

OSMONICS E4, E4LE, EZ4 SERIES™

WATER PURIFICATION MACHINES



INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

GE Infrastructure
Water & Process Technologies



**INSTALLATION, OPERATION AND
MAINTENANCE MANUAL**

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WATER PURIFICATION MACHINES**

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2.0 INSTALLATION

2.1 Mounting the Unit

When installing your new GE Infrastructure Water & Process Technologies reverse osmosis (RO) machine, allow at least 45-inches (114 cm) above the machine for membrane element removal and loading. If space is not available, the entire membrane element housing can be removed for membrane element change outs. If the membrane element housings are to be removed to change out the membrane elements, at least 6-inches (15.2 cm) is required at the end of each membrane element housing and 24-inches (61 cm) behind the machine.

2.2 Plumbing

The feed water source must be able to provide water quantity and pressures to maintain an operating feed water pressure of 30 - 60 psig (2.1 - 4.1 barg). If the feed water pressure with the machine is in excess of 60 psig (4.1 barg) or fluctuates by more than 5 psig (0.34 barg) a pressure regulator should be installed up stream of the machine Inlet. If proper water pressure cannot be maintained to the RO, a booster pump may need to be installed in front of the pretreatment to provide the proper water quantity and pressure for the operation of the machine.

Table 2.1
Connections

E4/EZ4/E4LE* MACHINE	INLET inches (cm)	PERMEATE inches (cm)	CONCENTRATE inches (cm)
2200	0.75 (1.90)	0.50 (1.27)	0.50 (1.27)
4400	0.75 (1.90)	0.50 (1.27)	0.50 (1.27)
6600	0.75 (1.90)	0.50 (1.27)	0.50 (1.27)
8800	0.75 (1.90)	0.75 (1.90)	0.75 (1.90)
11000	0.75 (1.90)	0.75 (1.90)	0.75 (1.90)
13200	0.75 (1.90)	0.75 (1.90)	0.75 (1.90)

* Low Energy Membrane Elements

2.3 Installing Clean-In-Place Valves

NOTE: Clean-In-Place (CIP) valves are not included with the machine. The CIP valves must be purchased and installed by the customer.

When installing the CIP valves, a three-way valve should be installed in the inlet feed stream of the machine. The tees on the permeate and concentrate lines should be installed with two-way valves. All valves should be installed in a manner that will allow circulation of the cleaning chemicals through the machine and back to the CIP container during cleaning.

CAUTION: If CIP valves are not installed when machine is installed, provisions must be made to bypass permeate and concentrate to drain for flushing at start-up.

WARNING: **NEVER OPERATE THE MACHINE WITH THE CONCENTRATE OR PERMEATE LINES BLOCKED. SEVERE DAMAGE TO THE UNIT MAY RESULT.**

2.4 Concentrate Outlet Connections

Connect proper size drain line to the concentrate outlet (Table 2.1) and run to an open drain. The drain capacity needs to be large enough to properly drain the feed water flow of the RO. The maximum concentrate back pressure is 60 psig (4.1 barg) for the RO machine.

CAUTION: Operation above 60 psig (4.1 barg) concentrate back pressure may damage the machine.

2.5 Feed Water Requirements

The following feed water requirements must be met before installing your new E4 machine to ensure quality permeate and extended membrane element life. Refer to Table 2.2 (E-Series Feed Water Requirements) for feed water information.

Table 2.2
E-Series
Feed Water Requirements

Temperature	Typical: 50° - 85°F (10° - 29°C) Limits: 33° - 104°F (0.16° - 40°C)
Inlet Pressure	Minimum: 30 psig (2.1 barg) Maximum: 60 psig (4.1 barg)
Chlorine (continuous feed)	0 parts per million (ppm)
Operating pH	5.5 - 8.5
Silt Density Index (SDI)	Less than or equal to 5 to minimize membrane element fouling and extend cleaning intervals. Refer to ASTM* standard D4189.

* American Standard for Testing Materials

2.6 Transporting Pure Water (Permeate) to Point-of-Use

The pure water, or permeate, is in an aggressive state and should only be transported from the machine to the point-of-use in food grade flexible nylon, stainless steel (SS) tubing, or polyvinyl chloride (PVC) material for the inlet, permeate, and concentrate piping sizes. Refer to Connections (Table 2.1) for inlet, permeate, and concentrate piping sizes.

WARNING: MACHINE DAMAGE MAY OCCUR IF PERMEATE BACK PRESSURE EXCEEDS 60 PSIG (4.1 BARG) DURING OPERATION.

2.7 Pressure Correction Factors

It is often necessary to operate RO machines with permeate back pressure. Permeate back pressure will decrease permeate production. See Table 2.3 (Pressure Correction Factors) to calculate loss of permeate.

