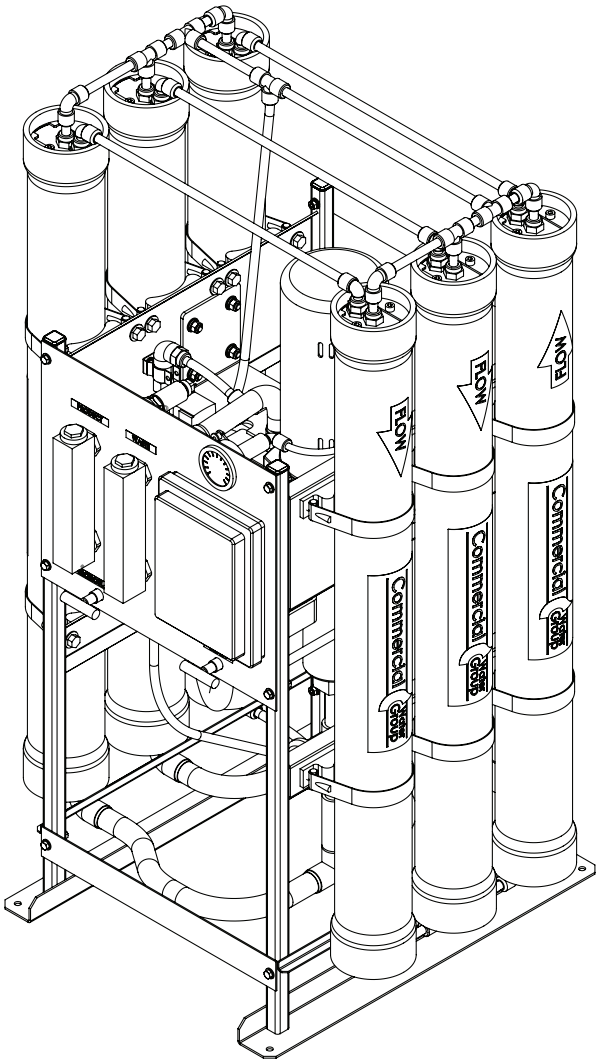
MacRO
Reverse Osmosis Water Treatment Systems

Operating and Maintenance Manual



#54955 Rev. 1/12

Attention Customer:

Your local WaterGroup dealer employs trained service and maintenance personnel who are experienced in the installation, function and repair of WaterGroup equipment. This publication is written specifically for these individuals and is intended for their use.

We encourage WaterGroup users to learn about WaterGroup products, but we believe that product knowledge is best obtained by consulting with your WaterGroup dealer. Untrained individuals who use this manual assume the risk of any resulting property damage or personal injury.

WARNING! Electrical shock hazard! Prior to servicing equipment, disconnect power supply to prevent electrical shock.

WARNING! If incorrectly installed, operated, or maintained, this product can cause severe injury. Those who install, operate, or maintain this product should be trained in its proper use, warned of its dangers, and should read the entire manual before attempting to install, operate, or maintain this product. Failure to comply with any warning or caution that results in any damage will void the warranty.

CAUTION! This product is not to be used by children or persons with reduced physical, sensory or mental capabilities, or lack of experience or knowledge, unless they have been given supervision or instruction.

CAUTION! Children should be instructed not to play with this appliance.

CAUTION! If the power cord from the transformer to the unit looks or becomes damaged, the cord and transformer should be replaced by a WaterGroup Service Agent or similarly qualified person in order to avoid a hazard.

WARNING! This device complies with Part 15 of the FCC rules subject to the two following conditions: 1) This device may not cause harmful interference, and 2) This device must accept all interference received, including interference that may cause undesired operation.

This equipment complies with Part 15 of the FCC rules. Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

CAUTION! To reduce the risk of fire, use only No. 26 AWG or larger telecommunications line cord.

NOTE This system is not intended for use with water that is microbiologically unsafe or of unknown quality without adequate disinfection either before or after the system.

NOTE Check with your public works department for applicable local plumbing and sanitation codes. Follow local codes if they differ from the standards used in this manual. To ensure proper and efficient operation of the WaterGroup equipment to your full satisfaction, carefully follow the instructions in this manual.

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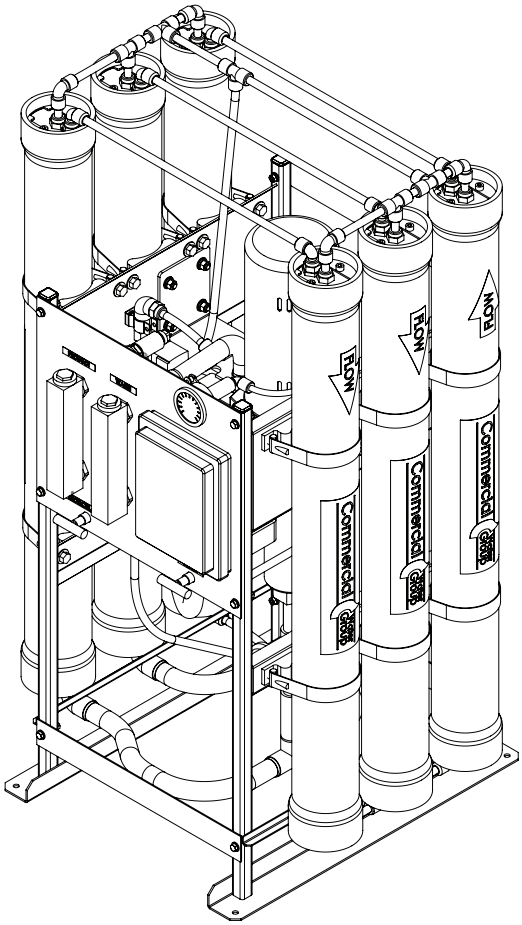

MacRO

Reverse Osmosis Water Treatment Systems

Contents

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Introduction

Read this Manual First

Before you operate the WaterGroup MacRO reverse osmosis systems, read this manual to become familiar with the device and its capabilities.

The reverse osmosis system is designed to meet the needs of applications for high quality water. This manual contains important information about the unit, including information needed for installation, operating, and maintenance procedures. A troubleshooting section provides a guide for quick and accurate problem solving.

In order for the water treatment system to continue to provide high quality water, you must develop a thorough understanding of the system and its operation. Review this manual before making any attempt to install, operate, or service the system. Installation or maintenance done on this system by an untrained service person can cause major damage to equipment or property damage.

About this Manual

This manual:

- Familiarizes the operator with the equipment
- Explains installation and setup procedures
- Provides basic programming information
- Explains the various modes of operation
- Gives specifications and troubleshooting information

This publication is based on information available when approved for printing. Continuing design refinements could cause changes that may not be included in this publication.

Safe Practices

Throughout this manual there are paragraphs set off by special headings.

Notice

Notice is used to emphasize installation, operation or maintenance information which is important, but does not present any hazard. For example,

NOTICE The nipple must extend no more than 1 inch above the cover plate.

Caution

Caution is used when failure to follow directions could result in damage to equipment or property. For example,

CAUTION! Disassembly while under water pressure can result in flooding.

Warning

Warning is used to indicate a hazard which could cause injury or death if ignored. For example,

WARNING! Electrical shock hazard! Unplug the unit before removing the timer mechanism or cover plates!

The CAUTION and WARNING paragraphs are not meant to cover all possible conditions and situations that may occur. It must be understood that common sense, caution, and careful attention are conditions which cannot be built into the equipment. These MUST be supplied by the personnel installing, operating, or maintaining the system.

Be sure to check and follow the applicable plumbing codes and ordinances when installing this equipment. Local codes may prohibit the discharge of acid or caustic solutions to drain. An extra solution tank should be used to neutralize the solution before discharging to drain.

Use protective clothing and proper face or eye protection equipment when handling chemicals or power tools.

Features

The MacRO reverse osmosis system is sized to serve small-to-medium-sized applications that require high-quality reverse osmosis water. It is designed with the flexibility to closely match your treatment requirements from 2.78 to 6.94 gallons per minute (4,000 to 10,000 gallons per day). A rich standard feature set with multiple options can satisfy virtually any application. Select the right size and choose any options needed to complete your system.

Key Product Features

- Simple System Integration
- Flexible Configurations
- Quick Delivery/Easy Installation
- Product and Waste Flow Meters
- Autoflush
- Electronic Features
  - Pretreatment Lockout
  - Storage Tank Level and Pressure Control
  - Low Pressure Auto-Restart
  - TDS Monitor/Temperature Sensor

Flush Options

- Start up flush: Inlet valve opens for one minute whenever system starts to make RO water. Flushes reject side of membrane and reduces the time it takes the RO to rinse up to quality.
- Time flush: In the running mode, the inlet solenoid valve remains open, allowing the reject side of the RO to be flushed based on preset number of running hours for a set number of minutes. (May extend membrane cleaning frequency in some applications).

Reverse Osmosis

In order to understand reverse osmosis, we must first define osmosis. Osmosis is the passage of a liquid through a semi-permeable membrane. A semi-permeable membrane is a membrane which allows one component of a solution to pass through it and not the others. In osmosis, there is a tendency for a liquid to go from an area of less concentration to an area of more concentration through a semi-permeable membrane. Figure 1 shows the osmotic process.

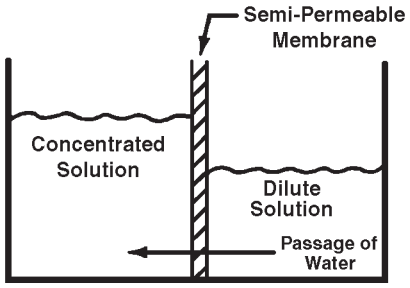


Figure 1. Osmotic process.

If pressure is applied to the concentrated solution, reverse osmosis will take place. The pressure causes a flow through the semi-permeable membrane into the dilute solution. The semi-permeable membrane acts as a barrier to ions and does not allow them to pass through into the dilute solution. When applied to water, this means that the product water has a reduced total dissolved solids content as a result of the passage of water molecules through the membrane while the mineral ions are rejected. See Figure 2.

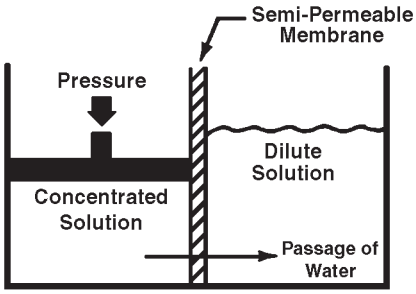


Figure 2. Effect of pressure on reverse osmosis.

Rejection and Recovery

Feed water entering the system is split into two streams, a product stream and a concentrate stream. See Figure 3.

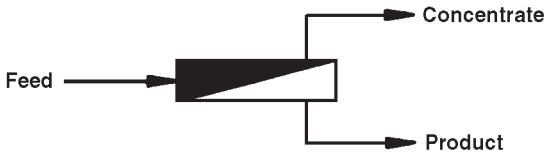


Figure 3. Feed water product stream and concentrate stream.

During the process of reverse osmosis, some of the water has its dissolved solids content reduced by approximately 99%. This high quality product water is sent to service.

The rest of the feed water contains the dissolved solids removed from the product water, in addition to the dissolved solids already present in the feed water. This concentrate water is sent to drain.

The amount of total dissolved solids rejected by the system is expressed as a percentage. A 90% rejection means that 90% of the dissolved solids have been removed from the feed water by the system. To calculate the percent rejection, use the following equation:

$$\frac{\text{(Feed TDS - Product TDS)}}{\text{(Feed TDS)}} \times 100 = \%\ \text{Rejection}$$

Where Feed TDS is the total dissolved solids content of the water going into the system, and Product TDS is the total dissolved solids content of the high quality product water. The controller displays the Product TDS (TDS OUT) on the information screen. The feed TDS needs to be measured with a handheld meter.

For example, if the Feed TDS is 600 ppm and the Product TDS is 24 ppm,

$$\frac{600\text{-}24}{600} \times 100 = 96\%\ \text{Rejection}$$

NOTE Numbers used in these examples might not reflect those of your unit.

The amount of high quality water recovered for use as a percentage of the water fed into the reverse osmosis system is called percent recovery. The controller displays the Feed Flow (FFLOW) and Product Flow (PFLOW) on the Information screen. The Recovery is also displayed on an Information screen. Use the following equation to calculate percent recovery:

$$\frac{\text{Product Water Flow Rate (PFLOW)}}{\text{Feed Water Flow Rate (FFLOW)}} \times 100 = \%\ \text{Recovery}$$

CAUTION! An understanding of rejection/recovery percentages and temperature compensation is essential for monitoring and evaluating the performance or condition of the reverse osmosis system. DO NOT operate the system before becoming familiar with these concepts.

Temperature Compensation

As the feed water temperature decreases so will the product water production. The rated product flow (gallons per minute, gpm) as shown for the various models is based upon the feed water temperature equal to 77° F.

Feed Water Limits

Before starting the installation, verify that the feed water meets the limits shown in Table 1, and that a water softener is used for pretreatment.

Property	Minimum	Maximum
Turbidity (NTU)	0.0	1.0
pH*	6	11
Chlorine (ppm)	0.0	0.1
Total Dissolved Solids (ppm)	50	2500
Temperature (°F)	33	100
Silt Density Index	0.0	5.0
Iron (ppm)	0.0	0.1

Table 1. Feed water limits.

*Short term cleaning is acceptable for pH ranges between 2.0/12.0. Additional treatment is required when chloramines are present and the pH levels exceed 9.0.

NOTICE In some applications, a water softener is not required. Consult a dealer for further information on these special applications.

Unit Configurations

MacRO unit is pictured in Figure 4 and Figure 5. Width of membrane rack varies with model. See “MacRO RO Parts Diagrams and Lists” on page 41 for a list of component part numbers.

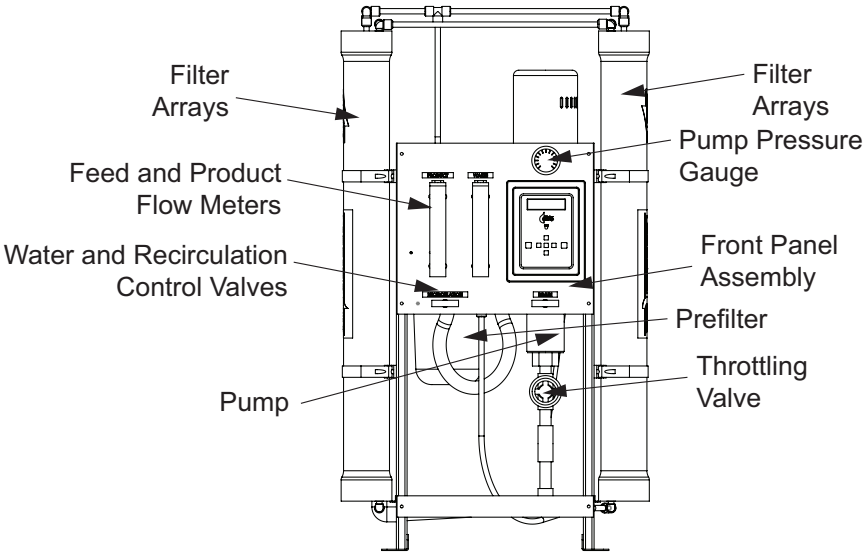


Figure 4. MacRO RO front view.

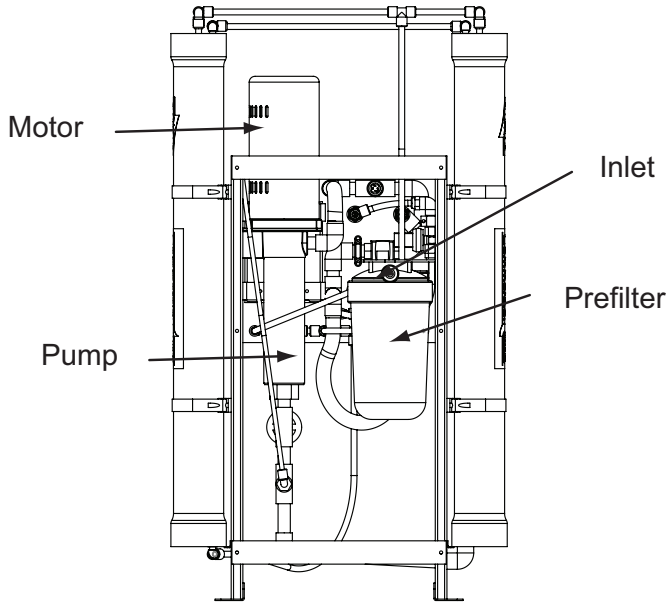


Figure 5. MacRO RO rear view.

