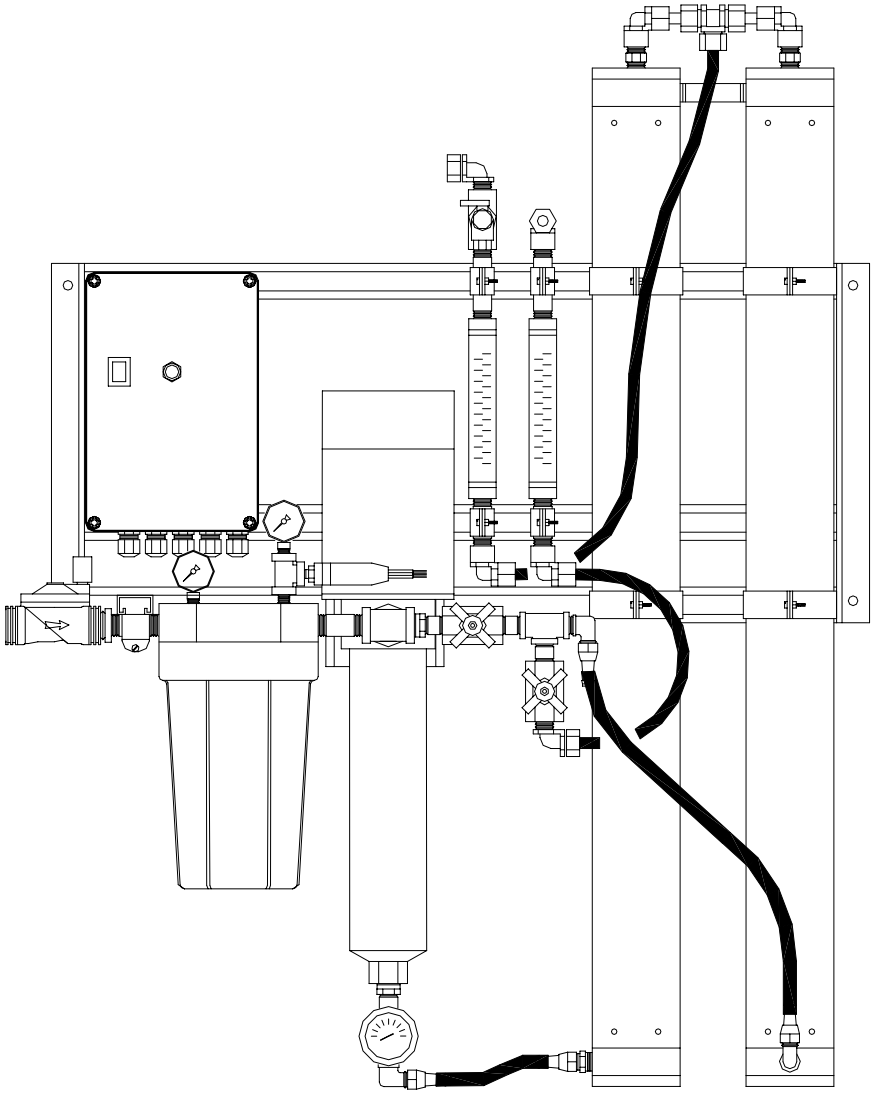
ALAMO WATER REFINERS

REVERSE OSMOSIS

INSTALLATION AND OPERATION MANUAL



R14-Wall Mount

Alamo Water Refiners, Inc.

13700 Hwy. 90 West

San Antonio, TX 78245

U.S.A. 210-677-8400

www.alamowater.com

IMPORTANT

Please read the entire manual before proceeding with the installation and startup:

- Do not use where the water is microbiologically unsafe.
- Always turn off the unit, shut off the feed water, and disconnect the electrical power when working on the unit.
- Never allow the pump to run dry.
- Never start the pump with the reject valve closed.
- Never allow the unit to freeze or operate with a feed water temperature above 100°F.

NOTES

Changes in operating variables are beyond the control Alamo Water Refiners, Inc. The end user is responsible for the safe operation of this equipment. The suitability of the product water for any specific application is the responsibility of the end user.

Successful long-term performance of a RO system depends on proper operation and maintenance of the system. This includes the initial system startup and operational startups and shutdowns. Preventing fouling or scaling of the membranes is not only a matter of system design, but also a matter of proper operation. Record keeping and data normalization is required in order to know the actual system performance and to enable corrective measures when necessary. Complete and accurate records are also required in case of a system performance warranty claim.