**Table 2.3
Pressure Correction
Factors**

BACK PRESSURE	% LOSS OF PERMEATE FLOW		PRESSURE CORRECTION FACTOR (PCF)	
	E4/EZ4	E4LE	E4/EZ4	E4LE
10 psig (0.7 barg)	5%	10%	0.95	0.90
20 psig (1.4 barg)	10%	20%	0.90	0.80
30 psig (2.0 barg)	15%	30%	0.80	0.70
40 psig (2.7 barg)	20%	40%	0.70	0.60
50 psig (3.4 barg)	25%	50%	0.60	0.50
60 psig (4.1 barg)	30%	60%	0.50	0.40

WARNING: IF PERMEATE BACK PRESSURE EXCEEDS 60 PSIG (4.1 BARG) MACHINE DAMAGE MAY OCCUR.

WARNING: INSTALLING A CHECK VALVE WILL PREVENT REVERSE FLOW THROUGH THE MEMBRANE ELEMENT WHEN THE MACHINE IS NOT IN OPERATION. REVERSE FLOW, WHEN THE MACHINE IS NOT IN OPERATION, CAN SEVERELY DAMAGE THE MEMBRANE ELEMENTS.

2.8 Electrical

This RO machine requires two supply voltages; the control voltage and the pump motor voltage.

2.8.1 Single-Phase Electrical

The control voltage can be connected to either a 115 VAC, 60 Hertz or 220 VAC, 50 Hertz single-phase power supply. The RO control circuit should always be installed on at least a 15 Amp, single-phase dedicated circuit. Reverse osmosis machines with 115 VAC, single-phase control voltage include an eight-foot (2.4 m) cord which plugs into a three-prong grounded receptacle. All machines shipped with a 220 VAC, single-phase control circuit are shipped with an eight-foot electrical cord, but customers must provide electrical plug.

2.8.2 Three-Phase Electrical

The three-phase pump motor requires a 15 AMP dedicated circuit. Always verify correct voltage and Amp rating by checking voltage tag on the starter box or by checking electrical specifications on the pump. The motor is wired for 460 Volts, 60 Hertz, three-phase voltage from the factory (Figure 2.1, Three-Phase Allen Bradley Motor Starter). The pump motor can be rewired to 208 or 230 Volts. If this is done, a wiring change must be made internally in the pump motor and a higher amperage relay and starter may need to be installed. All field wiring must comply with applicable local and national electrical codes.

After checking the voltage tag on the motor starter to ensure the available voltage and amperage are correct, connect the provided three-phase power to the motor starter (Figure 2.1). This can be done by connecting the three phase power to the top of the starter relay terminals: L1, L2, and L3. A separate, fused disconnect for the motor wiring with proper protection for the Horsepower and Amp draw of the motor is recommended. All field wiring must comply with applicable local and national electrical codes. See Figure 2.1 for three-phase Allen Bradley Starter Hook-Up.

