Installation Operation Maintenance Manual

D Series Double Pass Reverse Osmosis Systems With EWS 'OS3030' controller & De-gassing Membrane

Three phase versions

Models

D 4-10
D 4-20
D 4-30
D 4-40

Rev 2.0 **09/03/07**

CONTENTS

1.0 GENERAL NOTES

These instructions cover the D Series Range of Commercial Double Pass Reverse Osmosis Systems, which includes models with nominal outputs ranging from 450 to 1800 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 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 REVERSE OSMOSIS PROCESS

2.1 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 though 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).

2.2 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

2.3 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 190 psi for the first pass and 250 psi for the second pass.

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

2.4 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 D Series is adjustable but should normally set at approximately 15 litres per minute. The second pass stage has no re-circulation due to the high flow rate across the membrane making this unnecessary

2.5 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 D 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% for the first pass and 85% for the second pass.

2.6 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 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 10-15 ppm from the first pass. This is then passed through the second pass for a further salt rejection giving a water quality of < 1 ppm. With the second pass no recirculation is required as the improved quality of the water allows a higher flow rate through the membrane.

2.7 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.

2.8 Double Pass

The principle of double pass is that the feed water is passed through a reverse osmosis unit (first pass) producing permeate with the normal 99% reduction in dissolved salts. The permeate is then re-boosted and passed through another reverse osmosis unit (second pass) giving a further reduction in dissolved salts, normally of the order of 90% (the reduction percentage is lower as we are approaching the limits of dissolved salts that can be removed by a reverse osmosis membrane). From typical softened towns mains water this will produce a permeate from the second pass of < 1 micra Siemen per cm.

Because carbon dioxide can pass through a reverse osmosis membrane and be readily absorbed by the permeate forming carbonic acid, the pH of the permeate will be lower than the feed water. This in turn increases the conductivity reading of the permeate. To eliminate this a degassing unit can be installed on the permeate from the first pass or the pH of the feed water can be raised via Caustic Soda dosing, Increasing the pH will convert free carbon dioxide gas to bicarbonate ion that can be rejected by membranes.

The recovery from the double pass unit is the same as a standard reverse osmosis unit as the flush and concentrate from the second pass are re-circulated back to the feed water tank. As the second pass is being fed with permeate from the first pass the flush and concentrate will be of a higher quality then the original feed water so this practice not only keeps the overall recovery high but also improves the quality of the feed water for the first pass.

3.0 UNPACKING AND IDENTIFICATION

3.1 Basic Packages

The Reverse Osmosis 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 625 kg depending on the model. It should be moved on its castors to its point of installation. Lifting eye points have been incorporated into each corner of the skid.

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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 D Series frame with three, six, nine or twelve single length ESPA membranes, electronic controller, flow meters, valves, vertical multistage immersible pressure pump, de-gassing membrane, storage tanks for each stage, permeate divert valves and all interconnecting pipe work.

Pass 1

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 for pass 1, the flush and concentrate outlets from pass 2 and the vertical multistage immersible pressure pump for pass 1.

The control panel will not initiate service unless the water level is above the minimum set point, the low level Kasuga in the raw water storage tank. This 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 and then the inlet of the 1st pass 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 2nd pass water storage tank.

The concentrate outlet from the membrane housing is connected to a manifold with a tee to a recirculation flow regulating valve and flow meter, back pressure gauge line, tee to the flush line and tee to the pressure regulating/concentrate flow valve mounted below the concentrate flow meter. 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.

Pass 2

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 inlet of the 2nd pass 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 permeate outlet terminating in a ½" John Guest push fit connection.

The concentrate outlet from the membrane housing is connected to a manifold with a tee to a back pressure gauge line, tee to the flush line and tee to the pressure regulating/concentrate flow valve mounted below the concentrate flow meter. The flush outlet and concentrate outlet from the 2nd pass are routed back to the raw water tank. The regulating valve is used to control the back pressure in the concentrate line and the flow of concentrate.

The flows have been factory tested under working conditions, but the concentrate valve may have been opened prior to despatch in order to fill the membranes with preservative. The valve will need setting up on site to balance the outputs to the user's requirements depending on the incoming water pressure and quality.

Pressure gauges supplied are glycerine filled to minimise bounce and prolong the service life.

If a permeate storage tank has not been ordered, a tank 'full/restart' level sensor and flying lead has been included with the system to be installed in the permeate tank. Installation will require the tank cable to be connected via the tank connector/stuffing assembly the two core flex and two way connector on the Reverse Osmosis system.

6.0 PRE INSTALLATION CHECKS

6.1 MECHANICAL

6.1.1 Foundations/Drainage

The Reverse Osmosis 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 $CaCO_3$.

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.

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 ½ “ 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 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 ampage 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 L & N in the 2 way connector which plugs into the transformer enclosure on the R/O unit.

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 mean 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

