LB-20,000 Containerized Watermakers with Spectra Connect

Installation and Operating Manual

Spectra Watermakers
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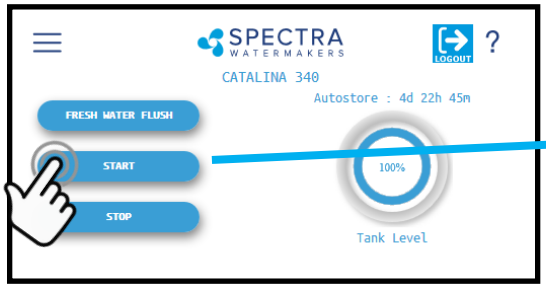
Spectra Connect Quick Start Guide

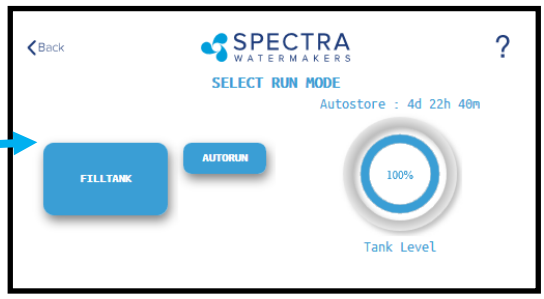
When you first power up the system, you will get a warning message, asking **if the system has been stored with chemicals.**

If the system has been pickled, winterized, this is the first startup, or the condition of the system is unknown, go to COMMISSIONING or serious damage to the membranes may occur.



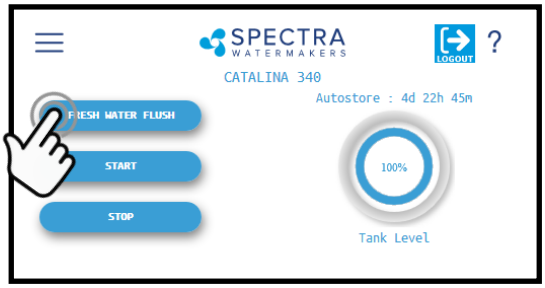
Start

Pressing the 'Start' button once advances to the Run Mode selection screen.



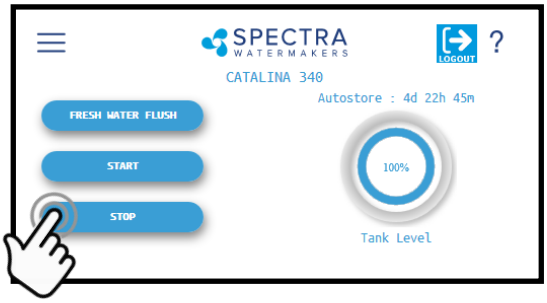
Run Mode

Select your desired Run Mode to start making water and filling your tanks. See details on Run Mode options on p. 37



Fresh Water Flush

Pressing the 'Fresh Water Flush' button flushes the watermaker with fresh water from the vessel's domestic water tanks. After completing the flush, Spectra Connect will automatically enter the Auto Store mode.



Stop

Pressing the 'Stop' button from the Home Screen will end the Auto Store mode countdown timer and leave your watermaker in Standby mode.

Spectra Connect Modes and Definitions

Auto Store: After the watermaker fresh water flushes, it will start a countdown timer that can be seen on the Home screen. The timer indicates the next programmed fresh water flush if the watermaker is not started again, or the 'Stop' button is not pressed.

Fill Tank: The watermaker will automatically run until the Tank Full switch in the water storage tanks closes. Once the Tank Full switch closes, the watermaker automatically fresh water flushes, then reverts to the *Auto Store* mode.

Auto Run: The watermaker can be set to run for a number of hours, or for a quantity of water to be produced. When the desired quantity of water is produced or the run timer expires, the watermaker will Fresh Water Flush and enter the *Auto Store* mode.

Getting Started

Please read through the complete manual before starting your installation. The system is easy to operate and maintain as long as it is installed and calibrated correctly.

Spectra Watermakers Land Based Desalination Systems are shipped pre-tested and pickled with propylene glycol for shipment. The system is ready for installation with the options specified with your order. Please unpack the system and inspect it to make sure that it has not been damaged in shipment.

Refer to the shipping list for your system to make sure you have received all of the components listed.

We will not be held responsible for shortages that are not reported within thirty days of the ship date. Shipping damage must be reported to the carrier within 24 hours of receiving goods.

LB-20k system shipping list:

This system is two independent LB-10000 units built into powder coated 304 stainless steel benches and installed into a 20ft. ISO Shipping Container, each unit includes:

- Feed/Boost Pump with VFD speed control
- Pre-filtration assembly with two Media filters
- LB-10000 desalination unit
- Inlet and Brine Discharge Service Connections
- Spectra Connect Control Box with Main Circuit Breaker
- Feed Valve (to isolate system from feed water)

- **Accessory kit;**
  - Service hoses and filter wrench
  - Hand held TDS meter
  - User's Manual
  - Log Book

- **Optional items;**
  - UV filter for product water
  - Pressure Regulator for feed
  - Feed water chemical injection (anti-scalant)
  - Chlorine injection for permeate
  - Remineralization filters for permeate
  - Wireless router for access and control
  - Up to two tank level sensors for permeate tank
  - Tank low and tank full switches for permeate tank

Introduction To The System

The LB-20000 Container system is built from two identical 10,000 GPD watermakers and they can be run individually or together. Each system has its own feed pump, two tank media filter, double 4”X20” cartridge filter and chlorine injection system. The systems do share a fresh water flush system and each system should be flushed separately.

The large control box contains the:

- Spectra Connect control panel
- Main circuit breaker for the system
- The Run Manual, Run Auto and Service switch.
- Start and stop buttons for manual operation

The small control box is for the feed/boost pump and includes:

- Auto (controlled by Spectra Connect) Manual (for priming or backflushing media filters)
- See the speed control manual (from the manufacturer) for more detailed instructions

The main valve panel for each LB-10,000 watermaker is identical and all the valves and gauges are clearly labeled.

The system contains both pressure transducers (for the Spectra Connect controller) and pressure switches for operation in manual mode.

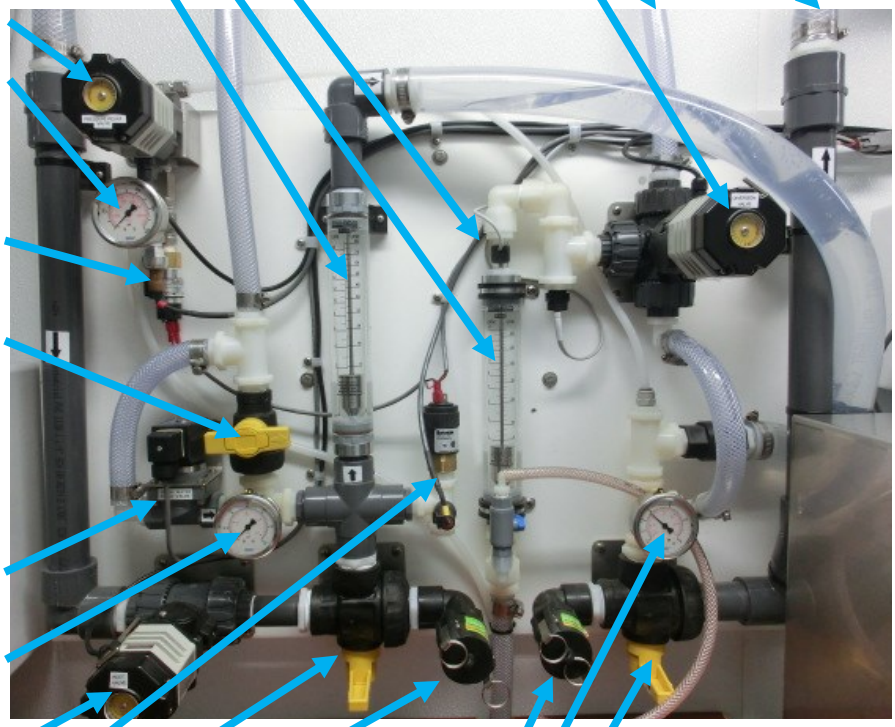
Note: All the valves in this picture are in the RUN position. There is an arrow on the yellow handle that shows the direction of flow. To open the valve turn the arrow in the direction you want the water to flow to (or from).

For example, the inlet/service valve needs to point to the left and the brine discharge valve needs to point to the right to run the system so water will flow from the prefilters and out the brine discharge.

The Valve and Gauge Panel

Both of the LB 10,000 watermakers in the Container are identical and are capable of fully automatic operation or can be run manually (without the Spectra Connect control unit). In manual mode there are pressure switches to protect the system from loss of feed pressure or excess membrane pressure, which are the two main system errors that can damage the system.

***Note*: The valves (yellow handles) are shown in the off position.**



Product flow sensor (Rotoflow)

Product Flow Meter

Feed Flow Meter

Brine discharge to drain

Product water to tank

Electric Diversion valve

Motorized pressure relief valve

Membrane Pressure gauge

Membrane pressure sensor and switch

Manual fresh water flush valve

Electric Fresh water flush valve

Flush water pressure gauge

Motorized feed water valve

Feed pressure sensor and switch

Feed/Service Valve

Feed Service Port

Brine Service port

Brine discharge pressure

Brine discharge/Service Valve

***Note:* Both the Feed and Brine service valves are show in the off position.**

Introduction To The System

Feed/Boost Pumps

There is one **Boost Pump** for each system to pressurize water from the feed water source connected to the LB 20,000 Container. There is a basket strainer on each pump that can be checked through the clear window on the top of the unit.