Changes in the operating parameters of a RO system can be caused by changes in the feed water, or can be a sign of trouble. Maintaining an operation and maintenance log is crucial in diagnosing and preventing system problems. For your reference, a typical log sheet is included in this manual.

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I. INTRODUCTION

The separation of dissolved solids and water using RO membranes is a pressure driven temperature dependent process. The membrane material is designed to be as permeable to water as possible while maintaining the ability to reject dissolved solids.

The main system design parameters require the following:

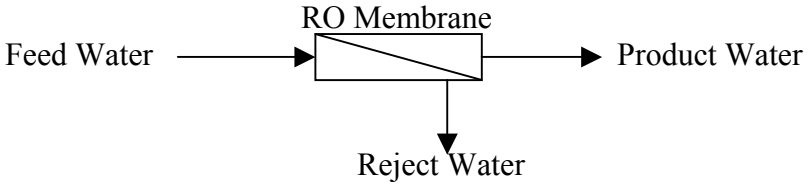
- Internal flows across the membrane surface must be high enough to prevent settling of fine suspended solids on the membrane surface.
- The concentration of each dissolved ionic species must not exceed the limits of solubility anywhere in the system.
- Pre-treatment must be sufficient to eliminate chemicals that would attack the membrane materials.

A. SPECIFICATIONS

Productivity (Gallons per day / Gallons per minute) Maximum production based on standard membranes and feed water of 25°C, SDI < 3, 1000 ppm TDS, and pH 8. Individual membrane productivity may vary (± 15%).	3600 / 2.5
Quality (Typical Membrane Percent Rejection) Based on membrane manufactures specifications, overall system percent rejection may be less.	98 %
Recovery with reject recycle (adjustable)	50 %
Membrane Size	4 x 40
Number Of Membranes Per Vessel	1
Pressure Vessel Array	1:1
Number Of Membranes	2
Prefilter (System ships with one 5 micron cartridge)	10" BB
Feed Water Connection	1" NPT
Product Water Connection	1/2" Tube
Reject Water Connection	1/2" Tube
Feed Water Required (Max)	9 gpm
Feed Water Pressure (Minimum)	10 psi
Drain Required	9 gpm
Electrical Requirement 115 VAC, 1-ph, 60 Hz (Other voltages available)	15 amps
Motor (Horse Power)	1
Dimensions L x W x H (Inches)	48” x 60” x 23”
Shipping Weight (Estimated Pounds)	200

B. RO OVERVIEW

Reverse osmosis systems utilize semipermeable membrane elements to separate the feed water into two streams. The pressurized feed water is separated into purified (product) water and concentrate (reject) water. The impurities contained in the feed water are carried to drain by the reject water.



C. PRETREATMENT

The RO feed water must be pretreated in order to prevent membrane damage and/or fouling. Proper pretreatment is essential for reliable operation of any RO system.

Pretreatment requirements vary depending on the nature of the feed water. Pretreatment equipment is sold seperatly. The most common forms of pretreatment are described below.

Media Filter - Used to remove large suspended solids (sediment) from the feed water. Backwashing the media removes the trapped particles. Backwash can be initiated by time or differential pressure.

Water Softener - Used to remove calcium and magnesium from the feed water in order to prevent hardness scaling. The potential for hardness scaling is predicted by the Langelier Saturation Index (LSI). The LSI should be zero or negative throughout the unit unless approved anti-scalents are used. Softening is the preferred method of controlling hardness scale.

Carbon Filter - Used to remove chlorine and organics from the feed water. Free chlorine will cause rapid irreversible damage to the membranes.

The residual free chlorine present in most municipal water supplies will damage the thin film composite structure of the membranes used in this unit. Carbon filtration or sodium bisulfite injection should be used to completely remove the free chlorine residual.

Chemical Injection - Typically used to feed antiscalant, coagulant, or bisulfite into the feed water or to adjust the feed water pH.

Prefilter Cartridge - Used to remove smaller suspended solids and trap any particles that may be generated by the other pretreatment. The cartridge(s) should be replaced when the pressure drop across the housing increases 5 - 10 psig over the clean cartridge pressure drop. The effect of suspended solids is measured by the silt density index (SDI) test. An SDI of five (5) or less is specified by most membrane manufacturers and three (3) or less is recommended.

