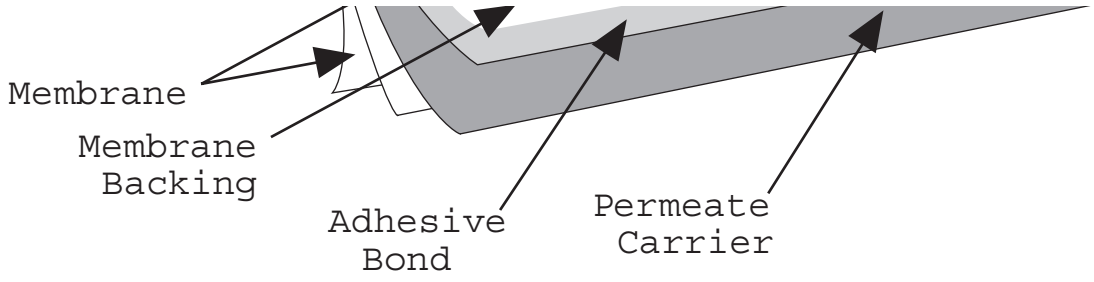
E4H-SERIES

WATER PURIFICATION MACHINES

14,400 GPD TO 43,200 GPD

OPERATION AND MAINTENANCE MANUAL



OSMONICS

E4H-SERIES WATER PURIFICATION MACHINES
14, 400 GPD – 43, 200 GPD

OPERATION AND MAINTENANCE MANUAL

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1.0 DESCRIPTION

1.1 General Information and Principles of Operation

Your E-Series reverse osmosis (RO) machine is a durable piece of equipment which, with proper care, will last for many years. These instructions give operating and maintenance details vital to the sustained performance of the machine.

RO is the separation of one component of a solution from another component by means of pressures exerted on a semipermeable membrane. Removal of ionic, organic and suspended / dissolved impurities occurs during the RO process. Unlike a filter, which separates by "normal" filtration, the Osmo® sepralator separates using a process called crossflow filtration. Feedwater solution is separated into two streams, permeate and concentrate, and collected from both sides of the membrane. A semipermeable RO membrane, under sufficient pressure, allows passage of purified water while rejecting and concentrating dissolved and suspended solids.

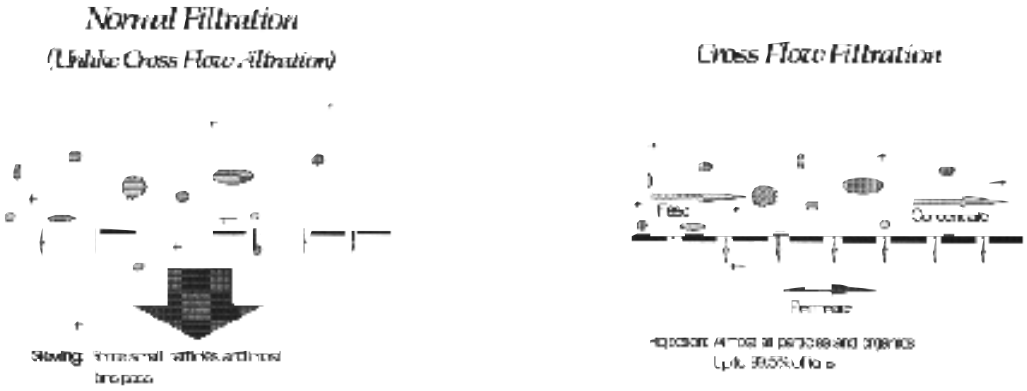

Figure 1 - Normal vs. Crossflow Filtration

Osmonics manufactures a patented spiral-wound membrane package, with a turbulent flow design. This membrane module, called a sepralator, collects the purified water within a central tube, the permeate tube (see Figures 2 and 3).

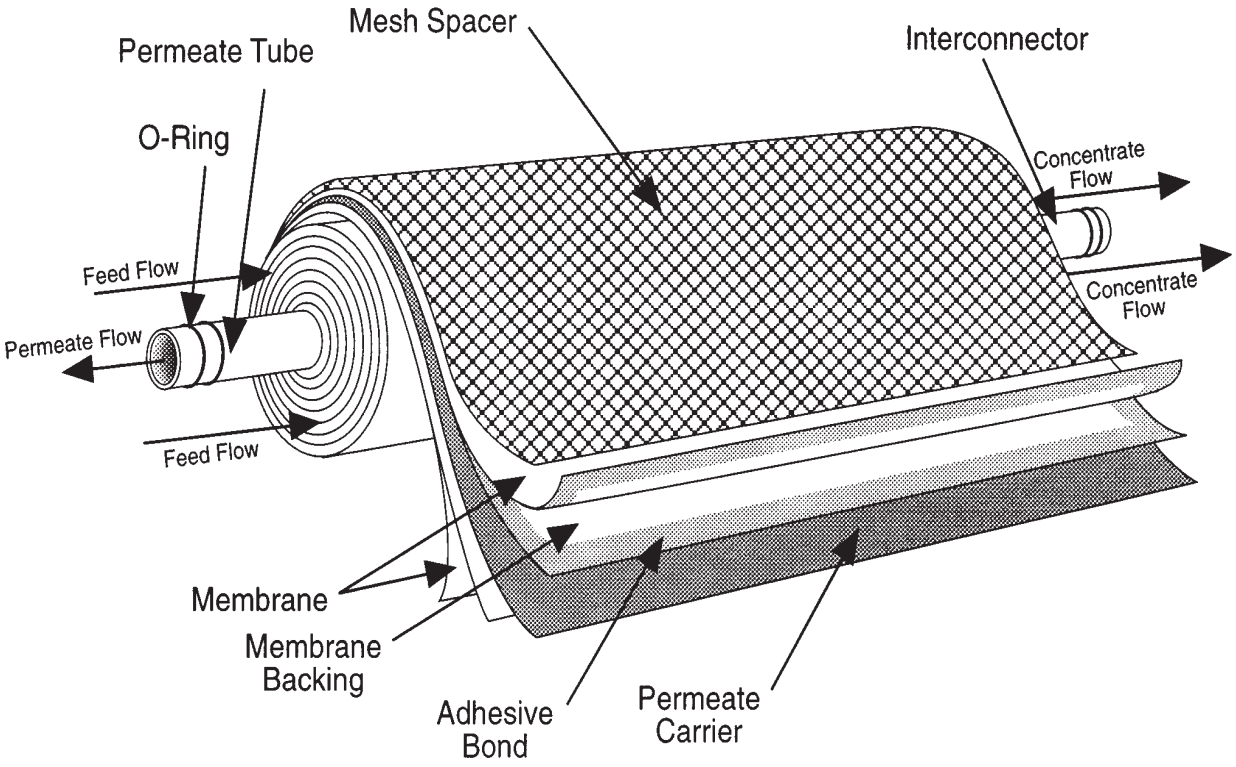

Figure 2 - Membrane Sepralator with Interconnectors

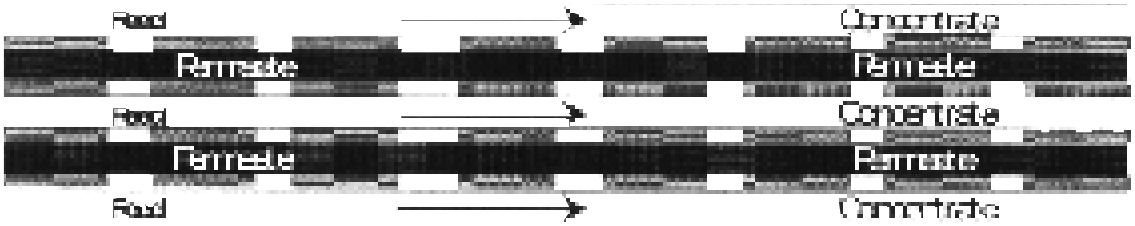

Figure 3 - Cross-Sectional View of Sepralator

Some operating definitions are provided to help you further understand your machine:

Permeate Rate [Product Water Rate (Q_p)] is the flow rate of purified water which has passed through the membrane and out of the sepralator; expressed in gal/min (gpm) or gal/hr (gph) [in metric, liter/min (Lpm) or cubic meters/hour (m^3/h)]. Specified permeate rates are normally at 77°F (25°C).

