Mar Cor Purification -
Biolab Equipment Ltd.

2200M – PORTABLE
WATER PURIFICATION SYSTEM

Installation, Operation, and Maintenance Manual

Rev. 0.3

INTENDED USE:

This system is intended to remove organic and inorganic substances and microbial contaminants from water that is used to dilute dialysis concentrate to form dialysate and to produce purified water for dialyzer reprocessing and equipment rinse and disinfection.

SOFTWARE VERSION: V6.7e.132

BIOLAB REFERENCE #: _____

PART #: _____

PANEL SERIAL #: _____

DATE MANUFACTURED: _____

MANUAL REVISION HISTORY

Revision	Author	Date	Changes
0.2	Richard Marmen	Oct. 3, 2006	
0.3	Richard Marmen	June 2008	Formatting

MANUAL PREPARATION

RICHARD MARMEN - Engineering Manager — June 2008

Mar Cor Purification - Biolab Equipment Ltd.

ABOUT THIS MANUAL…

This Manual contains information that is **CONFIDENTIAL** to Mar Cor Purification – Biolab Equipment Ltd. and should not be disclosed to third parties or duplicated for any purposes, in whole or in part.

This Manual describes procedures necessary to install, operate and maintain the 2200M – Portable Water Purification system. It will make reference to different manufacturer's component manuals for detailed instructions. Please read this Manual carefully before installing and operating your system.

Your warrant may be voided if installation or operation instructions are not followed exactly.

If you need further assistance, please call our Technical Support Department

Toll Free: 1-800-268-5035 **In Canada: 905-639-7025**

Website: www.mcpur.com

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SAFETY

This Manual describes procedures necessary to install, operate, and maintain the 2200M – Portable Water Purification System. It makes references to the component manuals of other manufacturers.

Please read this entire Manual carefully before installing and operating your system. Pay particular attention to all danger and caution statements to avoid serious injury to the operator and damage to the system.

This equipment is a medical device and changes to the design and substitution of components are performed only under design controls and are documented. Any changes without design controls are not allowed and are in contravention to regulation(s).

Operation of this system outside of its intended use and without adequate pretreatment/post-treatment that meets AAMI RD62:2006 and CSA Z364.2.2-03 standard guidelines is not allowed and is in contravention to regulation(s).

DEFINITIONS

WARNING:

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION:

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate personal injury or possible damage to the system.

NOTE:

Information that requires special emphasis.

LABELS

This symbol, if noted on the equipment, indicates high voltage output. Disconnect the main power supply to the equipment before opening panels.

GENERAL PRECAUTIONS

The following are general precautions that must be taken with the 2200M – Portable RO Water Purification System. Please read these precautions before installing or operating the system.

- **WARNING:** Use this device only with the specified feed water and pretreatment chemicals determined by a Mar Cor water analysis. Use all sanitizing and cleaning agents according to the instructions in this Manual. Failure to comply with the above could result in personal injury.
- **WARNING:** Ensure that the system is connected to a power source in compliance with local and national electrical codes. Failure to comply may create a shock or fire hazard.
- **WARNING:** To prevent electrical shock, disconnect the electrical power to the system before servicing.
- **WARNING:** Ensure that all piping connections are tight to avoid leakage.
- **WARNING:** Always relieve the pressure in chemical lines before disassembly to protect yourself against possible chemical spray.
- **WARNING:** Ensure that there is adequate ventilation around the system to avoid the build up of chemical fumes.
- **WARNING:** Follow carefully the manufacturer's safety instructions in their individual manuals and labels on chemical containers.

1.0 WHAT IS THE 2200M PORTABLE RO SYSTEM?

1.1 HOW DOES A PORTABLE RO SYSTEM WORK?

Reverse Osmosis, invented in 1959, is the newest major method of water purification and one of the types of cross flow membrane filtration. It is a process, which removes both dissolved organics and salts using a mechanism different from ion exchange or activated carbon. The pressurized feed water flows across a membrane, with a portion of the feed permeating the membrane. The balance of the feed sweeps parallel to the surface of the membrane to exit the system without being filtered. The filtered stream is the “permeate” because it has permeated the membrane. The second stream is the “concentrate” because it carries off the concentrated contaminants rejected by the membrane (FIGURE 1). Because the feed and concentrate flow parallel to the membrane instead of perpendicular to it, the process is called “cross-flow filtration” (or, erroneously, “tangential flow”). Depending on the size of the pores engineered into the membrane, cross- flow filters are effective in the classes of separation known as reverse osmosis, nano-filtration, ultra-filtration and the more recent micro-filtration.

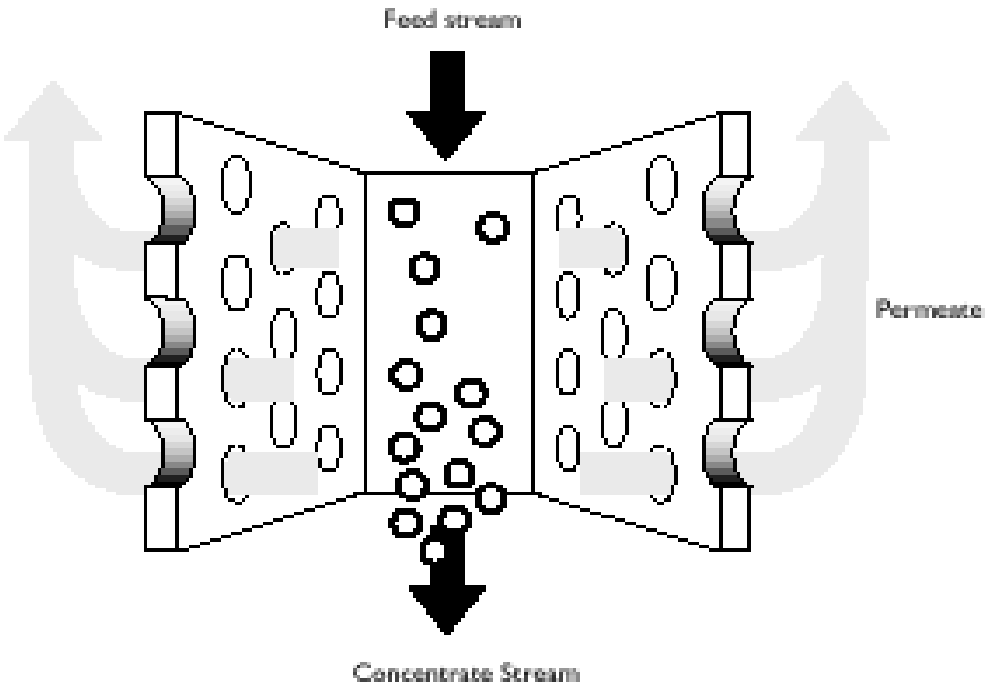


FIGURE 1 - CROSS FLOW FILTRATION

Cross-flow membrane filtration allows continuous removal of contaminants, which in “normal flow” filtration would “blind” (cover up) or plug the membrane pores very rapidly. Thus the cross-flow mode of operation is essential to these processes.

Reverse Osmosis (RO) was the first cross-flow membrane separation process to be widely commercialized. RO removes most organic compounds and up to 99% of all ions (FIGURE 2). A selection of RO membranes is available to address varying water conditions and requirements.

RO can meet most water standards with a single-pass system and the highest standards with a double-pass system. This process achieves rejections of 99.9+% of viruses, bacteria and pyrogens. Pressure in the range of 50 to 1000 psig (3.4 to 69 bars) is the driving force of the RO purification process. It is much more energy-efficient compared to phase change processes (distillation) and more efficient than the strong chemicals required for ion exchange regeneration.

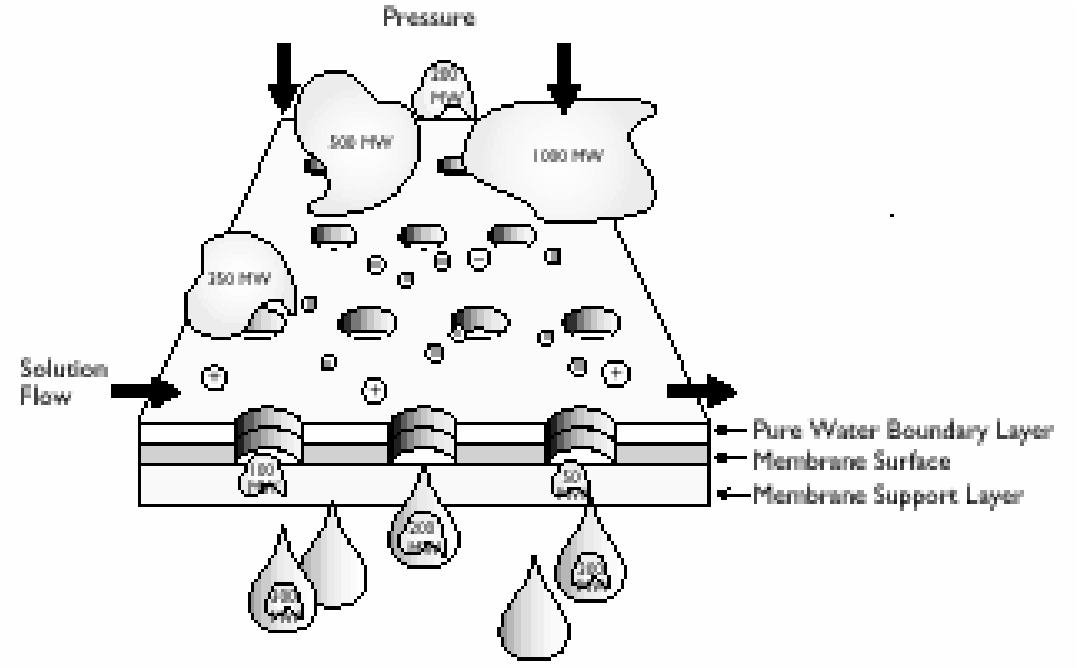


FIGURE 2 - REVERSE OSMOSIS

Sepralators (Spiral-Wound Membrane Elements) have gained the greatest acceptance in the market. They are the most rugged, leak-free and pressure-resistant configuration. The spiral design allows for optimum membrane surface area and fluid dynamics to produce a high permeate flow for the size of equipment required. Sepralators are available with RO, NF, UF, and MF membranes. Sepralators (FIGURE 3) are quite easy to maintain with a routine cleaning program. A major advantage is enhanced "self-cleaning" due to turbulent flow at the membrane surface. This feature dramatically reduces fouling, thereby enhancing performance and membrane life. Spiral-wound designs also offer the greatest selection of membrane material, allowing users to "tailor" a system design to suit their purification requirements.

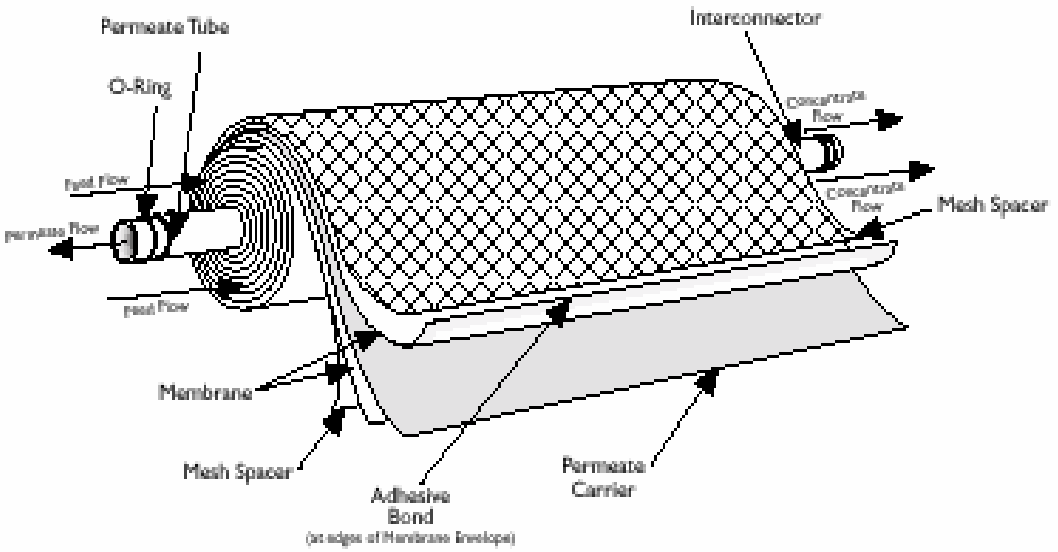


FIGURE 3 - SPIRAL WOUND MEMBRANE ELEMENT (SEPRALATOR)

2.0 DESCRIPTION AND FUNCTION OF SYSTEM COMPONENTS

This section describes briefly the function of the major components of the standard 2200M - Portable Water Purification System. Refer to the manufacturer of the individual components for a more detailed description.

NOTE: Due to the custom nature of the Reverse Osmosis system (i.e. pumps, ultraviolet sterilizers, filters, valves, gauges, etc.) some components are not described.

2.1 PRE-FILTER CARTRIDGE

A pre-filter housing is installed on the inlet (feed) of the system and is located on the right side of the system. The housing contains a 1.0 micron filter cartridge. As the feed (raw) water flows through the filter the suspended particles that are greater than the micron rating of the filter are trapped. The filter used is a graded density type, meaning the outer core of the filter has a larger pore size and progressively gets smaller towards the middle of the filter. The rating (micron size) is measured at the core of the filter. This type of filter will help prevent premature plugging.

2.2 PRESSURE GAUGES

Four pressure gauges are installed at various points in the Reverse Osmosis system. They are as follows:

- Two 0-100 psig gauges are installed on the inlet and outlet of the pre-filter housing. They provide indication of the feed water pressure and also provide indication of the pre-filter(s) delta pressure. This delta pressure allows the operator to determine when the filter is required to be changed.
- One 0-600 psig gauge is surface mounted on the front of the cabinet. The gauge will provide an indication of the pump discharge pressure before entering the first membrane housing.
- The final gauge 0-600 psig is surface mounted on the front of the cabinet. It provides an indication of pressure after the water has passed through all the membrane housings. With this gauge and the pump discharge gauge the delta pressure can be calculated. This reading will provide an indication as to whether or not the membranes have become fouled.

2.3 SOLENOID VALVE

One inlet solenoid valve is installed on the system. The solenoid (½") is located on the outlet of the pre-filter housing. It is a normally closed valve that isolates the feed (raw) water and opens when the system is in operation or in **FLUSH** mode.