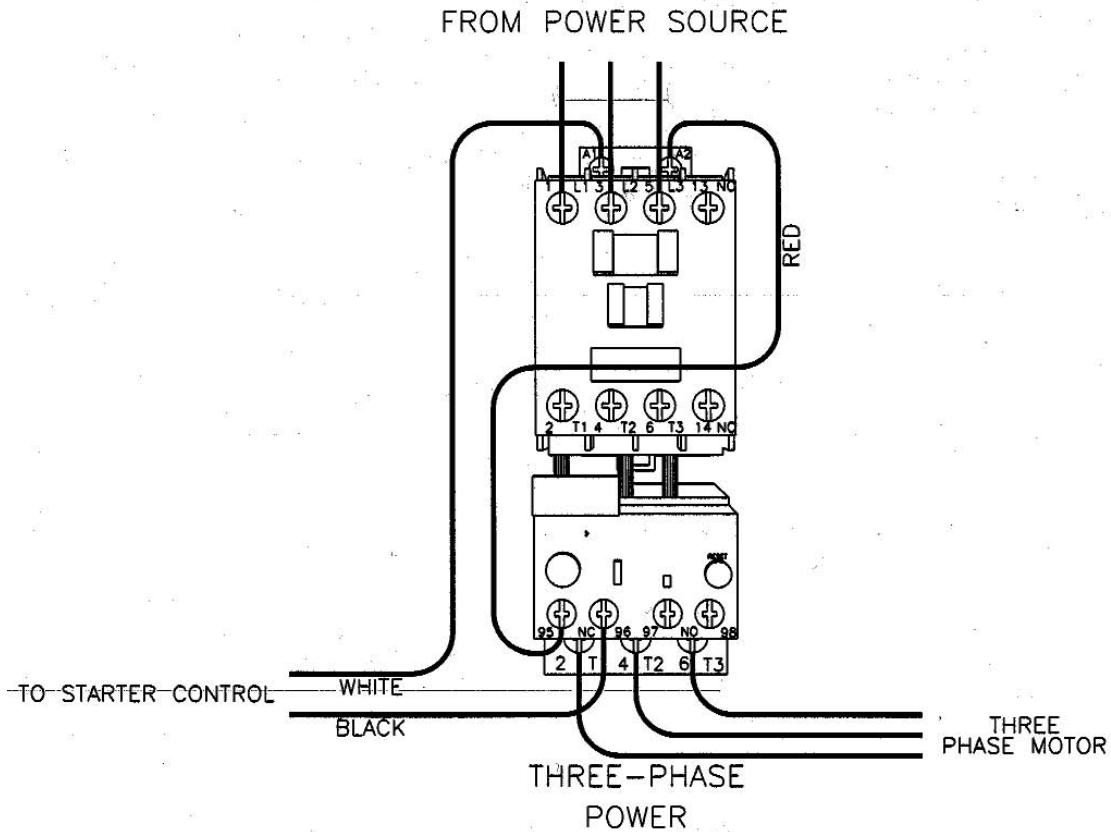


Figure 2.1
Three-Phase
Allen Bradley Motor Starter

2.9 Machine Control

2.9.1 Economy Model

To remotely control the Economy Model (ECN) with float switches and/or pretreatment lockout, remove the jumper between terminals 4 and 5 and wire in the float switches or pretreatment components in series. After all field wiring is complete and complies with local and national electrical codes, move onto Section 2.10 (Pretreatment for Water Purification).

NOTE: External control contacts are normally closed, dry contacts.

2.9.2 Deluxe Model

To remotely control the Deluxe Model (DLX), with float switches and/or pretreatment lockout, remove the jumper between terminals 2 and 3 and wire in the float switches and pretreatment in series. After all field wiring is complete

and complies with local and national electrical codes, move onto Section 2.10 (Pretreatment for Water Purification).

NOTE: External control contacts are normally closed, dry contacts.

2.10 Pretreatment for Water Purification

A water analysis of your feed water should have been performed, as part of the planning and engineering that went into developing your RO system.

The water analysis will provide information on what type of pretreatment may be required and what recovery the machine can be run at on the feed water provided. If the machine is moved to a different water source, a new water analysis should be taken before operating the machine.

Your RO is designed to operate on tap feed water with an SDI of 5 or less. The pH should be in a range of 5.5 - 8.5. Exposure to any levels of chlorine may cause irreversible damage to the Thin-layer composite (TLC) polyamide (PA) membrane elements in your machine. Daily water checks are recommended to ensure the integrity of your pretreatment and RO system.

2.11 Machine Start-Up Preparation

Check the function and integrity of your pretreatment equipment. Ensure that your water softener and activated carbon filters have been leaked checked and properly flushed, before starting up your RO machine.

CAUTION: Improperly flushed pretreatment may cause serious RO machine problems at start-up.

2.12 Machine Start-Up

STEPS

1. Turn the feed water supply ON, while checking for leaks in the pretreatment and inlet feed water lines.
2. Check to ensure power to the motor is de-energized and the ON/OFF button on the machine is in the OFF position.
3. Plug in the factory-supplied power for the control voltage.
4. For initial start-up, redirect the permeate and concentrate lines to the drain.
5. Open the concentrate and recycle flow control valves two complete turns. These valves are positioned on the flow control plumbing in the top right rear section of the machine.

6. Turn the ON/OFF button on the machine ON. System will open allowing water to flow through the machine to the drain through the permeate and concentrate CIP valves.

Let the machine run to drain for 5 - 10 minutes. This provides a wet start-up of the pump and removes any air in the system.

7. Turn the ON/OFF button on the machine to the OFF position.
8. Re-energize the pump power and trigger the ON/OFF button on the machine to check rotation of the pump motor. Observing from the back of the pump motor, pump rotation should be clockwise. If rotation is wrong, de-energize the pump voltage from the source and switch any two of the three-phase wires coming in on top of the three-phase starter. Re-energize the pump voltage and re-check, to ensure correct rotation for the start-up and operation of your machine.

WARNING: IF THE RO PUMP IS STARTED WITH INCORRECT ROTATION (i.e., BACKWARDS), A NOTICEABLE DROP IN FLOWS AND PRESSURES WILL RESULT. IF PUMP MOTOR OPERATES BACKWARDS FOR ANY LENGTH OF TIME, PUMP DAMAGE MAY RESULT.

After correct rotation has been verified, you are now ready to start the machine and set the flows and pressures.

9. With the recycle and concentrate orifices still two (2) turns open and adequate feed water available, start the machine by turning the ON/OFF button to the ON position.
10. As the pump starts to build pressure, begin to adjust the orifices in the following manner: start by slowly closing the concentrate orifice while slowly opening the recycle valve.

Primary Pressure for Normal Operation at 77°F (25°C)

E4-Series: 220 psi (15.2 bar) at 77°F (25°C)

EZ4/E4LE-Series: 115 psi (7.9 bar) at 77°F (25°C)

While you are doing these valve adjustments, to obtain correct flows and pressures, observe the primary or pump pressure. The pump pressure, while adjusting the orifices, should never operate outside of these ranges:

E4-Series Range: 190 - 275 psi (13.1 - 19.0 bar)

EZ4/E4LE-Series Range: 100 - 140 psi (6.9 - 9.6 bar)

The concentrate valve is drilled, and when completely closed the machine is running at the correct concentrate flow for a 75% recovery (Table 2.4, Flow Specifications for E4-Series Machines).