Note: These pumps must be full of water before starting. Running these pumps dry will damage the unit very quickly. If the inlet to the pump is below the container a ball check valve should be installed to maintain the water level in the pump (prime). The pump speed is controlled by the small control box next to the main control. See the boost pump manufacturers manual in the binder for more detail.

Boost Pump

Chlorine Injector

Boost Pump Speed Control

Chlorine Injection

There are two Chlorine Injectors (one for each system) that add chlorine when the unit is making product water (the injection pump is powered when the diversion valve is open. The manufacturers operation manual is in the binder.

Media Filters

Each system has two media filters connected in parallel. Pressurized water from the Boost Pump is pushed into the media filters and then on to the cartridge filters.

The pressure gauges on the end of the manifolds show the pressure in and out of each media filter pair. Note what the normal pressure drop is after the filters are back-flushed and monitor the pressure difference (pressure drop) across the filters. Back flush the filters when the pressure drop is 3-5psi. See the media filter manufacturers manual in the binder for more detailed instructions.

The Boost pump will start automatically when the Media filter valve is backflushing.

Introduction To The System

Cartridge Prefilters

Each system uses two 4x20” 5 micron filters as the final stage of filtration before going to the Pearson Pump and the seawater membranes.

There is a button on top of each housing to bleed air out of the housing after changing filters. There are pressure gauges on both the inlet and outlet to monitor pressure drop across the filters. When the pressure drop across the filters is 5 to 10psi (maximum) the filters should be replaced.

Test Ports

There are product water test ports for each system so the operator can confirm the produce quality. Note that measuring the chlorine concentration should be measured from the product tank as the chlorine injection point is too close to the sampling valve for adequate mixing.

The black ABS **Drain Manifold** is the drain for the brine discharge and the back-wash from media filters.

This manifold is vented to the outside of the container it should be noted that if the drain line outside the watermaker is too small or is not graded properly that this vent pipe may need to be extended.

Carbon Block Filters

Product water from the storage tank needs to be pressurized and connects to the “Flush Water” port on the outside of the container. The flush water goes through Carbon block filters for removing chlorine from the flush water to protect the membranes and the pump regulates the flow rate for proper chlorine removal.

Introduction To The System

Input / Output Manifold

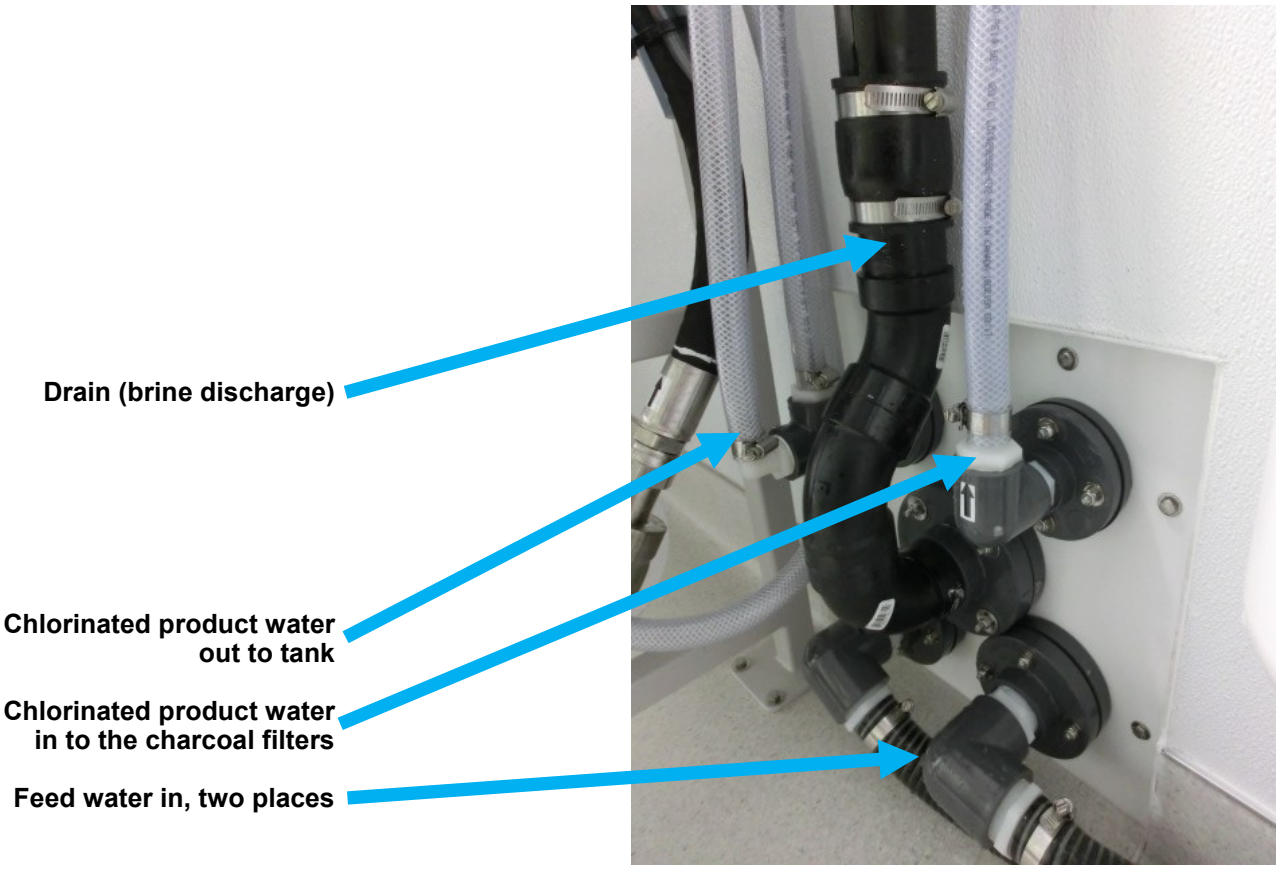
The ports that allow the plumbing connections to go in and out of the container are located at the floor level.

The bottom two ports are feed water to the boost pumps.

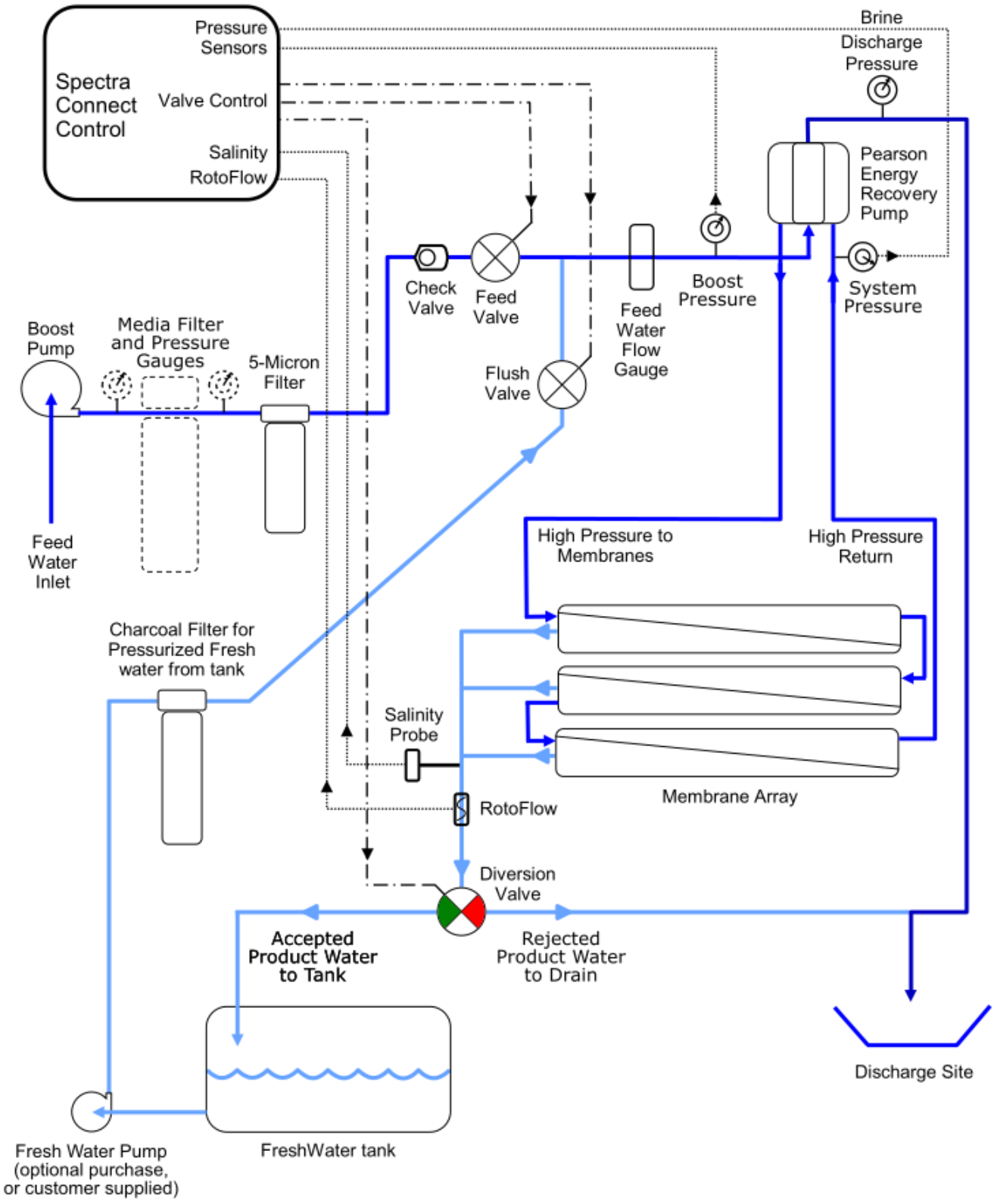
The next two are chlorinated product water out to the storage tank (on the left) and pressurized chlorinated water back from the storage tank.