Iron & Manganese - These foulants should be removed to less than 0.1 ppm. Special media filters and/or chemical treatment is commonly used.

pH - The pH is often lowered to reduce the scaling potential.

Silica: Reported on the analysis as SiO2. Silica forms a coating on membrane surfaces when the concentration exceeds its solubility. Additionally, the solubility is highly pH and temperature dependent. Silica fouling can be prevented with chemical injection and/or reducing the recovery.

II. CONTROLS, INDICATORS, and COMPONENTS (see figure 1)

A. Controller - Controls the operation of the system.
B. Reject Control Valve - Controls the amount of reject flow.
C. Reject Recycle Control Valve – Controls the amount of recycle flow.
D. Prefilter Pressure Gauges - Indicates the inlet and outlet pressure of the prefilter. The difference between these two gauges is the prefilter differential pressure.
E. Pump Discharge Pressure Gauge - Indicates the pump discharge pressure.
F. Reject Flow Meter - Indicates the reject flow rate in gallons per minute (gpm
G. Product Flow Meter - Indicates the product flow rate in gallons per minute (gpm).
H. Prefilter Housing - Contains the RO prefilter.
I. Automatic Inlet Valve - Opens when pump is on and closes when the pump is off.
J. Low Pressure Switch - Sends a signal to the controller if the pump suction pressure is low.
K. RO Feed Pump - Pressurizes the RO feed water.
L. RO Membrane Vessels - Contains the RO membranes.

