

CRANE

CRANE ENVIRONMENTAL
PURE *Water* MADE SIMPLE™

EPRO SERIES OPERATIONS & MAINTENANCE MANUAL



EPRO-150



EPRO-250



EPRO-600



EPRO-1200



EPRO-1500



EPRO-3000



EPRO-4500



EPRO-6000



EPRO-8000

Water Purification Technologies



THE ORIGINAL NAMES IN WATER TREATMENT

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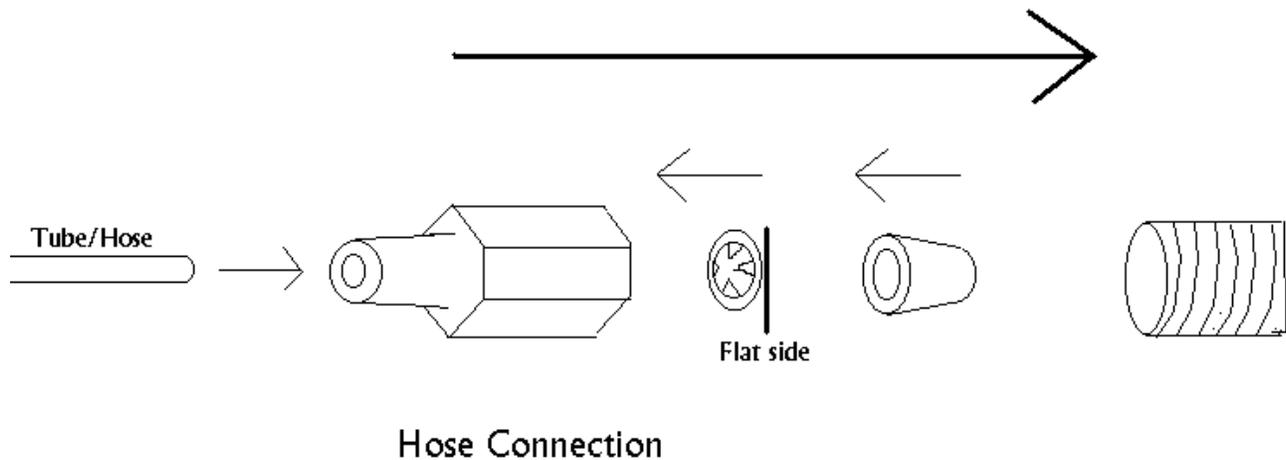
Assembly Components Checklist

EPRO 150 - 1200 SYSTEMS:

- (1) 5-Micron Filter Cartridge
- (1) 10' X 3/8" Clear Hose
- (1) 10' X 3/8" Black Tube
- (1) 10' X 1/2" Garden Hose
- (2) Hose Connections

EPRO 1500 – 8000 SYSTEMS:

- (1) 5-Micron Filter Cartridge
- (2) 10' X 3/4" Black Tube
- (2) Clamps
- (2) Hose Connections



Introduction

Reverse osmosis systems from Crane Environmental produce high quality water from municipal and well water. The highest quality components and the latest technology is 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.

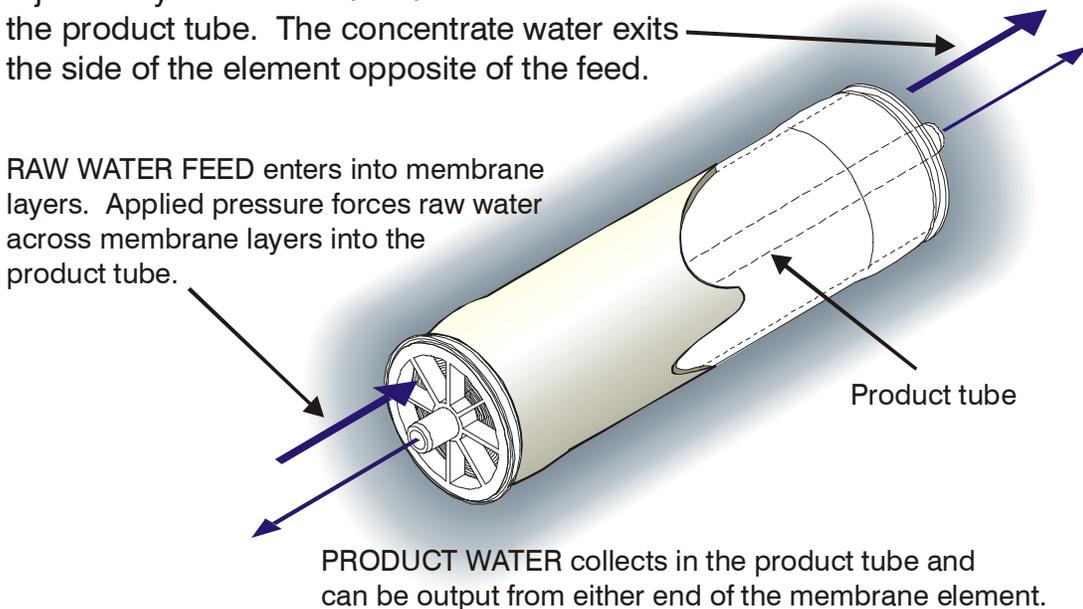
What is a semi-permeable membrane?

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.

THE REVERSE OSMOSIS MEMBRANE ELEMENT

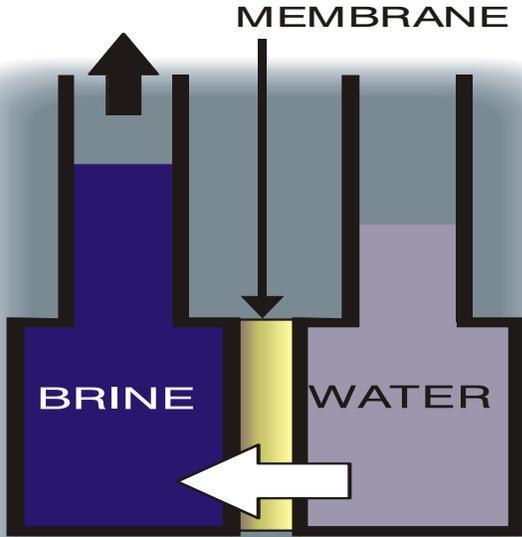
CONCENTRATE WATER containing salts is rejected by the membrane and does not enter the product tube. The concentrate water exits the side of the element opposite of the feed.

RAW WATER FEED enters into membrane layers. Applied pressure forces raw water across membrane layers into the product tube.



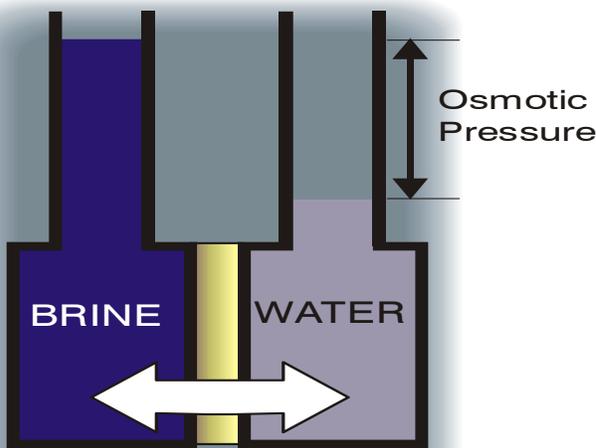
How does osmosis and reverse osmosis work?

Fig. 1A: OSMOSIS



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, below.

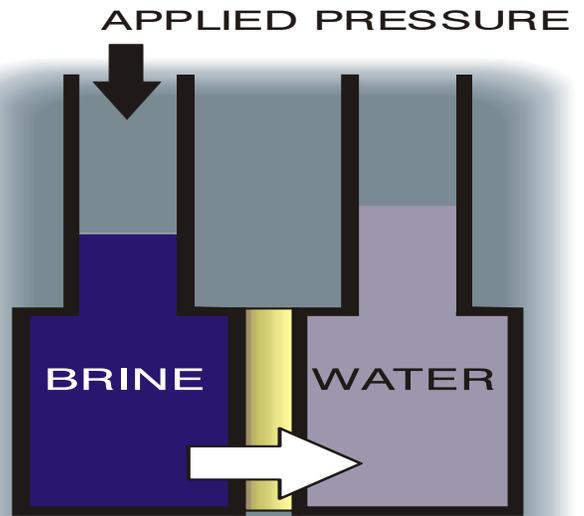
FIG. 1B: EQUILIBRIUM



Osmotic Pressure is the pressure required to stop water flow and reach equilibrium.

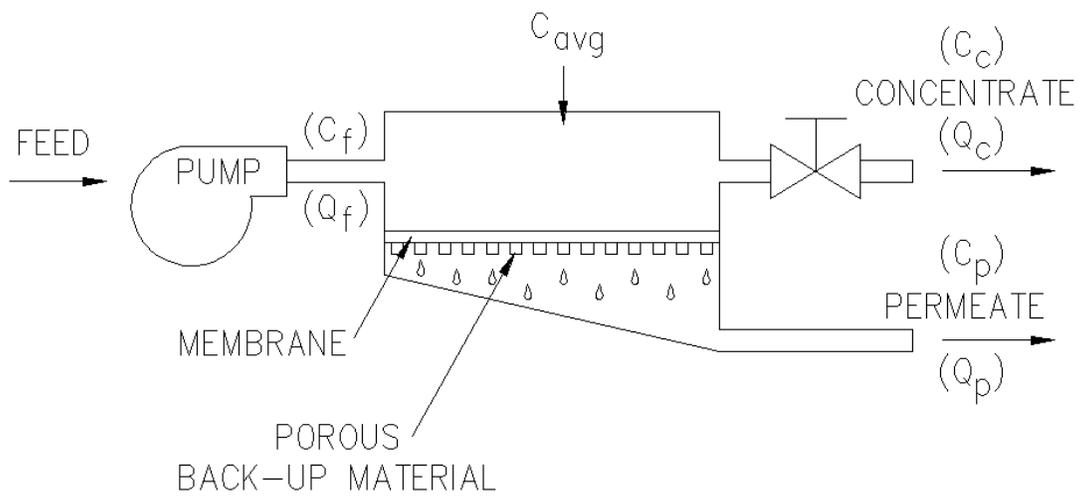
When the applied pressure equals the osmotic pressure, the water flow stops. When applied pressure exceeds the osmotic pressure, reverse osmosis will take place. In reverse osmosis, water passes through the membrane to the dilute solution, leaving behind dissolved particles. This process purifies the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

FIG. 2A: REVERSE OSMOSIS



Crane Environmental systems use semi-permeable spiral wound, thin film 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. 2B: Reverse Osmosis System



Specifications

The basic EPRO unit is designed to produce purified water at the capacities indicated by the suffix in the model number under the following conditions: water temp 77°F (25°C) and a total dissolved solid (TDS) of 500 ppm or less. For example, the EPRO-1200 produces 1200 gallons per day (GPD) or 4,542 liters per day (LPD) of purified water.

