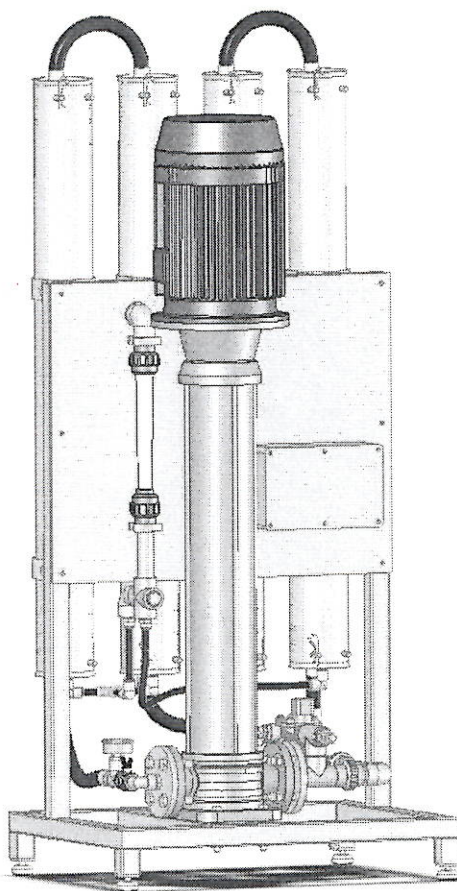


OPERATING & MAINTENANCE INSTRUCTION FOR HOH RO 2000-SERIES REVERSE OSMOSIS PLANT



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1. GENERALLY

This operating and maintenance instruction applies to HOH Water Technology's reversed osmosis plants, the RO 2000 series.

The instruction shall be read carefully prior to assembly and start-up of the plant. Correct installation and operation forms the basis for our 12-month warranty.

Your RO 2000 plant with its compact and finished design is easy to install since all internal installations are pre-assembled and tested in our factory.

Your RO 2000 plant is designed for minimum maintenance and long and trouble-free service. However, a condition for this warranty is correct installation and maintenance.

1.1 Dimensioning Conditions

The raw water, which is to be treated in the RO 2000 plant, must be drinking water quality with maximum 500 mg/l TDS.

The raw water may maximum contain:

- **Hardness:** 0.5 °dH (can be obtained by installing a softening plant (option))
- **Fe:** 0.05 mg/l
- **Mn:** 0.05 mg/l
- **Free chlorine:** 0.1 mg/l (if higher then a carbon filter must be installed (option))
- **Turbidity max.** 1.0 NTU
- **Silt index:** 3.0
- **KMnO₄ max.:** 10 mg/l

The plant is pre-adjusted in our factory for service at 10 °C.

If there are doubts about the composition of the raw water, then a water analysis will have to be made.

The plant must be connected to a raw-water pressure of minimum 3 bar and maximum 6 bar.

The quality of the treated water will be < 20 µS/cm at 10 °C.

1.2 Explanation of Words

A few technical expressions will appear in this instruction, consequently we have made below explanation.

Permeate:	Is the treated, totally desalinated water which is produced in the RO plant and supplied to a reservoir.
Concentrate:	Is the water which is led to sewer. This water contains the minerals and salts which have been removed from the raw water.
Raw water:	Is the water which is led to the RO plant and then desalinated in the plant.
Recovery:	Is a designation for the capacity of the plant which is measured in per cent (%).
TDS:	The amount of totally dissolved salts is measured in the unit mg/l.
Conductivity:	Is the designation for the salt concentration of the water and is measured in the unit $\mu\text{S}/\text{cm}$. The lower the figure, the better the water quality.
Membrane:	Is the filter of the plant which at high pressure and flow is capable and desalinating the raw water.
RO:	Is the abbreviation for Reverse Osmosis.
Reservoir: (OPTION)	Is the tank used for collecting the permeate/totally desalinated water.
Reservoir pump:	Is the pump which transports the treated water from the plant reservoir to the consumer.
Level sensor:	Is a sensor giving signal to the RO plant to either start or stop and which stops the reservoir pump if the reservoir runs dry.
Softening plant: (OPTION)	Is a pre-filter which softens the water, i.e. removes hardness from the water

1.3 Functional Description

The water is pressed through the RO membrane by means of a high-pressure pump. The desalinated water/permeate is then led to consumption and can e.g. be collected in a reservoir. The water containing the concentrated salts/concentrate is led to outlet. The relation between permeate/concentrate shall be adjusted manually on the needle valve.

Under normal operating conditions the RO membranes have a long lifetime. But even with a good raw-water quality, layers of impurities will, to a certain extent, occur and there will be a slow reduction of the permeate capacity.