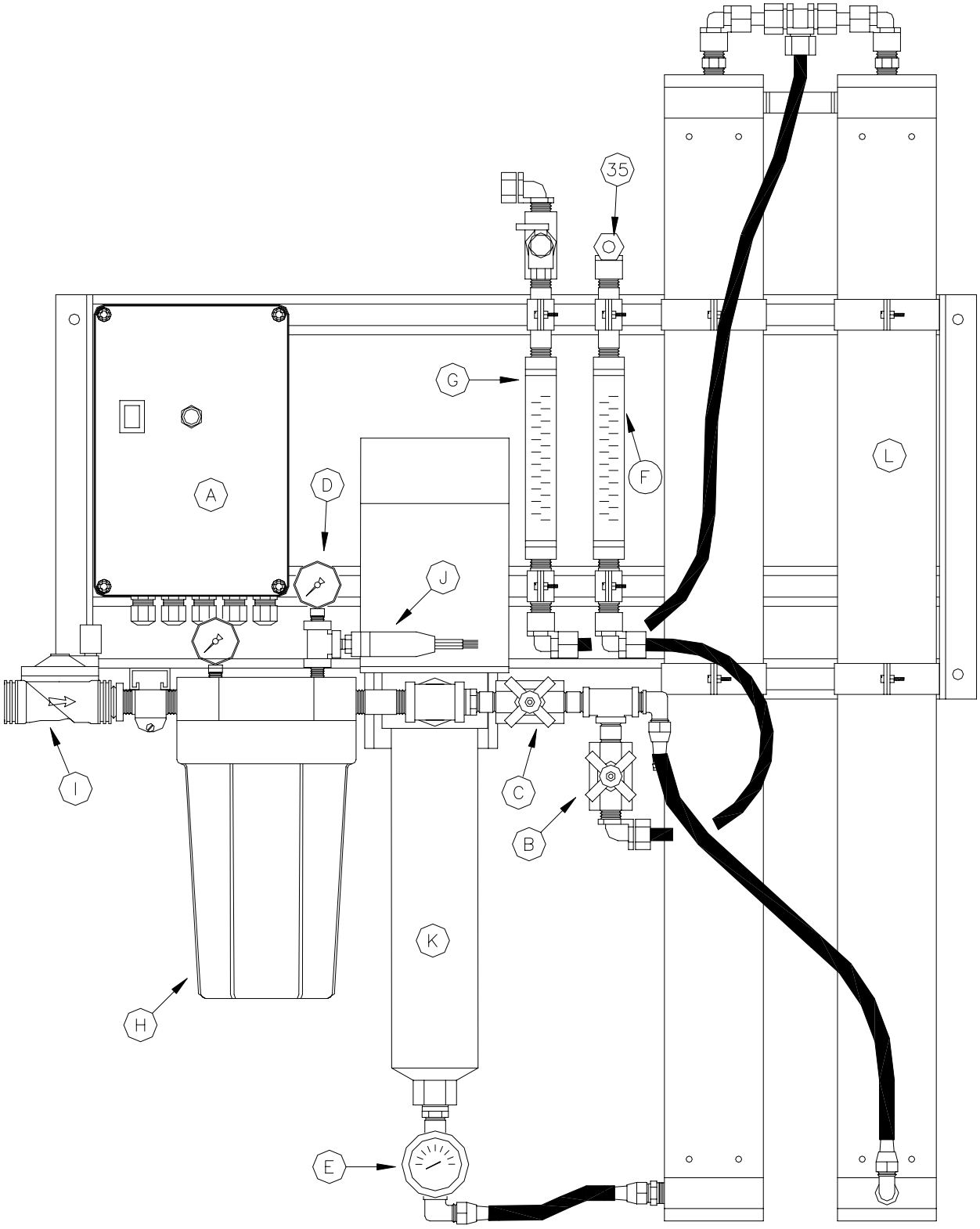


Figure 1

III. OPERATION

A. INSTALLATION

1. The water supply should be sufficient to provide a minimum of 20 psig pressure at the design feed flow.
2. Proper pretreatment must be determined and installed prior to the RO system.
3. A fused high voltage disconnect switch located within 10 feet of the unit is recommended. This disconnect is not provided with the RO system.
4. Responsibility for meeting local electrical and plumbing codes lies with the owner / operator.
5. Install indoors in an area protected from freezing. Space allowances for the removal of the membranes from the pressure vessels should be provided.

B. PLUMBING CONNECTIONS

Note: It is the responsibility of the end user to ensure that the installation is done according to local codes and regulations.

1. Connect the pretreated feed water line to the inlet valve. (Figure # 1 item I) A feed water shutoff valve should be located within 10 feet of the system.
2. Temporarily connect the outlet of the product water flow meter to drain. (Figure # 1 item G) The product water line should never be restricted. Membrane and/or system damage may occur if the product line is blocked.
3. Connect the outlet of the reject water flow meter to a drain. (Figure # 1 item F) The reject drain line should never be restricted. Membrane and/or system damage may occur if the reject drain line is blocked. An air gap must be located between the end of the drain line and the drain. The use of a standpipe or other open drain satisfies most state and local codes and allows for visual inspection and sampling.

C. ELECTRICAL

Note: It is the responsibility of the end user to ensure that the installation is done according to local codes and regulations.

1. Make sure the on off switch located on the controller is in the off position.
2. Wire the input power supply to the bottom of the contactor inside the controller. (See drawing in the appendix.) Make sure the voltage selector jumpers match the voltage you are suppling.

D. STARTUP

1. Verify that the pretreatment equipment is installed and working properly. Verify that no free chlorine is present in the feed water.
2. Verify that the on/off switch is in the off position.
3. Install a 10" five micron filter cartridge in the prefilter housing. (Figure #1 item H)
4. Open the reject control valve completely (Figure # 1 item B) by turning it counterclockwise.
5. Close the reject recycle control valve completely by turning it clockwise.
6. Open the feed water shutoff valve installed in step III-B-1 above.
7. Manually open the inlet solenoid valve (figure #1 item I) by turning the white lever located near the valve outlet.
8. Water will flow through the system and to drain through the reject flow meter (figure # 1 item F).
9. Manually close the inlet solenoid valve after the air has been purged from the system, or after 10 minutes, whichever occurs first.
10. Open the reject recycle valve two turns.
11. Move the controller on/off switch to the on position.
12. Adjust the reject control valves (figure # 1 items B & C) until the desired flows are achieved. Closing the reject valve increases the product flow and decreases the reject flow. Opening the reject recycle valve decreases both the reject and product flow. See the flow rate guidelines and temperature correction table in the appendix to determine the flow rates for different operating temperatures.
13. Allow the product water to flow to drain for 30 minutes.
14. Turn off the system and connect the product line to the point of use. (Figure # 1 item G) The product water line should never be restricted. Membrane and/or system damage may occur if the product line is blocked.
15. Restart the system and record the initial operating data using the log sheet in the next section.