MacRO Specifications

	MacRO-2	MacRO-3	MacRO-4	MacRO-5	MacRO-6
Nominal Capacity, GPD*	5000	7800	10,400	11,520	12,700
Dimensional, Series AP Units					
Width - in [mm]	28.9 [733]				
Depth - in [mm]	26.0 [661]				
Height - in [mm]	50.9 [1293]				
Operating Weight lb [kg]	198 [89.1]	228 [102.6]	258 [116.1]	288 [129.6]	318 [143.1]
Unit Connections					
Inlet (NPT)	0.5"				
Product (Tube)	0.5"				
Concentrate (Tube)	0.5"				
Electrical					
Motor Horsepower (hp)	1.0				
Power Requirement (VAC/Hz/phase)	208–230/60/1				
Full Load Current (amp)	10.4/8.5				
Hydraulic - Prefilter					
Cartridge Quantity	1				
Cartridge Size - in [mm]	10 [254]				
Cartridge Rating (micron)	5				
Hydraulic - RO					
Type	Low Energy (XLE)	Low Energy (XLE)	Low Energy (XLE)	Low Energy (XLE)	Low Energy (XLE)
Manufacturer	Filmtec	Filmtec	Filmtec	Filmtec	Filmtec
Membrane Size	4” x 40”	4” x 40”	4” x 40”	4” x 40”	4” x 40”
Membrane Array	1-1	1-1-1	1-1-1-1	2-1-1-1	2-2-1-1
Number of Membranes	2	3	4	5	6
Product Flow - gpm [L/min]*	3.61 [13.67]	5.41 [20.48]	7.22 [27.33]	8.00 [30.28]	8.81 [33.35]
Concentrate Flow - gpm [L/min]*	3.61 [13.67]	2.32 [8.78]	2.41 [9.12]	2.67 [10.11]	2.94 [11.12]
Recovery (%)*					
Design	50	70	75	75	75
Minimum	40	50	60	60	60
Maximum Module Feed Pressure psig [kPa]	160 [1103]				
Nominal Module Feed Pressure psig [kPa]	140 [965]				
Maximum Product Pressure psig [kPa]	40 [276]				
Operating Temperature °F [°C]	40–100 [4–38]				
Inlet Pressure					
Minimum, dynamic psig [kPa]	15 [103]				
Maximum, dynamic psig [kPa]	40 [276]				
Maximum, static psig [kPa]	100 [689]				
Required Inlet Feed Flow gpm [L/min]	7.22 [27.33]	7.73 [29.26]	9.63 [36.45]	10.67 [40.39]	11.75 [44.48]
Pump Flow @ 125 psi gpm [Lmin]	11.0 [41.6]	11.0 [41.6]	11.0 [41.6]	11.0 [41.6]	11.0 [41.6]
Salt Rejection, Nominal (%)	98	98	98	98	98

†Calculated using a 0.85 fouling factor

* Determined by Membrane Manufacturer in following conditions - 1000 ppm Nacl Solution, 77°F water temperature, 140 psi pressure. Actual flow rates may vary depdending on the pre-treatment used, water conditions, system size,membrane array and applied pressure

Unpacking the RO

This manual, the warranty, and registration card are packed in the control assembly box. Please complete the registration card and mail it promptly.

NOTICE	**Examine each unit component carefully to check for loose or damaged parts. Report any apparent or concealed shipping damage to the freight carrier immediately.**

Materials Required

To install the system, the following items are required:

1. Level
2. Drill
3. Screws for mounting the bracket for the main plumbing assembly
4. Screwdrivers, including a small, flat-bladed (1/8” wide) screwdriver for wiring
5. Adjustable wrench
6. Tubing;
   All—Black 3/4” Feed Water and Water plumbing
7. Bucket calibrated for taking flow rates
8. Clean rags
9. Thermometer
10. Portable Total Dissolved Solids meter
11. Safety glasses

Installation Location

The specification data lists the dimensions. Note that these figures do not account for working space around the unit and the space for plumbing connections. The work space requirements for the module assembly is at least four (4) feet of space at the top end of the housings. This will allow for future replacement of RO membrane modules.

The steel frame is designed to distribute the operating weight on an even floor space. If the floor is uneven, grout beneath the steel frame feet so that the unit is evenly supported. Secure the base of the frame with four (4) 5/16” diameter bolts.

NOTICE	**Do NOT use any bolt size smaller than 5/16" diameter.**

The unit must be located near a drain able to handle 5 gallons per minute (18.9 liters/min). This is in addition to the flow from any other water treatment equipment.

CAUTION! The system must not be located near any corrosive chemicals which may cause failure of the plastic or metal parts of the unit. In addition, do not locate the unit where the temperature may exceed the feed water temperature limits.

A 230 VAC/60 Hz/single-phase grounded power supply with 15 Amp fuse protection and a local disconnect switch is required.

WARNING! The system must be grounded. An improperly grounded unit could cause injury from electrical shock!

RO Module Tubing

For 3-D tube fitting diagrams, see the parts section starting on page 41.

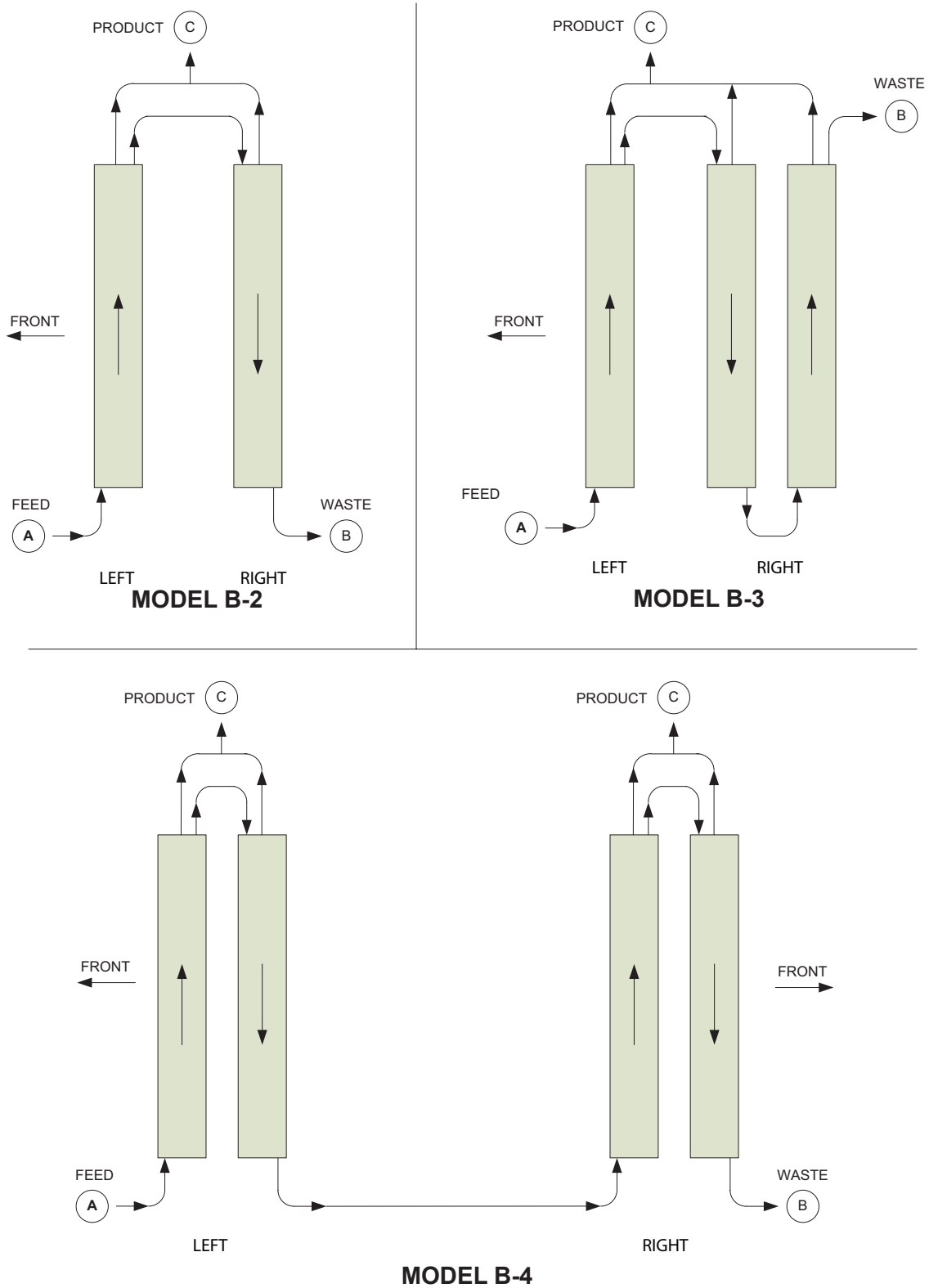
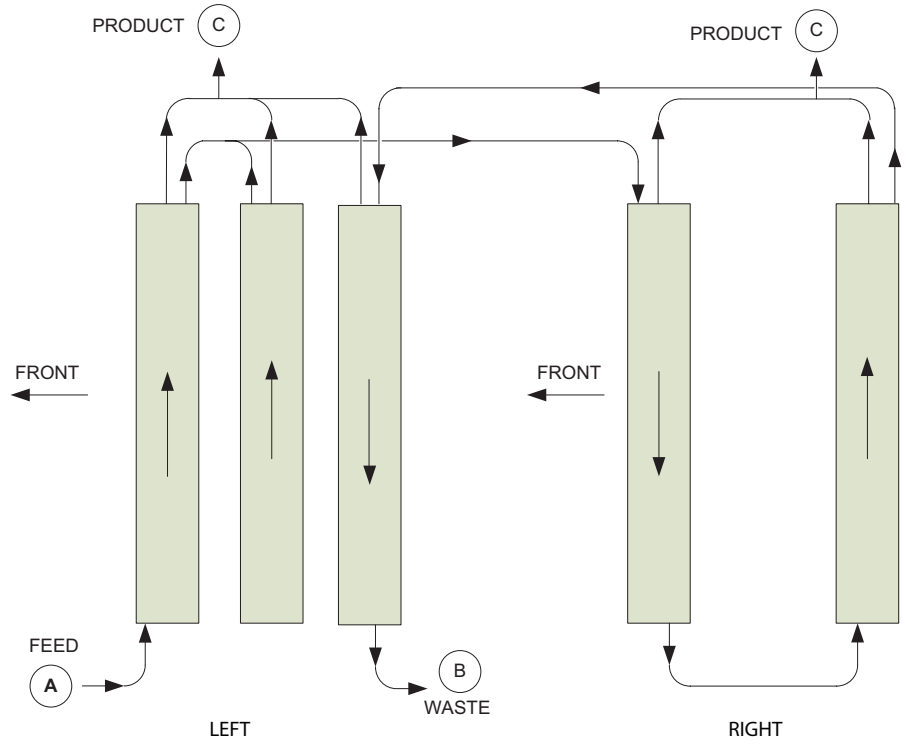
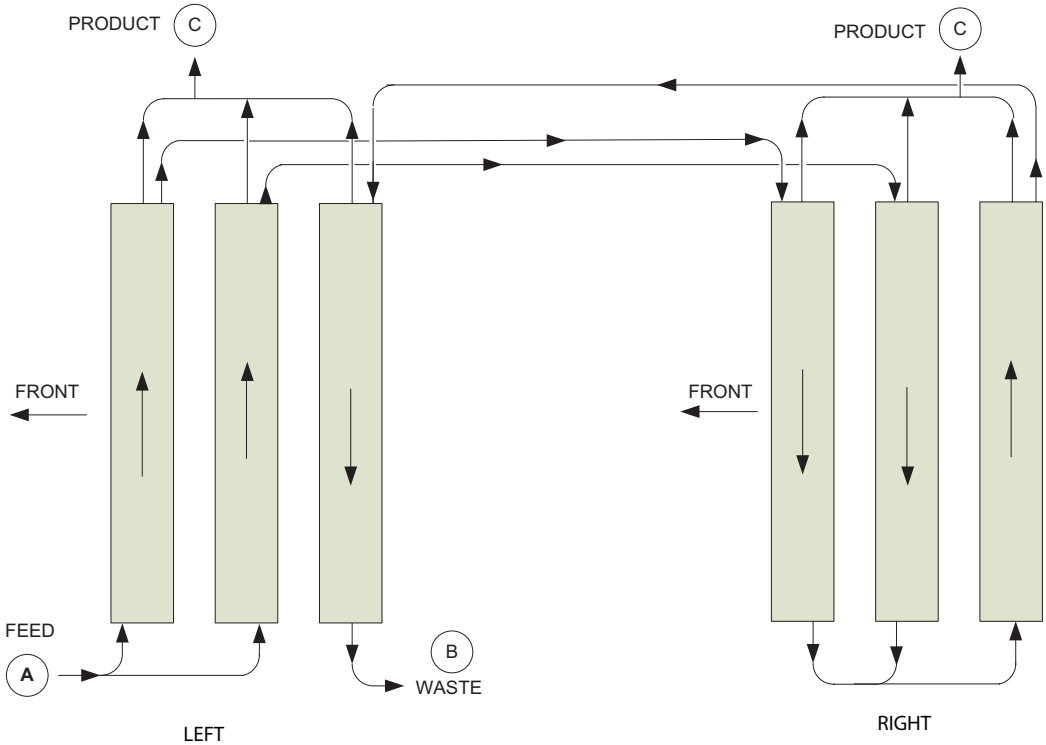


Figure 6. MacRO Module Tubing, two to four membranes.



MODEL B-5



MODEL B-6

Figure 7.MacRO Module Tubing, five or six membranes.

WARNING! The system must be grounded. An improperly grounded unit could cause injury from electrical shock!

Plumbing Installation

Refer to the appropriate hydraulic schematic on page 3 for further information.

Feed Water Connections

Connect pipe or tubing to the Feed water inlet. Observe the following:

1. To minimize pressure loss, the pipe or tubing size should be at least 3/4”.
2. Install optional pressure gauges (quantity 2 of PN D1006272) before and after the pre-filter to measure the pressure differential across the filter cartridge.
3. Install a tee, with a shutoff valve on the branch, before the feed flow meter to provide a connection for introducing cleaning solutions.
4. If necessary, install a pressure regulator (100 psi downstream max. setting) in the inlet plumbing, to assure constant pressure and to prevent harmonic vibration.
5. Install a shutoff valve in the inlet plumbing to simplify maintenance and service.
6. If the feed water can be used for a short period, install bypass plumbing around the unit.

Concentrate Water Connections

1. Direct 1/2" plumbing to drain from the outlet of the unit.
2. To prevent siphoning of the water in the unit to drain, raise the concentrate plumbing above the level of the modules and provide an anti-siphon loop.

WARNING! An air gap must be provided between the end of the concentrate tubing and the drain to prevent back-siphoning of drain contents.

Product Water Connections

The product water exits the unit at the product flow meter on the back side of the unit. Connect the product plumbing to the fitting on the flow meter.

CAUTION! This unit produces high quality product water. This water can be contaminated by plumbing following the unit or it can corrode the plumbing. Use only plumbing components of inert material that are compatible with the application.

The connection of the main product plumbing to service plumbing will depend on how the product water will be stored.

CAUTION! Reverse osmosis elements will fail immediately if product water is allowed to flow backward into the unit.

Pressurized Storage Tank

The product water can be stored in a pressurized storage tank with the reverse osmosis unit controlled by a pressure switch. Use the same components used for direct feed (see Figure 8) with the addition of a pressure switch which needs to be wired to the control panel (see page 18 for RO standard wiring).

Non-Pressurized Product Water Storage Tank

Connect the product tubing to a bulkhead fitting at the top of the storage tank.

CAUTION! The highest point of the tubing should not be higher than four feet above the top of the reverse osmosis modules, or the elements may be damaged.