If the temperature of the inlet feed water is not 77°F (25°C) use the Temperature Correction Factor Table (Technote 113). The proper adjustment of the recycle and concentrate valves are critical to the correct operation of the machine.

CAUTION: Optimum recovery will vary according to water quality.

2.13 Temperature Correction Factor

If the temperature of the inlet feed water is not 77°F (25°C), refer to Technote 113 for Temperature Correction Factors.

NOTE: Optimum recovery will vary according to water quality.

2.14 Recovery

The machine flow specifications listed below are based on 25°C (77°F).

**Table 2.4
Flow Specifications for
E4-Series Machines**

E4-Series	2200	4400	6600	8800	11000	13200
Recovery	50-75%	50-75%	50-75%	50-75%	50-75%	50-75%
Units	LPM/GPM	LPM/GPM	LPM/GPM	LPM/GPM	LPM/GPM	LPM/GPM
Permeate Rate	5.8/11.6	11.6/3.06	17.3/4.6	23.1/6.1	28.9/7.6	34.7/9.2
Concentrate Rate (50%)	5.8/11.6	11.6/3.06	17.3/4.6	23.1/6.1	28.9/7.6	34.7/9.2
Concentrate Rate (75%)	1.9/0.5	3.9/1.0	5.8/1.5	7.7/2.0	9.6/2.5	11.6/3.06
Feed Rate (50%)	11.5/3.0	23.2/6.1	34.7/9.2	46.2/12.2	57.8/15.3	69.4/18.3
Feed Rate (75%)	7.7/2.0	15.4/4.1	23.1/6.1	30.8/8.2	38.5/10.2	46.2/12.2

2.15 Autoflush Timer

2.15.1 Programming the Autoflush Timer

The Autoflush timer clock operates and displays in real time, but the Autoflush feature will only work when the RO machine is operating. When the machine is operating in the Autoflush Mode, the total flow through the machine is increased. This provides extra cross flow which flushes the loose foulants from the surface of the membrane elements. When the machine is operating in the Autoflush Mode a slight drop in permeate production, as well as a decrease in the primary and final pressures may be observed. An ideal way to set the timer up is to program ten Autoflush sequences, with a 10 to 15 minute duration, per 24 hours. To do this, follow the procedure below.

2.15.2 Setting Up the Autoflush Timer Clock

IMPORTANT: Before proceeding with setting the timer and programming the unit, press the RESET KEY to clear all data. After pressing the RESET KEY, the display may show A.M., this is in military time mode.

If the machine is in Military Time, do the following:

SELECTING AM/PM OR MILITARY TIME

After pressing reset, the display may show A.M.(right). The numbered day symbols will be flashing ON and OFF.

If the display does not show A.M., it is in military time mode (24:00 hr.). To change to A.M./P.M. mode, press and hold the **h** Key and press the **± 1h** Key once, A.M. will appear in the display.

If display is in A.M.. mode and military mode is desired, press and hold the **h** Key, press the **± 1h** Key once.

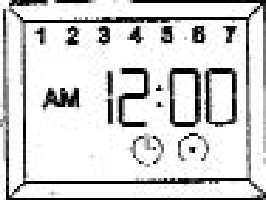


Figure 2.2
Setting-Up the Correct Time
on the Autoflush Timer

STEPS

1. While holding down the Clock Key (⊗), press the **h** key to advance to the current minute.
2. While holding down the Clock Key (⊗), press the **h** key to advance to the current minute.
3. While holding down the Clock Key (⊗), press the **h** key to advance to the current minute.

NOTE: If the **h** and **m** keys are held down for longer than 2 seconds, the numbers will advance rapidly.

If the days are flashing, it indicates the day of the week was not set when setting the time. The timer cannot be programmed unless the day of the week is entered. Each year, in the spring, press the Button to advance the time one hour (Daylight Savings Time). In the fall, press the button to set the timer back one hour (Daylight Savings Time).

2.15.3 Programming the Autoflush Timer Clock

This timer will accept up to 20 programs. Each program consists of the following:

1. ON/OFF Command
2. Time of Day (hours and minutes)
3. Single day or multiple days

IMPORTANT: The current time of day and day of the week must be set prior to programming the timer. See Section 2.15.3 (Setting Up the Autoflush Timer).

2.15.4 Programming Twenty-Four Hour or Seven Day Schedules

NOTE: It is helpful to write out the program schedules before programming the time.