E. Controller

1. When the power switch is turned on, the pump will run as long as the circuit between the tank level terminals and the interlock terminals are closed, and the low-pressure switch contacts are open.
2. To install a tank level switch, remove the jumper wire from the terminal strip and connect the level switch to the terminals. The RO pump and inlet valve will turn on when the level switch contacts are closed (tank not full), and turn off if the level switch contacts open (tank full).
3. To install a pretreatment interlock, remove the jumper wire from the terminal strip and connect the normally closed pretreatment switch contacts to the terminals. The RO pump and inlet valve will turn on when the switch contacts are closed, and turn off if the switch contacts open.
4. If the low-pressure contacts close continuously for five (5) seconds, the RO pump and inlet valve will turn off and the low-pressure light will illuminate. The controller will automatically restart the unit after the user selected time delay. Turning the controller off then back on will manually reset a low-pressure shutdown.

Note: Use the plastic lever to push the terminal strip contacts open. Insert the bare end of the wire into the terminal and release the lever. The lever can be moved from one terminal to another as needed. One lever is included with each controller.

<u>Automatic low pressure reset</u>
If the unit shuts down due to low pressure, a red light on the front of the controller will illuminate. The controller will automatically restart the unit after a user selected time delay. The user selects the delay time by positioning a jumper cap inside the controller (see drawing in the appendix)

<u>Tank Level / Pretreatment Indicator</u>
If the unit shuts down due to a high product tank level or pretreatment interlock, an amber lamp will illuminate. The lamp will turn off and the unit will restart when the condition clears. The same lamp is used for both tank level and pretreatment interlock.

F. Operation and Maintenance Log

DATE	PRODUCT GPM	REJECT GPM	PUMP DISCHARGE PRESSURE	REJECT PRESSURE	FEED TDS PPM	PRODUCT TDS PPM	FEED WATER TEMP	FEED WATER HARDNESS	FEED WATER CHLORINE LEVEL	PRE FILTER INLET PRESSURE	PRE FILTER OUTLET PRESSURE	REMARKS

Note: Change the prefilter when the differential pressure increases by 5 - 10 psi over the clean differential pressure.
Clean the RO membranes when the product flow drops by 15% or more. (See appendix)

F. TROUBLESHOOTING

RO TROUBLE SHOOTING GUIDE						
SYMPTOMS						
Salt Passage	**Permeate Flow**	**Pressure Drop**	**Location**	**Possible Causes**	**Verification**	**Corrective Action**
Normal to increased	Decreased	Normal to increased	Predominantly first stage	Metal oxide	Analysis of metal ions in cleaning solution.	Improved pretreatment to remove metals. Cleaning with acid cleaners.
Normal to increased	Decreased	Normal to increased	Predominantly first stage	Colloidal fouling	SDI measurement of feed/ X-ray diffraction analysis of cleaning sol. Residue.	Optimize pretreatment system for colloidal removal. Clean with high pH, anionic detergent formulation.
Increased	Decreased	Increased	Predominantly last stage	Scaling ($CaSO_4$, $CaSO_3$, $BaSO_4$, SiO_2)	Analysis of metal ions in cleaning sol. Check LSI of reject. Calculate maximum solubility for $CaSO_4$, $BaSO_4$, SiO_2 in reject analysis.	Increase acid addition and scale inhibitor for $CaSO_3$ and $CaSO_4$. Reduce recovery. Clean with an acid formulation for $CaCO_3$, $CaSO_4$ and $BaSO_4$.
Normal to moderate increase	Decreased	Normal to moderate increase	Can occur in any stage	Biological fouling	Bacteria count in permeate and reject. Slime in pipes and vessels.	Shock dosage of sodium bisulfite. Continuous feed of low conc. Of bisulfite at reduced pH. Formaldehyde sterilization. Clean with alkaline anionic surfactant. Chlorine dosage up-stream with subs. Dechlorination. Replace cartridge filters.
Decreased or moderately increased	Decreased	Normal	All stages	Organic fouling	Destructive testing, e.g. IR reflection analysis.	Optimization of pretreatment system (e.g. coagulation process.) Resin/activated carbon treatment. Clean with high pH detergent.
Increased	Increased	Decreased	Most severe in the first stage	Chlorine oxidant attack	Chlorine analysis of feed. Destructive element test.	Check chlorine feed equipment and dechlorination equipment.
Increased	Increased	Decreased	Most severe in the first stage	Abrasion of membrane by crystalline material	Microscopic solids analysis of feed. Destructive element test.	Improved pretreatment. Check all filters for media leakage.
Increased	Normal to increased	Decreased	At random	O-ring leaks, End or side seal glue leaks.	Probe test. Vacuum test. Colloidal material passage.	Replace O-rings. Repair or replace elements.
Increased	Normal to low	Decreased	All stages	Conversion too high.	Check flows and pressures against design guidelines	Reduce conversion rate. Calibrate sensors. Increase analysis and data collection.

