not be responsible for, any damage to the goods or failure of the services supplied hereunder, to the extent caused by Buyer's neglect, failure to follow operational and maintenance procedures, or the use of technicians not specifically authorized by newterra to maintain or service the equipment. newterra will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration, or repair, or if the product was not installed in accordance with newterra's printed installation and operating instructions. The warranties and remedies contained herein are in lieu of and exclude all other warranties and remedies, whether expressed or implied by operation of law or otherwise, including any warranties of merchantability or fitness for a particular purpose.

Seller reserves the right to utilize the most compact and feasible design compatible with sound engineering practices, and to make changes in details of design, construction and arrangement of goods unless precluded by limitations specified by Buyer in writing in the purchase order or contract at the time the order is placed. If no such limitations are specified, Seller accepts no responsibility for incompatibility of prepared goods with actual space or design limitations, which may become apparent at a later date. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may have other rights, which vary from jurisdiction to jurisdiction. Unless stated specifically on a formal, official "Performance Warranty Document" signed by an officer of the Seller and an employee of the Buyer who is authorized to make such representations, there is no performance warranty on products or systems or warranty on process results. Any performance warranties shall apply only if equipment is operated in accordance with Seller's instructions when operated on water or other liquids having the characteristics specified in the proposal or purchase order. Any costs incurred by newterra customers, mechanical contractors or end-users related to newterra products or accessories will not be reimbursed by newterra without prior approval in writing by the newterra Operations Manager or a newterra Co. Corporate Officer. newterra has a "No Backcharge" and "No Short-Payment" policy. In addition, newterra will not be responsible for consequential damages. newterra will fully support its products and correct any unlikely deficiencies in a timely manner.

Terms and Conditions

1. **APPLICABILITY / SCOPE**: All goods and services provided shall be governed by the terms and conditions set forth herein. Any modifications to these terms or to the scope of any order or project hereunder, shall be mutually agreed upon and set forth in an appropriate writing executed by both parties. Such writing shall clearly set forth the nature and extent of the change, and, if applicable, any adjustment in price associated with such change.

2. **PRICING / PAYMENT**: The price to be paid by Buyer shall be mutually agreed upon by the parties and set forth in an appropriate writing. Unless otherwise agreed to, prices quoted do not include any state or local sales or use tax, special fees, duties or custom fees, freight and handling charges, or export crating costs that may be added to the price at invoicing. newterra reserves the right to change prices without notice.

Method of Payment. All orders shall be shipped C.O.D. or require payment in advance until credit has been established. A complete credit check is required prior to shipping on a Net-30 or "C.O.D. - CUSTOMER CHECK ACCEPTABLE" basis. Upon credit approval on open account terms, payment shall be made in U.S. Dollars without discount, payable within 30 days of the date of invoice. Minimum billing amount is $100. Shipments outside of the U.S.A. shall be prepaid (by credit card, wire transfer, or U.S. cashier's check), or by irrevocable Letter of Credit. Processing fees may be assessed for additional costs incurred for credit card charges, returned checks, Letters of Credit, or other bank charges.

Payment. All payments shall be remitted as follows: (a) If by Check: newterra, Inc. 730 Commerce Drive, Venice, FL 34292 (b) If by wire transfer: Suntrust Swift Code: SNTRUS3A, Routing Number: 061000104, Account Name: newterra, Inc, Account Number 1000172130402. Wire transfers should be initiated with all bank charges paid from the account of the applicant. newterra reserves the right to specify the method and/or timing of payment (including prior to shipment) if newterra, in good faith, believes that the prospect of payment by Buyer has been impaired. newterra shall be entitled to a liquidated late charge calculated at a rate of 1.5% per month (18% per annum) or if lower, at the maximum rate permitted by law, for any payment not made within 10 days following the date due. If the Buyer disputes any portion of an invoice, they shall notify Seller in writing with specific details and pay the undisputed portion within 30 days. Buyer shall reimburse all costs incurred in collection of past due amounts including but not limited to attorney's fees, court costs and collection fees incurred by Seller.

Letters Of Credit. Letters of Credit will be accepted by newterra only when compliant with the following: The Letter of Credit must (a) Be IRREVOCABLE and CONFIRMED by a US bank; (b) Be in favor of newterra; (c) State payment is by site draft payable AT SIGHT; (d) State that ALL bank charges, including those outside the country of origin, are to be applied to BUYER'S account; (e) Must state Ex-Works, point as factory unless terms of Pro Forma Invoice specify otherwise, (f) Be advised through a class A U.S. bank; (g) Show buyer as applicant for the Letter of Credit.