1.4 Placing of the Plant

The plant shall be placed in a frost-free environment and on an even foundation. The foundation shall be able to stand a weight load of 150 kg totally as this is the approximate weight of the RO plant in operation. However, the weight of a possible softening unit and reservoir shall be taken into consideration!

An extra 1000 mm to be able to maintain the membranes must be expected.

Also, room shall be made on the left side of the plant for the water installation. Especially the outlet hose from the plant shall be considered. The outlet hose must never be bent.

By possible stop-down there may be cases where the level of the reservoir flows over. Consequently there must always be a floor drain placed in a way that prevents the water from making any damage.

1.5 Water Connections

Note! All water connections of the plant must be made in accordance with local regulations.

Feed water : DN25 pipe or pressure hose

Permeate: ø14 mm hose

Concentrate: ø14 mm hose

Important! Totally desalinated water may accelerate corrosion, therefore always use noncorrosive piping for permeate, e.g. stainless steel or PVC pipe.

The outlet pipe shall not be led completely into the outlet water of the floor drain as this water may then be sucked back to the plant during stand stills.

1.6 Electric Connections

Note! The electric connections must be made in accordance with local regulations.

Voltage [V] :	3 x 400 V + 0 + PE
Net :	TN-S
Frequency [Hz] :	50 Hz
Consumption RO plant (kW), [A] :	2.2 kW, 4.75 A – 4 kW 8A
Recommended protection [A] (Class	16 A
Maximum protection [A] (Class gL/gI) :	25 A

2. PRETREATMENT

2.1 Softening Plant

See instruction for softening plant.

3. OPERATION RO PLANT

Note! Check before start-up that all water and electric connections have been made as described in previous sections and in accordance with local regulations.

Check the quality of the raw water.

Check that there is a free outlet for permeate and concentrate and that motor protection for high-pressure pump P1 has been engaged.

3.1 Capacity RO plant		
Plant type	Permeate capacity l/h	Outlet amount l/h (Recovery 75 %)
2010	480	160
2020	800	270
2030	1500	500
2040	1900	630

3.2 Start-up RO Plant		
Description:	RO plant is in stand-by and ready for operation.	
Duration (N):	30 minutes	
Flow:		
Open valves:	Y1, V1, V3, close V2, V4	
Pumps:		
Change to sequence:	Sequence	Change to sequence when
	Opstart RO	Manuelt tryk "Start"
	Stop	
	Alarm	
Signal interchange	Signal to RO	
	Signal from RO	

3.3 Adjustment of Concentrate Amount		
Description:	RO plant is in operation and now supplies permeate	
Duration (N):		
Flow:	See section "Capacity RO Plant.	
Adjust valve	V3	
Pumps:	P1	
Change to sequence	Sequence	Change to sequence when:
	Start-up RO:	
	Stop	Press "Stop"
	Alarm	
Signal interchange	Signal to RO	Signal from RO
Comment:	V3 must be adjusted at 75 % recovery.	

3.4 Adjustment of Recirculation Amount		
Description:	RO plant is in operation and now supplies permeate	
Duration (N):		
Flow:		
Adjust valve	V2	
Pumps:	P1	
Change to sequence	Sequence	Change to sequence when:
	Start-up RO	
	Stop	Press "stop"
	Alarm	
Signal interchange:	Signal to RO	Signal from RO

3.5 Operation RO Plant		
Description:	RO plant is in operation and now supplies permeate	
Duration (N):		
Flow:	See section "Capacity RO Plant.	
Open valves:	Y1, V1, V2 and V3	
Pumps:	P1	
Change to sequence	Sequence	Change to sequence when:
	Start-up RO	
	Stop	Press "Stop"
	Alarm	PS1, LS3 and (QIS1, option)
Signal interchange	Signal to RO	Signal from RO

4. AUTOMATIC FUNCTION

The RO 2000 is equipped with a control panel with built-in control functions as follows:

4.1 PS1: Alarm, low inlet pressure	
Description:	Alarm, low inlet pressure PS1.
Setpoint:	0.5 bar.
Pumps:	Stops P1 – P3 is in service.
Valves:	All valves open (÷ V4).
Active sequence:	When the pressure drops below 0.5 bar for 10 seconds, then pump P1 stops.
Reset:	Line breaker
Remark:	P1 will try to restart 3 times at 10 seconds' interval – then it will stop.

4.2 LS1: High level in reservoir.	
Description:	Alarm, high level in the reservoir LS3
Setpoint:	Top of reservoir
Pumps:	P1 stopped - P3 is in service
Valves:	Y1 and V4 closed
Active sequence.	LS2 setpoint, starts P1
Reset:	Line breaker

4.3 LS2: Intermediate level in reservoir.

Description:	Intermediate level in reservoir LS2
Setpoint:	Middle of reservoir.
Pumps:	P1, P3 are in service
Valves:	All valves are open. (÷ V4).
Active sequence:	LS1 and LS3 setpoint, stop P3.
Reset:	Line breaker.