Concentrate Rate [Waste Water Rate (Q_c)] is the flow rate of water containing rejected solids to drain in gpm or gph (Lpm or m^3/h).

Feed Rate (Q_f) is the flow rate of incoming water in gpm or gph (Lpm or m^3/h). Feedwater rate equals permeate rate plus concentrate rate.

Recovery equals permeate rate divided by feed rate and is expressed as a percentage. For example, 33% recovery means that out of a given feed rate, 33% is produced as purified water (permeate).

Concentration equals the Total Dissolved Solids (TDS) concentration of a solution expressed as milligrams per liter (mg/L) or conductivity (microSiemens/cm).

C_f = Feed Concentration
C_p = Permeate Concentration
C_c = Concentrate Concentration
C_{avg} = Average Concentration in Machine

Salt (Ionic) Rejection equals the percent of dissolved salt rejected by the membrane, calculated from an average concentration over the membrane.

Salt (Ionic) Passage equals (100% - rejection) or the percent of dissolved salts passed through the membrane.

An example of how to calculate salt rejection and recovery is given below:

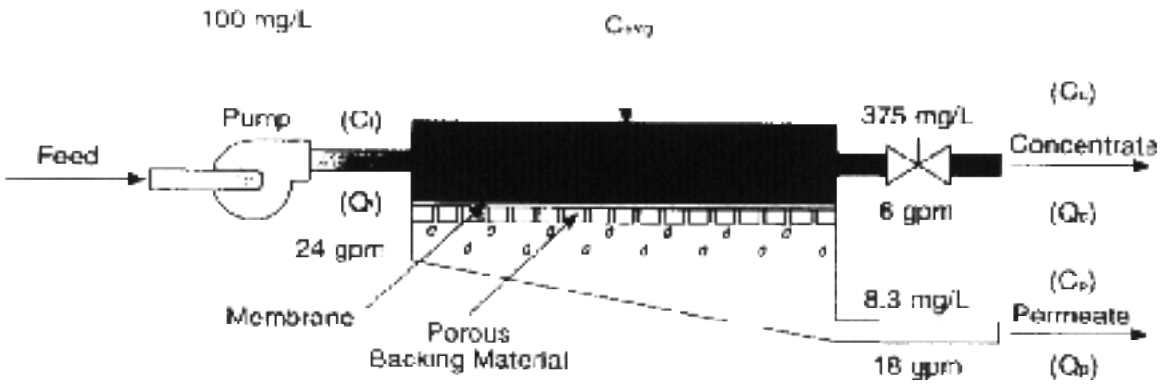

Figure 4 - Principles of Operation

Given the system case in Figure 4:

$$\text{Average Concentration } (C_{avg}) = \frac{(C_f)\ 100\ \text{mg/L} + (C_c)\ 146.9\ \text{mg/L}}{2}$$

$$(C_{avg}) = 123.5\ \text{mg/L TDS}$$

$$\text{Rejection} = \frac{(C_{avg})\ 123.5 - (C_P)\ 6.2}{(C_{avg})\ 123.5} \times 100 = 95\%$$

$$\text{Passage} = \frac{(C_P)}{(C_{avg})} = \frac{6.2}{123.5} \times 100 = 5.0\%$$

$$\text{Recovery} = \frac{(Q_P)\ 2\ \text{gpm}}{(Q_f)\ 6\ \text{gpm}} \times 100 = 33\%$$

Flow Description - The feedwater passes through a replaceable 5-micron cartridge filter which removes bulk suspended solids. Filtered water then flows to the inlet control valve. This solenoid-controlled diaphragm valve is wired to the on/off switch and opens when the machine is turned on, allowing water to flow to the pump inlet. When the machine is turned off, the valve closes, preventing non-turbulent flow through the sepralators, which would lead to shortened membrane life.

The pump feeds water to the sepralator housings arranged in parallel and serial combinations. The direction of water flow is indicated by an arrow on each sepralator housing. Water is separated by the membrane within the sepralators and leaves the sepralator housings in two streams: permeate and concentrate.

Permeate from each sepralator housing is collected in a common manifold. The permeate then flows through a flow meter and to the outlet point of the machine.

The concentrate leaves the last sepralator housing and flows to the flow control center (recycle/concentrate manifold). At this point, the recycle valve channels a predetermined amount of concentrate into the pump inlet. Recycle increases recovery while maintaining adequate crossflow through the sepralators. The other two ports of the flow control center lead to the concentrate valve and final pressure gauge. The concentrate valve has three functions: It controls the amount of concentrate flowing to the drain; it controls the pressure within the machine; and it helps control the system recovery. An autoflush solenoid is added to the flow control center with an additional tee. The concentrate then flows through a flow meter and to the outlet point of the machine.

1.2 Machine Nomenclature

E-Series water purification machines are numbered in such a way as to indicate the permeate flow and quality you can expect from the machine:

Example: E4H-21K/ECN, 230, 6, 50-75

- E4H indicates the machine series
- H indicates horizontal membrane element housing configuration

- 21K indicates the rated permeate flow in thousands of gallons per day @ 77°F (25°C), i.e., 21K = 21,000 gallons per day
- ECN indicates Economy Model and DLX indicates the Deluxe Model
- 230 indicates 230 VAC, three-phase voltage to starter
- 6 indicates 60 Hz operation, whereas 5 indicates 50 Hz operation
- 50 - 75 indicates 50% to 75% recovery

1.3 Machine Permeate Quality

The permeate rejection performances are as follows:

E4H machines use high rejection Osmo 415 - HR(PA) membrane elements, providing the ultimate in high purity water.

1.4 Economy (ECN) Model and Deluxe (DLX) Model Option

1.4.1ECN Model

E-Series ECN model water purification machines have all the features necessary for safe, continuous production of high purity water. This assumes good quality feedwater, adequate pretreatment and regular operator maintenance, each shift or daily, to the operation of the system.

- 50% to 75% recovery
- Multi-stage centrifugal pump, SS construction (stainless steel castings with Noryl* stages)
- Base model electrical package includes NEMA-1 enclosure with a 110 VAC, 60 Hz or 220 VAC, 50 Hz single-phase control circuit; applies to all ECN models
- Automatic inlet shutoff valve
- Pre-filter housing and 5-micron cartridge filter
- Pre-filter, post-filter, primary and final pressure gauges
- Digital concentrate and permeate flow meters
- Digital conductivity monitor, panel-mounted, for permeate quality monitoring
- Autoflush System - programmable, automated high-velocity membrane flushing for the longest membrane life; set at the factory and adjustable in the field

* Noryl is a trademark of General Electric Company.

- Gauges, valves and rigid piping of stainless steel or plastic
- Sepralator housings, all 304 stainless steel, with Noryl end caps
- 316 stainless steel concentrate and recycle valves
- All components in contact with the purified water (permeate) are either FDA-acceptable plastic (nylon, Noryl, polypropylene, PVC) or stainless steel materials.
- All high pressure fittings are 304 stainless steel.
- Alarms included: low inlet pressure and high amp draw

1.4.2 DLX Model Option

The DLX package contains all of the above ECN standard features along with a PLC control system.