3. **DELIVERY**: Once newterra has confirmed acceptance of an order from Buyer, unless otherwise mutually agreed upon: (a) all goods to be supplied hereunder and delivered within the United States shall be shipped Ex-Works, point as factory; (b) all goods to be supplied hereunder and delivered outside the United States shall be shipped in accordance with the applicable provisions of the Incoterms); and (c) title and risk of loss shall pass to Buyer upon newterra's delivery of the goods to the carrier unless otherwise specified. newterra shall not be bound by any delivery requirements unless and until mutually agreed upon by the parties in writing.

Export preparation is not included in the total price and all shipments are Ex-Works, point as factory. Seller reserves the right to choose the location of manufacture. When the total price indicated includes a freight allowance, it is understood that all rail freight charges are included to rail depot nearest to job site and all motor freight charges are included to the job site. All freight charges should be "Prepaid and "Add." If Purchaser indicates equipment is to be shipped "Prepaid," such transportation charges plus processing fee will be added to the invoice as a separate item. All parcel post shipments will be prepaid, the cost of which shall be added to the invoice. Parcel post shipments will be uninsured unless otherwise requested. Equipment requiring the use of large traveling cranes for erection and shipment cannot be held after completion without incurring additional charges.

4. **ACCEPTANCE**: (a) Buyer shall inspect all shipments of equipment or other goods within 10 days of receipt, and shall promptly notify newterra of any defects or non-conforming goods. The parties acknowledge that acceptance of any goods supplied hereunder shall be deemed to have occurred if Buyer fails to notify newterra of any such defects or non-conforming goods within 30 days of the date of receipt. The parties acknowledge that acceptance of any services provided hereunder shall be deemed to have occurred if Buyer fails to notify newterra of any defects or non-conformance in such services within 30 days of the date the services were completed; (b) For any order hereunder which requires newterra's involvement in the installation, start-up, check-out and/or commissioning of any newterra equipment or system, the parties acknowledge that system acceptance shall be deemed to have occurred upon completion of the startup and checkout of the system, or upon operational use of the system by Buyer, whichever occurs first.

5. **WARRANTY**: (See WARRANTY document)

6. **OPERATIONAL AND MAINTENANCE PROCEDURES**: Buyer acknowledges that any improper use, maintenance, or modification of the equipment provided hereunder, or use of unqualified maintenance or service technicians will severely impair the operational effectiveness of the entire system. Buyer hereby agrees to indemnify, defend and hold harmless newterra from and against any and all third party claims arising, in any manner, out of: (a) Buyer's neglect of the equipment; (b) Buyer's use of technicians not authorized by newterra to service the equipment; or (c) Buyer's improper use or modification of the equipment or failure to follow the operational and maintenance procedures provided with the equipment.

7. **LIMITATION OF LIABILITY / DAMAGES**: In no event (even should circumstances cause the exclusive warranties and remedies set forth in the Warranty section to fail their essential purpose) shall either party be liable for any indirect, incidental, special or consequential damages (including, but not limited to, loss of use, loss of anticipated profits, or damages arising from delay) whether such claims are alleged to have arisen out of breach of warranty, breach of contract, strict or absolute liability in tort, or other act, error or omission, or from any other cause whatsoever, or any combination of the foregoing.

8. **CUSTOM EQUIPMENT OR SYSTEMS**: Buyer acknowledges that any approvals and/or listings specified in newterra's proposal are limited to the specific scope and application set forth in the proposal, and may not cover or apply to any custom or special equipment or services which are outside the scope of newterra's proposal. newterra shall retain all proprietary rights in any and all technical data, designs, or other information developed by newterra (and not provided by Buyer) in the course of designing, developing and/or manufacturing custom equipment or systems.

9. **BREACH**: In addition to any failure to comply with any other terms as set forth herein, the occurrence of any of the following events shall constitute a breach on the part of Buyer: (a) If Buyer shall become insolvent or make a general assignment for the benefit of creditors; (b) If a petition under the Bankruptcy Act is filed by or against Buyer; (c) If, at any time Buyer fails to fulfill its obligations under the terms and conditions hereof, or acts in such a manner as to endanger performance of such obligations; (d) If newterra shall reasonably believe that Buyer will not timely fulfill its obligations or otherwise perform hereunder, and Buyer is unable to provide reasonable assurances that such timely performance will occur. Upon breach by Buyer, newterra may terminate the contract or agreement by giving notice to the Buyer. Such termination shall be effective immediately. In the event of a breach and contract termination, Buyer is still responsible for costs incurred by newterra.