4.4 LS3: Low level in reservoir.

Description:	Alarm, low level in reservoir LS3
Setpoint:	Bottom of reservoir.
Pumps:	P1 is in operation, P3 stopped
Valves:	All valves are open (÷ V4).
Active sequence:	LS2 setpoint, starts P3.
Reset:	Line breaker

4.5 PS4: Alarm, low pressure

Description:	Alarm, low pressure PS4.
Setpoint:	3-4 bar
Pumps:	Starts/stops P3. P1 is in service.
Valves:	All valves are open (÷ V4).
Active sequence:	When the pressure drops below 3 bar for 10 sec., P3 starts. When the pressure exceeds 4 bar, P3 stops.
Reset:	Line breaker.

4.6 QIS1: Alarm, high conductivity (Option)

Description:	Alarm, high conductivity QIS1.
Setpoint:	Higher than 20 $\mu\text{S}/\text{cm}$
Pumps:	Stops P1 and P3.
Valves:	Y1 and V4 closed.
Active sequence:	The RO plant is being checked.
Reset:	Line breaker
Remark:	See section "Trouble-shooting"

5. MAINTENANCE AND TROUBLE-SHOOTING

5.1 General information

Besides the maintenance directions given in the operating instruction, below-mentioned check-ups/maintenance jobs have to be carried out.

HOH Water Technology offers service agreement on membranes and fully covering service on your water treatment plant. The operating conditions are very important to the lifetime of the membranes. The lifetime will be reduced in following cases:

The membrane is allowed to dry out

The concentrate flow is too little

Pre-treatment fails

The plant has not been operating for more than 1 week.

5.2 Maintenance

Following must be checked regularly:

If the operating conditions of the plant are changed comparee to adjustment on day of commissioning, then the plant must be checked concerning a possible replacement of membranes. The capacity of the plant will change, fi the water temperature is not 10 °C. For every degree (°C) the capacity will change. If the water is 12 °C, capacity will increase by approx. 6 %.

Note! Warranties are granted on condition that the Operating and maintenance instructions are complied with, and that the operating journal is updated at the stated intervals. In case of deviations, HOH Water Technology's service department may be contacted:

- If capacity has dropped by more than 10 %
- If the pressure after the high-pressure pumps has increased
- Conductivity has increased.

5.3 Trouble-Shooting

This section deals with the problems that may arise with your plant

5.4 The plant capacity has changed	
This can be read on the flow meter FI1 while the RO plant is operating	
<u>Check</u>	<u>Action:</u>
Operating pressure PI1:	+/- 10 %. Membranes shall be CIP-cleaned.
Softening Plant:	See instruction for Softening plant.
Change of raw-water temperature	For every °C +/- the capacity will increase/drop by abt.3 %
Bend on the outlet hose or other resistance:	Correct
Capacity:	Less than 10 %. Membranes shall be CIP-cleaned
Remark:	If this did not help, then the membranes must be replaced.

5.5 Conductivity is higher than 20 µS/cm. (Option)	
This can be read on QIS1 (option) while the RO plant is operating.	
<u>Check:</u>	<u>Action:</u>
Bend on the outlet hose or other resistance:	Correct.
The plant has been out of operation for a longer period (1-2 weeks):	Flush the plant for 1-2 hours. See section "Start-up of Plant".
Change in raw-water temperature:	For every °C +/- the water quality will increase/drop at approx.3 %.
Change of the raw water TDS:	Contact HOH's service dept.
Remark:	If this did not help, then the membranes must be replaced.

5.6 The plant stops and red lamp comes on.	
This can be seen on the control panel of the RO plant.	
Check:	Action:
If raw-water pressure is available.	The fault shall be located in the raw-water supply. When a raw-water pressure has been re-established, interrupt the power supply for 20 seconds. Then connect power again.
Remark:	If none of above-mentioned faults are present, pressure switch PS1 located at the inlet of the RO plant may be defective, or PLC in control panel may be defective.

5.7 The plant does not run	
Check:	Action:
If main power is connected	If not, connect.
If the level sensor in the reservoir is sagging or defective. LS1, LS2 and LS3.	Replace.
If the plant needs to operate	Reservoir full or no "call" for water!
Remark:	If none of above-mentioned faults are present, the high-pressure pump or the control PCB may be defective; check these.

5.8 Replacement of Membranes

Please read this chapter carefully before disassembling/replacing the membranes.

If the reservoir is installed after the RO plant, this must be drained so that it is only half full.