Example:

Press **Prog.** key only once. Display shows:

Program 1 (ON at 7:00AM Monday thru Saturday)

Press **ON** key once ON symbol (☉) appears
Press **h** key to 07AM
Press **m** key once to 00
Press **Day** key once 1 2 3 4 5 6 is displayed
Press **Prog.** key to enter

Program 2 (OFF at 5:00PM Monday thru Friday)

Press **OFF** key twice OFF symbol (☾) appears
Press **h** key to 05PM
Press **m** key once to 00
Press **Day** key two times 1 2 3 4 5 is displayed
Press **Prog.** key to enter

Program 3 (OFF at 7:00PM Saturday)

Press **OFF** key twice OFF symbol (☾) appears
Press **h** key to 07PM
Press **m** key once to 00
Press **Day** key 9 times until only 6 is displayed
Press **Prog.** key to enter
Press **Run** key to enter Run Mode

Figure 2.3
Programming the Timer

2.15.5 Changing a Program

Select the program to be changed with the **Prog.** Key. A new set of days may be selected with the **Day** Key just as in the initial programming. Hour and minute can be changed with the **h** and **m** Keys.

2.15.6 Deleting a Program

To delete one or a few programs: Press the **Prog.** Key until the desired program is displayed:

1. Press the **m** Key to **:59** and press once again to blank out.
2. Press **h** Key to **11 P.M.** and press once again to blank out.
3. Press the Clock Key, (⊗) display will flash for several seconds and then enter the Run Mode.
4. Using the Reset Key will delete ALL programs, the time of day, and day of the week.

2.15.7 Troubleshooting the Autoflush Timer

PROBLEM: Days are flashing, pressing any Key does nothing except "Hand" Key turns output ON and OFF.

SOLUTION: **Time of Day** and **Day of Week** have not been set. See Section 2.15.3 (Setting-Up the Autoflush Timer Clock).

PROBLEM: Time of day was set while holding the Clock Key down, but days are still flashing.

SOLUTION: Current day of week was not set **while holding down the Clock Key**. See Setting-Up the Autoflush Timer Clock (Section 2.15.2).

PROBLEM: It is 10 A.M. and a ON program for 8 A.M. was entered, but the output is not ON.

SOLUTION: The ON or OFF was not entered as part of the program. ON or OFF **must be selected**.

2.16 Calibrating the Conductivity Probe

STEPS

1. Make sure the calibration meter is in Measure Mode (with the MEAS LED light ON).
2. Immerse the Conductivity Probe in a 13.00 microSiemens (mS) prepared solution.
3. Immerse and agitate Conductivity Probe, and wait for the reading to stabilize.
4. Calibrate the meter by adjusting the CAL adjustment screw until the Liquid Crystal Display (LCD) display reads 13 mS of the solution.

The meter is now calibrated

NOTE: The alarm function on the conductivity meter is not used on E4/EZ4/E4LE-Series machines.

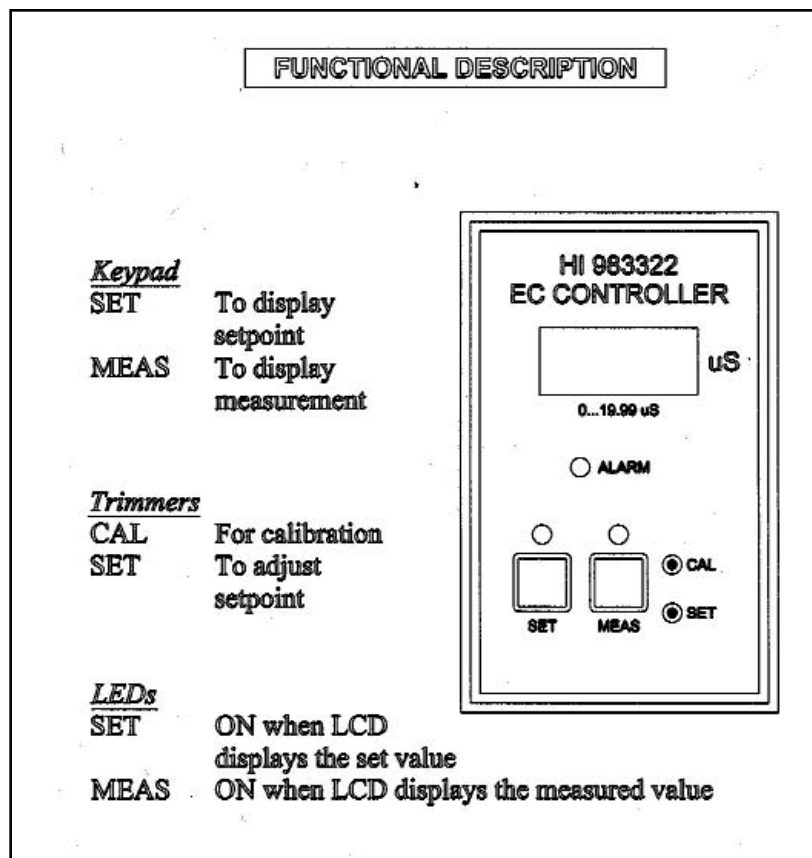


Figure 2.4
Conductivity Probe Display

2.17 Operation and Maintenance

The operation and maintenance of an E-Series RO machine requires regular data recording and routine preventative maintenance. It cannot be emphasized enough the importance of filling out the Daily Log Sheet (Technote 106) during each operating shift. A Start-Up Data Sheet (Technote 105) should have been completed at start-up containing pertinent facts on the operation of your machine. These two records are invaluable in diagnosing the performance of the equipment, and must be kept for reference. If you have questions concerning the operation of your machine or the method of data recording, contact the manufacturer.