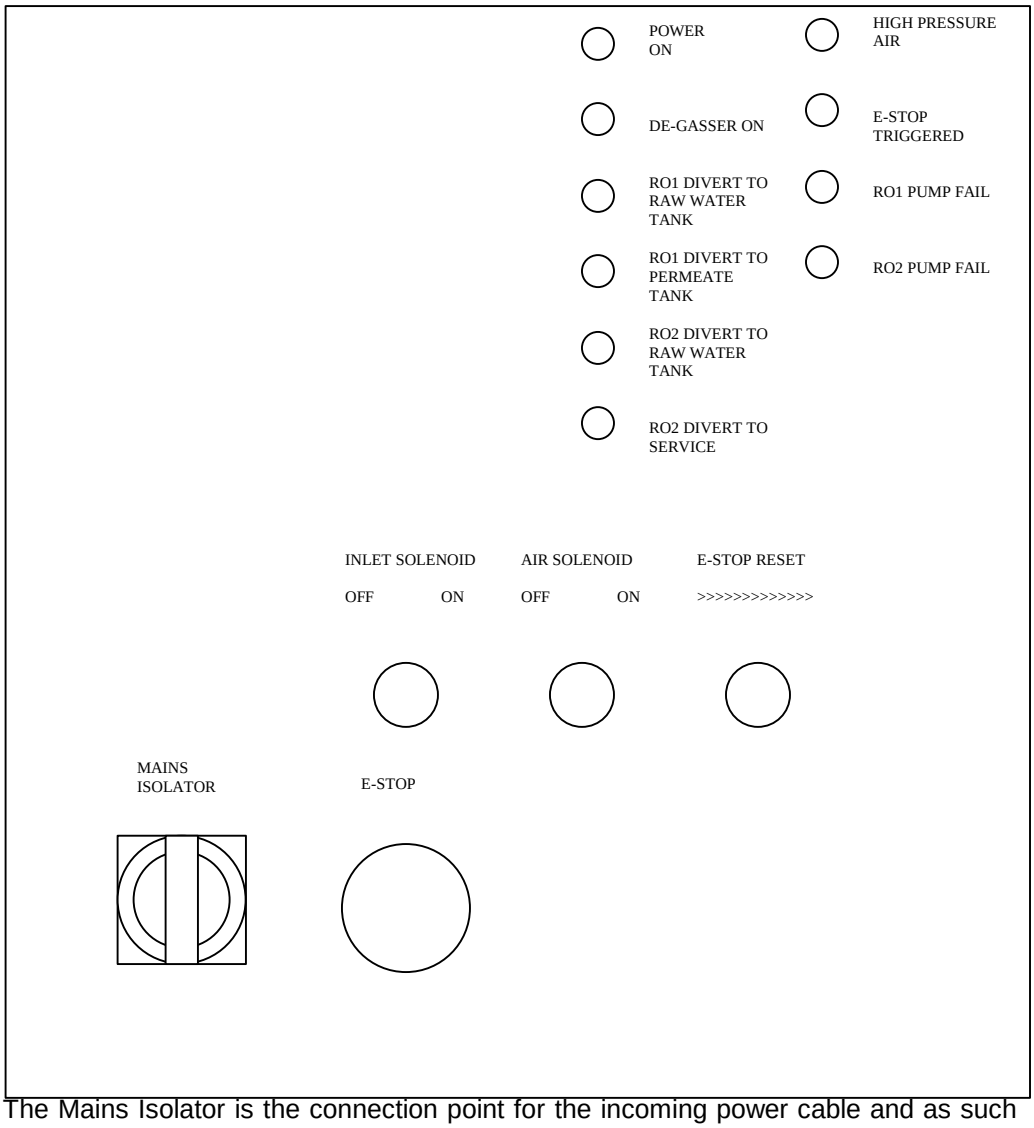
8.0 COMMISSIONING

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 Controls

Each pass of the RO is separately controlled via an EWS 3030 controller, left EWS 3030 controller for pass 1 right EWS 3030 controller for pass 2. In addition to these mounted in the front control box there is a pump contactor and pump circuit breaker/Overload again the left for pass 1 and the right for pass 2, see section 14 for electrical drawings. Each RO can be turned on/off using the power button on the respective EWS 3030 controllers. The facia for the lower control box has a series of switches and lights as shown below:-

Front Control Box Layout



The Mains Isolator is the connection point for the incoming power cable and as such when turned off the unit is electrically isolated. The inlet solenoid switch is used to turn

the power to the inlet solenoid on/off independent of the EWS 3030 RO controllers, the raw water tank will only fill if the fill switch is turned to on and the high level Kasuga in tank 1 indicates a requirement for water. The air solenoid switch is used to turn the air solenoid on/off independent of the EWS 3030 RO controllers. The air solenoid will be on provided the switch is in the on position and RO1 is running.

The 'Power On' green light signifies that 24 VAC is available. The De-Gasser on green light indicates that the air solenoid is open and the De-Gasser membrane is operational. The 'RO1 Divert to Raw Water Tank yellow light indicates that the RO 1 is operational and the conductivity is above the programmed maximum so it is re-circulating back to the raw water tank. The 'RO1 Divert to Permeate Tank yellow light indicates that the RO 1 is operational and the conductivity is below the programmed maximum so it is diverted to the permeate tank. The 'RO2 Divert to Raw Water Tank yellow light indicates that the RO 2 is operational and the conductivity is above the programmed maximum so it is re-circulating back to the raw water tank. The RO2 Divert to Permeate Tank yellow light indicates that the RO 2 is operational and the conductivity is below the programmed maximum so it is diverted to service. The High Pressure Air Red lamp signifies that the high pressure switch post the govener on the air inlet has been tripped. The E-Stop Triggered Red Lamp signifies that the E-Stop button has been pressed, the system will only come back on line if the E-Stop button is un-latched and the reset E-Stop switch turned. The 'RO 1 Pump Failure' red lamp signifies a problem with the pump for pass 1. The 'RO 2 Pump Failure' red lamp signifies a problem with the pump for pass 2.

8.2 De-Gassing System

An integral de-gassing membrane is included with the unit. The membrane removes the CO2 from the permeate of RO1 so allowing the permeate for RO2 to achieve a conductivity below 1 micra Siemen per cm. The membrane (Liqui-Cel 4 x 13 X-50) allows CO2 but not water to permeate through from the liquid side to the air side, the CO2 is then swept clear by compressed air. The controls for the de-gasser membrane are: -

- A pneumatic govener and filter
- An air line solenoid valve
- A needle valve to control the air flow rate
- An air flow gauge
- A pressure gauge for measuring the air pressure into the membrane.
- A high pressure switch post the govener

The operation conditions for the De-Gasser membrane are

- Air Pressure at the inlet to the membrane when the RO1 unit is running of 0.5 bar
- Air flow rate of 120 Litres/min

The air solenoid is set up to come on as soon as RO1 starts the pressure pump, the air solenoid will close down when RO1 is in standby to conserve air. A detailed decription of the start-up procedure for the De-Gasser membrane is given in Appendix 1 (Sweep Mode Vertical).