MOTOR TROUBLE SHOOTING CHART

TROUBLE	CAUSE	WHAT TO DO
Motor fails to start	Blown fuses	Replace fuses with proper type and rating
	Overload trips	Check and rest overload in starter.
	Improper power supply	Check to see that power supplied agrees with motor nameplate and load factor.
	Open circuit in winding or control switch	Indicated by humming sound when switch is closed.
	Mechanical failure	Check to see if motor and drive turn freely. Check bearing and lubrication.
	Short circuited stator	Indicated by blown fuses. Motor must be rewound.
	Poor stator coil connection	Remove end bells, locate with test lamp.
	Rotor defective	Look for broken bars or end ring.
	Motor may be overloaded	Reduce load.
Motor Stalls	One phase connection	Check lines for open phase.
	Wrong application	Change type or size. Consult manufacturer.
	Overload motor	Reduce load.
	Low motor voltage	See that nameplate voltage is maintained. Check connection.
	Open circuit	Fuses blown, check overload relay, stator and push buttons.
Motor runs and then dies down	Power failure	Check for loose connections to line, to fuses and to control.
Motor does not come up to speed	Not applied properly	Consult supplier for proper type.
	Voltage too low at motor terminals because of line drop.	Use higher voltage on transformer terminals or reduce load. Check connections. Check conductors for proper size.
	Broken rotor bars or loose rotor.	Look for cracks near the rings. A new rotor may be required as repairs are usually temporary.
Motor takes too long to accelerate	Open primary circuit	Locate fault with testing device and repair.
	Excess loading	Reduce load.
	Poor circuit	Check for high resistance.
	Defective squirrel cage rotor	Replace with new rotor.
	Applied voltage too low	Get power company to increase power tap.
Wrong rotation	Wrong sequence of phases	reverse connections at motor or at switchboard.
Motor overheats while running under load	Overloaded	reduce load.
	Frame or bracket vents may be clogged with dirt and prevent proper ventilation of motor.	Open vent holes and check for a continuous stream of air from the motor.
	Motor may have one phase open	Check to make sure that all leads are well connected.
	Grounded could	Locate and repair.
	Unbalanced terminal voltage	Check for faulty leads, connections and transformers.
Motor vibrates after correcting have been made	motor misaligned	Realign
	Weak support	Strengthen base.
	Coupling out of balance	Balance coupling.
	Driven equipment unbalanced	Rebalance driven equipment.
	Defective ball bearing	Replace bearing.
	Bearing not in line	Line properly.
	Balancing weights shifted	Rebalance motor.
	Polyphase motor running single phase	Check for open circuit.
	Excessive end play	Adjust bearing or add washer.

MOTOR TROUBLE SHOOTING CHART (CONTINUED)

TROUBLE	CAUSE	WHAT TO DO
Unbalanced line current on polyphase motors during normal operation	Unequal terminal volts	Check leads and connections
	Single phase operation	Check for open contacts
Scraping noise	Fan rubbing air shield	Remove interference.
	Fan striking insulation	Clear fan.
	loose on bedplate	Tighten holding bolts.
Noisy operation	Airgap not uniform	Check and correct bracket fits or bearing.
	Rotor unbalance	Rebalance.
Hot bearings general	Bent or sprung shaft	Straighten or replace shaft.
	Excessive belt pull	Decrease belt tension.
	Pulleys too far away	Move pulley closer to motor bearing.
	Pulley diameter too small	Use larger pulleys.
	Misalignment	Correct by realignment of drive.
Hot bearings ball	Insufficient grease	Maintain proper quantity of grease in bearing.
	Deterioration of grease, or lubricant contaminated	Remove old grease, wash bearings thoroughly in kerosene and replace with new grease.
	Excess lubricant	Reduce quantity of grease: bearing should not be more than ½ filled.
	Overloaded bearing	Check alignment, side and end thrust.
	Broken ball or rough races	Replace bearing: first clean housing thoroughly.