2.4 FEED WATER LOW PRESSURE SWITCH

The feed (raw) water normally closed low pressure switch, preset to 12.5 psig, is located on the bottom left side of the panel. It is connected (1/4" tube) to the inlet water block just after the feed solenoid valve and senses the feed water pressure. When the system is in operation and the feed pressure drops below 12.5 psig it will shut down (alarm) after a 10 second delay. This will prevent damage occurring to the booster pump.

CAUTION: Feed water pressure must be between 30-60 psig when the system is operating. Continuous operation of the system below 12.5 psig can result in premature pump and motor failure.

2.5 BOOSTER PUMP

A rotary vane pump increases the feed water pressure to 100-220 psi (6.9-15.2 bars), the pressure that is required for purification by reverse osmosis. The pump is located in the cabinet, mounted in the horizontal position.

2.6 CONDUCTIVITY/TEMPERATURE SENSORS

Two conductivity/temperature sensors are installed on the system. They provide an indication of the feed and product conductivity/temperature. Their location and purpose are as follows:

- The feed conductivity/temperature sensor is installed in the feed block. It measures the combined feed and reject recycle conductivity/temperature before the booster pump. The measured conductivity will be higher than the raw source. The feed water temperature is also measured at this point. An adjustable alarm set-point of 30-50°C (86-122°F) will shut the system down after a 10 second delay to prevent damage to the membrane cartridges.
- The product conductivity/temperature sensor is installed in the product block. It measures the product conductivity/temperature of the final product. The controller calculates the system percent rejection using the feed and product conductivity readings. The percent rejection indicates the amount of impurities that the system is removing from the feed. It is calculated as follows:

$$\% \text{ Rejection} = \left[\frac{\text{Feed - Product}}{\text{Feed}} \right] \text{X } 100$$

A poor quality adjustable set-point of 1-100 µS (1-100 x 10K Ω) can be programmed. If the product water quality is greater than the set-point a poor quality alarm will display on the screen.

2.7 MANUAL FLOW CONTROL NEEDLE VALVES

Two manual needle control valves are installed on the system to provide pressure and flow adjustment of the various streams. Their location and purpose are as follows:

- The reject valve is mounted on the front of the cabinet. This valve is used to control the reject flow to drain and pressure.
- The reject recycle valve is mounted on the front of the cabinet. This valve is used to control the recycle flow and pressure.

CAUTION: Never fully close the reject and reject recycle valves when the system is in operation. Damage to equipment can occur.

CAUTION: Proper flows, pressures and recoveries must be maintained at all times. Failure to operate the system within the design parameters will result in permanent damage to the membrane cartridges.

2.8 FLOW ROTA-METERS

Three flow Rota-meters are installed on the system. Their location and purpose are as follows:

- The reject Rota-meter is surface mounted on the front of the cabinet. This Rota-meter shows how much reject water the system is sending to drain.
- The reject recycle Rota-meter is surface mounted on the front of the cabinet. It provides indication of the amount of reject water that is being recycled back into the feed of the system.
- The product Rota-meter is located to the right of the recycle Rota-meter. It indicates the amount of product water the system is producing.

From these flow readings the following system performance data can be calculated:

$$\%\ \text{Array Recovery} = \left[\frac{\text{Product}}{\text{Product + Reject + Reject Recycle}}\right] \times 100$$

$$\%\ \text{System Recovery} = \left[\frac{\text{Product}}{\text{Product + Reject}}\right] \times 100$$

2.9 CHECK VALVE

A check valve is installed on the system. Its location and purpose is as follows:

- The recycle check valve is mounted inside the cabinet after the recycle needle valve. This check valve will prevent the back-flow of feed water from the pump suction into the reject line.

2.10 SONALERT ALARM

An audible alarm is mounted on the side of the cabinet and will sound if an alarm has occurred. The alarm must be silenced by pressing SILENCE or STOP on the keypad interface.

2.11 PRODUCT DIVERT SOLENOID

A normally closed product divert solenoid valve is installed on the product block of the system. When the RO is stopped, or in 'Flush', 'Standby', 'Tank Full' or any other alarm condition, the product solenoid is closed preventing any product water from exiting the system.

2.12 PRODUCT PRESSURE RELIEF VALVE

An adjustable (0-60 psig) pressure relief valve is installed on the product block. The relief port is connected to the drain line. When the system is running and product water is closed off the product water will divert through the relief valve and into the reject (drain). If there is an alarm (ex. Poor Quality) the product divert solenoid will close and the product water will divert to drain. One of the other relief ports is capped with quick connect; a gauge can be installed to set the pressure (maximum 60 psig) on the relief valve. The relief valve will also prevent any reject water from entering the product line.

2.13 SYSTEM MATERIALS OF CONSTRUCTION

Component	**Std. Material**
Feed Manifold Block	PVC
High Pressure Piping	Polypropylene Flexible Tubing
Low Pressure Piping	Polypropylene Flexible Tubing or PVC
Housings	304 SS
Membrane	
• Permeate Carrier	Polyester
• Feed Spacer	PP
• Central Tube	ABS
• Glue	Urethane
• Brine Seal	Buna N
• O-ring	Buna N
• External Wrap	FRP
• ATD	Noryl
Pressure Gauge	316 Stainless Steel and Brass
Conductivity Sensors	Noryl/SS
Pump	316L SS
Inlet Solenoid	Brass
Flow Meter	Acrylic Body, 316 Stainless Steel Float
Needle Valve	316L Stainless Steel
Filter Housing	PP
Cabinet	Steel Powder Coated

3.0 INSTALLATION REQUIREMENTS

Once the system is unpacked and in place, the following items are to be completed before start-up:

- Interconnect piping including drains
- Electrical interconnect wiring
- Feed Water Supply
- Electrical Source (G.F.I. Receptacle Required)

Refer to the P&ID and Electrical Drawing to assist in the installation.

NOTE: Due to site conditions some of the Installation procedures might have to be altered.

3.1 UNPACKING THE SYSTEM

Unpack the system carefully and inspect all components for any possible signs of damage. Do not install the 2200M - Portable Water Purification System if damage is apparent. Notify your representative and the carrier. Retain all literature for future reference.

3.2 SPACE/ROOM REQUIREMENTS

The system must be floor mounted in a space that includes unobstructed access to the feed, drain and electrical controls for ease of operation and service. Position the unit in its approximate final location with all of the pre- and post-treatment accessories. Provide enough room to remove the membrane(s). The room must have adequate lighting and safety equipment (safety shower, face shield, gloves, chemical suits, spill equipment etc.)

WARNING: A room with good ventilation is required to help remove heat and any chemical fumes.

3.3 DRAIN CONNECTIONS

Facility drains are to be sized for the maximum flow of the system. Drain connections are to be plumbed such that siphoning of the system will not occur. Provide adequate air gaps for each drain connection.

3.4 ELECTRICAL HOOK-UP

Before starting the system it is very important that electrical services have been checked for the following

1. Ensure that the fused (G.F.I. Receptacle) power supply to panel is connected.
2. Ensure proper voltage is connected and verified.
3. Ensure that all input or output devices in the panel are hooked up properly and verified.
4. Ensure all electrical work meets or exceeds local electrical codes.

WARNING: Use proper safety procedures when working in the electrical panel. Disconnect and/or lock out power supply to the system and tag it out. The system must be properly grounded to prevent personal injury or damage to the system.

WARNING: All electrical connections are to be made by a qualified electrician. All local codes and regulations are to be observed. Refer to the electrical drawing for connection points, voltage, phase and current load.

WARNING: The system must be properly grounded to prevent personal injury or damage to the system.

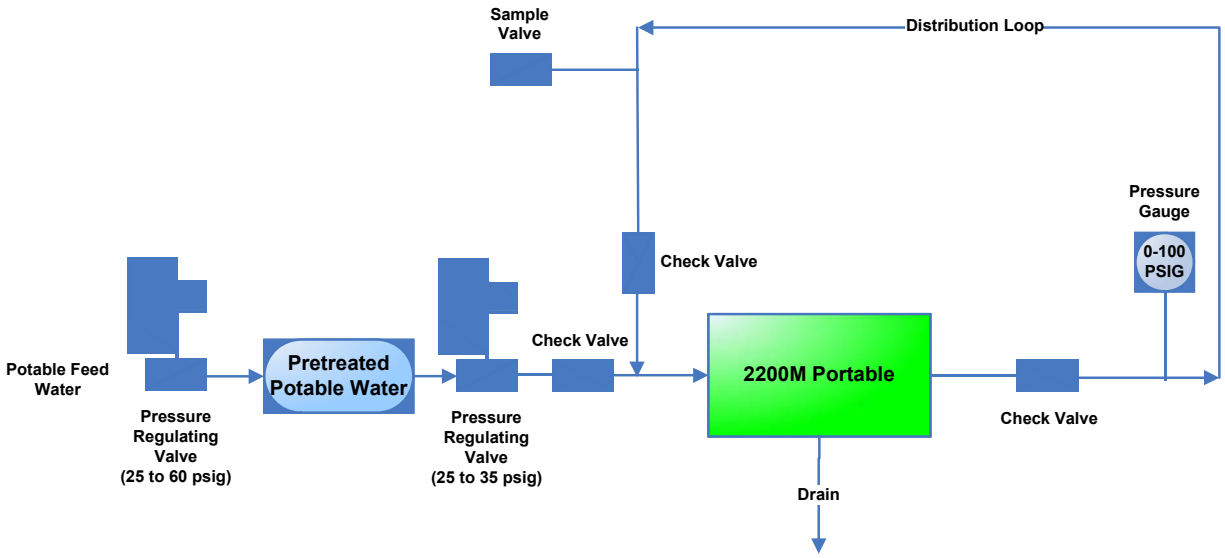
3.5 PRE-TREATMENT REQUIREMENTS

To assure peak operating performance the pretreatment to the system must be chosen carefully. Water must meet or exceed the feed water parameters. The following pretreatment is for a typical surface potable drinking water.

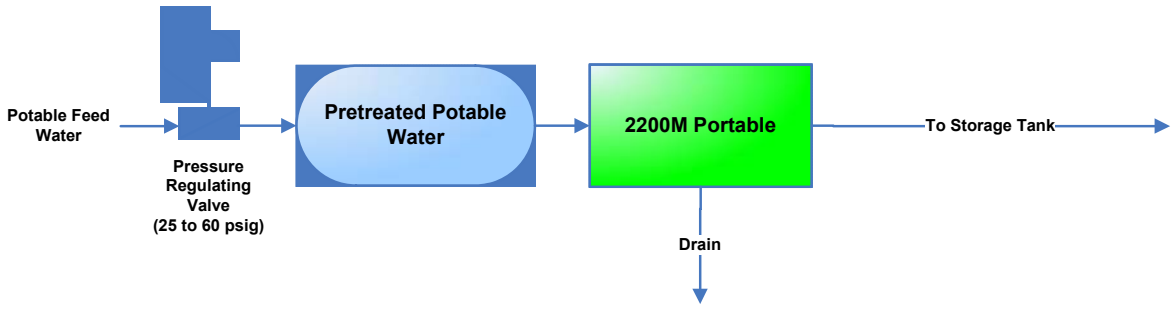
- Temperature blending valve. To maintain 25°C feed water.
- Pressure regulating valve – to maintain a constant feed pressure between 30-60 psig.
- Safety pressure relief valve set to 60 psig – to prevent over pressurization of the pretreatment components.
- Second pressure regulating valve installed just before the RO in direct feed application. Set between 25 and 35 psig.
- Back-washable carbon for removal of chlorine.
- Automatic water softener for removal of hardness.
- Vacuum breaker to prevent pretreatment (carbon, softener) from imploding.

CAUTION: The above information is just a typical pretreatment. Feed water sources can vary significantly and can require more or less pretreatment components. Please consult your local water treatment representative if you are unsure.

3.5.1 Installation Options



Direct Feed Applications
Minimum Installation Requirements



Tank Feed Applications
Minimum Installation Requirements

3.6 FEED WATER PARAMETERS

Feed water must meet the following specifications for successful operation of the 2200M - Portable Water Purification System and warranty validation:

CAUTION: Feed water must meet or exceed the National Drinking Water Regulations for potable water including the following listed in the table below.

Variable	Service	Units	Min.	Max.
Temperature	Feed Inlet	°C	2	35
Chlorine	Feed Inlet	ppm	0.0	0.0
Optimum pH	Feed Inlet		7.0	7.5
Operating pH	Feed Inlet		4.0	11.0
Cleaning pH	Feed Inlet		2.0	11.5
Free Chlorine	Feed Inlet	ppm	0.0	<0.1
Iron, Manganese	Feed Inlet	ppm	0.0	<0.1
Feed NTU	Feed Inlet		<1.0	
LSI	Reject		<-1.0	
Feed SDI	Feed Inlet		<3.0	

CAUTION: System design is based on a computer projection analysis. Refer to the analysis provided for detailed information on system parameters and performance.

NOTE: The computer project analysis provided does not represent a guarantee of performance and is solely provided as a service.

3.7 PANEL ELECTRICAL CONTROL INTERLOCKS

Listed in the table below are the electrical termination points to the microprocessor controller and the individual components on the system. Also included is brief description and function of customer terminations. The terminal numbers listed are connection made directly at the microprocessor control. Refer to the electrical drawing for additional component terminations (Booster/Distribution Pumps, Ultraviolet Sterilizers, Solenoids, Tank Low Level Switches ext.)