In addition to the standard models the EPRO models are offered in the following variations:

- ◀ The "P" series EPRO systems are reverse osmosis systems that deliver purified water to a pressurized storage tank. The product water is typically stored in the pressurized tank at 20-40 psi and is distributed with tank pressure.
- ◀ The "A" series EPRO systems are reverse osmosis systems that feed permeate to a 65 gallon atmospheric storage tank and distribute the permeate with a small dispensing pump.
- ◀ The "XP" series EPRO systems are modular systems with a reverse osmosis unit, a 300-gallon atmospheric storage tank, a liquid level control, and a re-pressurization system. A variety of storage tanks and re-pressurization systems are available.
- ◀ The "WM" series are reverse osmosis systems suitable for wall-

mounted installation to save 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 percent recovery. To calculate % recovery, use the following formula:

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

NOTE: All Flow Rates must be expressed in the same units, usually gallons per minute (gpm).

Table 1 on page 6 lists specifications for EPRO-150 through 1200 models. Table 2 on page 7 lists specifications for EPRO-1500 through 8000.

Table 1:

SPECIFICATIONS FOR EPRO-150 THROUGH 1200 SYSTEMS

GENERAL PART DESCRIPTIONS AND PART NUMBERS:

EPRO 150-1200		
Prefilter	2.75" X 10", 5 micron	PFC01
Prefilter Housing	4" D X 12" H	HPO04
Concentrate Control Valve	1/2"	DDO01
Concentrate Pressure Gauge	0 – 300 psi	DGO02
Inlet Solenoid Valve	1/2" 115 V, 60 HZ or 1/2" , 230 V, 50 HZ	GCV050B or GCV050C
Element Housing Clamp (2 req'd)	2.5"	CH-6PW

MEMBRANE SPECIFICATIONS:

Membrane Type	Thin - Film Composite
Operating Pressure (Max)	300 psi (2.1 Mpa)
Operating Temperature (Max)	113° F (45° C)
Feed Turbidity (Max)	1 NTU
Free Chlorine (Max)	< 0.1 ppm
pH Range (Continuous)	2 to 11
pH Range (Cleaning)	1 to 12
Feed Flow (Max)	6 gpm (2.5")
Feed SDI (Max)	5

MOTOR CURRENT DRAWS (AMPS):

	1/3 HP	1/2 HP
115 V, 60 HZ	7.2	9.8
230 V, 60 HZ	3.6	4.9
220 V, 50 HZ	3.6	4.9

ADDITIONAL SPECIFICATIONS AND PARTS:

	EPRO-150	EPRO-250	EPRO-600	EPRO-1200
Recovery	18% (24% at 50HZ)	21% (27% at 50HZ)	25% (24% at 50HZ)	40% (48% at 50HZ)
Rejection (min)	98%	98%	98%	98%
3rd year operating pressure	180 psi	155 psi	170 psi	172 psi
Feed Flow GPD	840 (625 at 50HZ)	1200 (926 at 50HZ)	2400 (2,500 at 50HZ)	3000 (3,333 at 50HZ)
Pressure Vessel	2.5" X 14" (HEO01)	2.5" X 21" (HEO02)	2.5" X 40" (HEO03)	(2) 2.5" X 40" (HEO03)
RO Element	2.5" X 14" (ETT06)	2.5" X 21" (ETT07)	2.5" X 40" (ETT28)	(2) 2.5" X 40" (ETT28)
Permeate Flow Meter	DFO01	DFO01	DFO03	DFO04
Concentrate Flow Meter	DFO03	DFO03	DFO04	DFO04
Recycle Flow Meter	DFO01	DFO01	DFO03	DFO03
Low pressure switch	DBO04	DBO04	DBO04	DBO04
Recycle Valve	DRO02	DRO02	DRO02	DRO02
Height (inch / cm)	53 / 135	53 / 135	53 / 135	53 / 135
Length (inch / cm)	17 / 43	17 / 43	20 / 51	24 / 61
Width (inch / cm)	17 / 43	17 / 43	17 / 43	17 / 43
Weight (lbs / kg)	67 / 30	68 / 31	70 / 32	74 / 34

	EPRO-150		EPRO-250		EPRO-600		EPRO-1200	
	60HZ	50HZ	60HZ	50HZ	60HZ	50HZ	60HZ	50HZ
Rotary vane Pump (Br)	DPO07	DPO07	DPO43	DPO43	DPO09	DPO11	DPO11	DPO11
Rotary vane Pump (SS)	DPO08	DPO08	DPO44	DPO44	DPO10	DPO12	DPO12	DPO12
Motor	DMO03A	DMO03A	DMO03A	DMO03A	DMO04A	DMO04A	DMO04A	DMO04A
HP	1/3	1/3	1/3	1/3	1/2	1/2	1/2	1/2

Table 2:

SPECIFICATIONS FOR EPRO-1500 THROUGH 8000 SYSTEMS

GENERAL PART DESCRIPTIONS AND PART NUMBERS:

	EPRO 1500-6000		EPRO- 8000	
Prefilter	2.75" X 20", 5 micron	PFC02	4.75" X 20", 5 micron	PFC03
Prefilter Housing	5" D X 23" H	HPO01	7.25" D X 12.75" H	HPO08
Concentrate Control Valve	3/4"	DDO02	← USE SAME	
Concentrate Pressure Gauge	0 - 300 psi	DGO02		
Inlet Solenoid Valve	3/4" 230 V, 60 HZ or 3/4" , 220 V, 50 HZ	GCV075C		
Element Housing Clamp (2 req'd)	4"	CH-9PW		

MEMBRANE SPECIFICATIONS:

Membrane Type	Thin - Film Composite
Operating Pressure (Max)	300 psi (2.1 Mpa)
Operating Temperature (Max)	113° F (45° C)
Feed Turbidity (Max)	1 NTU
Free Chlorine (Max)	< 0.1 ppm
pH Range (Continuous)	2 to 11
pH Range (Cleaning)	1 to 12
Feed Flow (Max)	17 gpm
Feed SDI (Max)	5

MOTOR CURRENT DRAWS (AMPS):

	1 HP	1.5 HP	3 HP
115 V, 60 HZ	16	20	34
230 V, 60 HZ	8	10	17
220 V, 50 HZ	8	10	17

ADDITIONAL SPECIFICATIONS AND PARTS:

	EPRO-1500	EPRO-3000	EPRO-4500	EPRO-6000	EPRO-8000
Recovery	20%	32%	40%	50%	50%
Rejection (min)	98%	98%	98%	98%	98%
3rd year operating pressure	137.1 psi	138.4 psi	140.0 psi	141.6 psi	148.7 psi
Feed Flow GPD	7,500	9,375	11,250	12,000	16,000
Pressure Vessel	4" X 40" (HEO07-1/2)	(2) 4" x 40" (HEO07-1/2)	(3) 4" x 40" (HEO07-3/4)	(4) 4" x 40" (HEO07-3/4)	(5) 4" x 40" (HEO07-3/4)
RO Element	4" X 40" (ETF01)	(2) 4" X 40" (ETF01)	(3) 4" X 40" (ETF01)	(4) 4" X 40" (ETF01)	(5) 4" X 40" (ETF01)
Permeate Flow Meter	DFO05	DFO05	DFO06	DFO06	DFO06
Concentrate Flow Meter	DFO06	DFO06	DFO06	DFO06	DFO06
Recycle Flow Meter	DFO05	DFO05	DFO05	DFO05	DFO05
Low pressure switch	DBO24	DBO24	DBO24	DBO24	DBO24
Recycle Valve	DRO02	DRO02	DRO02	DRO02	DRO02
Pump Throttle valve	GLV10	GLV10	GLV10	GLV10	GLV10
Height (inch / cm)	53 / 135	53 / 135	53 / 135	53 / 135	53 / 135*
Length (inch / cm)	26 / 66	26 / 66	26 / 66	26 / 66	26 / 66*
Width (inch / cm)	20 / 50	20 / 50	20 / 50	20 / 50	20 / 66*
Weight (lbs / kg)	110 / 50	140 / 64	165 / 75	180 / 82	210 / 96*

* 60HZ unit

	EPRO-1500		EPRO-3000		EPRO-4500		EPRO-6000		EPRO-8000	
	60HZ	50HZ	60HZ	50HZ	60HZ	50HZ	60HZ	50HZ	60HZ	50HZ
Centrif. Pump SS/1 ph	DPM14	DPM05	DPM14	DPM05	DPM16	DPM04	DPM16	DPM04	DPM120	DPM600
Motor HP	1.0	1.0	1.0	1.0	1.5	1.5	1.5	1.5	3.0	3.0
Centrif. Pump SS/3 ph	DPM52	DPM122	DPM52	DPM122	DPM150	DPM11	DPM150	DPM11	DPM150	DPM600
Motor HP	1.5	1.0	1.5	1.0	3	1.5	3	1.5	3.0	3.0

System Requirements & Operation Guidelines

PLUMBING

The membranes and high-pressure pumps used on the EPRO systems require a continuous and non-turbulent flow of water to the unit. Minimum feed pressure is 20 PSI. See the tables on pages 6 - 7 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.

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 113° F (45° C).

ELECTRICAL

All motors on the EPRO-150 through the 1200 are single-phase, open drip type. The standard motors are 60 and 50 Hz. The voltage will be either 115VAC or 230VAC for the 60 motors, or 220VAC for the 50 Hz motors.

The motors on the EPRO-1500 through the 8000 are pump/motor combinations. They are available single-phase: 115VAC or 230VAC at 60 Hz or 220VAC at 50 Hz. The three

phases are available in 230-460VAC at 60Hz or 220-380VAC at 50 Hz.

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 the EPRO-4500, the EPRO-8000 and all three-phase units, is equipped with a 10 foot electrical cord. Typical 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 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 pumps supplied with EPRO-150 to 1200 systems are positive displacement, rotary vane type. The pumps supplied with the EPRO-1500 to 8000 are multi-stage, centrifugal pumps.

Follow these guidelines for proper operation of both pumps:

- ◀ The pump must NEVER be run dry. Operating the pump without sufficient feed water will damage the pump.
- ◀ ALWAYS feed the pump with filtered water. The rotary vane type pump is especially susceptible to damage from sediment and debris.

Feed Water Requirements

Nothing has a greater effect on a Reverse Osmosis System than the feed water quality. For lasting performance it is important to supply the reverse osmosis system with the feed water quality shown below on

Table 3. It is also important to feed the system the required amount of feed water, shown on Table 1 on page 6, and Table 2 on page 7.

Table 3: 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		

Note: The EPRO Tap Water Systems' projected output is based on feed water with a TDS of 500 ppm or less at 77°F. Higher TDS and/or lower temperature will reduce system production.

Note: It is very important to meet feed water requirements. Failure to do so will cause membranes to foul and void the warranty.

Start-Up

Unless otherwise indicated, these instructions cover the basic EPRO-150 to 8000 systems as well as the “P”, the “XP”, the “A”, and the “WM” series. When following instructions please refer to the appropriate pictures and diagrams depicting your EPRO system.

- ◀ The Diagram of the EPRO-150 to 1200 is FIG. 3 on page 16.
 - ◀ The Diagram of the EPRO-1500 to 8000 is FIG. 4 on page 17.
 - ◀ The Diagram of the “XP” Series is FIG. 5 on page 20.
 - ◀ The picture of the “A” Series is FIG. 6 on page 21.
 - ◀ The picture of the “P” Series is FIG. 7 on page 21.
 - ◀ The picture of the “WM” Series is FIG. 8 on page 22.
- The Picture of the “XP” Series is FIG. 9 on page 22.

