

E Series RO/EDI

Installation Operation Maintenance Manual

**E Series Reverse Osmosis/EDI Systems
With EWS 'OS3051' controller & De-
gassing Membrane**

Three phase versions

Models

E 4-10

E 4-20

E 4-40

E 4-50

E 4-60

Rev 1.0

22/02/07

E Series RO

Installation Operation Maintenance Manual

CONTENTS

| | Section | Pages |
|------------|-------------------------------------|--------------|
| 1.0 | General Notes | 4 |
| 2.0 | The Process | |
| 2.1 | The Reverse Osmosis Process | 5 |
| | 2.1.1 Introduction | 5 |
| | 2.1.2 Membrane construction | 5 |
| | 2.1.3 Pressure pump | 6 |
| | 2.1.4 Recirculation | 6 |
| | 2.1.5 Recovery | 6 |
| | 2.1.6 Rejection | 7 |
| | 2.1.7 Flush | 7 |
| 2.2 | The De-Gassing Membrane | 7 |
| | 2.2.1 Introduction | 7 |
| 2.3 | The EDI Process | 7 |
| | 2.3.1 Introduction | 7 |
| | 2.3.2 EDI Module | 10 |
| | 2.3.3 EDI Controller | 10 |
| | 2.3.4 Isolating Transformer | 11 |
| | 2.3.5 EDI Flow Switches | 11 |
| 3.0 | Unpacking and Identification | |
| 3.1 | Basic packages | 12 |
| 3.2 | Unpacking notes | 12 |
| 3.3 | Lifting | 12 |
| 4.0 | Temporary Storage | 13 |
| 5.0 | Description of System | 14 |
| 6.0 | Pre-Installation Checks | |
| 6.1 | Mechanical | 16 |
| 6.1.1 | Foundations/drainage | 16 |
| 6.1.2 | Operating space | 16 |
| 6.1.3 | Incoming water | 16 |
| 6.1.4 | Pipework | 17 |
| 6.1.5 | Water Supply Company Requirements | 17 |
| 6.2 | Electrical | 17 |
| 6.2.1 | Three phase systems | 17 |
| 7.0 | Installation | |
| 7.1 | Mechanical | 18 |
| 7.1.1 | Inlet pipework | 18 |
| 7.1.2 | Drain connection | 18 |
| 7.1.3 | Permeate connection | 19 |
| | Section | Pages |

E Series RO

Installation Operation Maintenance Manual

| | | |
|-------------|---|----|
| 7.2 | Electrical | 20 |
| 7.2.1 | Mains Supply | 20 |
| 7.2.2 | Auxiliary closedown | 20 |
| 7.2.3 | Level sensor installation | 20 |
| 7.2.4 | BMS/Alarm connection | 20 |
| 8.0 | Commissioning | |
| 8.1 | EDI | 21 |
| 8.2 | Controls | 21 |
| 8.3 | Pre Service flush | 23 |
| 8.3 | Service connections and checks | 26 |
| 9.0 | Operation | 27 |
| 9.1 | Routine Maintenance | 27 |
| 9.2 | Temporary shutdown | 27 |
| 9.3 | Example data recording sheet | 28 |
| 10.0 | Fault Finding & Rectification | 29 |
| 11.0 | Warranty & Service | 31 |
| 12.0 | Technical Data | |
| 12.1 | Process and Operating Data | 32 |
| 12.2 | Engineering data | 33 |
| 12.3 | Parts data | 34 |
| 13.0 | EWS OS3030 Controller | |
| 13.1 | Manufacturer's manual | 35 |
| 13.2 | Factory programming notes | 35 |
| 13.3 | Maintenance program | 35 |
| 13.4 | Factory programming | 35 |
| 14.0 | Drawings | |
| 14.1 | Dimensions and parts identification E Series 8000 | 37 |
| 14.2 | Plumbing layout | 38 |
| 14.3 | General cabling diagram | 39 |
| Appendix 1 | De-Gasser Details | |
| Appendix 2 | EDI Trouble Shooting Charts | |
| Appendix 3 | EDI Current Calculation | |

E Series RO

Installation Operation Maintenance Manual

1.0 GENERAL NOTES

These instructions cover the E Series Range of Commercial Reverse Osmosis /EDI Systems, which includes models with nominal outputs ranging from 500 to 3000 litres per hour.

It is recommended that these instructions are read throughout before commencing any work on the unit, particularly if you have no previous experience of installing and using a high pressure Reverse Osmosis/EDI System.

The instructions have been written in such a manner that the vast majority of the text applies to all the models in the range. However, in some cases, there are differences between different models, and when these result in a requirement to undertake a task in a different way, individual sections have been written to cover each case. These are clearly marked, and should be easy to identify.

2.0 THE PROCESS

2.1 THE REVERSE OSMOSIS PROCESS

2.1.1 Introduction

Osmosis is a natural process involving fluid flow across a semi-permeable membrane barrier. It is the process by which nutrients feed the cells in our bodies and how water gets to the leaves at the top of trees.

If you separate a solution of salts from pure water using a basic thin semi-permeable membrane like a sausage skin, the pure water passes through the membrane and tries to dilute the salt solution. If the salt solution is connected to a vertical pipe then the progressively diluted solution will fill the pipe until the 'osmotic pressure' drawing the pure water through the membrane is the same as the head of solution.

This process can be reversed - hence 'Reverse Osmosis' - by applying a higher pressure to the salt solution. Pure water will then pass the other way through the membrane in a process that is easy to visualise as 'filtration' where the filter will only let through the small water molecules and retain almost all of the other molecules.

The mechanism of water and salt separation by reverse osmosis is not fully understood at the 'atomic' level. Current scientific thinking suggests two transport models: porosity and diffusion. That is, transport of water through the membrane may be through physical pores present in the membrane (porosity), or by diffusion from one bonding site to another within the membrane. The theory suggests that the chemical nature of the membrane is such that it will absorb and pass water preferentially to dissolved salts at the solid/liquid interface. This may occur by weak chemical bonding of the water to the membrane surface or by dissolution of the water within the membrane structure. Either way, a salt concentration gradient is formed across the solid/liquid interface. The chemical and physical nature of the membrane determines its ability to allow for preferential transport of solvent (water) over solute (salt ions).

2.1.2 Membrane construction

The semi-permeable membrane for reverse osmosis applications consists of a thin film of polymeric material a fraction of a millimetre thick cast on a fabric support. Commercial grade membranes have high water permeability and a high degree of semi-permeability; that is, the rate of water transport is much higher than the rate of transport of dissolved ions.

The membranes are stable over a wide range of pH and temperature, and have good mechanical integrity. The stability of these properties over a period of time at field conditions defines the commercially useful membrane life, which is in the range of 3 to 5 years. There are a number of different materials used for membranes and several ways of constructing them. This system uses a Composite polyamide spiral wound membrane.

In a spiral wound configuration two flat sheets of membrane are separated with a permeate collector channel material to form a leaf. This assembly is sealed on three sides with the fourth side left open for permeate to exit. A feed/brine spacer material sheet is added to the leaf assembly.

A number of these assemblies or leaves are wound around a central plastic permeate tube. This tube is perforated to collect the permeate from the multiple leaf

assemblies. The feed/brine flow through the element is a straight axial path from the feed end to the opposite brine end, running parallel to the membrane surface. The feed channel spacer induces turbulence and reduces concentration polarisation.

The spiral membrane is then enclosed by wrapping with glass reinforced resin into which is bonded an adapter cap at each end. Water under pressure is introduced into one end of the membrane assembly so that it runs between the feed channel spacers, with the concentrate and permeate output piped away at the other

2.1.3 Pressure pump

In order to develop sufficient water pressure to overcome the Osmotic Pressure of the feed water and produce an acceptable volume of permeate, a vertical multistage immersible pump is used to boost the supply pressure by approximately 230 PSI.

This type of pump is both quiet and reliable in continuous applications, requiring minimal maintenance.

2.1.4 Recirculation

Single membranes will normally 'recover' only 10-15% permeate from the raw water without fouling. However by returning a proportion of the concentrate exiting from the membrane to the inlet of the pressure pump, the flow across the surface of the membrane is dramatically increased allowing a recovery ratio of up to 75% to be achieved without significant fouling. Recirculation also allows a higher flow of water through the pump, reducing the load on its bearings and helping the pump to run cooler. The recirculation rate on the E Series is adjustable but should normally set at the rate set in the technical data.

2.1.5 Recovery

The 'recovery' of a Reverse Osmosis System is a measure of the proportion of the total input water that is converted to high quality permeate. A recovery ratio of 10% means that only 1 part in ten of the input water is converted to permeate. At 50% recovery, half of the input water is converted. At 75% recovery, three quarters of the input water is converted to permeate.

The recovery ratio on the E Series is adjustable, and its setting will affect the final water quality. At high recovery ratios, the amount of solids in the concentrate water as it exits the membrane will be high which will result in a higher level of solids in the permeate. However by reducing the recovery, the operating pressure in the system will also be reduced, which in turn can also result in a raised level of solids in the permeate since rejection rates are better at higher pressures.

A balance of the optimum water quality and volume is usually found at recovery ratios of 75%.

2.1.6 Rejection

The rejection ratio is a measure of the amount of solids dissolved in the raw water that are 'rejected' by the membrane. A rejection rate of 99% means that only 1% of the dissolved solids will pass through the membrane, and these are usually of low molecular weight.

At 99% rejection on a raw water supply of 400 ppm, you would therefore expect a permeate quality of 4 ppm. However by running single membranes at high recovery levels with considerable recirculation will mean that the membrane actually 'sees' a raw water of 1000-1500 ppm which could give a product water quality of 5-10 ppm from the reverse osmosis. This is then passed through the EDI further salt rejection giving a water quality of < 1 ppm.

2.1.7 Flush

In order to remove fouling that accumulates during service it is essential to periodically flush the membrane at a high water flow.

The controller fitted will automatically flush the membrane at the beginning and end of a production run, and also flush it periodically during standby and service.

2.2 DE-GASSING MEMBRANE

2.2.1 Introduction

CO₂ passes through a reverse osmosis element and can lead to excessive loads on the EDI, to overcome this a de-gassing membrane to remove the CO₂ is installed in the line between the reverse osmosis unit and the EDI unit.

The membrane preferentially passes CO₂ from the liquid side to the air side, this is then carried away either via a vacuum pump or with compressed air. As some liquid can migrate with the CO₂ the air exhaust of the membrane is connected to the gravity drain via a tun dish.

If compressed air is used to evacuate the CO₂ then the air supply is governed down to the required inlet pressure, filtered to 0.1 microns, the flow rate adjusted via a needle valve and shown on a variable area flow indicator. A high pressure switch is incorporated which will close the air solenoid should the air pressure exceed the pre set limit.

2.3 THE EDI PROCESS

2.3.1 Introduction

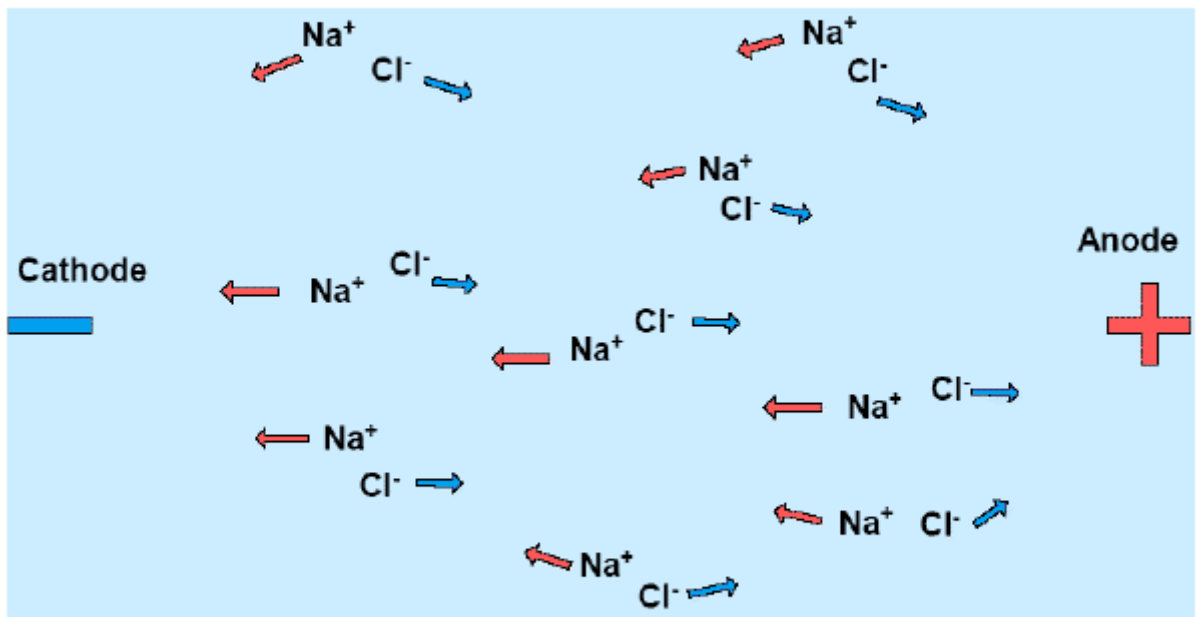
The EDI acts as a polisher post the Reverse Osmosis membranes removing ions that have passed through and producing water with a typical quality better than 10 Meg Ohms. The EDI unit acts in the same manor as a mixed bed unit except it is continuously regenerated by DC Electrical Power.

How The EDI Works

A typical EDI device contains alternating semipermeable anion and cation ion-exchange membranes. The spaces between the membranes are configured to create liquid flow compartments with inlets and outlets. A transverse DC electrical field is applied by an external power source using electrodes at the ends of the membranes and compartments.

When the compartments are subjected to an electric field, ions in the liquid are attracted to their respective counter-electrodes. The result is that the compartments bounded by the anion membrane facing the anode and the cation membrane facing the cathode become depleted of ions and are thus called diluting compartments. The compartments bounded by the anion membrane facing the cathode and cation membrane facing the anode will then “trap” ions that have transferred in from the diluting compartments. Since the concentration of ions in these compartments increases relative to the feed, they are called concentrating compartments, and the water flowing through them is referred to as the concentrate stream (or sometimes, the reject stream).