8.3 Pre Service Flush

After connecting the air inlet and water inlet, run a line to drain from the concentrate and permeate outlets. Remove the plug from the air solenoid and turn on the power at the isolation switch underneath the control boxes, check that RO 1 and 2 are turned off at the rocker switch on the OS 3030 controllers. 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.

Wind in the pressure regulator knob until it stops then back it off 1/4 turn.

Turn the fill switch on and wait until tank 1 has stopped filling, check that the water level has reached the middle of the upper sinker of the high level float switch.

Turn on the controller for RO 1 with the rocker switch.

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, CONSULATE A QUALIFIED ELECTRICIAN.

The controller should default to the pre-service rinse for one minute and then Service, but if it does not then press the service button (top left of the six).

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 tank 2 will begin to fill, RO 1 will shut down once the water level in tank 2 has reached the middle of the upper sinker of the high level float switch.

If the system cuts out at this point because of high permeate TDS, reset the maximum threshold (see EWS OS3030 instruction manual) and continue.

Turn on the controller for RO 2 with the rocker switch when the permeate tank is full of water from the first pass.

The controller should default to the pre-service rinse for one minute and then Service, but if it does not then press the service button (top left of the six).

Check for Leaks.

The pressure pump will fire up, the permeate divert valve will energise when in service (red light on the electrical connection).

Monitor the permeate and concentrate flows and balance with the pressure regulator so that the permeate flow is approximately equal to the concentrate flow (50% recovery) or as otherwise required.

This should give a back pressure on the pump (centre) pressure gauge of 190 psi for RO 1 and 250 psi for RO2.

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

Check the air pressure at the governor and adjust to 2 bar **NOTE AN AIR PRESSURE IN EXCESS OF 8.3 BAR ON THE DE-GASSING MEMBRANE CAN CAUSE IRREPARABLE DAMAGE**, turn the unit off and reconnect the air solenoid plug. Turn the unit back on and adjust the air flow rate to 80 litres/minute via the De-Gasser Needle valve and the air pressure entering the unit to less than 0.7 bar while RO1 is producing permeate.

Leave to run to drain for 30-60 minutes to flush the preservative out of the membranes. During the flush period, monitor the concentrate flow and fine tune to no more than 75% recovery (concentrate 1/3 of permeate) for RO 1 and 85% for RO 2.

If the permeate is then to the correct quality, the system can be put into 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 both tank switch floats. 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 that 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 RO1 is in stanby by lifting the permeate tank float switch.

The system is now commissioned.

9.0 Operation

The D 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 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 should be filled with an appropriate preservative. The system should then be re-commissioned prior to putting back into service. See Section 8.0

9.3 Example Data Recording Sheet

Model .....

Date installed .....

Membrane serial no(s) .....

Pump Pressure (PP) RO 1	Back Pressure (BP) RO 1	Conc Flow (CF) RO 1	Perm Flow (PF) RO 1	Total Flow (TF) = CF+PF RO 1	Recovery % (R) = (PF/TF) 100 RO 1	Pump Pressure (PP) RO 2	Back Pressure (BP) RO 2	Conc Flow (CF) RO 2	Perm Flow (PF) RO 2	Total Flow (TF) = CF+PF RO 2	Recovery % (R) = (PF/TF) 100 RO 2	Raw Water Temp °C (Weekly)	Operator initials

10.0 FAULT FINDING AND RECTIFICATION

Problem	Possible cause
No Power	Main fuse or supply cabling fault
Power on controller motor does not run	High level probe jammed or failed Motor failure Power relay failure Permeate quality above limit (membrane 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
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 2.1 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

11.0 WARRANTY AND SERVICE

11.1 AFTER SALE WARRANTY

Your Reverse Osmosis unit is covered by a parts warranty for a period of one year from installation on all mechanical and electrical components. Filters cartridges 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 unit or require routine service, please contact your supplier.

12.1 PROCESS AND OPERATING DATA

D Series Reverse Osmosis Units

MODEL		**4-10**	**4-20**	**4-30**	**4-40**
PARAMETER	**UNITS**				
Max. Output	Lit/hr	450	900	1350	1800
Min Input Flow* @ 75% recovery	Lit/hr	600	1200	1800	2400
Min Cont. Flow to drain* (during service @ 75% recovery)	Lit/hr	150	300	450	600
Max Flow to drain (during flush per unit)	Lit/hr	1500	1500	1500	1500
Min salt Rejection	%	99.9	99.9	99.9	99.9
Maximum Recovery	%	75	75	75	75

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	4-30	4-40
PARAMETER	**UNITS**				
Width	mm	1300	1300	2500	2500
Depth	mm	1100	1100	1100	1100
Height to frame	mm	1700	1700	1700	1700
Inlet Conn.	ins (Solvent Weld)	¾	¾	1	1
Permeate Outlet Conn.	ins O/D	1/2	1/2	1/2	1/2
Pressure. Drain Conn	Ins (Solvent Weld)	1	1	1	1
Gravity. Drain Conn	Ins (Solvent Weld)	1 ½”	1 ½”	1 ½”	1 ½”
Delivered Wt.	Kg.	350	450	550	650
Working Wt. (approx.)	Kg.	800	900	1,000	1,100
Thee Phase Electrical Power	v	415	415	415	415
	Hz	50	50	50	50
	kW	3	5	7.5	7.5
FLC	Amp	7.23	12.05	18.07	18.07

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

12.3 PARTS DATA

Model		**4-10**	**4-20**	**4-30**	**4-40**
Frame		BS304 Stainless Steel (all)			
Membrane no		3	6	9	12
Membrane type			ESPA2		
Membrane ref		4040	4040	4040	4040
Pump ref Pass 1 MTR		1-36/30	3 36/25	5 24/22	5 24/22
Pump ref Pass 2 MTR		1s36/36	1 36/33	3 36/33	3 36/33
Controller		EWS OS3030 (all)			
Transformer		200 VA (all)			
Voltage		240 - 24v (all)			
T/former supply fuse	F1	1 A (all)			
General Controller	F2	5 A			
RO 2	F3	5 A to controller			
RO 1	F4	5A to controller			
Circuit Breaker		Telemecanique GV2 (three phase units)			
Recirc F/C lpm		All adjustable			
Flush F/C lpm		15	15	15	15
		Lt/min	lt/min	lt/hr	lt/hr
Perm flow meter RO 1		2.0-20	2.0-20	250-2500	250-2500
Conc flow meter RO 1		0.7-7	0.7-7	100-1000	100-1000
Recirc flow meter RO 1		2.0-20	2.0-20	250-2500	250-2500
Perm flow meter RO 2		2.0-20	2.0-20	250-2500	250-2500
Conc flow meter RO 2		0.7-7	0.7-7	65-650	65-650

13.0 EWS OS303 CONTROLLER

13.1 Manufacturers Manual

A manufacturers manual for the EWS OS3030 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.