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 18 and 19.

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

The following hoses are shipped loose to assist in installation:

- ◀ A 10’ clear braided inlet hose.
- ◀ A 10’ poly tube permeate hose.
- ◀ A 10’ poly tube concentrate hose.

START-UP

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

1. Locate the 5-micron pre-filter housing (FIG. 4 or pointer 1 on the picture or diagram of your EPRO system). Unscrew the filter housing. If necessary, use a spanner wrench (not provided).

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 with the package. 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 (pointer 2 on the drawing or picture of your system).
7. Attach the provided inlet hose to the feed water inlet, or permanently plumb the feed water piping or tubing to the inlet.

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

8. Locate the permeate outlet. (Pointer 3 on the picture or diagram of your EPRO system)
9. Attach the permeate hose 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.

Backpressure can cause damage to the membrane.

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 of 6.5 or lower can be very aggressive to some plumbing materials, such as copper piping.

10. Locate the concentrate (waste) outlet (pointer 4 on the picture or diagram of your EPRO system). 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 pointer 4 on FIG. 3 and 4).

11. Attach, the clear drain hose 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.

Make sure that NO backpressure exists on the concentrate line.

13. Ensure that the electrical power requirements of the EPRO system match your electrical power supply.

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 switch in a storage tank. The liquid level switch 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 electrical control box, the level control is connected to the level control connections in the control box (see electrical diagrams provided). 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.

DO NOT exceed the level control's power rating.

Liquid level switches can be obtained from Crane Environmental or a plumbing supplier. A liquid level switch is standard with the "XP" system.

If a liquid level switch 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 three to five minutes with the concentrate control valve fully open 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. Turn the concentrate control valve until the

concentrate pressure gauge indicates a pressure of 50 psi. Flush the machine at 50 psi for one (1) hour to remove the preservative from the system. Check for leaks. All Crane Environmental reverse osmosis systems are fully tested prior to shipment, but leaks may occur due to shipping.

16. **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.

17. Locate the concentrate control valve (Pointer 5 on Fig. 3 and 4) and the concentrate pressure gauge (Pointer 6 on Fig. 3 and 4).

18. Turn the concentrate control valve until the designated permeate flow is acquired. For example an EPRO-150 should be adjusted until it produces about 150 GPD or 0.10 GPM of permeate flow. The concentrate pressure will increase as the concentrate control valve is closed. The exact operating pressure may vary depending on the temperature and 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.

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

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

NOTE: The EPRO 1500-8000 Reverse Osmosis Systems are equipped with a pump discharge throttle valve. This valve is used to adjust the Reverse Osmosis system to the desired recovery. For information about the pump throttle valve, refer to page 25.

Feed water enters the system through an automatic shut-off valve. Ensure that the valve opens when the system turns on, allowing water flow through the system, and 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 4: Operation Log on page 15 with your Start-Up data and return to Crane Environmental 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.

Table 4: 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 (°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 CaCO ₃)					
TURBIDITY (NTU)					

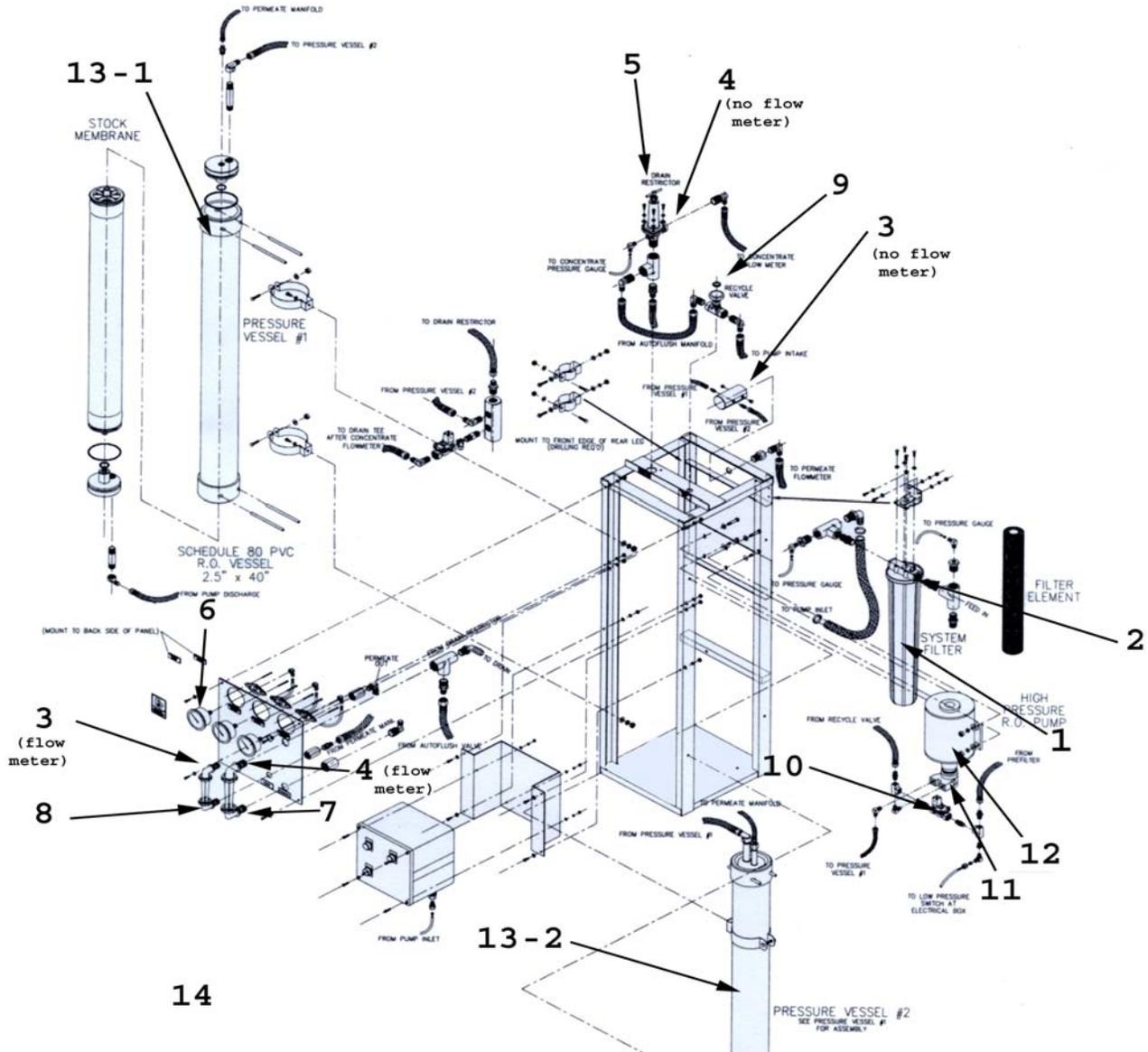


FIG. 3: EPRO-150 to 1200 Diagram

- | | |
|-------------------------------|---|
| 1. PRE-FILTER HOUSING | 8.* PERMEATE FLOW METER |
| 2. FEED WATER INLET | 9.* WASTE RECYCLE VALVE |
| 3. PERMEATE OUTLET | 10. INLET SOLENOID VALVE |
| 4. CONCENTRATE OUTLET | 11. PUMP |
| 5. CONCENTRATE CONTROL VALVE | 12. MOTOR |
| 6. CONCENTRATE PRESSURE VALVE | 13. PRESSURE VESSEL (SEE BELOW) |
| 7.* CONCENTRATE FLOW METER | 14.* CONTROL BOX (LOW PRESSURE
OPTIONS / FLOAT SWITCH) |

* INDICATES THAT THE ITEM IS OPTIONAL.

NOTE: THE SIZE AND NUMBER OF THE PRESSURE VESSELS VARIES ACCORDING TO EPRO MODEL.

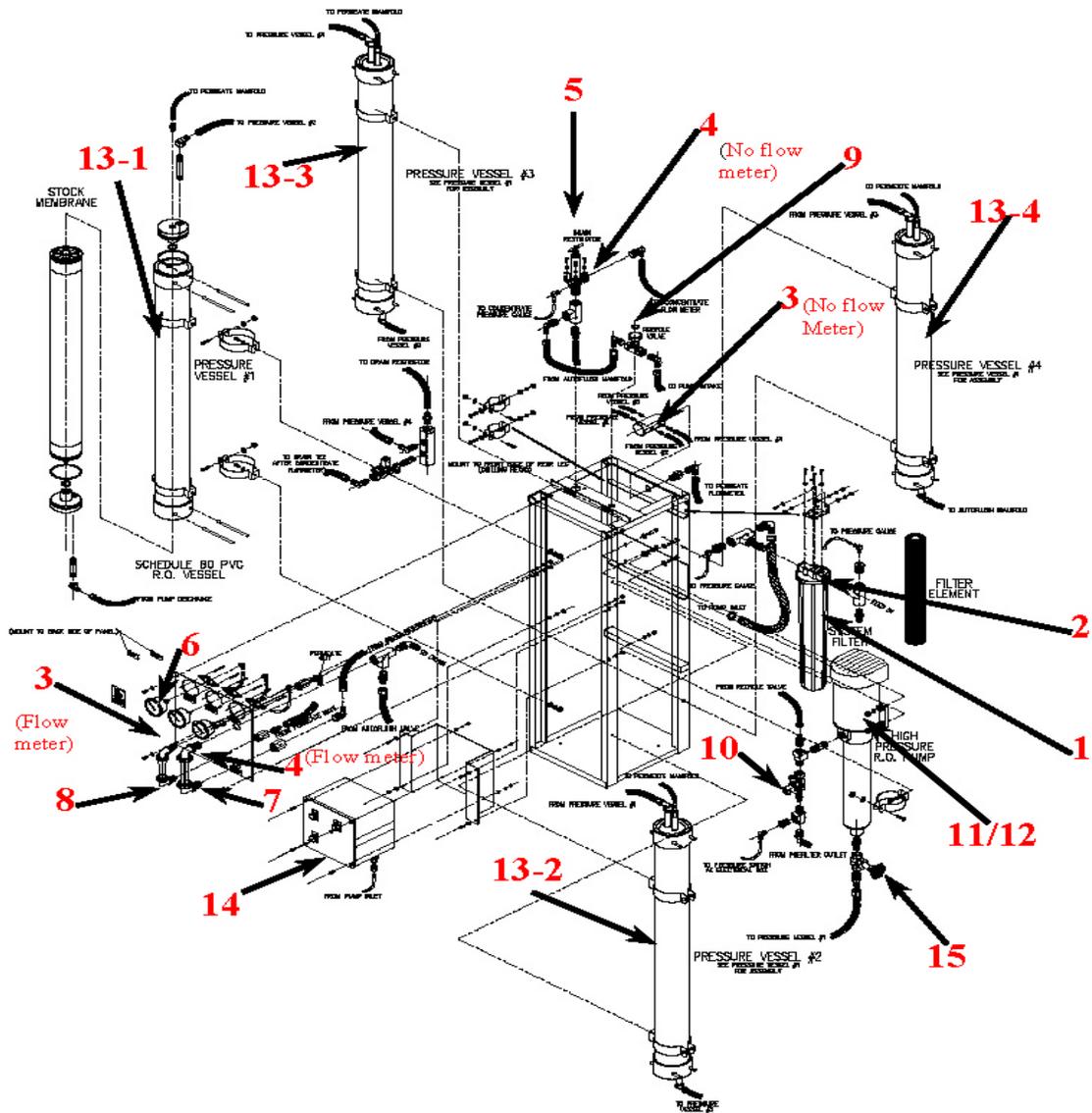


FIG. 4: EPRO-1500 to 8000 Diagram

- | | |
|--------------------------------|---|
| 1. PRE-FILTER HOUSING | 8.* PERMEATE FLOW METER |
| 2. FEED WATER INLET | 9.* WASTE RECYCLE VALVE |
| 3. PERMEATE OUTLET | 10. INLET SOLENOID VALVE |
| 4. CONCENTRATE OUTLET | 11. PUMP |
| 5. CONCENTRATE CONTROL VALVE | 12. MOTOR |
| 6. CONCENTRATE PPRESSURE VALVE | 13. PRESSURE VESSEL (SEE BELOW) |
| 7.* CONCENTRATE FLOW METER | 14.* CONTROL BOX (LOW PRESSURE
OPTIONS / FLOAT SWITCH) |

* INDICATES THAT THE ITEM IS OPTIONAL.