These instructions do not cover all details or variations in equipment nor provide for every possible condition to be met in connection with installation, operation or maintenance. Chart courtesy of Marathon Electric.

RO SYSTEM TROUBLE SHOOTING

PROBLEM	REMEDY
General	
High Product Water TDS	
Membrane expanded.	Replace membrane.
Membrane attack by chlorine	Carbon pre-filter may be exhausted. Replace with a new cartridge.
Clogged pre-filter-creates pressure drop and low reject flow.	Replace pre-filter cartridge.
Feed pressure too low.	Feed pressure must be at least 20 psi.
Insufficiently flushed post-filter cartridge.	Flush post-filter with pure water.
Brine seal on membrane leaks.	Determine if seal or o-ring is bad. Replace as needed.
No Product Water or Not Enough Product Water	
Feed water shut off.	Turn on feed water.
Low feed pressure. Feed pressure must be at least 20 psi.	Consider booster pump.
Pre-filter cartridge clogged.	Replace pre-filter cartridge.
Membrane fouled.	Determine and correct cause; replace membrane.
Product check valve stuck.	Replace check valve fitting.
Low pump discharge pressure	Open pump discharge valve, replace pump

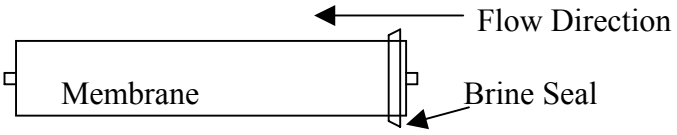
IV. REPLACEMENT PARTS LIST

A list of common replacement parts is provided below Contact you dealer for replacement parts assistance.

Part Number	Description
S7553A-D/T	**Pre filter housing 10" Big Blue**
R9677-SV4040.1	**RO Membrane Pressure Vessels 4" x 40" SS**
R2451	**Pressure Gauge, 2", 0-100 psi, Dry**
R2452B	**Pressure Gauge, 2 1/2", 0-400 psi, LF**
R5138	**Flow Meter 1-5 gpm**
R2184-1.0	**Pump & Motor 1 HP Single Phase**
R2316-214B	**Low Pressure Switch, 6.5 psi**
K8013-24	**Inlet Solenoid Valve, 1”, 24 volt coil**
S7828	**Filter Cartridge 5 micron 10” Big Blue**

V. MEMBRANE REPLACEMENT

1. Turn off the system and close the feed water shutoff valve.
2. Disconnect the membrane feed hoses by loosing the brass fittings between the end of the hoses and the pressure vessel end caps.
3. Remove the retaining "U" pins from the pressure vessels.
4. Push the old membrane out of the vessel in the direction of the feed flow
5. Record the serial numbers of the new membranes.
6. Lightly lubricate the brine seals on the new membranes with clean water.
7. Install the new membranes in the direction of flow with the brine seal end going in last.
8. Lightly lubricate the end cap internal and external o-rings with glycerin.
9. Install the end caps and secure them with the "U" pins.
10. Install the membrane feed hoses.
11. Verify that all retaining "U" pins are installed.
12. Follow the start up procedure in section III-D.