The top connection is the drain that is connected to the brine discharge from both watermakers and the back-flush drain from all four media filters.

A wash down hose is connected to unchlorinated product water (after the charcoal filter to use for rinsing after filter changes and filling the chlorine injectors with water.



Simplified Typical Container Plumbing and Control Layout



Installation

Recommended Site Layout

It is always preferable to draw feed water from a **Borehole or Beach Well.** Drawing water directly from the open ocean creates additional maintenance requirements, as pipes, pumps and the filtration system are exposed to sea life. All of this is avoided by using the local geology as a barrier to sea life. The feed water from a Borehole or Beach Well will typically run quite clear after the system has been running for a few days.

Feed water is moved and pressurized by either a **Jet Pump or a Well Pump** depending on site specific conditions. If the system cannot be installed close to the feed water source, the Jet Pumps provided with the system can be relocated closer to the water source. Jet Pumps are more efficient when placed close to the feed water source and will self-prime up to 10ft. (3m). If the feed pump is lifting water then it is advisable to install a ball check valve on the inlet (as near to the water source as possible) to keep the pump primed. The pump will self prime up to 3m but it is always advisable to keep the pump properly primed so it is not damaged by cavitation. The pipe runs for each of the two systems should be at least 1-1/2" (40mm) up to 50 ft. (15m) and be increased to 2" (50mm or more) if it needs to be longer.
Please consult our application engineers to select the correct pump and pipe diameters for your installation.

If the feed water has high turbidity (cloudy water) a **Settling Tank** may be a good addition to the installation. A Settling tank is also useful if the feed water intake varies due to tides or other site specific constraints.

The input and output connections to the **Container** are outlined on the next page.

The Product Water Tank should ideally be sized to so there is enough storage to supply water for at least 24 hours to allow for service and maintenance. Water going to the product tank will be chlorinated by the chlorine injection system in the Container.

The **Potable Water Delivery System** (by others) needs to provide pressurized water 20-50 psi (1.5 to 3.5 bar) to the **Fresh Water Flush Connection** on the container.

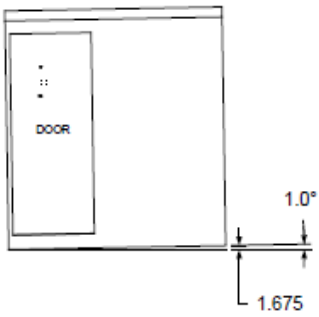
Installation - Cont.

Site requirements for container

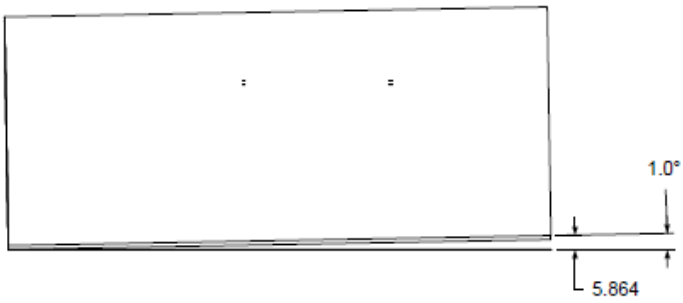
The container weighs a little under 20,000 lbs (9090 kg.) and should be mounted on a concrete pad in accordance with local regulations.

The ideal installation has a gentle slope that allows water drain out the door and drain holes. The far end of the container needs to be elevated 5-6" (130-155mm) from flat. With the container sloped toward the door from the far end, the right side (when standing at the door end) of the container needs to be 1-1/2 to 2" higher than the left side.

The weatherstripping on the bottom of the door should be cut away to allow water to drain out to a suitable location or a gravel catch basin should be installed in the ground.



Door End View



Right Side View

Pipe connections:

The brine discharge drain is 2" NPT (pipe thread) and should be sloping away from the container if at all possible. With both units running the flow through the drain will be 28 gpm (106 lpm), so if the drain is not sloped correctly the vent pipe inside the container may need to be extended.

Feed water from settling tank is 1-1/2" NPT (pipe thread) and it is recommended that this connection is made with flexible hose. If relying on the feed pumps in the unit, be sure the lowest level in the feed tank is no more than 10ft (3m) below the floor of the container.

Installation - Cont.

The Fresh Water Flush is a 1" NPT (pipe thread) fitting. Connect the pressurized fresh water supply from the potable water delivery system to this connection. The potable water system must supply 5 gpm (20lpm) of potable water at 30psi (2 Bar) to fresh water flush the systems.

The Product Water Outlet is a 1" NPT (pipe thread). Route the product water pipe from the container to the top of the storage tank. Ideally the product water should fall into the tank so there is no back pressure on the product line.

The top of the water tank must be no more than 10 feet (3M) above the top of the watermakers frame and if you need the unit to pump water over 10 ft. it is recommended to install a transfer tank and a delivery pump.

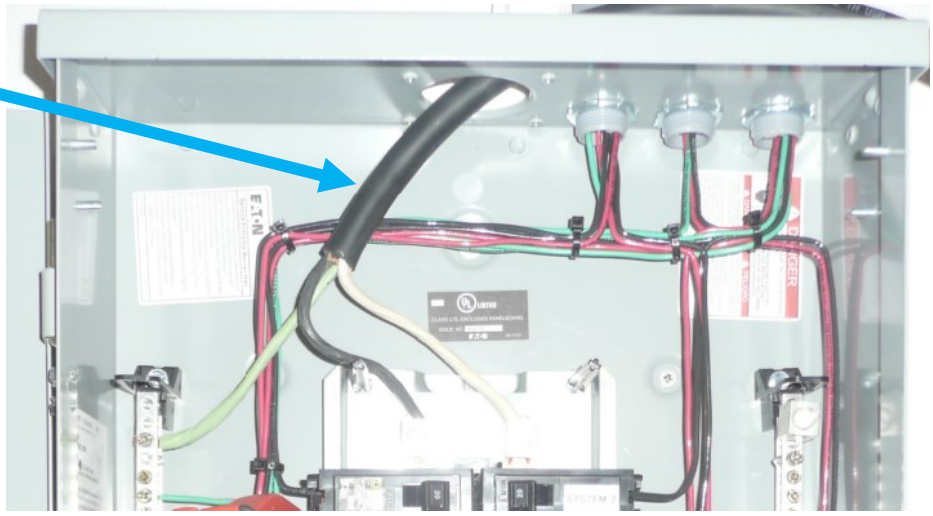
It is not recommended to use the watermaker as a product water delivery pump as stopping the flow from the product line can damage the membranes. If the product water must be delivered up hill or to a tank more than 50 feet/15M away and/or more than 10feet/3m up run it to a transfer tank and use a separate pump to move water to the desired location.

Electrical

Connect the main incoming power feed to the AC main disconnect panel.

Connect all wires in accordance with local regulations.

Wire should be sized for 30Amp max current draw at 220VAC.



Note: The photo above shows the temporary wiring we used for testing the unit. Follow all local codes and best practices when making the connections to the power source on site.

All internal wiring is complete to the main distribution panel, with separate circuits that are clearly labeled. All equipment should be in the off position when applying power for the first time.

Installation - Cont.

The outside port for the **Brine Discharge Drain** is located on the outside of the container, directly above where the manifold is positioned.

There is a threaded PVC Plug in the port that will need to be removed before the Brine Discharge Drain elbow that came in the **Service Kit** can be installed.

Thread the elbow into the port and orient the black check valve so that the elbow points down.

Note: If properly installed, the black Check Valve located on the end of the drain should be oriented pointing downward.

Tank Switch Installation

Optional Tank Switches

There are two types of tank float switches available depending on your installation requirements. Often making an assembly as pictured below (right) is a good solution as there is only a single penetration and it can be above the high water level.

Top mounted float switch EL-SWT-LV

Side mounted float switch EL-SWT-SMLV

Typical float valve tree that is attached to the inside of the tank with a bulkhead fitting

Terminal connections for the float switches are inside the control box.

The control system is designed to shut down when the tank switches close. When tank is full, both switches must be closed to stop the watermaker.

Conversely both tank switches must be open for the watermaker to start.

Note: If tank switches are not used you **must disable the tank switches** in the system settings.

Tank Level Sensor

Installing a tank level sensor (**KIT-SC-TNKSS**) in the discharge line from your storage tank will allow the Spectra Connect to track the tank level. Once the sensor is installed connect to the Terminal Block above referring to the wiring diagram for terminal location.