Disconnect the main power and close the feed-water supply to the plant.

Remove the lock fittings placed at the top of the pressure pipe (the lock fitting keeps the bottom plate of the membrane in place).

The bottom plate shall now be pulled up of the pressure pipe by wriggling the end plate from side to side and simultaneously pulling upwards.

Note! at which end the big, black O-ring on the outside the membrane is placed. If it is placed at the top of the membrane, then the new membrane shall also be fitted with the O-ring at the top.

When the membrane(s) has (have) been replaced and the end plates assembled with the lock fitting, connections for the pressure pipe shall be fitted.

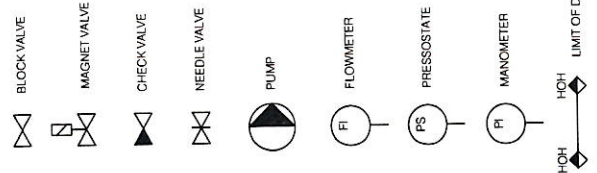
When all connections have been refitted and end plates securely fastened with the lock fitting, the plant shall be started anew. See section "Operation RO Plant".

6. SUNDRY ENCLOSURES

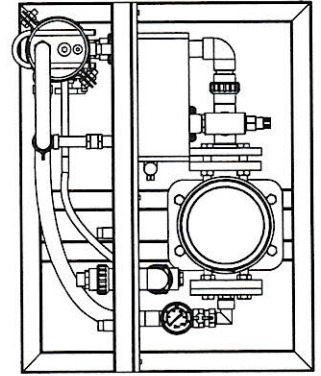
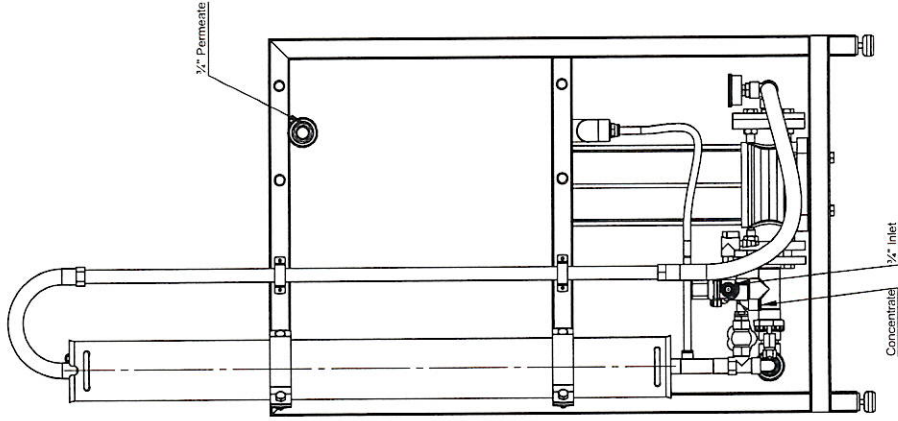
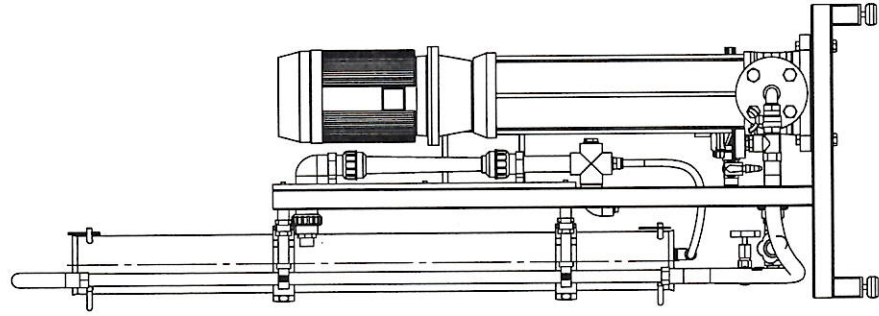
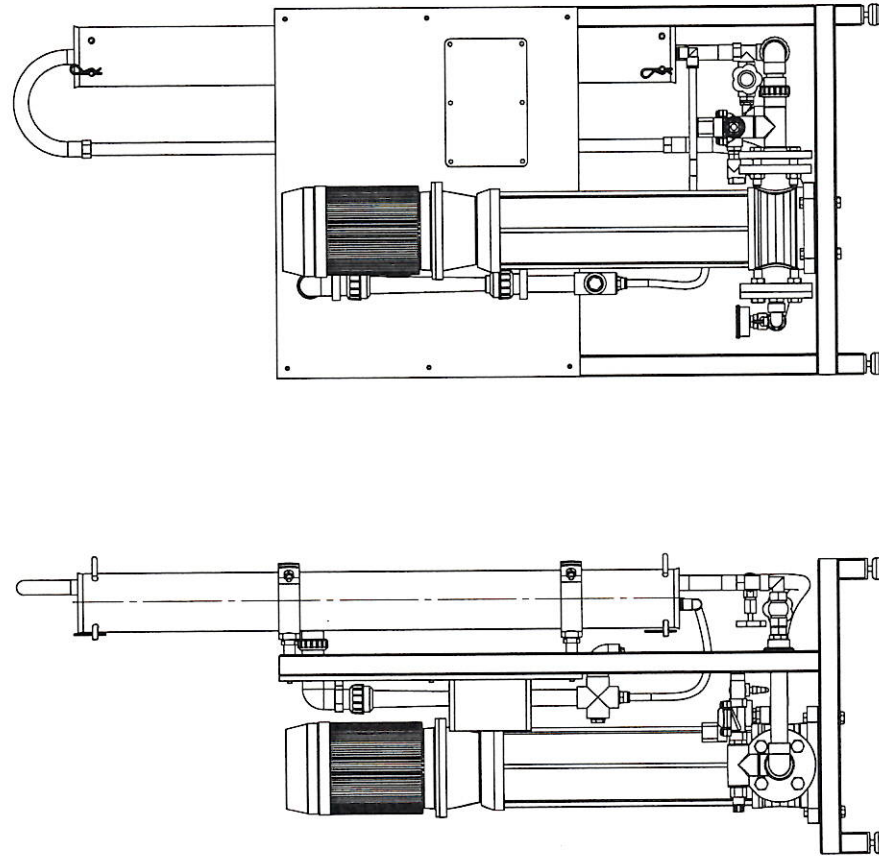
- 6.1 Operating journal**
- 6.2 P & I diagram**
- 6.3 Layout drawing**
- 6.4 Electrical diagram**
- 6.5 Spare parts drawing**
- 6.6 Spare parts list, RO plant**
- 6.7 Agreement of Conformity**