Three preventative maintenance procedures, which must be done on a regular basis, are as follows:

1. Change the pre-filter cartridges as needed. Pressure drop across the pre-filters should not exceed 8 psi (0.6 bar).
2. Clean the RO membrane elements with approved cleaners at least quarterly, depending on feed water quality.
3. Flush the RO machine daily.

2.17.1 Daily Flushing for the Economy Model

If your E4-Series machine is an ECN Model it needs to be manually flushed daily. The DLX E4-Series machine is equipped with an Autoflush Timer (Section 2.15, Autoflush Timer). A daily manual flush must be performed. To flush the machine:

1. With the machine running, open the concentrate valve 1/2 - 3/4 turn.
NOTE: During flushing procedure, the machine must be running.
2. Allow the machine to operate with the concentrate valve open (Step 1) for 10 - 15 minutes.
3. After 10 - 15 minutes, return the concentrate valve to its previous setting, and return to normal operation.

CAUTION: When opening the concentrate valve, never allow the machine's primary pressure to drop more than 10% below normal operating pressure.

2.17.2 Daily Flushing for the Deluxe Model

The DLX Model machine includes an Autoflush Timer Option. The Autoflush Timer Option automatically flushes the machine at preset intervals.

2.18 Pre-filter Cartridge

A 5 micron pre-filter cartridge is factory installed to protect the membrane elements and valves from particles, which may be in the feed water. To order replacements, see the Spare Parts List (Technote 118, P/N 1233377).

A pressure drop across the filter of 8 psi (0.55 bar) or more during operation indicates that the pre-filters cartridge(s) need changing. Use only GE approved filters rated for 5 microns or less. Do not attempt to clean used filters.

IMPORTANT NOTE: Failure to change the pre-filter cartridge according to these requirements will void machine warranty.

2.19 Membrane Element Cleaning

GE recommends that you clean your RO every quarter, depending on the quality of your feed water. Cleaning of the membrane elements is vital because contaminants can build up on the membrane element surfaces, reducing the permeate flow rate and affecting the quality of the permeate.

2.19.1 Step Wise Cleaning

This RO machine and many others have a centrifugal pump on them. Centrifugal pumps are not designed to draw water. They are designed to operate with flooded suction only. The manufacturer recommends using a Clean-In-Place (CIP), or booster pump, to provide water pressure and flow to the RO machine pump from the CIP container.

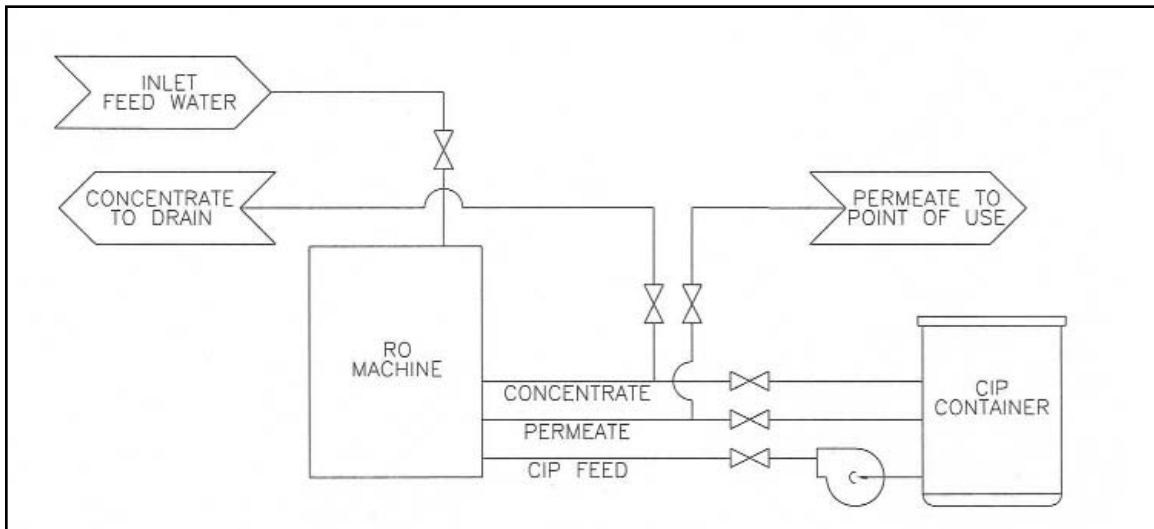
2.19.2 Procedure to Clean with a CIP Pump

STEPS

1. With the machine running, open the CIP permeate valve, close the permeate service valve and fill the CIP tank with permeate water. When the container is filled to desired level, turn machine OFF.
2. Add and mix up the cleaners in the CIP container. Please use only PA membrane element compatible cleaners.
3. Close the inlet feed water supply valve to the machine and open the CIP inlet feed water to the CIP container.
4. Close the permeate valve to point of use and also the concentrate valve drain.
5. Open the CIP valves, allowing permeate and concentrate to return to the CIP container.