Tank Switch or Level Sensor Installation LB-10000

Optional Factory Supplied Tank Switches

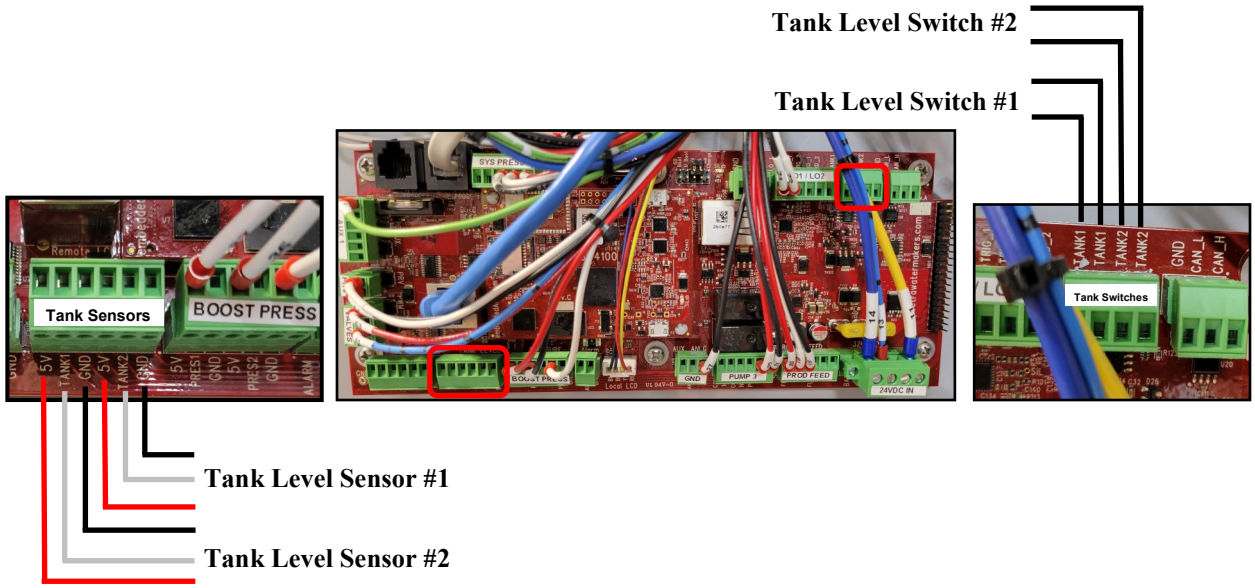
The system can be started and stopped with tank level switches. The system will start when the low level switch opens and will then stop when the high level switch closes. There are two types of tank float switches available depending on your installation requirements. Often making an assembly as pictured below (right) is a good solution as there is only a single penetration and it can be above the high water level.

Top mounted float switch
EL-SWT-LV

Side mounted float switch
EL-SWT-SMLV

Use the Dealer Access settings (pg.39) to enable the tank switches

Tank Setup - Enable/disable tank sensors.
Enable Tank Switch High - Enable/disable tank high switch high. If this is disabled Auto Fill and Fill Tank run modes will not be available.
Enable Tank Switch Low - Enable/disable tank high switch low. If this is disabled Auto Fill mode will not be available. Both High and Low tank switches must be enabled for Auto Fill mode.
Enable Tank Level 1 - Enable/disable tank level sensor 1. If this is disabled there will be no tank level reading and tank level gauge will read "!".
Enable Tank Level 2 - Enable/disable tank level sensor 2.

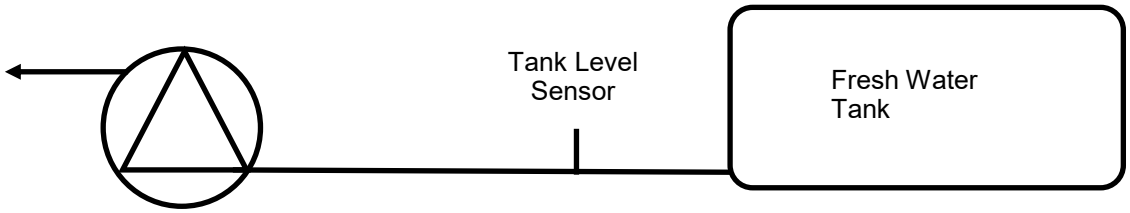


Optional Tank Level Sensor Installation

The optional Tank Level sensor allows even greater control of your fresh water storage systems. This unique level monitoring system requires no holes to be drilled into your tank while measuring tank volume with greater accuracy than a standard resistive float.

Turn off the freshwater supply pump, close the fresh water supply valve at the water tank, then bleed off the pressure by opening a tap in the galley or head sink.

Install a tee in the **water supply hose at the bottom of the tank, or at the inlet to the domestic water pump**. Connect open leg of the tee to the Tank Level Sensor. Note: The tank level sensor requires a 1/4" npt connection. We recommend installing a minimum 1/2" tee, and using a reducing bushing to connect the sensor.



Note: Be sure the pipe between the tank and the tank level sensor is large enough to eliminate pressure drop when the product pump is running. Any pressure drop will effect the tank level sensor accuracy.

Route the 3 conductor cable back to the Spectra Connect control box and extend the wires as necessary. *If you must extend the wires beyond 50' contact the factory to ensure proper operation.*

Connect the Tank Level Sensor cables to the appropriate terminals in the control board inside the main Control Box (pg. 14) and refer to the wiring diagram on pg.54 to identify the correct terminals. **Polarity must be maintained!**

If a 2nd Tank Level Sensor is going to be installed, it should be installed at the base of the second tank. **If monitoring two connected water tanks, they must be isolated from each other with a valve to read properly.**

The wiring connections for the second Tank Level Sensor are located inside the Spectra Connect control box. **See System Settings section of this manual for instructions on enabling the second Tank Level Sensor.**

See the Tank Level Calibration (pg. 22) in the "New System Start-Up" section of this manual.

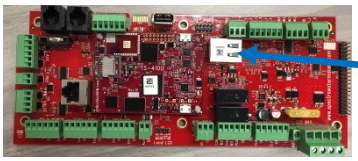
Networking

Your Spectra Connect is equipped with state of the art networking options to allow the maximum user control in a wide variety of installations. The instructions below will help you get the most out of your Spectra Connect.

Note: *Your Spectra Connect is only available to your portable devices when connected to the same local network as the Spectra Connect control board. If you have difficulty connecting to your watermaker control application, double check the that your device network is the same as your Spectra Connect*

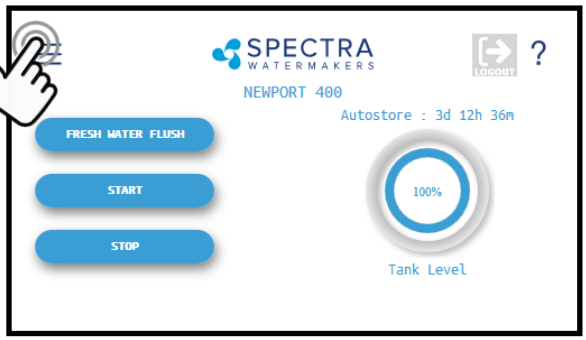
Connecting to the existing Network

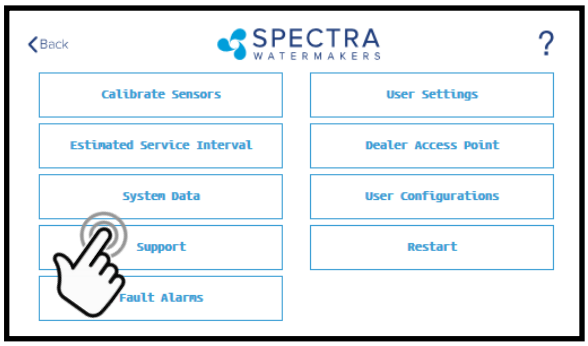
1. Turn power to the system off.
2. Connect a standard Cat5e or Cat6 ethernet cable from the control board located inside the feed pump module to your router or networking switch.

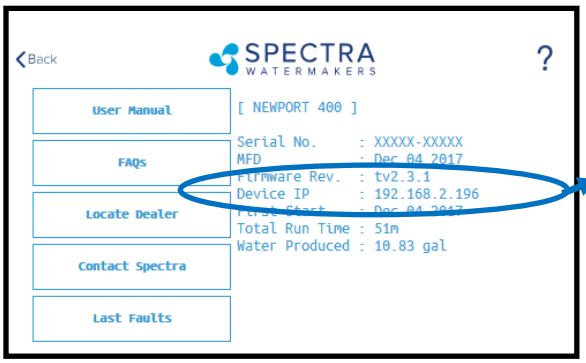


Note: If you are connecting directly into a wireless router, **DO NOT CONNECT TO THE WLAN (Wireless Local Area Network)** ethernet port. You must connect to one of the LAN ports typically labeled 1, 2, 3, 4, etc.

3. Turn power to the system back on.
4. Follow the screen prompts below:







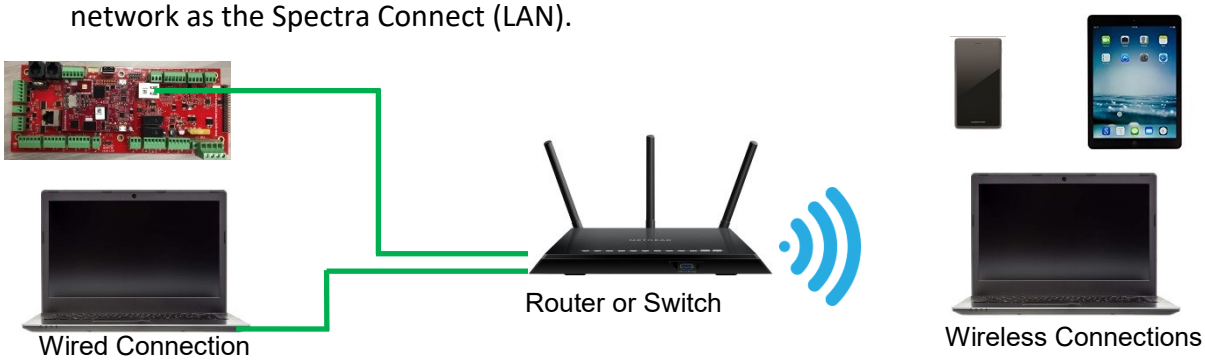
5. Note the 'Device IP' address shown in and record the 10 digit numerical address on the front of this manual for future reference.