3.8 D0841.4 MICROPROCESSOR
(C/W V6.7e.132 Software) Electrical Installation Termination Table

Description	Term	I/O	Voltage	Comments
Feed Probe	5,6,7,8	I	Sensor	Pre-wired (grn, wht, red, blk)
Product Probe	13,14,15, 16	I	Sensor	Pre-wired (grn, wht, red, blk)
Optional 0.1 Cell Constant Product Probe (EPROM Req.)	15,16	I	Sensor	Connect Thornton Sensor Leads 1 and 2 to 15, 6 to 16
AC Voltage Supply	17,18,19	I	12,CT,12	Pre-wired
RO Pump Starter (ROP)	23,24	O	24VAC	Pre-wired
Water Inlet Solenoid (WIS)	25,26	O	24VAC	Pre-wired
Reject Solenoid (RS)	27,28	O	24VAC	Not Used
Alarm Group	29,30	O	24VAC	Customer Connection
Audible Alarm (Option)	31,32	O	24VAC	Customer Connection
Low Pressure Switch (LP)	33,34	I	12VDC	Pre-wired
RO Pump Overload (O/L1)	35,36	I	12VDC	Not Used
Remote Start Timer (Option)	36,37	I	12VDC	Customer Connection
Intermediate Level (INT)	37,38	I	12VDC	Customer Connection
Remote Standby (RS-B)	39,40	I	12VDC	Customer Connection
High Level (HL)	40,41	I	12VDC	Customer Connection
Drain Valve Switch	42,43	I	12VDC	Pre-wired (Jumper)
Drain Valve	45,46	O	24VAC	Pre-wired

3.9 D0903 DISPLAY ELECTRICAL INSTALLATION TERMINATION TABLE

Description	Term	I/O	Voltage	Comments
Interface Cable, When Remote D0949 Card Not Used	DB9	I		Pre-wired Option Connection Cable Direct To D0841.4 Controller
Interface Cable, When Remote D0949 Card Used	DB9 (P2)	I		Pre-wired Option Connection Cable To D0949 Controller DB9 (P2)

3.10 D0949 REMOTE ELECTRICAL INSTALLATION TERMINATION TABLE

D0949 Remote Card (Option)	Term	I/O	Voltage	Comments:
Interface Cable To D0841.4 Controller	DB9 (P1)	O		Pre-wired Option Connect Cable To D0841.4
Interface Cable To Alarm Monitor D0871	2,3,4,5,6	O	12VDC	Customer Connection (5 Wire Cable) To Alarm Monitor D0871
Interface Cable to Remote PC Monitor	DB9 (P3)	O		Customer Connection (1000' Max.) To Remote PC. Software For PC Required.

3.11 10 PINS FEMALE CHASSIS MOUNTED RECEPTACLE (FOR 26M15A-2RO MODEL)

Description	Term	I/O	Voltage	Comments:
Product Divert	1	O	12VAC	Customer Connection
High Level	2	I	12VDC	Customer Connection
Common	3	O		Customer Connection
Common	4	O		Customer Connection
Remote Standby	5	O	12VDC	Customer Connection
Alarm Group	6	O	12VAC	Customer Connection
Alarm Group (Common)	7	O	12VAC	Customer Connection
Control Power	8	O	12VAC	Customer Connection
CR4 By-Pass Relay	9	O	12VAC	Customer Connection
	10			Not Used

3.12 PANEL ELECTRICAL FIELD TERMINATION DESCRIPTION

3.12.1 Alarm Group

This 24VAC contact can be used to provide a signal to a building control system, nurse's station, etc. When an alarm condition occurs the contact will be active.

CAUTION: It is recommended that a 24VAC relay be installed between the contact and the monitoring device to prevent damage to the controller. The contact is rated for a maximum load of 1.0 Amps @ 24VAC when the standard 150VAC step-down transformer is used. If a higher current is required (maximum 5.0 Amps @ 24VAC) the step-down transformer will have to be increased.

3.12.2 Audible Alarm (Option)

This 24VAC contact can be used to activate an audible alarm. When an alarm condition occurs the contact will activate an audible alarm. If the audible alarm is silenced and the alarm condition is still present the audible alarm will re-activate within two minutes.

CAUTION: It is recommended that a 24VAC relay be installed between the contact and the monitoring device to prevent damage to the controller. The contact is rated for a maximum load of 1.0 Amps @ 24VAC when the standard 150VAC step-down transformer is used. If a higher current is required (Maximum 5.0 Amps @ 24VAC) the step-down transformer will have to be increased.

3.12.3 Remote Start/Stop Timer (Option)

This contact is designed to interface with an optional 7-day timer. This allows the user to program a start and stop time when the system is in operation. The contact used to activate this input must be a normally open TYPE-C DRY CONTACT.

NOTE: Customize menu configuration is required to use this function.

CAUTION: Contacts must be a TYPE-C DRY CONTACT. Damage to controller will occur if powered contacts are used.

3.12.4 Tank High Level, Start/Stop (HL)

This contact is used to start and stop the system via an optional tank level controller. The contact used to activate this input must be a normally open TYPE-C DRY CONTACT. When the contact is open the system will operate and when the contact closes the system will be placed in standby (Tank High Level). To reduce the On/Off cycling of the system a dead band must be incorporated in the level controller or a second level contact can be installed and tied in the intermediate level terminal.

CAUTION: Contacts must be a TYPE-C DRY CONTACT. Damage to controller will occur if powered contacts are used.

3.12.5 Tank Intermediate Level (INT)

This contact is used in conjunction with the tank high level contact. A two point level controller can be used. The level controller contacts must be a normally open TYPE-C DRY CONTACTS. As the tank is filling the intermediate level contact will close and then the high level contact will close placing the system in standby (Tank High Level). As the water is being consumed, the water level will drop. The tank high level contact will open and then the intermediate level contact will open. The system will restart at this point. This configuration will provide a dead band reducing the On/Off cycling of the system.

CAUTION: Contacts must be a TYPE-C DRY CONTACT. Damage to controller will occur if powered contacts are used.

3.12.6 Remote Standby (RS-B)

This contact is used to interlock pretreatment / post treatment equipment with the system. The contact must be a normally open TYPE-C DRY CONTACT. When a pretreatment / post treatment device such as a softener goes into regeneration the contact closes placing the system in **STOP** mode. When the regeneration cycle is complete and the contact opens the system will restart in whatever mode it was in before. When multiple pretreatment / post treatment devices are used the electrical connections are to be terminated in parallel.

CAUTION: Contacts must be a TYPE-C DRY CONTACT. Damage to controller will occur if powered contacts are used.

3.12.7 Drain Valve Switch Contact

The valve switch contact can be used to install a drain/auto switch (or jumper). What this switch does is allows the operator to either divert the product water to drain manually (Drain Position) or set it to auto so the valves (option) will automatically divert to drain on poor quality (programmable set-point), during manual or auto flush or when the system is stopped or standby including tank full. The switch contact must be a normally open TYPE-C DRY CONTACT.

CAUTION: Contacts must be a TYPE-C DRY CONTACT. Damage to controller will occur if powered contacts are used.

3.12.8 Drain Valve Contact

The valve contacts are used to connect a solenoid divert valve(s). The valve can be air solenoid to activate pneumatic valves or two solenoid valves, one normally open and one normally closed. The normally closed valve should be plumbed to the tank (loop) and the normally open to drain. The valve will only activate when the product water quality is below the programmable set-point (fail-safe operation).

CAUTION: The contact is rated for a maximum load of 1.0 Amps @ 24VAC when the standard 150VAC step-down transformer is used. If a higher current is required (Maximum 5.0 Amps @ 24VAC) the step-down transformer will have to be increased.

NOTE: Each individual panel can be custom designed or modified to suit customer needs. Please contact your local representative for options.

4.0 RO DIGITAL CONTROLLER

4.1 PROCESS OPERATION AND CONTROLS

This section provides an overview of the operation of the control panel and microprocessor controller. Included here are the basic functions of the control panel components and explanations of panel control functions.

NOTE: The purpose of this section is only to familiarize operators with the control panels and its basic functions. Operators must refer to the Vendor's Literature for detailed information on individual components.

4.2 AUTOMATIC CONTROL SYSTEMS

Many water treatment units and systems are controlled automatically by mechanical or microprocessor controllers. The programming of the controller, whether done with mechanical devices or with computer "software", provides preset step times and termination set points for most of the unit or system process steps.

The programmable controller uses "Inputs" and "Outputs" to monitor and control the system. "Inputs" come from such devices as conductivity sensors, pressure switches, valve limit switches and control panel switches. "Outputs" consist of signals to open or close the various control valves, signals to sound alarms at appropriate times and signals to start pumps and motors.

In simplest terms, a programmable controller uses the information from "Input" devices and the logic of its programming to make "decisions" about process step advancement and individual "Output" signals.

4.3 CONTROL PANEL COMPONENTS

The control panel is constructed from the following main components:

- Electrical enclosure
- Power cord
- Step down transformers
- Microprocessor controller
- Keypad interface
- Pump motor protection devices
- Fuses, Terminals

4.4 RO MICROPROCESSOR CONTROLLER OVERVIEW

The user-friendly DO841.4 monitoring controller with V6.7e.132 software is designed for operating a reverse osmosis system. The controller uses a touch pad interface keypad and display to provide useful information on the system. Parameters can be easily changed to suit the user's needs. Optional output cards can provide information via a remote display or with a Personal Computer (PC). The PC will provide the information in a Windows format. The system has many unique features including programmable automatic restart for low pressure conditions, programmable alarm set-points for product quality, feed temperature, programmable poor quality shutdown delay and programmable flush times and durations. The controller has non-volatile memory backup for power failure conditions. If a power failure should occur once the power has been restored the system will re-start in the same mode as it was in before the failure occurred.

The rest of this section will provide the user with the many features available and programming steps to operate the reverse osmosis system.

4.4.1 Water Quality Monitoring

- Feed water conductivity (resistivity)
- Feed water temperature
- Product water conductivity (resistivity)
- Product water temperature
- Product water non-temperature compensated conductivity (resistivity) using the 0.1 cell constant optional probe. This probe is factory set.
- % Rejection of water impurities between input and output conductivities.

4.4.2 System Indication

- Product tank levels (Low, Intermediary, High)
- Active modes (**RUN**/ **FLUSH**/**STANDBY**/**CLEAN**)
- Operation mode status (**RUNNING**, **FLUSHING**, **STOPPED**, **TANK FULL**, **TANK FILLING**)
- Pump running time in hours (ROP), up to 32000 hours.
- Time remaining before next flush cycle in minutes and seconds.
- Time remaining when in auto flush condition.

4.4.3 Alarm/Warning Monitoring

- Poor quality of purification
- Feed water low pressure <12.5 psi (Fixed digital input)
- Pump input current overload (digital input)
- Feed water high temperature of water

- Remote standby
- Optional audible alarm (Re-alarm <2 minutes if alarm still present)

4.4.4 Programmable Set-points

- Product water poor quality (1-100 µS/cm)
- Poor quality shutdown delay (4-240 Seconds)
- Feed high temperature shutdown (2-50°C (36-122°F))
- Flush period (10-600 seconds)
- Flush cycle (30-120 minutes)

4.4.5 Operation Modes

The following will provide the user with information on the controller modes of operation **('RUN'/ 'STANDBY'/'FLUSH'**).

To alter the setup data or change the system mode of operation it is necessary to be in the **STOP** mode. The message **"SYSTEM STOPPED"** will be on the display in this menu. If the system is not in this mode you will have to press the **"STOP"** or **"OK"** key to reach it. These steps are required to prevent the user from altering certain parameters or operation modes during service.

4.4.5.1 STOP Mode

When the **"STOP"** key is pressed the system will stop and remain in this state until another mode key is pressed.

4.4.5.2 RUN Mode

This is the main mode of operation for the controller. When the **"RUN"** key is pressed the water purification cycle will begin. Refer to the SETUP menu for different RUNNING options available.

4.4.5.3 FLUSH Mode

When the **"FLUSH"** key is pressed the system will continually flush. This will help reduce membrane fouling by allowing more water to pass over the membrane surface.

4.4.5.4 STANDBY Mode

When the **"STANDBY"** key is pressed the system will stop. In this state the system will automatically FLUSH (programmable set-point) to prevent stagnant water and reduce membrane fouling.

4.4.6 Controller Options

4.4.6.1 Product Divert (Option)

When this optional controller input is activated via a manual or timer external switch the product divert valves (optional) will be activated to allow the product water to flow to drain. When the external switch is in the auto position the product divert valves (optional) will automatically divert to drain on the following conditions:

- In **"STANDBY"**/**"FLUSH"** and **"STOP"** mode.
- In **"RUN"** mode only if product quality is greater then the programmable set point.
- In all alarm conditions.

4.4.6.2 Remote Alarm Panel (Option)

A Remote Alarm Panel can be mounted in a different location (control room/ nurses station) to provide the operator with a LED indication of the system operation. The display indicates the following:

- Power (Green Light)
- Power Quality (Red Light)
- Low Pressure (Red Light)
- Pump Overload/High Temperature (Red Light)
- Alarm Silence (Black Push Button) (Re-alarm <2 min. if alarm still present)

4.4.6.3 RS-232 Remote PC Interface & Software (Option)

A RS-232 output card and software can be installed to communicate to a PC (Maximum 1,000'). The PC will display graphically real time information on the system operation. The PC monitor will indicate the following:

- Operation Mode
- Quality Reading
- Tank State
- Alarms

4.4.7 Monitoring Information on the Display

In all three modes of operation, it is possible to monitor pertinent information in real time on the screen. The different topics are displayed on the keypad. Depending on what mode the system is running, all topics or only a few will be enabled. Only pertinent information is available in each mode. For instance, it will be impossible to monitor the % rejection in **FLUSH** mode.

Some keys have two topics on the same button. If both of them are available in the active mode, it is possible to switch between them just by pushing on the button. If you push once, the first topic appears on screen, pushing once again gives you the second topic, and if pushed again, a blank space appears and no information is displayed.

The following shows the different monitoring parameters accessible by pressing corresponding keys:

4.4.7.1 Tank Level

When the system feeds a tank the display will indicate the level (LOW, INTERMEDIATE and HIGH).

4.4.7.2 Temperature

Feed and Product water temperature can be displayed. By pressing the key the second time, the temperature reading will switch between the feed and product water.

4.4.7.3 % Rejection

The product % rejection will be displayed. This will tell the user the condition of the membranes.

4.4.7.4 Pump Time

This will display the pump operational timer (Max. 32000 hrs). It gives the user an indication of the pump operation and if any maintenance is required.

4.4.7.5 Conductivity/Resistivity

This will display the feed and product water conductivity or resistivity.

4.4.7.6 Flush Time

This will display the status of the flush process. “FLUSH IN” indicates the time remaining before the next flush and “REMAINING” indicates the amount of time remaining when flushing.

4.4.8 Setup Parameters

To alter the setup data it is necessary to be in **“STOP”** mode. The screen message **“SYSTEM STOPPED”** will be on the display. If the system is not in this mode you will have to press the **“STOP”** or “**OK”** key to reach it.

NOTE: It is recommended that all the set-up data that the user enters is recorded for reference and troubleshooting. Refer to page 39 for a reference table that can be copied and filled in.

4.4.8.1 SETUP Menu

Screen Description: **SET-UP MAIN MENU**

Access: SETUP

Item	Options	Selection
1>	Clean Mode	
2>	Customize	
3>	Alarms	
		<OK>

NOTE: The system must be in the STOP mode to modify the set-up parameters. The screen message "SYSTEM STOPPED" is displayed when the STOP mode is activated.