NOTE: THE SIZE AND NUMBER OF THE PRESSURE VESSELES VARIES ACCORDING TO EPRO MODEL.

Additional Instructions for “XP” Installation

“XP” SYSTEM COMPONENT CHECKLIST:

- 1) RO system
- 2) Atmospheric Tank
- 3) Re-pressurization System
- 4) Suction Tube Assembly
- 5) Liquid Level Control (Float Switch)

1. Storage Tank Preparation:

Plumb the RO permeate line to the storage tank. A white nylon compression fitting is supplied with the permeate line. Fasten this fitting to the storage tank in the hole in top of the tank by:

- (a) Removing the compression fitting and hex nut from one side,
- (b) Sliding the threads through the hole in the tank, and
- (c) Reattaching and tightening the hex nut from inside the tank.

Attach the permeate line to the compression fitting on the RO machine. Attach the other end of the permeate line to the newly installed compression fitting on the storage tank.

2. Connect the atmospheric storage tank to the re-pressurization system:

Use the suction tube assembly supplied. Some connections on the suction tube assembly are not glued to facilitate assembly. Remove the male adaptor that is near the ball valve on the suction tube assembly. 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 re-pressurization system to the point of use:

This will be from the cross fitting on the bottom of the pressure tank piping.

4a. Level Control (Solo Float, standard):

The cord from the solo float must be secured inside the storage tank at a pivot point between the desired high and low level. Adjust the differential between high or low level by changing the length of the cord between the pivot and float. Adjust the high and low levels by moving the pivot point up or down.

4b. Level Control (Ball and Rod, optional on XP system):

Mount the level control onto the storage tank through diagonal holes using the attached stainless steel fasteners. Remove the setscrew from the brass collar on the float switch shaft. Make a single vertical slit in the 1” diameter float arm screen. From the inside of the tank, slip the float arm through the slit then attach the float arm to the brass collar. Slide the brass collar onto the shaft of the float switch and tighten securely using the float rod as the setscrew.

Attach the float ball to the unattached end of the float arm. Adjust the float arm so that the top of the float ball doesn't rise above the lowest point of the bottom of the switch. Refer to Figure 5.

5. Electrical Connection:

Make sure water is available to the reverse osmosis system before making this connection because this will start the RO machine. Insert the EPRO system male plug into the float switch female connector. Insert the float switch male plug to a power source. This will start the RO system when the float switch is in the down position.

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

6. Re-pressurization 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:

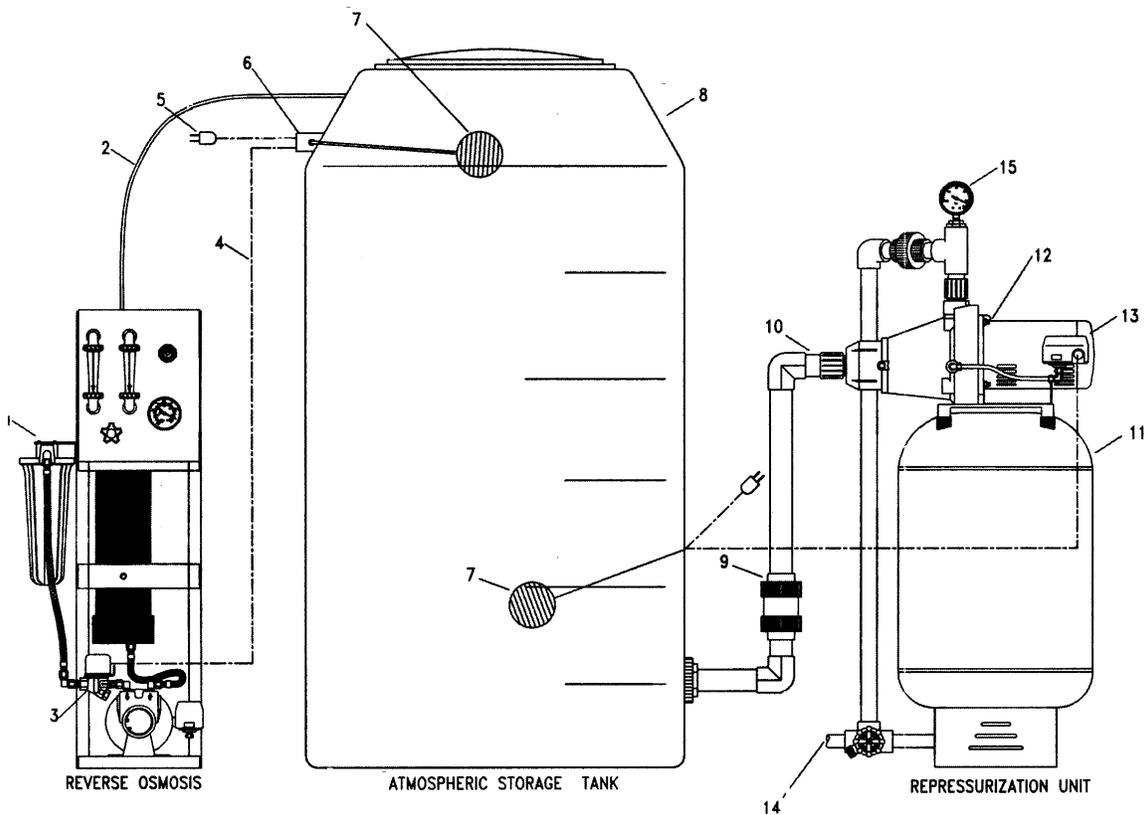
Operating Pressure Range	20-40 PSI	30-50 PSI
Bladder Tank Pre-charge	18 PSI	28 PSI

7. Priming:

After the 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 in the fitting. Move the lever on the side of the pressure switch to the "START" position. Open the drain valve slightly to allow air to escape during start up. This is located at the bottom of the pressure tank. Close after start up. After the unit is primed, and the unit begins to pump, hold the lever on "START" until pressure reaches 30 psi. Operation from this point on is automatic. If the pump doesn't 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.

Connect the re-pressurization pump power plug to a power source.

Fig. 5: EPRO "XP" System



- | | |
|--|---|
| <ul style="list-style-type: none"> 1. RO INLET 2. PERMEATE LINE 3. INLET SOLENOID & VALVE 4. LEAD from RO MOTOR OR CONTROL BOX TO FLOAT SWITCH 5. LEAD to ELECTRIC POWER SOURCE 6. FLOAT SWITCH 7. FLOAT BALL (2) | <ul style="list-style-type: none"> 8. ATMOSPHERIC STORAGE TANK 9. CHECK VALVE 10. SUCTION LINE 11. PRESSURE SWITCH 12. PUMP & MOTOR 13. PRESSURE SWITCH 14. POINT OF USE 15. PRESSURE GAUGE |
|--|---|

Fig. 6: EPRO “A” Series



Fig. 7: EPRO “P” Series



Fig. 8: EPRO “WM” Series



Fig. 9: 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 Crane Environmental service representative for pre-treatment recommendations.

OPERATION OF OPTIONAL FEATURES

◀ Prefilter 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 (pointer 8 on FIG. 3 and 4) and Waste Water (Concentrate) Flow Meter (pointer 7 on FIG. 3 and 4):

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 (pointer 9 on FIG. 3 and 4):

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.

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

◀ Low Pressure Reverse Action Switch (normally offered on the EPRO-150 to 1200):

The reverse action switch shuts off the EPRO system when the feed water pressure drops too low for the system to function properly. This 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.

◀ Low Pressure Shut-Off Control Box (normally offered on the EPRO-1500 to 8000):

This option consists of an electrical control box with a low-pressure protection circuit, level control connections, pre-treat lockout connections, and an on/off switch. The low-pressure shut-off switch can

be ordered with manual or automatic reset.

◀ **Automatic Fast Flush:**

The automatic fast flush option bypasses the concentrate control valve, reducing the concentrate pressure and increasing the flow of feed water across the membrane. The fast flush removes foulants that may have attached to the surface of the membrane. By removing these foulants before they crystallize on the surface of the membrane, the system can operate longer without cleaning and/or replacing membranes. Crane Environmental recommends the use of the automatic fast flush in several instances:

1. When injecting antiscalant chemicals. These chemicals keep scaling ions in solution up to a higher concentration so the ions don't 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 automatic fast flush, pre-treat the water with an antiscalant or a softener. Do not use the automatic fast flush instead of pretreatment.
3. Where minimal maintenance is important, an auto flush can increase the time between membrane cleaning.

4. For high TDS (total dissolved solids) applications where the TDS exceeds 500 ppm, consider installing an auto 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, a fast flush should be installed. The automatic fast flush will not operate if the electrical power is removed from the system.

The auto flush option includes a timer with two adjustable settings that regulate its operation. One timer setting allows you to set the interval between flushing, and the other timer setting allows you to set the length of the flush time. The timer is preset at the factory to initiate a 5-minute flush every 10 hours. This is based on the time the system has electrical power applied.

In the fast flush conditions the water flushes across the membrane in the same direction as water flows in normal operation; this is not a "backwash" flow.