Depending on the type of application, a level control may be required to turn the unit off when the storage tank is full. Install the level control according to the instructions provided with the control. Refer to the wiring section in this manual for electrical connections.

NOTICE If a repressurization pump is used, an additional level control is recommended to prevent the pump from running dry if the storage tank is empty.

To maintain high water quality, a hydrophilic air vent filter, vacuum breaker, pop-off valve, ultraviolet lamp, and pressure relief valve may be required.

Direct Feed

If the product water is to be used directly, without storage, a few precautions are necessary to prevent damage to the elements. Install a pressure gauge, pressure relief valve, and a normally-open (“dump”) solenoid in the product water line as shown in Figure 8. The pressure gauge will allow the operator to monitor the product water pressure. The relief valve, which should be set to open at 40 psig, will prevent the product water pressure from exceeding 40 psi. The dump solenoid will relieve all pressure when the unit is off.

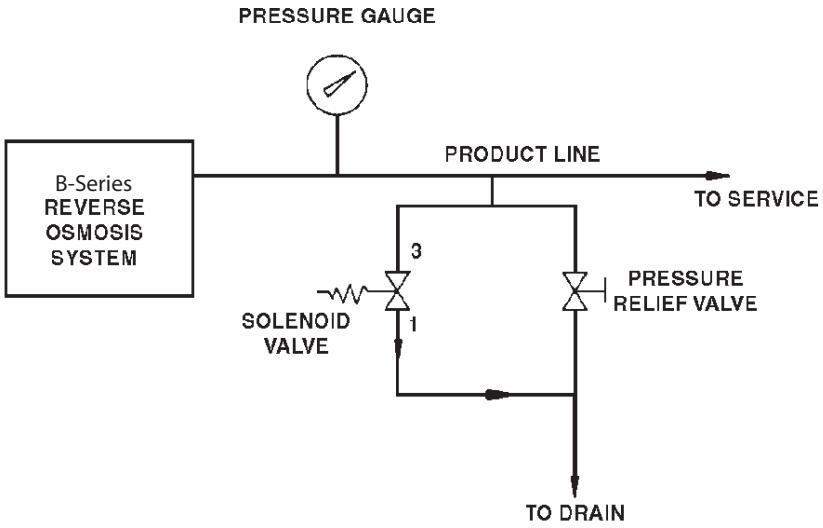


Figure 8. Direct feed connection.

Wire the direct feed/pressurized storage solenoid valve in parallel with the motor.

NOTICE Install a check valve after these valves in case the service line remains under pressure. Product back pressure will decrease the net pressure pushing water through the reverse osmosis elements. Therefore, the flow of product water will decrease.

Initial Startup

1. Open the feed water supply valve.
2. Direct the product water tubing to drain.
3. Open the recirculation valve (HCV-1) fully counterclockwise, then close two turns.
4. Connect the system to the power supply. You must press the power button (see Figure 10 on page 17) for the unit to start up without delay.

NOTE **If the inlet pressure falls below 20 psi during operation, a booster pump will be necessary.**

CAUTION! **If the pump chatters loudly, it is starving for water (cavitating). Turn the unit OFF immediately to prevent pump damage. Correct the low pressure condition before proceeding.**

5. Check for leaks at all tube fittings and threaded joints.
6. Slowly close the recirculation valve until the desired (normalized) product flow rate is attained. Check again for leaks.

CAUTION! **As the concentrate flow is reduced, the system pressure will increase. Open the system pressure control valve as required to prevent the system pressure from exceeding 150 psi (1034 kPa). Excessive pressure will damage the pump and may cause property damage.**

7. Measure the product flow. Adjust the feed pressure with the system pressure control valve until the product flow is approximately 10% higher than the flow required for the application.

CAUTION! **DO NOT exceed 150 psi (1034 kPA) or the membranes may be damaged. The fittings and tubing may also fail and may cause property damage.**

NOTICE **By adjusting the feed pressure as low as possible to meet the application requirement, the service life of the pump and RO elements will be optimized. The system should run continuously, rather than go through frequent start/stop cycles. Do not exceed specified product flow rate!**

8. Once all the desired flows are set, allow the system to run for approximately 30 minutes, and then record the following measurements using the units gauges (U) and your instruments (I):

   a. Feed Water Temperature, °F (I) _____

   b. Feed Water SDI (I) _____

   c. Feed TDS, ppm (I) _____

   d. Inlet Pressure, psig (U) _____

   e. System (pump outlet) pressure, psig (U) _____

   f. Product Pressure, psig (I) _____

   g. Concentrate (waste) flow, gpm (U) _____ x TCF = _____

   h. % Recovery (see page 4) _____

   i. % Rejection (see page 4) _____

   [1]TCF = Temperature Correction Factor. Refer to Table 2 for this value.

9. Turn the power switch OFF. Connect the product tubing to the service plumbing.

10. Test the operation of the pressure switch by closing the inlet water supply valve. The unit should shut off immediately.

> **CAUTION! If the unit does not shut off, turn the unit OFF immediately to prevent pump damage. Disconnect electrical power source, then check the wiring and replace the switch, if necessary.**

11. Open the inlet water supply valve. The unit should restart and the light should go out.

12. If connected, test the storage tank level control shutdown and the pretreatment lockout function.

Normal Operation

During normal operation, the system usually will start up and shut down based on signals from a level control or pressure switch. Adjust the feed pressure as required (no higher than 150 psig) to maintain a constant product flow. Record the performance data regularly and compare it to the performance on initial start up. If any changes are noticed, the product flow should be normalized to determine if cleaning is required (see Product Flow Calculations in the Service and Maintenance section).

Product Flow Calculations

The product flow rate depends primarily on feed water pressure, product water pressure, and temperature. All Series B units have specified nominal flow rates based on 200 psig net pressure and 77°F temperature. However, in most applications the temperature and pressure are lower, so the product flow rate is lower than the nominal flow rate. The actual flow rate must be converted to flow under standard conditions, then compared to the initial performance (also converted to standard conditions) to determine whether the system is still working properly.

To convert the data to standard conditions,

1. Measure the product flow. Example: 500 ml/min
2. Measure the feed pressure. Example: 175 psig
3. Measure the product pressure. Example: 35 psig
4. Subtract the product pressure from the feed pressure. Example: 140 psig
5. Divide the product flow by the result from step 4. Example: 500 / 140 = 3.57 ml/min/psi
6. Multiply the result from step 5 by 200. Example: 3.57 x 200 = 714 ml/min
7. Measure the temperature of the feed water, then determine the temperature correction factor from Table 2. Example: At a temperature of 55°F , the factor is 1.54.

Temp. °F	Temp. °C	Correction Factor	Temp. °F	Temp. °C	Correction Factor
40	4.4	2.12	75	24	1.04
45	6.7	1.90	80	27	0.95
50	10	1.71	85	29	0.86
55	13	1.54	90	32	0.79
60	16	1.39	95	35	0.72
65	18	1.26	100	38	0.66
70	21	1.14			

Table 2. Temperature Correction Factors

8. Multiply the result of step 6 by the temperature correction factor. Example: 714 ml/min x 1.54 = 1099 ml/min.

NOTICE **To convert ml/min to gallons per day, multiply by 0.38. For example, 1099 ml/min x 0.38 = 417 gpd.**

9. Compare the current standardized flow to the initial standardized flow. If the flow has decreased by 10% or more, it is time to clean the elements.

   Example: If the initial standardized flow was 570 gpd, and the current standardized flow is 470 gpd, the flow has decreased by 100 gpd, or 18% (100/570) = 0.18. The elements should be cleaned.

10. If the problem cannot be corrected with the troubleshooting guide and assistance is required, please have the following information available when calling the WaterGroup dealer:
    - Product flow rate
    - Concentrate flow rate
    - Feed pressure
    - Product water quality
    - Feed water quality
    - Feed water temperature
    - Prefilter outlet (and inlet if the optional prefilter inlet gauge was installed)
    - Product pressure

Process Flow Diagram

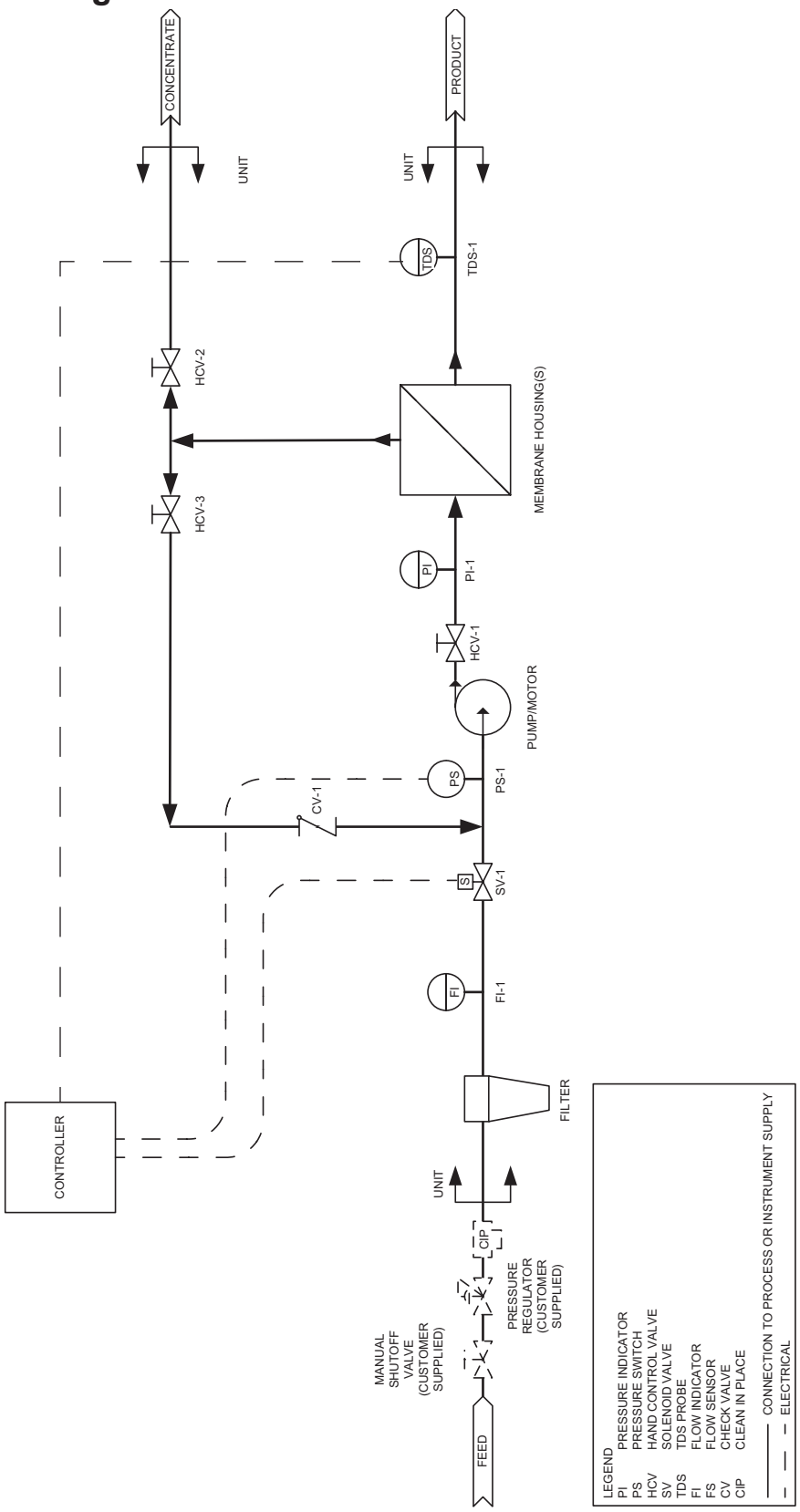


Figure 9

Introduction

The WaterGroup MacRO RO controller is a state of the art control system for commercial and industrial reverse osmosis systems. It combines features that have not previously been available in one compact unit.

The MacRO uses is a microprocessor controlled system that can monitor pressure and level switches. A TDS / Conductivity monitor/controller with programmable Setpoints is an integral part of the controller. This unit displays system status and sensor and switch input status on an easy to read backlit display. User programmable Setpoints are provided that allow fast and easy adjustment of system parameters.

SPECIFICATIONS

Power:
240 VAC -15+10%, 50/60Hz, 25Watts

Environment:
-22/F to 140/F, 0-95% RH, noncondensing

Enclosure:
8” X 6” X 4” (203mm X 152mm X 102mm) NEMA 4X

Display:
2 line X 20 character, alphanumeric backlit LCD

Front Panel:
Overlay with LCD window, alarm lamp, 7 key membrane switch

Switch Inputs, Dry Contact:
- Pressure fault
- Pretreat lockout
- Tank full high
- Tank full low

Relay Outputs:

RO pump relay	240VAC, 1HP
Inlet valve relay	240VAC, 5A
Flush valve relay	240VAC, 5A

Relays supply same output voltage as board power(240 VAC)

Cell:
TDS / Conductivity cell with digital display, standard range, 0-250PPM or uS. Other ranges available:50, 100, 500, 1000, 2500, 5000. Wetted parts ABS and 316SS, 3/4” NPT, 300 PSI max.

Optional I/O expander:

Auxiliary/divert/boost relay	240VAC, 1HP
Divert/alarm relay	240VAC, 5A

Tank low switch input, dry contact

FRONT PANEL CONTROLS AND INDICATORS

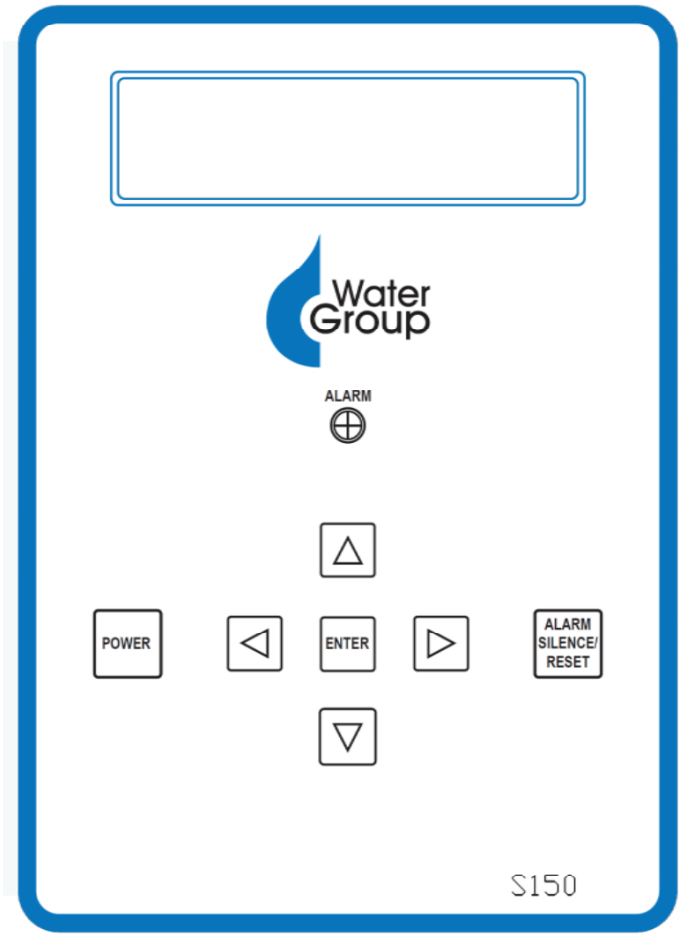


Figure 10

DISPLAY - Shows status of system.

ALARM LAMP -Flashes when fault causes an RO system shut down.
On steady when a Setpoint is exceeded that does not cause an RO system shut down.

POWER KEY - Places controller in operating or standby mode.

LEFT ARROW KEY - Scrolls through Setpoints starting with first Setpoint.

RIGHT ARROW KEY - Scrolls through Setpoints starting with last Setpoint.

UP ARROW KEY - Increases value of Setpoint.

DOWN ARROW KEY - Decreases value of Setpoint.

ENTER KEY - Confirms entry of new Setpoint value

ALARM SILENCE/ RESET KEY - Push once for alarm silence and twice to reset system after a shut down has occurred.

Process Flow Diagram

Pretreat Switch
In systems with pretreatment, a pretreat lockout switch can be connected to the pretreat input of P9. This switch should operate when the pretreatment device is out of service. NOTE: The output from the pretreatment device must be a dry contact and must not supply voltage.