- Multi-stage centrifugal pump, SS construction (316 stainless steel end castings and other wetted parts, Noryl internals)
- Autoflush System - programmable, automated high-velocity membrane flushing for the longest membrane life; set at the factory and adjustable in the field
- All high pressure fittings are 304 stainless steel.
- Special electrical upgrade package includes PLC controller with alarm delay shutdown for low inlet pressure condition to prevent pump damage should pressure fall below 15 psig (1 bar)
- Clean-In-Place (CIP) system
- Digital flow meter and conductivity controller
- Digital pH controller
- Alarms included: low inlet pressure, high amp draw, high / low pH

1.5 Specifications for E-Series Machines

1.5.1 Feedwater Specifications

Temperature	35-77°F (2-25°C) [Not to exceed 85°F (29°C) unless specifically designed for higher temperatures]
Inlet Pressure	Minimum 30 psig (2.1 bar); Maximum 60 psig (4.1 bar)
Chlorine (continuous feed)	For Osmo HR(PA) membranes 0 ppm

	Operating pH	For soft water [less than 1 grain per gallon (gpg) or 17 mg/L hardness], acceptable pH is 3.0 -10.0. For unsoftened water (contact factory with water analysis), acceptable pH is 5.5 - 6.0.
	Pre-Filter	5-micron Hytrex® cartridge (See machine label for part number.)
	Inlet Connections	1.5-inch FNPT

1.5.2 Permeate (Product Water) Flow Rate

Stated on the serial number label (assumes no permeate backpressure, 2000 mg/L TDS maximum feed concentration, and rated temperature)

To estimate permeate output with backpressure, use the formula below:

$$\text{Permeate Flow on Label} \times \frac{\text{Operating pressure - (Permeate backpressure)}}{\text{Operating Pressure}}$$

Permeate Backpressure	Maximum - 80 psig (5.5 bar)
Permeate Outlet	1-inch FNPT

1.5.3 Concentrate Flow Rate

Factory-set as stated on serial number label

Concentrate Outlet	1-inch FNPT

1.5.4 Typical Pure Water

Recovery:	50 - 75%

1.5.5 Operating Final Pressure: Minimum - 200 psig (13.8 bar)
Maximum - 235 psig (16.2 bar)

1.5.6 Pump

Multi-stage centrifugal; approximate primary operating pressure of 190 psig (13.1 bar) excluding line pressure

1.5.7 RO Membrane Rejection - (See Figure 4)

	Osmo HR(PA)
Typical Ionic Rejection	95 - 98%
Average Molecular Weight (MW) Cutoff *	150 MW *

* The MW cutoff is based on the pore size of the membranes and the nature (size/shape) of the organic molecule.

SALTS

CATIONS

Name	Symbol	Percent Rejection	Percent Passage (Avg)	Maximum Concentration Percent
Sodium	Na^{+}	94-96	5	5-10
Calcium	Ca^{+2}	96-98	3	*
Magnesium	Mg^{+2}	96-98	3	*
Potassium	K^{+1}	94-96	5	5-10
Iron	Fe^{+2}	98-99	2	*
Manganese	Mn^{+2}	98-99	2	*
Aluminum	Al^{+3}	99+	1	10-20
Ammonium	NH_4^{+1}	88-95	8	3-8
Copper	Cu^{+2}	98-99	1	10-20
Nickel	Ni^{+2}	98-99	1	10-20
Zinc	Zn^{+2}	98-99	1	10-20
Strontium	Sr^{+2}	96-99	3	-
Hardness	Ca & Mg	96-98	3	*
Cadmium	Cd^{+2}	96-98	3	10-20
Silver	Ag^{+1}	94-96	5	*
Mercury	Hg^{+2}	96-98	3	-

ANIONS

Chloride	Cl^{-1}	94-95	4	5-8
Bicarbonate	HCO_3^{-1}	95-96	4	5-10
Sulfate	SO_4^{-2}	99+	1	5-15
Nitrate	NO_3^{-1}	85-95	10	3-6
Fluoride	F^{-1}	94-96	5	5-8
Silicate	SiO_2^{-2}	80-95	10	-
Phosphate	PO_4^{-3}	99+	1	10-20
Bromide	Br^{-1}	94-96	5	5-8
Borate	$B_4O_7^{-2}$	35-70**	-	-
Chromate	CrO_4^{-2}	90-98	6	8-12
Cyanide	CN^{-1}	90-95**	-	4-12
Sulfite	SO_3^{-2}	98-99	1	5-15
Thiosulfate	$S_2O_3^{-2}$	99+	1	10-20
Ferrocyanide	$Fe(CN)_6^{-3}$	99+	1	10-20

* Must watch for precipitation; other ion controls maximum concentration

** Extremely dependent on pH; tends to be an exception to the rule

The following are typical rejections and passages for various salts and organics using the SEPA® -HR membrane at 400 psig (27.6 bar) operating pressure. Modules made with this membrane, such as the OSMO® -HR, can be expected to give these same passages. As can be seen, multivalent ions tend to have less passage than do monovalent ions. If monovalent ions are combined with multivalent ions to form a salt, the passage will be controlled by the multivalent ion. In RO all ions must be combined as the salt form before passages can be considered.

For estimating purposes, to obtain the expected permeate quality when handling a solution of salts, take a simple average of the feed concentration and the
concentrate concentration and multiply this figure by the average percent passage to calculate the average concentration of the permeate.Salts or organics that are complexed with organics of large molecular weights will tend to act like the organics with which they are complexed.

To estimate passage of salts for membranes other than SEPA-HR, take the passage for the SEPA-HR and multiply by the factor for the passage for the particular membrane. The factors are:

SEPA-SR is 1.6 times SEPA-HR passage
SEPA-PR is 2.5 times SEPA-HR passage

Operation of the SEPA-HR membrane at pressures over 400 psig (27.6 bar) will reduce salt passage slightly. Operation at 200 psig (13.8 bar) will increase the passage of monovalent ions by approximately 2.0 times and the passage of multivalent ions will increase by 1.5 times the 400 psig (27.6 bar) passage.

For SEPA membranes with larger pores than the SEPA-PR it is recommended that actual tests be run prior to estimating the permeate quality.

The maximum concentrations given in the table are the approximate concentrations resulting in an osmotic pressure of 500 psi (34.5 bar) for the solution.

Compounds such as $CaSO_4$ which have specific solubility limits can be controlled with proper addition of dispersants. Check with the factory for more information on Osmonics' special line of dispersants.

ORGANICS

	Molecular Weight	Percent Rejection	Maximum Concentration Percent
Sucrose Sugar	34299.9	30-35	
Lactose Sugar	360	99.9	30-35
Protein	10,000 Up	99.9	50-80
Glucose	180	99.0	15-20
Phenol	94	***	-
Acetic Acid	60	***	-
Formaldehyde	30	***	-
Dyes	400 to 900	99.9	-
Biochemical Oxygen Demand	(BOD)	90.0-99.9	
Chemical Oxygen Demand	(COD)	99.9	-
Urea	60	40-60	Reacts similar to a salt
Bacteria & Virus	50,000 to 500,000	99.9+	-
Pyrogen	1,000 to 5,000	99.9+	-

*** Permeate is enriched in material due to preferential passage through the membrane.

GASES, DISSOLVED

Carbon Dioxide	CO_2	30-50%
Oxygen	O_2	Enriched in permeate
Chlorine	Cl_2	30-70%

NOTE: The actual permeate water quality will vary with the inlet water quality and can only be verified by actual analysis of the permeate stream.

Figure 5 - Typical Membrane Rejections/Passages

2.0 INSTALLATION

2.1 Mounting

E4H machines are equipped with a stand alone frame, 61-inch (155-cm) H x 132-inch (335-cm) W x 34-inch (86-cm) D, which supports the machine. At least 45 inches (114 cm) of space should be allowed on each end of the sepralator housings for removal and loading of sepralators. If 45 inches (114 cm) are not available, the entire sepralator housing may need to be removed for sepralator changes.

2.2 Piping

2.2.1 Inlet Piping

The feedwater source is piped to the inlet using 1.5-inch NPT fittings. A CIP system is supplied with the DLX Model E4H. FOR ECN MODEL: To install a CIP system, remove plug and install valves on the E-Series machine as described in Section 2.2.2. If the inlet pressure is in excess of 60 psig (4.1bar) or fluctuates by more than 5 psig (0.4 bar), a pressure regulator should be installed ahead of the CIP tee.