Connecting To An Existing Network - Cont.

6. Connect your computer, tablet or smart phone to the local network your Spectra Connect is plugged into;

Wired Connection: simply plug your computer's ethernet port directly into the router or switch where you connected the watermaker.

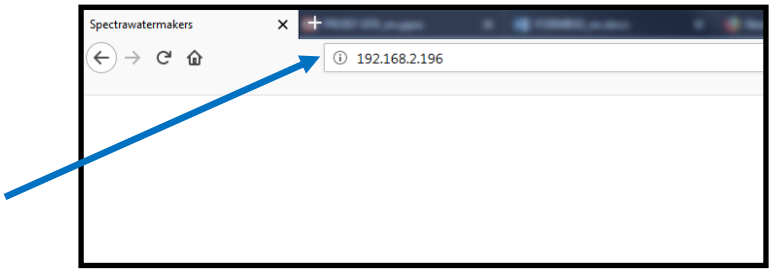
Wireless Connection: make sure your device is connected to the same local wireless network as the Spectra Connect (LAN).



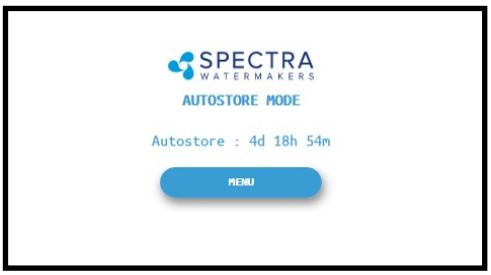
7. On the computer, tablet or smartphone, open a web browser such as Firefox, Chrome, or Safari. In the web address bar at the top, type the 'Device IP' address previously recorded. Press 'Enter'.

Note: Some Browsers may not be compatible with your Spectra Connect web app. If formatting issues occur, use another browser such as Firefox, Safari, or Chrome.

Ex: Address Bar—Firefox



8. Your computer should now show the same image as shown on your local Spectra Connect.



9. Your web browser is now synced with your Spectra Connect. Any buttons you press on your web browser will be controlling your watermaker.

Caution! If operating your watermaker from a computer, phone, or tablet, you must keep the tab open while the system is in operation and the volume turned up on your device in order to hear any audible alarm faults.

New System Start-Up and Testing

Use this procedure when the system contains preservative or cleaning chemicals.

Warning! Damage will occur if the system is not purged of the storage chemicals before pressurizing the system.

Maintenance note; Get into the habit of recording the pressures and flow rates of the system in the Log Book. Knowing what is normal for this installation is one of the best tools you will have to keep the system running properly.

Initial power-up

When power is first applied to the unit the main breaker (Emergency Shut-Off) should be in the off position. The Run toggle switch should be in the AUTO position.

1. **First Check that:**

- Brine discharge is directed to a suitable location. The brine discharge will contain a small amount of propylene glycol (non-toxic potable anti-freeze) during the purge cycle.

- **Confirm there is oil in the crankcase** (check the dip-stick)

- **Pressure Relief Valve is OPEN one full turn**

New System Start-Up and Testing - Cont.

2. **Confirm there is water in the feed pumps:** the pumps must be full of water (primed) before starting or damage to the seals will occur. See boost pump manual for priming instructions, if required.

Start the boost pump and confirm there is pressure showing on the gauges at the media filters;

- Set Boost pump switch to manual
- Push the switch on the right up to manual start and the pump will start, adjust pressure (with the dial) to 25psi at the media filter gauges

- Follow the instructions on the media filter valves and do two manual back flushes on each filter prior to going to the next step.
- When the membrane flush is completed turn the feed pump off.

3. Reset the switches on the boost pump control to the Auto Run position (left switch up and right switch in the middle).

Note: Proper boost pressure is critical to optimize system performance. If the pressure is too low or too high the Pearson pump will knock. When the system is running change the boost pressure to find where the pump sounds the smoothest. Set the boost pressure as high as possible without knocking.

New System Start-Up and Testing - Cont.

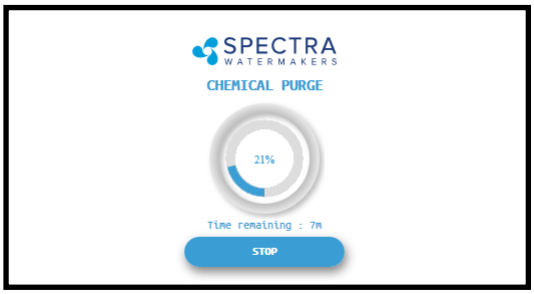
4. Confirm the inlet valve and the brine discharge valves are in the RUN position.

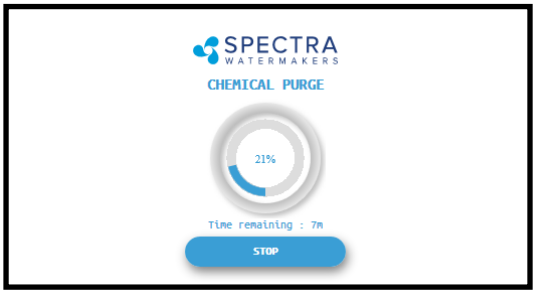
5. Open the oilers on the SP20 crankcase and allow 5-6 drops of oil to lubricate the pump plungers.
See Seals/Ceramic Oilers for more detailed info.

6. Turn on the power to the system and the Spectra Connect screen will display, “Has the system been stored with chemicals?” Press ‘Yes’, to start the Purge sequence. The system will purge the storage chemicals with feed water.

Note: **The watermaker will shut down if the pressure relief valve is closed during the Purge mode.**

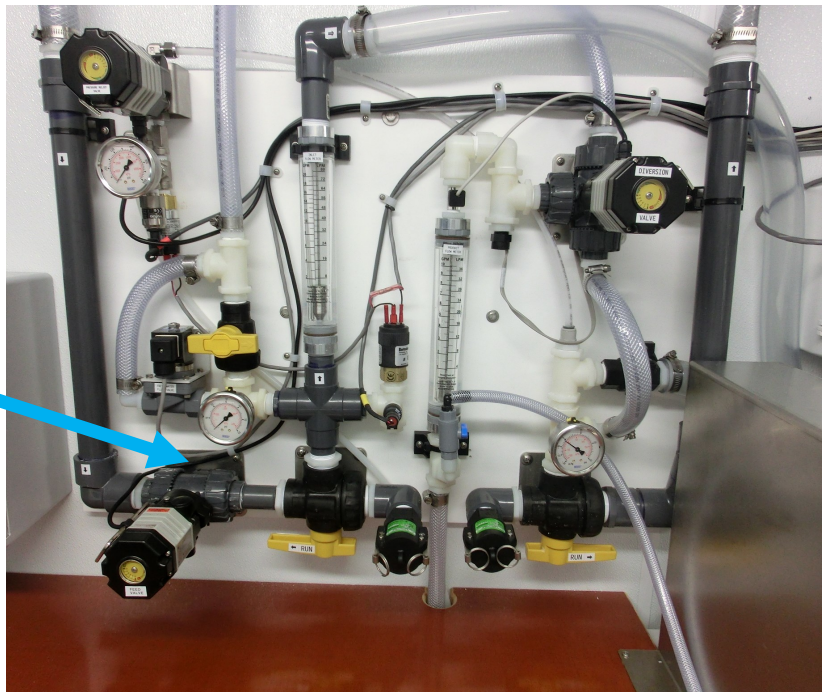
7. The system will start purging and the display will show the progress and time remaining for the purge cycle.





New System Start-Up and Testing - Cont.

8. Note that the Boost (feed) Pressure sensor and gauge are after the feed valve so it will only read when the feed valve is open. The Boost Pressure should be **about 20 psi (1.4 Bar) during operation**.



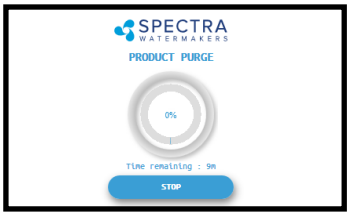
9. Using the buttons on top of the filter housings, bleed out the air in the filter housings until water is coming out.

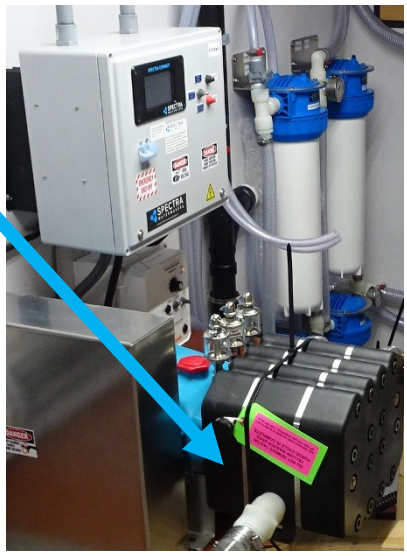
10. Check the brine discharge for water flow. The system should fully prime within 60-90 seconds and all air should be out of the feed water hoses. The pump should sound smooth.
- Note if the Boost Pressure drops below 10 psi the system will alarm “Service Prefilters”.

If you must stop the purge sequence for any reason, the control will default back to the beginning of the purge cycle to protect your system.

New System Start-Up and Testing - Cont.

11. After the purge sequence the display will alarm with the message “Close pressure relief valve.” Remove the tag and the rubber washer under the knob for the valve and close it. Proceed by pressing Ok to resume the last part of the Purge Cycle which will direct product water to the drain.





Note: It may be necessary to adjust the Boost Pressure again once the system is running at Full Speed and pressure, suing this knob on the speed control.