6.1 Operating Journal

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Drawing no.	S450P01	Page	revision
CAD file: S450P01			



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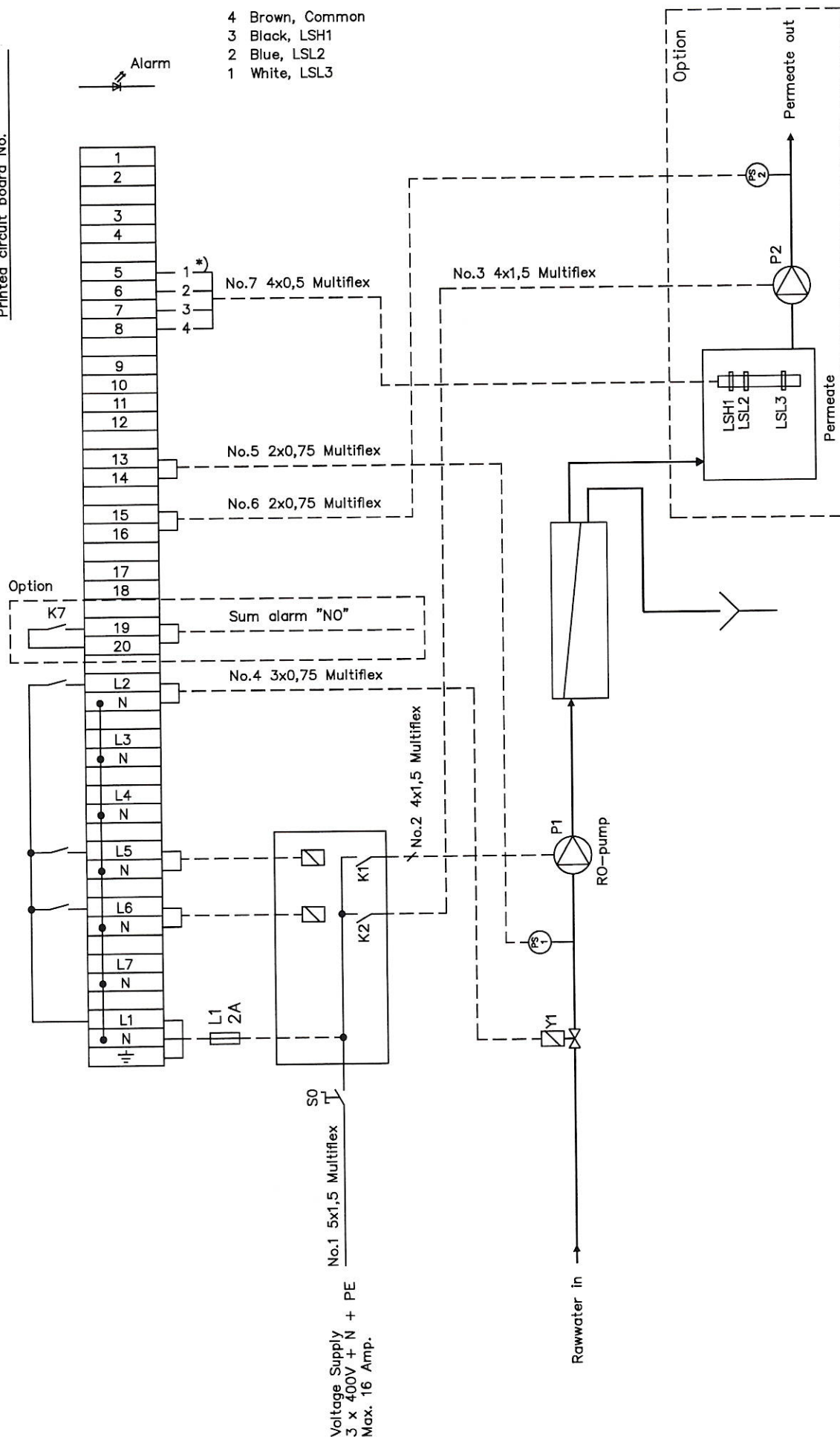
Reverse Osmosis
 RO 2010
 Arrangement drawing