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

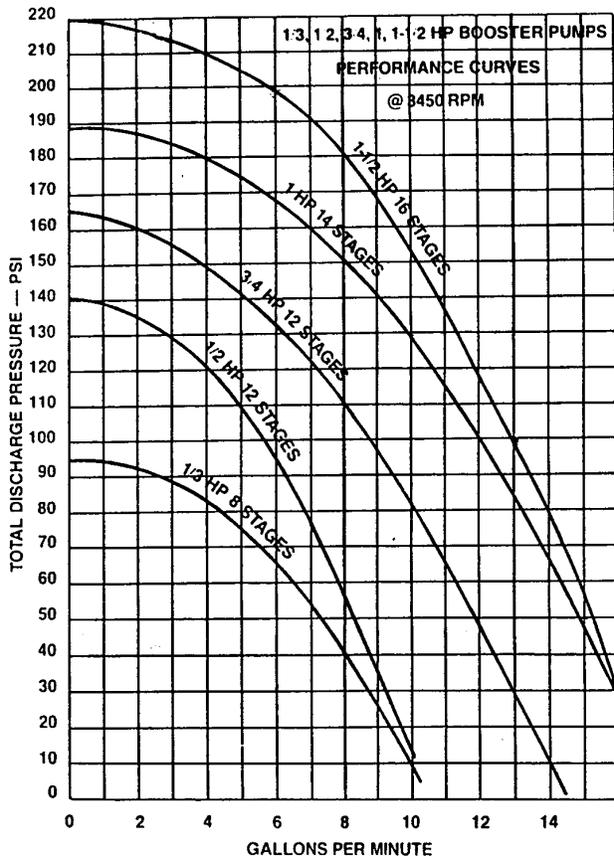
Pump Throttle Valve (pointer 15 on Fig. 4)

This valve is installed as a standard feature on all EPRO – 1500 through EPRO – 8000 reverse osmosis systems. It provides an adjustment for pump flow, which will vary as the required system 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.

Example:

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 10: Pump Curves



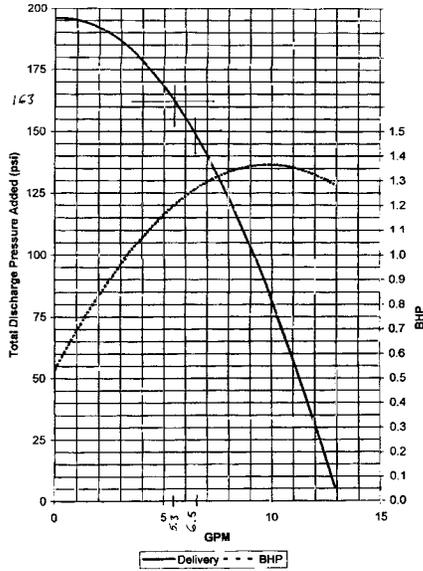
As the feed water temperature decreases, and/or the feed water TDS increases, the system will require a higher operating pressure to produce the specified permeate flow. An EPRO-1500 installed in Florida may provide the specified permeate flow of 1 gpm at 130 psi; however, the same EPRO-1500 installed in Maine – much colder feed water – may require 190psi 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.

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

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

EPRO 1500 – 3000 50 HZ

PRESSURE BOOSTER PUMP
PB1022Y101

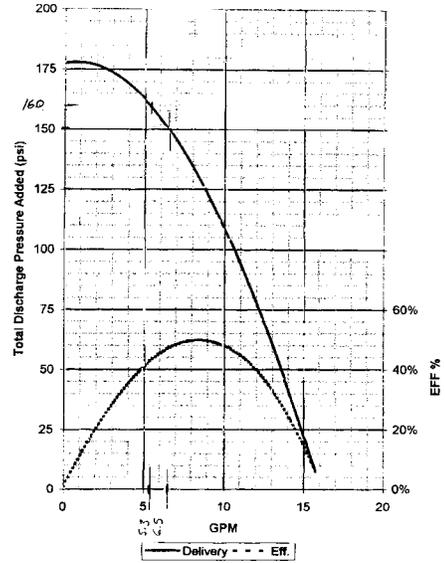


Typical performance. Not guaranteed as minimum performance.

RBC 6/5/01

EPRO 1500 – 3000 60 HZ

PRESSURE BOOSTER PUMP
PB1014S101

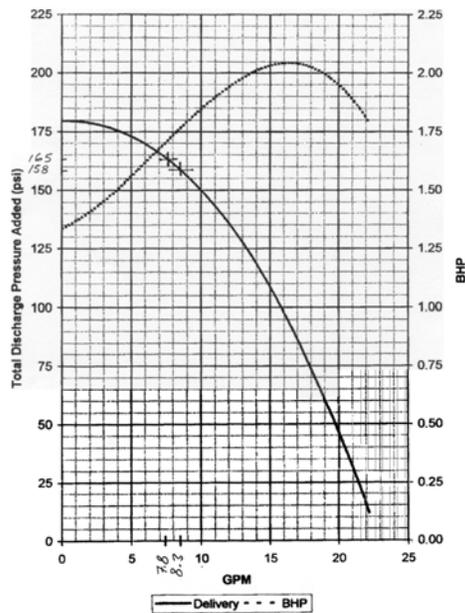


Typical performance. Not guaranteed as minimum performance.

RBC 6/4/01

EPRO 4500 – 6000 50 HZ

PRESSURE BOOSTER PUMP
PB1920Y153

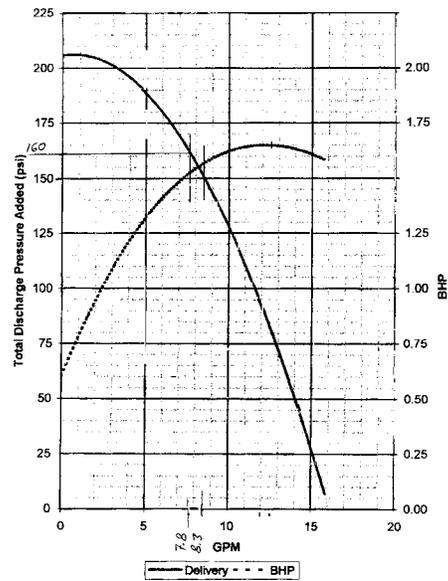


Typical performance. Not guaranteed as minimum performance.

RBC 6/4/01

EPRO 4500 – 6000 60 HZ

PRESSURE BOOSTER PUMP
PB1016S151



Typical performance. Not guaranteed as minimum performance.

RBC 6/4/01

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.

Crane Environmental 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):

- ◀ Crane Environmental Cleaning Solution #3 (1 lb. per 15 gal. of RO water).
- ◀ 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 ($\text{NH}_2\text{SO}_3\text{H}$), or
- ◀ A solution of 1.0% sodium hydrosulfite ($\text{Na}_2\text{S}_2\text{O}_4$)

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):

- ◀ Crane Environmental Cleaning Solution #2 (8 oz. for every 15 gallons of RO water).

- ◀ A solution of 0.1% sodium hydroxide (NaOH) and 0.1% of tetra-sodium salt of ethylene diamine 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 amount and TDS of the permeate with the system set at normal operating pressure.
2. Prepare about 15 gallons of the inorganic cleaning solution (approx. a pH of 2 - 3) in a polypropylene or fiberglass reinforced plastic tank with a removable cover. Use RO water if possible.

3. Connect a hose from the cleaning solution tank to the inlet of the pre-filter (pointer 2 on FIG. 3 and 4) from the cleaning solution tank. Ensure a flooded inlet to the pump or positive feed pressure.
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. Adjust the concentrate control valve (drain restrictor) (pointer 5 on FIG. 3 and 4) to a concentrate pressure of 50 psi. Run the pump for about 30 minutes or longer.
6. Turn the machine off and reconnect to the feed water supply.
7. Turn the machine on and flush at 50 psi for 15 minutes or longer. Discard all of the permeate and concentrate water.
8. Adjust the system to normal operating pressure and record the amount and TDS of the permeate water after the acid cleaning to assess any improvements in the system's performance.
9. Repeat this procedure for the organic cleaning solution (with a pH from 11 to 12).
10. Readjust the concentrate pressure to original operating pressure for normal operation. After the cleaning procedure is complete, check the amount and TDS of the permeate to evaluate the effectiveness of the cleaning process.

MEMBRANE REMOVAL AND REPLACEMENT

Changing membranes in pressure vessels is easy with the proper tools. The pressure vessel may have to be removed from the system. Please refer to Figure 11 and 12 on page 30 when following these instructions:

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: Most fiberglass pressure vessels use a snap ring to hold the plug in place. Use properly sized snap ring pliers to safely remove the snap ring.
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 30 for examples of these tools). Remove any fittings used to extract the end plugs.
5. Remove the membrane from the pressure vessel, noting which side 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 on the feed side of your membrane.

Do not pull the membrane out using the permeate port 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 plug and O-rings with a food grade 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 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.

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. 11: Membrane Removal Tools

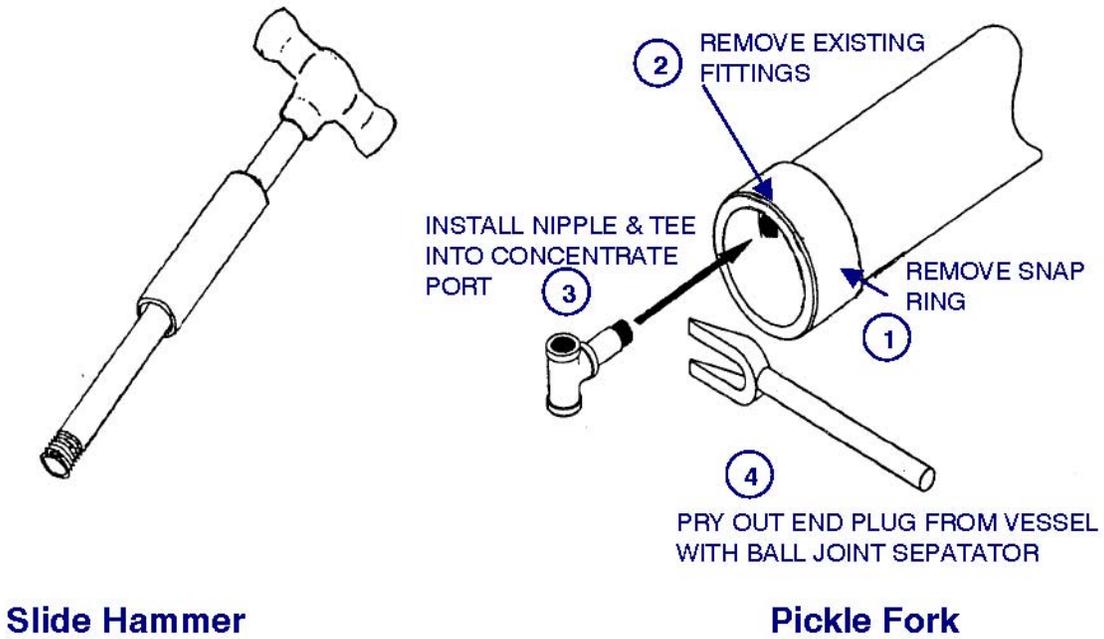
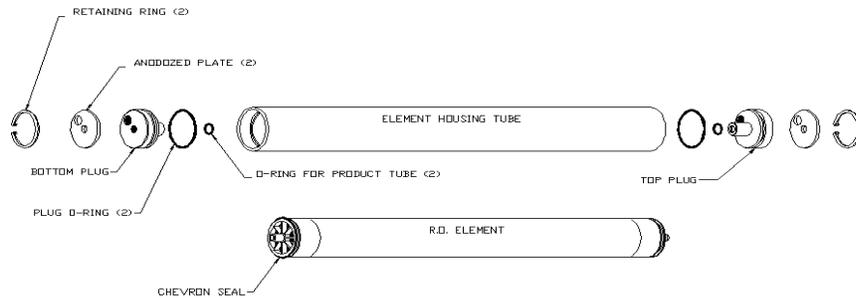


Fig. 12: Pressure Vessel Housing & Membrane



Are Carbon Fines Fouling Your Membrane?