Tank Full Switch
In systems with a single tank level switch for controlling the RO pump, the level switch connects to the tank full high input of P9. If dual level switches are used for controlling the RO pump, the upper level switch connect

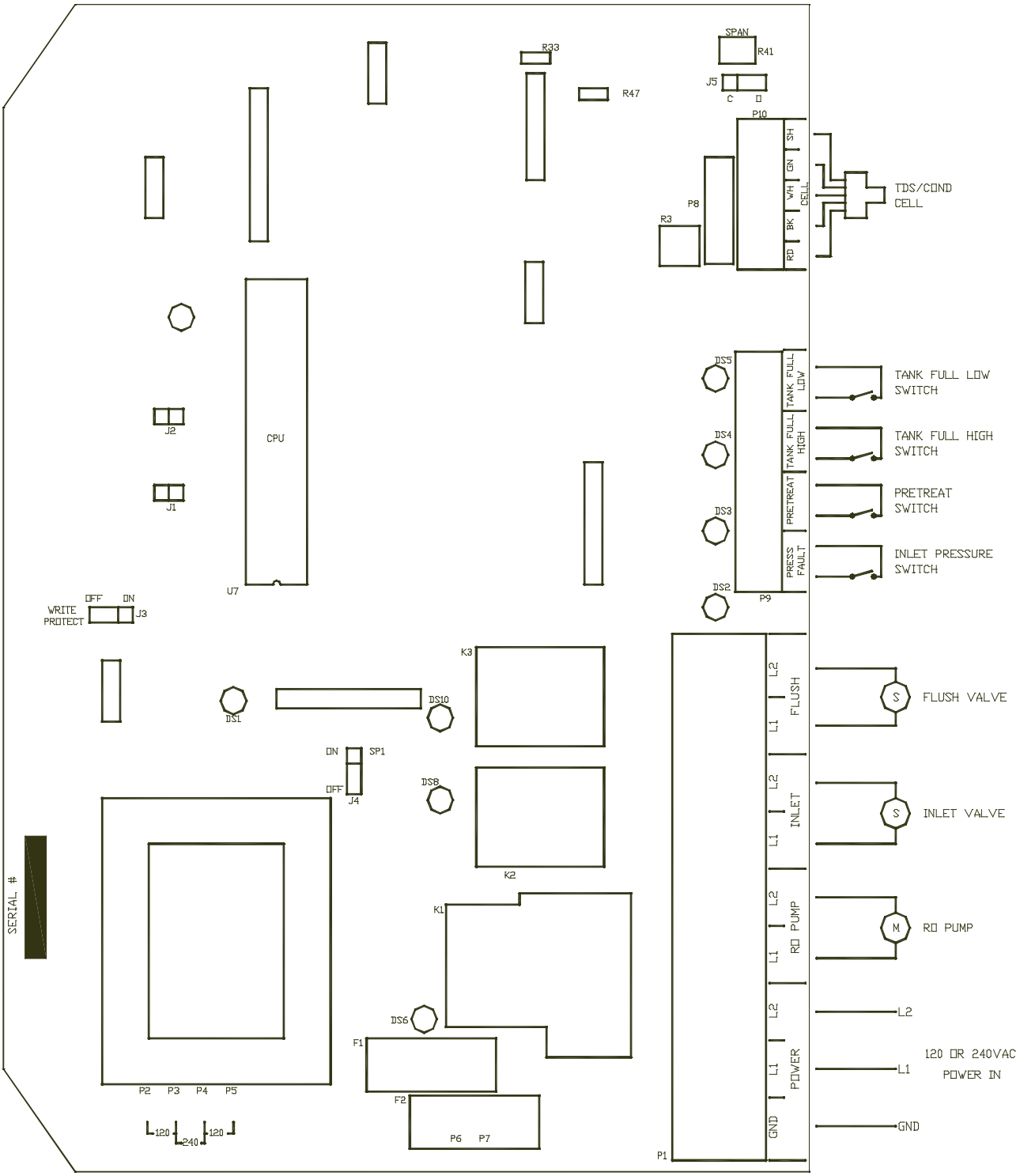


Figure 11

System Operation

General Operation
The unit has 2 modes of operation, a standby mode and an operating mode. In the standby mode, the unit is effectively off. All outputs are turned off and the display shows STANDBY. In the operating mode, the unit operates automatically. All inputs are monitored and the outputs are controlled accordingly. Pressing the Power key will toggle the unit from standby to operate or from operate to standby. If power is removed from the unit, when power is reapplied, the unit will restart in the mode it was in when power was removed.

Display
The display is a 2 line x 20 character backlit liquid crystal display. System operating status and sensor readings are shown on this display. Setpoint information is also shown on this display.

Operating Status Messages
The operating status of the unit is shown on the top line of the display. The following list describes the items shown for the operating status.

STANDBY - The unit is in the standby mode.

DELAY 99 - The unit is in the RO start delay. The number is the seconds remaining before the RO pump starts.

OPERATING - The RO unit is operating.

TANK FULL - The unit is shut down due to a tank full condition.

TANK FULL 99 - The unit is shut down due to a tank full condition. If the number is blinking, the tank full high switch has cleared, but the tank full low switch is still active. If the number is on steady, both tank level switches have cleared and the delay is counting down.

PRETREAT - The unit is shut down due to a pretreat lockout condition.

PRESS FAULT - The unit is shut down due to a pressure fault condition.

MEMB FLUSH 99 - Membrane flush is active. The number is the minutes remaining in the flush cycle.

TDS / Conductivity
The TDS / Conductivity is shown on the top line after the unit operating status. When the unit is offline because of a shut down condition, the reading is replaced with '----' If the reading is over range, the reading is shown as '^^^^'.

Operating Hours
The current operating hours are shown on the bottom line.

Temperature
The current water temperature is shown on the bottom line after the operating hours. When the unit is offline because of a shut down condition, the reading is replaced with '---'.

Warning Messages
Warning messages are also shown on the second line. If any warnings are active, the active warnings will alternate with the normal displays for the bottom line. The following lists the warning messages.

HI TDS / Cond - The TDS / Conductivity reading has exceeded the programmed limit.

TANK LOW - The tank low input is active.

TANK LOW 99 - The tank low input has cleared, but the tank low restart delay is active. The number is the minutes left in the delay.

OP HOURS EXCEEDED - The current operating hours have exceeded the programmed limit.

Tank Full Operation
The unit can be operated with 1 or 2 level switches. With 1 level switch, the switch is connected to the tank full high input. When this switch has been active for 5 seconds, the unit will shut down on tank full. TANK FULL will show on the display. When the tank full condition clears, the display will show TANK FULL 99. The number is the tank full restart time and the unit will restart when this delay times out.

For 2 level switch operation, the upper switch is connected to the tank full high input and the lower switch is connected to the tank full low input. When both switches are clear, the RO unit will run. The RO unit will continue to run when the water level rises and the lower switch becomes active. When the upper switch becomes active, after the 5 second delay, the RO unit will shut down. TANK FULL will show on the display. When the tank level drops and the upper level switch clears, the display will show TANK FULL 99 and the RO unit will remain off. The number is the tank full restart time and the number will blink until the lower level switch clears. When the lower level switch clears, the number will remain steady and the RO will restart when the delay times out.

Tank Full Restart
The tank full restart is the delay before the RO unit starts when a tank full condition clears. This delay can be in minutes or in seconds. The TF Restart Setpoint selects seconds of minutes.

Tank Full Override
A timed tank full override can be initiated when the RO unit is shut down due to a tank full condition. Pressing the Alarm Silence/Reset key for 3 seconds during a tank full condition will enable the tank full override. The RO will start and TF OVERRIDE 9 will show on the display. The number is the minutes remaining in the override timer. When the override times out, the unit will return to the tank full shut down condition.

Pressure Fault
If the pressure fault input becomes active and stays aftive for the delay programmed in the PF Delay Setpoint, the unit will shut down for a pressure fault. The display will show PRESS FAULT, the alarm lamp will flash and the audible alarm will sound. The pressure fault can be cleared by pressing the Alarm Silence/Reset key twice.

Auto Reset
If a pressure fault shut down occurs and the Auto Reset Setpoint is programmed to 0, the unit will remain shut down until manually reset. If the Auto Reset Setpoint is programmed to a value greater than 0, the unit will automatically clear the pressure fault and attempt to restart after this delay times out.

Alarm Silence
When a shut down occurs that causes the audible alarm to sound, the alarm can be silenced by pressing the Alarm Silence/Reset key once. The alarm will remain silenced if the Alarm Silence Setpoint is programmed to 0. If the Alarm Silence Setpoint is programmed to a value greater than 0, the alarm will resound after this delay times out. Pressing the Alarm Silence/Reset key will silence the alarm and reset this delay.

Pretreat
If the pretreat input becomes active and stays active for 2 seconds, the unit will shut down in a pretreat lockout condition. PRETREAT will show on the display and the unit will remain shut down as long as the pretreat input is active.

Membrane Flush
If ths Flush Type Setpoint is programmed to 0, flush is disabled. If membrane flush is desired, several types of flush are available. When the unit enters a flush cycle, the flush relay will activate. The flush cycle will last for the time programmed in the Flush Time Setpoint. Table 3 shows the value that must be programmed in the Flush Type Setpoint for each type of flush.

Membrane Flush
If ths Flush Type Setpoint is programmed to 0, flush is disabled. If membrane flush is desired, several types of flush are available. When the unit enters a flush cycle, the flush relay will activate. The flush cycle will last for the time programmed in the Flush Time Setpoint. Table 3 shows the value that must be programmed in the Flush Type Setpoint for each type of flush.

Flush Type	Description
0	No Flush
1	Tank Full
2	Operating Hours
3	Operating Hours and Tank Full
4	Elapsed Time
5	Elapsed Time and Tank Full
6	Off Hours
7	Off Hours and Tank Full
8	RO Start/Stop

Table 3

TANK FULL - The RO unit will flush each time a tank full condition occurs.

OPERATING HOURS - A flush will occur when the RO pump has operated for the number of hours programmed in the Flush Interval Setpoint.

ELAPSED TIME - A flush will occur after the number of hours programmed in the Flush Interval Setpoint has passed.

OFF HOURS - A flush will occur when the RO has been shut down due to a tank full condition for the number of hours programmed in the Flush Interval Setpoint.

RO START/STOP - A flush will occur each time the RO starts or stops. The tank full flush can be combined with any of the 3 interval flush A manual flush can be initiated by pressing the Alarm Silence/Reset key for 3 seconds.

Flush Mode
The Flush Mode Setpoint can be used to control the operation of the inlet valve and RO pump during flush. Each can be independently programmed to operate during flush. Table 4 shows the values to program into the Flush Mode Setpoint to control the operation of the inlet and RO outputs during flush.

Flush Mode	RO PUMP	INLET VALVE
0	OFF	CLOSED
1	OFF	OPEN
2	ON	CLOSED
3	ON	OPEN

Table 4

High TDS / Conductivity Warning/Alarm
Tf the TDS / Conductivity reading exceeds the limit programmed the TDS / Cond Limit Setpoint for the delay programmed in the TDS / Cond Delay Setpoint, the alarm lamp will light and the HI TDS / Cond warning message will show on the display. This warning will clear when the TDS / Conductivity drops below the Setpoint. If the TDS / Cond Shtdwn Setpoint is programmed to 0, the unit will continue to operate. Otherwise, once a high TDS / Cond warning occurs, after the time programmed in this setpoint, the RO unit will shut down and the alarm will sound. The alarm can be cleared by pressing the Alarm Silence/Reset key twice. NOTE: the auto reset function is not active for this shut down.

Operating Hours Exceeded
If the current hours exceed the limit programmed in the Maximum Hours Setpoint, the alarm lamp will light and the OP HOURS EXCEEDED warning message will be shown. This warning can be cleared by programming the current hours to 0 or by increasing the maximum hours limit.

I/O Expander
The I/O Expander board addes 2 relays and 1 switch input. The operation and programming of the 2 relays is described in teh installation section.

Auxiliary Output
Relay 1 can be used to control a repressurization pump when relay 1 of the expander board is configured to operate an aux relay. In this mode, this relay will be energized as long as the tank low input is not active. When energized, the relay supplies power to the repressurization pump

Tank Low
When the tank low input has been active for 5 seconds, the auxiliary output will turn off. The alarm lamp will light and the TANK LOW warning message will show on the display. When the tank low condition clears, the TANK LOW 99 warning message is displayed. The number is the delay in minutes before the auxiliary relay will energize.

For boost pump operation, when the tank low input has been active for 5 seconds, the boost pump output will turn off, the RO unit will shutdown, the alarm lamp will flash and the audible alarm will sound. TANK LOW shutdown message will show on the display. When the tank low condition clears, the TANK LOW 99 shutdown message is displayed. The number is the delay before the RO unit will restart. The shutdown can be manually reset by pressing the Alarm Silence/Reset button twice.

Boost Pump Output
Relay 1 can be used to control a boost pump when the expander board is configured to operate relay 1 as boost pump relay. This relay will operate the same as the inlet solenoid relay. This option is used to directly operated a boost pump up to 1 HP

Divert Output
When relay 1 or relay 2 has been programmed to operated as a divery relay, the relay will energize when the TDS/Conductivity exceeds the TDS/ Cond Limit Setpoint. This will occur as soon as the reading exceeds the limit, there is no delay. When the reading drops below the limit and stays below the limit continuously for 5 seconds, the divery relay will turn off.

Alarm Output
When realy 2 has been programmed to operate as an alarm relay, the relay will energize whenever a warning or alarm condition occurs. The relay will remain energized as long as the warning/alarm condition is active.

Adjustments

TDS/Conductivity Calibration
Refer to figure 11 for adjustment location. To calibrate the TDS / Conductivity, place the cell in a known standard solution. Adjust the span adjustment for the correct reading. If the cell is installed, the unit can be calibrated by taking a sample of the permeate water and testing it with a known, good meter. Adjust the span control until the reading matches the meter. NOTE: If the TDS / Cond range is changed, the unit must be recalibrated AND some components may need to be changed.

Display Adjustment
The display contrast can be adjusted for best viewing by adjusting control R3. This control is located toward the upper right corner of the board, just to the left of the cell connector.

Installation

Physical Installation
Mount the controller in a convenient location on the RO equipment using the four mounting ears provided with the unit or the optional panel mounting bracket.

NOTE: All terminals on the board are labeled.

Terminal Strip, Jumper and Adjustment Locations
Refer to figure 2 for the location of all terminal strips and connectors. Figure 2 also shows all jumper and adjustment locations. Figure 3 shows a sample wiring diagram.

Power Wiring
Refer to figure 2-3 for terminal strip and jumper locations. Before applying power to the unit, verify that the voltage jumpers are configured correctly for the voltage that will power the unit. The voltage jumpers are located below the transformer. A single wire jumper should be installed between P3 and P4.

AC power for the unit is connected to terminal strip P1. Connect the ground wire of the AC power to the terminal labeled GND. For AC power with a neutral and hot wire, the hot wire connects to L1 and the neutral wire connects to L2. For AC power with 2 hot wires, either wire can connect to L1 and L2. On AC power with 2 hot wires, the wire jumper between P6 and P7 should be removed and a fuse(GMA 1/4A) installed in F2.

Pump and Valve Relay Outputs
The controller supplies relay outputs to control the RO pump and solenoid valves. NOTE: The relays output the same voltage as the AC power to the board. If the pump and solenoids operate on different voltages, a contactor will need to be supplied to operate the pump.

RO Pump Wiring
The RO pump connects to the L1 and L2 RO pump terminals of P1. This output can operate 240VAC motors up to 1HP directly. For motors larger than 1HP or 3 phase motors, this output can be used to operate a contactor.

Inlet and Flush Valve Wiring
The inlet and flush valves must operate at the same voltage as supplied to the board. These outputs can supply 5A maximum and are not designed to operate pump motors directly. If these outputs are to be used to operate a boost or flush pump, the output should be used to operate a contactor. The inlet valve connects to the L1 and L2 inlet terminals of P1. The flush valve connects to the L1 and L2 flush terminals of P1.