2.2.2 Valves Required for CIP, ECN Models Only

IMPORTANT NOTE: Osmonics has installed a plugged pipe tee in the inlet line of the E4H units. This plug, when removed, will facilitate cleaning of the unit. A tee with (two) two-way valves or a single three-way valve should also be installed on the permeate and concentrate outlets to allow flow back to the cleaning tank. Never operate the machine with the concentrate or permeate lines blocked. Severe damage to the unit may result. (Refer to the attached drawing # 1163858 for a system flow schematic.)

2.2.3 Concentrate Outlet Connection

Install the CIP valve on the concentrate outlet tee, connect a 1-inch hose or pipe, and run it to an open drain. To avoid drainage from the machine while not in use, the concentrate outlet piping should be placed at a height at least equal to the height of the machine. A siphon break may also be installed in the concentrate line for added protection. The concentrate outlet hose can be any length, and the diameter should match the outlet on the machine. [Maximum backpressure is 60 psig (4.1 bar).]

2.2.4 Permeate Outlet Connection

Install the CIP valve on the permeate outlet tee. The pure water (permeate) should be transported to the point of use via noncorroding-type tubing, pipe, or hose. Examples are: food-grade flexible nylon tubing, stainless steel tubing, or PVC hose. The permeate outlet is 1-inch FNPT.

2.3 Electrical

The DLX and ECN E-Series models are supplied with a single-phase, 110 VAC 60 Hz or 220 VAC 50 Hz control circuit and 8-foot cord which plugs into a three-prong grounded receptacle. For 220 VAC, 50 Hz units, plug must be customer-supplied. A 20 amp dedicated service circuit is required for proper operation.

For each model, the motor is wired at the factory to an overload protection magnetic motor starter which is controlled by a panel-mounted manual switch.

The electrical system control circuit is separate from the motor voltage. Therefore, electrical wiring required in the field needs two supply voltages, the control circuit voltage and a separate three-phase motor voltage. All field wiring must comply with applicable local and national electric codes.

2.3.1 ECN Electrical System

2.3.1.1 Connect the control circuit power cord to 115 VAC, 60 Hz, or 220 VAC, 50 Hz, single-phase power.

2.3.1.2 Connect the magnetic motor starter 230/460 VAC or 220/380 VAC, three-phase power to match the motor voltage and phase. Check the tag (located on the motor starter) that indicates the factory wiring. A separate, fused disconnect for the motor wiring is required, with proper protection for the Hp and amp draw of the motor.

(See attached drawing #1164309 for the ECN electrical diagram). The ECN circuit has a timing relay for delayed machine shutdown.

2.3.2 DLX Electrical System

2.3.2.1 Connect the control circuit power cord to 115 VAC, 60 Hz, or 230 VAC, 50 Hz, single-phase power.

2.3.2.2 Connect the magnetic motor starter 230/460 VAC or 220/380 VAC, three-phase power to match the motor voltage and phase. Check the tag (located on the motor starter) that indicates the factory wiring. A separate, fused disconnect for the motor wiring is required, with proper protection for the Hp and amp draw of the motor.

3.0 PREPARATION AND START-UP

3.1 Pretreatment for Water Purification

All systems will operate most efficiently on filtered water with a pH of less than 6.5 and a Silt Density Index (SDI) of 5 or below. If the machine is operated on higher pH water, other forms of pretreatment may be necessary. A water analysis prior to start-up of the machine is required. To minimize the chances of calcium carbonate, calcium sulfate, or

other salt precipitation on the membrane, Osmonics evaluates each application and water condition and makes specific recommendations to ensure continuity of the membrane sepralator warranty. Data from the water analysis is processed with a computer program analysis to determine if potential problems exist. If the machine is to be run at a different location than was originally intended, a new water analysis is required for warranty consideration and should be sent to Osmonics for review and recommendations for operation of the machine.

Before entering the machine, the feedwater must be filtered to 5 microns.

TLC membrane feedwater must not contain the following chemicals or permanent loss of rejection and/or permeate flow may result:

- free chlorine
- formalin (until after a sepralator has been run for 24 hours; thereafter, 0.5% formaldehyde may be used as a biocide)
- iodine compounds
- quaternary germicides
- cationic surfactants
- detergents containing non-ionic surfactants
- cleaners not approved by Osmonics

CAUTION: A water softener should not regenerate while the machine is running unless safeguards are used to be sure the machine is operated on softened water during regeneration.

3.2 Start-Up

NOTE: If your machine is provided with the sepralators installed in the housings, proceed to 3.2.1. If your machine is provided with the sepralators in shipping boxes, you must load the sepralators in the housings prior to starting the machine. For sepralator loading instructions, skip to 4.6. Upon completion of sepralator installation, return to section 3.2.1 to continue your start-up procedure.

3.2.1 Re-check the function and integrity of your pretreatment equipment. Ensure that your water softener, activated carbon filters and iron filters (where applicable) have been leak-checked, backwashed, and thoroughly rinsed for service before starting up your RO unit.

3.2.2 Attach the feedwater pipe to the inlet of the machine.

3.2.3 Check for leaks at all connection points.

3.2.4 Turn on the feedwater gradually and check for leaks in the inlet piping. No flow should go through the machine while the power is off and the inlet solenoid is in the closed position.

NOTE: When the machine is off, there should never be flow through the machine. Flow through the machine when it is off can ruin the sepralators, and the inlet solenoid must be repaired.

3.2.5 Attach tubing from permeate and concentrate outlet points, and run the tubing to drain.

3.2.6 Ensure that you have made provisions for both voltages required to operate your machine. The machine requires two power sources: (1) the high voltage for the motor operation, and (2) the control circuit power supply. The factory provides the 110 VAC (or 220 VAC 50 Hz) power cord needed for the control circuit. The motor electrical service must be field-wired directly into the motor starter on the machine. Bring your motor service to terminals labeled "T" on the motor starter. Check the voltage label to ensure that you have brought the correct voltage to the starter.

3.2.7 Be sure the power to the motor starter is de-energized.

3.2.8 With the machine ON/OFF switch in the OFF position, plug in the factory-supplied 110 VAC (or 220 VAC 50 Hz) power cord.

3.2.9 Open your concentrate and recycle flow control valves two complete turns. These valves are positioned on the flow control center of the machine. This piping is located on the left section of the machine, near the sepralator housings. The flow control center features a concentrate flow control valve, a recycle flow control valve, and a pressure gauge sensor point piped into the panel-mounted pressure gauge.

NOTE: The autoflush valve is positioned in this flow control center.

The proper adjustment of these valves is critical to the operation of the RO machine. The concentrate valve determines the amount of rejected water leaving the machine, and creates the operating pressure shown on the pressure gauge. The recycle valve returns unused reject flow back into the inlet stream to the RO pump. It is important to balance the operating pressure and the respective flows of these valves to ensure that your machine is operating correctly. It is also important to understand the relationship of these two valves, the pressure gauge, and your RO pump. The pump has a fixed amount of flow produced, and the valves are the control devices to distribute this fixed flow amount. The pressure gauge is an indicator of applied membrane pressure, at the flows set by the valves.

3.2.10 Turn the ON/OFF switch to the ON position. Water will begin to flow through the machine at this point but the pump will not start. Allow the machine to operate in this manner for 10 minutes, to purge the air out of the machine. Verify alarm set-points in the Lakewood 2450 Reverse Osmosis controller.

Consult the Lakewood Model 2450 Installation and Operation Manual (P/N 1109695) for operating instructions. The factory alarm setpoints are as follows:

Low Inlet Pressure	12 psig
Low pH	2.0
High pH	8.0
pH Control	5.6-6.2
High Temperature	120ÞF (39ÞC)

NOTE: The high-pressure pump should not be operating at this time.

3.2.11 As your machine is filling check for leaks and repair as needed.

3.2.12 Turn the ON/OFF switch to the OFF position.

3.2.13 Energize the power source to the motor starter. The pump should not operate at this point.

3.2.14 Check the rotation of the high pressure pump by briefly turning the ON/OFF switch to the ON position. Watch the motor, or coupling shaft, for direction of rotation. The motor should rotate clockwise as one looks at the motor end of the high pressure pump. If the motor is not rotating clockwise, change any two of the three leads (for three-phase) in the motor starter and recheck rotation. Always turn the power off to change any wiring.