CLEAN MODE
Use this mode when the system requires a cleaning, sanitization or preservative for the membranes during a shutdown.

When this function is activated the inlet valve remains closed and the cleaning/disinfectant solution is fed (drawn) into the pump (ROP). It is recirculated through the membranes and back to the cleaning tank. The reject solenoid (RS) remains open. The remote standby signal (RS-B) and low pressure alarms are disabled in this function. To exit this function, press the **"STOP"** key.

CAUTION: This function should only be used when the RO pump(s) is less than 5 horse power (hp). Damage to the system and pump can occur. System with greater than 5.0 hp, should use a separate cleaning pump (Clean-In-Place System) when a cleaning or sanitization is required.

CUSTOMIZE
Select this option to enter the sub menu for setting system parameters for flush operation, units of display and feeding of product water.

ALARMS
Select this option to enter the sub menu for setting the system alarm set-points.

4.4.8.2 CLEAN Mode

This mode is only to be used when the system requires a cleaning, sanitization or to preserve the membranes during a shutdown.

When this function is entered the inlet valve remains closed and the solution is fed (drawn) into the pump (ROP). It is re-circulated through the membranes and back to the cleaning tank (The reject solenoid (RS) is also open). The remote standby signal (RS-B) and low pressure alarms are disabled in this function. To exit this function, press the **"STOP"** key.

4.4.8.2.1 CLEAN Mode Initialization

The following will provide you with the necessary instruction to place the controller in **CLEAN** Mode. Refer to the MAINTENANCE section of this manual for more detailed information on using the clean function.

1. Press the **"STOP"** key. The display should read **"SYSTEM STOPPED**".
2. Follow the cleaning setup procedure in the MAINTENANCE section of this manual
3. Press the **"SETUP"** key and then the **# "2"** key. The following screen will appear.

4.4.8.3 Clean Menu

Screen Description: **CLEAN MENU**	
Access from Main Menu: SETUP → 1 RUN	
READ INSTRUCTION MANUAL BEFORE DOING THIS COMMAND <OK> <CANCEL>	First, follow the cleaning/sanitization procedure in SECTION 4.4.4 and 4.4.5 for set-up. Press the OK key to start the cleaning/sanitization process or the CANCEL key to return to the set-up main menu. After the cleaning/sanitization process is completed, press the STOP key to end.

4. Press the **"OK"** key to start the cleaning process or **"CANCEL"** to return to Setup Menu #1.
5. After the cleaning process is complete press the **"STOP"** key to end.

4.4.9 Customize Menu

In this menu the user has the option of changing certain settings to suit their needs. Three different setup menus are available. To change between them press the **"SETUP"** key as indicated in the bottom left corner of the screen. Described below is the function of each menu option that can be accessed.

4.4.9.1 Customize menu #1

Screen Description: **CUSTOMIZE MENU #1**

Access from Main Menu: 

Item	Option	Selection
1>	Direct Feed:	NO (Default)
2>	Flush-> Run Mode:	YES (Default)
3>	Flush w/o Pump	NO (Default)
<SETUP=next>		<OK>

DIRECT FEED:
This option is provided to feed product water to a storage tank or directly to the point of use. When this option is changed to **YES** the system is set to operate in direct feed mode. A jumper (switch or 7 day timer) must be installed between terminals 36 & 37 directly on the circuit board terminals. When the contact closes the system will operate and never flush. When the contact is open the system will go into the STANDBY mode and perform its programmed flush cycle. In the default **NO** selection is made, the system will run until the water in the holding tank reaches high level. At this point the system will stop and wait until the water in the tank drops to the intermediate level and then restart. The system will automatically flush at a programmable cycle weather it is in tank full or standby mode.

FLUSH → RUN MODE:
When this option is changed to **NO**, the system will not flush at any time while in the RUN mode. In the default **YES** selection the system will flush at a programmed cycle.

FLUSH w/o PUMP:
When this option is changed to **YES**, the system will flush without the pump. In the default selection **NO,** the system will flush with the pump running.

4.4.9.2 Direct Feed

When this option is changed to **YES** the system is set to operate in direct feed. A jumper (switch or 7 day timer) must be installed between terminals 36 and 37 directly on the circuit board terminals. When the contact closes the system will operate and never flush. When the contact is open the system will go into **STANDBY** mode and perform its programmed flush cycle. In the default position **NO** the system will run

until the water in the holding tank reaches high level. At this point the system will stop and wait until the water in the tank drops to the intermediate level, then restarts. The system will automatically flush (programmable cycle) whether it is in tank full or standby.

4.4.9.3 FLUSH-> RUN Mode

When this option is changed to **NO**, the system will not flush at any time while in **RUN** mode. In the default position the system will flush at the programmed cycle.

4.4.9.4 Flush w/o Pump

When this option is changed to **YES**, the system will flush without the pump. In the default position **NO** the system will flush with the pump running.

4.4.9.5 Customize menu #2

Screen Description: **CUSTOMIZE MENU #2**

Access from Main Menu: 

Item	Option	Selection
1>	Ω Resistivity or S Conductivity	Ω (Default)
2>	Temp. comp	NO (Default)
3>	Flush At Start	YES (Default)
<SETUP=next>		<OK>

RESISTIVITY / CONDUCTIVITY:
Provides an option to select the display for water quality in terms of electrical resistivity or conductivity.
When this option is changed to **S** the feed and product water quality is measured in conductivity and the unit display is shown in µS beside the value. In the default selection, the feed and product water is measured in resistivity and the unit display is shown in **Ω** beside the value.

TEMPERATURE COMPENSATE:
When the option is changed to **YES,** the feed and product water will be displayed with a temperature compensated value. In the default position **NO,** the feed and product water will be displayed without temperature compensation.

NOTE: The optional sanitary product conductivity has a 0.1 cell constant. The reading displayed is a non-temperature compensated and cannot be changed. The jumper settings on the product are factory preset and cannot be changed.

FLUSH AT START:
When this option is changed to **NO**, the system will not flush at system start-up. In the default selection **YES,** the system will flush every time it will start.

4.4.9.5.1 Ω Resistivity or S Conductivity

When this option is changed to **S** the feed and product water is measured as conductivity and the screen will have a µS beside the value. In the default position the feed and product water is measured as resistivity and the screen will have a **Ω** beside the value.

4.4.9.6 Temp. Comp

When the option is changed to **YES** the feed and product water will be displayed as a temperature compensated value. In the default position **NO** the feed and product water will be displayed as a non-temperature compensated value.

NOTE: The optional sanitary product conductivity has a 0.1 cell constant. The reading displayed is non-temperature compensated and cannot be changed. The jumper settings on the product are factory preset and cannot be changed.

4.4.9.7 Flush at Start

When this option is changed to **NO**, the system will not start with a flush. In the default position **YES** the system will go into a flush every time it starts.

4.4.9.8 Customize menu #3

Screen Description: **CUSTOMIZE MENU #3**

Access from Main Menu: SETUP → 2 FLUSH → SETUP → SETUP

Item	Option	Selection
1>	Temperature in °C or °F	°C (Default)
2>	Clear ROP Timer	NO (Default)
3>	Flush Delays	Sub-Menu's
<SETUP=First>		<OK>

TEMPERATURE IN °C or °F:
Displays water temperature in select unit.

CLEAR RO PUMP TIMER:
When the option is changed to **YES,** the pump timer will be reset to 00000. The option will automatically default back to **NO**.

FLUSH DELAYS:
Choose this option to enter a sub menu for setting flush duration time and flush frequency, time between each flush cycle.

4.4.9.9 Temperature in °C or °F

When this option is changed to **°F** the feed and product temperature will be displayed in the selected temperature units. In the default position the feed and product temperature will be displayed in **°C**. The adjustable feed water high temperature set-point menu will also change temperature units.

4.4.9.10 Clear pump timer

When the option is changed to **YES** the pump timer will be reset to 00000. The option will automatically default back to **NO**.

4.4.9.11 Flush Delays

When this option is selected the following screen will appear:

Screen Description: **CUSTOMIZE MENU #3 – Item #3 Sub-Menu**

Access from Main Menu: 

Flush Period 9? (1, 60) X 10s <CANCEL> <OK>	**FLUSH PERIOD:** Enter the flush duration time in seconds. The processor will multiply the number entered by 10. This means if the number 9 is entered, the system will flush for 90 seconds. Press OK to go to next to the Flush Cycle screen.
Flush Cycle 60? (30,120)nm (period included) <CANCEL> <OK>	**FLUSH CYCLE:** Enter the time between the flush cycles in minutes. **NOTE: The flush cycle time is calculated according to the current flush period.**

The processor will multiply the number entered by 10. This means if the number 9 is entered the system will Flush for 90 seconds.

The number that is entered indicates the time in minutes between Flush cycles.

NOTE: The flush cycle is calculated according to the current flush period.

4.4.9.12 Changing the Customize Setting

The following will provide the steps required to change the customize menu settings as described in the previous pages.

1. Press the **"STOP"** key. The display will read, **"SYSTEM STOPPED**".
2. Press the **"SETUP"** key and then the desired menu.
3. Press the desired number key to change the setting. If **<Cancel>** appears in the bottom left corner it can be pressed to escape that menu.
4. Press the **<SETUP=next>** to go to next menu or press **"OK"** to return to main display.
5. If **<SETUP=first>** appears in the bottom left corner it can be pressed to return you to the first menu.
6. Once your selections are made press **"OK"** until the **"SYSTEM STOPPED"** screen appears. At this point the system can be started.

4.4.10 Alarms

In this menu the user has the following options available to change.

4.4.10.1 Alarm menu #1

Screen Description: **ALARM MENU #1**

Access from Main Menu: SETUP → 3 STDBY

Item	Option	Selection
1>	Alarm->Stop:	YES (Default)
2>	Alarm->Stop->Restart	1 retry (Default) retry every 010m (Default)
3>	Poor Quality Delay	Sub Menu
<SETUP=next>		<OK>

ALARM → STOP:
Select the option to shut-down the system when an alarm occurs. When **NO** selection is made, the system will not stop when an alarm condition is detected.

ALARM → STOP → RESTART:
Select this option to set the number of retries and the time between each retries. (See ALARM MENU #1 – Item #2 Sub-Menu screens)

POOR QUALITY DELAY
Select this option to enter desired time delay before the system shut-down when a poor quality alarm occurs. (See ALARM MENU #1 – Item #3 Sub-Menu screens)

4.4.10.2 Alarm->Stop

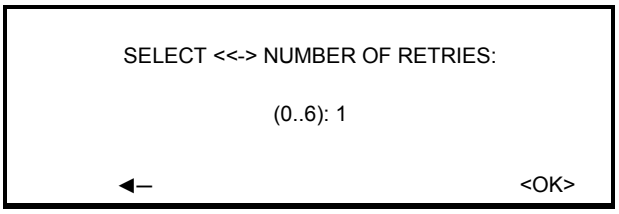
When this option is changed to **NO** the system will not stop when an alarm condition occurs. The alarm will only be displayed on the screen. In the default position **YES** the system will shut down if an alarm occurs.

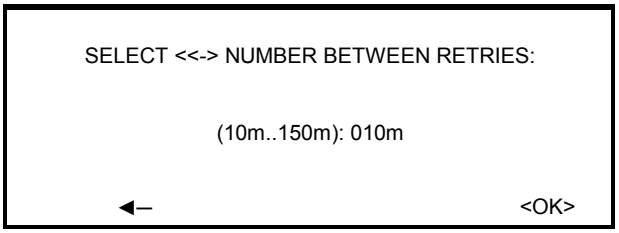
4.4.10.3 Alarm->Stop->Restart

When this option is selected the following screen will appear:

Screen Description: **ALARM MENU #1 – Item #2 (Alarm→Stop→Restart) Sub-Menu**

Access from Main Menu: 





NUMBER OF RETRIES:
Enter the number of retries (0-6) the system will perform before shut-down using the arrow key.

Press the OK key to go to the next set-up screen.

NUMBER BETWEEN RETRIES:
Enter the desire amount of time (10, 20, 40, 90 or 150 minutes) between retries using the arrow key and press the OK key to return to the Alarm Menu #1 screen.

NOTE: This function is only available on a low pressure alarm. The system considers a successful restart when no alarm condition has occurred in 11 minutes from an automatic restart.

The user will enter the desired number of retries (0-6) the system will perform using the arrow key. After the selection is made the user is to press **"OK"** and the next screen will appear.

The user will now enter the desired amount of time (10,20,40,90 or 150 minutes) between retries using the arrow key and then press **"OK"** to return to the alarm menu.

NOTE: This function is only available on a low pressure alarm. The system considers a successful restart, when no alarm conditions have occurred in 11 minutes since an automatic restart.

4.4.10.4 Poor Quality Delay

When this option is selected the following screen will appear:

Screen Description: **ALARM MENU #1 – Item #3 (Poor Quality Delay) Sub-Menu**	
Access from Main Menu: 	
Poor Quality Delay 120? (4,240) s <CANCEL> <OK>	**POOR QUALITY DELAY:** Enter the desired time delay in seconds before the system shut-down when a poor water quality alarm occurs. Press the CANCEL key if this menu has been mistakenly accessed or press the OK key to return to the Alarm Menu #1 screen. **NOTE: When the system starts or restarts with ROP pump ON, an 8 minute and 30 second delay is activated. This allows the system to flush and bring up the quality after long shutdown periods. The system will still indicate a poor quality alarm and the product will be diverted to drain if it is installed. Once the delay has elapsed, the poor quality shutdown delay will become the default.**

The user can enter the desired time delay before the system will shut down (Stop) when a poor quality alarm has occurred. Press the **"CANCEL"** key if this menu has inadvertently been accessed or press **"OK"** to return to the alarm menu.

NOTE: When the system starts or restarts (RO Pump ON) an 8 minute and 30 second delay will activate. This allows the system to flush up to quality during long shutdown periods. The system will still indicate a poor quality alarm and the product will divert to drain if they are installed. Once the delay has elapsed the poor quality shutdown delay will become the default.