Salt Movement in Solution with Electric Field



Opposite charges attract

Like charges repel

Anions migrate towards anode

Cations migrate towards cathode

Ion exchange membranes are used to direct the ions into different flow channels. The negatively-charged anions (e.g., Cl⁻) are attracted to the anode (+) and repelled by the cathode (-). The anions pass through the anion-selective membrane and into the adjacent concentrate stream where they are blocked by the cation-selective membrane on the far side of the chamber, and are thus trapped and carried away by the carrier water in the concentrate stream. The positively-charged cations (e.g., Na⁺) in the purifying stream are attracted to the cathode (-) and repelled by the anode (+).

The cations pass through the cation-selective membrane and into the adjacent concentrate stream where they are blocked by the anion-selective membrane and are carried away.

In the concentrate stream, electrical neutrality is maintained. Transported ions from the two directions neutralize one another's charge. The current draw from the power supply is proportional to the number of ions moved. Both the "split" water (H^+ and OH^-) and the intended ions are transported and add to the current demand.

In an EDI device, the space within the ion depleting compartments (and in some cases in the ion concentrating compartments) is filled with electrically active media such as ion exchange resin. The ion-exchange resin enhances the transport of ions and can also participate as a substrate for electrochemical reactions, such as splitting of water into hydrogen (H^+) and hydroxyl (OH^-) ions. Different media configurations are possible, such as intimately mixed anion and cation exchange resins (mixed bed or MB) or separate sections of ion-exchange resin, each section substantially comprised of resins of the same polarity: e.g., either anion or cation resin (layered bed or LB and single bed or SB).

The electrodeionization process uses a combination of ion-selective membranes and ion-exchange resins sandwiched between two electrodes (anode (+) and cathode (-)) under a DC voltage potential to remove ions from RO-pretreated water.

Ion-selective membranes operate using the same principle and materials as ion-exchange resins, and they are used to transport specific ions away from their counter ions. Anion-selective membranes are permeable to anions but not to cations; cation-selective membranes are permeable to cations but not to anions. The membranes are not water-permeable.

By spacing alternating layers of anion-selective and cation-selective membranes within a plate-and-frame module, a "stack" of parallel purifying and concentrating compartments are created. The ion-selective membranes are fixed to an inert polymer frame, which is filled with mixed ion-exchange resins to form the purifying chambers. The screens between the purifying chambers form the concentrating chambers.

This basic repeating element of the EDI, called a "cell-pair", is illustrated in Figure 1. The "stack" of cell-pairs is positioned between the two electrodes, which supply the DC potential to the module. Under the influence of the applied DC voltage potential, ions are transported across the membranes from the purifying chambers into the concentrating chambers. Thus, as water moves through the purifying chambers, it becomes free of ions. This stream is the pure water product stream.

Most commercial EDI devices comprise alternating cation- and anion-permeable membranes with spaces in between configured to create liquid flow compartments with inlets and outlets. The compartments bound by a positively charged anion exchange membrane (AEM) facing the positively charged anode (+) and a negatively charged cation exchange membrane (CEM) facing the negatively charged cathode (-) are diluting or purifying compartments. The compartments bound by an anion membrane facing the cathode and a cation membrane facing the anode are concentrating compartments. To facilitate ion transfer in low ionic strength solutions, the dilute compartments, and sometimes the concentrate compartments, are filled with ion exchange resins. A transverse DC electrical field is applied by an external power source using electrodes at the bounds of the compartments such that ions in the liquid are attracted to their respective counter electrodes. The result is that the diluting compartments are depleted of ions and the concentrating compartments are concentrated with ions. Figure 1 is a representation of the process showing two diluting compartments and one concentrating compartment.

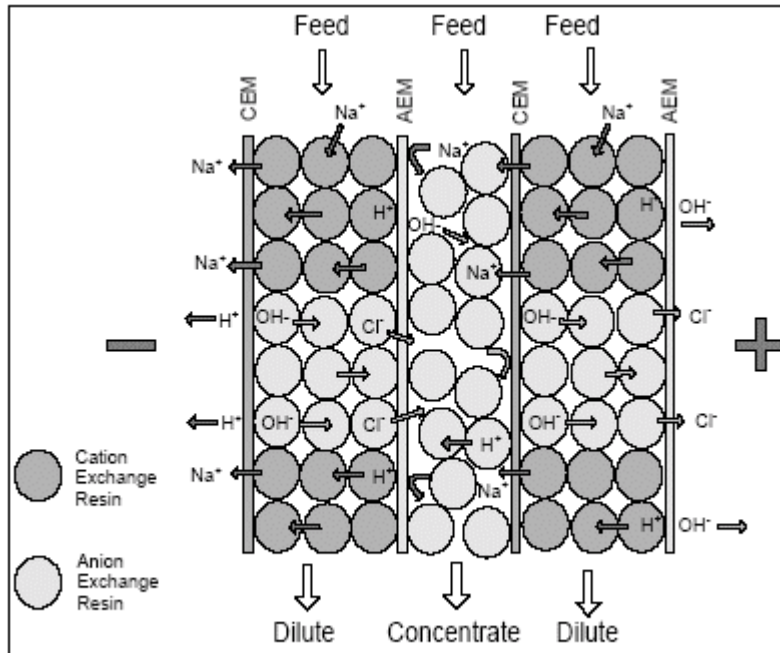


FIGURE 1.

NOTES:

CEM = Cation exchange membrane.

AEM = Anion exchange membrane.

The product stream may also be referred to as the dilute stream.

The reject stream may also be referred to as the concentrate stream.

2.3.2 The EDI Module

The module comprises a series of plates that are held together with tie bars. The electrical connections dilute/concentrate inlet and outlet ports are all located on the same side.

2.3.3 EDI Controller

The Panel Mounted EDI Controller shows whether the EDI unit is in standby or on and is used to control the electrical current. The Current is set on the control pad via the up and down buttons, the specific current is dependent on water quality and flow rate. Once set the current will remain constant and the voltage will change with the load within the limits of the tapping on the isolating transformer, see figure 5.

The EDI Controller is connected to the EDI PCB via a ribbon cable, the only component on the EDI PCB that may need to be changed is the Jumper for Selection of AC Voltage, see figure 4.

NOTE The jumper for the AC input voltage must be placed in the position corresponding to the voltage of the AC input from the isolating transformer. Failure to do so will result in failure of the unit.

2.3.4 Isolating Transformer

A separate isolating transformer is used to electrically isolate the EDI unit from the rest of the unit, this enables the DC circuit to be earthed safely. There are three voltage tapings on the transformer which are used for different water qualities. The enclosure incorporates a microswitch which trips the E-Stop circuit when the lid is removed.

NOTE The jumper for the AC input voltage must be placed in the position corresponding to the voltage of the AC input from the isolating transformer. Failure to do so will result in failure of the unit.

2.3.5 EDI Flow Switches

Both the dilute and concentrate stream of the EDI has a flow switch fitted in line, for the EDI to power up both flow switches have to indicate a minimum flow has been achieved. The flow switches ensure that the EDI can not power up with no flow as this leads to overheating and permanent failure of the unit.

3.0 UNPACKING AND IDENTIFICATION

3.1 Basic Packages

The Reverse Osmosis/EDI unit will normally be delivered as a single item mounted onto 4 lockable castors. Additional items may also be supplied if ordered, such as a product water storage tank, pre-filter or water softener. If no additional items have been ordered, then a set of level probes will also be supplied for installation in to the customer's treated water storage tank.

3.2 Unpacking notes

The unpacking of the system is straightforward and there are no 'hidden' items. It is advisable to keep the system with any external wrapping until ready to complete installation to prevent dust or water ingress.

Care must be taken if carton slitters or hobby knives are used to remove any external wrapping since there are control cables and high pressure hoses routed around the system frame.

3.3 Lifting

Caution: The system will weigh between 350 and 750 kg depending on the model. It should be moved on its castors to its point of installation.

E Series RO

Installation Operation Maintenance Manual

4.0 Temporary Storage

If installation is not to start immediately after delivery, the equipment should be stored in a clean dry area, where it will not be damaged, or be subjected to temperatures below freezing.

5.0 DESCRIPTION OF SYSTEM

Single E Series frame with three, six, ten, fourteen or eighteen single length ESPA membranes, electronic controller, flow meters, valves, vertical multistage pressure pump, de-gassing membrane, inlet storage tank, permeate divert valves, EDI and all interconnecting pipe work.

Reverse Osmosis

The inlet connection is positioned prior to the inlet solenoid. After the inlet solenoid is the raw water storage tank. The raw water storage tank has a high and low level Kasuga float switch, the returns from the reject side of the permeate divert valves, the re-circulation return point and the concentrate outlet from the EDI. The low level Kasuga in the raw water storage tank acts as a pump protection device.

From the pump, high pressure water is piped from a manifold with a high pressure switch and pump pressure pressure point to the inlet on the bottom of the first membrane housing. The permeate outlet from the housing is connected to the de-gassing membrane via a variable area flow indicator and then the inlet of the reverse osmosis permeate divert valve. The outlet of the permeate divert valve on the 'B' side (poor quality side) goes back to the raw water storage tank, the 'A' side (good quality side) goes to the EDI unit.

The concentrate outlet from the membrane housing is connected to a manifold with a tee to a recirculation flow regulating valve and variable area flow indicator, back pressure gauge line, tee to the flush line and tee to the pressure regulating/concentrate flow valve mounted below the concentrate variable area flow indicator. The regulating valve is used to control the back pressure in the concentrate line and the flow of concentrate to drain.

The recirculation flow valve directs a proportion of the concentrate water back to the raw water storage tank. Water is recirculated to help give high recovery of permeate from the concentrate water, and also to keep up the flow across the surface of the membrane to prevent fouling.

De-Gasser

The liquid inlet of the de-gasser has a high pressure switch, the outlet goes to the EDI unit. On the gas side the inlet for a compressed air system has a governor, filter, high pressure switch, pressure indicator, needle valve and variable area flow indicator. The outlet of the gas side is to atmosphere with a tun dish to collect any liquid that has migrated through the membrane.

EDI

The inlet to the EDI splits into a concentrate and dilute stream, each of these passes a flow switch (protection for low flow) needle valve (to set the ratio between concentrate and dilute) variable area flow indicator, pressure indicator and sample valve before entering the EDI module. Each stream on exiting the EDI module passes a sample valve, pressure indicator and diaphragm valve (to set the back pressure ensuring the dilute is higher than the concentrate). The concentrate is then returned to the raw water tank. The dilute passes a conductivity cell and enters the EDI divert valve. If the conductivity is below the programmed maximum then the divert valve sends the stream through port A and to service. If it is above the programmed maximum then the divert valve sends the stream through port B back to the raw water tank.

6.0 PRE INSTALLATION CHECKS

6.1 MECHANICAL

6.1.1 Foundations/Drainage

The Reverse Osmosis/EDI unit will not require any special foundations, provided that a firm, level area which is capable of supporting the working weight (see Engineering Data, **Section 12.2**) is available.

Pressure Drain

Reject/concentrate water from the process must flow to drain, or to a nearby storage tank where it can be utilised for other processes that do not require high quality water, such as washdown or lavatories.

If the system is simply run to waste this must be to an open drain or gully, capable of passing the necessary flow as required (see Process and Operating Data, **Section 12.1**, for relevant flows). The total flow of water to drain depends on site conditions, but will typically be between 50-100% of the product water flow. The drain must not be at a level higher than the Reverse Osmosis unit and preferably should be installed with an air break at the same height as the drain outlet.

Gravity Drain

A separate overflow drain from the two storage tanks has been included with an integral air break. If the system is simply run to waste this must be to an open drain or gully.

6.1.2 Operating Space

It is difficult to be precise with regard to the floor space which will be occupied by the assembled unit, since there will usually be associated pre-treatment and product water storage. However, an idea can be gained from reference to the Engineering Data (**Section 12.2**). The RO frame has a 1300mm or 2,500 mm W x 1100 mm D footprint

Access will be required to monitor the operating pressures, permeate & concentrate flows, and permeate conductivity. Access will also be needed to carry out adjustments or maintenance on the equipment. It is therefore recommended that a minimum of 500mm clearance be allowed around the base for this purpose.

6.1.3 Incoming Water

The raw water to be fed to the Reverse Osmosis unit must comply with the following:

- (a) Available at all times at a flow equal to the required maximum service flow or greater.
- (b) At a pressure between 1.0 and 7.0. bar at the service flow required.
- (c) Temperature between 10°C and 40°C.
- (d) Pre-filtered to below 5 micron nominal.
- (e) Iron less than 0.2 p.p.m., Manganese less than 0.1 p.p.m.
- (f) Free of chlorine
- (g) Softened to no greater than 10ppm hardness as CaCO₃ .

6.1.4 Pipework

Pipework to be connected to the Reverse Osmosis Unit should not have an excessive amount of Iron or hardness scale deposit. Piping that is heavily built up with scale or Iron deposits should be replaced.

Make sure that the pipework can be connected to the Reverse Osmosis Unit in such a way as to impose no stresses on the inlet connection, and so that it is properly aligned and supported. Excessive vibration can cause erratic operation of the solenoid valves, so, if required, a suitable vibration damper should also be installed. Final connections to the Unit should be made where possible using flexible connections to avoid stresses during operational cycles.

6.1.5 Water Supply Company Requirements

It is essential that the equipment is connected to a pressurised water supply. If connected to a mains supply the local bye laws must be adhered to. These cover both plumbing and the prevention of back flow into the mains. If there is any doubt, the local water inspector should be consulted, but in general, the installation of a 'Double check valve assembly' conforming to BS.6282 part 2 will be required in the supply pipework to the system.

6.2 ELECTRICAL

6.2.1 Three phase system

A continuous supply of 415v, 50 Hz three phase and neutral with motor rated fuses as per the technical details is required by the three phase Reverse Osmosis Unit. An electrical isolator is fitted to the control panel. A 240/24v safety isolating transformer is fitted to the frame to provide power to the controller. A 240/240 isolating transformer is included to electrically isolate the EDI circuit from the rest of the unit.