TDS / Conductivity Cell Wiring
For accurate TDS / Conductivity readings, the cell should be installed in a tee fitting where a continuous flow of water passes over the cell and no air can be trapped around the cell. Refer to figure 5 for example installation. The cell is connected with 5 wires to terminal strip P10. Connect each colored wire to the terminal labeled with the same color.

Switch Inputs
Switch inputs are connected to P9. The connections for these inputs are not polarity sensitive and can be connected to either terminal. The switch inputs should be dry contact closures only. NOTE: Applying voltage to these terminals will damage the controller. The switches can be either normally open or normally closed in any combination. The switch connected to an input that is configured as normally open must be open for the unit to run. The switch connected to an input that is configured as normally closed must be closed for the unit to run. The Switch Select Setpoint allows each input to be configured as normally open or normally closed. The Switch Select Setpoint is defaulted to 0 which programs all inputs as normally open. This means that all switch inputs must be open for the unit to run. Table 1 lists the values used to program the Setpoint to configure the inputs.

SWITCH	N.O.	N.C.	VALUE
PRESSURE FAULT	0	1	
PRETREAT	0	2	
TANK FULL HIGH	0	4	
TANK FULL LOW	0	8	
TANK LOW	0	16	
		TOTAL	

Table 5

Select the type of switch used for each input and put that number in the value column. Add the values and programs the total in the Switch Select Setpoint. For example, if the pressure fault and tank low inputs were normally closed and all others normally open, the value programmed in the Switch Select Setpoint would be 17 (1 + 16).

Pressure Faults Switch
On systems where a low feed pressure shut down is required, a feed pressure switch can be connected to the pressure fault input of P9. If a high pump pressure shut down is required, a high pressure switch can be connected to this input. If both low feed pressure and high pump pressure shut down are required, both switches can be connected to this input. Both switches must be either normally open or normally closed to operate properly.

I/O Expander Board
If the optional I/O expander board is installed, 2 additional relay outputs and 1 additional switch input are provided. Refer to figure 4 for the location of terminal strips, jumpers and wiring for this board. AC power for the relays is connected to the L1 and L2 power terminals of P1. Relay 1 is connected to this power input and will supply the same voltage. This relay is rated for 240VAC at 1HP maximum. Relay 1 can be configured to supply a dry contact by connecting a jumper wire between the L1 and L2 power terminals of P1. NOTE: If Relay 1 is configured as a dry contact, Relay 2 must be configured as a dry contact also. If Relay 1 is configured to supply voltage, Relay 2 can be selected to supply voltage, 240, 5A maximum, or as a dry contact output. Jumpers J1-J4 are used to select the relay 2 output type. To output voltage, a wire jumper is installed between J1 and J4 and a second wire jumper is installed between J2 and J3. For a contact closure output, a single wire jumper is installed between J3 and J4. The 2 relay outputs can be selected to operate as an auxiliary pump output, a divert output or an alarm output by programming the Expander Mode Setpoint. Table 2 shows the values used to program the relay outputs.

EXPANDER MODE	RELAY 1	RELAY 2
0	AUXILIARY PUMP	DIVERT
1	AUXILIARY PUMP	ALARM
2	DIVERT	ALARM
3	BOOST	DIVERT
4	BOOST	ALARM

Table 6

Auxiliary Pump
If the Expander Mode Setpoint is programmed to 0 or 1, relay 1 operates as an auxiliary pump output. This output is energized when the tank low input is not active. This output will supply power or a contact closure determined by the connections L1 and L2 of the terminal strip P1.

Boost Pump
If the Expander Mode Setpoint is programmed to 3 or 4, relay 1 operates as a boost pump output. This output is energized when the inlet solenoid output is active. This output will supply power or a contact closure determined by the connections L1 and L2 of the terminal strip P1.

Divert Output
If the Expander Mode Setpoint is programmed to 0 or 3, relay 2 operates as a divert relay and will operate whenever the unit is in the divert mode. This output will supply voltage or provide a contact closure based on the configuration of the relay 1 and on the position of jumpers J1-J4. If the Expander Mode Setpoint is programmed to 2, relay 1 operates as a divert relay and will operate whenever the unit is in the divert mode. This output will supply power or a contact closure determined by the connections L1 and L2 of the terminal strip P1.

Alarm Output
If the Expander Mode Setpoint is programmed to 1, 2 or 4, relay 2 operates as an alarm relay. When an alarm or warning is active, this relay will supply voltage or provide a contact closure based on the configuration of relay 2 and the position of jumpers J1-J4

Tank Low Switch
A tank low switch input can be connected to the tank low input of P2 on the expander board. This input will provide a tank low warning on the unit and if the expander is programmed to provide an auxiliary pump output, will provide low tank level protection for this pump.

Standard Setpoints

Setpoint	Description	Range	Default
TDS / Cond Limit	When this value is met or exceeded, the alarm lamp with light and high TDS / Cond will show on the display. To disable, set to 0.	0-999 uS or PPM	100
TDS / Cond Delay	When the limit Setpoint is exceeded, no alarm will be given until this time has expired.	0-999 seconds	30
TDS / Cond Shtdwn	One a TDS / Cond alarm is active, if the time in this exceeded, a TDS / Cond shut down will occur. To disable, set to 0.	0-99 minutes	0
RO Start Delay	The amount of time between the inlet valve opening and the RO pump start.	0-99 seconds	5
Press Fault Delay	The time a pressure fault must be active before a pressure fault shut down occurs.	0-99 seconds	5
Auto Reset	When a pressure fault shut down is active, the system wil lattempt to restart after this delay. If set to 0, system must be manually reset.	0-99 minutes	60
Alarm Silence	If the audible alarm is silenced, after this delay, the alarm will resound. If set to 0, the alarm will remain silenced.	0-99 minutes	0
TF Restart Delay	When a tank full condiotin clears, the system will restard after this delay.	0-99 sec/min	5
TF Restart	Selects whether the tank full restart delay is in seconds or minutes. 0=seconds, 1=minutes.	0-1	0
TFO Time	The amount of time that a tank full override lasts.	0-9 minutes	5
Tank Lo Restart	When a tank low condition clears, the auxilary pump will restart after this delay.	0-99 minutes	15

Setpoint	Description	Range	Default
Flush Type	Selects the type of flush. Set to 0 to disable flush.	0-8	0
Flush Time	The length of time a membrane flush cycle will last when a flush is active.	0-99 minutes	5
Flush Interval	The interval between flush cycles. Only valid with op hour, elapsed time or off flush types.	0-99 hours	24
Flush Mode	Selects if the inlet and RO pump relays operate during flush.	0-3	0
Maximum Hours	If the current operating hours exceeds this limit, the operating hours warning will occur. To disable, set to 0.	0-65000 hours	0
Current Hours	Current numbers of hours of RO system operation.	0-65000	0
Expander Mode	Selects how the relays on the I/O expander board operate.	0-4	0
Temp Offset	Allows adjustement of temperature reading by +-5 degrees.	-5 - +5	0
Temp UOM	Selects display of temperature in °F or °C	0-1	0
Switch Select	Selects if switch inputs are normally open or normally closed.	0-32	0
TDS/Cond UOM	Selects display of water quality in uS or PPM NOTE: If this Setpoint is changed, the unit must be recalibrated.	0-1	0
TDS/Cond Range	Selects range of TDS / Conductivity monitor 0-50, 1-100, 2-250, 3-500, 5-2500, 6-500 NOTE: If this Setpoint is changed, the unit must be recalibrated and may require some components be changed.	0-6	2

To Display or Change Setpoints

1. Refer to figure 1 for the location of the keys used to display or change the Setpoints and figure 2 for the location of the write protect jumper, J3. For the unit to be able to accept a change in a Setpoint, the shorting jumper must be in the off position(center and left pins).

NOTE: Setpoints cannot be changed if the write protect jumper is in the ON position.

2. Use the Left and Right arrow keys to display the Setpoints. Each press of an arrow key will advance the display to the next Setpoint. The Left arrow key starts with the beginning Setpoint and the Right arrow key starts with the last Setpoint.

3. The Up and Down arrow keys are used to increment or decrement the Setpoint value. The value will change by 1 count each time a key is pressed. If the key is pressed and held for ~1 second, the Setpoint value will change at a fast rate. When the key is released, the fast rate will be reset. Pressing both the Up and Down arrow keys together will reset the Setpoint value to 0.

4. Pressing the Alarm Silence/Reset key at any time will cancel the operation and return the display to the main screen.

5. To accept the new Setpoint value, press the Enter key.

6. The unit will beep twice if the change is accepted. If the write protect jumper is on, the unit will show WRITE PROTECTED on the display and one long beep will sound.

7. When finished changing Setpoints, the write protect jumper should be placed in the on position(center and right pins).

TDS/ Conductivity Expander

Installation / Wiring

The TDS / Conductivity expander board allows a 2nd TDS / Conductivity to be monitored an displayed by the controller. The expander board is mounted on the main board to the left of the connector for the 1st cell. Figure 13 shows the wiring and adjustment information for the expander.

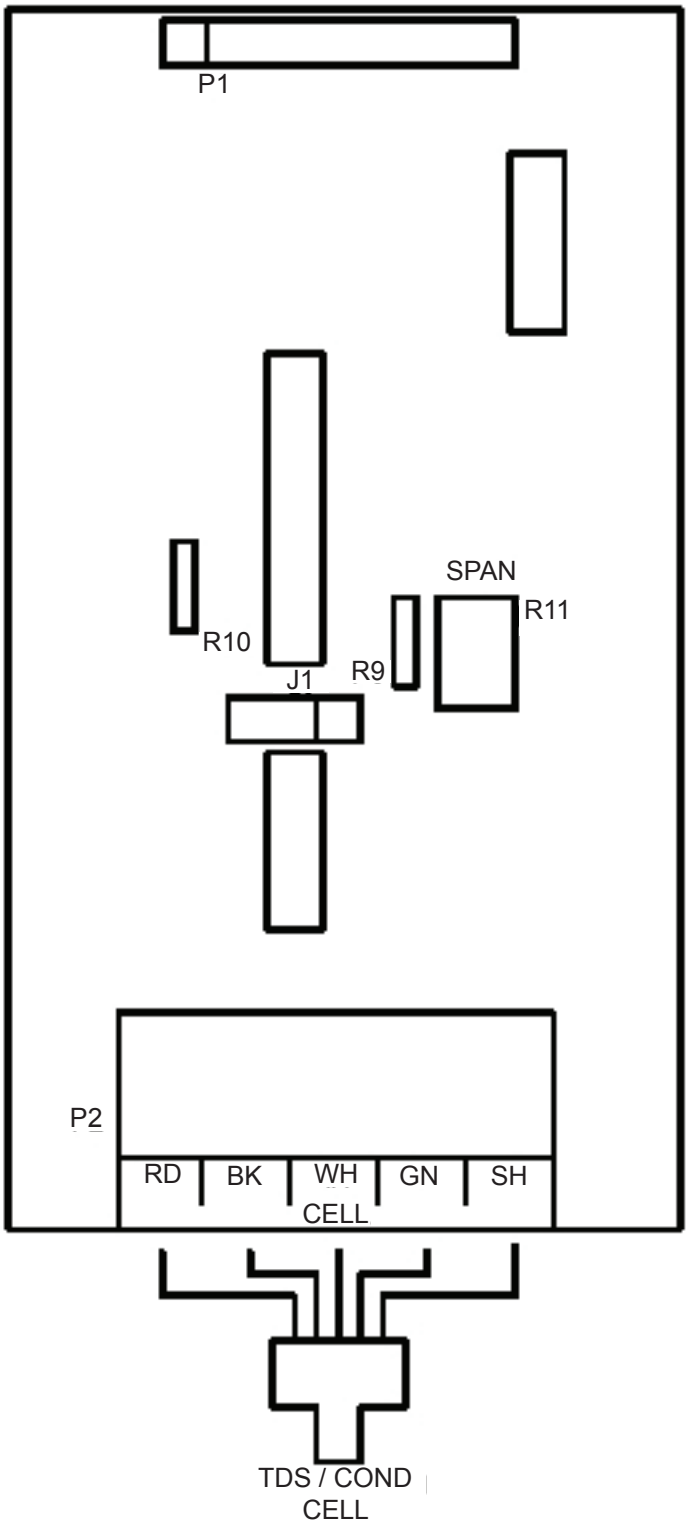


Figure 13

Setpoints

When the expander is installed, 3 additional setpoints are provided to allow features of the expander to be changed. Refer to Displaying of Changing Setpoints section of the manual on page 27 for information on changing the setpoints. The additional setpoints are listed below.

Setpoint	Description	Range	Default
C2 Range	Selects range of TDS / Conductivity monitor 0-50, 1-100, 2-250, 3-500, 4-1000, 5-2500, 6-5000 NOTE: If this Setpoint is changed, the unit must be recalibrated and range components may need to be changed.	0-6	2
C2 Limit	When this value is met or exceeded, the alarm lamp with light and high TDS / Cond will show on the display. To disable, set to 0.	0-999 uS or PPM	100
% Rej	If the 2nd TDS / Conductivity is used to monitor 0-1 feed water, programming this setpoint to 1 allows the $ rejection to be displayed.	0-1	0

Operation
When the TDS/ Conductivity expander is installed, the reading will be shown on line 2 and will alternate every 3 to 4 seconds with the hours and temperature. If the % rejection display is enabled, it will be down on line 2 with the 2nd TDS / Conductivity reading.

If the C2 limit is enabled, and the 2nd TDS / Conductivity reading exceeds the limit programmed the C2 Limit Setpoint for the delay programmed in the TDS / Cond Delay Setpoint, the alarm lamp will light and the HI TDS / Cond 2 warning message will show on the display. This warning will clear when the 2nd TDS / Conductivity drops below the Setpoint.

Calibration
Refer to Figure 13 for adjustment location. To calibrate the 2nd TDS / Conductivity, place the cell in a known standard solution. Adjust the span adjustment for the correct reading. If the cell is installed, the unit can be calibrated by taking a sample of the water and testing it with a known, good meter. Adjust the span control until the reading matches the meter.

Troubleshooting

Problem	Probable Cause	Solution
1. Unit does not start.	A. No power to unit.	A. Check circuit breaker.
	B. Low feed pressure.	B. Correct low pressure condition.
	C. Inlet solenoid failure	C. Replace solenoid
	D. Prefilter fouled.	D. Replace cartridge
2. Unit running but not holding high pressure.	A. Pump malfunction.	A. Replace pump.
	B. System pressure control valve malfunction.	B. Replace valve.
	C. Concentrate flow too high.	C. Check and adjust concentrate flow, replace tubing on A.
	D. Product flow too high.	D. Test modules.
3. Unit running but poor quality (less than 95% rejection)	A. Low pump pressure.	A. See 2.
	B. Module failure.	B. Replace modules. Check product line over pressurization.
	C. Concentrate throttling valve open.	C. Throttle valve down.
	D. Poor seal on endcap or membrane.	D. Check o-rings inside endcap. Replace o-rings if necessary. Check membrane sealing surface for debris. Check membrane O-ring and replace if necessary.
4. Low quantity of product water.	A.-D. Same as 3.	A.-D. Same as 3.
	E. Cold water.	E. Install additional modules.
5. Excessive noise.	A. Air in the plumbing.	A. Check fittings for leaks. Purge air from system.
	B. Misaligned pump.	B. Remove pump and check for bearing wear.
	C. Harmonic vibration.	C. Install a pressure regulator ahead of the prefilter.
	D. Low feed pressure.	D. Increase feed pressure above 20 psig.
6. Inadequate product pressure (direct feed systems)	A. Low quantity of product water.	A. See 4.
	B. Demand for product water exceeds unit capacity.	B. Install additional modules.

Controller Troubleshooting

CAUTION: Hazardous voltages are present when power is applied to the unit. Care should be taken when troubleshooting any of the input power or output circuits. When disconnecting or connecting any board or accessory, be sure power is turned off at the disconnect. Before contacting WaterGroup for technical help, verify the programming of all Setpoints, check the display and check the status of all lights and indicators. The more information available when you contact us, the easier it will be to determine the source of the problem.