4.4.10.5 Alarm menu #2

Screen Description: **ALARM MENU #2**

Access from Main Menu: 

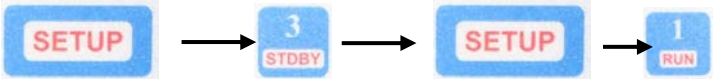
Item	Option	Selection
1>	Feed Temp. SetPt	Sub Menu
2>	Poor Quality SetPt	Sub Menu
<SETUP=first>		<OK>

FEED TEMPERATURE SET-POINT:
Select the option to shut-down the system when an alarm occurs. When **NO** selection is made, the system will not stop when an alarm condition is detected.

ALARM → STOP → RESTART:
Select this option to set the number of retries and the time between each retries. (See ALARM MENU #1 – Item #2 Sub-Menu screens)

POOR QUALITY DELAY
Select this option to enter desired time delay before the system shut-down when a poor quality alarm occurs. (See ALARM MENU #1 – Item #3 Sub-Menu screens)

Screen Description: **ALARM MENU #2 – Item #1 (Feed Temp. SetPt) Sub-Menu**

Access from Main Menu: 

Feed Temp. SetPt

35? (30, 50) °C Or 95? (86,122) °F

<CANCEL> <OK>

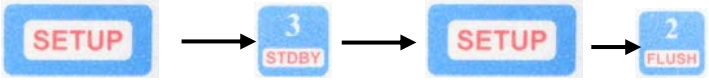
FEED TEMPERATURE SET-POINT:
Enter the desired set-point for feed water alarm temperature. When the system reaches this set-point, it will alarm and shut-down (stop). Press the CANCEL key if this menu has been mistakenly accessed or press the OK key to return to the Alarm Menu #2 screen.

NOTE: The processor uses temperature in °C to calculate the conductivity and resistivity measurements. When temperature unit is set in °F, rounding error may occur.

The user can enter the desired feed water alarm temperature that will shut down (Stop) and alarm when that temperature is reached. The **"CANCEL"** key can be pressed if this menu has inadvertently been accessed or press **"OK"** to return to the alarm menu.

4.4.10.6 Conductivity or Resistivity Set-Point

When this option is selected the following screen will appear:

Screen Description: **ALARM MENU #2 – Item #2 (Poor Quality SetPt) Sub-Menu**	
Access from Main Menu: 	
Conductivity or Resistivity. SetPt 2? (1,100) µS Or 50? (1,100) x 10 K Ω <CANCEL> <OK>	**CONDUCTIVITY or RESISTIVITY SET-POINT:** Enter the desired set-point for product water quality alarm. This will trigger a poor quality alarm, divert the product water to drain, if installed, and shut-down the system after programmed time delay. Press the CANCEL key if this menu has been mistakenly accessed or press the OK key to return to the Alarm Menu #2 screen.

The user can enter the desired product water alarm set-point that will trigger a poor quality alarm, divert the product to drain (if installed) and shut-down the system after the programmable time delay. The **"CANCEL"** key can be pressed if this menu has inadvertently been accessed or press **"OK"** to return to the alarm menu.

4.4.10.7 Changing Alarm Settings

The following will provide the steps required to change the settings as described in the previous page.

1. Press the **"STOP"** key. The display will read, **"SYSTEM STOPPED**".
2. Press the **"SETUP"** key and then the desired menu.
3. Press the desired number key to change the setting. If **<Cancel>** appears in the bottom left corner it can be pressed to escape that menu.
4. Press the **<SETUP=next>** to go to the next menu or press **"OK"** to return to main display.
5. If **<SETUP=first>** appears in the bottom left corner it can be pressed to return to the first menu.
6. Once your selections are made press **"OK"** until the **"SYSTEM STOPPED"** screen appears. At this point the system can be started.

4.5 Set-Up Reference Table

The following table lists the factory settings for the set-up parameters. Record all the set-up data at the system start-up and every time a value is modified. Keep these log sheets for future reference.

Screen Name	Parameter Name	Factory Default	Customer Setting
Customize			
Menu #1	Direct Feed		
Menu #1	Flush → Run Mode	Yes	
Menu #1	Flush w/o Pump	No	
Menu #2	Ω or S	Ω	
Menu #2	Temp. Comp.	Yes	
Menu #2	Flush At Start	Yes	
Menu #3	Temperature	°C	

Screen Name	Parameter Name	Factory Default	Customer Setting
Menu #3	ROP Timer	0	
Menu #3	Flush Delay		
Menu #3 – Item #3 Sub-Menu	• Flush Period	90 s	
Menu #3 – Item #3 Sub-Menu	• Flush Cycle	60 min.	
Alarm			
Menu #1	Alarm → Stop	Yes	
Menu #1	Alarm → Stop → Restart	1,10 min.	
Menu #1	Poor Quality Shutdown Delay	120 s	
Menu #2	Feed Temperature Set-Point	35°C or 95°F	
Menu #2	Poor Quality Set-point		
Menu #2 – Item #2 Sub-Menu	• Conductivity	2 µS	
Menu #2 – Item #2 Sub-Menu	• Resistivity	500K Ω	

5.0 START-UP

5.1 PRE-START-UP VERIFICATION

After the system has been installed the following items are to be checked before commissioning of the system is to begin:

- Feed water supply is connected and verified
- Electrical supply is connected and verified
- Interconnect piping including drains are complete and verified
- All water piping lines pressure are tested and flushed to remove debris
- Pretreatment devices are installed and a functional test performed
- Post treatment devices are installed and a functional test performed
- Pre-filter cartridges are installed
- All appropriate valves are open on system
- Feed water tests are performed
- All tank accessories are installed and ready to receive water

Refer to the individual manufacturers component manuals for additional start-up procedures.

WARNING: Use proper safety procedures when working in the electrical panel. Disconnect and/or lock out power supply to system and tag it out. The system must be properly grounded to prevent personal injury or damage to the system.

NOTE: A pressure test of the piping, connections and tanks must be performed before starting the system.

WARNING: A complete sanitization is required on the reverse osmosis system prior to use. This will assure that the system is operating and producing product water that meets and exceeds the standards. Refer to the MAINTENANCE section in this manual for sanitization instructions.

5.2 CONTROL PANEL/MICROPROCESSOR START-UP PROCEDURE

The follow procedure will assist the user in the commissioning of the main control panel and microprocessor.

NOTE: Due to site conditions some of the procedures might have to be altered.

1. Check that the Ground Fault Interrupt (G.F.I.) receptacle is wired and installed correctly.
2. Check that the proper voltage is connected and verified.
3. Check that all input and output devices in panel are hooked up properly and verified.
4. Plug the electrical cord into the receptacle.
5. Allow the panel view to initialize.
6. Enter the desired set-up parameters in the microprocessor controller.

WARNING: Use proper safety procedures when working in the electrical panel. Disconnect and/or lock out power supply to system and tag it out. The system must be properly grounded to prevent personal injury or damage to the system.

5.3 TANK FEED REVERSE OSMOSIS SYSTEM START-UP PROCEDURE

1. Divert the product line to drain.

NOTE: The flexible hose that is to be used must be the same size or larger than the line (valve) that it is being hooked up to.

2. Fully open the reject and recycle needle valve.
3. Verify and adjust if necessary if the feed water pressure is between 25 and 60 psi. Water must be flowing to drain to perform this adjustment.
4. Set the water tempering device output to 25ºC (if applicable). Water must be flowing to drain to perform this adjustment.
5. Slowly allow feed water in to the system pre-filter.
6. Place the controller in **RUN** mode. The inlet valve will open and after a five second delay the pump will start. The system will enter **FLUSH** mode for 90 seconds. Allow the flush cycle to finish.

NOTE: The RO will not flush if it has been disabled in the controller set-up menu.

7. Adjust the reject flow control needle valve to the flow in SECTIONS 6.4. Flow rates are based on the feed water temperature on the system.
8. Adjust the reject recycle flow control needle valve to the flow in SECTIONS 6.4. Flow rates are based on the feed water temperature on the system.

NOTE: Flow adjustment should be made slowly.
NOTE: System not using a water softener must be set to operate at 50% recovery.

CAUTION: Never fully close the reject and reject recycle flow control needle valves when the system is in operation. Damage to the system can occur.

NOTE: The flow rates in steps 7-8 are to be verified and adjustment will be required until the system has stabilized. A +25 / - 15% in product flow can occur during the first 1-3 months of operation. Refer to SECTIONS 6.1 - 6.5 for the membrane operating parameters and performance notes.

9. Allow the system to operate to drain for 2 hours (4 hours for dialysis application) and record and verify the system parameters are within the desired limits.
10. Once the time has elapsed and the system parameters are met turn the controller to **OFF** mode. Connect the product line to the process tank.
11. Place the system back to **RUN** mode.

CAUTION: Once the system is in operation a daily (per shift) log sheet is required to be filled out to validate the warranty. Flow and pressure adjustment will also be required during this time. Refer to the MAINTENANCE section of this manual for

more details.

5.4 DIRECT FEED REVERSE OSMOSIS SYSTEM START-UP PROCEDURE

1. Divert the product line to drain.

NOTE: The flexible hose that is to be used must be the same size or larger than the line (valve) that it is being hooked up to.

2. Fully open the reject and recycle needle valve.
3. Verify and adjust if necessary if the feed water pressure is between 25 and 60 psi. Water must be flowing to drain to perform this adjustment.
4. Set the water tempering device output to 25ºC (if applicable). Water must be flowing to drain to perform this adjustment.
5. Slowly allow feed water in to the system pre-filter.
6. Set the controller for Direct Feed: Yes and the Flush → Run Mode: No. Refer to section 4.4.9 for instructions.
7. Place the controller in **RUN** mode. The inlet valve will open and after a five second delay the pump will start. The system will enter **FLUSH** mode for 90 seconds. Allow the flush cycle to finish.

NOTE: The RO will not flush if it has been disabled in the controller set-up menu.

8. Adjust the reject flow control needle valve to the flow in SECTIONS 6.4. Flow rates are based on the feed water temperature on the system.
9. Adjust the reject recycle flow control needle valve to the flow in SECTIONS 6.4. Flow rates are based on the feed water temperature on the system.

NOTE: Flow adjustment should be made slowly.

NOTE: System not using a water softener must be set to operate at 50% recovery.

CAUTION: Never fully close the reject and reject recycle flow control needle valves when the system is in operation. Damage to the system can occur.

NOTE: The flow rates in steps 7-8 are to be verified and adjustment will be required until the system has stabilized. A +25 / - 15% in product flow can occur during the first 1-3 months of operation. Refer to SECTIONS 6.1 - 6.5 for the membrane operating parameters and performance notes.

10. Set the second pressure regulator between 25 and 35 psi. Water must be flowing to drain to perform adjustments.
11. Allow the system to operate to drain for 2 hours (4 hours for dialysis application) and record and verify the system parameters are within the desired limits.
12. Once the time has elapsed and the system parameters are met turn the controller to **OFF** mode. Connect the product line to the loop feed.

13. Place the system back to **RUN** mode.

CAUTION: Once the system is in operation a daily (per shift) log sheet is required to be filled out to validate the warranty. Flow and pressure adjustment will also be required during this time. Refer to the MAINTENANCE section of this manual for more details.

NOTE: When the system is operating in direct feed and there and no or little water is being drawn off from the loop you will notice a decrease in product flow due to back pressure in the loop. As water is being drawn off the loop, the system will produce more product water as the loop pressure decreases.

CAUTION: Do not make flow adjust to increase the product flow when in direct feed. Flow adjustments are to be made when product water is diverted to drain.

6.0 OPERATION

6.1 MEMBRANE OPERATING PARAMETERS

Variables	Service	Units	Min.	Max
Temperature	Feed Inlet	°C	2	35(1)
Chlorine	Feed Inlet	ppm	0.0	0.0
Optimum pH	Feed Inlet		7.0	7.5
Operating pH	Feed Inlet		4.0	11.0
Cleaning pH	Feed Inlet		2.0	11.5
Free Chlorine	Feed Inlet	ppm	0.0	<0.1
Iron, Manganese	Feed Inlet	ppm	0.0	<0.1
Feed NTU	Feed Inlet		<1.0	
LSI	Reject		<-1.0	
Feed SDI	Feed Inlet		<3.0	
Typical Operating Pressure	Pump Outlet	psig	100	200 (2)
Membrane Pressure Drop	Pump Outlet To Reject	psig	5	13(3)
Design Product (Flux) Flow Rate	Product Outlet	gpd	1050 per membrane	
Product (Flux) Flow Rate Variation	Product Outlet	%	-15	+25
Rejection	Inlet To Product	%	Avg. 99.0 / Min. 98.0	

Notes:

(1) Actual membrane maximum temperature is 50°C. System alarm set-point 35°C.

(2) Actual membrane maximum pressure 400psig. System components maximum pressure 220 psig.

(3) Maximum pressure drop includes piping and is shown per membrane.

6.2 EFFECTS OF PRESSURE ON PERFORMANCE

The operating pressure of the system also affects the product flow rate. The amount of permeate produced is directly proportional to the pressure difference between the feed and product sides of the RO membrane. This pressure difference is known as the Trans-Membrane Pressure (TMP) and can be calculated as:

TMP = Feed Pressure - Product Pressure

If the product from the RO system feeds directly to a loop or downstream equipment such as Electrical Deionization or ion exchange polishing, there may be significant product pressure that decreases the TMP. The product flow rate given for each system is based on the TMP. It may be necessary to increase the feed pressure to get sufficient TMP if the product pressure exceeds 15 psi (1 bar).

CAUTION: Never exceed a trans-membrane pressure of 220 psi (15 bars) for Thin Film Composite (TFC) cartridges.

CAUTION: Trans-membrane pressure should be reduced if the feed water temperature is greater than 25°C, to avoid exceeding the design flow rate.

6.3 EFFECTS OF RECOVERY ON PERFORMANCE

The recovery of RO systems is defined as the percent of the feed water (including reject recycle) that becomes purified product water. The recovery is calculated by:

$$\%\ \text{Array Recovery} = \left[\frac{\text{Product}}{\text{Product + Reject + Reject Recycle}}\right] \times 100$$

$$\%\ \text{System Recovery} = \left[\frac{\text{Product}}{\text{Product + Reject}}\right] \times 100$$

The design recoveries of the RO systems are given in the chart on the following page. The percent salt rejection and rate of membrane fouling can be affected by the array recovery and system recovery. At higher recoveries, the reject flow rate through the system is reduced. This results in an increase in the concentration of dissolved solids at the membrane surface, and a decrease in the ability of the reject stream to flush suspended materials from the system.

$$\text{Recycle Flow} = \left[\frac{\text{Product}}{\%\ \text{Array Recovery}}\right] \text{-Product-Reject}$$

# of Membranes In Series	1	2	3	4
Delta P. - psig (kPa)	10 (69)	20 (138)	30 (207)	38 (262)
Maximum Recovery Percentage	15%	25%	35%	45%

CAUTION: Recoveries are listed above without recirculation, with the optional recirculation valve closed. Exceeding these recoveries will result in short membrane life. This will invalidate the normal 1-year warranty.