7.0 INSTALLATION

7.1 MECHANICAL

A flow diagram showing the suggested overall layout of the system is included as Fig 14.1 ,and should be referred to for guidance.

Check all the items against the parts list and shipping documents, and ensure you have them all before starting work. In addition to the components you will require basic tools, (i.e. spanners, screwdrivers etc., and P.T.F.E. tape).

7.1.1 Inlet Pipework

Pipework should be assembled incorporating the features shown in the Flow Diagram, Fig 14.4. It is essential that the water main is protected by a double check valve where appropriate (see Local Water Bye laws).

Pipework can be constructed from any normally acceptable material (Copper, Galvanised, Plastic), provided it is properly supported and aligned. Ensure that the pipe is sufficiently large to accommodate the flow of water required.

NOTE: IF BRAZED OR SOLDERED FITTINGS ARE TO BE USED, THE PIPEWORK MUST BE DISCONNECTED FROM THE SYSTEM CONNECTIONS DURING HEATING AND COOLING. EXCESS HEAT CAN CAUSE PERMANENT DAMAGE TO SOME OF THE SYSTEM COMPONENTS.

The inlet pipework should be connected to the left hand piping supplying tank 1 (1" solvent weld.) See Drawings Section 14

7.1.2 Drain Connection

The drain pipework should be connected to the two drain ports, the pressure drain is the port on the right hand side towards the front (1" solvent weld) the gravity drain is the port on the right hand side towards the rear of the skid (1" solvent weld).

This should be run to a drain or concentrate storage tank capable of taking the maximum flow during flushing (see **Section 12.1**), using flexible tube if at all possible An air gap has been incorporated into the unit for the gravity drain.

7.1.3 Permeate Connection

The permeate connection is made to the outlet ½" John Guest push fit connection or ¾" socket fitting on the top of the control panel on the right hand side.

Install a suitable overflow in the permeate storage tank. This must be below the level of the permeate inlet (**see Section 7.2.3 & Drawing 14.4**)

The top of the permeate storage tank should be no higher than 500mm above the outlet fitting on the top of the membrane to prevent operating back pressure on the membrane during production or static pressure on the membrane during standby. Back pressure during production reduces the output of the system. Static pressure on the membrane from a column of water can de-laminate the membranes during standby.

The permeate inlet to the tank must be open with no restriction. Under no circumstances must a float shut off valve be used to close off the permeate delivery line.

The permeate inlet must be at least 100 mm above the overflow level in the storage tank to prevent permeate being drawn back through the membrane by osmosis during standby.

Prior to making the permeate connection final, make a temporary pipe connection from the permeate outlet to drain so that the system can be fully flushed during commissioning.

7.2 ELECTRICAL

Electrical installation is very straightforward, but should still be carried out by a competent electrician, and must conform to the appropriate standards of safety.

7.2.1 Mains Supply

The mains supply connection should be made through a separate, switched supply, fused and earthed in accordance with Institute of Electrical Engineers Regulations. Current rating should be rated to the ampere shown in the technical data.

7.2.2 Level sensor installation

Install the level switch on the treated water storage tank. This may require the cabling to be disconnected at the 2 way plug on the end and the terminals re-made when the probes have been installed. The blue and brown wires run from terminals A and C in the sensor and are connected to the terminals specified in the wiring connection schedule in the control box.

The floats for the sensor will need to be tied to hook on the underside of the sensor using the rot proof cord provided. When the second float is tied to the bottom of the first float, the R/O unit will switch off when the level reaches the middle of the upper float, and will turn on again when the level drops to the middle of the lower float. This means that the highest practical treated water level in the storage tank is 150mm from the top and the minimum differential is 170mm

7.2.3 BMS/Alarm connection

Each controller has an integral volt free alarm contact that can be utilised to connect in to a BMS system. See controller wiring diagram in controller manual

8.0 COMMISSIONING

The membrane(s) are shipped in preservative which will need to be flushed prior to putting permeate water to service. Commissioning and flushing should take place immediately before the system is put into service

8.1 EDI

Before starting the IP-LX Module for the first time, check the tightness of the Module end plate tie-bar nuts. Referring to figure 2 and the corresponding instructions ensure that the tie-bar nuts are correctly torqued before starting the unit.

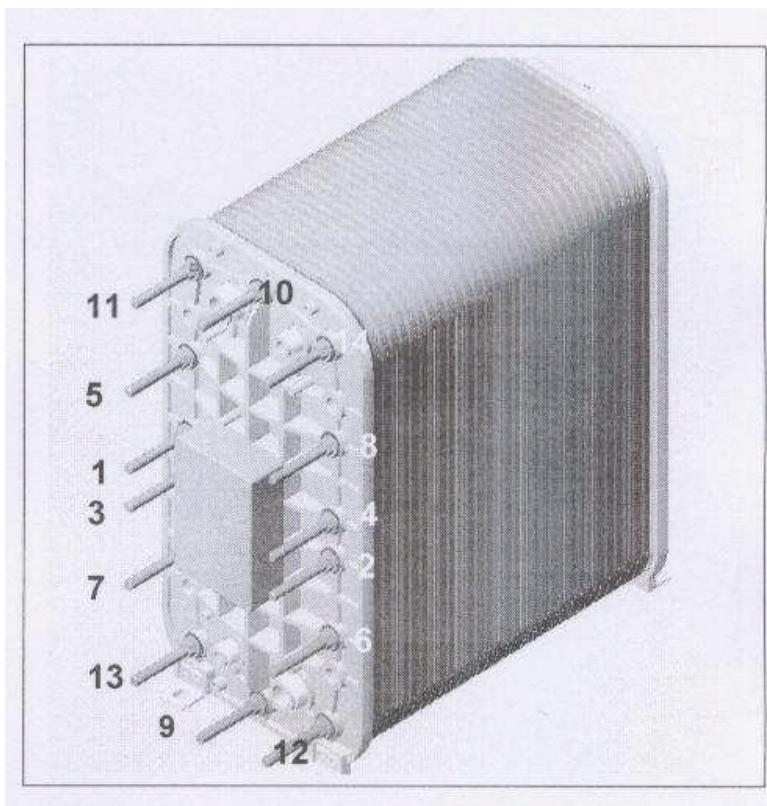


Figure 2

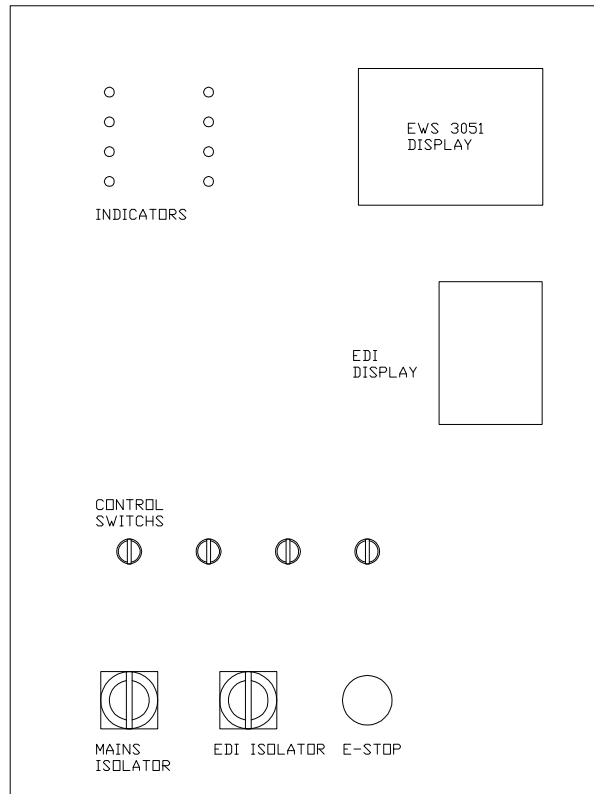
Using a 19 mm deep socket and wrench torque Tie-Bars 1-14 to 10 ft lbs working from tie bar 1 to 14. Then torque tie-bars 1-8 and 11-14 to 12.5 ft. lbs. working in ascending numerical order. Then torque tie-bars 1-8 to 25 ft. lbs. working in ascending numerical order. Finally confirm tie-bars 11-14 are still at 12.5 ft. lbs. and 9,10 are still at 10 ft. lbs. If not retighten.

8.2 Controls

An EWS 3051 controller panel mounted into the control panel controls the system shows the conductivity of the two conductivity probes and the operational state of the reverse osmosis unit. On top of this there is a separate EDI controller, which is used to show the state of the EDI, set the current applied to the unit and display the voltage drawn. There are also indicators to show the state in which the unit is running and control switches for the inlet solenoid, EDI, air solenoid and E-Stop reset. There is a

mains isolator, which isolates the whole unit and an EDI isolator and an E-Stop. The layout of the control panel is shown in figure 1

Figure 3 Front Control Box Layout



The E-Stop when pressed will trip power to all circuits except the 240/24V transformer and the E-Stop reset circuit. Either the E-Stop being pressed or the isolating transformer enclosure micro switch trips the E-Stop circuit. To reset the E-Stop circuit the following has to occur

- E-Stop must be un-latched
- Isolating transformer enclosure micro-switch must be closed
- E-Stop reset switch turned to reset position

The starting position for Commissioning is Mains Isolator and EDI Isolator on, E-Stop un-latched, inlet, air and EDI control switches turned off.

E Series RO

Installation Operation Maintenance Manual

Within the control box is the EDI PCB a shown in figure 4 below:

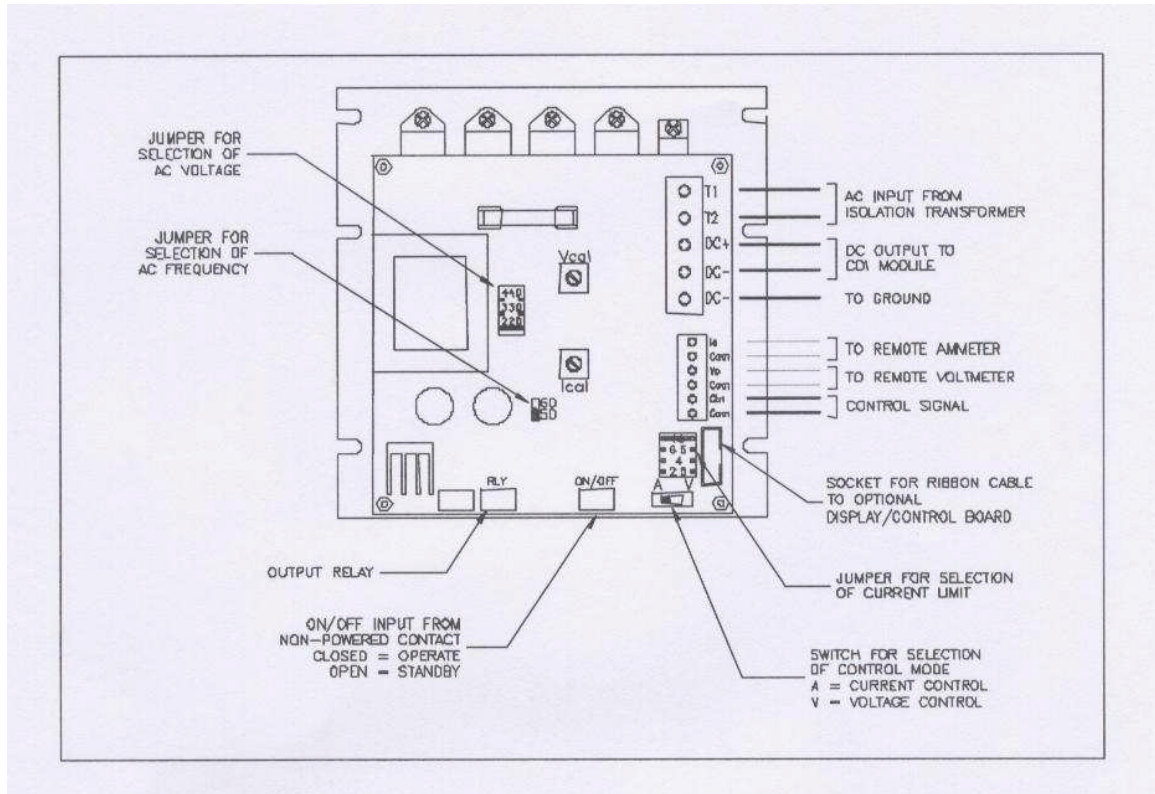


Figure 4 EDI PCB

The PCB will be fully configured and the only item that may need to be changed is the jumper for selection of AC voltage which must match the tapping on the isolating transformer.

NOTE The jumper for the AC input voltage must be placed in the position corresponding to the voltage of the AC input from the isolating transformer. Failure to do so will result in failure of the unit.

8.3 Pre Service Flush

After connecting the air inlet and water inlet, run a line to drain from the concentrate and permeate outlets. Turn on the water supply to the system and check the inlet side for leaks up to the inlet solenoid. Turn the fill switch on.

Turn the fill switch on and wait until the raw water tank has stopped filling, check that the water level has reached the middle of the upper sinker of the high level float switch.

Open the needle valves adjusting the recirculation, concentrate for the reverse osmosis unit and the dilute and concentrate for the EDI unit. Open the EDI back pressure valves fully.

Turn on the EWS 3051 controller for the reverse osmosis unit with the rocker switch on the bottom left of the EWS controller.

ON THREE PHASE SYSTEMS ENSURE THAT THE PUMP IS ROTATING IN THE CORRECT DIRECTION. IF IT IS NOT, SWITCH OFF IMMEDIATELY, ISOLATE THE MAIN POWER SUPPLY AND CHANGE OVER TWO OF THE PHASE CONNECTIONS TO REVERSE THE ROTATION. IF YOU ARE UNSURE ABOUT THIS PROCEDURE, CONSULT A QUALIFIED ELECTRICIAN.

The controller should default to the pre-service rinse for 3 times 30 seconds and then Service, but if it does not then press the service button.

Check for Leaks.

The pressure pump will fire up, the permeate divert valve will energise when in service (red light on the electrical connection) and water will flow through the EDI unit and then onto the drain.