When set properly, the RO machine, the CIP pump, and the CIP container should be assembled in a loop configuration to recirculate the water through the machine and back to the container during cleaning. The size of the CIP container should be a minimum of three times the permeate rate.

CAUTION GE recommends the use of a CIP or booster pump to provide the proper feed water pressure and quantity to the RO machine during cleaning.



**Figure 2.5
Clean-In-Place Pump
and Tank Hook-Up**

With the machine set-up in the CIP configuration and the cleaning solution mixed in the container, you are now ready to start the CIP process. Follow the Steps below.

STEPS

1. Check to ensure that the feed, permeate, and concentrate valves and line are open and unrestricted in the tank loop.
2. Start the CIP and RO machine pumps together. As they start up, observe all RO machine pressures and flows.
3. Recycle the cleaning solution for about 15 minutes. Damage may result to membrane elements if the temperature of the CIP solution exceeds 105°F (40°C). If the water temperature exceeds 100°F (38°C), place bags of ice into the CIP container to absorb the extra heat.
4. After recirculating the cleaner for 15 minutes, shut down the RO and the CIP pump.

5. Let the CIP solution dwell in the machine for 20 minutes.
6. After the 20 minute dwell time, start the CIP recirculation process again for 10 minutes.
7. After the 10 minute recirculation time is complete, de-energize the machine. Then, open the inlet water line and route the concentrate and permeate lines to the drain.
8. Start the RO machine and flush to drain for 20 minutes. Verify the permeate quality is good before returning to normal operation.
9. After permeate quality is verified as good, route the permeate to point of use and concentrate to drain. You are now ready for normal operation.

2.20 Suction Cleaning

GE does not recommend the suction cleaning method to clean the E4-Series RO machine. If using suction cleaning, reference cleaning with a CIP pump above (Section 2.19.2, Procedure to Clean with a CIP Pump).

STEPS

1. Arrange the RO and the CIP container in a closed loop situation with the cleaning solution, reference Section 2.19 (Membrane Element Cleaning).
2. Move the L1 and L2 wires on the pressure switch across to the motor terminals (Figure 2.1, Three Phase Allan Bradley Motor Starter). The wires can also be temporarily jumped.
3. Open the inlet feed valve.
4. Start the RO machine
5. As the machine starts up on inlet feed water, slowly close the inlet feed water valve while slowly opening the feed water valve to the CIP tank.

You will begin to hear the RO pump draw the CIP solution into the machine and circulate it back into the CIP tank. After achieving prime, observe the RO closely to ensure that you do not lose pump prime, which may result in pump damage.

6. Refer to the CIP cleaning procedure (Section 2.19.2) for cleaning steps.

WARNING: LOSS OF PRIME DURING SUCTION CLEANING MAY RESULT IN SERIOUS DAMAGE TO THE PUMP.

NOTE: As previously mentioned, the manufacturer recommends use of a CIP or booster pump to circulate the cleaning solution during membrane element cleaning.

7. After suction cleaning cycle is complete, reopen inlet water and flush machine to drain for twenty minutes.
8. After permeate quality is verified as good, return machine to normal operation mode.

2.21 Changing Out Membrane Elements

CAUTION: Replacement membrane elements are shipped from the factory in a plastic bag with a small amount of bactericide solution to prevent biological growth. When installing the membrane elements, always provide adequate ventilation and wear gloves while handling the membrane elements as recommended. The membrane elements must be kept moist at all times in to prevent possible damage to the membrane element material.

STEPS

1. Remove the top end caps and clamps from the membrane element housings. Lubricate all O-rings and brine seals, and the PVC membrane element stems (stingers) with a non-petroleum based lubricate (i.e., glycerin or poly water).
2. Load the down flow membrane elements first, by inserting the membrane element into the membrane element housing with the brine seal end of the membrane element up. Slowly turn the membrane element as you lower it into the membrane element housing. As you reach the bottom of the housing slowly guide the PVC stem or stinger on the end of the membrane element into the head of the end cap. As the membrane element slides into the housing the brine seal will be on the top.
3. Next, load the up flow membrane elements, by lubricating all brine seals, O-rings, and the membrane element stingers. With the up flow membrane element and the brine seal will be on the bottom of the membrane element. Turn the membrane element slowly as you lower it down into the housing. As with the down flow membrane element, one must slowly guide the PVC stinger on the end of the membrane element into the end cap.
4. Reinstall the end caps by using non-petroleum based lubricant to lubricate the O-ring inside the end cap. Reinstall the end cap on the membrane element by first, aligning the stinger into the hole in the end cap and then turn the end cap slowly clockwise, as you push it down into the membrane element housing.

5. Reattach the housing clamp and tighten.
6. Next reconnect the permeate and concentrate lines.

The machine is ready for start-up.