- If the High Pressure Pump knocks or bangs, the Boost Pressure requires adjustment, it is either too high or too low.
  to be as high as possible with the pump running smoothly.

Knocking can also be controlled by adding a little back pressure by partially closing (as shown) the Brine Discharge valve. Note the valve is shown partially closed.
3-5psi of back pressure on this gauge is a good target.

Caution -Take care that the back pressure does not exceed 10 psi or it can blow off one of the hoses.

12. The system will now run under pressure and desalinate water. This mode diverts the product water to drain in case there are any residual chemicals in the membrane. Carefully inspect for leaks over the entire system! Shut down the system and repair any leaks you find.

13. After the Product Purge cycle completes, the system will prompt to Restart, then advance to the Main Menu. **If this is a new installation, continue to the Calibration Instructions to finalize the installation.**

If the system was stored with Propylene Glycol, if there is a chemical odor to the product water, or if salinity remains high after the purge sequence, additional purging time may be required. All systems are shipped from the factory stored with Propylene Glycol.

New System Start-Up and Testing - Cont.

Setup Instructions on Chlorine Injection System

Note: There is a float switch in the bottom of the chlorine tank that is in the "Lock Out" circuit. If the tank level is too low the watermaker will not run (Pretreatment Lockout).

The chlorine injection system is activated when the diversion valve closes, directing product water to the storage tank(s).

Priming the system
Fill the Chlorine injection tank halfway with water and with the watermaker(s) running set both the stroke and frequency to 100%.

Mark the chlorine injection lines so you can reconnect them correctly. Disconnect both of the chlorine injection lines from the fittings behind the black drain pipe. When water is coming out of the tubes, reconnect to the fittings on the product lines (be sure to connect to the correct system). It may take up to 30 minutes to prime the system.

With the system is primed add 1/2 gallon (2 liters) of liquid bleach (5% solution) and then top off the tank with fresh water.

If powdered Calcium Hypochlorite is used, add 565grams of 65% hypochlorite, then top off the tank with fresh water.

Make adjustments to the Stroke Rate (strokes per minute) and Stroke Length (amount per stroke) while the unit is running. Start with the stroke length at 100% and set the rate at 50% which should be about 1 stroke every 5 seconds. The actual flow rate from the injection pump is 3 gpd (11 lpd) at 100% Stroke and 100% Frequency.

These settings should result in a chlorination level of about 1 ppm. Test with the test strips at the storage tank after the system has run for at least an hour, and adjust as required.

To increase the PPM level increase the stroke frequency.

Check the chlorine level in the tanks daily for the first week to confirm the system is working at the rate expected. The concentrated solution should be replaced every 10 days. Adjust the batch size of the concentrate tank according to anticipated usage.

The manufacturers manual for the chlorine injector included in this binder.

Sensor Calibration

Many of the settings on your system have been pre-calibrated during standard factory testing, however, there are a few settings that will vary based on the installation conditions. **If the system has just been installed you must calibrate the Prefilter Condition graph before proceeding.**

Prefilter Gauge Calibration

This procedure does **not** need to be done with each filter change under normal operation, it should **ONLY BE DONE IF THE FILTER CONDITION GAUGE WON'T RESET TO 100% WITH NEW FILTERS.**

1. During the calibration sequence the system will automatically start, begin to make water for several minutes and then shut itself down. *Make sure that new filters are in place before proceeding.*
2. Follow the steps in Figures 1—4 below to initiate the Calibration Sequence.

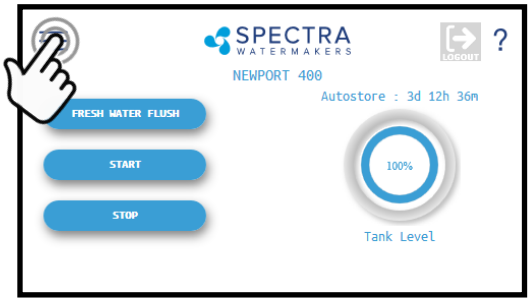


Fig. 1

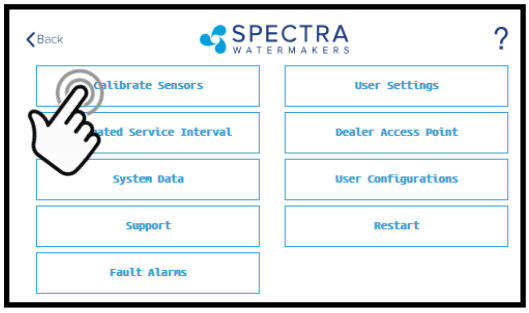


Fig. 2

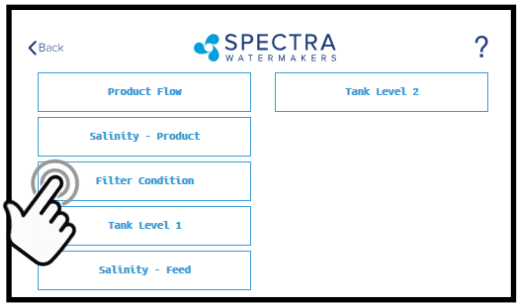


Fig. 3

Fig. 4

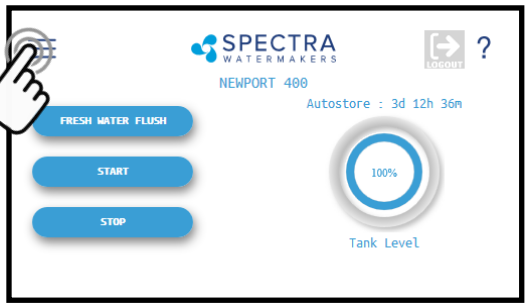
3. When the Calibration Sequence is complete, press the Back button in the upper left corner to return to the Main Menu.
   *When prompted by the display, Click **Save** to make sure that the Calibration is stored in the system memory.*
4. The **Filter Condition gauge** has now been calibrated to match your installation.

Tank Level Sensor Calibration
(with optional transducer installed)

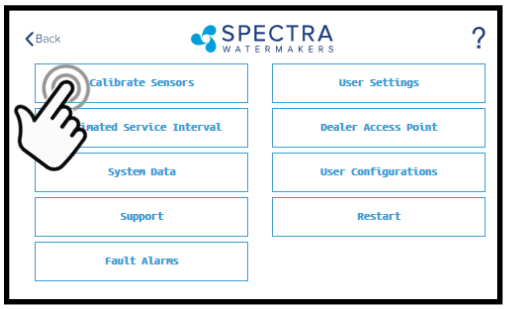
Installing the optional tank level sensor (KIT-SC-TNKSS) will allow the control to display tank levels in up to two tanks. Follow the steps below to enter the calibration sequence for the optional Tank Level Sensor(s).

The tank needs to be full to proceed with the calibration process and you need to measure the approximate height of the tank.

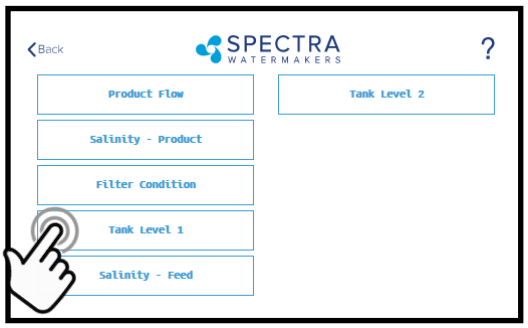
1. With a full tank, press the Menu Button



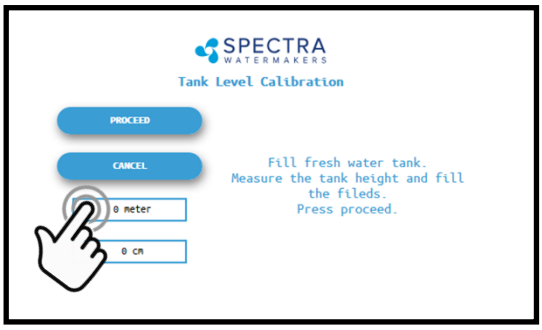
2. Press the Calibrate Sensors Button



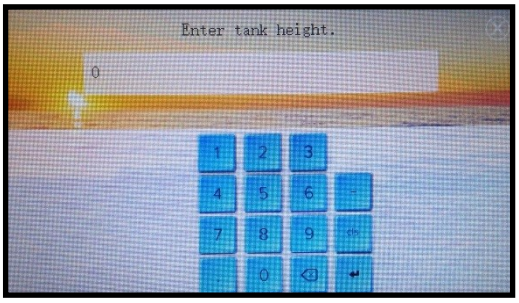
3. Press the Tank Level 1 button



4. Press to enter the tank height



5. Enter the height

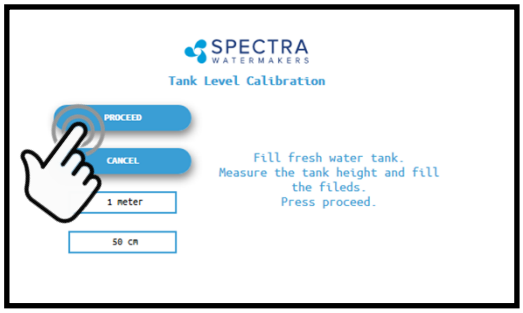


Press the Feet (Meter) field to enter the tank height in feet (meters).

Press the Inch (cm) field to enter the height in inches.