CAUTION: Operation of the pump backwards for even a short time can cause damage to the pump.

3.2.15 Turn the ON/OFF switch to the ON position. The high-pressure pump will operate and the machine will begin to build pressure. As you are operating, be sure to watch the pressure gauge on the instrument panel. The machine is designed to operate at 220 psi (15.2 bar).

NOTE: Do not allow the pressure to exceed 250 psi (17.3 bar). If the pressure exceeds 250 psi (17.3 bar), open the concentrate flow control valve until the pressure gauge shows 250 psi (17.3 bar) or less.

As the machine purges the air and fills with water, the pressure will gradually increase. You should see water flowing through the permeate and concentrate flow meters. If you do not see flow, turn the machine off and return to Section 3.2.1.

NEVER ALLOW THE MACHINE TO OPERATE WITHOUT ADEQUATE WATER PRESSURE. THIS CAN CAUSE SEVERE DAMAGE TO THE HIGH-PRESSURE PUMP.

3.2.16 Gradually close the concentrate flow control valve. As you close the valve, watch the pressure gauge and your concentrate flow meter. Close the valve until your concentrate flow meter displays your design flow, and you do not

exceed 250 psi (17.3 bar). If you reach 250 psi (17.3 bar) before the valve is completely closed, open the recycle flow control valve one full turn, then continue to close the concentrate flow control valve. Continue to close the concentrate flow control valve until it is completely closed and your pressure is below 250 psi (17.3 bar).

The concentrate flow control valve has a drilled orifice to ensure a predetermined amount of flow and pressure in the closed position. This orifice is sized to operate the machine at 75% recovery.

3.2.17 With the concentrate flow control valve fully closed and the pressure below 250 psi (17.3 bar), gradually close the recycle flow control valve until the pressure reaches 250 psi (17.3 bar).

Your machine is now operating at the design pressure and flow rates, in a 75% recovery configuration. Your specific needs or conditions may dictate the need to operate the machine at a lower recovery. If you wish to operate in a recovery configuration lower than 75%, Section 3.2.18 will explain the necessary steps.

3.2.18 Your machine is equipped with flow meters and a pressure gauge that will assist you in setting alternate flow rates for variable recoveries. If you wish to operate at a recovery lower than 75% you must ensure that the flow rates for the permeate and concentrate are at desired levels. Some minor adjustments in the concentrate and recycle flow control valves may be necessary.

See Table 1 below for specified flow rates for various machine recoveries. When you have selected your desired flow rate, gradually adjust the concentrate flow control valve to achieve desired flow and use the recycle valve to bring the operating pressure up to 250 psi (17.3 bar).

Once the desired flow rate is achieved [250 psi (17.3 bar) operating pressure] no further valve adjustment is needed.

The table below shows flow rates at 50%, 66% and 75% recovery for the E4H models. Use this table in adjusting flow rates.

NOTE: Permeate flow rates are dependent upon temperature and conditions at your site. Contact your dealer if you have any questions.

Table 1 - Machine Recovery

	Permeate Flow (gpm)	Concentrate Flow (gpm)		
Model	at 50%, 66%, and 75% Recovery	at 50%	at 66%	at 75%
		Recovery	Recovery	Recovery
E4H-16K	11.25	11.25	5.80	3.75
E4H-21K	15.00	15.00	7.73	5.00
E4H-27K	18.75	18.75	9.66	6.25
E4H-38K	26.25	26.25	13.52	8.75
E4H-43K	30.00	30.00	15.45	10.00

3.2.19 The system is now operational.

3.2.20 Before putting the machine into final operation, continue to run the permeate and concentrate streams to drain for at least 30 minutes. This is done to ensure that all of the bactericide has been removed from the sepralators.

3.2.21 Connect the permeate line to the point of use of the permeate. Check for leaks and ensure that you have no kinks in hoses, or blockage of any piping on the permeate and concentrate outlet lines.

3.2.22 Make any necessary final adjustments to flows and pressure according to Section 3.2.18.

NOTE: The sepralator(s) in your machine are rated for certain flow rates at 77°F (25°C). Maximum flow rates are achieved when the seprala-tors have been completely rinsed and on-line for at least 24 hours.

3.2.23 A daily log sheet which includes general operating conditions (pressures, flows, concentrations, pH, and pretreatment conditions), and routine or special maintenance (flushing or cleaning as needed) must be kept. This log sheet will be required by Osmonics if a warranty question arises.

4.0 OPERATION AND MAINTENANCE

The operation and maintenance of your Osmonics E4H Machine is relatively simple but requires regular data recording and routine preventative maintenance. We cannot emphasize too strongly the importance of filling out the daily log sheet during each operating shift. A data sheet was filled out upon 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 refer-ence. If you have questions concerning the operation of your machine or the method of data recording, contact the Osmonics Application Engineering Department.

The three preventative maintenance procedures which must be done on a regular basis are as fol-lows:

1. Change the pre-filter cartridge.

2. Flush the machine daily.

3. Clean the machine with approved Osmonics cleaners.

See the following sections for specific maintenance procedures.

4.1 Daily Log Sheets

A daily log sheet which includes general operating conditions (pressures, flows and concentrations) and routine or special maintenance (pre-filter changes, flushing, cleaning, etc.) must be kept. Copies of the log can be made from the template. A copy of this log sheet will be required by Osmonics if a warranty question arises.

4.2 Pre-Filter

4.2.1 A 5-micron pre-filter is factory-installed to protect the sepralators and valves from particles which may be in the feedwater. The pre-filter uses two 20-inch (50.8-cm) diameter, 5-micron nominal rated cartridges. To order replacements, see the standard parts list.

4.2.2 The filter cartridges must be replaced, at a minimum, once per week or after every 100 hours of operation, whichever comes first. A pressure drop of 8 psig (0.6 bar) across the filter or more during operation indicates one or more cartridges need changing. Use only Osmonics approved filters rated for 5 microns or less. Do not attempt to clean used filters - install new replacements.

IMPORTANT NOTE: Failure to change the filter according to these requirements will void the warranty.

4.3 Flushing

The machine should be flushed at least daily to remove sediment from membrane surfaces. To flush the unit:

4.3.1 Open the concentrate valve until the pressure gauge indicates the minimum pressure designated on the nameplate. This increases the flushing action on the membrane.

NOTE: If pressure will not decrease to designated pressure, or if the concentrate rate does not increase when the valve is opened, the valve may be plugged.

4.3.2 Operate the machine at the designated minimum pressure for 10 to 20 minutes.

CAUTION: Do not operate the machine below the designated pressure without approval from Osmonics. Operation below the stated pressure may be detrimental to the pump.

4.3.3 Close the concentrate valve and ensure that the proper concentrate flow rate is going to the drain (see the nameplate on the panel).

NOTE: The Autoflush (AUF) system, available in DLX packages, automatically flushes the machine and eliminates the need for frequent manual flushing.

4.4 Cleaning

Cleaning the E-Series machine on a regular basis is vital. Over time, contaminants build up to form a layer on membrane surfaces, reducing the permeate flow and quality. If this build-up is not removed from the membrane, it may cause permanent chemical damage and reduce sepralator life. A decrease in permeate flow and/or rejection of salts, or an

increased pressure drop across the machine will indicate when cleaning is required. Cleaning may be required as often as once every week or as infrequently as every two months, depending upon the local water supply conditions. Osmonics recommends cleaning at least every month to ensure good sepralator performance and long sepralator life.

Osmonics offers a full line of chemical cleaners for specific cleaning needs. See Table 2.