2.22 Troubleshooting

This troubleshooting guide can assist you in identifying common operating problems you may experience with your machine. Many of these problems can be easily corrected by the operator, however, for those that persist or are not understood, you should contact the GE Customer Support Center. Have the following information available when calling the Customer Support Center:

1. Machine installation date
2. Model number
3. Serial number
4. Weekly log sheets
5. Detailed description of problem.

T R O U B L E S H O O T I N G G U I D E		
PROBLEM	POSSIBLE CAUSE	SOLUTION
Low Operating Pressure	Insufficient feed water pressure or flow	Open the feed pressure, open the feed water valve, check for restrictions
	Clogged pre-filter	Replace the cartridge.
	High flow rates	Close the concentrate valve, check the permeate and concentrate flow rates and adjust if necessary. Excessive permeate flow may indicate a damaged O-ring.
	Dirty or fouled membrane elements	Flush and clean the membrane elements.
	Solenoid valve not opening	Clean or replace the solenoid valve.

TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	SOLUTION
Low Operating (continued)	Pump rotating backwards (three-phase power only)	Switch any two of the three-phase leads to the motor starter.
	Insufficient electrical power	Check the fuses or circuit breaker, measure the voltage.
	Pump not operating correctly	See pump instructions.
Low Permeate Flow Rate	Low operating pressure	See possible causes for low pressure.
	Dirty or fouled membrane elements	Flush and clean membrane elements
	Operating on cold water less than 55°F (13°C)	Install a hot/cold feed water tempering valve if more permeate flow is needed. Operate with a feedwater temperature of 72° - 75°F (22° - 25°C).
	Membrane elements installed backwards or damaged concentrate seal	Install membrane elements in the direction of fluid flow. Flush and clean the machine immediately . Membrane elements with damaged concentrate seals should be cleaned and may be returned for repair.
	Flow meter inaccurate	Check the flow rate manually with a stop watch and calibrated container.

TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	SOLUTION
Low concentrate flow rate, normal or higher than normal pressure	Concentrate valve plugged	Remove the concentrate valve step and/or disassemble the plumbing. Clean the valve
	Concentrate outlet line restricted	Examine the concentrate line for obstructions or kinks, repair or replace the tubing.
	Flow meter inaccurate	Check the flow rate manually with a stop watch and calibrated container.
High operating pressure	Dirty concentrate valve	Disassemble and clean the plumbing to the valve
	Recycle or concentrate valve plugged	Disassemble the plumbing to the recycle valve and remove foreign particles. Check the concentrate valve stem.
	Inaccurate pressure gauge	Replace or calibrate the gauge as required.
	Restricted or reduced permeate flow rate	See possible causes for low permeate rate.
Excessive pressure drop [over 50 psig (3.0 barg)] (high primary pressure - low final pressure)	Restricted flow after pump outlet	Check for blockage of the concentrate flow at the inlets and outlets of the membrane element housings.

TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	SOLUTION
Excessive pressure drop [over 50 psig (3.0 barg)] (high primary pressure - low final pressure) (continued)	Telescoped membrane element covering membrane element housing outlet port	Flush and clean the membrane elements
	Severely fouled or dirty membrane elements	Flush the machine then clean it with detergent.
Water flowing when machine is turned OFF	Inlet solenoid valve not closing or seating properly	Clean or replace the valve. Clean the membrane elements with detergent <u>immediately</u> . Water must not pass through the inlet when the machine is OFF.
Declining rejection (high permeate conductivity)	Dirty or fouled membrane elements	Flush and clean the membrane elements
	O-ring seal broken or damaged	Replace the O-ring, check the sealing surfaces on the O-ring groove, interconnectors and end caps. Replace the damaged parts.
	Change in incoming water quality	Open the concentrate valve and flush. Test the water for pH, hardness, TDS and iron content. A water analysis should be sent to GE Infrastructure for review.
	Inaccurate conductivity monitor or fouled probe	Calibrate the monitor with a DS standard solution or check the readings with another conductivity meter. Replace or clean the probe. Check the connections between the probe and monitor.

TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	SOLUTION
Switch ON, unit not operating	Pressurized storage switch or float switch has cut power to machine	Check the permeate back pressure or position of float in the storage tank.
	Fluid temperature higher than 100F (38C) or thermal overload in motor	Allow the machine to cool; check the feed water supply and/or amp draw to the motor.
	No power to machine	Check the fuses or circuit breakers, measure the voltage.
Deluxe (DLX) electrical machine shutdown	Motor and/or pump not operating properly	See the pump instructions. Contact GE Infrastructure for possible repair or replacement.
	Alarm condition has turned machine OFF	Restart the machine by pushing the alarm bypass. Check all possible alarm conditions: inlet pressure or motor starter overload
	Motor starter overloaded, heater tripped	Turn the switch OFF. Rest the heater(s). Check the motor amp draw and the line voltage.
	Timing relay defective/burned out	Replace the relay.

For more information call 952-933-2277 or 800-848-1750 in the U.S., or visit www.gewater.com.

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