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 acid, either citric or muratic. In addition to these items, you will need a pH test kit and a new prefilter.

1. Close feed water supply line to RO. Close the RO recycle valve if equipped.
 2. Release pressure from prefilter 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 prefilter sediment bowl, discard the used prefilter and clean the inside of the bowl.
 6. Install a new prefilter 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 and then attach the housing bowl back on to the inlet/outlet head.
 8. Open feed water supply line to the RO slowly and push the red button on top of the prefilter 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 psig 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 psig. 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.

Note: If the RO membrane(s) are producing proper flow and % Rejection, the Recycle valve (if so equipped) may be opened to increase % Recovery.

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 controller valve head per 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 per 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 controller unit per 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, per 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 ARE COMPLETE.

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 CONTINUES TO DISCHARGE TO THE DRAIN DURING BACKWASH—STOP!

- (1) The backwash flow controller orifice maybe installed incorrectly;
- (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 – 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.

Perform a Chlorine test before the Carbon filter and record the PPM level of Chlorine residual.

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

11. If Chlorine is still present, check the installation of the controller 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. Possible Chlorine level is too high rated 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.

Troubleshooting

If the system production declines or the unit stops working, check the mechanical components for any visual problems. Listed below are the items to check for two of the most commonly encountered problem conditions: **LOW SYSTEM PRESSURE** and **ABNORMAL PERMEATE FLOW**. Also refer to the RO troubleshooting matrix on page 37.

LOW SYSTEM PRESSURE

Low system pressure occurs when sufficient feed water pressure and flow are not obtained. This causes the high-pressure RO pump to cavitate. Failure to provide the proper feed will result in lower system pressure that may result in low production and poor rejection. Check the following components:

1. PUMP:

Isolate the pump and determine how much pressure can be achieved. This can be determined by checking the pump discharge pressure gauge at this point. If the system is not equipped with this gauge, disconnect the hose that runs from the pump to the pressure vessel. Install a pressure gauge. The pressure of the pump must reach at least 190 psi when the flow is restricted.

2. PRE-FILTER:

Check the differential in the pre-filter 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. Replace, if necessary.

3. LOW FEED WATER FLOW RATE:

Determine that the unit is getting a sufficient volume of feed water. Disconnect the feed water hose from the machine and place it in a one-gallon bucket. Measure the time it takes to fill the bucket to determine the feed flow. (Feed flow is measured in gallons per minute, so divide 1 gallon by the time in minutes to obtain the flow rate).

Refer to the System Specifications (Table 1 on page 6, or Table 2 on pages 7) for the required feed flow.

4. INLET SOLENOID VALVE: (see pointer 15 on the diagram of your system):

Feed water enters the system through an automatic solenoid shut-off valve, which is normally closed. Ensure that the solenoid opens when the RO pump starts. The system can be operated without the solenoid for troubleshooting. Remove the solenoid to see if it is contributing to the problem. Normally, cleaning the solenoid diaphragm will correct any malfunction of the solenoid.

5. ELECTRIC:

Check to ensure that there are no electrical fuses blown and that all

electrical connections are secure. Use a voltmeter to verify that the motor is getting sufficient power. Refer to System Specifications (Table 1 On page 6 or table 2 on pages 7) for the power requirement of your motor.

6. PRESSURE GAUGE:

Check for foreign matter on the gauge fitting. Remove any visible matter and replace the fitting. Verify that the tube is not pushed too far inside the fitting. This could restrict flow and cause an inaccurate display. If the fitting and tube are fine and the pressure gauge is still malfunctioning, the gauge should be replaced.

7. CONCENTRATE CONTROL VALVE:

The concentrate control valve may have a tear in the diaphragm. Remove the valve, inspect the diaphragm, and replace if necessary.

8. MOTOR:

The motor may not be drawing the correct current. Use a clamp-on ammeter to check the current draw.

9. LEAKS:

Check the system for leaks, as this can result in low pressure.

ABNORMAL PERMEATE FLOW:

Permeate flow should be within 15% of the rated production, after

correcting for feed water temperatures above or below 77° F (see table 2). 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 then calculate the permeate flow rate at gallons per minute or gallons per day.

NOTE: To determine the temperature correction factor, go to page 38 and follow the directions.

Causes of Low Permeate Flow:

- 1) Cold Feed Water.
- 2) Low Operating Pressure.
- 3) Defective Membrane Brine Seal.
- 4) Fouled or scaled membrane.

Causes of High Permeate Flow:

- 1) Defective product tube O-rings.
- 2) Defective or oxidized membrane.

Causes of Poor Permeate Quality:

- 1) Low operating pressure.
- 2) Defective product tube O-rings.
- 3) Defective or oxidized membrane

TABLE 5: REVERSE OSMOSIS TROUBLESHOOTING

SYMPTOMS			LOCATION	POSSIBLE CAUSES	VERIFICATION	CORRECTIVE ACTION
Salt Passage	Permeate Flow	Pressure Drop				
NORMAL to INCREASED	DECREASED	NORMAL to INCREASED	PREDOMINATELY FIRST STAGE	METAL OXIDE FOULING	ANALYSIS OF METAL IONS IN CLEANING SOLUTION	IMPROVE PRETREATMENT TO REMOVE METALS. CLEAN WITH ACID CLEANERS.
NORMAL to INCREASED	DECREASED	INCREASED	PREDOMINATELY FIRST STAGE	COLLOIDAL FOULING	SDI MEASUREMENT OF FEED WATER	OPTIMIZE PRETREATMENT FOR COLLOID REMOVAL. CLEAN WITH HIGH pH ANIONIC CLEANERS.
INCREASED	DECREASED	INCREASED	PREDOMINATELY FIRST STAGE	SCALING (CaSO ₄ , CaSO ₃ , BaSO ₄ , SiO ₂)	ANALYSIS OF METAL IONS IN CLEANING SOLUTION CHECK LSI OF REJECT. CALCULATE MAX SOLUBILITY OF CaSO ₄ , BaSO ₄ , SiO ₂ IN REJECT.	INCREASE ACID ADDITION AND ANTISCALANT DOSEAGE FOR CaVO ₃ AND CaCO ₄ . REDUCE RECOVERY. CLEAN WITH ACID CLEANERS.
NORMAL to MODERATE INCREASE	DECREASED	NORMAL to MODERATE INCREASE	ANY STAGE	BIOLOGICAL FOULING	BACTERIA COUNT IN PERMEATE AND REJECT. SLIME IN PIPES AND PRESSURE VESSELS.	SHOCK DOSAGE OF SODIUM BISULFATE. CONTINUOUS FEED OF SODIUM BISULFATE AT REDUCED Ph. FORMALDEHYDE DISENFECTION. CHLORINATION AND DECHLORINATION. REPLACE CARTRIDGE FILTERS.
DECREASED or SLIGHTLY INCREASED	DECREASED	NORMAL	ANY STAGE	ORGANIC FOULING	DESTRUCTIVE TESTING	ACTIVATED CARBON OR OTHER PRETREATMENT. CLEAN WITH HIGH Ph CLEANER.
INCREASED	INCREASED	DECREASED	MOST SEVERE IN FIRST STAGE	CHLORINE OXIDATION	CHLORINE ANALYSIS OF FEED WATER. DESTRUCTIVE ELEMENT TEST.	CHECK CHLORINE FEED EQUIPMENT AND DECHLORINATION SYSTEM.
INCREASED	INCREASED	DECREASED	MOST SEVERE IN FIRST STAGE	ABRASION OF MEMBRANE BY CRYSTALLINE MATERIAL	MICROSCOPIC SOLIDS ANALYSIS OF FEED. DESTRUCTIVE ELEMENT TEST.	IMPROVE PRETREATMENT. CHECK ALL FILTERS FOR MEDIA LEAKAGE.
INCREASED	NORMAL to INCREASED	DECREASED	AT RANDOM	O-RING LEAKS, END or SIDE SEAL LEAKS	PROBE TEST. VACUUM TEST. COLLOIDAL MATERIAL TEST.	REPLACE O-RINGS. REPAIR OR REPLACE ELEMENTS.
INCREASED	NORMAL to LOW	DECREASED	AT RANDOM	RECOVERY TOO HIGH	CHECK FLOWS AND PRESSURES AGAINST DESIGN GUIDELINES.	REDUCE RECOVERY RATE. CALIBRATE AND/OR ADD SENSORS.

Temperature Correction Factors

CORRECTION FACTOR BY MEMBRANE MANUFACTURER

TEMPERATURE		FILMTEC	FLUID SYSTEMS TFCL	DESAL C.A.	DESAL N.F.	E.P. TRISEP HYDRANAUCS
°C	°F					
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

Technical Field Services

Complete product-line field-service support worldwide...

Technical Support

Cleaning System

Pretreatment System

PLC Programming

Trouble-Shooting

200 gpm Reverse Osmosis System

CRANE

CRANE ENVIRONMENTAL
PURE *Water* MADE SIMPLE™



THE ORIGINAL NAMES IN WATER TREATMENT

Customer Technical Services

Crane Environmental is continually expanding our service capabilities to provide our customers with the assistance that is needed and therefore, we have added outside field service engineers (FSE) in addition to our in-house customer call center service technicians. Our highly trained team of professionals assure system performance by providing the highest level of customer service support throughout the life of your equipment. This level of service availability continues to separate Crane Environmental from the competition.

ON-SITE FIELD SERVICES

Service of equipment or related systems:

- Inspections/Evaluations
- Repair Assistance
- Trouble-shooting
- Installation Supervision
- Start-up Assistance
- Operator Training
- Maintenance Agreements
- Technical Support

SYSTEMS SERVICED INCLUDE

- Aerators
- Chemical Feeders
- Deaerators
- Dealkalizer
- Degasifier
- Demineralizer
- Filters: Carbon, Iron, Media
- Softeners
- Reverse Osmosis

CALL-IN TECHNICAL SERVICES

- Situation Analysis
- Trouble-shooting
- Operator Assistance
- Repair Parts
- Technical Support

NEW! ONE YEAR SERVICE AGREEMENTS - PLANNED MAINTENANCE SERVICES (PMS)

One Year Service Agreement Includes:

- Discounted Service Rates
- Minimum of 4 Quarterly Scheduled Site Inspections
- Assigned Field Service Engineer (FSE)
- Operational Log Sheet Reviews via fax or email
- Emergency Technical Support - 24/7
- Trouble-shooting - phone support or field services
- Extended Operator Training
- Discount on Service Maintenance Parts

**Our service engineers do not perform the equipment installation involving piping, rigging, etc. However, we will provide a field service engineer to supervise or assist your personnel or contractor to install, modify or repair a system.*

PRICING

Please call a Service Technician for a competitive quote for your service needs. Special discount service rates are available with system orders.

Limited Warranty

Crane Environmental (C.E.) 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. This warranty applies only to the original purchaser. C.E.'s liability under this warranty shall be limited to repairing or replacing at C.E.'s option, without charge, F.O.B. C.E.'s factory, any product manufactured by C.E. Crane Environmental 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.