Table 2 - Dry Chemical Cleaners

Cleaner	Description	Part No.	Quantity
Osmo AD-20	Dry acid-surfactant for cleaning	1155420	8- x 4-lb. pkgs/case
	TLC, PA and CA sepralators	1155421	45-lb pail
		1155422	100-lb keg
		1155423	300-lb drum
Osmo AK-110	High pH alkaline cleaner for PA	1155416	8- x 4-lb pkgs/case
	membranes. Recommended	1155417	45-lb pail
	for situations where microbial	1155418	100-lb keg
	fouling is a problem. Do not	1155419	300 lb drum
	use on CA sepralators.		
Osmo ET-70	Cleaner intended to deal with	1155424	8- x 4-lb pkgs/case
	sulfate or iron precipitation	1155425	45-lb pail
	fouling. Recommended for CA	1155426	100-lb keg
	and PA sepralators.	1155427	300 lb drum

CLEANING PROCEDURE

4.4.1 With the RO machine running, open the CIP permeate valve. After this valve has been opened, close the permeate service valve. Permeate water will flow into the CIP tank. Allow the water to run through the CIP tank and the CIP tank drain valve for a few minutes to ensure the tank is rinsed thoroughly. After a minute or so, close the CIP tank drain valve. The CIP tank should begin to fill with RO permeate. When the CIP tank has filled to the indicated full line, turn the ON/OFF switch on the RO machine to the OFF position.

4.4.2 While the machine is OFF, open the CIP inlet valve. Divert the permeate and concentrate streams to the cleaning container for recirculation. Ensure that the pre-filter is clean. A CIP pump (supplied with DLX models only) is recommended to supply feed pressure into the machine.

4.4.3 To circulate the cleaning solution through the machine with suction, remove the CIP plug. Use a noncollapsible suction hose or pipe to feed the machine.

NOTE: Do not allow the machine pump to operate without concentrate flow. If pump prime is lost while cleaning on suction, positive inlet pressure is required to reprime. No air should be sucked into the inlet line during suction cleaning.

4.4.4 Turn the CIP ON/OFF switch to the ON position and recirculate the cleaning solution through the machine. The cleaning solution should be recycled for approximately 15 minutes or until the solution temperature reache 85°F (29°C). If heat rise occurs too quickly, larger volumes of cleaning solution or the use of a heat exchanger will slow the temperature rise. Turn the CIP off and allow it to soak for 10 minutes.

NOTE FOR TLC MEMBRANE: It is best to clean at temperatures of 100°F to 110°F (38°C to 43°C), but lower temperatures will suffice. Do not allow the cleaning temperature to exceed 110°F (43°C). Allow the cleaning solution to recirculate for 10 minutes. Turn the machine off and allow the sepralators to soak in the solution for approximately 20 minutes.

CAUTION: Do not leave a cleaning strength solution in the machine for a period longer than one hour. The cleaning solution may damage the sepralators and/or the machine during an extended period of contact.

4.4.5 To flush the detergent from the machine, close the CIP inlet valve and divert the permeate and concentrate to drain by opening the CIP drain valve. Operate the machine as described in the flushing section (see Section 4.3) for at least one hour. The detergent is sufficiently flushed when the permeate conductivity is restored to nearly its previous level.

4.4.6 To return the RO to service, open the permeate, concentrate valves so that flow is routed as intended in the service mode. Close the CIP permeate, CIP concentrate valves. The RO is now ready for operation.

4.5 Draining Machine for Shipment

Prior to shipping or outside storage of an Osmonics E4H Machine, the system should be cleaned with the appropriate cleaner, flushed with water, and protected from biological attack with the appropriate solution for TLC membrane. The sepralator housings and piping lines of the machine must be completely drained. Any water remaining in the piping of a machine may freeze, causing damage to the piping, pump, sepralators, etc. The party shipping or storing the machine is responsible for any damage resulting from freezing.

4.5.1 Disconnect the inlet, concentrate and permeate outlets.

4.5.2 Drain all water from the cartridge filter housing.

4.5.3 Remove the tubing connections on the inlets and outlets of the sepralator housings.

4.5.4 Open the concentrate valve.

4.5.5 Remove the drain plugs from all PVC manifolds.

4.5.6 Be sure the flow meters are drained by disconnecting the bottom fitting of each meter.

4.5.7 Allow the machine to drain for a minimum of eight hours or until the opened ports quit dripping.

4.5.8 After draining is complete, reconnect all of the piping.

4.6 Sepralator Installation

4.6.1 For machines with sepralators not loaded at the factory, the following steps are to be used for installation.

CAUTION: The sepralator is packaged in a small amount of bactericide solution to prevent biological growth; provide adequate ventilation when handling. The sepralator must be kept moist at all times in order to prevent possible damage to the membrane material.

4.6.2 Remove the sepralator bag containing the sepralator from the shipping tube.

4.6.3 Cut the bag open as close as possible to the seal at the end of the bag, so that the bag may be re-used if necessary.

4.6.4 Remove the sepralator from the bag and remove the foam protectors from each end of the sepralator.

4.6.5 Remove the parts from the parts container (if included) and inspect. Make sure that all parts are clean and free from dirt. Examine the O-rings, brine seal, and permeate tube for nicks or cuts. Replace the O-rings or brine seal if damaged. Set the sepralator aside in a clean space and continue on to Section 4.6.6.

4.6.6 Remove the end caps from both ends of all sepralator housings on your machine. This is done by loosening the clamp bolts at each end cap closure assembly.

4.6.7 Determine the direction of fluid flow in the sepralator housing. (Be certain to look at the "Direction of Flow" arrow for each sepralator housing. Direction of flow may vary within a given machine.)

4.6.8 Inspect the sepralator housing and clean as necessary to remove any contaminants, obstructions, etc.

4.6.9 Apply a small amount of O-ring lubricant to all O-rings on the end caps, and the brine seal on the sepralator.

4.6.10 Insert the downstream end of the sepralator in the upstream end of the sepralator housing (i.e., load in the direction of flow; the brine seal is on the end of the sepralator that goes in last. For sepralator housings with the flow arrow pointing up refer to Section 4.6.12).

4.6.11 Insert the sepralator in the sepralator housing with a smooth and constant motion. When you reach the point where the brine seal is about to enter the housing, gently turn the sepralator to ensure the brine seal enters the housing without coming out of the brine seal groove.

4.6.12 When all of your sepralators are installed, you must close the sepralator housing package by re-installing the end caps and clamps. It is preferred to install the bottom end cap first, and tighten the clamp completely, before installing the top end cap.

4.6.13 Re-install the end caps by gently twisting the end cap while pushing it on to the permeate tube. Ensure that you do not pinch or fatigue any O-rings while pushing the end cap on. Push the end cap on until the outer diameter of the cap is flush with the outer diameter of the sepralator housing. Install the clamp halves, and tighten the bolts until the clamp halves meet.

4.6.14 Re-connect any fittings that were removed when disassembling the sepralator housings.

4.6.15 Return to Section 3.2.1 in the Start-Up Procedure.

4.7 Sepralator Replacement

As time progresses, the efficiency of the sepralator will be reduced. In general, the salt rejection does not change much until two-three years after installation, when operated on properly pretreated feedwater and when routine maintenance is performed. The permeate flow rate will begin to decline slightly after one year of operation but can be extended with diligent flushing and cleaning of the machine. High pH feedwater and/or precipitation of hardness can cause premature loss in rejection and even flow rate. The following procedure is to be followed to replace existing sepralators in the machine.

4.8 Remove the end caps and clamps from all of the sepralator housings.

4.9 Remove all of the sepralators from the sepralator housings in the direction of flow where possible. If necessary, a sepralator can be removed against the direction of flow. A heavy-duty pliers or channel lock pliers may be necessary to pull the old sepralator out of the sepralator housing.

4.10 To re-install replacement sepralators, follow Sections 4.6.2-4.6.15.

NOTE: Do not operate the machine on water over 85°F (29°C).

NOTE: Do not allow the machine to freeze unless it is totally drained. It must thaw a minimum of 24 hours before starting.

5.0 OPTIONAL ACCESSORIES

5.1 Level Controls

Float switches, pressurized storage switches or other level controls should be wired into the control circuit line prior to the switch on the unit. The following ensures that the inlet valve, instruments, and pump are not powered when storage tanks are full: float switch assembly with cord, counterweight, and plastic float (used with an atmospheric storage tank).