Drawing no.	Page	Revisions
S450M10	1	

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*)
Level stick, wire colors

- 4 Brown, Common
3 Black, LSH1
2 Blue, LSL2
1 White, LSL3



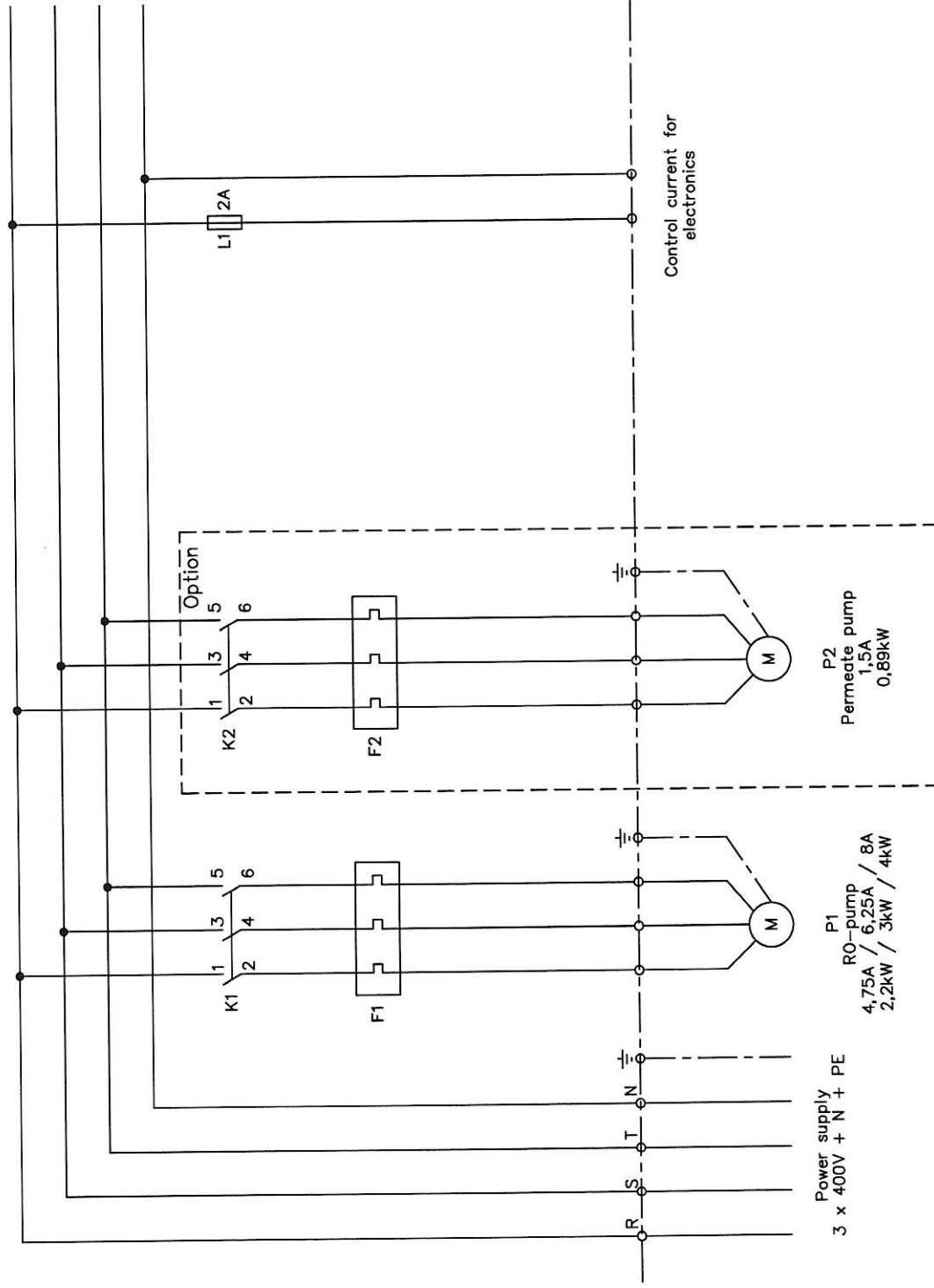
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Reverse osmosis Series 900/1900/2000
Electric control