Problem	Probable Cause	Solution
No Power to Unit	Failed Fuse	Check fuse - replace if necessary
	Faulty Wiring	Check power to circuit board - repair wiring if necessary
Display Blank	No Power	See above
	Contrast Too Low	Adjust contrast setting until display becomes visible
Inlet Valve Not Functioning	Faulty Wiring	Check wiring to inlet valve solenoid - repair wiring if necessary
	Faulty Valve	Check that valve functions normally when power is applied - replace valve if necessary
Pump Not Functioning	Faulty Wiring	Check wiring to pump - repair wiring if necessary
	Faulty Pump	Check that pump functions normally when power is applied - replace pump if necessary
Not Flushing or Not Flushing Completely	Flush Disabled	Enable Flush
	In Alarm Lockout Mode	Press & hold Alarm Silence for 3 seconds - unit should display "Flush"
	Faulty Wiring	Check power to flush valve solenoid - repair wiring if necessary
	Faulty Valve	Check that valve functions normally when power is applied - replace valve if necessary
No/Incorrect TDS Reading	Faulty Wiring	Check wiring to TDS sensor - repair wiring if necessary
	Incorrect Sensor Installation	Check that the TDS sensor is installed per the installation instructions - reinstall if necessary
	Faulty Sensor	Check if TDS reading is 0 when sensor is disconnected and when sensor is removed and dry. Check if TDS reading is "^^^^" when sensor pins are shorted. If either requirement is not met the sensor is faulty.
If none of the above corrective measures work it is possible that the circuit board is defective - As a final measure if no other solution works, replace the circuit board.		

Prefilter Cartridge Replacement

The prefilter cartridges should be changed when the pressure drop across the prefilter increases by 15 psi (103 kPa). Refer to the diagram in the installation section.

CAUTION! The pressure after the prefilter should not be less than 20 psi (138 kPa), or the pump might be damaged.

Replacing the Prefilter Cartridge

1. Disconnect power to the unit, then shut off the inlet water supply.
2. Unscrew the filter bowl.
3. Remove the old cartridge.
4. Clean the filter bowl with a damp cloth, rinse thoroughly.
5. Remove the wrappers from a new cartridge. Install the cartridge in the bowl, making sure it seats in the bottom of the bowl.
6. Check the O-ring seal for dryness and cuts. Replace the seal if necessary and use silicone lube as needed.

CAUTION! Do not use petroleum-based lubricants, because they destroy the synthetic rubber seal.

7. Screw the filter bowl back onto the filter head.
8. Turn on the inlet water supply.

Membrane Replacement

Replace an element that has been damaged or cannot be cleaned. See Figure 14.

1. Disconnect power to the unit. Allow pressure to be completely relieved. Turn main feed line to RO off.
2. Remove retaining rings from both ends of all vessels.
3. Remove end caps from all vessels, with the tubing remaining in place. Note placement the caps to assure re-installation in the same orientation.
4. Remove the RO element from the housing. Note orientation of membranes to assure re-installation in same orientation. Flow direction is indicated by the arrow on the outside of the membrane vessel.
5. Check the O-ring seals on the element and end plug, and the element brine seal for damage. If an O-ring is cut or crimped, it may have caused high flow and poor quality. Replace the O-rings and retest before replacing the entire element.
6. Remove a new element from its plastic bag. Lightly lubricate the O-rings with a silicone-based lubricant or use a mixture of 70% glycerin and 30% water.

CAUTION! DO NOT use a petroleum-based lubricant, because it will damage the synthetic rubber and the membrane.

7. Make sure the brine seal is located in the direction of the incoming feed to that vessel according to the flow arrow and the original membrane orientation.
8. Lubricate the O-ring on the end plugs with a silicone-based lubricant or use a mixture of 70 percent glycerin and 30 percent water. Re-install the end plugs in to the vessels same as the original orientation. Reinstall the retaining rings.
9. Refer to the section on Initial Startup for information on flushing the shipping solution form the new elements.

NOTE Do not forget to enter the new values for flow, pressure, temperature, and TDS.

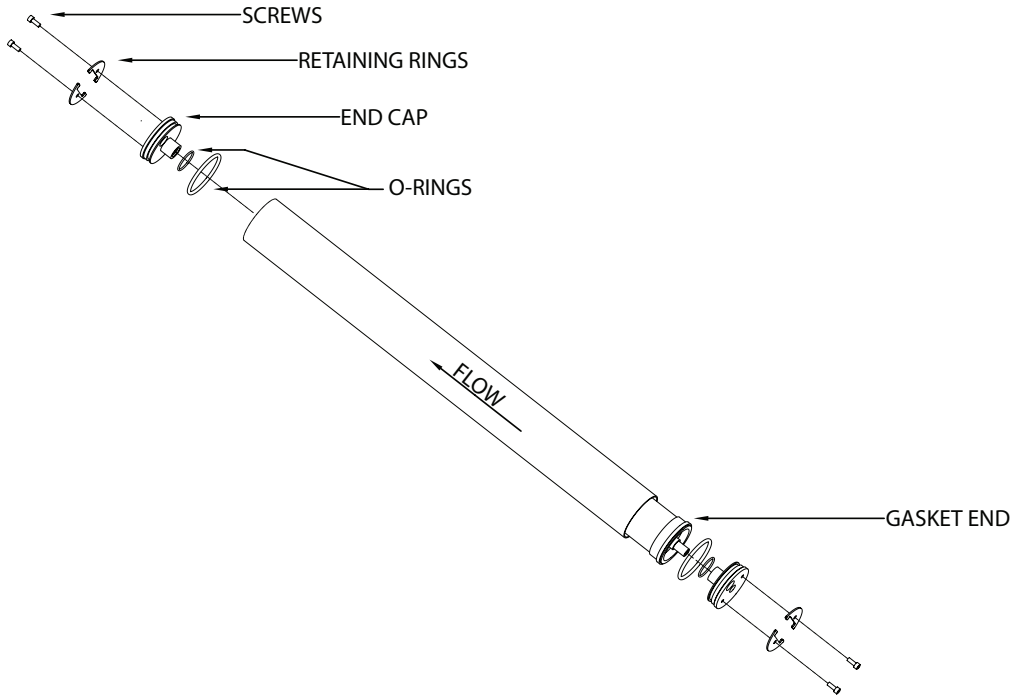


Figure 14. MacRO membrane.

Pump Replacement

The most common cause of pump failure is inadequate pressure to the pump inlet. Therefore, correct any low inlet pressure problem before replacing the pump to prevent damage to the new pump. Replace the pump when it cannot develop the pressure required to maintain the desired product flow rate, up to the maximum pump pressure of 150 psig.

To replace the pump:

1. Disconnect power to the unit, then shut off the inlet water supply.
2. Remove the tubing from the pump inlet and outlet.
3. While holding the bottom of the pump with one hand, loosen the screw on the coupling band securing the pump to the motor. The pump will drop down. Remove the coupling band.
4. Examine the pump shaft. If it is broken or rounded, remove the old shaft and install a replacement shaft. Examine the slot in the motor. If the slot is damaged, replace the motor.
5. Remove the plumbing fittings from the old pump, apply fresh Teflon tape, and install the fittings in the new pump. (Skip this step if replacing only the shaft.)
6. Place the coupling band over the shaft end of the new pump. Insert the pump shaft into the slot in the motor.
7. Observe the alignment of the pump against the motor, making certain the pump and motor flanges are in complete contact and are not skewed.
8. Make sure the clamp is fully seated around the entire circumference of the pump and motor flanges. Tighten the coupling screw fully, then loosen the screw 1/4 to 1/2 turn.
9. Rotate the pump so that the inlet and outlet ports point to the right. Verify that the pump is still aligned properly to the motor.

CAUTION! If the pump is not properly aligned, the pump bearings will wear prematurely.

10. Tighten the coupling screw using 15 to 30 inch-pounds of torque, then attach the inlet and outlet.

Motor Replacement

1. Disconnect the pump from the motor as outlined in steps 1-4 in pump replacement section.
2. Disconnect the motor cord from the old motor.
3. Remove the pump and motor assembly from the mounting bracket by removing the four (4) nuts, lock-washers and washers, holding the motor onto the motor mounts.
4. Mount the new motor onto the motor mounts and secure with nuts and washers.
5. Wire the motor cord connections to the new motor as indicated on the wiring schematic on the motor label for 220 volt operation.
6. Reinstall the pump, fittings and tubing following steps 7 through 10 as outlined in the pump replacement section.

NOTICE Some replacement motors may be prewired for 110 Volt operation at shipment. Refer to wiring schematic on the motor label and verify that the motor is wired for 220 Volt operation.

Sanitizing Modules

The modules may need sanitizing if either of the following conditions exist:

- The RO system is subject to biofouling and the operator wants to reduce the cleaning frequency.
- The water treatment application limits the microbial count in the product water.

CAUTION! The bottom of the tank must be higher than the pump on the RO unit to prevent cavitation of the pump when solution is drawn from the tank.

NOTICE Replace the prefilter cartridges if they are discolored by iron.

The frequency of sanitization will depend on the frequency of biofouling or excess microbial counts. Once the frequency of the problem has been determined, sanitization can be scheduled for preventative maintenance. To sanitize the system, obtain a tank which will hold the sanitizing solution volume.

CAUTION! DO NOT sanitize the system during the first 24 hours of operation. Formaldehyde will cause a significant decrease in product flow with new elements.

1. Disconnect power to the unit.
2. Disconnect the product tubing from the service line and direct it into a ten gallon bucket.
3. Plug in the unit and press the RUN NOW button. Fill the bucket with product water to the 4 gallon mark, then disconnect power to the unit.
4. Direct the product tubing to drain, plug in the unit, and then press the RUN NOW button. Open (counterclockwise) the system pressure control valve until the system pressure is approximately 50 psig. Disconnect power to the unit.
5. Add one litre of 37% formaldehyde solution to the bucket. Mix the solution well.

CAUTION! Always use caution when handling any chemical. Refer to the material safety data sheet for recommendations in the safe handling of this chemical. The MSDS is available from the manufacturer of the chemical. Use the proper protective safety equipment.

6. Turn off the inlet water supply.

CAUTION! Local codes may prohibit the discharge of hazardous materials to drain. If necessary, an extra tank can be used to neutralize the solutions before discharge to drain.

7. Remove wires from terminals labeled PRESS SW, located next to the power button. Install a jumper wire across those two terminals. You many also need to jumper the TANK FULL terminals if a tank level switch is being used and the tank is full
8. Disconnect the inlet tubing from the prefilter and run a section of tubing from the prefilter inlet into the sanitization solution. Raise the bucket so that the bottom of the bucket is higher than the pump.
9. Plug in the unit and press the power button. Allow the unit to draw in all but about 1/2” of the sanitizing solution. Do not allow air to be drawn into the system.

CAUTION! If the unit vibrates severely, the pump may be cavitating. Disconnect power to the unit**. Raise the bucket to ensure adequate pressure to the pump.**

10. Disconnect power to the unit.
11. Allow the unit to sit undisturbed for at least two hours.

NOTICE If the unit is going to be left unused for up to three months, allow the solution to remain in the unit. If the unit will remain unused for longer than three months, sanitize the unit every three months.

12. To flush the unit, reconnect the inlet tubing to the prefilter and plug in the unit. Press the power button. Slowly close (clockwise) the system pressure control valve until the system operating pressure increases to the normal pressure. Increase pressure no faster than 5 psi per second.
13. Allow the unit to run for at least 30 minutes to drain. Check the product water for formaldehyde using a Formalert test or equivalent. Continue rinsing until the formaldehyde level is lower than 5 parts per million (5 mg/L) and until the pH for the concentrate and product remains stable for five (5) minutes.
14. Disconnect power to the unit. Reconnect the product tubing to the service line. Remove the jumper(s) installed in Step 7 and reconnect the pressure switch. The system is now ready for use.

Testing

If the product flow calculations show a loss of flow, or the product quality has become poor, one or more elements will require cleaning or replacement. Because poor performance might be due to only one element, test the product flow and quality from individual housings.

To test each element:

1. Disconnect the product tubing from the housing to be tested.
2. Plug in the unit, then press the power button. Measure the product flow and TDS from the test element.
3. Disconnect power to the unit and reinstall the tubing.
4. Continue testing the elements as needed to determine which should be cleaned or replaced.

Cleaning

During the operation of any reverse osmosis system, dissolved solids and particulate matter are concentrated inside the module element. If these contaminants are present in relatively low concentrations, the concentrate flow from the system flushes them to drain. In most cases, water pretreatment such as filters and softeners will prevent the deposit of these contaminants.

When these deposits occur, there will be a decrease in the product water flow and quality. When these symptoms become excessive, the modules must be cleaned before they are permanently damaged.

To determine when cleaning is needed, compare the current system performance to the performance of the system when the reverse osmosis elements were new. Use Table 3 to obtain data and compare the performance of the system, "new" and "now" (record the data in pencil).

Test Data	Feed		Product		Concentrate	
	New	Now	New	Now	New	Now
Flow (gpm)						
TDS (ppm)						
Pressure (psi)						
Temp. (°F)						

Table 3. System performance—new vs. present.

NOTICE	**If new data is not available, use the specifications listed earlier in these instructions. However, keep in mind that the new elements may have exceeded these specifications, so performance may have decreased even if the unit still exceeds specifications.**

In addition to differences in product flow and quality (TDS), determine whether there were any changes in concentrate water flow, feed water TDS, feed water temperature and feed or product pressures. Changes in these values provide clues to indicate the cause of any problems with the product water.

If there were changes in feed water temperature or pressure, the product water flow rates will have to be converted to flow rates under standard conditions (77° F and 100 psig) in order for any comparison to be valid. Refer to the Product Flow Calculation section to calculate flow rates under standard conditions, then compare the converted values. A decrease in the product water flow may have been due only to a decrease in temperature or pressure, in which case cleaning would not be indicated.

If any change in the performance of the elements was not due to a change in operating conditions, it may be time to clean the elements. In general clean the elements:

1. When the standardized product flow rate decreases by 10% (or when the feed pressure must be increased by 10% to maintain the same product flow), or
2. When the percent of rejection decreases below specification.

NOTICE	**Because strong chemicals are used to clean the elements, maintenance cleaning is not recommended. If the elements need to be cleaned frequently (more than twice a year), the pretreatment may be inadequate. Obtain a current water analysis and test the Silt Density Index and the Total Chlorine level of the water on-site to review what changes in pretreatment may be needed.**

When cleaning is required, the type of material which is fouling the element should be identified, if possible. Refer to Table 4 to determine the possible causes of the performance change.

Percent Rejection	Flow		
	Low	Normal	High
Low	Hardness Scale	Hardness Scale (light) or Iron	Membrane Damage
High	Silt or Biofouling	—	Membrane Damage (light)

Table 4. Performance change possible causes.

For example, if the product flow is low but the percent rejection is normal, the likely causes of the problem are silt or biofouling. Please note that if the product flow rate has increased (with no increase in temperature or pressure) the likely reason is damage to the membrane, which cannot be repaired by cleaning.

Once the foulant has been identified, choose the recommended cleaning chemical(s) from Table 5.

Membrane Problem	Cleaning Chemical
Hardness Scale	Hydrochloric acid, phosphoric acid
Iron	Hydrochloric acid, phosphoric acid
Silt	Phosphoric acid and sodium hydroxide
Biofouling	Phosphoric acid and sodium hydroxide

Table 5. Recommended membrane cleaning chemicals.

Because phosphoric acid can be used by itself or in combination with sodium hydroxide to clean almost all types of foulants, it is generally recommended over hydrochloric acid when choosing a “stock” acid.

NOTICE **Some municipal surface water supplies are treated with alum. Aluminum fouling results in low flow and, occasionally, in low rejection. If aluminum fouling is suspected, use only hydrochloric acid.**

Use a pH meter to prepare acid and caustic solutions, and to monitor pH changes as the solutions react with any foulants.

Materials required:

1. Solution tank (50 gallon capacity, minimum), to prepare and store the chemical solution.
2. Tank stand, to elevate solution tank to level above pump.
3. (Optional) Tubing 1/2” O.D. to connect cleaning adapter ahead of Pre-filter.
4. A pH meter.
5. A pre-filter cartridge.

Before proceeding record the “NOW” values in Table 3.