Factory programming

RO 1

Program Step	Display	Setting	Function
1.1	Constant	0.10	Cell constant setting
1.2	Limit Min	Yes	Sets min. conductivity condition
1.3	Value Min	1.0	Sets minimum value
1.4	Switch Off	No	Not sw. off if min val. reached
1.5	Limit Max	Yes	Sets max. conductivity condition
1.6	Value Max	50.0	Set maximum value
1.7	Switch Off	Yes	Switch off is max.val. reached
1.8	Delay	60s	Delay before switching off
2.1	Temperature	25	Manual temperature comp. val.
3.1	Factor	1	Compensation correction factor
4.1		LP	Input 1 function
4.2		ST	Input 2 function
4.3		EP	Input 3 function
4.4		FU- EM- LP- STI EP-	Function activation condition
5.1	Level Switch	1	Single level switch
5.5	Delay	10s	Low water cutout delay
5.6	Switch On	0	Number of restarts
5.8		PI R1I R2I R3I M- S1-	Phases when pressure monitored
5.13		PI R1I R2I R3I M- S1-	Phases when stop signal monitored
5.14	Manual Start	No	Auto start after stop signal canx
5.15	Stop Power Failure	No	Auto start after Power Failure
6.1		PV	Output 1 function Permeate Valve
6.2		MF	Output 2 function Alarm Relay
6.3		PUI IVI CVI PVI MFI	Output activation state
7.6	Limit CM	10	Conductivity setting for RO1 divert valve
7.7	Rise Delay	1s	Delay on RO1 divert valve
7.8	Falling Delay	1s	Delay on RO1 divert valve
7.9		MII MAI EM- FU-	Events triggering alarm relay
7.10		LP- ST- EPI	Events triggering alarm relay
7.11		PSI PFI MT-	Events triggering alarm relay
8.1		MII MAI EM- FU-	Events triggering alarm buzzer
8.2		LP- ST- EP-	Events triggering alarm buzzer
8.3		PSI PFI MT-	Events triggering alarm buzzer
9.1	Production 1	60s	Length of first production phase
9.2		PUI IVI CVI PVI	Functions active
9.3	Production 2	0s	Length of second production phase
9.5	Production 3	0s	Production phase skipped
9.7		PUI IVI CV- PVI	Main production phases active

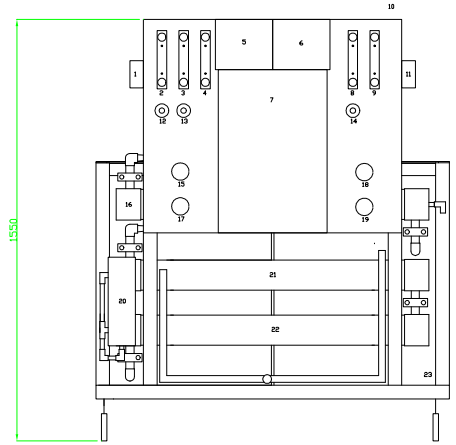
10.1		IV- CV- PVI	Stop in production functions
10.2		IV- CV- PVI	Stop in rinse functions
11.1		IV- CV- PVI	Stop in alarm functions
12.1	Standby	0s	Standby stage one skipped
12.3		IV- CV- PVI	Standby functions
13.1	Rinse	Yes	Rinse after production
13.2	Rinse 1	180s	Length of post production rinse 1
13.3		PUI IVI CVI PVI	PP rinse 1 functions
13.4	Rinse 2	0s	Length of post production rinse 2
13.6	Rinse 3	0s	Length of post production rinse 3
14.1	Rinse Standby	Yes	Rinse during standby
14.2	Interval	24h	Frequency of standby rinse
14.3	Rinse 1	180s	Length of standby rinse 1
14.4		PUI IVI CVI PVI	Standby rinse 1 functions
14.5	Rinse 2	0s	Length of standby rinse 2
14.7	Rinse 3	0s	Length of standby rinse 3
15.1	Rinse Production	Yes	Rinse during production
15.2	Interval	8h	Frequency of production rinse
15.3	Rinse 1	60s	Length of production rinse 1
15.4		PUI IVI CVI PVI	Production rinse 1 functions
15.5	Rinse 2	0s	Length of production rinse 2
15.7	Rinse 3	0s	Length of production rinse 3
16.1	Maintenance 1	0s	Length of maintenance st. 1
16.2		PUI IVI CVI PVI	Maintenance st. 1 functions
16.3	Maintenance 2	500m	Length of maintenance st. 2
16.4		PUI IVI CVI PVI	Maintenance st. 2 functions
16.5	Interval	No	Maintenance interveal set
18.1	Code Number	No	Code number not required

RO 2

Program Step	Display	Setting	Function
1.1	Constant	0.10	Cell constant setting
1.2	Limit Min	Yes	Sets min. conductivity condition
1.3	Value Min	0.1	Sets minimum value
1.4	Switch Off	No	Not sw. off if min val. reached
1.5	Limit Max	Yes	Sets max. conductivity condition
1.6	Value Max	5.0	Set maximum value
1.7	Switch Off	Yes	Switch off is max.val. reached
1.8	Delay	60s	Delay before switching off
2.1	Temperature	25	Manual temperature comp. val.
3.1	Factor	1	Compensation correction factor
4.1		LP	Input 1 function
4.2		ST	Input 2 function
4.3		EP	Input 3 function
4.4		FU- EM- LP- STI EP-	Function activation condition
5.1	Level Switch	1	Single level switch
5.5	Delay	10s	Low water cutout delay
5.6	Switch On	0	Number of restarts
5.8		PI R1I R2I R3I M- S1-	Phases when pressure monitored
5.13		PI R1I R2I R3I M- S1-	Phases when stop signal monitored
5.14	Manual Start	No	Auto start after stop signal canx
5.15	Stop Power Failure	No	Auto start after Power Failure
6.1		PV	Output 1 function Permeate Valve
6.2		MF	Output 2 function Alarm Relay
6.3		PUI IVI CVI PVI MFI	Output activation state
7.6	Limit CM	3	Conductivity setting for RO1 divert valve
7.7	Rise Delay	1s	Delay on RO1 divert valve
7.8	Falling Delay	1s	Delay on RO1 divert valve
7.9		MII MAI EM- FU-	Events triggering alarm relay
7.10		LP- ST- EPI	Events triggering alarm relay
7.11		PSI PFI MT-	Events triggering alarm relay
8.1		MII MAI EM- FU-	Events triggering alarm buzzer
8.2		LP- ST- EP-	Events triggering alarm buzzer
8.3		PSI PFI MT-	Events triggering alarm buzzer
9.1	Production 1	60s	Length of first production phase
9.2		PUI IVI CVI PVI	Functions active
9.3	Production 2	0s	Length of second production phase
9.5	Production 3	0s	Production phase skipped
9.7		PUI IVI CV- PVI	Main production phases active
10.1		IV- CV- PVI	Stop in production functions
10.2		IV- CV- PVI	Stop in rinse functions

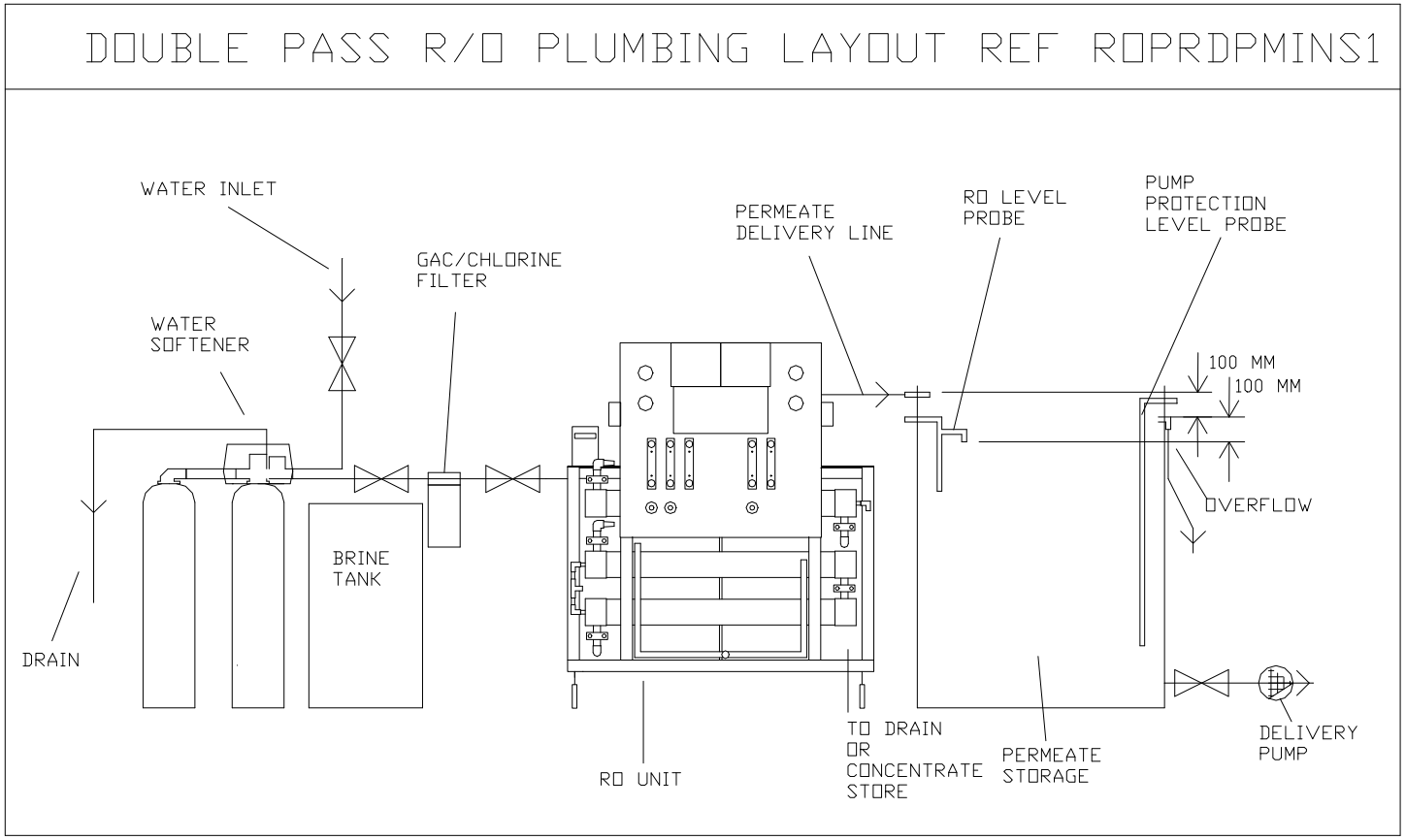
11.1		IV- CV- PVI	Stop in alarm functions
12.1	Standby	0s	Standby stage one skipped
12.3		IV- CV- PVI	Standby functions
13.1	Rinse	Yes	Rinse after production
13.2	Rinse 1	180s	Length of post production rinse 1
13.3		PUI IVI CVI PVI	PP rinse 1 functions
13.4	Rinse 2	0s	Length of post production rinse 2
13.6	Rinse 3	0s	Length of post production rinse 3
14.1	Rinse Standby	Yes	Rinse during standby
14.2	Interval	24h	Frequency of standby rinse
14.3	Rinse 1	180s	Length of standby rinse 1
14.4		PUI IVI CVI PVI	Standby rinse 1 functions
14.5	Rinse 2	0s	Length of standby rinse 2
14.7	Rinse 3	0s	Length of standby rinse 3
15.1	Rinse Production	Yes	Rinse during production
15.2	Interval	8h	Frequency of production rinse
15.3	Rinse 1	60s	Length of production rinse 1
15.4		PUI IVI CVI PVI	Production rinse 1 functions
15.5	Rinse 2	0s	Length of production rinse 2
15.7	Rinse 3	0s	Length of production rinse 3
16.1	Maintenance 1	0s	Length of maintenance st. 1
16.2		PUI IVI CVI PVI	Maintenance st. 1 functions
16.3	Maintenance 2	500m	Length of maintenance st. 2
16.4		PUI IVI CVI PVI	Maintenance st. 2 functions
16.5	Interval	No	Maintenance interveal set
18.1	Code Number	No	Code number not required

14.1 Dimension & parts identification all D Series models

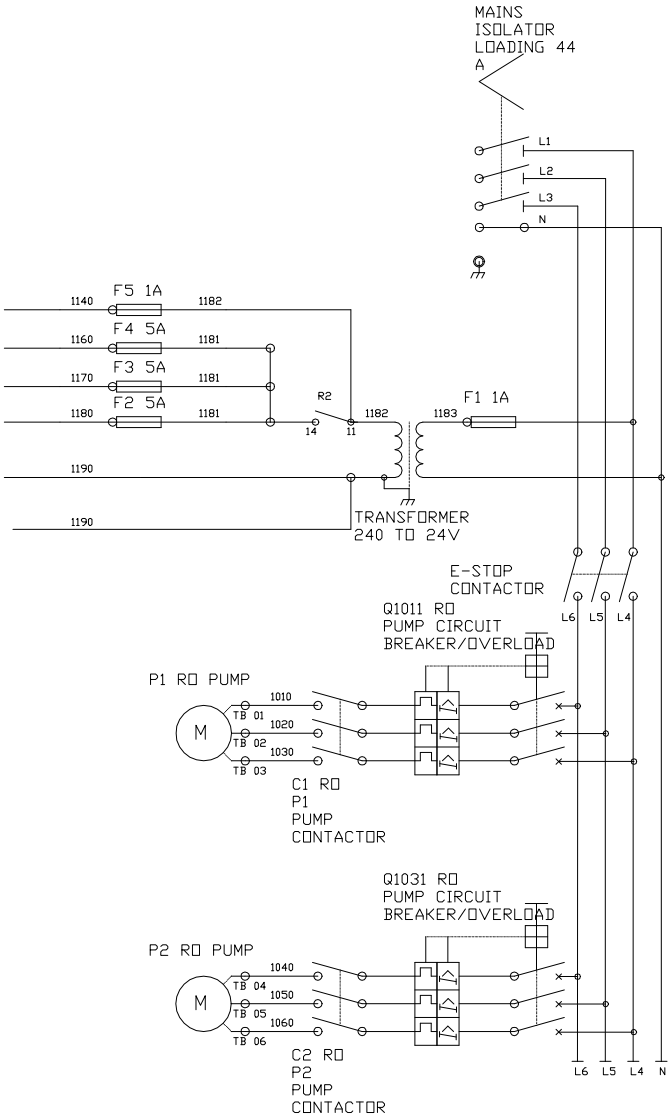


1 RO1 PERMEATE DIVERT VALVE
2 RO1 CONCENTRATE FLOW METER
3 RO1 RECIRCULATION FLOW METER
4 RO1 PERMEATE FLOW METER
5 RO1 CONTROLLER
6 RO2 CONTROLLER
7 GENERAL CONTROL BOX
8 RO2 CONCENTRATE FLOW METER
9 RO2 PERMEATE FLOW METER
10 PERMEATE SERVICE CONNECTION
11 RO2 PERMEATE DIVERT VALVE
12 RO1 CONCENTRATE FLOW CONTROL
13 RO1 RECIRCULATION FLOW CONTROL
14 RO2 CONCENTRATE FLOW CONTROL
15 RO1 PUMP PRESSURE GAUGE
16 RO2 MEMBRANE
17 RO1 BACK PRESSURE GAUGE
18 RO2 PUMP PRESSURE GAUGE
19 RO2 BACK PRESSURE GAUGE
20 DE-GASSER MEMBRANE
21 RO1 MEMBRANE 2
22 RO1 MEMBRANE 1
23 DRAIN
24 HIGH LEVEL FLOAT SWITCH RAW WATER TANK
25 RO1 PRESSURE PUMP
26 LOW LEVEL FLOAT SWITCH RAW WATER TANK
27 HIGH LEVEL FLOAT SWITCH PERMEATE TANK
28 RO2 PRESSURE PUMP
29 LOW LEVEL FLOAT SWITCH PERMEATE TANK
30 RAW WATER TANK
31 PERMEATE TANK
32 ANTI-BACTERIAL VENT

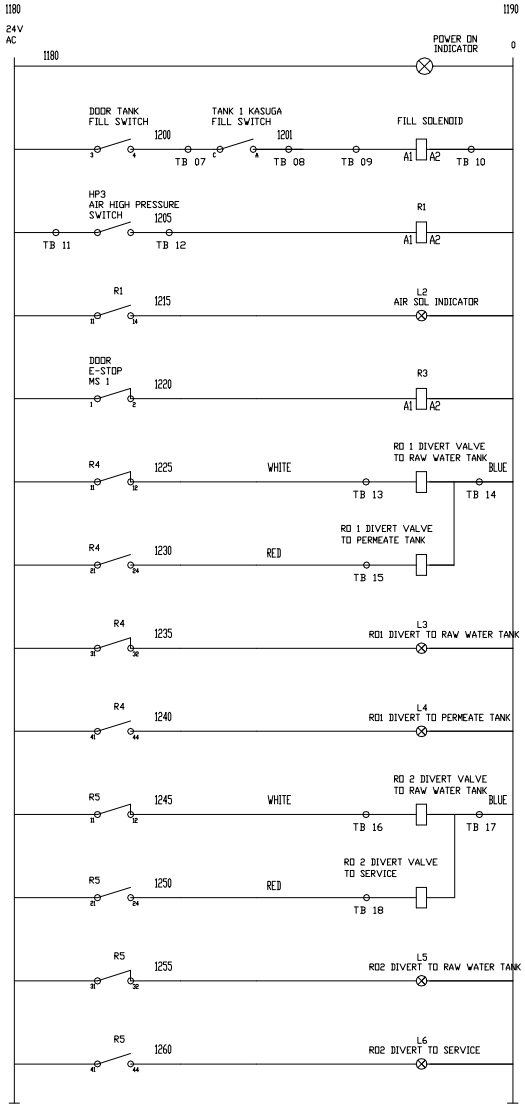
14.2 Plumbing layout

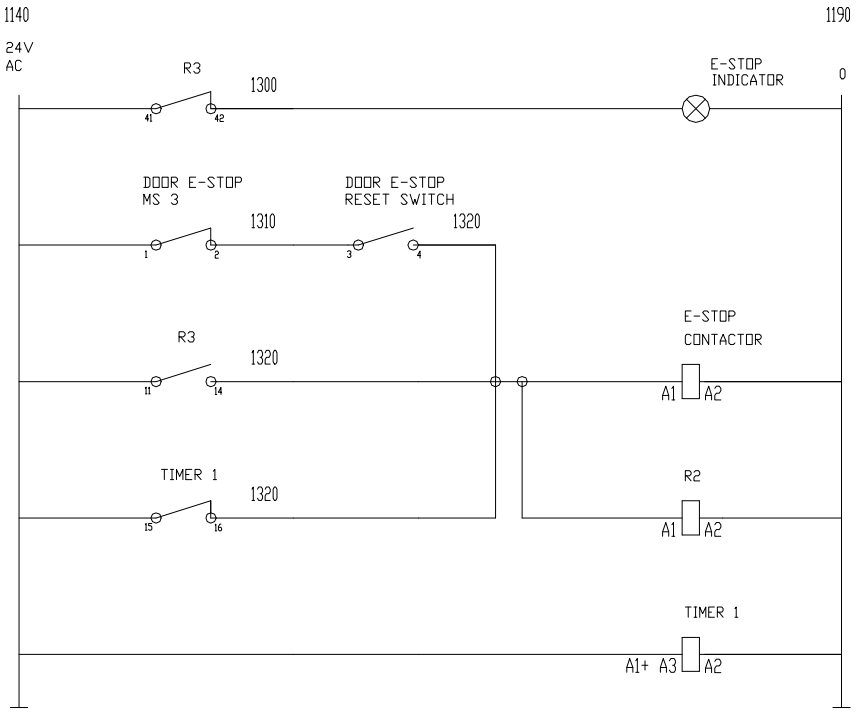


14.2 General cabling diagram 240 Volt Cabling

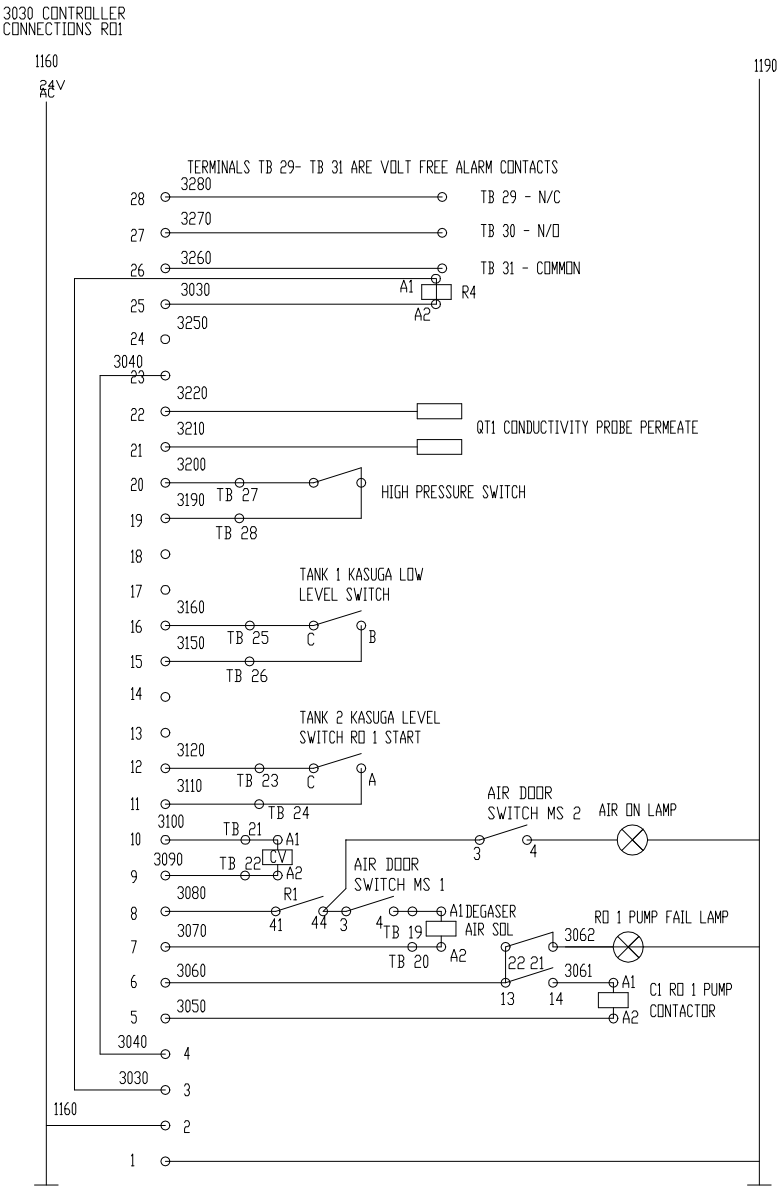


General Cabling

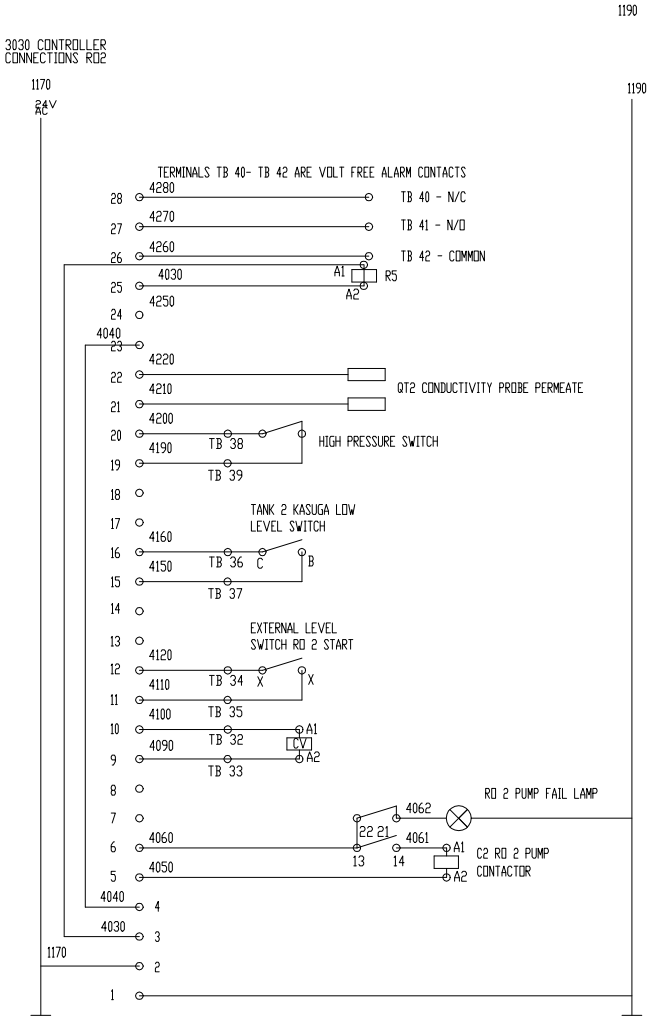



1140
1190
24V
AC
R3
1300
41
42
E-STOP
INDICATOR
0
DOOR E-STOP
MS 3
1310
1
2
DOOR E-STOP
RESET SWITCH
1320
3
4
R3
1320
11
14
E-STOP
CONTACTOR
A1
A2
TIMER 1
1320
15
16
R2
A1
A2
TIMER 1
A1+
A3
A2

RO1 Controller Cabling



RO2 Controller Cabling



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.

SERVICE QUESTIONS: Contact your OEM or your Membrana representative.

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A POLYPORE Company

Liqui-Cel®
Membrane Contactors

FLOW DIAGRAMS

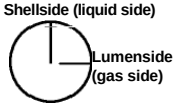
Steps:

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.

NOTES:

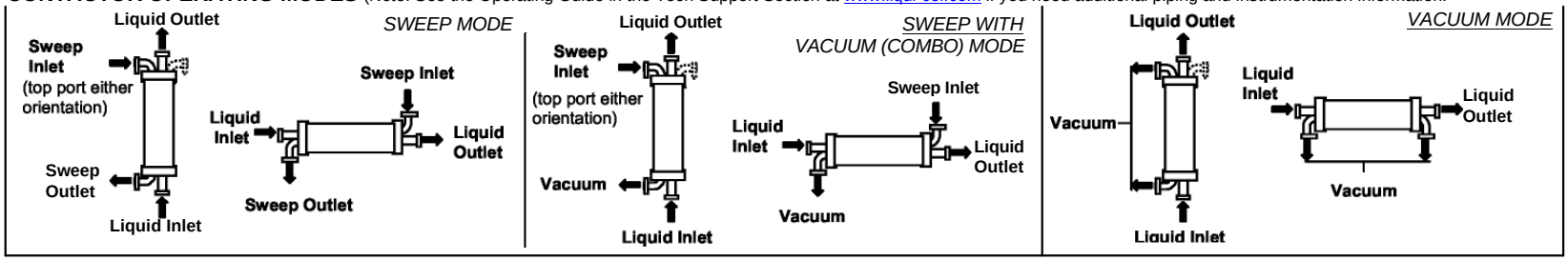
- The liquid pressure should always be higher than the gas phase pressure inside the contactor.

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 m^3/hr), 4 x 28 - 30 gpm (6.8 m^3/hr), 6x28 - 50 gpm (11.4 m^3/hr), 10 x 28 - 210 gpm (47.7 m^3/hr) with X50 fiber, 250 gpm (56.8 m^3/hr) with X40 fiber, 14 x 28 – 400 gpm (90.8 m^3/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/cm^2). For SuperPhobic Contactors, use 75psi (5.2 bar, 5.3 Kg/cm^2) 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 d 10 psig (0.7 bar, 0.7 kg/cm^2) 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 d 1 psig (0.07 bar, 0.07 kg/cm^2) 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 m3/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.

Manufacturer's Declaration of Conformity

We the undersigned

EURAQUA UK, HITCHIN, ENGLAND

Certify that the product

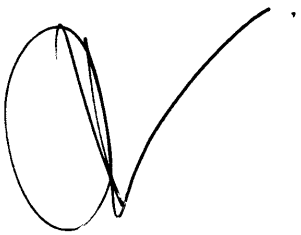
---

type: D Series Automatic Series Reverse Osmosis Unit
Models D 4-10, D 4-20, D 4-30, D 4-40 with EWS 'OS3030' controller

---

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

Directive	**Standard**
Machinery Directive 89/392/EEC	EN 292-1, EN 292-2
Low Voltage Directive 73/23/EEC	EN 60 335-1
EMC-Directive 89/336/EEC	EN 55 014



RT Adam
Director

Hitchin, England 01/01/02
Issue place & date