Order no.		Drawing no.		Revision B
Designed	2005-02-08	MSA	S448A01 p. 1	
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Approved		MSA		
		Scale:	CAD File: s448a01	

Group no.	Rev.	Date	Drawn	Approved
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	B	2007-03-21	HO	JRI
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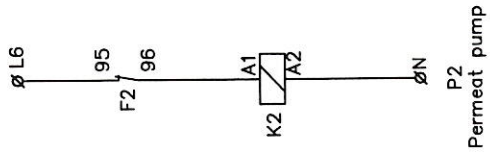
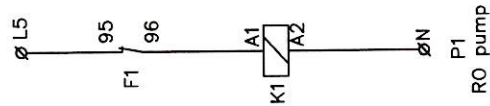


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Order no.	2005-02-08	MSA	HO	MSA	Scale:	Drawing no.	Revision
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Drawn							A
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Reverse osmosis Series 900/1900/2000 Power supply

Group no.	Rev.	Date	Drawn	Approved
Page no.	A	2006-09-27	HO	JRI
Related drawing no.	B			
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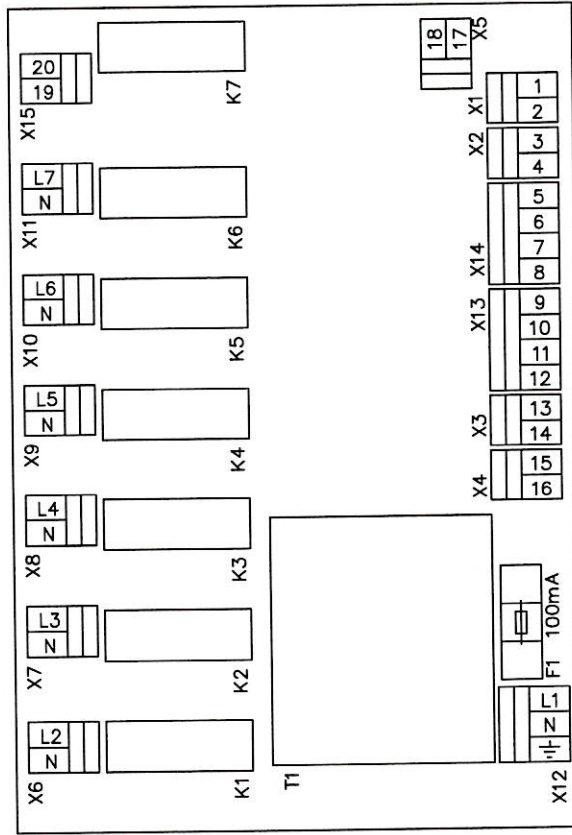
Reverse osmosis Series 900/1900/2000 Control current motor protection



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Title: Technology				Drawing no.		Revision		
Order no.		2005-02-08		MSA		S448A03 p. 3		A
Designed				HO				
Drawn								
Approved				MSA		Scale:		CAD File: S448A03