NOTE: After setting the proper recovery (above) you can then open the recirculation valve to increase the "system" recovery up to 75% provided the feed water is still within specification (sample at reject).

6.4 ADJUSTING FLOWS, PRESSURE AND RECOVERY

The reject and reject recycle flow control valves are used to adjust the flow rates and recovery on the system.

Periodic flow adjustment will be required as the membrane cartridges age and as the feed water changes (ex. temperature).

CAUTION: Do not exceed the design recovery as this can result in decreased salt rejection and membrane fouling or scaling.

CAUTION: Never completely close the reject and reject recycle valves.

2200M 75% System Recovery / 30% Array Recovery						**2200M 50% System Recovery / 30% Array Recovery**					
°C	°F	Pro FL	Rej FL	Rec FL		°C	°F	Pro FL	Rej FL	Rec FL	
25.0	77.0	1.5	0.5	3.0	gpm	25.0	77.0	1.5	1.5	2.0	gpm
24.0	75.2	1.5	0.5	2.9	gpm	24.0	75.2	1.5	1.5	1.9	gpm
23.0	73.4	1.4	0.5	2.8	gpm	23.0	73.4	1.4	1.4	1.9	gpm
22.0	71.6	1.4	0.5	2.7	gpm	22.0	71.6	1.4	1.4	1.8	gpm
21.0	69.8	1.3	0.4	2.6	gpm	21.0	69.8	1.3	1.3	1.8	gpm
20.0	68.0	1.3	0.4	2.6	gpm	20.0	68.0	1.3	1.3	1.7	gpm
19.0	66.2	1.2	0.4	2.5	gpm	19.0	66.2	1.2	1.2	1.6	gpm
18.0	64.4	1.2	0.4	2.4	gpm	18.0	64.4	1.2	1.2	1.6	gpm
17.0	62.6	1.1	0.4	2.3	gpm	17.0	62.6	1.1	1.1	1.5	gpm
16.0	60.8	1.1	0.4	2.2	gpm	16.0	60.8	1.1	1.1	1.5	gpm
15.0	59.0	1.1	0.4	2.1	gpm	15.0	59.0	1.1	1.1	1.4	gpm
14.0	57.2	1.0	0.3	2.0	gpm	14.0	57.2	1.0	1.0	1.3	gpm
13.0	55.4	1.0	0.3	1.9	gpm	13.0	55.4	1.0	1.0	1.3	gpm
12.0	53.6	0.9	0.3	1.8	gpm	12.0	53.6	0.9	0.9	1.2	gpm
11.0	51.8	0.9	0.3	1.7	gpm	11.0	51.8	0.9	0.9	1.2	gpm
10.0	50.0	0.8	0.3	1.7	gpm	10.0	50.0	0.8	0.8	1.1	gpm
9.0	48.2	0.8	0.3	1.6	gpm	9.0	48.2	0.8	0.8	1.0	gpm
8.0	46.4	0.7	0.2	1.5	gpm	8.0	46.4	0.7	0.7	1.0	gpm
7.0	44.6	0.7	0.2	1.4	gpm	7.0	44.6	0.7	0.7	0.9	gpm
6.0	42.8	0.6	0.2	1.3	gpm	6.0	42.8	0.6	0.6	0.9	gpm
5.0	41.0	0.6	0.2	1.2	gpm	5.0	41.0	0.6	0.6	0.8	gpm
4.0	39.2	0.6	0.2	1.1	gpm	4.0	39.2	0.6	0.6	0.7	gpm
3.0	37.4	0.5	0.2	1.0	gpm	3.0	37.4	0.5	0.5	0.7	gpm
2.0	35.6	0.5	0.2	0.9	gpm	2.0	35.6	0.5	0.5	0.6	gpm
1.0	33.8	0.4	0.1	0.8	gpm	1.0	33.8	0.4	0.4	0.6	gpm

Pro FL: Product Flow Rej FL: Reject Flow Rec FL: Recycle Flow

6.5 EFFECTS OF TEMPERATURE ON PERFORMANCE

The product flow rate for the RO system given is based on a feed water temperature of 25°C. The product flow rate will be reduced at temperatures below 25°C as the viscosity of the water increases, making it more difficult to force water through the reverse osmosis membrane.

CAUTION: At temperatures higher than 25°C, the operating pressure should be reduced to maintain the design flow rate. Operating at a higher product flow will invalidate the RO membrane warranty.

If the temperature is not 25°C, a correction factor must be used to calculate the expected product flow rate from the system. The table below gives temperature correction factors to be applied for feed temperatures other than 25°C.

Temperature correction factors are listed for all **Reverse Osmosis** elements. The reference temperature is 77°F (25°C).	
Temperature F ° (C °)	**RO**
40 (4)	0.48
50 (10)	0.60
60 (16)	0.73
70 (21)	0.88
77 (25)	1.00
80 (27)	1.06
90 (32)	1.26

7.0 MAINTENANCE

7.1 MAINTENANCE REQUIREMENTS

After the system has been commissioned, it will require scheduled maintenance on a daily, weekly, and monthly basis. Regular maintenance is necessary:

- to ensure operating efficiency
- to ensure maximum membrane life
- to ensure warranty protection

The prescribed maintenance program ensures that the feed water meets the system specifications despite seasonal and unexpected changes in the feed water quality.

The system requires maintenance such as cartridge replacement, cleaning, and sanitization of the system and accessory storage tanks. **Feed water quality** must be monitored and recorded on a **daily basis** to ensure that it remains within the specified parameters. When replacing cartridges, inspect the O-rings for signs of deterioration or cracking; replace as required.

The performance of the system and the quality of feed and permeate water **must** be monitored and recorded in a log book. Refer to next page for a sample log sheet.

WARNING: Each component on the system has its own maintenance requirements. Refer to the individual component manuals for instructions.

NOTE: The sample log sheet provided is only a guide and may not contain all the monitoring points that are required for warranty of some of the manufactured components. Please refer to the individual component manufacturer's manual for details on other monitoring requirements. The limits are based on computer projections and calculations. They may not reflect actual readings when the system is in operation.

Sample Log Sheets Notes:

1) A +25 / -15% in product flow can occur during the first 1-3 months of operation. The array and total system recovery must be maintained to prevent premature fouling of the membrane elements.
2) Refer to the computer performance projection provided for limits.

NOTE: It is recommended that the system should be disinfected using Minnclean® and Minncare® products at least monthly and more often as required.

SAMPLE LOG SHEET

All readings and test are to be performed when system is in operation.
Feed water must meet or exceed the National Drinking Water Regulations for potable water including the following listed in this table **to validate the warranty:**

Parameter	Test D/W	Units	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Date		D/M/Y							
Time		HH/MM							
Feed Temperature	D	°C							
Feed pH	W								
Feed Total Chlorine	D	ppm							
Feed Iron	W	ppm							
Feed Total Hardness	W	ppm							
Feed Iron, Manganese	W	ppm							
LSI of Reject	W								
Feed SDI	W								
Feed NTU	W								
Pre-Filter Inlet Press	W	psig							
Pre-Filter Outlet Press	D	psig							
Pre-Filter Δ Press	D	psig							
Pump Press	D	psig							
Reject Press	D	psig							
Membrane Δ Press	D	psig							
Product Flow	D	lpm							
Reject Flow	D	lpm							
Recycle Flow	D	lpm							
Feed Recycle Quality	D	uS/cm							
Product Quality	D	uS/cm							
Rejection	D	%							
Array Recovery	D	%							
System Recovery	D	%							

$$\%\ \text{Array Recovery} = \left[\frac{\text{Product}}{\text{Product + Reject + Reject Recycle}}\right] \times 100$$

$$\%\ \text{System Recovery} = \left[\frac{\text{Product}}{\text{Product + Reject}}\right] \times 100$$

$$\%\ \text{Rejection} = \left[\frac{\text{Feed – Product}}{\text{Feed}}\right] \times 100$$

NTU (Nephelometric Turbidity Units)
SDI (Silt Density Index)
Press (Pressure)
ΔP (Pressure Differential)

7.2 REVERSE OSMOSIS SANITIZATION CLEANING OVERVIEW

The following procedures will assist in the sanitization and cleaning of the reverse osmosis system.

NOTE: Due to site conditions some of the procedures might have to be altered.

There is no specific frequency for cleaning the Reverse Osmosis system. A cleaning should only be performed when the RO system requires it. A specific cleaning schedule can do more harm than good. Cleaning should only be performed if flow rates and/or quality begin to drop below allowable limits. Cleanings are performed to remove particulate, inorganic scale and organic fouling. Routine sanitization treatment is recommended on the Reverse Osmosis system to control bacteria and remove biological film.

In order to understand the concept of RO membrane cleaning, it is important to know something about membrane fouling. The purpose of this guide is to present basic information about the different types of foulants and how to identify them when they affect RO membrane performance. Also discussed is how to choose the right cleaner and the correct use of available cleaning agents.

There are three major groups of RO membrane foulants: hardness/metal oxides, colloidal/silica, and alum/polymers. These potential problems can exist independently, but can also occur together resulting in a "mixed" fouling. These major groups have been selected for discussion because they represent the most common problems that have been encountered by the operators of industrial RO systems.

The symptoms of RO membrane fouling can range from gradual declines in flux (product) over several months, to severe losses overnight. The ultimate results of membrane fouling can also vary widely, from complete recovery after cleaning, to permanent damage.

The correct cleaning method is essential to a successful cleaning. The cleaning instructions on the following pages will allow selection of the appropriate cleaner based on the types of RO pretreatment being employed and feed water characteristics. While the occasional need for cleaning may arise due to pretreatment equipment failure or a temporary change in feed water composition, persistent or severe fouling should be a cause for re-evaluation of the RO pretreatment.

The following basic discussions are of RO foulants, how to identify them, and what to do once they have affected membrane performance.

7.3 DEALING WITH A HARDNESS/METAL OXIDE FOULING PROBLEM

7.3.1 What are Hardness and Metal Oxides?

Hardness most commonly encountered is in the form of calcium carbonate (CaCO3) and/or calcium sulfate (CaSO4). These compounds are found widely throughout the United States and Canada and occur naturally in groundwater. Metal oxides are the result of soluble substances naturally occurring in groundwater being oxidized prior to, or at the membrane surface. Iron and manganese are examples of commonly found metals that can pose significant fouling problems to an RO element.

7.3.2 The Problem

Membranes become scaled (a term used in cases of hardness fouling) when the hardness minerals become supersaturated and they precipitate out of solution onto the membrane surface. This is caused by pure water being removed from the feed solution at the membrane surface resulting in an increase of the concentration of mineral salts left behind. When the solubility limits are exceeded, precipitation occurs. The severity of the problem is related to hardness levels, pH, water temperature, and recovery efficiency of the RO system. The same type of fouling problem can occur with several types of soluble metals that are forced out of the solution and become deposited on the membrane surface.

7.3.3 Recognizing Hardness Scaling and Metal Oxide Fouling

In general, simple hardness scaling results in a slow decline of flux and the attendant decrease in salt rejection. The decline can take from weeks to months to become apparent. If a combination of scaling and metal oxide fouling occurs, there will be a rapid decrease in flux and salt rejection.

7.3.4 What to do if Hardness/Metal Oxide Fouling is Suspected?

- Check to see if the softener is working properly.
- Find out the levels of hardness and metals in the feed water.
- Clean the RO system before there is a 15-20% decline in flux from normal. Failure to reverse this type of scaling will result in permanent damage to the membranes.
- Generally, the use of solution is recommended. Refer to cleaning instructions.

7.4 DEALING WITH COLLOIDAL/SILICA FOULING PROBLEMS

7.4.3 What Are Colloids? What Is Silica?

Colloids are very fine, suspended solids that can coagulate and become entrapped on the RO membrane surface. Colloids found in feed water usually are of the aluminum silicate group. Colloidal materials including aluminum hydroxide can also be found. Silica that is dissolved (SiO2) is naturally present in most feed waters. It is usually found in concentrations ranging from 1-100 mg/L.

7.4.3 The Problem

During the process of Reverse Osmosis, colloids are destabilized and as the concentration of salts increase, they coagulate and foul the element. The rate of fouling is directly related to the concentration of colloidal material present, and their stability. A test called the SDI (Silt Density Index) is usually used as a measure of colloidal concentration. The stability of colloids in solution is a function of their electrical charge. This stability is often expressed as a measurement of zeta potential. Silica poses a problem when, due to the removal of pure water in the RO process, it becomes more concentrated and can then polymerize to form colloidal silica, or precipitate as a silicate.

7.4.3 Recognizing Mixed Colloidal/Silica Fouling

Fouling due to colloidal/silica material is usually quite slow, with a gradual decline in flux and no real change in salt rejection as the symptoms. In the presence of metal oxides, however, the decline can be more dramatic. If fouling continues untreated, an eventual decrease in salt rejection is common.

7.4.3 What to do if Colloidal/Silica Fouling is Suspected?

- Find out from your water department if the presence of colloidal/silica material is temporary or a standard constituent of your feed water.
- Pretreatment may be required for these foulants. Check to see if the pre-filter is of the right type and working properly. An "absolute" rated filter may be required.
- Consider the addition of an appropriate chemical feed system.
- Reference the cleaning instructions.

7.5 DEALING WITH AN ALUM AND/OR POLYMER FOULING PROBLEM

7.5.1 What Are Alum And Polymers?

Alum and/or polymers are frequently used by municipal water treatment facilities as flocculants to settle out dirt and other suspended matter in water sources. Ideally, all of the added alum/polymer is supposed to be removed in the process, but in actual practice, a small amount of alum/polymer often remains in the water supply. One of the properties of these flocculants that make them effective is that they easily coagulate and come out of solution. Unfortunately, this property can present troublesome conditions for high efficiency RO systems (i.e.-over 33%recovery) or if feed water residual of these substances is high after municipal treatment.