10. **INDEMNIFICATION**: Each party shall defend, indemnify and hold each other's officers, directors and employees, harmless from and against any third party claims, damages or losses, including reasonable attorney's fees and costs (whether based on negligence, contract or any other legal theory), to the extent such claims, damages or losses are attributable to the negligence of each party or each party's failure to perform in accordance with the terms and conditions set forth herein.

11. **CONFIDENTIAL & PROPRIETARY INFORMATION**: Buyer acknowledges that the information and processes utilized by newterra in the manufacture and supply of its products and systems are confidential and proprietary to newterra. Buyer agrees to treat as confidential and proprietary any such information or processes, including, but not limited to, design information or data, proposals, software, schematics, drawings, operational and maintenance manuals, testing procedures or other similar technical information ("Confidential Information") provided by newterra in connection with the supply or installation of products or systems hereunder, and will, at a minimum, protect any such

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confidential Information in a manner commensurate with the measures taken to protect Buyer's own confidential or proprietary information. newterra retains all rights, titles and interests in all such Confidential Information and Buyer shall not use or otherwise disclose to any third party any such Confidential Information except to the extent authorized by newterra in writing.

12**. INTELLECTUAL PROPERTY RIGHTS**: newterra retains any and all intellectual property rights in and to the equipment, services, and/or information supplied hereunder (including, but not limited to, patents, copyrights, trademarks and trade secrets) ("Intellectual Property"). Buyer is not granted any interest, right, or license with respect to any such Intellectual Property, except to use the equipment, services and/or information for the purposes for which it is specifically provided to Buyer in accordance with the terms and conditions hereof. newterra shall indemnify and hold Buyer harmless from and against all third party claims of infringement or alleged infringement arising out of Buyer's use of any equipment, services, or information supplied by newterra hereunder. Provided, however, that newterra's indemnity obligation hereunder shall not apply to, and newterra shall not be responsible for, any claims to the extent arising out of Buyer's modification of newterra's equipment, services or information, or use of such equipment, services or information: (a) in combination with equipment, services or information not supplied by newterra, or (b) in the operation of any process or in any other manner inconsistent with the purpose for which newterra's equipment, services or information were intended.

13. **INSURANCE**: Each party shall provide and maintain at its own expense, such policies of insurance in such amounts as are appropriate and commercially reasonable for parties engaging in the type of activities contemplated by the projects entered into hereunder. Upon request, each party shall furnish the other with certificates evidencing the required insurance coverage.

14. **LIENS**: newterra shall promptly pay for all materials, supplies and labor employed by it in providing the goods and/or services hereunder, such that any equipment or system supplied to Buyer remains free of materialmen's, warehousemen's, mechanics', and any other similar liens. newterra shall promptly discharge any such liens arising out of its performance hereunder.

15. **COMPLIANCE WITH LAWS**: In providing the goods and/or services hereunder, newterra shall comply with all applicable federal, state, and local laws and all rules and regulations issued thereunder. Any provisions required to be included by any such law; rule or regulation shall be deemed to be included by reference herein.

16. **ASSIGNMENT**: The rights and responsibilities of Buyer as set forth herein, are personal to Buyer and may not be assigned or delegated without the prior written consent of newterra.

17. **NON-WAIVER**: The parties' failure to demand strict performance or to otherwise enforce any rights hereunder shall not constitute a waiver of any rights hereunder. No claim arising out of a breach hereof may be discharged in whole or in part by a waiver of the claim unless supported by consideration and set forth in a writing signed by the waiving party. Any such waiver shall apply to the specifically identified claim only, and shall in no way constitute a waiver or discharge of any other prior or subsequent claim.

18. **SUSPENSION BY BUYER**: If any project or order, for which newterra is to supply goods and/or services hereunder, is suspended by Buyer, for any reason other than a breach by newterra, newterra shall take all reasonable measures to cooperate with Buyer in rescheduling any planned or ongoing work, and in otherwise complying with the suspension instructions. Provided, however, that in the event of any such suspension which continues for a period of 90 days, newterra shall be entitled to terminate that order, without any further liability or obligation thereunder. Provided, further, that newterra shall be entitled to prompt reimbursement from Buyer IAW Provision 24 below.