5.2 Filters and Water Softeners

Backwashable filters and softeners should be installed such that unfiltered or unsoftened water will not be fed to the machine while the RO unit is operating. Failure to do this may cause fouling or precipitation of calcium carbonate or other materials onto the membranes.

5.3 Storage Tanks

Fiberglass, polyethylene and stainless steel storage tanks are available. All tanks are available with fittings installed at the factory. These tanks must be installed with even support along the bottom.

6.0 TROUBLESHOOTING

TROUBLESHOOTING GUIDE		
Symptom	**Possible Causes**	**Remedies**
Low operating pressure	Insufficient feedwater pressure or flow	Open the feed pressure, open the feedwater 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 indi cate a damaged O-ring.
	Dirty or fouled sepralators	Flush and clean the sepralators.
	Solenoid valve not opening	Clean or replace the solenoid valve.
	Pump rotating backwards (three-phase power only)	Switch any two three-phase leads to the motor starter.
	Insufficient electrical power	Check the fuses or circuit breakers, measure the voltage.
	Pump not operating correctly	See the pump instructions.
Low permeate flow rate	Low operating pressure	See the possible causes for low pressure.
	Dirty or fouled sepralators	Flush and clean the sepralators.
	Operating on cold water less than 55°F (13°C)	Install a hot/cold feedwater temper ing valve if more permeate flow is needed. Operate with a feedwater temperature of 72 to 77°F (22 to 25°C).
	Sepralators installed backwards	Install sepralators in the direction of or damaged concentrate seal fluid flow. Flush and clean the machine immediately. Sepralators with dam aged concentrate seals should be cleaned and may be returned for repair.
	Flow meter inaccurate	Check the flow rate manually with a stopwatch and calibrated container.

TROUBLESHOOTING GUIDE		
Symptom	**Possible Causes**	**Remedies**
Low concentrate flow rate, normal or higher than normal pressure	Concentrate valve plugged	Remove the concentrate valve step and/or disassemble the piping. 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 stopwatch and calibrated container.
Pressure does not drop when concentrate valve is opened	Dirty concentrate valve	Disassemble and clean the piping to the valve.
High operating pressure plugged	Recycle or concentrate valve	Disassemble the piping 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 the possible causes for low permeate rate.
Excessive pressure drop [over 50 psig (3.5 bar)] (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 sepralator housings.
	Telescoped sepralator covering sepralator housing outlet port	Ensure that the anti-telescoping device (ATD) is located properly on the sepralator.
	Severely fouled or dirty sepralators	Flush the machine, then clean it with detergent.
Water flowing when machine is turned off	Inlet solenoid valve not closing	Clean or replace the valve. Clean or seating properly the seprala tors with detergent immediately. Water must not pass through the inlet when the machine is off.

TROUBLESHOOTING GUIDE		
Symptom	**Possible Causes**	**Remedies**
Declining rejection (high permeate conductivity)	Dirty or fouled sepralators	Flush and clean the sepralators.
	O-ring seal broken or damaged	Replace the O-ring, check the seal ing surfaces on the O-ring groove, interconnectors and end caps. Replace damaged parts.
	Change in incoming water quality	Open the concentrate valve and flush. Test the water for pH, hard ness, TDS and iron content. A water analysis should be sent to Osmonics for review.
	Inaccurate conductivity monitor or fouled probe.	Calibrate the monitor with a solu-tion of known conductivity or check the readings with another conductivity meter. Replace or clean the probe. Check the con nections between the probe and monitor.
Switch on, unit not operating	Pressurized storage switch or float switch has cut power to machine	Check the permeate backpressure or position of float in the storage tank.
	Thermal overload in motor has tripped	Allow the machine to cool; check the feewater supply and /or amp draw of the motor.
	No power to machine	Check the fuses or circuit break ers; measure the voltage.
	Motor and/or pump not operating properly	See the pump instructions. Contact Osmonics for possible repair or replacement.
	Alarm condition has turned off machine	Check for minimum inlet pressure and push alarm reset switch.
Electrical machine shutdown	Alarm condition has turned off machine	Restart the machine by pushing the alarm by-pass. Check all possible alarm conditions: inlet pressure, or motor starter overload.
	Motor starter overloaded; heater tripped	Turn the switch off; rest the heater(s).
	Timing relay defective/burned out	Replace the relay.

7.0 Spare Parts List

Membranes, Housings and Associated Hardware	Part Number
Mechanical Coupling, 4.0", EPDM Gasket	1153148
Mechinaical Coupling, 1.25", EPDM Gasket	1157370
Mechanical Coupling, 1.0", EPDM Gasket	1163602
Gasket for 4.0" Victualic Coupling	1146970
Gasket for 1.25" Victaulic Coupling	1146969
Gasket for 1.0" Victaulic Coupling	1146968
Pipe Clamp, 4.25" OD	1111640
End Cap Adapter Kit*	1141054
Interconnector, 4.0"	1158747
Membrane, OSMO 415-HR(PA)	1200344
Interconnector, 4.00, FT, SW	1154854
Cartridge, Depth Filter, LD05-20	1201459
Pump, Discharge Screen 1.25", Victaulic	1120264
Coupling, MC, Glv, EPDM, 1.25 HP	1157370
*End Cap Adapter Kit includes:	
O-Ring, Buna-N, 116, 70 Dur (2 each)	1111759
O-Ring, Buna-N, 016, 70 Dur (2 each)	1117408
Endcap Adapter, PVC (1 each)	1140413

Electrical	Part Number
Low Inlet Pressure Switch	1111944
Programmable Logic Controller With program loaded	1220169
Selector Switch, Illuminated System, CIP On/Off	1220722
Pushbutton Switch, Momentary, Illuminated Alarm Reset	1220723
Lakewood 2450 Controller	1169339
Complete Control Box Assembly	1164309

Instrumentation	Part Number
Pressure Gage, 0-600 psi	1117178
Pressure Gage, 0-100 psi	1164157
pH Sensor	1165305
Conductivity Sensor	1104591
Permeate Flow Sensor	1156637
Concentrate Flow Sensor	1156630

Valves	Part Number
Autoflush Solenoid Valve, 110V, SS, 0.25" FPT	1153037
Autoflush Solenoid Valve, 220V, SS, 0.25" FPT	1151239
Inlet Solenoid Valve, 110V, 1.5" FPT	1163940
Inlet Solenoid Valve, 220V, 1.5" FPT	1163941
Valve, PVC, 0.25" MPT x HSB	1156744
Angle Valve, PVC, 0.25" MPT x HSB Permeate Sample Valve	1156560
Check Valve, PVC, 1.50" Permeate Valve	1143417
Ball Valve, PVC, 1.00" FPT Permeate/Concentrate Outlet Valve	1110433
Needle Valve, 0.38" FPT, 303 SS Recycle/Concentrate Valve	1158618

Literature	Part Number
Intruction Manual, OSMO, E4H-16-43K	1163955
Manual, I&O, 2450	1109695

Cleaning Chemicals, Test Kits	Part Number
OSMO AD20, 45 lb. pail Acid Cleaner of PA membranes	1155421
OSMO AK110, 45 lb. pail Alkaline Cleaner for PA membranes	1155417
Conductivity Meter Myron L, Handheld	1112316
pH Test Kit (pH 4 - 10)	1155478
pH indicator Solution	1112844
Hardness Test Kit	1155479
Hardness Tablets, #6	1112973
Hardness Reagent, #6	1112860
Hardness Reagent, #7	1112972
Chlorine Test Kit	1144477
Chlorine Reagent, 500 mL	1113166
SDI Kit Manual SDI Kit	1112697

Pumps/Motors*	Part Number	Where Used
PUMP, TF, SS2823G, 7.5 HP, 60 HZ Reverse Osmosis	1120986	16K, 21K
PUMP, TF, SS2834D-50, 7.5 HP, 50 HZ Reverse Osmosis	1123571	16K, 21K
PUMP, TF, SS2805AZ, 2 HP, 60 HZ Clean-in-Place	1120521	16K, 21K, 27K
PUMP, TF, SS2808AZ-50, 2 HP, 50 HZ Clean-in-Place	1120523	16K, 21K
PUMP, TF, SS2828D, 10 HP, 60 HZ Reverse Osmosis	1123487	27K
PUMP, TF, SS5512D-50, 10 HP, 50 HZ Reverse Osmosis	1123583	27K
PUMP, TF, SS5512KA, 15 HP, 60 HZ Reverse Osmosis	1123972	38K, 43K
PUMP, TF, SS518KB-50, 15 HP, 50 HZ Reverse Osmosis	1125024	38K, 43K
PUMP, TF, SS5503G, 5 HP, 60 HZ Clean-in-Place	1121062	38K, 43K
PUMP, TF, SS5503G-50, 3 HP, 50 HZ Clean-in Place	1123575	27K, 38K, 43K

* All motors are three-phase and totally enclosed fan cooled (TEFC).