7.5.2 The Problem

When residual alum/polymers are present in the feed water supply to an RO system, a membrane fouling problem may exist. Alum/polymers can coagulate on the membrane surface and slowly clog it, especially in the presence of other constituents such as silica and iron. Unfortunately, water softeners and filters are not effective at removing alum/polymers. The extent of the fouling problem is also related to the pH of the feed water and the recovery efficiency of the RO system. The lower the pH and the lower the recovery, the less alum/polymer complexes will tend to foul the membrane.

7.5.3 Recognizing Alum/Polymer Fouling

The first sign of alum/polymer fouling is a loss of product water flow rate. Unlike most other types of fouling which take a long time to developed, alum/polymer fouling can cause a reduction in product water flow rate in a matter of days. There may be little or no decrease in % rejection performance. The sooner the signs of alum/polymer fouling are recognized, the easier it will be to reverse its effects. Therefore, it is important to check the product water flow rate on a frequent basis.

NOTE: There are other causes for lowered product flow rate such as colder feed water temperature. This should be ruled out as a possible cause before alum/polymer fouling is suspected.

7.5.4 What to do if Alum/Polymer Fouling is Suspected

- If you haven't already, call the water department and ask if alum and/or polymers are used in their treatment.
- Find out the levels of silica and iron (even that imparted by galvanized piping) present in the feed water.
- If the product flow rate decreases from its expected level, refer to the cleaning instructions.
- If the water conditions are such that alum/polymer fouling continues to occur, then periodic cleaning may have to become part of regular maintenance.
- Consider additional methods (e.g. adding a Chem. Feed system, or lowering the recovery) to deal with the fouling.

7.6 MANUFACTURER'S RECOMMENDED CLEANING AND SANITIZATION CHEMICALS

The following cleaners and sanitizers have been evaluated and found to be compatible with the elements. In addition to the generic cleaners listed below, there are many chemical companies that market membrane cleaners. For best results, use factory approved brand anti-scalants, cleaners and sanitizers for your specific elements.

Type of Foulant:	**Cleaner/Sanitizer:**
Mineral scale and metal precipitates:	HCl, or citric acid, pH 2
Organics, silt, bacterial slime:	Sodium hydroxide, 0.5% Sodium dodecyl sulfate, 0.1% Adjust to pH 11.5 with HCl if necessary
Organics, silt, bacterial slime:	Trisodium phosphate, 1% Sodium tripolyphosphate, 1% Sodium dodecyl sulfate, 0.1% Tetrasodium EDTA, 1% Adjust to pH 11.5 with HCl if necessary
Bacteria (Sanitizers):	Sodium bisulfite, 0.1% Chlorine dioxide, 30 ppm

NOTE: It is recommended that the system should be disinfected using Minnclean® and Minncare® products at least monthly and more often as required.

7.7 CLEANING AND SANITIZATION CHEMICAL SOLUTION CONCENTRATION REQUIREMENTS

Listed in the table below are the cleaning and sanitization chemical solution concentration requirements to be used with the Clean In Place (CIP) skid provided.

NOTE: Due to site conditions some of the procedures might have to be altered.

Chemical quantities to be used are to be diluted with 100 litres of RO quality water (10-30°C) or better.

CAUTION: RO quality water or better **must** be used when rinsing and preparing the cleaning and sanitization solutions. Failure to do so will result in damage to the membrane elements.

CAUTION: An RO quality water flush (with CIP system) is required between each cleaning or sanitization step. If not performed, a thermal reaction can occur resulting in damage to the membrane elements.

CAUTION: When performing a cleaning or sanitization you must first do an acid cleaning. This will remove any metal build up on the membrane and prevent the membranes from oxidization. When cleaning the system make sure that you are operating at high flow rates and low pressure. If high pressure is used, contaminants can be further pushed inside the membranes

7.7.1 Foulants and Chemicals:

Type of Foulant:	Chemical Type:
Mineral scale and metal precipitates:	Minnclean® AC Cleaner
Organics, silt, bacterial slime:	Minnclean® TF Cleaner
Bacteria (Sanitizers):	Minncare® Cold Sterilant

7.7.2 Chemical Concentrations:

Chemical Used:	Quantity when diluted in 100 litres of RO quality water or better:
Minnclean® AC Cleaner	1.76 lbs (0.798 kg), pH 2.0 to 2.4
Minnclean® TF Cleaner	1.76 lbs (0.798 pH 11.4 to 11.2
Minncare® Cold Sterilant	0.361 US Gallons (1.40 liters), pH 3.0 to 3.5

7.8 MINNCLEAN® AC CLEANER CHEMICAL OVERVIEW

For use on thin film composite (polyamide) reverse osmosis membrane systems, it is especially formulated to remove mineral scale (calcium carbonate) and metal hydroxides from the membrane surface. Minnclean® AC is an acidic (low pH) membrane cleaner.

7.8.1 Specifications

Compound:	Acidic Powder
Normal Cleaning:	1 pound cleaner per 15 gallons RO water
pH of Solution:	2.0-2.4
Foam Level:	Moderate
Cloud Point:	None
Rinse-ability:	Good
Storage:	Store sealed container in a cool dry place. Indefinite cleaner stability under good storage conditions.

CAUTION: When performing a cleaning or sanitization you must first do an acid cleaning. This will remove any metal build up on the membrane and will prevent the membranes from oxidization. When cleaning the system make sure that you are operating at high flow rates and low pressure. If high pressure is used you might push the contaminants further inside the membranes

WARNING: When performing a cleaning or sanitization it is very important to use the proper safety apparatus. Refer to the Material Safety Data Sheet (MSDS) provided with the sanitant or cleaner before using them.

WARNING: CAUSES EYE AND SKIN IRRITATION, HARMFUL IF SWALLOWED, CONTAINS SULFAMIC ACID. Prevent contact with skin, eyes and avoid contamination of clothing. Do not take internally. Prevent breathing dust. Use approved goggles and rubber gloves when handling. For industrial use only.

In case of contact, flush eyes and skin with plenty of water for at least 15 minutes; for eyes, get medical attention. Contaminated clothing should be removed immediately and washed before reuse. If taken internally and person can swallow, give one glass of water or milk. Do not induce vomiting. Get immediate medical attention. DO NOT MIX WITH CHLORINATED SOLUTIONS OR COMPOUNDS.

7.9 MINNCLEAN® TF CLEANER CHEMICAL OVERVIEW

For use on thin film composite (polyamide) reverse osmosis membrane systems, it is especially formulated to remove organic foulants such as grease, grime and biological matter from the membrane surface. Minnclean® TF is an alkaline (high pH) membrane cleaner.

7.9.1 Specifications

Compound:	Acidic Powder
Normal Cleaning:	1 pound cleaner per 15 gallons RO water
pH of Solution:	11.4 to 11.2
Foam Level:	Moderate
Cloud Point:	None
Rinse-ability:	Good
Storage:	Store sealed container in a cool dry place. Indefinite cleaner stability under good storage conditions.

CAUTION: When performing a cleaning or sanitization you must first do an acid cleaning. This will remove any metal build up on the membrane and will prevent the membranes from oxidization. When cleaning the system make sure that you are operating at high flow rates and low pressure. If high pressure is used you might push the contaminants further inside the membranes.

WARNING: When performing a cleaning or sanitization it is very important to use the proper safety apparatus. Refer to the Material Safety Data Sheet (MSDS) provided with the sanitant or cleaner before using them.

WARNING: MAY CAUSE BURNS, HARMFUL IF SWALLOWED, CONTAINS SODIUM METASILICATE. Prevent contact with skin, eyes and avoid contamination of clothing. Do not take internally. Prevent breathing dust. Use approved goggles and rubber gloves when handling. For industrial use only.

In case of contact with eyes, flush thoroughly with water. Get medical attention. If taken internally and person can swallow, give one glass of water or milk. Do not induce vomiting. Get immediate medical attention. For external contact, thoroughly wash affected areas after handling.

7.10 MINNCARE® DISINFECTANT CHEMICAL OVERVIEW

DIN (Canada):	02277484
Compound:	Hydrogen Peroxide 22.0% / Peroxyacetic Acid 4.5% / Inert Ingredients 73.5%
Normal Cleaning:	1% Concentration
pH of Solution:	1.3
Foam Level:	Moderate
Cloud Point:	None
Rinsability:	Good
Storage:	Store sealed container in a cool (<24°C) dry place. 1 year shelf life

PRECAUTIONARY STATEMENTS

CAUTION: Hazard to humans and domestic animals. Corrosive. Causes irreversible eye damage. Harmful if absorbed through skin. Do not get in eyes, on skin, or on clothing. Avoid contact with skin. Prolonged or frequent repeated skin contact may cause an allergic reaction in certain individuals. Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. Remove contaminated clothing and wash hands before reuse. Caution should be used when applying indoors because pets may be at risk. KEEP OUT OF REACH OF CHILDREN.

CAUTION: First Aid - If inhaled, move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice. If on skin or clothing, take of contaminated clothing, rinse skin immediately with plenty of water for 15-20 minutes. Remove contact lenses, if present, after first 5 minutes, then continue rinsing.

Call a poison control center or doctor for treatment advice. If swallowed, call a poison control center or doctor immediately for treatment advice. Have a person sip a glass of water if able to swallow. Do not induce vomiting unless told to by a poison control center or doctor. Do not give anything by mouth to an unconscious person.

NOTE: Hot Line Number – For chemical emergency, spill, leak, fire, exposure and accident, call Chemtrec, day or night (800) 424-9300, (703) 527-3887. Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact Chemtrec at 1-800-424-9300 for emergency medical treatment information. **Note to Physician** – Probable mucosal damage may contraindicate the use of gastric lavage.

NOTE: Personal Protective Equipment (PPE) – Handlers must wear: goggles or face shields, and protective rubber gloves.

WARNING: Environmental Hazards – This product is toxic to birds, fish and aquatic invertebrates. For guidance, contact your regional or local regulatory authority. **Physical and Chemical Hazards** – This product contains an oxidizing agent.

NOTE: Storage and Disposal – Do not contaminate water, food or feed by storage or disposal. **Storage**: Store upright in shipping carton. Do not expose to direct sunlight. Maintain temperature below 24°C (75°F). Avoid contact with combustible materials. Avoid contamination from any source, including metals, dust, etc. Such contamination may cause rapid decomposition, generation of large quantities of oxygen gas and high pressures. Store in original closed container – NEVER TAMPER WITH VENT. **Disposal**: Waste resulting from the use of this product may be disposed of on-site by dilution in a sanitary sewer or at an approved waste disposal facility. **Container Disposal**: Triple rinse empty container with water, then offer for recycling or reconditioning or puncture and dispose of in a sanitary landfill, incinerate, or, if allowed by state and local authorities, by burning. If burned, stay clear of the smoke.

PRODUCT EFFICACY

▪ Sporicidal	100X dilution, 11 hours	20°C
▪ Bactericidal	100X dilution, 11 hours	20°C
▪ Fungicidal	100X dilution, 11 hours	20°C
▪ Cleaner/Sanitizer		
(Non-food contact surfaces)	32X dilution, 10 minutes	20°C
(Food contact surfaces Staphylococcus aureus and Escherichia coli)		
	320X dilution, 1 minute	25°C
▪ Hospital Disinfectant Pseudomonacidal	100X dilution, 10 minutes	20°C
▪ Broad Spectrum Disinfectant	100X dilution, 10 minutes	20°C
▪ Germicidal Spray Disinfectant	100X dilution, 10 minutes	20°C
▪ RO Membrane Sanitizer	100X dilution, 36 minutes	20°C

GENERAL DIRECTIONS FOR USE

DO NOT USE AFTER EXPIRATION DATE.
Do not allow MINNCARE Liquid Disinfectant to mix with alkaline substances such as bleach (sodium hypochlorite).
If spilled, flush away with large quantities of water.
Use purified water when diluting MINNCARE Liquid Disinfectant.
MINNCARE Liquid Disinfectant is a single-use product not intended for reuse.
Fresh sanitizing solution should be prepared daily or more often if the solution becomes diluted or soiled.

DIRECTIONS FOR SANITIZING OF REVERSE OSMOSIS MEMBRANES

MINNCARE Liquid Disinfectant is recommended for sanitizing reverse osmosis membranes and their associated distribution systems. This product has been shown to be an effective disinfectant when tested by AOAC methods. MINNCARE Liquid Disinfectant may not totally eliminate all vegetative

microorganisms in reverse osmosis membranes and their associated piping systems due to their construction and//or assembly, but can be relied upon to reduce the number of microorganisms to acceptable levels when used as directed. The possibility of recontamination by the incoming water supply may exist. MINNCARE Liquid Disinfectant should be used in a sanitation program which includes bacteriological monitoring of the entire RO water system.

MINNCARE Liquid Disinfectant may be used for reverse osmosis (RO) systems, which are compatible with diluted hydrogen peroxide solutions. The MINNCARE Liquid Disinfectant has a shelf life of one year. MINNCARE Liquid Disinfectant should not be stored at its 1% use dilution since this may compromise its effective concentration. This product is not registered for use on kidney dialyzers and dialysis machines.

The RO manufacturer should be consulted prior to use of MINNCARE Liquid Disinfectant to determine the temperature and pH range acceptable for the particular membranes. At a 100X dilution (1% concentration), the pH range for MINNCARE Liquid Disinfectant is 3.0-3.5. RO water systems vary in design according to the particular needs of the user. Because of the variations in materials of construction at different facilities, some systems may have components of pumps, gasket, etc. that are not compatible with long term exposure to copper, brass, iron and certain other metals. MINNCARE Liquid Disinfectant has also exhibited a decreased resistance to latex and Buna-N with extended exposure. MINNCARE Liquid Disinfectant solution has been found compatible with typical system materials such as stainless steel. It is also compatible with polypropylene, high-density polyethylene, polysulfone, Teflon, polycarbonate, neoprene, ABS, nylon, acrylic silicone, Plexiglas, ethylene propylene, VITON, FLUOREL, PVC and CPVC.

Because of the individuality of the RO water system in design and construction as well as the quality of raw feed water, all OR water does not contain the same components. Dependent upon your particular system, all or portions of the following procedure may be for sanitizing.