If the system re-circulates to the raw water tank at this point because of high permeate TDS, reset the maximum threshold (see EWS OS3051 instruction manual) and continue.

Monitor the permeate and concentrate flows and balance with the pressure regulator so that the permeate flow is three times the concentrate flow (75% recovery) for the reverse osmosis unit. Set the re-circulation flow to that specified in the test document. Monitor the EDI dilute and concentrates flows and adjust the concentrate flow to give a ratio of 9 to 1 dilute to concentrate. Adjust the EDI back pressure valves to give a higher dilute outlet pressure than the concentrate (2-4 PSI increase in dilute of concentrate is adequate).

NOTE: At no point fully close the EDI dilute, concentrate or back pressure valves as this will cause de-lamination of the reverse osmosis membranes.

This should give a back pressure on the reverse osmosis membranes of circa 230 PSI.

Do not adjust the concentrate valve so that the pump pressure exceeds 300 psi

Check the air pressure at the governor and adjust to 1 bar **NOTE AN AIR PRESSURE IN EXCESS OF 8.3 BAR ON THE DE-GASSING MEMBRANE CAN CAUSE IRREPARABLE DAMAGE**, turn air solenoid on and adjust the air flow rate to the rate specified in the test document via the De-Gasser Needle valve.

Leave to run to drain for 30-60 minutes to flush the preservative out of the membranes.

If the permeate is then to the correct quality, then the EDI unit can be started. To run the EDI unit the following conditions must be met

- Electrical Power to unit
- E-Stop circuit not tripped
- EDI door switch in the on position
- Dilute and concentrate flow switches indicate a greater than minimum flow

Once the EDI unit has changed from standby to on the current can be set using the output control buttons shown in figure 5

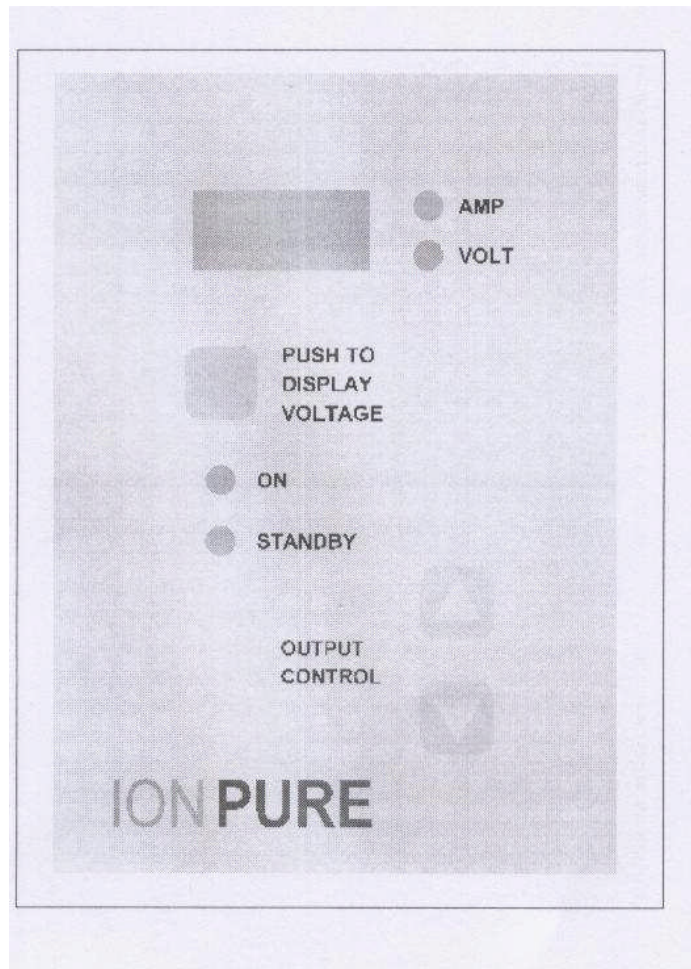


Figure 5 EDI Display

The current will need to be increased until the water quality desired has been achieved, this will be site specific but a guide value can be taken from the test document. The system takes a few seconds to equilibrate and so this process should be done slowly in small steps. Once the desired quality has been achieved the system is ready for service.

8.4 Service connections and checks

With the system switched off, connect the permeate tube to the storage tank. Turn the system on and leave to run to service.

Test the flush circuitry by lifting the permeate float switch. This will initiate a 'post service' flush. The pressure pump will cut out as the float switch is operated. Shortly afterwards the flush solenoid will open and then the pump will start up again. This will flush the membranes at a high flow rate for the time set in the controller. Lowering the floats will immediately switch the system back to the pre-service rinse and then service. During both rinses the permeate divert valve will not be energised so the permeate flow will be diverted back to the raw water tank.

During normal production, there should be no more than 2.6 bar (40 psi) pressure difference between the feed pressure off the pump (top gauge) and the back pressure on the membrane (bottom gauge).

Check the air solenoid closes when the reverse osmosis unit is in standby.

Check the EDI unit goes into standby when the reverse osmosis unit is in standby.

The system is now commissioned.

9.0 Operation

The E Series Reverse Osmosis systems are designed to run and flush automatically and should not be turned off at the mains after a production run of permeate.

For the first few days of use, the operating pressures, permeate and concentrate flows should be monitored every few hours and the system fine tuned as the membrane settles down to its working environment.

Thereafter the flows, pressure and permeate conductivity should be monitored daily at a regular time when production is taking place. These readings will vary slightly due to variations in incoming water temperature and pressure. An example data recording sheet can be found in section 9.3

If a variation of more than 15% is noted in the permeate flow at usual operating pressures then the system should be cleaned with an appropriate recirculating cleaner. This must be done by a service technician with a thorough understanding of reverse osmosis/EDI systems and their cleaning regimes

9.1 Routine maintenance.

Daily Monitor permeate and concentrate flow, inlet, pump and back pressures, and product water conductivity.

Weekly Monitor raw water temperature

Monthly Inspect system for leaks and tighten fittings where necessary

3 Monthly Replace inlet filter cartridges (if any)

Annually Clean membrane with a recirculating cleaner if normalised output has fallen by greater than 15%

9.2 Temporary Shutdown

If permeate is not required for up to five days then the system should be left with the permeate tank empty, the level probes disconnected and the water and power supplies turned on. The controller will automatically flush the system every 24 hours.

If the system needs to be powered down for more than 7 days, then the membrane housing and EDI should be filled with an appropriate preservative. The system should then be re-commissioned prior to putting back into service. See Section 8.0

E Series RO/EDI

9.3 Example Data Recording Sheet

Model

Date installed

Membrane/EDI serial no(s)

| | | | | | | |
|---------------------------------------|---------------------------|--|--|--|--|--|
| Date | | | | | | |
| Time | | | | | | |
| Feed Water Hardness | ppm CaCO ₃ | | | | | |
| Feed Water Total Chlorine | ppm as Cl ₂ | | | | | |
| Feed Water Carbon Dioxide | ppm as CO ₂ | | | | | |
| RO Pump Pressure | Bar | | | | | |
| RO Back Pressure | Bar | | | | | |
| RO Permeate Pressure | Bar | | | | | |
| Ro Conductivity | Micra Siemens | | | | | |
| Permeate Flow | L/min | | | | | |
| Re-Circulation Flow | L/min | | | | | |
| Concentrate Flow | L/min | | | | | |
| Raw Water Temperature | Degrees C | | | | | |
| Air Flow | L/min | | | | | |
| Air Pressure | Bar | | | | | |
| Dilute Inlet Pressure | Bar | | | | | |
| Dilute Outlet Pressure | Bar | | | | | |
| Concentrate Inlet Pressure | Bar | | | | | |
| Concentrate Outlet Pressure | Bar | | | | | |
| Dilute Flow Rate | L/min | | | | | |
| Concentrate Flow Rate | L/min | | | | | |
| DC Voltage | Volts | | | | | |
| DC Current | Amps | | | | | |
| Module Resistance (volts/amps) | Ohms | | | | | |
| EDI Conductivity | Micra Siemens | | | | | |

FAULT FINDING AND RECTIFICATION

| Problem | Possible cause |
|--|---|
| No Power | Main fuse or supply cabling fault |
| Power on controller Pump motor does not run | High level probe jammed or failed Motor failure Power relay failure |
| Pump motor runs low/no production | Pump motor drive loose Concentrate valve fully open Inlet filter blocked Membrane fouled Concentrate valve fully closed |
| Pump cuts out during flush | Inlet filter blocked Low pressure threshold too high |
| Pump cuts out during service | Inlet filter blocked Water supply failure |
| Permeate quality reads 0 | Conductivity probe disconnected/failed |
| RO Permeate quality poor | Membrane fouled Concentrate valve fully closed. Permeate storage tank too small No air to De-Gasser membrane De-Gasser has become flooded, adjust inlet pressure to 2 bar and sweep until no water drips from the gas exit port |
| Inlet Valve does Not open | Door Fill Switch on 'off' High level Kasuga in raw water tank satisfied |
| EDI Module Leaks | Module has loosened during shipment, movement or operation. Check torque of tie bars |
| Poor water quality With power ON to unit | Operating current incorrect, reset using calculation in Appendix 2 |
| Loss of EDI Flow | Module is Fouled see trouble shooting chart Appendix 3 Check downstream valves are open |

E Series RO

Installation Operation Maintenance Manual

System is plugged with particulates see
trouble shooting chart Appendix 3

Check upstream valves are open

11.0 WARRANTY AND SERVICE

11.1 AFTER SALE WARRANTY

Your Reverse Osmosis/EDI unit is covered by a parts warranty for a period of one year from installation on all mechanical and electrical components. Filters cartridges, EDI and membranes are excluded from this warranty since they can deteriorate due to operational or site conditions.

Should you have any problems with your Reverse Osmosis/EDI unit or require routine service, please contact your supplier.

12.1 PROCESS AND OPERATING DATA

E Series Reverse Osmosis Units

| MODEL | | 4-10 | 4-20 | 4-40 | 4-50 | 4-60 |
|---|--------|------|------|------------|------|------|
| PARAMETER UNITS | | | | | | |
| Max. Output | Lit/hr | 500 | 1000 | 2000 | 2500 | 3000 |
| Min Input Flow* @ 75% recovery | Lit/hr | 667 | 1333 | 2667 | 3333 | 4000 |
| Min Cont. Flow to drain* (during service @ 75% recovery) | Lit/hr | 167 | 333 | 667 | 833 | 1000 |
| Max Flow to drain (during flush per unit) | Lit/hr | | | 1500 (all) | | |
| Min salt Rejection | % | | | 99.9 (all) | | |
| Maximum Recovery | % | | | 75 (all) | | |

IMPORTANT NOTES

The data quoted in the above table is affected by the inlet pressure, raw water quality and period of usage, and so should be regarded as nominal only. * Total inlet flow and flow to drain will depend on the recovery settings chosen for the Reverse osmosis unit.

12.2 ENGINEERING DATA

D Series Reverse Osmosis Units

| MODEL | | 4-10 | 4-20 | 4-40 | 4-50 | 4-60 |
|-----------------------|--------------------|------|------|------------|------|-------|
| PARAMETER | UNITS | | | | | |
| Width | mm | 1300 | 2500 | 2500 | 2500 | 2500 |
| Depth | mm | | | 1100 (all) | | |
| Height to frame | mm | | | 2000 (all) | | |
| Inlet Conn. | ins (Solvent Weld) | | | 1 (all) | | |
| Permeate Outlet Conn. | ins O/D1/2" | | 1/2" | 3/4" | 3/4" | 3/4" |
| Pressure. Drain Conn | Ins (Solvent Weld) | | | 1" (all) | | |
| Gravity. Drain Conn | Ins (Solvent Weld) | | | 1" (all) | | |
| Delivered Wt. | Kg. | 350 | 450 | 550 | 650 | 750 |
| Working Wt. (approx.) | Kg. | 600 | 700 | 800 | 900 | 1,000 |
| Thee Phase Electrical | | | | | | |
| Power | v | 415 | 415 | 415 | 415 | 415 |
| | Hz | 50 | 50 | 50 | 50 | 50 |
| | kW | 3.4 | 4.2 | 6.7 | 7.5 | 7.5 |
| FLC | Amp | 9 | 11 | 17 | 19 | 19 |

MAXIMUM INLET PRESSURE 7 Bar MINIMUM INLET PRESSURE 1.0 Bar
MAXIMUM OPERATING TEMPERATURE 40.0C
HEADROOM - Allow 500 mm greater than overall height.

E Series RO

Installation Operation Maintenance Manual

12.3 PARTS DATA

| Model | 4-10 | 4-20 | 4-40 | 4-50 | 4-60 |
|------------------------------|---------------------------------------|-------|-------|-------|--------|
| Frame | BS304 Stainless Steel (all) | | | | |
| Membrane no | 3 | 6 | 10 | 14 | 18 |
| Membrane type | ESPA2 (all) | | | | |
| Membrane ref | 4040 (all) | | | | |
| Pump ref CRi | 1-33 | 3-33 | 5-32 | 5-36 | 5-36 |
| Controller | EWS OS3051 (all) | | | | |
| Transformer | 200 VA (all) | | | | |
| Voltage | 240 - 24v (all) | | | | |
| T/former supply fuse | F1 1 A (all) | | | | |
| Isolating Transformer Feed | F2 5 A | | | | |
| Isolating Transformer Supply | F3 5 A | | | | |
| E-Stop Circuit | F4 1 A | | | | |
| General Circuit | F5 3.15 A | | | | |
| Circuit Breaker | Telemecanique GV2 (three phase units) | | | | |
| Recirc F/C lpm | All adjustable | | | | |
| Flush F/C lpm | 15 (all) | | | | |
| | Lt/hr | lt/hr | lt/hr | lt/hr | ltr/hr |
| Perm flow meter | 1000 | 1600 | 4000 | 4000 | 4000 |
| Conc flow meter | 650 | 650 | 1000 | 1600 | 1600 |
| Recirc flow meter | 2500 (all) | | | | |
| Dilute flow meter EDI | 1000 | 1600 | 4000 | 4000 | 4000 |
| Conc flow meter EDI | 650 (all) | | | | |

13.0 EWS OS3051 CONTROLLER

13.1 Manufacturers Manual

A manufacturers manual for the EWS OS3051 controller is enclosed with the system. Please refer to this for information operation and programming of the controller.