1. Disconnect power to the unit.
2. Place the solution tank on the tank stand.

NOTICE **The tubing length should be as short as possible to prevent excessive pressure drop. Cut the tubing as required to minimize the length.**

3. Remove the product tubing from the service connection and place the end in the solution tank. The concentrate tubing should still be directed to drain.
4. Replace the Pre-filter cartridge.
5. Plug in the unit and press the power button. Fill the tank with 30-40 gallons of RO product water.

CAUTION! **DO NOT turn on the RO system unless water can flow from the product and waste lines.**

NOTE **Soft water is an acceptable substitute for RO water. When the solution tank is filled, direct the product tubing to drain. Next, open the pump system pressure control valve until the system pressure is approximately 50 psig.**

6. Disconnect power to the unit. Remove wires from terminals labelled PRESS SW and install a jumper wire across those two terminals. You might need to put a jumper across the terminals labeled TANK FULL if you are using a level control and the tank is full.
7. Connect the tubing to the prefilter inlet (remove existing inlet connection first) then place the other end of the tubing at the bottom of the solution tank.
8. Plug in the unit and press the power button.

CAUTION! If the pump is noisy, cavitation is occurring and the pump will be damaged. Unplug the unit and check for any obstructions to flow. Reduce the pump pressure as required to prevent cavitation.

9. Record the pump pressure and measure the product water flow at low pressure. This flow will be used to estimate if cleaning has been successful. Disconnect power to the unit.
10. Add enough acid to the solution tank until the pH is between 2.0 and 2.5.

NOTE If the foulant to be removed is silt or a biofilm, use phosphoric acid.

WARNING! Acid and Sodium Hydroxide are strong chemicals that must be handled carefully to avoid injury. Wear protective clothing and have a source of water nearby to flush any spills.

CAUTION! Local codes may prohibit the discharge of acid and caustic solutions to drain. If necessary, an extra tank can be used to neutralize the solutions before discharging to drain.

11. Plug in the unit and press the power button. After approximately 5 gallons have been drawn from the solution tank, disconnect power to the unit.
12. Allow elements to soak for 15 minutes. Plug in the unit and press the power button. Draw another 5 gallons from the solution tank. Disconnect power to the unit.
13. Remove the end of concentrate tubing from the drain and place it in the solution tank. Plug in the unit and press the power button. Allow the acid solution to circulate for 30 minutes. During recirculation, monitor the pH of the solution. If the pH rises above 3.0, add acid to reduce the pH to 2.0.

CAUTION! The temperature of the chemical solution will rise as it is recirculated. If the temperature exceeds 95°F, unplug the unit and allow the solution to cool to prevent damage to the RO elements.

NOTE A plastic gallon jug filled with ice may be placed in the solution to cool it.

14. When 30 minutes have passed, adjust the system pressure to the pressure recorded in Step 9. Measure the product flow rate, then compare this flow to the flow recorded in Step 9. If cleaning is successful a noticeably higher product flow should now be observed.
15. Disconnect power to the unit. If the cleaning was for removal of hardness scale or iron only, go to Step 23.
16. If the cleaning was for silt or biofouling, take a 250 ml sample of phosphoric acid solution and carefully add sodium hydroxide until the pH is at least 12. If the solution turns cloudy, it contains hardness and/or iron. Discard the contaminated acid and prepare a fresh 30 gallons of phosphoric acid solution. If the solution remains clear, then continue with Step 16.
17. Add sodium hydroxide to the phosphoric acid solution. The pH of the solution should be increased to 11.0-11.5.

NOTE The result is an alkaline solution of tri-sodium phosphate (TSP), a common ingredient in detergents.

18. Direct the concentrate tubing to drain, plug in the unit and press the power button. Check that the unit is drawing chemical solution.

CAUTION! If the pump is noisy, cavitation is occurring and the pump will be damaged. Unplug the unit and check for any obstructions to flow. Reduce the pump pressure as required to prevent cavitation..

19. After approximately 5 gallons have been drawn from the solution tank, disconnect power to the unit.
20. Allow the elements to soak for 15 minutes. Plug in the unit and press the power button. Draw another 5 gallons from the solution tank. Disconnect power to the unit.Remove the end of concentrate tubing from the drain and place it in the solution tank. Plug in the unit and press the power button. Allow the alkaline solution to circulate for 30 minutes. During recirculation monitor the pH of the solution. If the pH drops below 10.0 add sodium hydroxide to increase the pH to 11.5.

NOTE If the caustic solution becomes dark brown (like coffee), it probably is saturated with organic material. Discard the solution and prepare a fresh batch of phosphoric acid and sodium hydroxide.

For more accurate testing, use a Hach Model DE-2 detergent test kit or equivalent to ensure that the product water is less than 0.05 ppm detergent.

A plastic gallon jug filled with ice may be placed in the solution tank to cool the solution.

CAUTION! The temperature of the chemical solution will rise as it is recirculated. If the temperature exceeds 95°F, unplug the unit and allow the solution to cool to prevent damage to the RO elements.

21. When 30 minutes have passed, adjust the system pressure to the pressure recorded in Step 9. Measure the product flow rate, then compare this flow to the flow recorded in Step 9. If cleaning is successful a noticeably higher product flow should now be observed.
22. Disconnect power to the unit. Remove the concentrate and product tubing from the solution tank and direct them both to drain. Plug in the unit and press the power button to draw most of the remaining cleaning solution from the tank.

CAUTION! Do not allow the unit to draw air from the tank, or the pump will be damaged.

23. Disconnect power to the unit. Reconnect the feed tubing to the prefilter, then open the feed water valve.
24. Connect power to the unit, press the power button, and flush the cleaning solution from the unit for 30 minutes or until the pH levels of the concentrate water and the product water remain constant.

CAUTION! Soft water must be used to flush the caustic solution, or hardness will precipitate. If soft water is not available, use temporary portable exchange softener tanks.

25. Adjust the system pressure to the normal value. Measure all flows, TDS levels, pressures, and temperature. Compare these values with the “new” and “now” values to determine if cleaning has been successful. If cleaning has not been successful, contact the service department at WaterGroup for suggestions on alternate cleaning chemicals. If cleaning has been successful, note which chemicals were effective. Use the same chemical(s) when the unit is cleaned again.
26. Replace the Pre-filter cartridge.
27. After cleaning and rinsing have been completed, connect the product tubing to the service line. Remove the jumper(s) installed in Step 6 and reconnect the pressure switch. Rinse the cleaning tank and tubing with fresh water.

MacRO Major Components and Water Connections

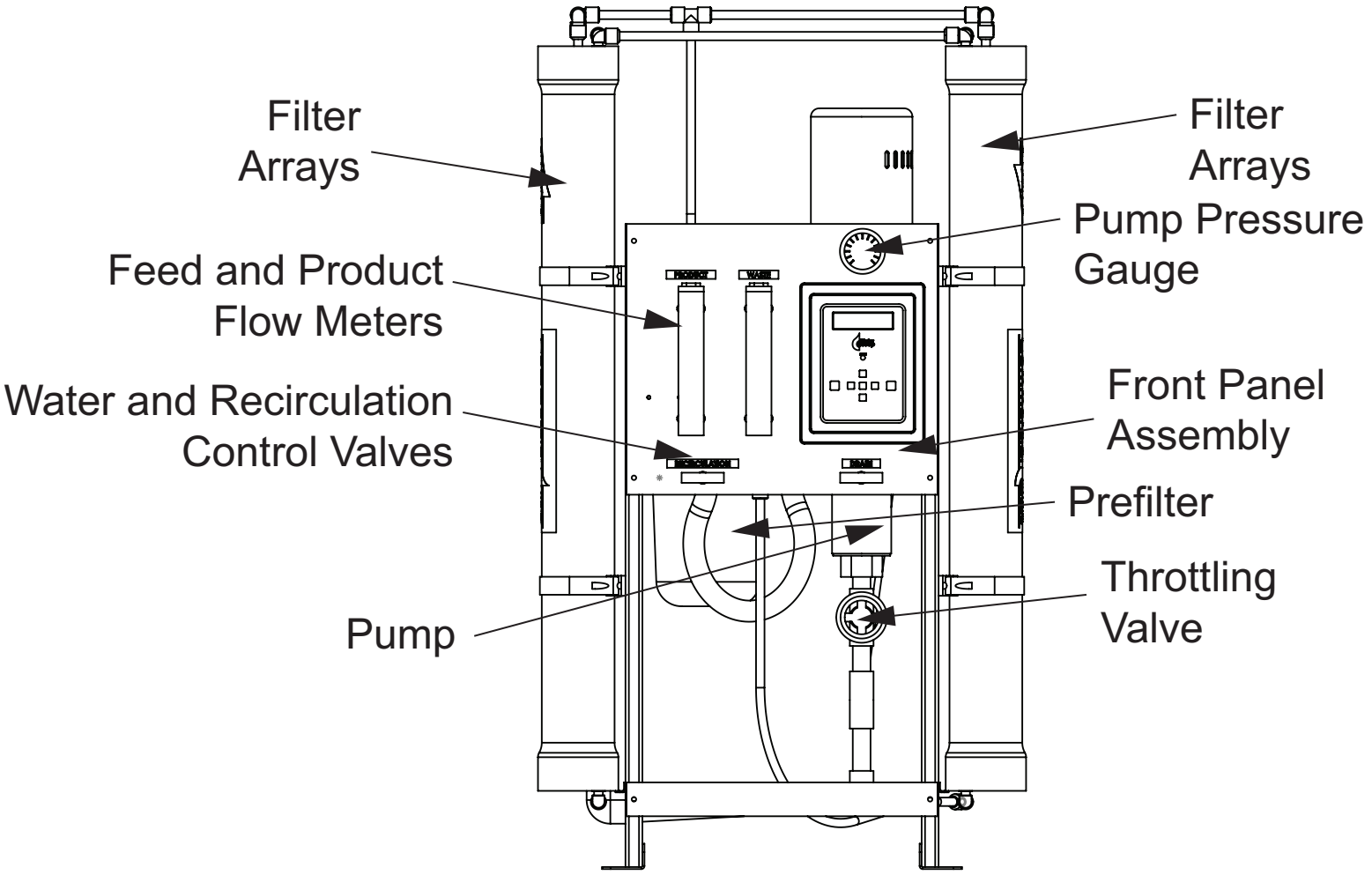


Figure 15

Front Panel Assembly

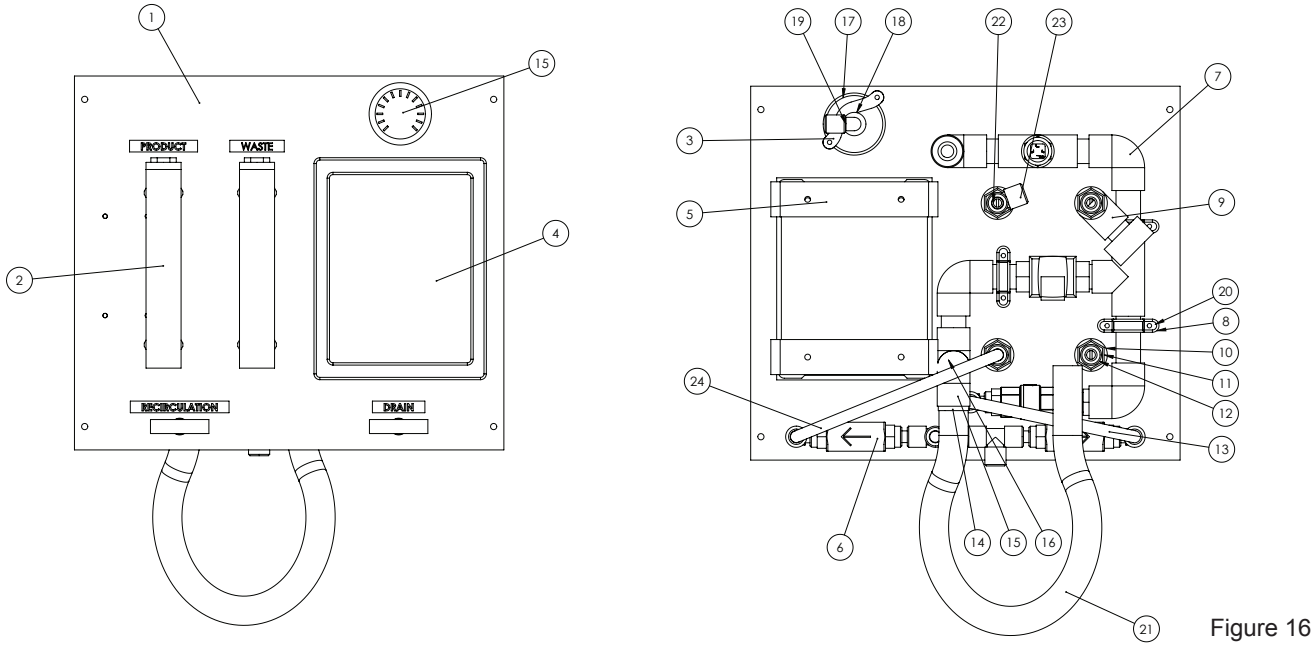


Figure 16

Item	Part No.	Description	Qty
1	92764	Front Panel	1
2	92765	1-10 GPM ROTAMETER	2
3	101052	Clamp, Gauge	1
4	33601033	RO Controller, Series B	1
5	33601042	Pair of PVC Brackets	1
6	92766	Concentrate Piping	1
7	92767	Feed Piping	1
8	92768	RIGID STRAP	3
9	92776	Tee, 3/4”, Threaded, PVC, Sch. 80	1
10	92777	Coupling, 3/4”, Thd, PVC, Sch. 80	3
11	420735	Bushing. 3/4x1/2, Txt, PVC Sch. 80	4
12	92712	Fitting, Male Connetor, 1/2Tx1/2NPTE, PI	4
13	115211 27in	Tubing, 1/2, Black 27”	1
14	92769	ADAPTER HOSE BARB 3/4” x 3/4” NPTE	1
15	92778	Elbow, 3/6”, TxT, PVC Sch. 80 NPT	1
16	242902	Nipple, 3/4” CL, SCH80 NPT	1
17	92770	Pressure Gauge 0-200psi, 2-1/2”, 1/4” CBM	1
18	92779	Coupling, 1/4”, Thd. PVC Sch. 80	1
19	92736	Fitting, Male, Elbow, 1/4T x 1.4 NPT	1
20	92771	Spacer, Nylon	6
21	199150 2ft	Tubing. 3/4. PVC, 2ft	1
22	115211 3in	Tubing. 1/2” black, 3”	1
23	92772	Fitting, Union Tee, 1/2T, PI	1
24	115211 25in	Tubing, 1/2”, Black, 25”	1