Products which are sold but not manufactured by C.E. are subject to the warranty provided by the manufacturer of said products and not by C.E.'s warranty. 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 Crane'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. No equipment shall be returned to Seller without Seller's prior written authorization. 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. Crane will determine the applicability of any such third-party warranties. C.E. 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 C.E.'s printed installation and operating instructions.

C.E. warrants its pumps and membrane elements for one year from ship date, providing that loss of performance was not caused by fouling or neglect. C.E. 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.

To obtain specific performance under this warranty, the defective product must be returned to C.E. together with proof of purchase, installation date, failure date, and supporting technical data. Any defective product to be returned to the factory or service center must be sent Freight Prepaid. Documentation supporting the warranty claim and a Returned Material Authorization (RMA) number must be included. Contact your C.E. sales engineer for details on obtaining an RMA number.

C.E. 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.

Services. Any services Crane 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, Crane will, for a period of 1 year from the date of completion, 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 Crane's warranty obligations with respect to services exceed 100% of the total cost of services provided hereunder.

Warranty Periods. Every claim by Buyer alleging a defect in the goods and/or services provided hereunder shall be deemed waived unless such claim is made in writing within the applicable warranty periods as set forth above. Provided, however, that if the defect complained of is latent and not discoverable within the above warranty periods, every claim arising on account of such latent defect shall be deemed waived unless it is made in writing within a reasonable time after such latent defect is or should have been discovered by Buyer.

Limitations / Exclusions. The warranties herein shall not apply to, and Crane 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 Crane to maintain or service the equipment. Crane 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 Crane'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. Components and materials of the type that need periodic replacement due to normal wear and tear, such as membranes, electrodes, frames, gaskets, filters, pump seals, spray nozzles, trays and fuses, are warranted against defects only as of the shipment date, unless expressly stated otherwise. 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.

Terms & 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. Crane 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 shipment. Minimum billing amount is \$100. Shipments outside of the U.S.A. shall be prepaid (by credit card, wire transfer, or U.S. cashiers 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: Crane Environmental, Lockbox 21092, 525 W. Monroe St., 8th Floor Mail Room, Chicago, Illinois 60661, (b) If by wire transfer: First Chicago NBD, Chicago, Illinois, Bank Routing Number: 071000013 (Domestic), Foreign Swift Address: FNBCUS44, for credit to: Crane Environmental, Account Number: 51-37950. Wire transfers should be initiated with all bank charges paid from the account of the applicant. Crane reserves the right to specify the method and/or timing of payment (including prior to shipment) if Crane, in good faith, believes that the prospect of payment by Buyer has been impaired. Crane 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 Crane 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 Crane; (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 Crane 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 (1990); and (c) title and risk of loss shall pass to Buyer upon Crane's delivery of the goods to the carrier unless otherwise specified. Crane 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 Crane 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 Crane 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 Crane 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 Crane's involvement in the installation, start-up, check-out and/or commissioning of any Crane 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 Crane 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 Crane 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 Crane'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 Crane's proposal. Crane shall retain all proprietary rights in any and all technical data, designs, or other information developed by Crane (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 Crane 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, Crane 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 Crane.

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 Crane in the manufacture and supply of its products and systems are confidential and proprietary to Crane. 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 Crane in connection with the supply or installation of products or systems hereunder, and will, at a minimum, protect any such Confidential Information in a manner commensurate with the measures taken to protect Buyer's own confidential or proprietary information. Crane 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 Crane in writing.

12. INTELLECTUAL PROPERTY RIGHTS. Crane 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. Crane 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 Crane hereunder. Provided, however, that Crane's indemnity obligation hereunder shall not apply to, and Crane shall not be responsible for, any claims to the extent arising out of Buyer's modification of Crane's equipment, services or information, or use of such equipment, services or information: (a) in combination with equipment, services or information not supplied by Crane, or (b) in the operation of any process or in any other manner inconsistent with the purpose for which Crane'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. Crane 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. Crane shall promptly discharge any such liens arising out of its performance hereunder.

15. COMPLIANCE WITH LAWS. In providing the goods and/or services hereunder, Crane 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 Crane.

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 Crane is to supply goods and/or services hereunder, is suspended by Buyer, for any reason other than a breach by Crane, Crane 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, Crane shall be entitled to terminate that order, without any further liability or obligation thereunder. Provided, further, that Crane 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 Crane against loss. If any project or order, for which Crane is to supply goods and/or services hereunder, is terminated iaw the provisions of these terms and conditions, Crane 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 Crane 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 Crane'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 Crane's error. To obtain specific performance under this warranty, the defective product must be returned to Crane 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 Crane 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 Crane shipped the order in error; (d) Return of products not manufactured by Crane will be subject to the original manufacturer's return to stock policy; (e) Crane will not accept C.O.D. return shipments; (f) A return authorization will become null and void if equipment is not received by Crane 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. Crane will not be responsible for any claimed shortages not reported within 10 days.

OPTIONAL ELECTRICAL CONTROL BOXES
CRANE ENVIRONMENTAL CONTROLLER CE1 6/26/02
(110-120V 1PH)

SPEPCIFICATIONS

Controller:

UL/CUL listed Industrial Panel

Enclosure:

8 x 6 x 4 NEMA 4X

Power:

120/240VAC 50/60Hz 6 Watts

Environment:

-22F(-30C) to 140F (60C), 0-95% RH, non-condensing

Inputs:

Low Pressure – Closed to run

Pretreat – Closed to run

Tank Full High – Closed to run

Tank Full Low – Closed to run

Outputs:

RO pump – 120V/1HP, 240V/3HP

Inlet Solenoid – 120/240V, 5A

Flush Solenoid – 120/240V, 5A

Cables:

Power – 120V/8', 12AWG, SJT w/15A plug, 240V/8', 12AWG, SJT w/20A plug

RO PUMP – 4', 12AWG, SJTw/#8 fork terminals

Inlet Solenoid – 4', 18AWG, SJT w/attached solenoid connector

Flush Solenoid – 4', 18AWG, SJT w/attached solenoid connector

Time Delays:

RO Start – 8 seconds

Tank Full – 5 seconds

Tank Full Restart – 2 seconds

Low Pressure – 4 seconds

Pretreat – 4 seconds

Auto Reset – 15 minutes

Flush Interval – 10 hours, elapsed time

Flush Time – 5 minutes

Installation / Wiring

The controller is shipped from the factory preset for either 120VAC or 240VAC operation with cables for power, RO pump motor and inlet solenoid installed. If the unit is equipped with flush, a flush solenoid cable is also installed. For units shipped as 120VAC, 1 fuse for the electronics is installed in position F1. Jumper J10 is installed to bypass fuse F2. For 240VAC operation, L1 is the hot leg and L2 is neutral. For 240VAC operation, both L1 and L2 are hot legs.

Power/Output Wiring:

Verify that the controller is jumpered correctly for the operating voltage. The voltage jumpers are located in the lower left corner of the board. For 240VAC operation, 1 jumper is installed between J5 and J6. For 120VAC operation, 1 jumper is installed between J4 and J6. For 120VAC operation, 1 jumper is installed between J4 and J6 and a

second jumper is installed between J3 and J5. NOTE: The pump and solenoid outputs will be the same voltage as the controller. Connect the pump and solenoid cables to the end devices.

Input Wiring:

Connect the low pressure, pretreat and level switches to the corresponding terminals of P2. The unit is configured for normally closed inputs. All inputs must be closed for the controller to run. If any input is unused, a jumper wire must be installed for that input before the unit will run.

NOTE: If only 1 tank level switch is used, it must be connected to the Tank Full High input, and the Tank Full Low input **MUST** be jumpered. **CAUTION:** These inputs are for dry contact switches only. Applying voltage to these inputs will damage the controller.

Operation

The controller has a two position power switch to control the operating mode of the controller. When the switch is in the left position, the controller is off and all outputs will be turned off. If the switch is moved to the right position, the controller is in the automatic mode. In this mode, the controller operation is automatic and is controlled by the input signals.

Auto Mode:

When the switch is placed in the auto position, the inlet solenoid will operate and the controller will monitor the low-pressure switch. The RO pump will start after the RO start delay if no shutdown condition is present.

Low Pressure:

If a low-pressure condition occurs and the low-pressure switch input opens for the low-pressure delay time, the controller will shut down for a low-pressure fault. The red Low Pressure lamp will light. If the auto-reset jumper is in the off position, the controller will remain in low pressure shut down until reset. Placing the power switch in the off position for several seconds and then returning it to the auto position reset the controller

Auto Reset:

If the auto reset jumper is in the on position when a low pressure shut down occurs, the unit will attempt to restart after the auto reset delay, (this should be approximately 15 minutes). If the low-pressure condition has cleared, the unit will continue to run. Otherwise, the unit will again shut down and the auto restart will continue as long as the low-pressure condition is active.

Pretreat:

If the pretreat lockout switch opens for the pretreat delay time, the unit will shut down for a pretreat condition. The amber Pretreat lamp will light. The unit will remain shut down until the pretreat switch closes. The unit will then restart.

Tank Full:

The controller is designed to operate with either 1 or 2 tank level switches. When a tank full condition occurs, the unit will shut down and the amber Tank Full lamp will light. When the tank full condition clears, the unit will restart after the tank full restart delay.

If the unit is operated with only 1 level switch, the Tank Full Low input must remain jumpered. In this mode, when the tank full high switch opens for the tank full delay time the unit

will shut down. When the tank full condition clears, the unit will restart.

If the unit is operated with 2 level switches, the controller will run when both switches are closed. When the water level rises and the tank full low switch opens, the unit will continue to run. When the water level rises and the tank full high switch opens, after the tank full delay, the unit will shut down for tank full. As the tank level drops and the tank full low switch closes, the unit will restart.

Flush:

If the flush option is installed, the unit will enter a flush mode every 10

hours. This flush will occur whether the unit is running or not. When the flush occurs, the inlet and flush solenoids will open and the RO pump will start. The amber Flush lamp will light. The flush will last for 5 minutes.

NOTE: A low pressure or pretreat condition will cancel the flush operation. Also note that if a unit is shutdown for long periods of time due to a tank full condition, there is the possibility of tank overflow because of permeate water produced during flush.

Troubleshooting

The controller has LED indicator lamps that facilitate isolating a problem to the controller or to an external device. There are 4 green LED=s, DS5-DS8, located next to the input terminal stop P2. When an LED is on, this indicates that the corresponding switch input is closed. When all 4 inputs have closed switches, all 4 green LED's should be on and the RO should be operating.

NOTE: The inputs on the controller are configured to operate with switches that are closed to run. For the controller to operate, ALL switch inputs must be closed. IF any of the inputs are not used, a wire jumper must be installed across the 2 terminals for that input or the unit **WILL NOT** operate.

There are 3 LED>s, DS9-DS11, located close to the corresponding relay. When an LED is on, this indicates the corresponding relay is activated and the proper voltage should be output at the terminals on P1 for the relay. The following table lists the LED and corresponding input or output:

LED	INPUT / OUTPUT
DS5	Tank Full Low Input
DS6	Tank Full High Input
DS7	Pretreat Input
DS8	Low Pressure Input
DS9	RO Pump Output
DS10	Inlet Solenoid Output
DS11	Flush Solenoid Output

Controller Has No Power:

Verify that the voltage jumpers J3-J6 are in the correct position for the supplied power. Verify that the correct power is being applied to the power in terminals L1 and L2. Check fuses F1. Check fuse F2 if installed. If F2 not installed, verify that jumper is installed at J10. Verify that power switch is in automatic position.