13.2 Factory programming notes

The controller has been set up with a typical operating program suitable for a reverse osmosis system of this size and type.

The programming includes a pre-service flush, post service flush, flush during service and flush during standby.

13.3 Maintenance program

The controller has been set up with a simple 'Maintenance' program that will enable a service technician to clean the membrane(s) by connecting a cleaning tank and pump to the system inlet and outlets. During this time the conductivity limits are not queried.

The controller has **not** been programmed with a default Maintenance alarm that would put up a Maintenance signal after a pre-set number of hours.

To access the Maintenance program, switch the system to the 'Standby' or Standby Stop' phase. Press and briefly hold the maintenance (spanner) button. The program is then started by using the 'On' and 'Off' buttons. If the maintenance time programmed in has elapsed, the procedure ends automatically. The system can be switched back to 'Standby' at any time by pressing the maintenance button again.

Warning!! The Maintenance phase should only be switched on by a properly trained operator.

The Maintenance program lasts up to 500 minutes and in addition to opening the valves also powers the pump.

E Series RO

Installation Operation Maintenance Manual

Factory programming

| Program Step | Display | Setting | Function |
|--------------|----------------|-----------------|--|
| 1.1 | Display | LCD | Conductivity Cell 1 RO (CC1) Reading shown on LCD Display |
| 1.2 | Constant | 0.1 | Sets CC1 Constant |
| 1.3 | Limit Min | Y | Enables a CC1 min valve to be set |
| 1.4 | Value Min | 1.0 | Sets CC1 minimum value |
| 1.5 | Switch Off | Y | Unit will Switch off if CC1 below minimum value |
| 1.6 | Limit Max. | Y | Enables a CC1 max value to be set |
| 1.7 | Value Max. | 10 | Sets the Maximum value for CC1 |
| 1.8 | Switch Off | N | Unit will not switch off if max value exceeded |
| 1.9 | Delay | 1 | Delay time in seconds for max value |
| 2.1 | Display | LED | Conductivity Cell 2 EDI (CC2) reading shown on the LED display |
| 2.2 | Constant | 0.01 | Sets CC2 constant |
| 2.3 | Limit Min | N | No minimum limit set for CC2 |
| 2.6 | Limit Max | Y | Enables a CC2 max value to be set |
| 2.7 | Value Max | 1 | Sets the maximum value for CC2 |
| 2.8 | Switch Off | N | Unit will not switch off if max value exceeded |
| 2.9 | Delay | 1 | Delay time in seconds for max value |
| 3.1 | Display | | Relative conductivity is not shown |
| 3.2 | Limit Min | N | No minimum is set for relative conductivity |
| 3.4 | Limit Max | N | No maximum is set for relative conductivity |
| 4.2 | Display | Y | Temperature is displayed on LED |
| 4.3 | Limit Temp | Y | Enables a temperature maximum to be set |
| 4.4 | Value Max | 30 | Maximum temperature of unit |
| 4.5 | Switch Off | Y | Unit will switch off if maximum temperature exceeded |
| 5.1 | Factor 1 | 1.00 | Correction factor for CC1 |
| 5.2 | Factor 2 | 1.00 | Correction Factor for CC2 |
| 6.1 | Delay | 30 | Sets start up delay time |
| 6.2 | WithConcZValve | Y | Sets start up procedure to Inlet & Conc Valve Opens Delay Pump Starts Delay Conc Valve Closes & Prod Starts |
| 7.0 | Schritt Nr | RS | Sets terminals 33 & 34 of controller to reset alarm output function |
| 8.1 | Rinse-Standby | Y | Unit will Rinse after production phase |
| 8.2 | Rinsetime 1 | 180 | Sets rinse time in seconds |
| 8.3 | | PUI IVI CVI PV- | Sets function active in rinse |

E Series RO

Installation Operation Maintenance Manual

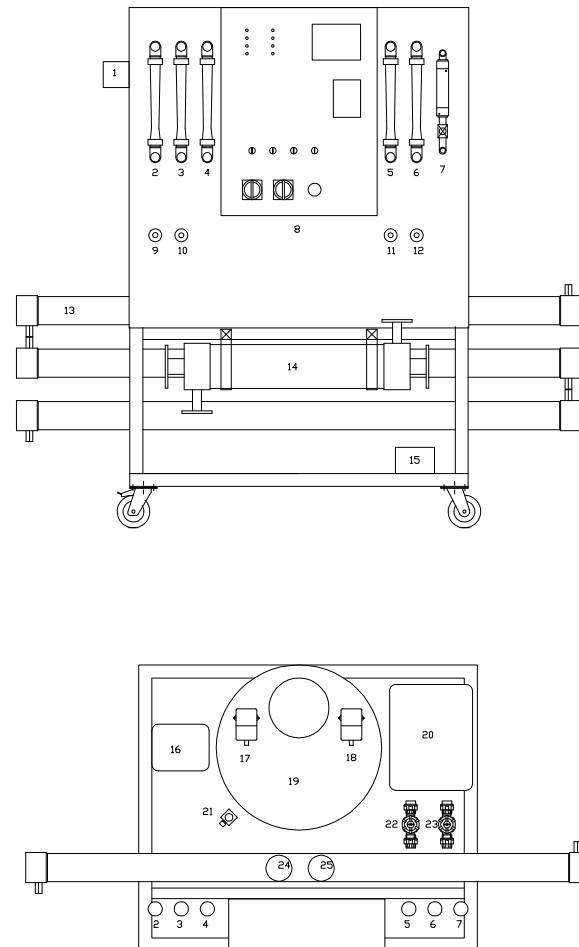
| | | | |
|-------|------------------|-----------------|---|
| 8.4 | Conc. Valve | Nc | Concentrate valve is normally closed |
| 9.1 | Interval | Y | Enables an interval rinse is unit not in use |
| 9.2 | Distance | 24 | Sets time delay between production phase and interval rinse |
| 9.3 | Rinsetime2 | 180 | Sets interval rinse time in seconds |
| 9.4 | | PUI IVI CVI PV- | Sets function active in rinse |
| 9.5 | Conc. Valve | Nc | Concentrate valve is normally closed |
| 10.1 | Dosing | N | No dosing function used |
| 11.1 | Level Switch | 1 | Level control |
| 12.1 | Delay1 | 10 | Delay for low level signal in raw water tank |
| 12.2 | Switch On | 0 | Unit restarts as soon as low level signal removed |
| 13.1 | CM1 Min | N | Does not instigate alarm relay |
| 13.2 | CM1 Max | Y | Instigates alarm relay to de-activate permeate valve |
| 13.3 | Stop | N | Does not instigate alarm relay |
| 13.4 | Empty | N | Does not instigate alarm relay |
| 13.5 | Full | N | Does not instigate alarm relay |
| 13.6 | Overpressure | N | Does not instigate alarm relay |
| 13.7 | Low Pressure | N | Does not instigate alarm relay |
| 13.8 | Concentrate | N | Does not instigate alarm relay |
| 13.9 | Motor Protection | N | Does not instigate alarm relay |
| 13.10 | SupplyFail | N | Does not instigate alarm relay |
| 13.11 | Maintenance | N | Does not instigate alarm relay |
| 13.12 | CM2 Min | N | Does not instigate alarm relay |
| 13.13 | CM2 Max | N | Does not instigate alarm relay |
| 13.14 | CM% Min | N | Does not instigate alarm relay |
| 13.15 | CM% Max | N | Does not instigate alarm relay |
| 13.16 | LimitTemp | N | Does not instigate alarm relay |
| 14.1 | CM1 Min | N | Does not instigate alarm relay |
| 14.2 | CM1 Max | N | Instigates alarm relay to de-activate permeate valve |
| 14.3 | Stop | N | Does not instigate alarm relay |
| 14.4 | Empty | N | Does not instigate alarm relay |
| 14.5 | Full | N | Does not instigate alarm relay |
| 14.6 | Overpressure | N | Does not instigate alarm relay |
| 14.7 | Low Pressure | N | Does not instigate alarm relay |
| 14.8 | Concentrate | N | Does not instigate alarm relay |
| 14.9 | Motor Protection | N | Does not instigate alarm relay |
| 14.10 | SupplyFail | N | Does not instigate alarm relay |
| 14.11 | Maintenance | N | Does not instigate alarm relay |
| 14.12 | CM2 Min | N | Does not instigate alarm relay |
| 14.13 | CM2 Max | * | Does not instigate alarm relay |
| 14.14 | CM% Min | N | Does not instigate alarm relay |
| 14.15 | CM% Max | N | Does not instigate alarm relay |

E Series RO

Installation Operation Maintenance Manual

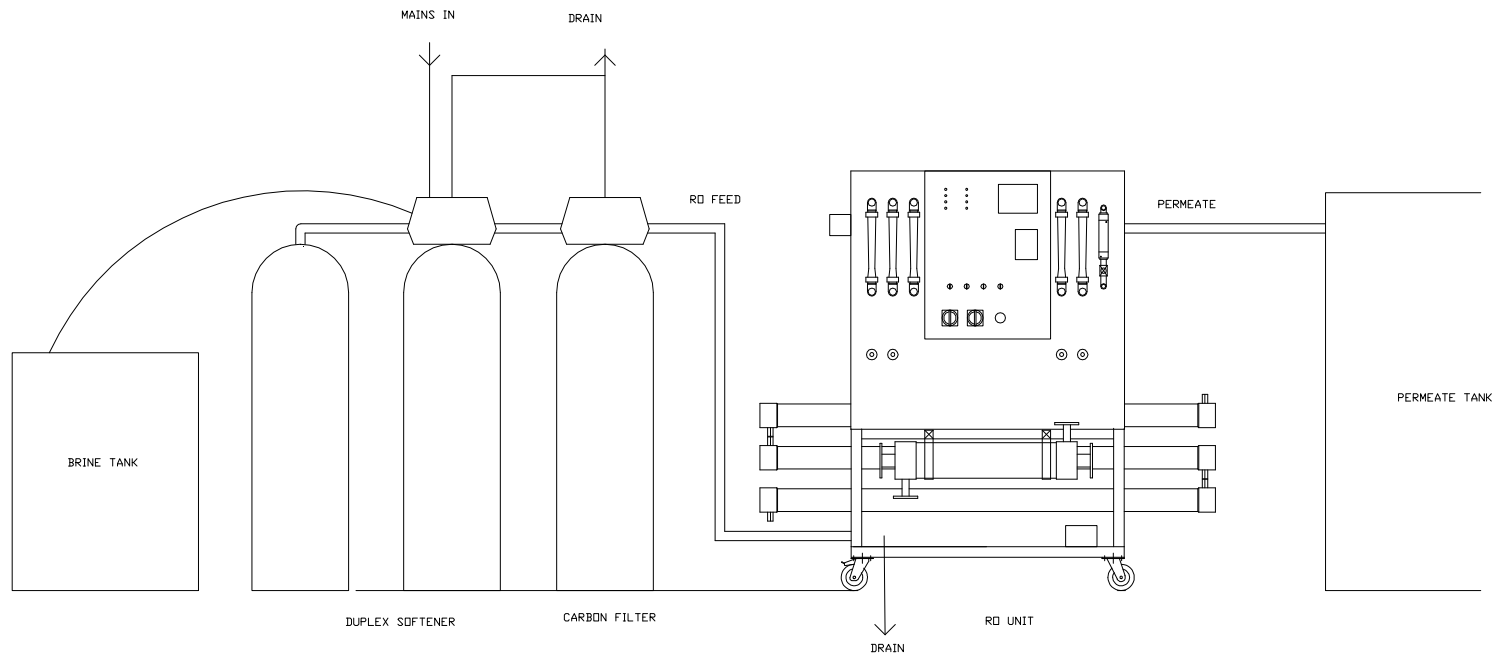
| | | | |
|-------|----------------|-----------------|--|
| 14.16 | LimitTemp | N | Does not instigate alarm relay |
| 16.2 | Interval | N | No programmed maintenance intervals |
| 16.4 | Maint. Time | 500 | Maintenance time set to 500 min |
| 16.5 | | PU- IVI CVI PV- | Sets function active in maintenance |
| 16.6 | CodeNumber | N | No code Number assigned |
| 17.1 | Permeate Valve | 0 | Permeate valve (not fitted) normally open in standby |
| 18.1 | Handstart | N | Stop signal does not stop the unit |
| 18.2 | Input Stop | 1 | Function activated when contacts closed |