Feed Assembly

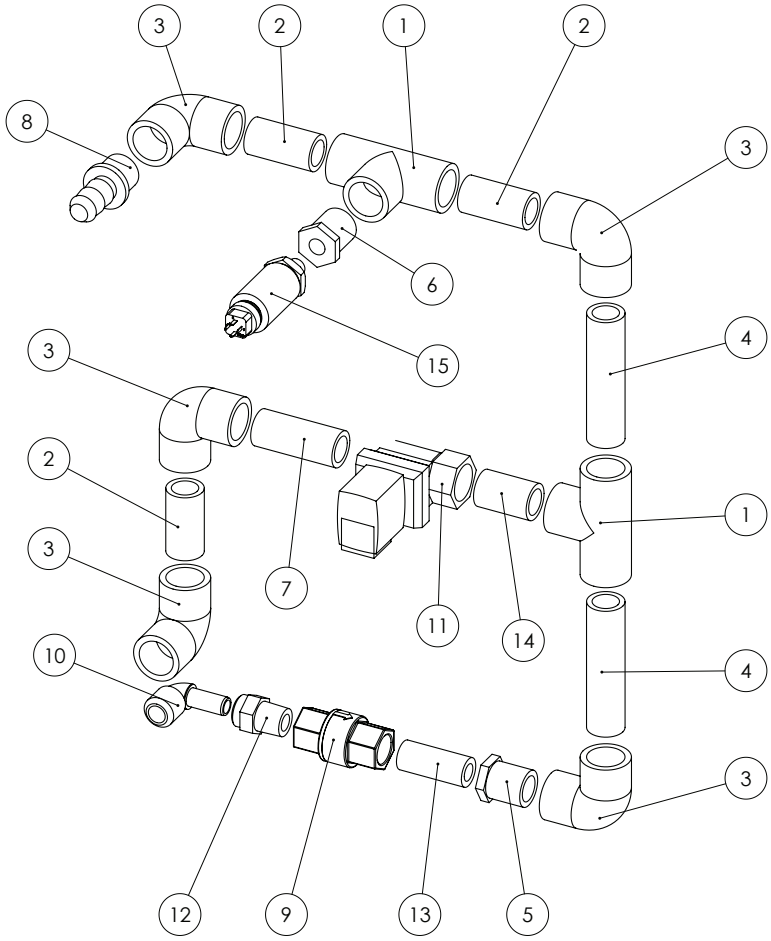


Figure 17

Item	Part No.	Description	Qty
1	92776	Tee. 3/4". Threaded, PVC Sch. 80	2
2	33601023	Nipple, 3/4" x 2" SCH80 NPT	3
3	92778	Elbow, 3/4", TxT, PVC, Sch.80, NPT	5
4	33601025	Nipple, 3/4" x 4" SCH80 NPT	2
5	420735	Bushing. 3/4x1/2. TxT, PVC Sch.80	1
6	420734	Bushing. 3/4x1/4. TxT, PVC Sch.80	1
7	33601026	Nipple, 3/4" x 2.5" NPT, SCH80	1
8	326800	ADAPTE HOSE BARB 3/4" x 3/4" NPTE	1
9	92780	Valve, Check	1
10	92736	Fitting, Stem Elbow, 1/2Tx1/2Stem, Pl	1
11	80309-1	Burket Valve, Solenoid, 3/4 NPT, N/C, 240/60Hz 220/50Hz	1
12	92712	Fitting, Male Connector, 1/2Tx1/2NPTE, Pl	1
13	92440	Nipple, 1/2xClose, PVC Sch. 80 TBE	1
14	242902	Nipple, 3/4" CL, SCH80 NPT	1
15	92773	SWITCH, ADJUSTABLE PRESSURE, 6-30PSI	1

Concentrate Piping Sub-Assembly

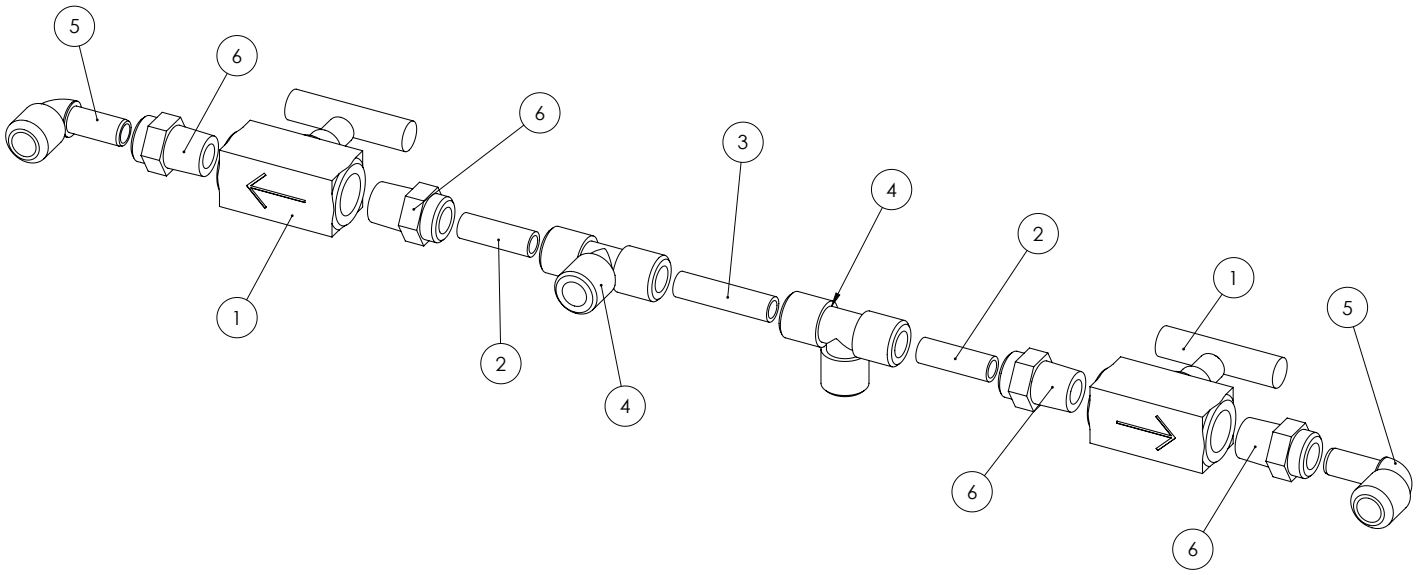


Figure 18

Item	Part No.	Description	Qty
1	303180	Valve, Needle, 1/2” Brass	2
2	115211 1.5in	Tubing, 1/2”, Black 1.5”	2
3	115211 2in	Tubing, 1/2”, Black, 2”	1
4	92772	Fitting, Union Tee, 1/2T, Pl	2
5	92736	Fitting, Stem Elbow, 1/2Tx1/2Stem, Pl	2
6	92712	Fitting, Male Connector, 1/2Tx1/2NPTE,Pl	4

Autoflush Assembly

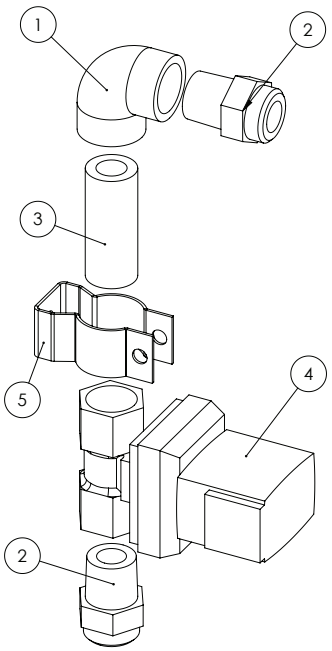


Figure 19

Item	Part No.	Description	Qty
1	33601028	Elbow, 1/2” NPT, SCH80	1
2	01021391	Fitting, Male Connector, 1/2Tx1/2NPTE,Pl	2
3	92441	Nipple, 1/2”x2”, NPT SCH80	1
4	80307-01	Burket Valve, Solenoid, 1/2 NPT, N/C, 240/60Hz 220/50Hz	1
5	01022322	Hanger, Clamp	1

Membrane Vessel

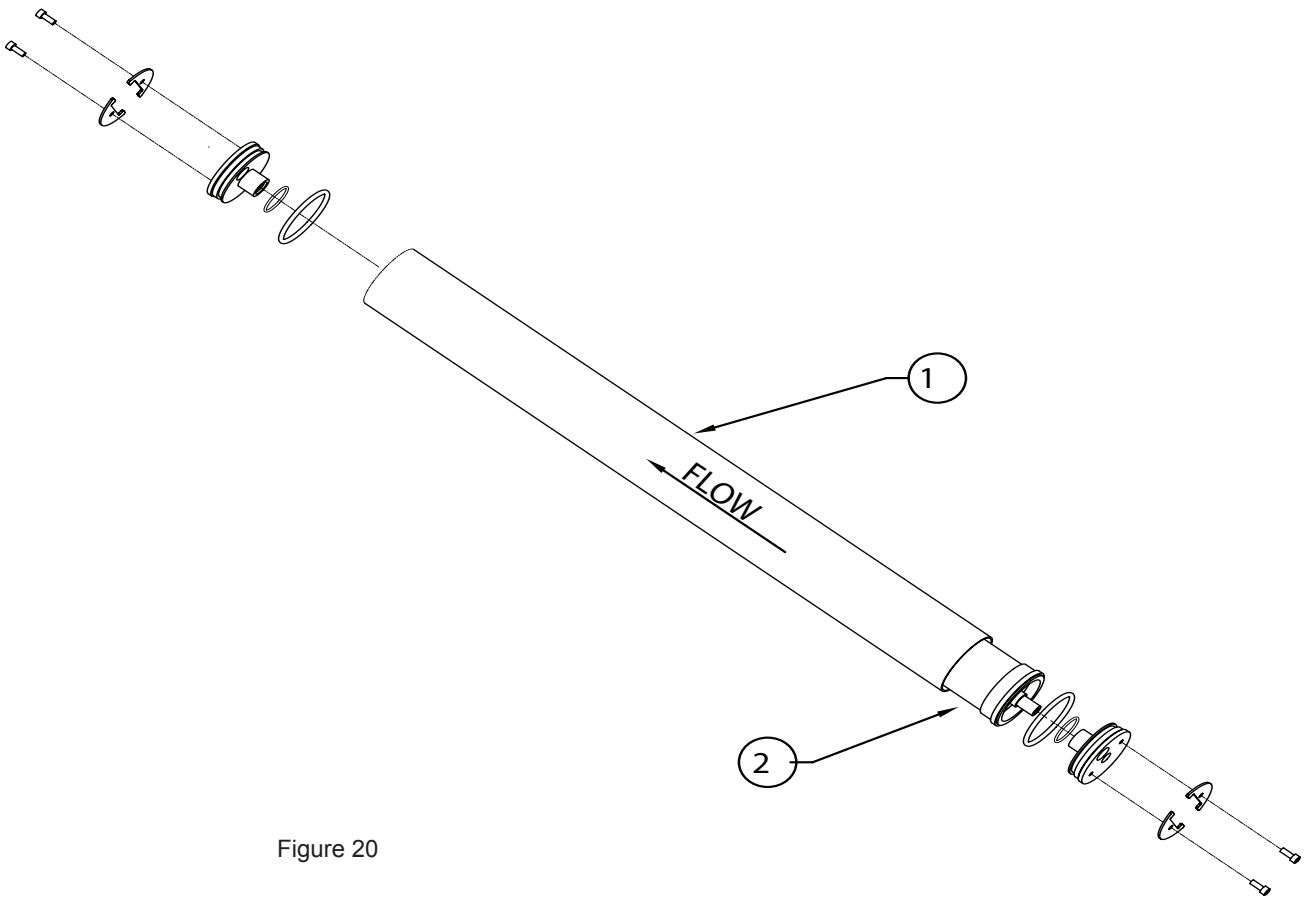


Figure 20

Item	Part No.	Description	B-2	B-3	B-4	B-5	B-6
1	92774	Housing, Filter, Wave Cyber FRP 4” End Port, with clamps	2	3	4	5	6
2	92036	RO Membrane, XLE-4040	2	3	4	5	6

Membrane Assembly, B-6

This assembly is used on the B-6. It is mounted on both sides of the B-6

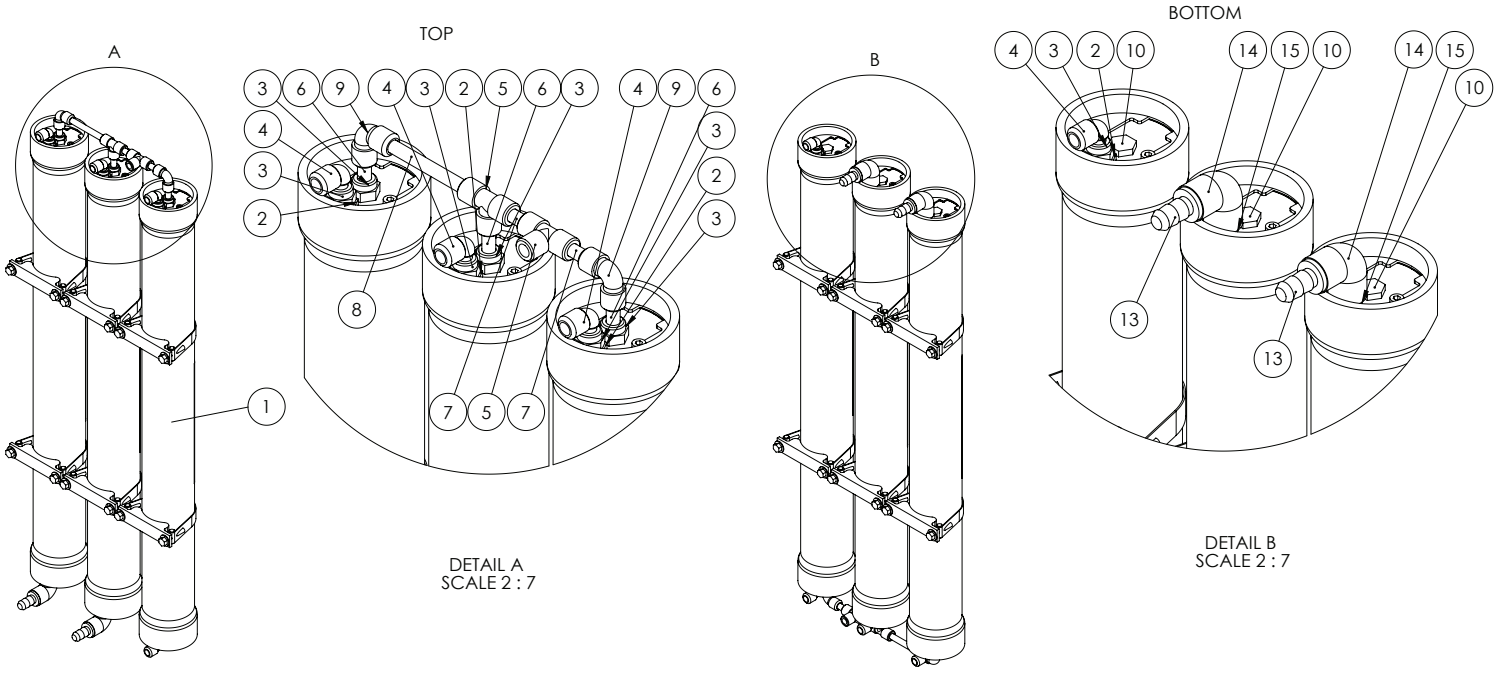


Figure 21

Item	Part No.	Description
1	92774	Housing, Filter, Wave Cyber, FRP, 4”, End Port with Saddles
2	420735	Bushing, 3/4x1/2, TxT, PVC Sch.80
3	92712	Fitting, Male Connector, 1/2Tx1/2NPTE,Pl
4	92736	Fitting, Stem Elbow, 1/2 Tx1/2Stem, Pl
5	92772	Fitting, Union Tee, 1/2T, Pl
6	115211 2.5in	Tubing, 1/2”, Black 2.5”
7	115211 2in	Tubing, 1/2”, Black, 2”
8	115211 5.5in	Tubing, 1/2”, Black, 5.5”
9	92775	Fitting, Union Elbow, 1/2T, Pl
10	420530	Plug, 1/2”, Threaded, PVC, Sch. 80
13	92769	Adapter Hose Barb 3/4” x 3/4” NPTE
14	92778	Elbow, 3/4”, TxT, PVC Sch.80, NPT
15	33601232v	Nipple, 3/4x2, PVC Sch.80 NPT

WaterGroup MacRO Controller

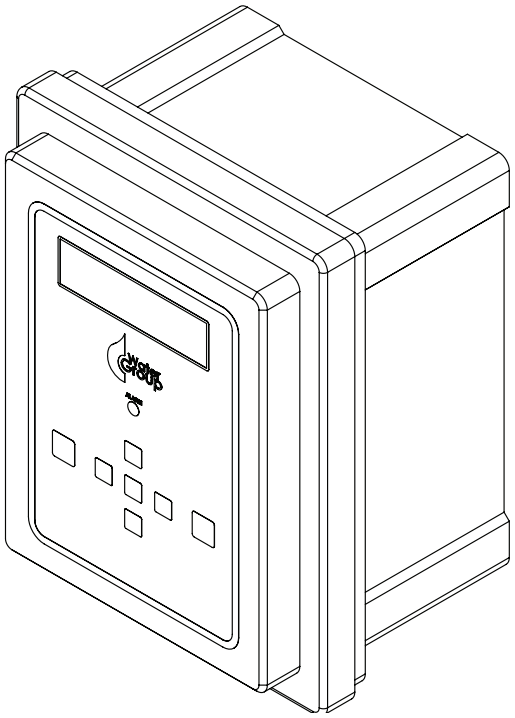


Figure 22

Item	Part No.	Description	Qty
1	33601033	MacRO Contoller	1