Biological or organic fouling of the membrane or other parts of the system should be removed with appropriate cleaner. It is important to follow the membrane manufacturer's recommended cleaning procedure. After cleaning, flush the system with RO permeate. Mineral deposits should be removed with an acidic cleaner prior to sanitizing of the membrane. Again, follow the membrane manufacturer's recommended cleaning procedure. Then flush the unit with RO permeate. The presence of iron or other transition metals, in conjunction with the hydrogen peroxide in MINNCARE Liquid Disinfectant, could cause membrane degradation. Prepare a 1% solution (1 part MINNCARE Liquid Disinfectant to 99 parts water) by adding the MINNCARE Liquid Disinfection solution to permeate water. Fill the entire water circuit to be sanitized with a 1% solution and allow the diluted solution to reach a minimum temperature of 20^{o}C (68^{o}F). Do not exceed the membrane manufacturer's recommended temperature. Recirculate the 1% MINNCARE Liquid Disinfectant until the entire system is filled. Allow the elements to soak in the 1% MINNCARE Liquid Disinfection solution for a minimum of 36 minutes at 20^{o}C (68^{o}F).

Rinse the RO system and check for residuals by following the directions on the MINNCARE Residual Test Strips label. The residual test strip should indicate less than 2ppm. Rinse times will vary depending on the size of the RO system. Residual sanitizer that may enter the system because of chemical rebound can be eliminated by diverting product water to drain for a short period of time.

7.11 MINNCARE® TEST STRIPS OVERVIEW

Minncare® test strips provide quick results with easy-to-read indicators. Use the Minncare® 1% TS test strips as a pass/fail measurement for adequate concentration of sterilant after dilution. Then, verify residual levels after rinse-out using Minncare® Residual Test Strips.

They verify adequate concentration of a 1% Minncare® solution during sanitization of your high purity water system. These convenient dip-and-read strips can be used at any test port in your system to provide an accurate pass/fail measurement of Minncare® solution. The Test Strips are easy-to-use and are conveniently packaged in 100 test strips per container. Each strip has a “reaction zone” pad located at one end of the strip. When stored and used properly, the test strip pad can indicate residual Minncare® levels as low as 1 part per million (ppm). The reaction zones are set to provide six different reading levels at 100, 30, 10, 3, 1 and 0 (zero) parts per million.

7.11.1 Specification:

Storage	1. Containers that have not been opened must be stored in a refrigerator (5-15°C Do not freeze). When a container has been opened do not put it back into the refrigerator. Repeated opening of a continuously refrigerated container will cause enough condensation to exceed the capacity of the container drying agent (located in stopper cap). The test strips are damaged by excessive moisture. 2. Store containers that have been opened in a cool and dry place without refrigerating. 3. Failure to store test strips properly will result in inaccurate readings. 4. To check the color reaction, strips should be tested against a known 3 ppm concentration of hydrogen peroxide (0.1 ml of 3% hydrogen peroxide in 1000 ml of purified water). If the result is not greater than 1 ppm and less than 10 ppm per the color chart, the strips must be discarded. 5. Each container has an expiry date. Do not use after date printed on the container.

7.12 TEST STRIPS USER INSTRUCTIONS

7.12.1 Minncare® P/N 78338 Residual Test Strips

1. Collect a sample of the rinse solution.
2. Remove a test strip from the tube and immediately replace the lid.
3. Dip the test strip into the solution to be tested for one second, such that the reaction zone is properly wetted.
4. Remove the test strip, gently shake off excess liquid, and compare the reaction zone with the color scale between 5 and 10 seconds after exposure.

NOTE: If test strip indicates dark blue to brown or green to brown, the concentrations are too high for the color scale. Read Minncare® Cold Sterilant package insert instruction for additional information

7.12.2 Minncare® P/N 78339 1% Test Strips

1. Collect a 1 ml or greater sample of the Minncare® sample.
2. Remove a test strip from the tube and immediately replace the lid.
3. Dip the test strip into the solution into the solution to be tested, such that the reaction zone is properly wetted.
4. Remove the test strip and gently shake off excess liquid.
5. Within 10 seconds, note the entire reaction pad color development.

- 1%= Blue-gray or blue-black color over the entire reaction pad within 2-5 seconds, and which does not fade, indicates Minncare® levels of 1% or greater.
- No color development, or immediate fading of blue-grey or blue-black, indicates Minncare® levels of less than 1%.
- 1% Minncare® = 400 ppm Peracetic Acid, test strips is accurate +/- 50 ppm.

NOTE: The reaction pad may slowly change/develop color after the initial reaction. This is normal and should be ignored for the purpose of test interpretation.

7.13 SANITIZATION/CLEANING PROCEDURE USING A TANK ONLY

The procedure below will assist the operator in sanitizing/cleaning the membrane cartridges using a small tank only.

NOTE: Due to site conditions some of the procedures might have to be altered

1. Pre-record the flow rates, pressures and product quality to determine if the cleaning / sanitization will improved the RO overall performance.
2. Place the RO system in **STOP** mode.
3. Remove the system side panel and disconnect the carbon tank inlet and outlet lines.
4. Using the 3/8” coupling supplied with the system connect the two lines together.

5. Connect a 3/8” poly tube line from the tank (bottom) to the cleaning inlet (CIP). Divert the product and reject lines to the top of the cleaning and secure the line.
6. Fill the tank with RO quality water (20-30°C) or better.
7. Fully open the RO C.I.P. inlet valve
8. Press the **“SETUP”** key and then the # **“2”** key. The following screen will appear.

READ INSTRUCTION MANUAL BEFORE DOING THIS COMMAND
<OK> <CANCEL>

9. Press the **“OK”** key to start the cleaning process.
10. Verify that water is flowing from the tank into the RO and back to the tank. Check for leaks and fix if any are found.

WARNING: Secure all hoses and check for leaks before adding chemicals. This will prevent possible chemical spray. Failure to comply with the above could result in personal injury.

11. Press the **“STOP”** key on the keypad.
12. Add the predetermined amount of sanitization/cleaning chemical to the tank. Mix the chemical until total dissolved.

CAUTION: When performing a sanitization/cleaning you must first do an acid cleaning. This will remove any metal build up on the membrane and prevent the membranes from oxidization.

13. Press the **“SETUP”** key and then the # **“2”** key.
14. Press the **“OK”** key to start the cleaning process.
15. Allow the solution to re-circulate for 5 minutes and check the solution concentration (pH) is within limits.

NOTE: If the concentration (pH) is too low add some more chemical to bring the concentration (pH) up. If the concentration is too high add some caustic (NaOH) or acid (HCl) to bring the concentration (pH) down.

NOTE: If the pH dramatically decreases/increases or become dirty the solution should be disposed of and a new batch made. Check your local municipality waste discharge limits before dumping the solution. See SECTION 9.17 for details.

16. Allow the solution to re-circulate for 30 minutes and check the solution concentration periodically. Monitor the temperature of the solution to make sure it does not reach >50°C.
17. After the time has elapsed press the **“STOP”** key on the keypad.
18. Neutralize the cleaning solution. Refer to SECTION 9.15.
19. Once the solution is neutralized dispose of the solution.
20. Fill the tank with RO quality (or softened and de-chlorinated) water or better.
21. Press the **“SETUP”** key and then the # **“2”** key.

22. Press the **"OK"** key to start the cleaning process.
23. Allow the water to re-circulate for 5 minutes. Check the concentration (pH) is within the discharge limits. If it is not the tank will have to be dumped and refilled until the limits are met.
24. Press the **"STOP"** key on the keypad.
25. Proceed to SECTION 9.16.

7.14 NEUTRALIZING CLEANING AND SANITIZATION SOLUTIONS

After each batch of solution is used it will be required to be neutralized. Each batch will have a different concentration after each use. Therefore it will have to be calculated at each time. The calculated volumes are a start point and additional chemicals may have to be added.

WARNING: When using chemicals it is very important to use the proper safety apparatus. Refer to the Material Safety Data Sheet (MSDS) provided with the chemicals before using them.

NOTE: Check your local municipality for waste discharge regulations.

Sodium Hydroxide (Caustic, NaOH) will neutralize low pH (2-6) solutions.
Hydrochloric Acid (HCl) will neutralize high pH (8-14) solutions.

7.15 TANK DECOMMISSIONING AND STORAGE

After each cleaning/sanitization of the system the following should be performed:

1. Ensure that all CIP hoses are disconnected and drained of any water.
2. Ensure that the cleaning tank and pump are drained of any water.
3. Ensure all chemical containers are closed and stored away.
4. Ensure all valves are in the proper position (Open or Closed) to restart the system.
5. Proceed to the RO restart procedure SECTION 8.17.

7.16 REVERSE OSMOSIS SYSTEM RE-START PROCEDURE

The following procedure will assist the operator in restarting the RO system.

1. Disconnect the product line connected to the process (ex. Tank).
2. Divert the product and reject line to drain.

NOTE: The flexible hose that is to be used must be the same size or larger than the line (valve) that it is being hooked up to.

3. Re-install the carbon filter.
4. Fully open the reject and recycle needle valve.
5. Install a pre-filter cartridge if required. See SECTION 9.19.

6. Slowly open feed water valve to the system pre-filter.
7. Place the controller in **RUN** mode. Allow the flush cycle to complete before making any adjustments.

NOTE: The RO will not flush if it has been disabled in the controller set-up menu.

8. Adjust the reject flow control needle valve to the flow calculated.
9. Adjust the reject recycle flow control needle valve to the flow calculated.

NOTE: Flow adjustment should be made slowly.

CAUTION: Never fully close the reject and reject recycle flow control needle valves when the system is in operation. Damage to the system can occur.

10. Allow the system to operate to drain for 2 hours (4 hours for dialysis application) and record and verify the system parameters are within the desired limits.
11. Once the time has elapsed and the system parameters are met, turn the controller to **OFF** mode. Divert the product to the process (ex. Tank).
12. Turn the controller to **RUN** mode.
13. Record the system performance and compare it to the data collected before the cleaning/sanitization to determine if the cleaning/sanitization has improved system performance.

7.17 RO SYSTEM SHUT-DOWN PROCEDURE

NOTE: Due to site conditions some of the procedures might have to be altered.

1. At shutdown, flush the system with permeate or pretreated DI water, if available. The flush water must be free of any chemical additives.
2. Relieve system pressure and shut down feed pumps.
3. When the system is secured, ensure that water does not drain from the elements. Also ensure that there is no back pressure on the elements from the permeate side.

CAUTION: If there is greater than atmospheric pressure on the permeate line during operation, check valves should be included in the permeate line to prevent even momentary back pressure on the membrane elements during a shutdown.

4. For extended shutdowns (greater than one week), a preservative solution should be added to the system to eliminate biological growth.
5. If the system is not being used for less than one week, it is usually sufficient to merely flush the system with fresh, pretreated feed once per day to minimize biological growth.

7.18 PRE-FILTER REPLACEMENT PROCEDURE

NOTE: Due to site conditions some of the procedures might have to be altered.

1. Turn the system off and close the inlet valve to the inlet of the pre-filter housing.
2. Turn the system back to **RUN** and then **OFF** to relieve the pressure.
3. Remove the filter bowl by turning it counter clockwise.

NOTE: Hold bowl securely as it is being removed. It is full of water.

4. Dump excess water and discard old filter cartridge.
5. Inspect and replace o-ring if signs of cracking and/or wear are found.
6. Using clean gloves sprayed with 70% isopropyl alcohol install the new filter cartridge.

NOTE: If gloves are not available open the top of the filter cartridge bag and insert the filter in the bowl as you remove the bag. Avoid touching the filter.

7. With the filter in the bowl, align with the center of the head and hand tighten the bowl clockwise.
8. Slowly open the inlet valve to the pre-filter housing. Check for leaks and repair if any are found.

NOTE: The bowl should only be tightened by hand. If it requires more torque this indicates that the o-ring requires replacement.

TROUBLESHOOTING

The following tables refer to troubleshooting of a standard 2200M - Portable Water Purification System. The "possible causes" and "corrective actions" may differ for custom systems.

Problem	Possible Cause	Corrective Action
Pre-filter High Pressure Drop	Dirty Filter	Replace filter.
Membrane High Pressure Drop	Fouled Membrane	Identify the foulant. Follow the appropriate cleaning procedure.
Low Product Flow	Fouled Membrane	Identify the foulant. Follow the appropriate cleaning procedure.
	Feed Temperature Low	Check Feed Temperature.
Poor Quality	Check Recoveries	Re-adjust Flows.
	Fouled Membrane	Identify the foulant. Follow the appropriate cleaning procedure.
	Feed Water out of Specification	Check Feed Water.
Low feed water pressure	Up Stream Valve Closed	Identify and open valve.
	Build Water Supply	Verify and/or install Booster System.
	Inlet Solenoid Valve Malfunction	Call Mar Cor Technical Support.
	Faulty Sensor	Call Mar Cor Technical Support.
Pump Overload	Motor and/or Pump Damaged	Verify and/or Replace.
System Will Not Start.	Tank Full	Check tank level, drain tank to intermediate level.
	No Power to System	Check that power is available to system.
High Temperature	Tripped Motor Thermal Overload	Check pump thermal overload.
	Pretreatment in Regeneration	Check pretreatment.
	System Stopped	Press **RUN**.
	Feed Water Temperature too High	Correct the Feed Water temperature. Add blending valve or adjust setting on Feed Line.

WARRANTY

General Limited Warranty

Mar Cor Purification and Biolab Equipment Ltd. (“Mar Cor”) warrants all products manufactured by Mar Cor to be free from defects in material and workmanship under normal use for a period of one year from date of shipment. Warranty is only provided when the equipment is properly maintained in accordance with Mar Cor instructions. Our obligation shall be limited to the repair or replacement at our option of any parts we deem defective. Consequential damages due to the failure of any part or system are not provided. Mar Cor provides no other warranty, expressed or implied. There is no warranty of merchantability or fitness for a particular purpose. Other manufacturer’s equipment offered, as part of any proposal shall carry the manufacturer’s warranty. On site, labour is covered for the first 90 days. Travel time and expenses are not covered.

CONTACT INFORMATION

For further information regarding the operation or maintenance of the 2200M – Portable Water Purification System and for ordering, please contact your local Mar Cor Purification office. When ordering replacement parts, please provide the Biolab Reference Number found on the cover page of this Manual.

UNITED STATES OF AMERICA

Mar Cor Purification, Inc.
4450 Township Line Rd
Skippack, PA 19474-1429
Tel: (484) 991-0220
Toll Free: (800) 346-0365
Fax: (484) 991-0230
info@mcpur.com

CANADA

Mar Cor Purification - Biolab Equipment Ltd.
3250 Harvester Rd - Unit 6
Burlington, ON L7N 3W9
Tel: (905) 639-7025
Toll Free: (800) 268-5035
Fax: (905) 639-0425

WORLD WIDE WEB
www.mcpur.com

CUSTOMER SYSTEM NOTES