14.1 Dimension & parts identification all E Series models

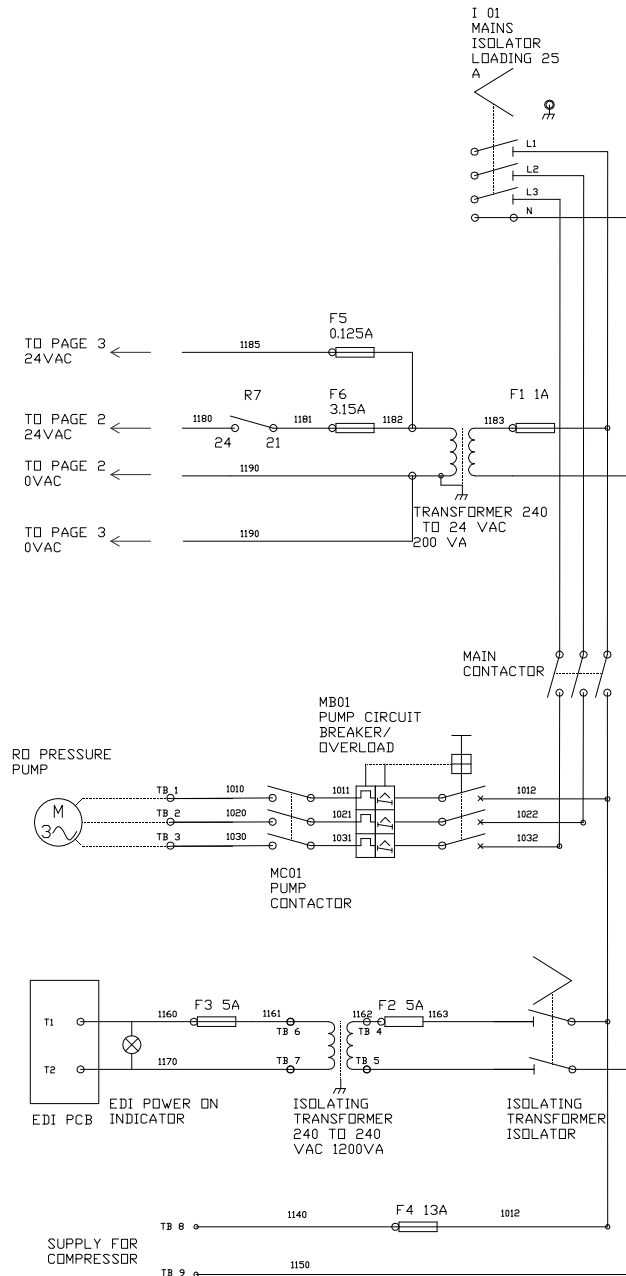


- 1 RO DIVERT VALVE
- 2 RO CONCENTRATE FLOW INDICATOR
- 3 RO RE-CIRCULATION FLOW INDICATOR
- 4 RO PERMEATE FLOW INDICATOR
- 5 EDI DILUTE FLOW INDICATOR
- 6 EDI CONCENTRATE INDICATOR
- 7 DE-GASSER AIR FLOW INDICATOR AND NEEDLE VALVE
- 8 CONTROL PANEL
- 9 RO CONCENTRATE NEEDLE VALVE
- 10 RO RE-CIRCULATION NEEDLE VALVE
- 11 EDI DILUTE NEEDLE VALVE
- 12 EDI CONCENTRATE NEEDLE VALVE
- 13 MEMBRANE HOUSING (E4-20 SHOWN)
- 14 DE-GASSING MEMBRANE
- 15 EDI DIVERT VALVE
- 16 PRESSURE PUMP
- 17 HIGH LEVEL FLOAT SWITCH
- 18 LOW LEVEL FLOAT SWITCH
- 19 RAW WATER TANK
- 20 EDI UNIT
- 21 INLET SOLENOID
- 22 EDI CONCENTRATE BACK PRESSURE VALVE
- 23 EDI DILUTE BACK PRESSURE VALVE
- 24 AIR FILTER
- 25 AIR GOVENER

14.2 Plumbing layout



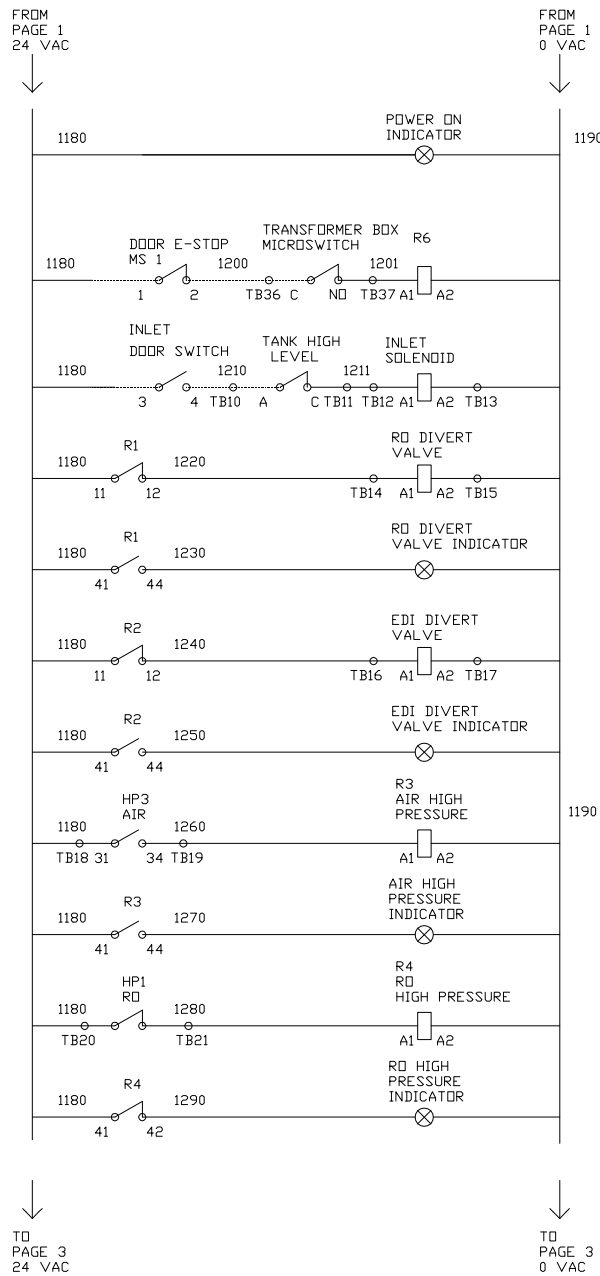
14.2 General cabling diagram 240 Volt Cabling



E Series RO

Installation Operation Maintenance Manual

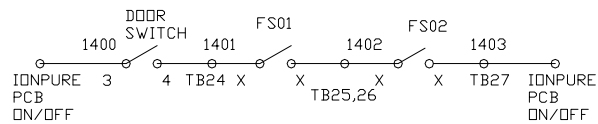
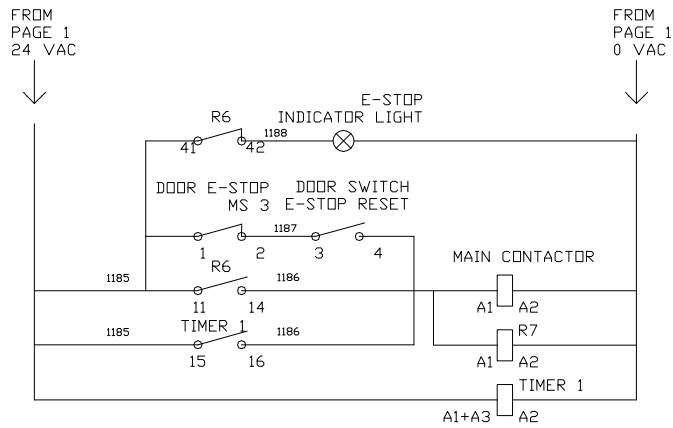
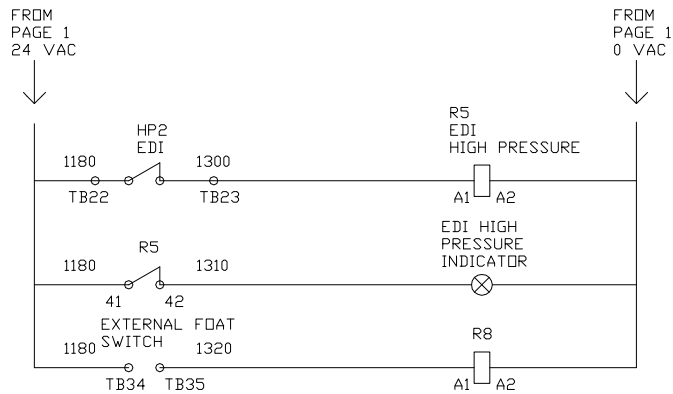
24 Volt Circuit 1