Ex: If the Tank height is 150cm:
Enter ‘1’ in the field labeled ‘Meter’
Enter ‘50’ in the field labeled ‘cm’

8. If the entry is correct press Proceed.



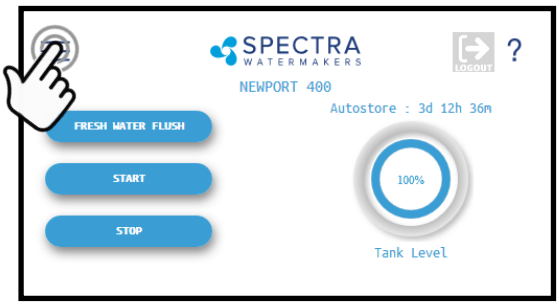
9. Press OK to save the settings

Salinity Calibration

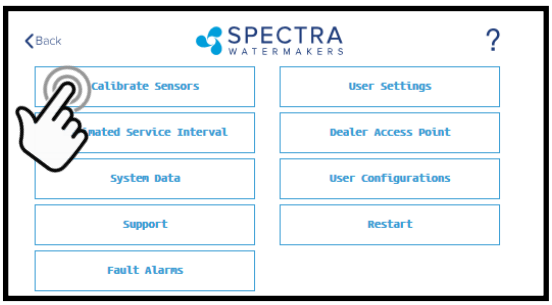
The Salinity probe has been calibrated at the factory during testing and is not normally required during commissioning. If the product quality is not reading accurately, follow calibration steps.

A handheld salinity meter (or other reliable device) is required to perform this calibration as you need to confirm the salinity of the product water.

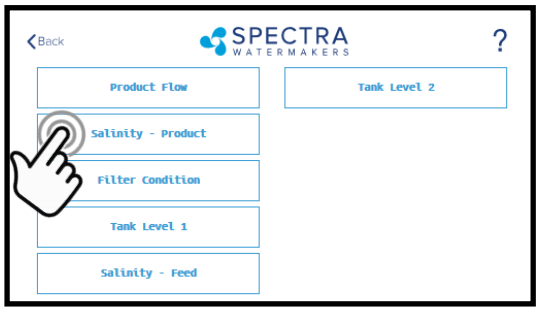
1. Press the Menu Button



2. Press the Calibrate Sensors Button

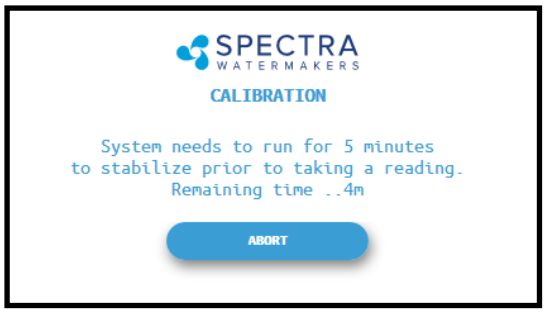


3. Press the Salinity—Product Button

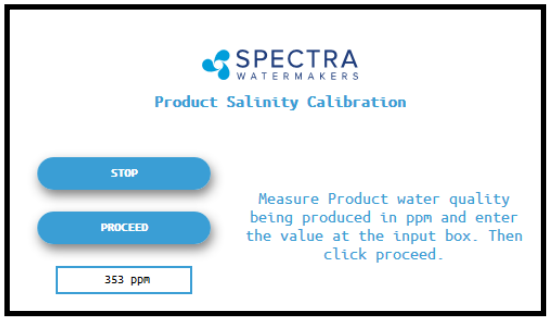


4. Press Continue to acknowledge the warning

5. Allow the salinity to stabilize for 5 minutes.



6. Press the PPM field and enter the PPM you measured. Press Proceed to save your entry.

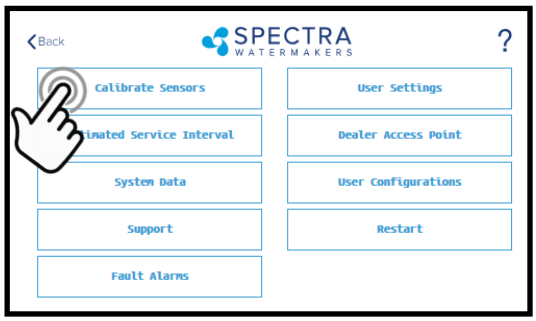


Product Flow Calibration

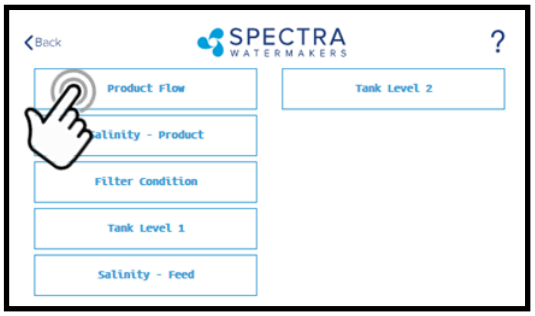
The Product Flow sensor has been calibrated at the factory during testing and isn't normally required during commissioning. If the product flow is not reading accurately, confirm the product flow rate by following the Product Flow calibration steps.

1. Press the Menu Button

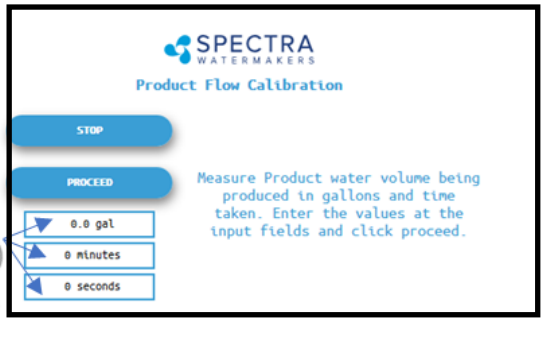
2. Press the Calibrate Sensors Button



3. Press the Product Flow Button



4. Measure the product flow per the process described below, enter the numbers below and press Proceed.



4. Allow the system to run for a few minutes to stabilize and then time in minutes and seconds, how long it takes to fill a container of a known volume.
5. Touch the 'Gal' ('Liter') field to enter the volume of the container used.
6. Touch the 'Minutes' field to enter the minutes it took to fill the container. *Only enter the minutes, ex: 3 min 15 sec should be entered as 3.*
7. Touch the seconds field to enter the seconds it took to fill the container. *Only enter the seconds, ex: 3 min 15 sec should be entered as 15.*
8. Press 'Proceed'. *You must save all changes when prompted after exiting the settings menu*

Normal Operation

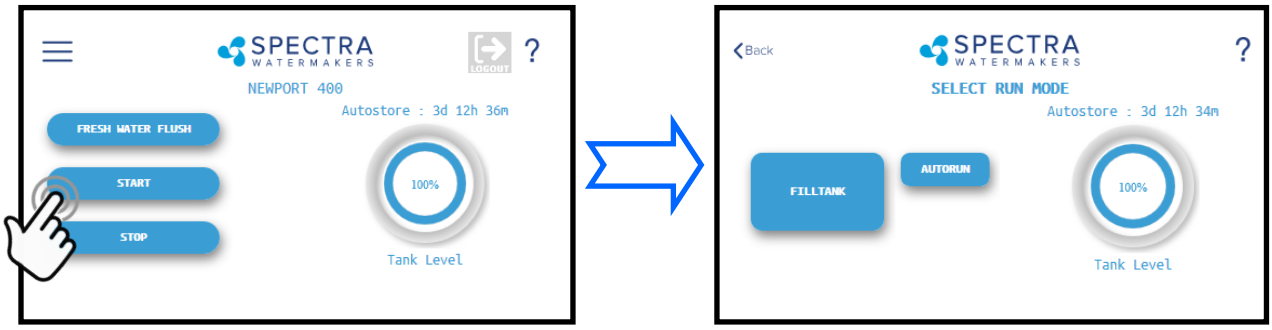
If the system has been pickled or stored with chemicals, use the New System Startup procedure.

Your system will fresh water flush **after every use**. Remember that you need to run the system approximately half an hour to make enough fresh water for one flush.

1. Check to see that the inlet and brine discharge seacocks are open and the domestic pressurized water system is turned on.