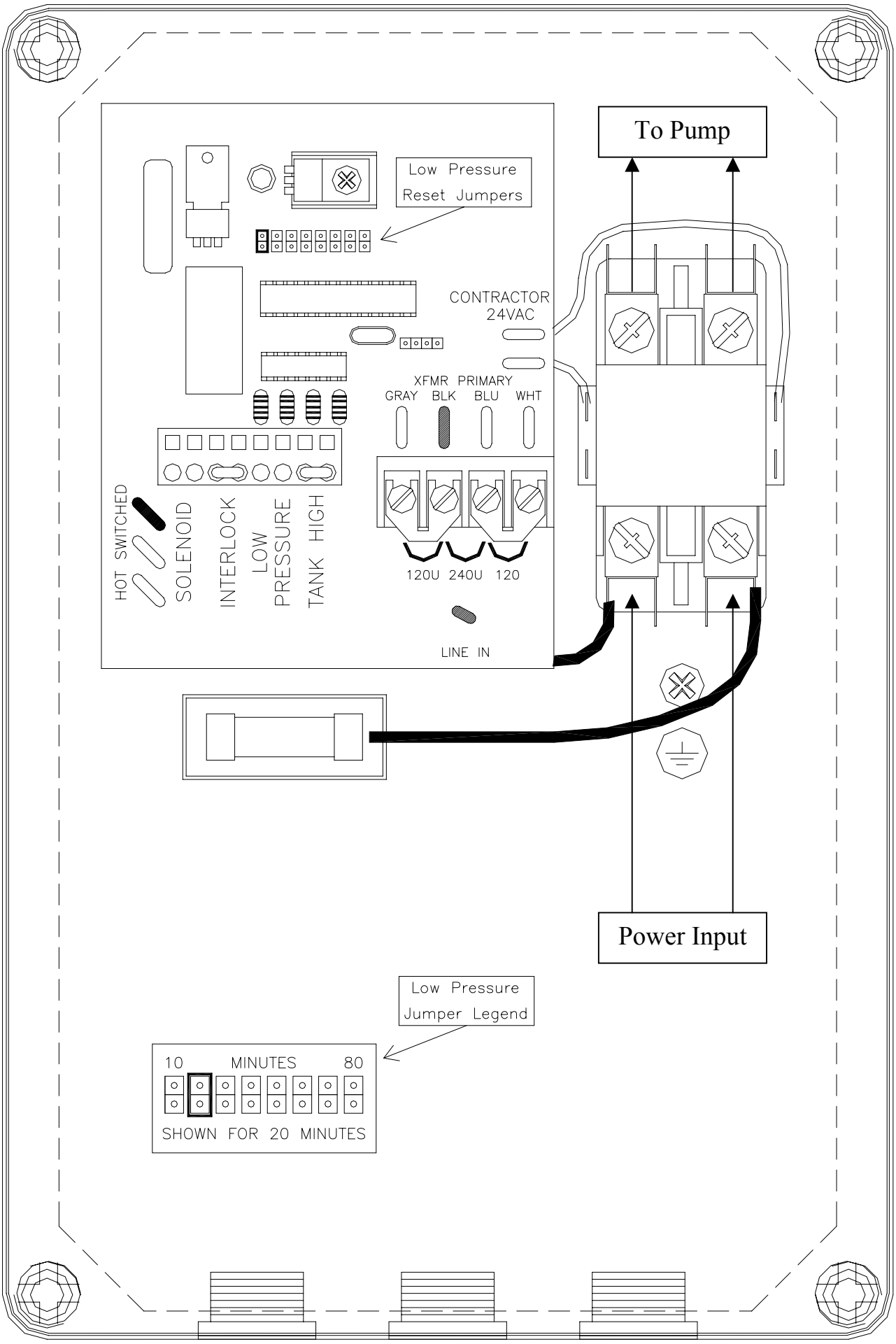


VI. APPENDIX

Temperature Correction Factors

Deg C	Deg F	Correction Factor
30	86	1.16
29	84.2	1.13
28	82.4	1.09
27	80.6	1.06
26	78.8	1.03
25	***77***	***1.00***
24	75.2	0.97
23	73.4	0.94
22	71.6	0.92
21	69.8	0.89
20	68	0.86
19	66.2	0.84
18	64.4	0.81
17	62.6	0.79
16	60.8	0.77
15	59	0.74
14	57.2	0.72
13	55.4	0.70
12	53.6	0.68
11	51.8	0.66
10	50	0.64
9	48.2	0.62
8	46.4	0.61
7	44.6	0.59
6	42.8	0.57
5	41	0.55

Multiply the nominal product flow at 25° C by the temperature correction factor to determine the flow at various other temperatures.


To Pump
Low Pressure
Reset Jumpers
CONTRACTOR
24VAC
XFMR PRIMARY
GRAY BLK BLU WHT
HOT SWITCHED
SOLENOID
INTERLOCK
LOW
PRESSURE
TANK HIGH
120U 240U 120
LINE IN
Power Input
Low Pressure
Jumper Legend
10 MINUTES 80
SHOWN FOR 20 MINUTES