E Series R0

Installation Operation Maintenance Manual

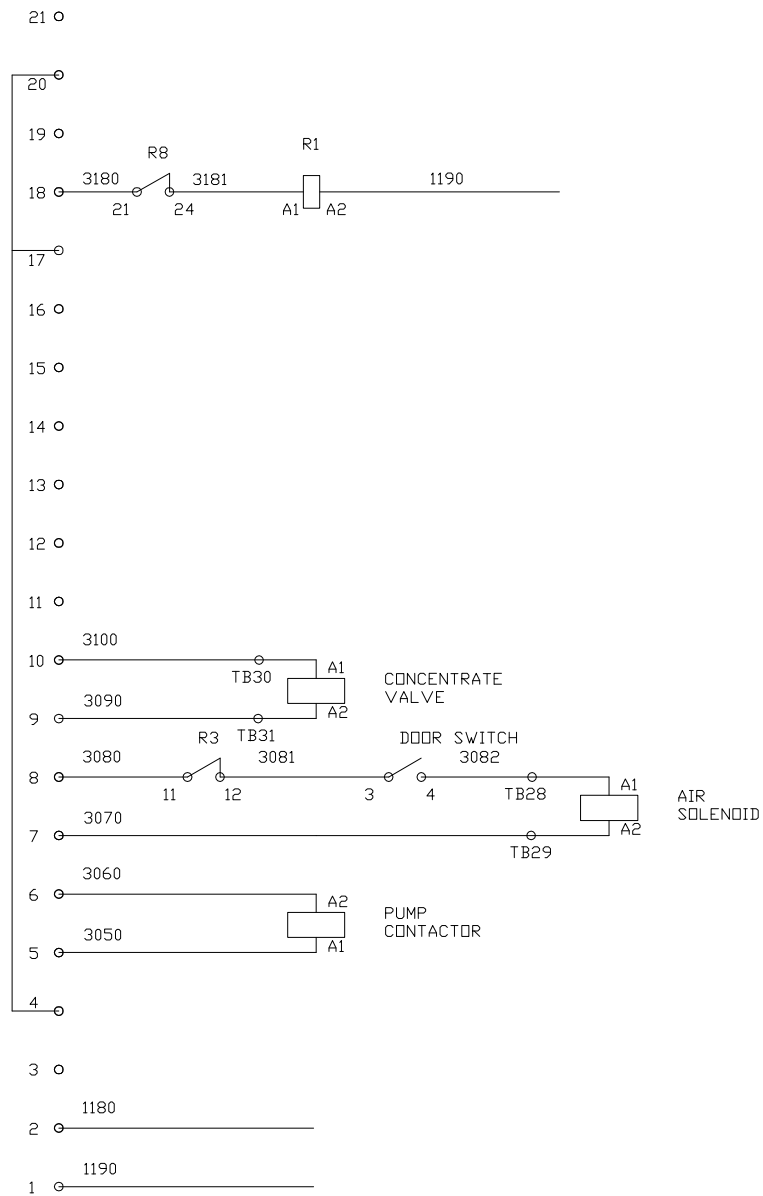
24 Volt Circuit 2



E Series 20

Installation Operation Maintenance Manual

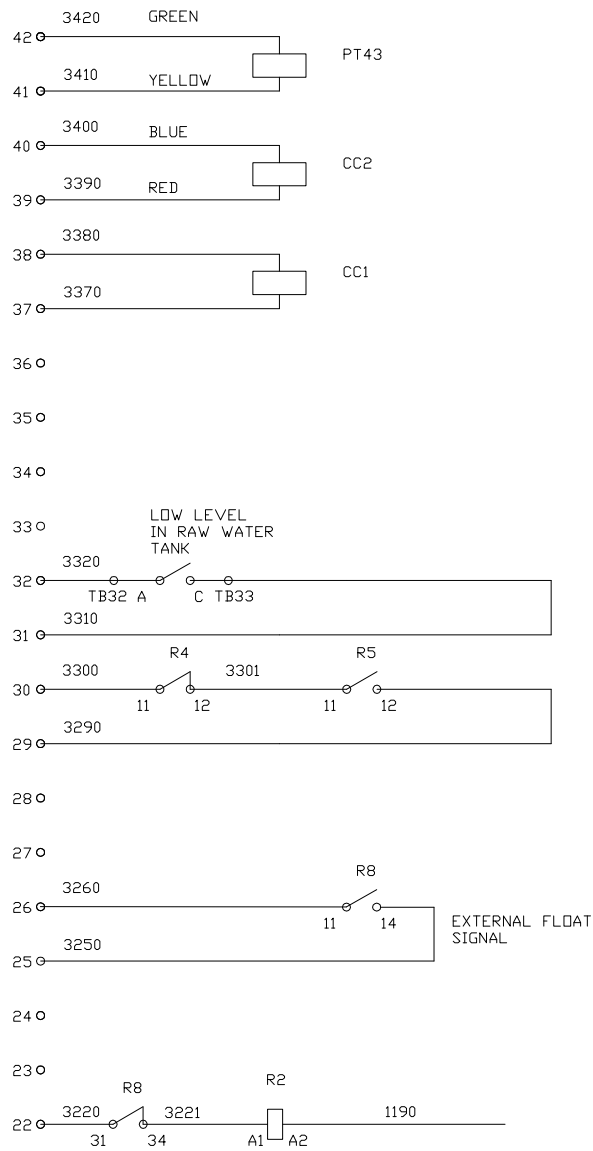
EWS 3051 Wiring 1



E Series RO

Installation Operation Maintenance Manual

EWS 3051 Wiring 2



E Series RO

Installation Operation Maintenance Manual

Connection Schedule

ELECTRICAL CONNECTION SCHEDULE

| TERMINAL | FUNCTION | CABLE NO. | TERMINAL SIZE | CABLE SIZE | VOLTAGE | COLOUR |
|----------|--|-----------|---------------|------------|---------|--------|
| TB 01 | RO PUMP LIVE RED PHASE | 1010 | 2.5 MM | 1.5 MM2 | 415 AC | RED |
| TB 02 | RO PUMP LIVE YELLOW PHASE | 1020 | 2.5 MM | 1.5 MM2 | 415 AC | YELLOW |
| TB 03 | RO PUMP LIVE BLUE PHASE | 1030 | 2.5 MM | 1.5 MM2 | 415 AC | BLUE |
| TB 04 | ISOLATING TRANSFORMER LIVE FEED | 1162 | 2.5 MM | 0.75 MM2 | 24 AC | BROWN |
| TB 05 | ISOLATING TRANSFORMER NEUTRAL FEED | N1 | 2.5 MM | 0.75 MM2 | 0 AC | BLUE |
| TB 06 | ISOLATING TRANSFORMER 230 VAC SUPPLY | 1161 | 2.5 MM | 0.75 MM2 | 230 AC | BROWN |
| TB 07 | ISOLATING TRANSFORMER NEUTRAL SUPPLY | 1170 | 2.5 MM | 0.75 MM2 | 0 AC | BLUE |
| TB 08 | COMPRESSOR 230 VAC SUPPLY | | | | | |
| TB 09 | COMPRESSOR NEUTRAL SUPPLY | | | | | |
| TB 10 | TANK HIGH LEVEL FEED | 1210 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 11 | TANK HIGH LEVEL RETURN | 1211 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 12 | INLET SOLENOID FEED | 1211 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 13 | INLET SOLENOID NEUTRAL | 1190 | 2.5 MM | 0.75 MM2 | 0 AC | BLUE |
| TB 14 | RO DIVERT VALVE FEED | 1220 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 15 | RO DIVERT VALVE NEUTRAL | 1190 | 2.5 MM | 0.75 MM2 | 0 AC | BLUE |
| TB 16 | EDI DIVERT VALVE FEED | 1240 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 17 | EDI DIVERT VALVE NEUTRAL | 1190 | 2.5 MM | 0.75 MM2 | 0 AC | BLUE |
| TB 18 | AIR HIGH PRESSURE SWITCH HP3 FEED | 1180 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 19 | AIR HIGH PRESSURE SWITCH HP3 RETURN | 1260 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 20 | RO HIGH PRESSURE SWITCH HP1 FEED | 1180 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 21 | RO HIGH PRESSURE SWITCH HP1 RETURN | 1280 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 22 | EDI HIGH PRESSURE SWITCH HP1 FEED | 1180 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 23 | EDI HIGH PRESSURE SWITCH HP1 RETURN | 1300 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 24 | EDI PERMEATE FLOW SWITCH FEED FS1 | 1401 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 25 | EDI PERMEATE FLOW SWITCH RETURN FS1 | 1402 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 26 | EDI CONCENTRATE FLOW SWITCH FEED FS2 | 1402 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 27 | EDI CONCENTRATE FLOW SWITCH RETURN FS2 | 1403 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 28 | AIR SOLENOID FEED | 3080 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 29 | AIR SOLENOID RETURN | 3070 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 30 | CONCENTRATE VALVE FEED | 3100 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 31 | CONCENTRATE VALVE RETURN | 3090 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 32 | LOW LEVEL IN RAW WAER TANK FEED | 3320 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 33 | LOW LEVEL IN RAW WAER TANK RETURN | 3310 | 2.5 MM | 0.75 MM2 | 24 AC | WHITE |
| TB 34 | EXTERNAL FLOAT FEED | | | | | |
| TB 35 | EXTERNAL FLOAT RETURN | | | | | |
| TB 36 | TRANSFORMER MICROSWITCH FEED | 1200 | 2.5 MM | 0.75 MM2 | 24AC | WHITE |
| TB 37 | TRANSFORMER MICROSWITCH RETURN | 1201 | 2.5 MM | 0.75 MM2 | 24AC | WHITE |

E Series RO

Installation Operation Maintenance Manual

Appendix 1 De-Gasser Details

STORAGE AND HANDLING

Membrane Contactors

The Liqui-Cel Membrane Contactor that you have purchased can be damaged through improper handling and storage. The following guidelines are intended to provide a framework for successful storage of these contactors. If you have any questions, please contact your Membrana representative.

Handling. Proper handling of contactors is critical. Care must be taken not to hit or jar (shock) the contactor to minimize the possibility of internal damage. All four (4) ports should be plugged to prevent the introduction of contaminants into the contactor. It is recommended that the contactors be stored in a dry, heat-sealed plastic bag or shrink wrap material [0.076 mm (0.003 in.) wall thickness] in their original box.

Important Note: All plastic port extensions should be supported to prevent bending of extensions under excessive piping loads

Temperature. Store the contactor dry in their original boxes at temperatures not to exceed 49°C (120°F). Contactor stored at very low temperatures < 5°C (41°F) should be allowed to equilibrate to room temperature prior to introducing water.

Humidity. It is recommended that contactors be stored at low to moderate humidity levels (< 60% relative humidity). Humidity will not affect the components of the contactor but exposure at high humidity levels may affect the integrity of the cardboard boxes.

Storage Position. Store the contactors in the horizontal position. Ten inch and fourteen inch contactors with SS housing are packaged in wooden crates. Ten inch contactors with FRP housings and 6 inch contactors are packaged in foam reinforced cardboard boxes. For safety considerations, they should not be stacked more than 3 boxes high.

Four inch contactors are packed in cardboard boxes and can be stacked up to 7 boxes high.

Shelf Life. Membrane samples from contactors stored for 4 years (room temperature, low to moderate humidity, heat-sealed bag but not stored in a box) have shown no changes in physical properties (hollow fiber tensile strength and elongation).

Exposure to Sunlight. Contactors should not be stored where they are exposed to direct sunlight. Contactors should always be stored in sealed bags, or shrink wrap material, in the original box or other opaque box.

This product is to be used only by persons familiar with its use. It must be maintained within the stated limitations. All sales are subject to Seller's terms and conditions. Purchaser assumes all responsibility for the suitability and fitness for use as well as for the protection of the environment and for health and safety involving this product. Seller reserves the right to modify this document without prior notice. Check with your representative to verify the latest update. To the best of our knowledge the information contained herein is accurate. However, neither Seller nor any of its affiliates assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of the suitability of any material and whether there is any infringement of patents, trademarks, or copyrights is the sole responsibility of the user. Users of any substance should satisfy themselves by independent investigation that the material can be used safely. We may have described certain hazards, but we cannot guarantee that these are the only hazards that exist.

Liqui-Cel, Celgard, SuperPhobic and MiniModule are registered trademarks and NB is a trademark of Membrana-Charlotte, A division of Celgard, LLC and nothing herein shall be construed as a recommendation or license to use any information that conflicts with any patent, trademark or copyright of Seller or others.

©2006 Membrana - Charlotte A Division of Celgard, LLC SU2-Rev.9 Xtra/Superphob Start-up 02-06

SERVICE QUESTIONS: Contact your OEM or your Membrana representative.

Membrana - Charlotte
A Division of Celgard, LLC
13800 South Lakes Drive

Membrana GmbH
Oehler Strasse 28
D-42289 Wuppertal

Japan Office
Shinjuku Mitsui Building,
1-1, Nishishinjuku 2-chome

A **POLYPOR** Company



Charlotte, North Carolina 28273
USA
Phone: (704) 587 8888
Fax: (704) 587 8585

Germany
Phone: +49 202 6099 -593
Phone: +49 202 6099 -224
Fax: +49 202 6099 -750

Shinjuku-ku, Tokyo 163-
Japan
Phone: +81-3-5324 3361
Fax: +81-3-5324 3369

FLOW DIAGRAMS

Steps:

1. Identify your mode of operation. Three options are available: sweep, vacuum, or combo, as shown in the three flow diagrams below.
2. Mount contactor in desired orientation (horizontal or vertical).
3. Refer to start-up procedures below for each mode of operation.

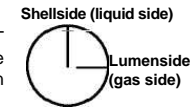
START - UP PROCEDURES

NOTES:

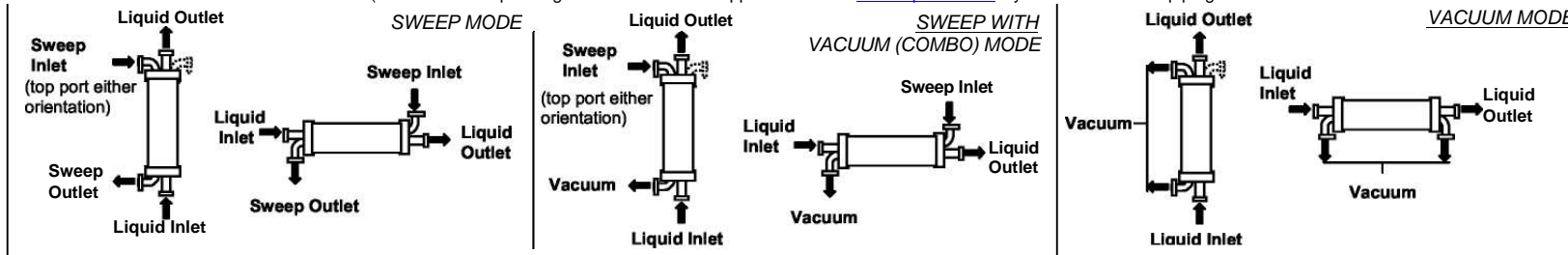
- The liquid pressure should always be higher than the gas phase pressure inside the contactor.

2.5-inch Connections:

2-inch contactors with NPT connections do not have port extensions as shown below. Use this diagram to determine which is the liquid and gas side port.



CONTACTOR OPERATING MODES (Note: See the Operating Guide in the Tech Support Section at www.liqui-cel.com if you need additional piping and instrumentation information.)



START-UP PROCEDURES

A. General start-up instructions for the liquid phase

Note: Both gas/vacuum ports should not be closed during operation. These ports provide a safety vent in the contactors so that pressure does not build up.

1. Slowly introduce water to the system, making sure that water inlet pressure and water flow rate through the contactor never exceed the maximum operating limits listed below. [Flow: 2.5 x 8 - 3gpm (0.68 m³/hr), 4 x 28 - 30 gpm (6.8 m³/hr), 6x28 - 50 gpm (11.4 m³/hr), 10 x 28 - 210 gpm (47.7 m³/hr) with X50 fiber, 250 gpm (56.8 m³/hr) with X40 fiber, 14 x 28 - 400 gpm (90.8 m³/hr.)]
2. Adjust water flow rate and inlet pressure to the desired levels by adjusting the appropriate valves on the system.

Maximum transmembrane pressure for membrane in Liqui-Cel Contactors is 120psi (8.3 bar, 8.4 Kg/cm²). For SuperPhobic Contactors, use 75psi (5.2 bar, 5.3 Kg/cm²) at 25 C (77 F).

Housing pressure ratings for liquid-side when using nondangerous liquids and gasses*:

| | |
|--|--|
| 2.5x8PP, 4x13, 4x28 FRP/PVDF and 6x28 | 120 psi (8.3 bar, 8.4 Kg/cm ²) |
| 4x28 SS, 10x28 SS, 10x28 FRP Liquid Contact | 150 psi (10.3 bar, 10.5 Kg/cm ²) |
| 4x28 PP | 105 psi (7.2 bar, 7.4 Kg/cm ²) |
| 14 x 28 PVC vessels, Nylon end caps Liquid Contact | 120 psi (8.3 bar, 8.4 Kg/cm ²) |

*See Operating Guide for other pressure restrictions in the European Communities (EU)

B. Start-Up Instructions for strip gas and vacuum phase

Note: Vacuum when used in combo, should always be pulled from the lowest gas port to facilitate draining and ensure performance.

Sweep Gas Mode

1. Set the pressure entering the contactor at 10 psig (0.7 bar, 0.7 kg/cm²) by adjusting the appropriate valve in the gas delivery system.
2. Set the recommended total sweep flow rate by adjusting the appropriate valves. See the sweep guidelines for typical sweep gas flow rate ranges in the table to the right.

3. Introduce fresh sweep gas into each contactor. **NOTE:** If using compressed air, make sure it is oil free and air temp < 20°C. A 0.2 micron filter is recommended with any gas.

Sweep Gas with Vacuum (Combo) Mode

1. Set the gas pressure entering the contactor at 1 psig (0.07 bar, 0.07 kg/cm²) by adjusting the appropriate valve on the gas delivery system.
2. Set the recommended total sweep flow rate by adjusting the appropriate valve. See sweep guidelines for typical sweep gas flow rate ranges in the table below.
3. Introduce fresh sweep gas into each contactor. **NOTE:** If using compressed air, make sure it is oil free and air temp < 20°C. A 0.2 micron filter is recommended with any gas.
4. Apply vacuum as described in the vacuum section below.

Note: If the lumens are filled with water vapor, the contactor performance can be restored by applying 40-60 psi of sweep gas on the lumen side for ~5 min.

| | Sweep Guidelines for Sweep Mode | Sweep Guidelines for Combo Mode |
|--------------|--|---|
| 2.5 x 8 inch | 0.1 - 1.1 scfm (0.16 - 1.8 m ³ /hr) | 0.02 - 0.1 scfm (0.03 - 0.16 m ³ /hr) |
| 4 x 13 inch | 0.5 - 3 scfm (0.8 - 5.1 m ³ /hr) | 0.025 - 0.25 scfm (0.04 - 0.4 m ³ /hr) |
| 4 x 28 inch | 1 - 6 scfm (1.6 - 10 m ³ /hr) | 0.05 - 0.5 scfm (0.08 - 0.8 m ³ /hr) |
| 6 x 28 inch | 1 - 20 scfm (1.6 - 33.9 m ³ /hr) | 0.025 - 0.5 scfm (0.04 - 0.8 m ³ /hr) |
| 10 x 28 inch | 4 - 25 scfm (6 - 42.5 m ³ /hr) | 0.15 - 3.5 scfm (0.25 - 5.9 m ³ /hr) |
| 14 x 28 inch | 6-40 scfm (10 - 64 m ³ /hr) | 0.2 - 10 scfm (0.32 - 16 m ³ /hr) |

Vacuum Only Mode

1. Start vacuum pump following vacuum pump manufacturer's instructions.
2. Apply vacuum to the contactor by opening appropriate valve.
3. Adjust absolute gas pressure on the vacuum side to the desired level at the vacuum port on the contactor.

E Series RO

Installation Operation Maintenance Manual

Appendix 2 EDI Trouble Shooting Charts

E Series RO

Installation Operation Maintenance Manual

Troubleshooting Flow Chart - Increase in DC Volts Page 1 of 1

START HERE



Are any
DC wires
loose?

Yes

▶ Tighten connections

No



Feed
water temp
drop?

Yes

▶ Increase in DC voltage
is normal

No



Excess
hardness in
CEDI reject?

Yes

▶ Acid clean,
reduce CEDI feed
hardness and/or
lower CEDI recovery

No



Excess
silica in
CEDI reject?

Yes

▶ Caustic clean,
reduce CEDI feed
silica and/or
lower CEDI recovery

No



Does NaCl/ NaOH
cleaning help?