19. **CANCELLATION/TERMINATION**: This contract is not subject to cancellation except by mutual consent and on terms that will indemnify newterra against loss. If any project or order, for which newterra is to supply goods and/or services hereunder, is terminated IAW the provisions of these terms and conditions, newterra shall be entitled to charge 25% of selling price to the Buyer who placed the order for standard equipment. As it relates to any specially-designed, non-standard equipment ordered, a 25% charge will be levied if canceled prior to incurring related engineering, drafting, and production time. If engineering, drafting, and production time has been incurred, 100% of the selling price plus additional costs incurred will be charged to the Buyer who placed the order. Additional costs incurred as a direct result of termination may include, but are not limited to, freight and storage charges, costs of labor, transportation, travel and living expenses for support.

20. **APPLICABLE LAW / DISPUTES**: It is the expectation of the parties that any disputes arising hereunder will be amicably resolved by mutual agreement of the parties. Any dispute, involving the supply of goods or services within the United States, which cannot be amicably resolved by the parties, shall be submitted to binding arbitration in accordance with the applicable rules and regulations of the American Arbitration Association. The substantive law of Pennsylvania shall apply to any such arbitration, which shall be conducted in Philadelphia, Pennsylvania. Any dispute, involving the supply of goods or services outside the United States, which cannot be amicably resolved by the parties, shall be submitted to binding arbitration in accordance with the applicable rules and regulations of the International Chamber of Commerce. Unless otherwise agreed upon by the parties, the applicable substantive law, language and the location for any such arbitration shall be determined by the arbitrator(s) in accordance with the applicable rules.

21. **FORCE MAJEURE**: Neither party shall be liable for any failure or delay in its performance resulting from any cause beyond its reasonable control including, but not limited to, acts of God; acts or omissions of civil or military authority; fires; floods; unusually severe weather; strikes or other labor disputes; embargoes; wars; political strife; riots; delays in transportation; sabotage; or fuel, power, material or labor shortages.

22. **INTEGRATION / MODIFICATION**: Except as otherwise specifically set forth herein, these terms and conditions are intended by both Buyer and newterra as the final integrated expression of their agreement with respect to any projects or orders subject hereto. No additions to or modifications of any of the terms or conditions herein shall be effective unless set forth in a writing duly executed by both parties.

23. **CONSTRUCTION**: If these terms and conditions have been provided in response to an invitation to bid or other solicitation from Buyer, and the provisions set forth herein differ in any way from the provisions (if any) of Buyer's invitation or solicitation, these terms and conditions shall constitute newterra's counteroffer and shall not be effective as an acceptance unless Buyer assents to the provisions herein. If these terms and conditions constitute a counteroffer, acceptance hereof must be on the exact terms contained herein. Any additional, conflicting or different terms proposed by Buyer shall constitute a counteroffer by Buyer, and shall not be effective unless set forth in a mutually agreed upon writing executed by both parties.

24. **RETURNED GOODS**: No equipment shall be returned to Seller without its prior written authorization. All returns due to unwanted products or customer error will be assessed a 25% restocking charge, based on the original invoice amount (shipping charges will be borne by the Buyer). The Buyer will be credited the full invoice amount, including return shipping charges, if the original shipment was newterra's error. To obtain specific performance under this warranty, the defective product must be returned to newterra together with proof of purchase, installation date, failure date, supporting technical data, and documentation supporting the warranty claim. Any defective product to be returned to the factory or service center must be sent Freight Prepaid. Buyers desiring to return product should contact our Customer Service Department at 1-800-828-2447 to obtain a Return Authorization (RA) number and a Return Material tag (RMT). Each carton must be visibly marked with the RA number and have the RMT tag (RMT) in the packing list pouch and shipped via ground transport to: The newterra facility indicated on the Return Authorization form. The following applies to returns: (a) Cartons that are not marked with the RA number or do not have the RMT tag in the packing list pouch will be returned to the sender, unopened; (b) The appropriate credit will be issued upon verification of the age and condition of the product returned; (c) Customized products cannot be returned for credit unless it is identified that newterra shipped the order in error; (d) Return of products not manufactured by newterra will be subject to the original manufacturer's return to stock policy; (e) newterra will not accept C.O.D. return shipments; (f) A return authorization will become null and void if equipment is not received by newterra within 30 days of the date of issue. Claims for error in quantity or condition must be made within 10 days of receipt of the material. newterra will not be responsible for any claimed shortages not reported within 10 days.