Controller Shows Low Pressure When Pressure IS OK:

Turn the power switch to the off position. After a couple of seconds, place the switch in the automatic position. Verify that DS10 lights and that the inlet solenoid has opened. If the solenoid does not open, verify that the proper voltage output is present on the inlet valve terminals L1 and L2. If the voltage is present, check the solenoid wiring and solenoid valve. If the solenoid does open, check to see if DS8 is on. If DS8 is off, check the pressure switch, the switch wiring and switch piping.

Controller Shows Pretreat Active When Pretreat Not Active or Not Connected:

If the pretreat lamp is on, check DS7 and see if it is on. If the lamp is off, check the pretreat wiring on P2. A contact closure must be applied to this input to allow the unit to run. If no pretreatment device is connected to the controller, a wire jumper must be installed on the pretreat terminals for the unit to operate properly.

Tank Full Not Operating Correctly:

If a single tank full switch is being used, it must be connected to the tank full high input, and the tank full low input must be jumpered. Verify that DS6 is on when the tank **IS NOT**

full. If DS6 is off, reverse the operation of the tank level switch and check the level switch wiring.

If dual level switches are used, the upper switch must be connected to tank full high and the lower switch must be connected to tank full low. When the water level in the tank is below both switches, DS5 and DS6 should be on and the unit should run. If both LEDs are not on, reverse the operation of the level switch corresponding to the LED that is off and check the level switch wiring.

Auto Reset Not Operating:

Verify that the auto-reset jumper is installed in the on position.

FLA:	208-230 60HZ	460 60HZ	380-415 50HZ	220-240 50HZ
1HP	4.2	2.1	2.18	4.2
1.5HP	6	3	3.15	6
3HP	9.6	4.8	5.81	9.6
5HP	15.2	7.6	9.2	15.2
7.5HP	22	11	13.32	22

OVERLOAD:

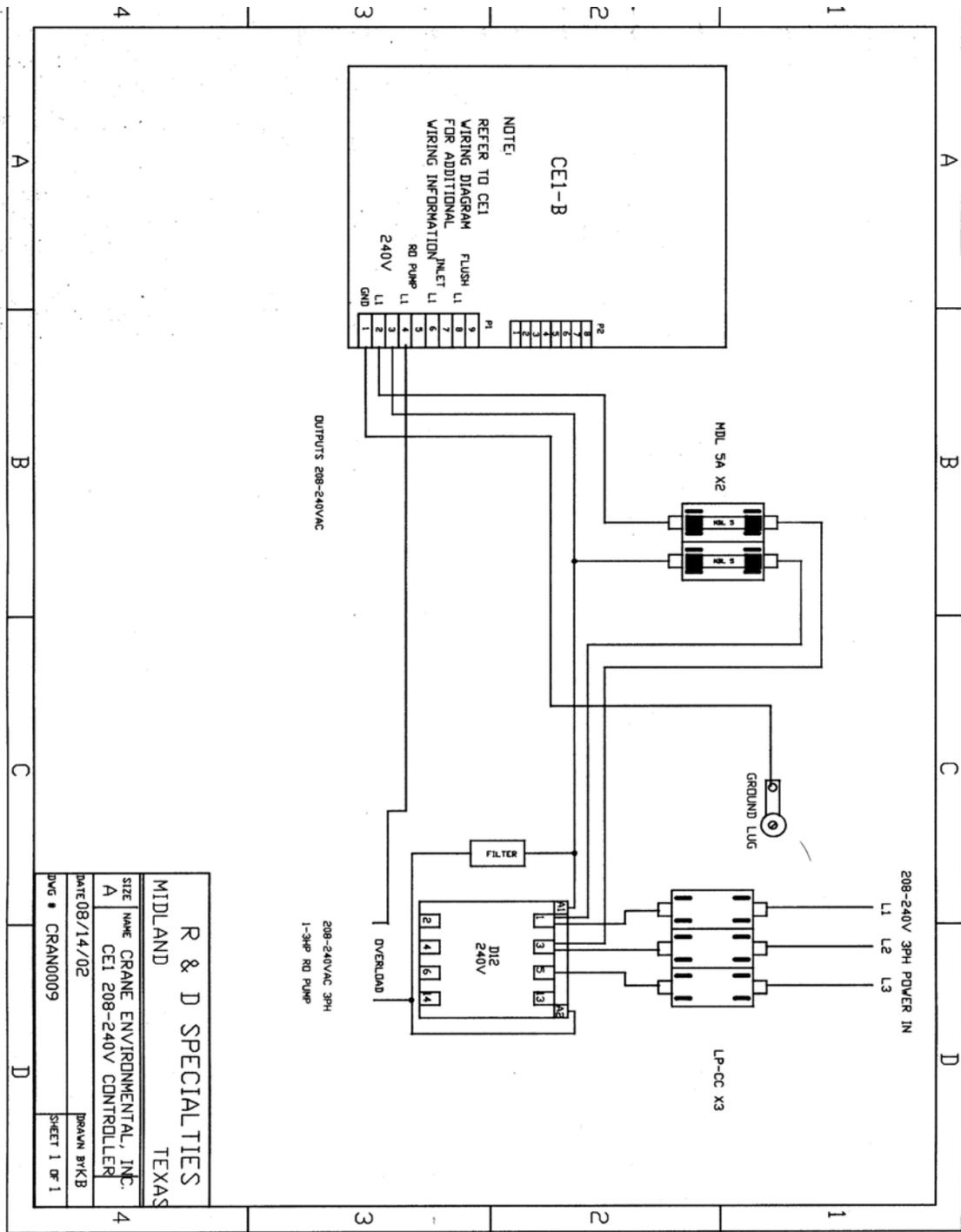
1HP	LR2D1310	LR2D1307	LR2D1307	LR2D1310
1.5HP	LR2D1312	LR2D1308	LR2D1308	LR2D1312
3HP	LR2D1316	LR2D1310	LR2D1312	LR2D1316
5HP	LR2D1321	LR2D1314	LR2D1316	LR2D1321
7.5HP	LR2D1322	LR2D1316	LR2D1321	LR2D1322

FUSE RATING:

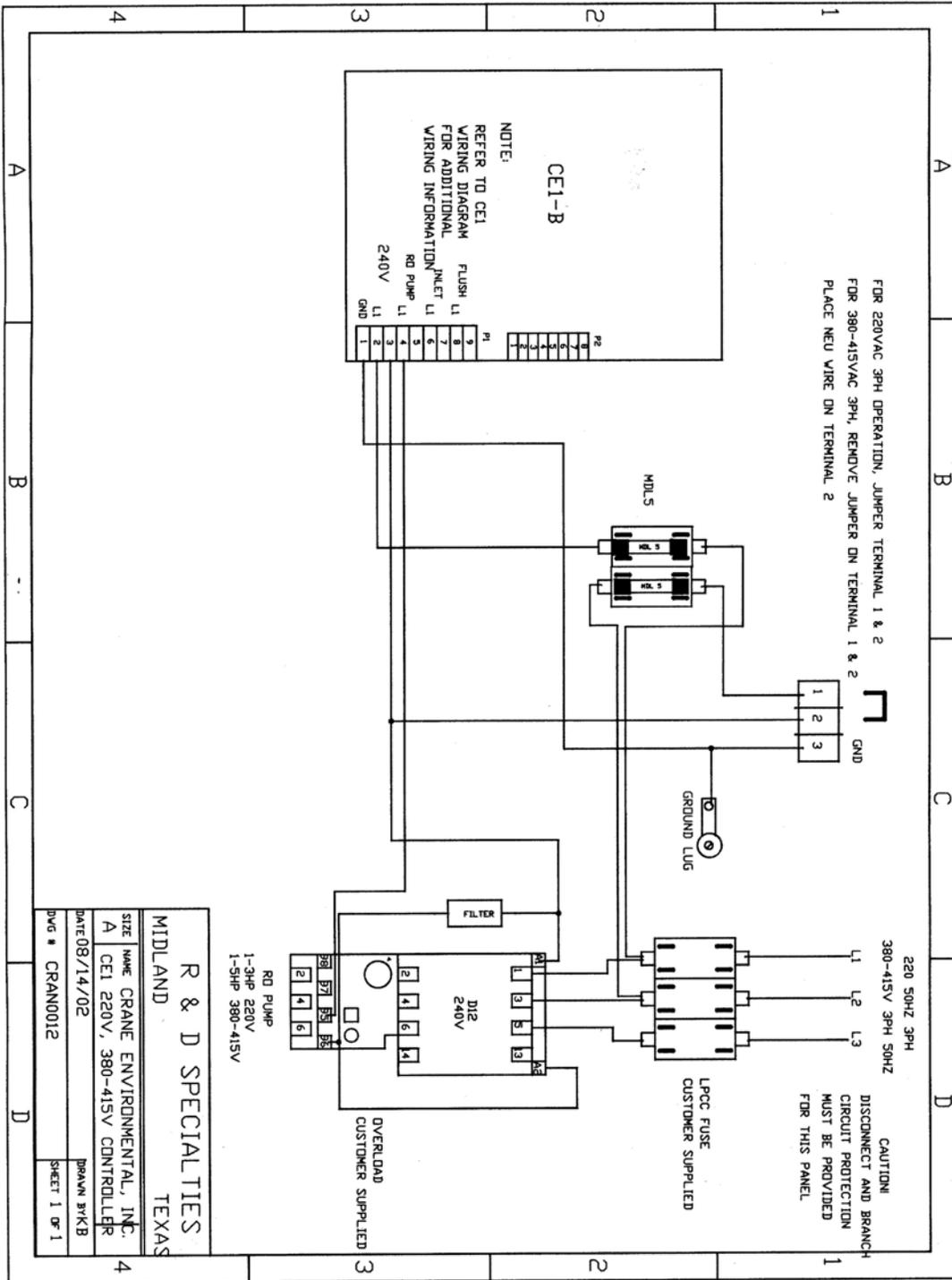
1HP	15AMP	15AMP	15AMP	15AMP
1.5HP	15AMP	15AMP	15AMP	15AMP
3HP	20AMP	15AMP	15AMP	20AMP
5HP	30AMP	15AMP	20AMP	30AMP
7.5HP	45AMP	20AMP	30AMP	45AMP

FUSE MACOLA NO.:

1HP	ZFU18	ZFU18	ZFU18	ZFU18
1.5HP	ZFU18	ZFU18	ZFU18	ZFU18
3HP	ZFU14	ZFU18	ZFU18	ZFU14
5HP	ZFU15	ZFU18	ZFU14	ZFU15
7.5HP	45AMP FUSE	ZFU14	ZFU15	45AMP FUSE



**208-240V 3PH
WIRING SCHEMATIC**
ALSO REFER TO CE-1 WIRING DIAGRAM on page 6A (CE1-B on this diagram)



**220V 50HZ 3PH
380-415V 50HZ 3PH
WIRING SCHEMATIC**

ALSO REFER TO CE-1 WIRING DIAGRAM on page 6A (CE1-B on this diagram)

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