Pumps Only, No Motor	Part Number	Where Used
PUMP, TF, SS2823G, 60 HZ Reverse Osmosis	1120219	16K, 21K
PUMP, TF, SS2834D, 50 HZ Reverse Osmosis	1120752	16K, 21K
PUMP, TF, SS2805AZ, 60 HZ Clean-in-Place	1120216	16K, 21K, 27K
PUMP, TF, SS2834D, 50 HZ Clean-in-Place	1120750	16K, 21K
PUMP, TF, SS2828D, 60 HZ Reverse Osmosis	1121571	27K
PUMP, TF, SS5512D, 50 HZ Reverse Osmosis	1121876	27K
PUMP, TF, SS5512KA, 60 HZ Reverse Osmosis	1123878	38K, 43K
PUMP, TF, SS5518KA, 50 HZ Reverse Osmosis	1123880	38K, 43K
PUMP, TF, SS5503G Clean-in-Place		
50 HZ	1121282	27K, 38K, 43K
60 HZ	1221282	38K, 43K

7.0 RETURN GOODS AUTHORIZATION (RGA) PROCEDURE

If you wish to return good for repair, warranty evaluation and/or credit, please have your original sales order or invoice available when you call Osmonics. Call (800) 848-1750 and press #6 to speak with Customer Service. An Osmonics Customer Service representative will provide instructions and a return authorization number which needs to be clearly written on the outside of the box used to ship your materials. All equipment must be shipped to Osmonics with the freight prepaid by the customer. Call our Customer Service Center with any questions or issues concerning freight claims and a representative will discuss your situation.

All materials to be returned must be rendered in a non-hazardous condition prior to shipping.

IMPORTANT NOTE: Machines must never be shipped with water in them; this will void the warranty. Drain the machine completely before shipping and avoid freezing before draining. The machine should be sanitized prior to draining (see Section 4.4). See the draining instructions (Section 4.5).

8.0 WARRANTY/GUARANTEE

Osmonics guarantees the proposed product to be free from defects in material or workmanship when operated in accordance with written instructions for a period of one year from start-up or 15 months from receipt, whichever is shorter. Parts not manufactured by Osmonics are covered by their manufacturer's warranties, which are normally for one year.

Osmonics' spiral-wound membrane sepralators are guaranteed to operate within specifications when used for general water treatment for a period of 24 months from receipt providing the sepralators have not been abused by operating at high temperatures, high or low pH's, on undisinfected water, or on solutions which tend to precipitate.

For applications or water conditions other than those specified in the original purchase order for the reverse osmosis or ultrafiltration machine, the User should consult Osmonics' Engineering Department as to the suitability of the solution to be run in the membrane sepralators.

Limitations on pH and temperature can vary with membrane type and the application of the equipment. For general water treatment, pH should be kept between 3.0 and 7.0 with a temperature below 85°F (29°C) unless specifically designed for higher temperatures. For special applications or for pH or temperature ranges outside the stated limits, Osmonics may reduce the warranty period.

A sepralator which fails to perform satisfactorily within the first 90 days after receipt, has not been mishandled, and is returned to the factory, will be replaced free of charge except for freight and local labor. If a sepralator fails to perform satisfactorily during the balance of the warranty period and with the return of the sepralator to the factory, Osmonics will replace the sepralator with a new sepralator and will charge the User for the portion of the 24 months that the sepralator was used plus incoming freight and local labor. Such pro rata charges will be based on the list price prevailing at the time of warranty consideration. A new sepralator supplied under warranty terms will carry the standard 24-month new sepralator warranty.

If a sepralator is to be returned for warranty inspection, the User must obtain a RGA number from Osmonics before returning the sepralators. Sepralators are to be returned freight prepaid to Osmonics and Osmonics will return any warranty replacement sepralators to the customer prepaid. Sepralators must be kept damp at all times and must be clean and bagged in a watertight bag before returning. Only Osmonics approved cleaners, biocides, dispersants or other chemicals may be used with the sepralators. Use of other chemicals may void the warranty. The User is responsible for knowing the sepralator membrane material and for ensuring that chemicals harmful to the membrane are never in contact with the sepralators.

It is the obligation of the User to maintain frequent operating data records. Osmonics may request these records in the warranty evaluation. User must notify Osmonics at the very first sign of changes in operation of the Osmo machine or sepralators. Such notification should be in writing and should include all data requested on the operating log sheets.

9.0 START-UP DATA

Customer: _____ Date: _____

Model No.: _____ Tested By: _____

Serial No.: _____

	Units (Circle One)				Data	Data	Remarks
Permeate Rate		°F		°C			
Concentrate Rate	gpm	gph	Lpm	Lph	/	/	
Total Flow Rate	gpm	gph	Lpm	Lph	/	/	
Recovery	gpm	gph	Lpm	Lpm	/	/	
Pre-Filter Pressure		psi		bar			
Post-Filter Pressure		psi		bar			
Primary Preasure		psi		bar			
Final Pressure		psi		bar			
Feed TDS		µS					
Concentrate TDS		µS					
Avg TDS		µS					
Permeate TDS (manual)		µS					
Permeate TDS (meter µS)		µS					
% Passage (Perm TDS/Avg TDS)							
Chlorine in Concentrate		ppm					
Pump Model No.							
Pump Serial No.							
Low Pressure Switch Setting		psi		bar			

NOMENCLATURE
PRESS = PRESSURE
CONC = CONCENTRATE (BLOW-BY) Q_c
PERM = PERMEATE (PURE WATER) Q_p
RESIST = RESISTANCE
TEMP = TEMPERATURE
RECY = RECYCLE
COND = CONDUCTANCE

DAILY LOG FOR OSMONICS E4H MACHINES

NAME OF COMPANY_____

PERIOD OF THIS SHEET_____ TO _____

MACHINE MODEL NO.:_____

SERIAL NO.:_____

NOTE: Please record all calibrations of instruments or other occurrences related to this system.

DATE AND TIME															
PRE-FILTER PRESS (psi or bar)															
POST-FILTER PRESS (psi or bar)															
PRIMARY PRESS (psi or bar)															
FINAL PRESS (psi or bar)															
TEMP (°F or °C)															
PERM FLOW (gpm or m^3/h) Q_p															
CONC FLOW (gpm or m^3/h) Q_c															
RECOVERY: $Q_p / (Q_p + Q_c)$															
FEED COND (μS) C_f															
CONC COND (μS) C_c															
AVG COND (μS) $(C_f + C_c) / 2$															
PERM COND (μS) C_p															
FILTER CHANGE ( ) & TYPE															
CLEAN ( )															
FEED CHLORINE (ppm)															
FEEDWATER HARDNESS (gpg or ppm)															
OPERATOR'S INITIALS															

This is a template. Make copies as needed.
*Symbols: Q - Flow Rate; C - Conductivity
Reference the Troubleshooting Guide in your Instruction Manual where trends or differences are noted.

Notes:

Notes: