INSTRUCTION MANUAL

Ecosoft RO MIDI systems

MO-1 MO-2 MO-3 MO-4 MO-6 MO-9

CONTENTS:

This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.

ACRONYMS AND ABBREVIATIONS

CIP Clean-in-place
FF Forward flush
GPM Gallon per minute
LPM Liter per minute
NC Normally closed
NO Normally open
P&ID Piping and instrumentation diagram
PCB Printed circuit board
RO Reverse osmosis
TDS Total dissolved solids

RO SYSTEM

1 Overview

Ecosoft industrial reverse osmosis systems are used for demineralizing water in industrial, municipal, commercial applications. Ecosoft RO system can be used to demineralize low to medium salinity feed water. All parts of the system that are in contact with water have the necessary certifications for use in food/drinking water applications.

Reverse osmosis system operates as follows. First, raw water is fed through sediment prefilters to remove particles. The water may be dosed with antiscalant or other RO chemicals with a dosing pump at this point. Then, high pressure pump feeds the water into the membrane module or membrane array, in which feed stream undergoes separation process and splits into purified and concentrated streams. Part of the concentrated stream is discharged to drain, and the rest is fed back to suction end of the high pressure pump, referred to as concentrate **recycle**. Drain line is fitted with **drain flow control** that limits rate of concentrate discharge and determines the ratio of purified water (**permeate**) to waste water (**concentrate**). The ratio is called **recovery**. Recycle line is fitted with **recycle flow control** that limits recycle flow rate and creates working pressure in the membrane array. Rate of permeate production is proportional to the pressure in the membrane modules. Commissioning and configuring the RO system includes carefully adjusting the flow controls to the right settings.

Improperly commissioned RO system may fail in the matter of minutes, including irreparable membrane failure, hardware failure, and also involves electrical and pressure hazard. Drain flow rate and recycle flow rates should only be configured by authorized staff.

Permeate stream comes out via permeate outlet and runs to permeate tank. Purification process will stop whenever the tank is full of water (signaled by the **float switch**) or when any backpressure in permeate line appears, indicating critical condition. The process will automatically resume when the full tank signal deactivates.

The system is operated with a process **controller**, which powers pump(s) and valves so as to carry out service or membrane rinse in the necessary times. The controller reads signals from pressure switches, float switch, permeate conductivity and temperature, and external inhibition. Depending on these signals, it chooses to run in service, rinse membranes, go to standby, or go to fault mode. Permeate conductivity and temperature data are displayed to the operator. Depending on system model, it can be additionally equipped with:

- antiscalant/chemical dosing pumps
- additional electric valve for raw water mixing or membrane permeate rinsing (see Annex A)

2 Technical data

Tap feed water must be pre-filtered from fine particulates and residual chlorine before entering the RO system. Well water may contain impurities such as hardness, iron, manganese, silica, hydrogen sulfide that can quickly lead to membrane failure. Some of these challenges can be addressed by using injection of antiscalant. Perform a detailed laboratory analysis of your well water and consult a water treatment specialist to see if you need additional equipment for treating your well water.

SPECIFICATIONS	MO-1	MO-2	MO-3	MO-4	MO-6	MO-9
Physical data						
Rated capacity ±10%, m^3/h	1	2	3	4	6	9
Feed water flowrate @ 0,2-0,4 MPa, m^3/h	1,3-1,6	2,8-3,6	4-5	5,5-7	8-10	12-16
Water use per rinse, L	130	130	130	270	270	400
Power consumption, kW	3-4	4	4	4-5,5	7,5	7,5-11
Dimensions (W×D×H), m	0,9×0,9×2,2	3,2×1,2×2,0	4,1×1,2×2,0	3,2×1,2×2,1	4,1×1,2×2,1	4,1×1,2×2,1
Maximum dry weight, kg	190	220	280	350	440	600
Connection port sizes feed water permeate concentrate	 DN32 DN25 DN32	 DN40 DN25 DN32	 DN50 DN32 DN40	 DN50 DN32 DN40	 DN50 DN32 DN40	 DN50 DN50 DN50
Normal operating specification[1]						
Drain flow rate, LPM GPM	6-9 1,6-2,4	11-14 3-3,7	17-23 4,6-6	25-30 7-8	35-45 9-12	50-60 13-16
Recycle flow rate, LPM GPM	75-95 20-25	65-85 17-23	75-110 20-30	50-80 13-22	125-200 33-55	110-150 29-40
Permeate flow rate, LPM GPM	15-20 4-5	30-35 8-9,2	50-55 13-15	68-75 18-20	95-105 25-28	140-160 38-42

[1] feed water must comply with requirements in the table of Limitations . If some data are not available or do not meet requirements, contact Ecosoft Customer support.

LIMITATIONS[2]

Hardness	150 mg/L $CaCO_3$
	8,5 °dH
Iron	0,1 mg/L
Manganese	0,05 mg/L
Silicate	20 mg/L
Total dissolved solids	3000 mg/L
Chemical oxygen demand	4,0 mg/L O_2
Residual chlorine	0,1 mg/L
Hydrogen sulfide	none

[2] the limitations may be exceeded if using antiscalant, oxygen scavenger, or other RO chemical pretreatment

Inlet pressure	0,2…0,4 MPa
Temperature of water	10…25 °C
Electrical power	400 V, 50 Hz 3-phase
Membrane pressure	0,8…1,2 MPa

RO SYSTEM

3 Installation and startup

Caution! Electrical installation should only be done by a qualified electrician.

3.1 Rest the unit on a flat level surface capable of supporting its weight (see table of Specifications). Install permeate tank next to the unit. Inspect the RO system carefully for damage, including piping, valves and instruments, pump, pressure vessels, pre-filter housings, power cabinet before proceeding with connection and startup.

3.2 Install membrane in each pressure vessel as follows.

Remove PVC piping with the pressure vessel ports. To remove PVC pipes, take apart pipe unions at the pressure vessel ports. If necessary, also loosen next closest downstream union to remove the entire piping fragment leading to the vessel. Remove the lid at the feed end of pressure vessel. First, remove spiral retaining ring by pulling bent tab towards the center of circle. If the pressure vessel lid is retained by half rims, remove the fastening screws and pull half rims out of circular groove. Take out the lid with membrane adapter.

Observe direction of arrow on pressure vessel when installing membrane. Use glycerol or a similar RO-compatible lubricant as needed. Avoid touching membrane with hands. Use sterile rubber gloves when handling membrane.

Make a cut in membrane packaging bag and insert membrane in the pressure vessel brine seal last. Central tube of the membrane has to mate with membrane adapter installed at the concentrate end of pressure vessel. If necessary, remove the lid at the concentrate end before installing the membrane.
If installing multiple membranes in one vessel, proceed with the next membrane in a similar fashion, after installing membrane connector in central tube of first membrane's rear end. Couple the second membrane with the connector, then push it forward all the way in the pressure vessel.
After the membrane(s) are installed in the pressure vessel, install the lid back in place. Put spiral retaining ring (or half rims) in the groove, fasten half rims with screws. Re-assemble the RO system in reverse order.

3.3 Connect raw water pipe from water main/pump to the entry solenoid of the RO system. Recommended pipe size is at least that of the connection port, plastic/composite pipe or rigid non-kinking hose. Use appropriate fittings as necessary. Connect

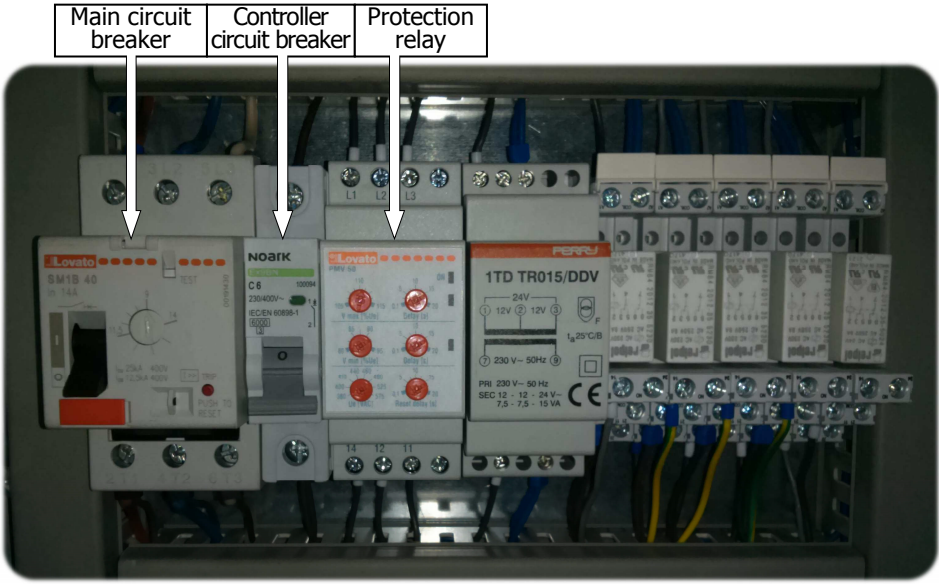
drain tube or hose with drain outlet of the RO system and run it to drain pipe. Ensure air gap at the end of drain line to prevent backsiphonage. Connect tube or hose to permeate outlet and extend it to permeate tank. Cut or bore an aperture at the top of tank wall, install pipe gland and pull the permeate tube through the gland (note: run permeate line to drain when carrying out initial membrane rinse).

It is strongly recommended to use short runs of pipe or hose the size of which matches or exceeds that of the connection port.

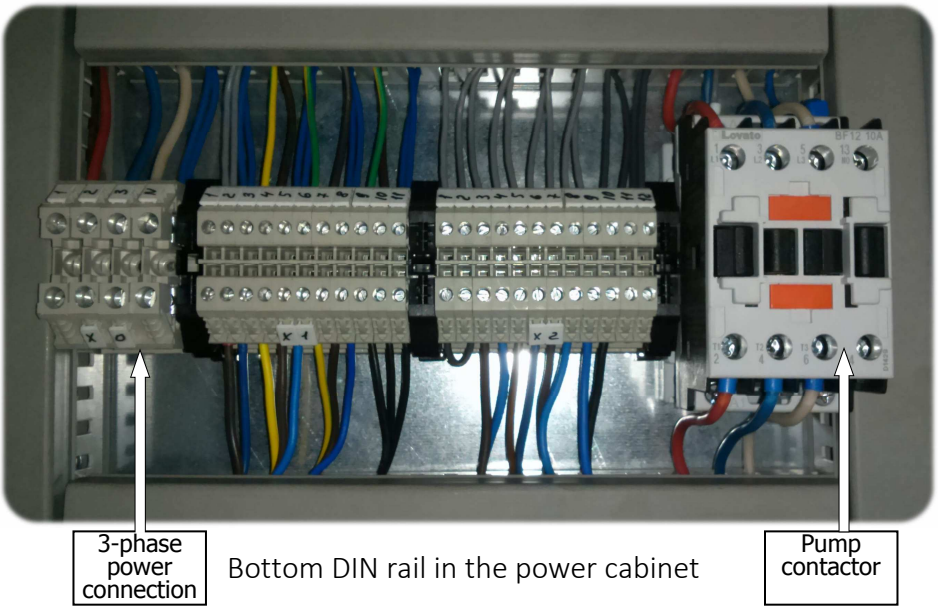
3.4 Put the float switch inside permeate tank after moving ballast the necessary length up the cord to provide enough level difference between activated and deactivated position. After the first filling of the tank, verify that the float switch activates and deactivates in the right positions.

3.5 If the RO system has permeate rinse enabled, install the necessary piping. If using service interruption by external signal (microswitch), remove conductor connecting terminals 6 and 7 together on controller PCB. Then, run wire from microswitch inside the controller housing and connect to the terminals. If using antiscalant or other RO chemicals, refer to dosing pump's instruction booklet for information concerning the dosing pump.

3.6 Run power to the RO system. Pull power cable inside power cabinet of the RO system through a gland in cabinet wall. Connect three phases and neutral to leftmost screw terminal block in the bottom row. Switch on main circuit breaker in the top row. Check protection relay status. Any LED signal except green light on indicates some power supply fault. Green LED indicates proper power supply. See pictures of the electrical panel.



Top DIN rail in the power cabinet



Bottom DIN rail in the power cabinet

3.7 Start up the system as follows:

3.7.1 Ensure recycle and drain flow regulating valves are fully open before starting. Run the permeate tube to drain for the duration of the first run of the RO system.

3.7.2 Switch on controller circuit breaker to start the RO system. After the controller starts up and the unit starts to operate, tighten drain regulating valve until drain rotameter reading meets specification (see table of Specifications). Then, start turning down recycle regulating valve. This will raise pressure in the membrane module shown on pressure gauge. Stop when recycle flow rate meets specification or pressure in the membrane module reaches above upper limit (see table of Specifications).

3.7.3 Calculate target drain flow using below formula. Use 75% recovery (unless specified otherwise) and permeate flow rate as shown on permeate rotameter:

$$\text{Drain flow rate} = \frac{\text{Permeate flow rate}}{\text{Recovery}} - \text{Permeate flow rate}$$

For example:
Permeate flow rate = 50 l/min (= 3 m^3/h)
Recovery = 75% = 0,75 (default)

$$\text{Target drain flow rate} = {}^{50}\!/_{0,75} - 50 = 16{,}67 \text{ l/min}$$

Make final adjustment of drain flow rate to your calculated target value. After you have finished setting up, verify that operating flow rates, rotameter and pressure gauge readings stay within specification as per table of Specifications.

Take care **not to exceed** 1,6 MPa in membrane module at any time. If membrane pressure rises above the upper limit in specification, open recycle flow regulating valve to bring it down.

Drain flow rate must not go below the calculated target value at any time. If at some point drain flow rate lowers, loosen drain flow regulating valve to raise it back.

Turn regulating valve knobs smoothly when regulating recycle and drain flow. Do not make rapid turns or apply disproportionate force as this can damage the unit.

3.7.4 Let the unit run for 1 hour discarding permeate and concentrate to drain to flush out membrane preservative. Watch pressure and flow rate readings to make sure these do not exceed requirements.

After 1 hour of operation, start forward flush cycle (by pressing ▷ START on controller front panel), then stop the unit. Switch off main circuit breaker. Connect permeate tube/hose to permeate tank. The RO system is ready for operation.

4 Installation requirements

- Installation and setup of the unit should be undertaken by a qualified professional. Room or area where the unit is to be installed must meet workplace standards of local building code.
- The unit must not be operated in outdoor environments. Do not expose to weather conditions (rain, temperature fluctuations, proximity of heating equipment, direct sunlight etc).
- Air at workplace should be free of corrosive vapors, airborne dust, and fibrous matter.
- To provide access to the unit for maintenance and repair purposes, respect the following clearances between the unit and building structures: 500 mm to the left or right, 200 mm above.

- Electrical connections must comply with local electrical code. Make sure to follow applicable grounding and insulation rules.
- Supply, drain, and delivery pipework must comply with local plumbing code and have sufficient flow capacity. Drain line of the unit must be separated from floor drain with an air gap.
- Construction material or inside lining of permeate tank must be resistant to water corrosion (e. g. stainless steel, polypropylene). Tank should be installed next to the unit.
- Antiscalant pump suction line length should not exceed 1,5 m. Refer to dosing pump's manual to adjust pump's settings if it has not been factory configured.

RO SYSTEM

5 Operating requirements

5.1 Operator of the unit must strictly follow these guidelines and general electrical safety precautions.

If power supply cord is damaged, it must be replaced by the manufacturer, its service agent or similarly qualified person in order to avoid hazard.

5.2 When operating the unit, ensure that pressure and flow rates are within specification limits and that power supply is clean and uninterrupted.

5.3 Perform the following at least once a month:

– verify that readings on pressure gauges and rotameters fall within the specified range per requirements specification;

– verify tightness of hydraulic connections and integrity of parts.

5.4 In order to monitor performance of the RO machine, regularly keep record of operation and write down parameter readings. Use membrane manufacturer's software tools for normalization to control for fluctuations of pressure, temperature, and other operating conditions.

5.5 Change polypropylene cartridge when it has clogged. Pressure drop of 0,1 MPa or greater on the sediment filter indicates that filter cartridge needs to be replaced as soon as possible.

5.6 Perform CIP or another suitable chemical cleaning protocol when any of the following conditions are encountered:

– normalized permeate flow rate drops 10-15% of its initial value;

– normalized conductivity of permeate increases 10-15% of initial value, raw water conductivity remaining at the same level;

– normalized pressure drop along the membrane module increases 10-15% of its initial value.

5.7 After installing freshly cleaned membrane, perform 1 hour rinse discarding all permeate and concentrate. If chemical cleaning fails to restore normalized flow or rejection to design specifications, membrane element is irreparably fouled and has to be replaced.

5.8 To prevent microbial contamination, the unit should be operated for at least 1 hour a day. In case 48 hours or longer shutdown is to occur, membrane should be treated with preservative solution. Preservative treatment is accomplished by circulating 1% sodium metabisulfite solution through the membrane module for 30 minutes or by preparing metabisulfite solution of the above strength in the module. Before resuming operation of a machine that had been treated with preservative, rinse the membrane.

Do not use raw water with over 0,1 mg/L of free chlorine without pre-treatment with activated carbon or other means of dechlorination. Chlorine will destroy the membrane.

5.9 To replace sediment filter cartridge proceed as follows:

– remove the power from the unit;

– shut off water supply and relieve pressure;

– screw off filter bowl and remove it, taking care not to spill water on parts of the unit;

– remove spent cartridge from the bowl, place a clean one inside and screw the bowl back on.

Do not torque over 2 kgf×m when tightening bowl.

5.10 To replace membrane element proceed as follows:

– remove the power from the unit;
– shut off water supply and relieve pressure;
– disconnect feed, permeate, and concentrate tube connections at membrane module outlets;
– remove caps from the pressure vessel;
– push the membrane element from the feed end towards the discharge end (in the direction of the arrow). Extract the membrane element by pulling it at the discharge end of the vessel;
– install new membrane element, observing flow direction as indicated by the arrow;
– fasten the caps and re-connect tubes back to the vessel.

Do not perform any maintenance, repair, cleaning, moving the unit or ancillary units (permeate tank, media filters etc), when the unit is connected to power and water supply.

Do not subject pressure vessel to mechanical impact (shocks, static load etc).

The manufacturer shall not be held liable for any damages incurred by the owner of the unit or any third party due to failure to adhere to the safety precautions or installation guidelines herein.

6 Shipping and storage requirements

- The unit must be stored indoors. Ambient air quality must meet workplace standards.
- Carry out preservative treatment of membrane elements when preparing for an extended downtime.
- The RO machine in its original packaging can be shipped by all types of air, sea or ground transport.
- During transportation, the unit must be protected from exposure to low temperatures and jolts/vibration.

7 Troubleshooting

Problem	Possible cause	Corrective action
Protection relay is not shining green light	No power	Check that there is power supplied to the system, power cable is properly connected and not damaged
	Power supply fault	Refer to protection relay manual or contact Ecosoft product support
The controller does not start after switching on controller circuit breaker	Protection relay is tripped	Ensure clean 380-400 V, 50 Hz electrical power supply to the system
	Loosened contact in screw terminal	Open controller housing, check that power supply conductors are firmly fixed in *220V* terminals of the PCB
	Other	Contact your dealer's product support
Main circuit breaker trips	Power supply does not meet system requirements	The system requires clean power supply conforming to electrical specification in chapter 2. Check for brownout, overvoltage, power surges
	Other	Contact your dealer's product support
High pressure pump is not starting after the controller has started up	Controller is in Standby mode	Check if permeate tank is full Check that permeate tube is not blocked or shut off with a valve
	Controller is in Stop mode	Open controller housing and check that terminals 6 and 7 are short-circuited with a conductor
	Controller is in Service	Contact your dealer's product support
Low feed pressure fault	Insufficient pressure of water supply	Ensure adequate supply of water per requirements in Chapter 2

	The system is connected to water supply using flexible hose or small size pipe	Set up proper connection to water supply pipe. Avoid long runs of small size pipe
	Clogged pre-filter cartridge	Check the filter cartridge and replace if necessary
	Other	Contact your dealer's product support
High permeate conductivity	Water temperature is higher than allowed	Test temperature of feed water and check that it conforms with requirements in chapter 2
	System is not operating with proper concentrate pressure and flow rate	Write down readings on pressure gauges and rotameters and contact your dealer's product support
	Water quality does not meet requirements	Check that the water analysis conforms with requirements in chapter 2
	Damaged brine seal or membrane adapter O-ring	Contact your dealer's product support
	Fouled or damaged membranes	Replace or chemical clean the membrane
	Other	Contact your dealer's product support
Low permeate flow rate	Water temperature is lower than allowed	Test temperature of feed water and check that it conforms with requirements in chapter 2
	System is not operating with proper concentrate pressure and flow rate	Write down readings on pressure gauges and rotameters and contact your dealer's product support
	Fouled membranes	Carry out chemical cleaning, contact your dealer's product support if membranes get fouled too often
Other		Contact your dealer's product support

CONTROLLER

1 Overview

Ecosoft OC5000 process controller provides means to control operation of RO machine via succinct user interface comprising two buttons and LED display. The controller is designed to ensure complete automation of the process while allowing for manual intervention on user part at any moment in time. When running a reverse osmosis machine, the controller executes the following tasks:

- turning the unit on and off with respect to tank permeate level and/or backpressure switch status;
- reading status of level, pressure, and stop switches; conductivity and temperature of permeate;
- going into Fault mode upon occurrence of any of the conditions indicating risk of damage to the RO machine or improper operation;
- performing hydraulic flushing of membranes ('forward flush') with preset frequency and duration;
- implementing manual control over the unit.

In order to deliver the above functionality, Ecosoft process controller supports the following connectivity:

- 5 dry contact switches (NC/NO);
- 3 electrical valves (solenoid or motor driven valves can be used);
- alarm signal;
- high pressure pump, antiscalant and/or biocide dosing pumps;
- temperature and electrical conductivity probes.

The controller supports scheduled maintenance alerts and passcode protected access to configuration menu. Conductivity reading is digitally corrected for temperature of permeate, while hardware interface offers good interference immunity and reliability with galvanically isolated terminal connections.

2 Technical data

Specifications

Electrical rating	230 V, 50-60 Hz, 6 A fuse
Power	4 VA
IP code	IP 65
Ambient temperature	5…40 °C
Weight	0,25 kg
Dimensions (L×W×H)	60×120×250 mm
Permeate conductivity ranges	0…50 µS/cm 0…1000 µS/cm

Screw terminal pinout

DESCRIPTION		DESIGNATOR	PIN #
Power			
Live	230 V	L	35
Neutral		N	34
Ground		⏚	33
Inputs			
Conductivity meter		cond	1 – white 2 – black
Temperature sensor		+ temp -	3 – red 4 – green 5 – blue
Pressure switch before pump	5 V 1 mA drv contact (NC/NO)	P_in	8-9
Pressure switch after pump		P_max	10-11
High permeate pressure switch		P_perm	12-13
Level switch		level	14-15
Stop switch		stop	6-7
Outputs			
High pressure pump or magnetic starter	230 V 750 W	pump	31-32 30 (ground)
Alarm signal	230 V 100 W	alarm	28-29
Entry valve		valve_in	18-17 (NO) 18-19 (NC) 16 (ground)
Bypass valve		valve_bypass	26-25 (NO) 26-27 (NC) 24 (ground)
Forward flush valve		valve_rinse	22-21 (NO) 22-23 (NC) 20 (ground)

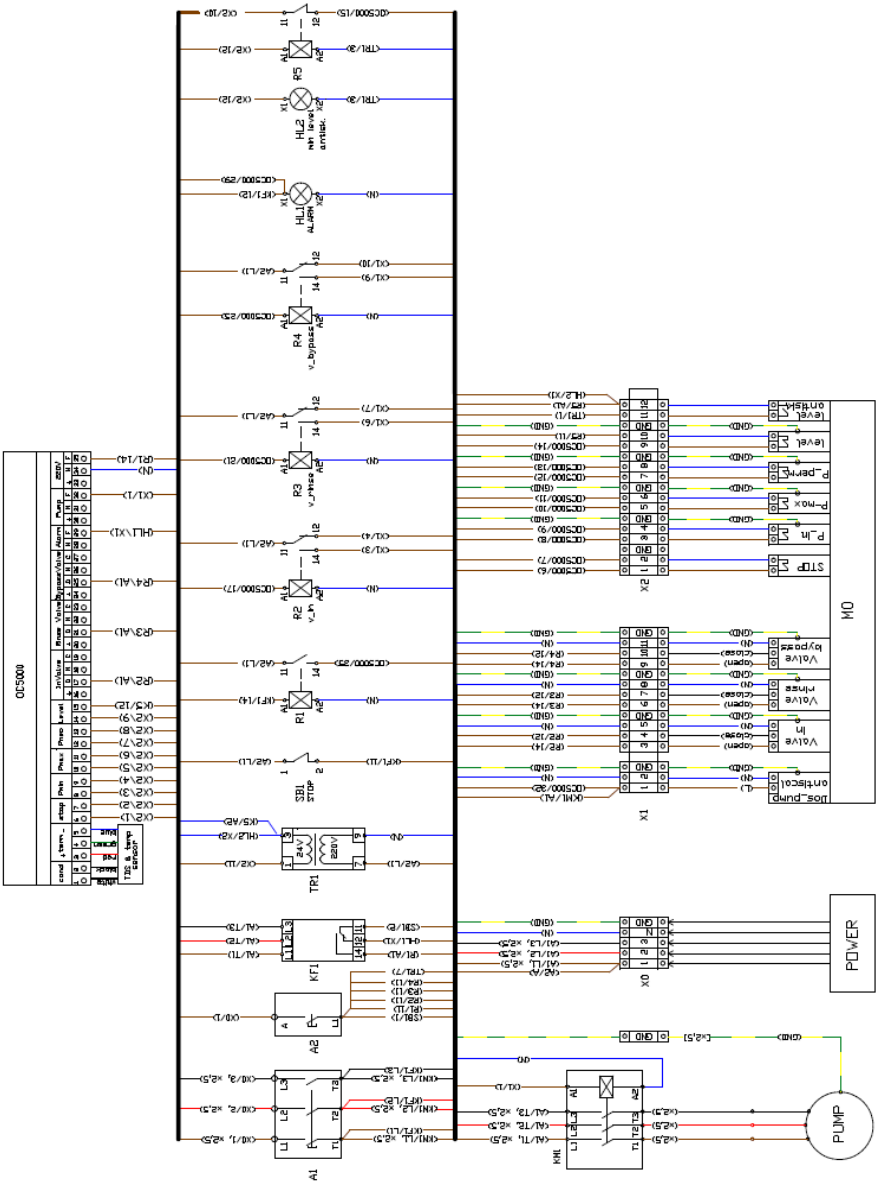


Figure 1. OC5000 controller wiring for 3 phase power supply

3 Operating modes

When operating, the controller will be in any one of the following modes: Service, Stop, Forward Flush 1, Forward Flush 2, Standby, Fault. Immediately after starting, the controller will display firmware version and then proceed to Service if tank permeate level is low and backpressure switch is not activated.

Configuring and manipulating the controller is done using ▷ START and □ STOP buttons. Current mode of operation and pertaining information is shown on the LED display. Opening the circuit in the Stop domain of terminal block (see figure 1) will bring the controller to Stop mode regardless of its current mode of operation. Closing the circuit will take the controller back to the mode that had been interrupted. Stop terminals can be used to connect a microswitch on pre-treatment media filter, a relay or other means of external control to the controller.

Following is the description of controller modes.

SERVICE

In Service mode, the RO machine produces permeate. If no fault conditions are taking place, float switch is low and backpressure switch is not activated, the controller will operate in Service mode.

Status of outputs in Service

High pressure and antiscalant pumps	on
Entry valve	open
Forward flush valve	closed
Bypass valve	open (if configuration step 1.3 is set to 0) closed (if config. step 1.3 is non-zero value)
Alarm	off

Display will flash cumulative runtime of the RO machine, remaining time before scheduled maintenance alert (if set in configuration step 3.1), temperature and conductivity of permeate

(OC5000 only). Pushing ▷ START once will initiate Forward Flush 1, pushing ▷ START twice in 0.5 seconds or less will initiate Forward Flush 2, pushing ☐ STOP will bring on Stop mode. If high feed pressure, low feed pressure, or high permeate conductivity condition occurs, the controller will go into Fault mode.

FORWARD FLUSH 1

During Forward Flush 1, membranes are rinsed with high flow of raw water allowing both permeate and concentrate run freely to drain. Forward Flush 1 occurs during normal operation with frequency set in configuration steps 1.5, 1.6. It is also activated in Service mode if the controller is going to transition to Standby after reading high tank level or pressure. It can be manually activated while in Service by pushing ▷ START button.

Status of outputs in FF1

High pressure and antiscalant pumps	on
Entry valve	open
Forward flush valve	open
Bypass valve	closed
Alarm	off

Pushing ☐ STOP will abort Forward Flush 1 and bring the controller to Stop mode. Pushing ▷ START will cycle the controller to Forward Flush 2 mode. If high feed pressure or low feed pressure occurs, the controller will go into Fault mode. Low feed pressure fault during Forward Flush 1 can be disabled in configuration step 1.7.

FORWARD FLUSH 2

Forward Flush 2 consists in rinsing membranes with permeate supplied from permeate tank by permeate pump.

Forward flush 2 with permeate is only possible if the RO system is equipped with rinsing electric valve.

Forward Flush 2 occurs after each Forward Flush 1 if configuration step 1.3 is set to non-zero value. It can be manually brought on by pushing ▷ START during Forward Flush 1 or double pushing ▷ START during Service.

Status of outputs in FF2

High pressure and antiscalant pumps	on (if configuration step 1.4 is set to 'on') off (if configuration step 1.4 is set to 'off')
Entry valve	open
Forward flush valve	open
Bypass valve	open
Alarm	off

Pushing ☐ STOP will abort Forward Flush 2 and bring the controller to Stop mode. Pushing ▷ START will abort Forward Flush 2 and bring the controller to Service or Standby (depending on tank level and backpressure status).

STANDBY

In Standby, the unit is stalled and ready to resume service. Standby mode is brought on by reading high tank level or tripping permeate backpressure switch.

Status of outputs in Standby

High pressure and antiscalant pumps	off
Entry valve	closed
Forward flush valve	closed
Bypass valve	closed
Alarm	off

Pushing ☐ STOP will bring the controller to Stop mode. Pushing ▷ START will take the controller into Service if permeate is low and backpressure switch is inactive. Otherwise, pushing ▷ START will initiate Forward Flush 1 and Forward Flush 2 (if set) and then bring

the controller back to Standby. When float switch or permeate backpressure switch deactivate, the controller will go back to Service.

FAULT

In Fault mode, the unit is stalled to protect the equipment from dangerous operating conditions. Fault mode is brought on by activating low feed pressure switch (to prevent 'dry running'), high feed pressure switch (to protect against overpressure), or reading an excessively high permeate conductivity value (which could mean membrane rupture or other malfunction).

Status of outputs in Fault

High pressure and antiscalant pumps	off
Entry valve	closed
Forward flush valve	closed
Bypass valve	closed
Alarm	on

Fault mode can only be quit manually by pushing ▷ START. Ensure the cause of fault is eliminated before quitting Fault mode. Pushing ☐ STOP will bring the controller to Stop mode.

STOP

In Stop mode, the unit is stalled and awaiting further input. Stop mode can be manually brought on by pushing ☐ STOP in any mode, or by stop switch opening circuit between STOP terminals on the printed circuit board.

Status of outputs in Stop

High pressure and antiscalant pumps	off
Entry valve	closed
Forward flush valve	closed
Bypass valve	closed
Alarm	off

Upon pushing ▷ START or deactivating stop switch, the controller will resume from where it was interrupted.

Configuration settings are stored in non-volatile memory. Access to each submenu is protected with passcode. To enter configuration menu, hold ☐ STOP for 8 seconds. In the menu, editing and storing values is helped by flashing cursor. ▷ START button moves cursor one position to the right, ☐ STOP button increments selected digit by one, cycles between options, or scrolls to the next screen when the cursor is at the '>' symbol.

Configuration menu layout is shown below.

MENU	Factory Setting
1. SETTINGS	
Settings and calibration passcode prompt	0000
1. High pressure pump delay, s	10 sec
2. Forward Flush 1 duration, s	60 sec
3. Forward Flush 2 duration, s	0 sec
4. High pressure pump power during Forward Flush 2, on/off	off
5. Frequency of periodic Forward Flush in Service, h	4 hour
6. Frequency of periodic Forward Flush in Standby, h	24 hour
7. Read low feed pressure during Forward Flush, on/off	on
8. Low feed pressure switch, NO/NC	NC
9. Low feed pressure Fault delay, s	3 sec
10. High feed pressure switch, NO/NC	NO
11. Permeate backpressure switch, NO/NC	NO
12. Backpressure Standby delay, s	1 sec
13. Tank level switch, NO/NC	NC
14. Tank level Standby delay, s	1 sec
15. Display TDS in ppm	off
16. Permeate conductivity Fault threshold, µS/cm	0 uS/cm
17. Permeate conductivity Fault delay, s	0
18. New settings and calibration passcode	-

2. CALIBRATION

Settings and calibration passcode prompt

2.1 First point value, µS/cm

2.2 Second point value, µS/cm

3. MAINTENANCE

Maintenance passcode prompt

3.1 Schedule maintenance stop, on/off	off
3.2 Scheduled stop period, h (if 3.1 is set to 'on')	500 hour
3.3 New maintenance passcode	

1. SETTINGS

Hold ☐ STOP for 8 seconds to launch menu prompt. Push ▷ START to enter Settings submenu. Enter passcode in the prompt. Factory passcode is '0000'.

1.1 High pressure pump delay

Enter length of interval between opening the entry valve and starting the pump when the unit is going into Service (0…255 seconds).

1.2 Forward Flush 1 duration

Enter length of Forward Flush 1 (0…255 seconds). Forward Flush 1 will not be performed if the parameter is set to zero.

1.3 Forward Flush 2 duration

Enter length of Forward Flush 2 (0…255 seconds). Forward Flush 2 will not be performed if the parameter is set to zero. Default setting is zero (Forward Flush 2 disabled).

1.4 High pressure pump power during Forward Flush 2

This setting specifies whether the high pressure pump will be powered during Forward Flush 2 (on/off).

1.5 Frequency of periodic Forward Flush in Service

This setting determines how often Service mode is interrupted to run forward flush sequence (once in 0…255 hours).

1.6 Frequency of periodic Forward Flush in Standby

This setting determines how often Standby mode is interrupted to run forward flush sequence (once in 0…255 hours).

1.7 Read low feed pressure during Forward Flush

This setting specifies if low feed pressure switch status will be read by the controller during forward flush. If set to 'off', low feed pressure situation will not bring about Fault mode.

1.8 Low feed pressure switch

This setting specifies whether low feed pressure switch is normally closed (NC) or normally open (NO) type.

1.9 Low feed pressure Fault delay

Specify the length of time before the controller goes into Fault mode if low feed pressure condition occurs (0…255 seconds). The pump will continue to run for this many seconds before Fault mode is switched to.

1.10 High feed pressure switch

This setting specifies if high feed pressure switch is normally closed (NC) or normally open (NO) type.

1.11 Permeate backpressure switch

This setting specifies whether backpressure switch is normally closed (NC) or normally open (NO) type.

1.12 Backpressure Standby delay

Specify the length of time before the controller goes into Standby if high permeate pressure condition occurs (0…255 seconds). Controller will continue to operate in Service mode for the set length of time before running pre-Standby forward flush.

1.13 Tank level switch

This setting specifies whether float switch is normally closed (NC) or normally open (NO) type.

1.14 Tank level Standby delay

Specify the length of time before the controller goes into Standby if tank level switch goes high (0…255 seconds). Controller will continue to operate in Service mode for the set length of time before running pre-Standby forward flush.

1.15 0…1000 µS/cm conductivity range

Specify if the controller will read electrical conductivity of permeate in the range of 0…1000 µS/cm (on/off). This setting will

reset to ‘off’ if 1.16 is set to ‘on’.

1.16 0…50 µS/cm conductivity range

Specify if the controller will read electrical conductivity of permeate in the range of 0…50 µS/cm (on/off). This setting will reset to ‘off’ if 1.15 is set to ‘on’.

1.17 Permeate conductivity Fault threshold

Specify maximum acceptable permeate conductivity. Conductivity reading above this value will initiate Fault mode (‘High permeate TDS’). If set to zero, fault threshold will not be used.

1.18 Permeate conductivity Fault delay

Specify the length of time before the controller goes into Fault mode when high permeate conductivity is being read.

1.19 Temperature probe

Select whether temperature probe is used (on/off).

1.20 Set permeate temperature

Specify temperature of permeate for correct conductivity measurement. Only active if 1.19 is ‘off’.

1.20 Divide temperature by 10

Temperature value ÷10 will be shown. Only active if 1.19 is set to ‘on’.

1.21 New settings and calibration passcode

Verify passcode.

2. CALIBRATION

Hold ☐ STOP for 8 seconds to launch menu prompt. Push ☐ STOP to skip Settings submenu and push ▷ START to enter Calibration submenu. Enter passcode in the prompt. Factory passcode is ‘0000’.

2.1 First point value

First calibration point can be done at zero electrical conductivity (dry conductivity meter). In order to use zero first point conductivity, remove the conductivity meter from its cell, wipe with clean cloth and keep dry for a few minutes. When conductivity reading on the display stabilizes, put zeroes in the bottom row, and go to the next step.

If using a weakly conducting solution to set the first point, rinse the meter with deionized water and wipe dry. Dip clean conductivity meter

into sample of known standard conductivity, wait until the reading on display stabilizes and input actual conductivity. Then go to the next step.

2.2 Second point value

Use water sample with greater conductivity than that of the first point standard. Follow the same procedure rinsing and wiping residual moisture on conductivity meter electrodes. Dip clean conductivity meter into sample of known standard conductivity, wait until the reading on display stabilizes and input actual conductivity. Then go to the next step. The controller will display 'OK' and show Maintenance submenu prompt.

3. MAINTENANCE

Maintenance submenu will be shown after completing calibration of conductivity meter and can be called up during Service by holding ☐ STOP for 8 seconds, then skipping Settings and Calibration prompt displays. Enter Maintenance passcode in the prompt. Factory passcode is '0000'.

3.1 Schedule maintenance stop

Select 'on' to turn on maintenance reminder after preset number of hours of cumulative runtime. Controller will put the RO machine to a halt and display maintenance alert message. Operation can only be continued after entering Maintenance submenu (with proper Maintenance passcode) and resetting scheduled stop period. If set to 'off', the controller will continue to count overdue hours after reaching zero hour count.

3.2 Scheduled stop period

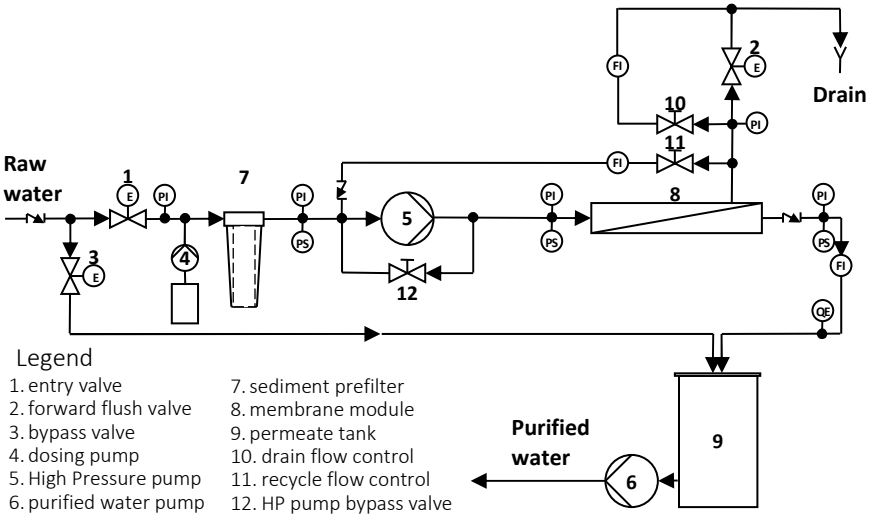
Enter the number of hours before the RO machine will be brought to a scheduled stop for maintenance. This setting will not be shown if the scheduled stop is turned off in step 3.1.

3.3 New Maintenance passcode

Enter new passcode for Maintenance submenu and confirm. This will exit the Configuration menu.

ANNEX A

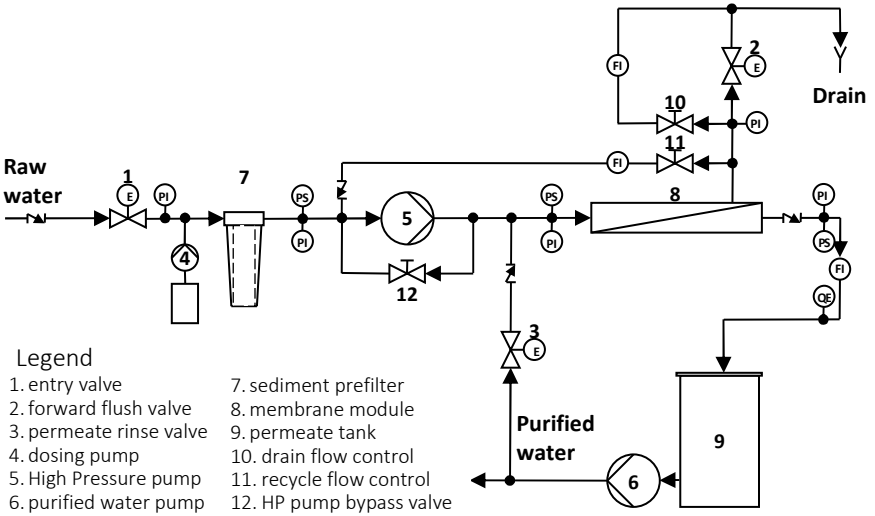
Bypass valve enabled system P&IDs



Legend

1. entry valve
2. forward flush valve
3. bypass valve
4. dosing pump
5. High Pressure pump
6. purified water pump
7. sediment prefilter
8. membrane module
9. permeate tank
10. drain flow control
11. recycle flow control
12. HP pump bypass valve

Reverse osmosis system with raw water blending



Legend

1. entry valve
2. forward flush valve
3. permeate rinse valve
4. dosing pump
5. High Pressure pump
6. purified water pump
7. sediment prefilter
8. membrane module
9. permeate tank
10. drain flow control
11. recycle flow control
12. HP pump bypass valve

Reverse osmosis system with permeate rinsing

ANNEX B
Operation record

Ecosoft RO_____. Operation record.								
Date and time	Water temperature	Pressure			Flow			Pump bypass
		Water supply	After sediment filter	In membrane module	Permeate	Recycle	Drain	

Serial number	

Factory Acceptance Test Protocol

Ecosoft MO_____reverse osmosis system

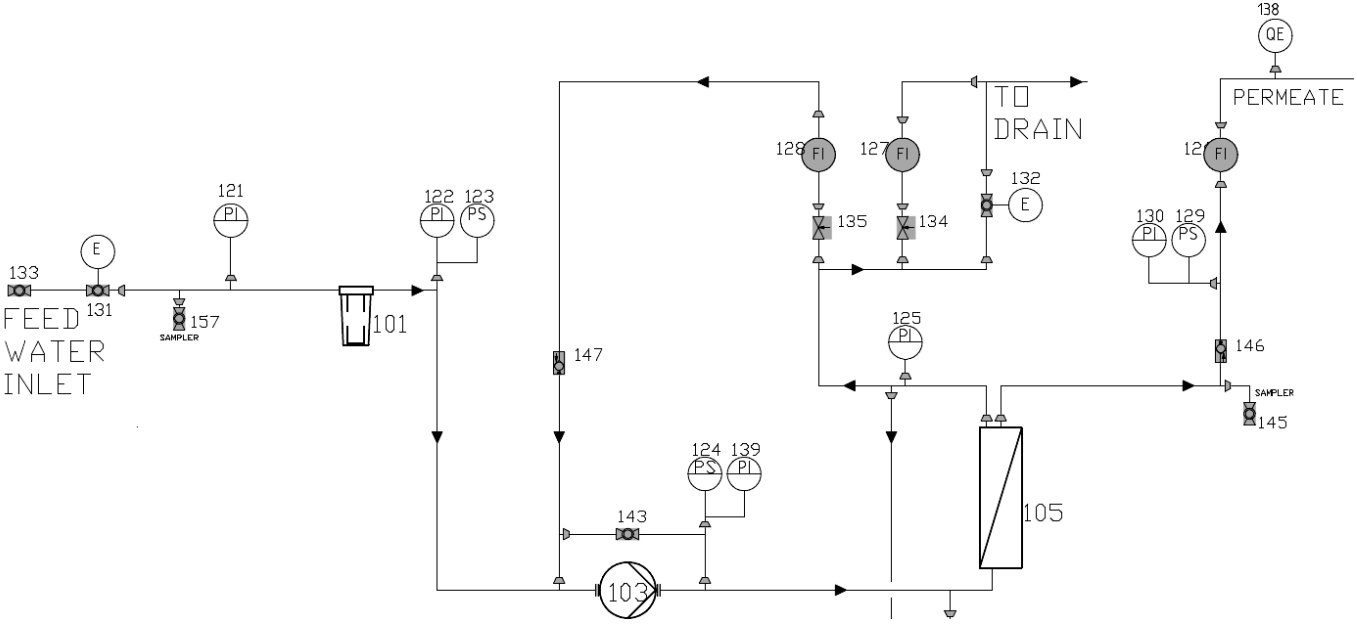
Type of test	Parameter	value	Pass	Signature
1. Hydraulic connections tightness			☐	
1.1 Water pressure at main	_____	MPa	☐	
1.2 Test duration	_____	h	☐	
1.3 No leaks detected			☐	
2. Valves and instruments performance			☐	
2.1 Controller programming			☐	
2.2 Low feed pressure switch			☐	
2.2.1 Trip point	_____	MPa	☐	
2.2.2 Delay	_____	s	☐	
2.3 High feed pressure switch			☐	
2.3.1 Trip point	_____	MPa	☐	
2.3.2 Delay	_____	s	☐	
2.4 High permeate pressure switch			☐	
2.4.1 Trip point	_____	MPa	☐	
2.4.2 Delay	_____	s	☐	
2.5 Entry solenoid valve			☐	
2.6 Forward flush solenoid valve			☐	
3. Float switch			☐	
4. Chemical dosing pump			☐	

Team:

Remarks _____

_____

Date	Signature	



Example of P&ID for MO-1

DESCRIPTION OF NUMBERS ON P&ID

101 = BB 10” housing with 5 mic sediment filter
103 = high pressure pump Grundfos CR
105 = pressure vessel with Dow Filmtec XLE-440 RO membrane element

121 = pressure gauge (FEED WATER PRESSURE)
122 = pressure gauge (PRESSURE AFTER FILTER)
125 = pressure gauge (CONCENTRATE PRESSURE)
130 = pressure gauge (PERMEATE PRESSURE)
139 = pressure gauge (OPERATING PRESSURE)

123 = pressure switch (LOW PRESSURE SWITCH)
124 = pressure switch (HIGH PRESSURE SWITCH)
129 = pressure switch (PERMEATE PRESSURE SWITCH)

126 = rotameter (PERMEATE)
127 = rotameter (DRAIN)
128 = rotameter (RECYCLE)

131 = Ball valve with actuator (FEED WATER INLET)
132 = Ball valve with actuator (FORWARD FLUSH)

134 = regulating valve (DRAIN)
135 = regulating valve (RECYCLE)

138 = electrical conductivity & temperature sensor

146 = no-return valve (PERMEATE)
147 = no-return valve (RECYCLE)

145, 157 = sample ports

151 = CIP inlet
152 = CIP outlet

133, 143, = ball valves