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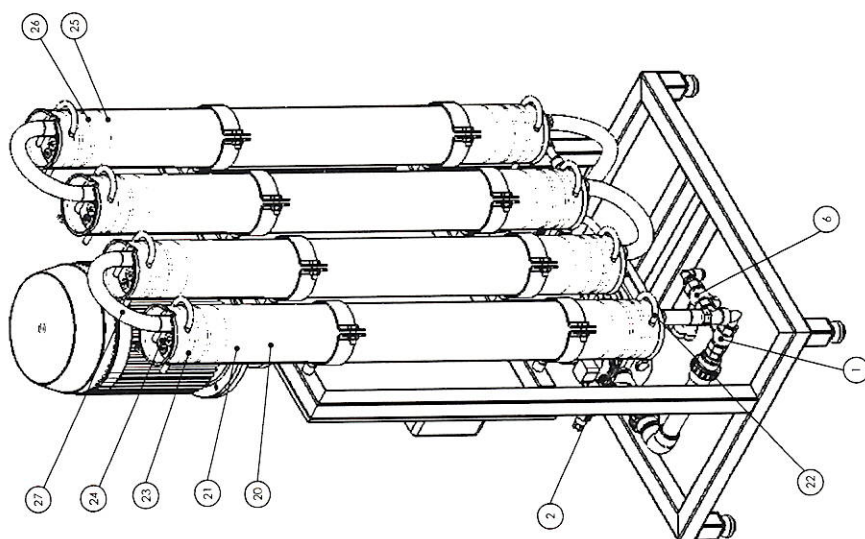
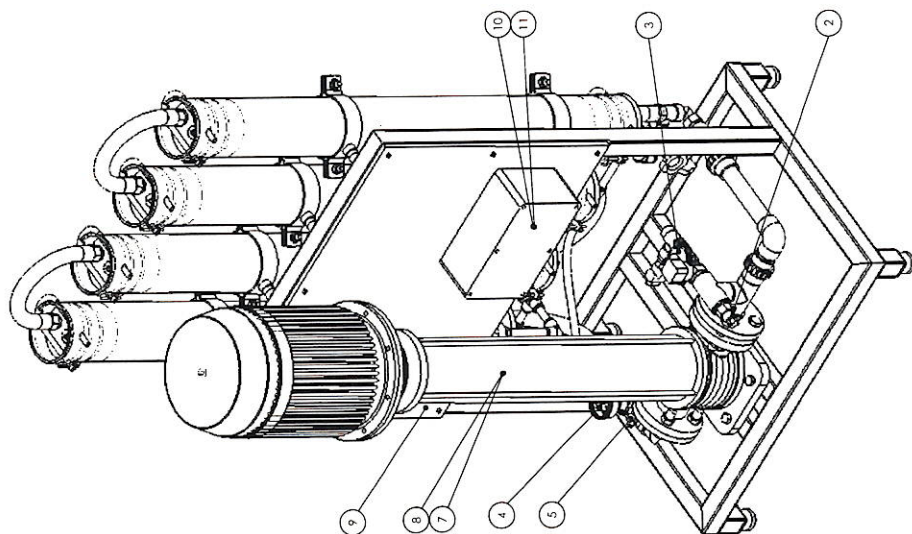


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Order no.	Order no.	Order no.	Order no.
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Drawn	HO	HO	HO
Approved			
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Scale:	MSA	CAD File: S448A05	

Reverse osmosis Series 900/1900/2000
Terminal block, Printed circuit board

Group no.	Rev.	Date	Drawn	Approved
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Reverse Osmosis RO 2040 Arrangement drawing									
Last Revision Date			Drawn by			Page			
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						spare parts drawing			
						1			
						New			

6.6 Spare Parts List RO

Item Ref.	RO plant	Recommended spare parts	Product No.
1	3/4" needle valve (recirculation).	-	200731006
2	Pressure switch 0.5 bar.	-	452550005
3	1/2" solenoid valve	-	200755006
4	Manometer 0-40 bar.	-	452266000
5	3/4" ball valve	-	200742006
6	3/4" needle valve (outlet valve)	-	200731006
7	High-pressure pump CR3-29 (RO 2010, -20)	-	454101230
8	High-pressure pump CR3-29 (RO 2030, -40)	-	454102225
9	Flow meter, permeate	-	453012016
10	Control panel complete	-	451404818
11	PCB.....	-	506708250
	<u>Membrane/pressure pipe</u>		
20	Pressure pipe	-	451404079
21	Membrane	1-4	451404038
22	Lock fitting	-	451404090
23	O-ring for membrane	2-8	451404208
24	End plate	1	451404112
25	O-ring outside (big)	8-32	451404211
26	O-ring inside (small)	8-32	451404215
27	3/4" pressure hose, l=400 mm (2010, -20, -30, -40)	1	451404177
28	3/4" pressure hose, l=190 mm (2010, -20, -30, -40)	-	451404179
29	3/4" pressure hose, L-210 mm (2030, -40)	-	451404180

6.7 Declaration of Conformity

**EC Declaration of Conformity
for Machinery
Directive 98/37/EC, Annex II, A
Low Voltage Directive
EMC Directive**



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herewith declares that:

- **RO 2010, 2020, 2030 and 2040**
- is in conformity with the provisions of the Machinery Directive (directive 98/37/EC)
- is in conformity with the provisions of the following other EC directives
- Low Voltage Directive (73/23/EEC)
- EMC Directive (89/336/EEC)
- Place: Greve, Denmark
- Date: 2006-02-17



Signature

Name: Lars Jensen