Yes

▶ Cleaning removed
organics from resin;
review process design
and operation

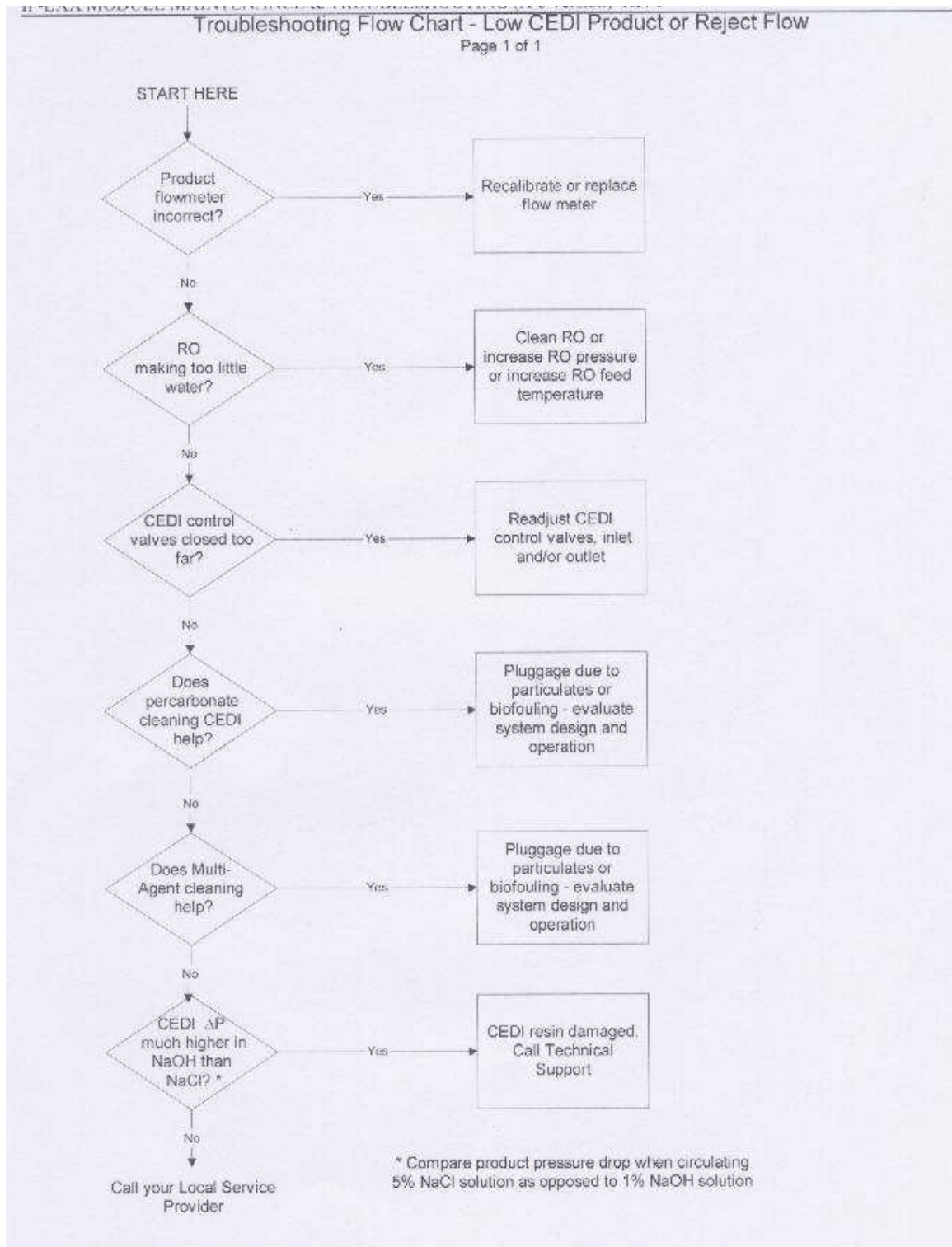
No



Call your Local
Service Provider

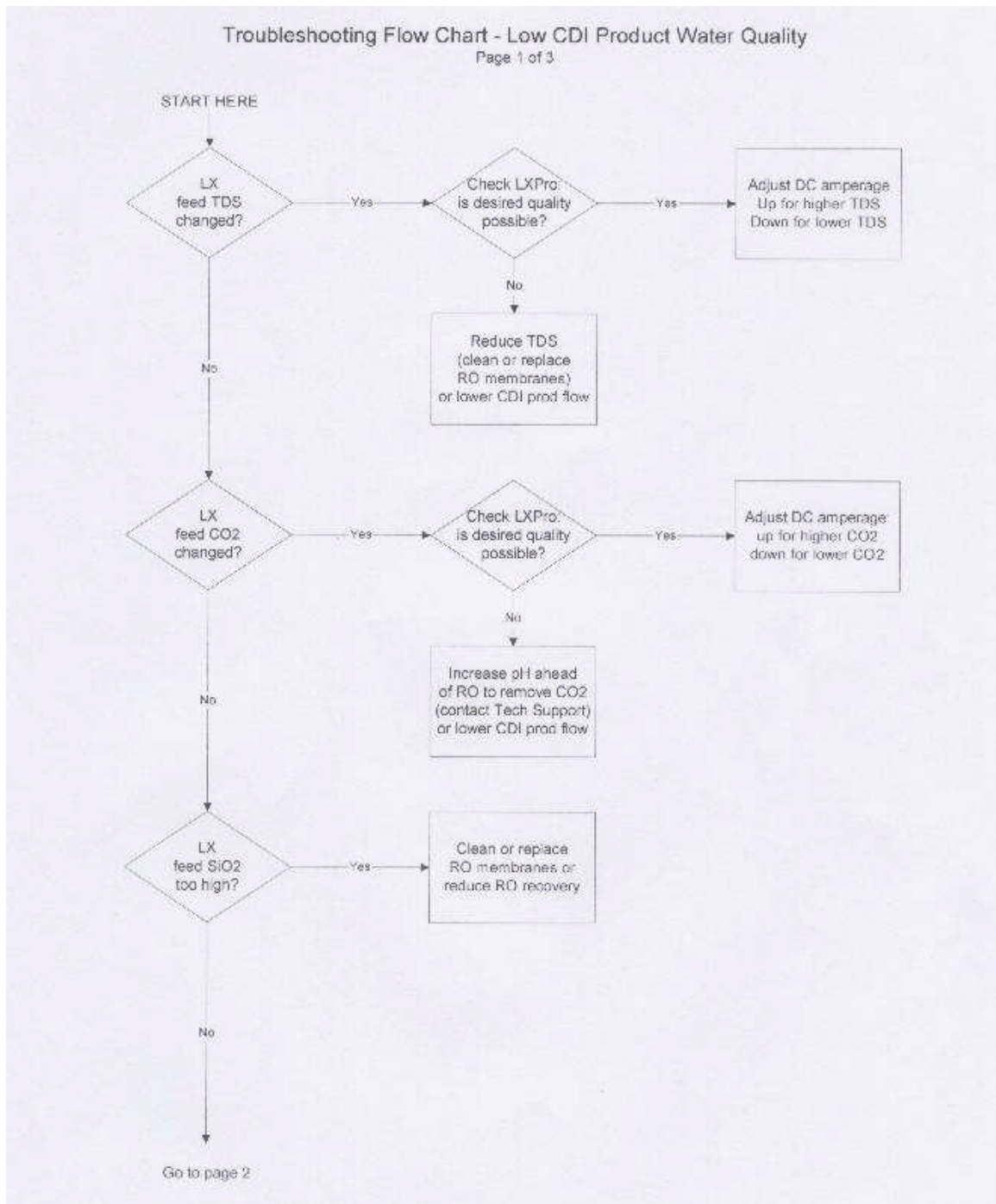
E Series RO

Installation Operation Maintenance Manual



E Series RO

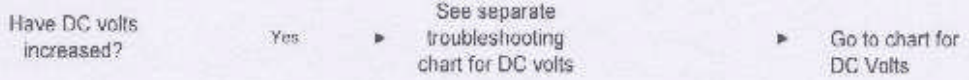
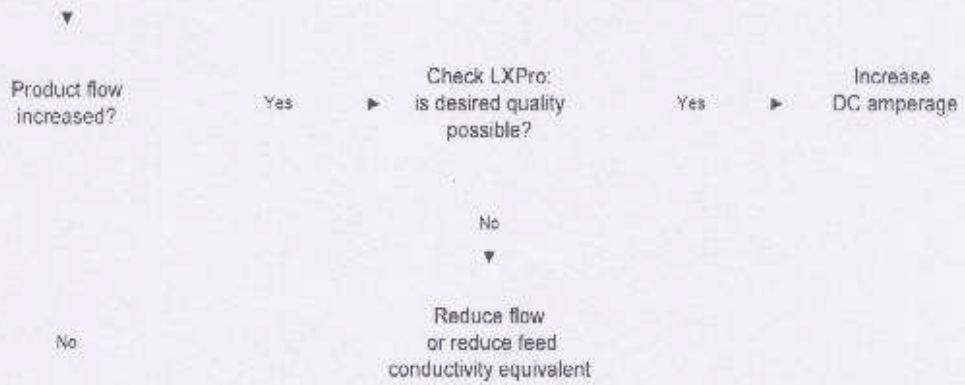
Installation Operation Maintenance Manual



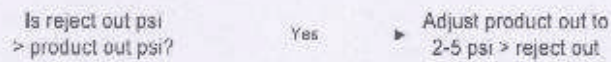
Troubleshooting Flow Chart - Low CDI Product Water Quality

Page 2 of 3

Continued from Page 1



No



No

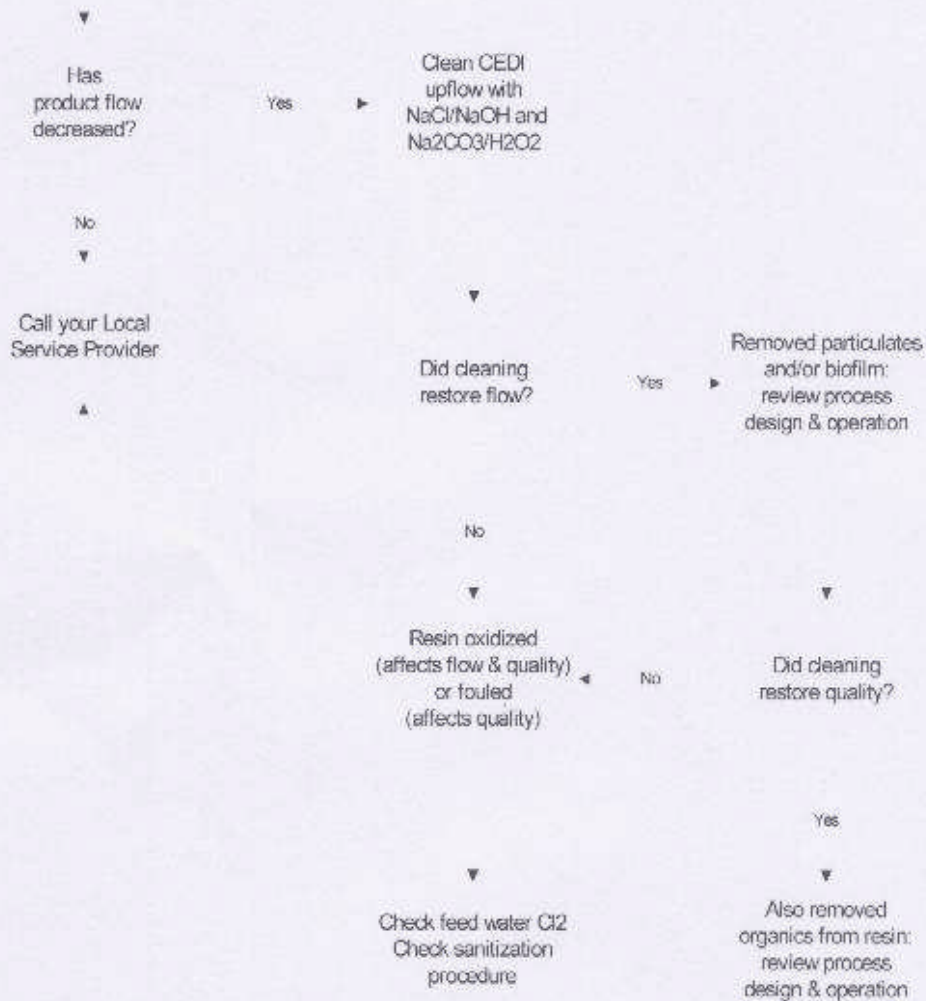


Go to page 3

Troubleshooting Flow Chart - Low CEDI Product Water Quality

Page 3 of 3

Continued from Page 2



Appendix 3 EDI Current Calculation

E Series RO

Installation Operation Maintenance Manual

The following equation is used to calculate the current requirement for the EDI unit

$$I = 1.31 (Q)(FCE)/(\# \text{ of CELLS})(EFF)$$

Q = Product Flow Rate per Module in lts/min

FCE = Feed Conductivity Equivalent (micra Siemens/cm)

$$FCE = (\text{ppm CO}_2 * 2.66) + (\text{ppm SiO}_2 * 1.94) + \text{conductivity}$$

EFF = 10%

Manufacturer's Declaration of Conformity

We the undersigned

EURAQUA UK, HITCHIN, ENGLAND

Certify that the product

*type: E Series Automatic Series Reverse Osmosis Unit
Models E 4-10, E 4-20, E 4-40, E 4-50, E 4-60 with EWS 'OS3051' controller*

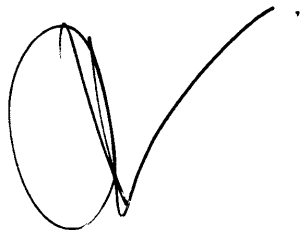
*has been designed and manufactured in accordance with the
specifications of the following:*

Directive

Machinery Directive 89/392/EEC
Low Voltage Directive 73/23/EEC
EMC-Directive 89/336/EEC

Standard

EN 292-1, EN 292-2
EN 60 335-1
EN 55 014



RT Adam
Director

Hitchin, England 01/01/07
Issue place & date