2. Open the oilers on the SP20 crankcase and allow 5—6 drops of oil to lubricate the pump plungers.

3. Press the 'Start' button, then select the desired operating mode.



Standard Operating Modes

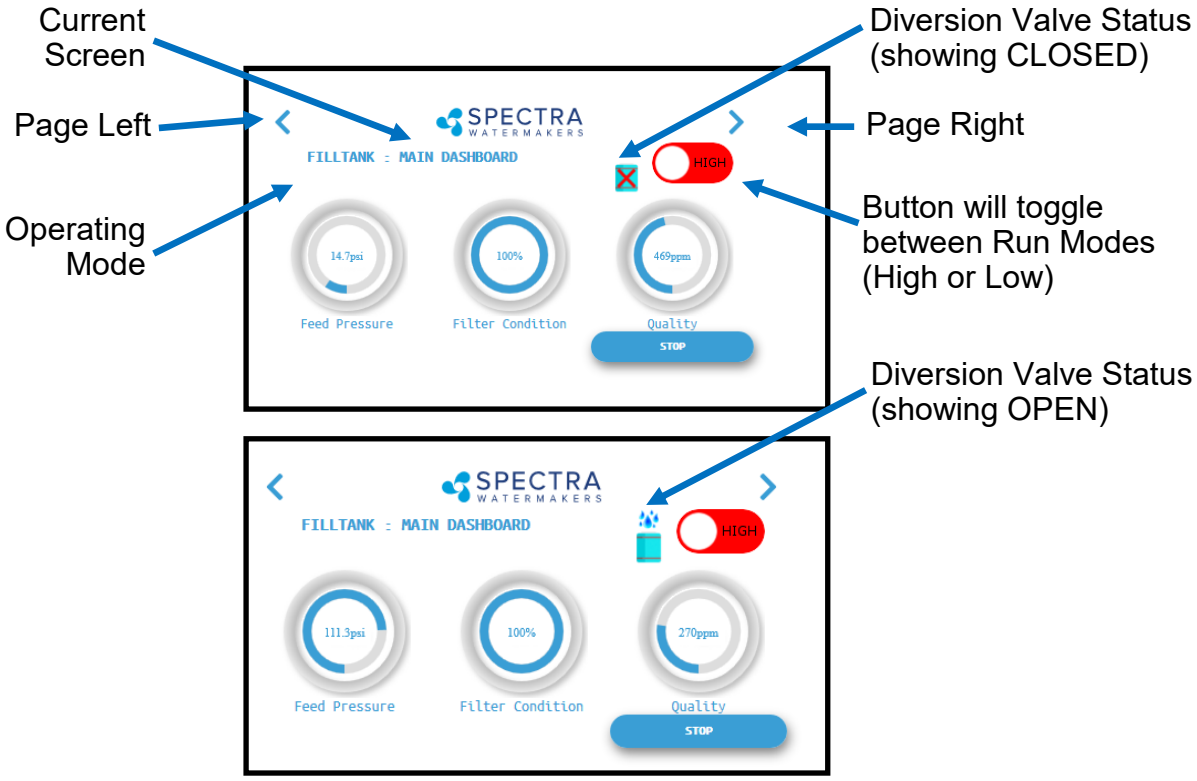
4. Runs your watermaker until the Tank Full switch closes, fresh water flushes the system, then goes into 'Auto Store' mode and the Flush Interval timer starts. *This option is only available if the Tank Full Switch is installed.*
-OR-

5. Gives you the option to run for a preset amount of time, or a preset volume of water to be produced. **If no tank switches are installed, and they have been disabled in the system settings**, this is the only Operating Mode available.

Normal Operation - Cont.

6. The system will now begin the start sequence and will count down to the pump starting. Pressing 'Stop' will stop the sequence and bring you back to the Main Menu.

7. Once the Boost Pressure reaches the minimum threshold, the system starts operating and you will be taken directly to the Main Dashboard which shows the current status.



8. When the
Product Water Quality is better than the programmed threshold, the Diversion Valve opens, allowing water to enter the tanks and the screen image changes.

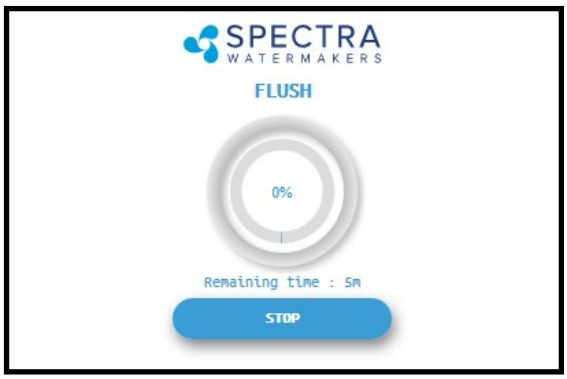
Verify that the system is operating according to the factory specifications detailed on p.36. See the Troubleshooting section to identify any anomalies.

9. Pressing the < (Page Left) or > (Page Right) arrows while the system is running will scroll through the different screens with operating information for your watermaker.

Normal Operation - Cont.

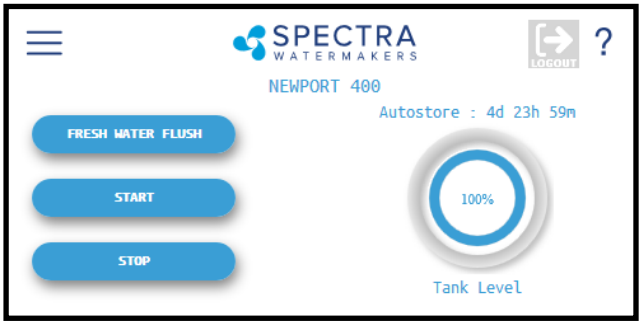
10. When the Run Cycle completes, the system will start the Fresh Water Flush cycle. If you stop the system (interrupting the run cycle) the system will also start a flush cycle.

The system must be FRESH WATER FLUSHED AFTER EACH USE, or serious damage can occur.



If the system is knocking during the flush cycle change the Pearson Pump run speed in the Dealer Access section. Adjusting the speed slightly should stop the knocking.

11. After Fresh Water Flushing, the system will enter standby mode waiting for the next run cycle.



Pretreatment Lockout - Operation Paused

There are several switches that can cause the Pretreatment Lockout;

- Feed tank Switch circuit is closed
- The Chlorine tank is low
- One of the media filters is backflushing

This is a 'Normally Open' circuit so the above switches close to pause watermaker operation. When the closed circuit is opened the system will resume operation.

Manual Operation Overview

The system can be operated in “Manual” mode if there is a problem with the Spectra Connect control system. In Manual mode there are two safety switches; one protects from low feed pressure and the other from excessive membrane pressure. If either of the safety switches are tripped the system will stop and will need to be restarted.

All the motorized valves work in Manual mode and the run sequence is explained in detail on the following pages.

- The toggle switch on the main control box is switched to Manual
- Confirm the Valves are in the Run position
- Open the pressure relief valve until everything is running at speed
- Leave the Feed/Boost pump control in the Auto position
- Push and hold the start button until the feed pressure is >10psi
- When the Pearson Pump is running at full speed, close the pressure relief valve
- After a few minutes flip on the Chlorinator and water will flow to the tank

To Stop, push the stop button and turn off the chlorinator.

Fresh Water Flush

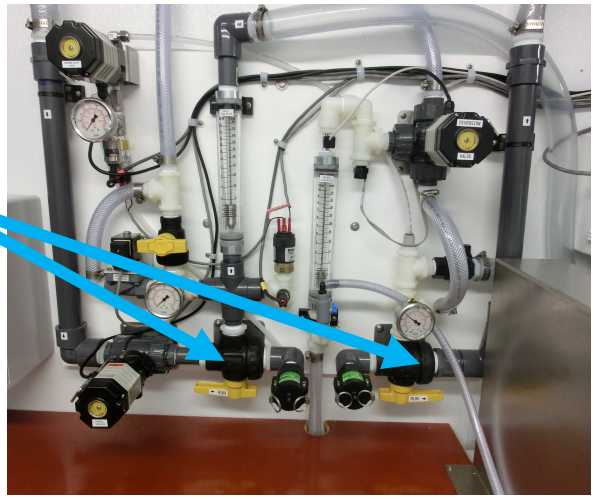
- Open the manual flush valve
- Flip the toggle switch to service so the Pearson Pump runs at low speed
- Flush the system for 5-6 minutes
- Flip Toggle switch back to Auto
- Close the flush valve

Manual Operation

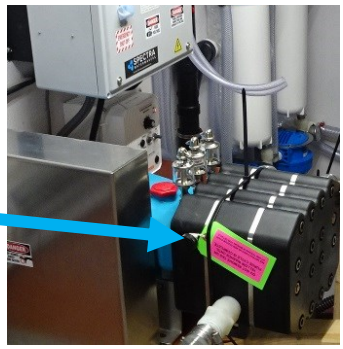
Each of the watermakers will operate as a manual system (no automation), protected by a low pressure switch for the feed and a high pressure switch for membrane pressure. The system will not stay running until the feed pressure is over 10psi so during startup you need to hold down the start button until you see 10psi on the feed gauge and if it drops below 8psi, it will shut down. If the membrane pressure goes over 900psi the system will also shut down.

When operating in manual mode you will;

1. Confirm the inlet valve and the brine discharge valves are in the RUN position.



2. Confirm the Pressure Relief valve is open one full turn which will make starting easier.



3. Confirm the boost pumps are full of water.
If the feed tank is above the level of the boost pumps they will fill by "burping" the lid. Be prepared to reseal the lid by placing a knee in the middle of the lid to push it down while tightening the lid.

Note; if the pump bowls do not fill per the above, follow the instructions in the pump manual for installing a priming tube.

Manual Operation - Cont.

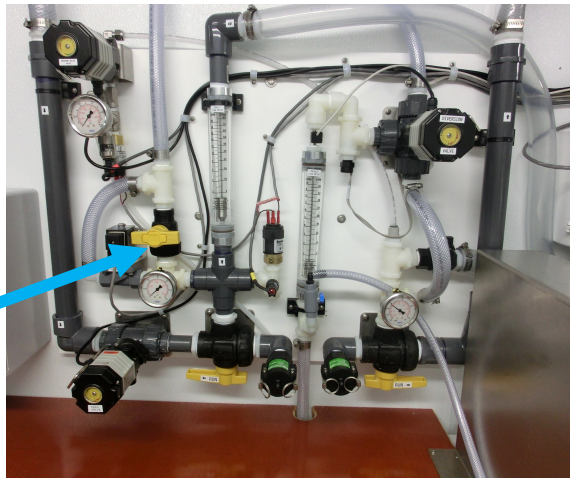
- Leave the Feed/Boost pump control set to AUTO

- Flip the toggle switch on the control box to Manual

- Press and hold the START button until the Feed pressure is above 10psi.

The Feed/Boost Pressure must be above 10psi for the system to stay running.

- After a few minutes flip on the Chlorinator switch which will close the diversion valve (product going to tank) and start the chlorinator



- Push the STOP button and turn off the Chlorinator to stop the system.

Fresh Water Flush

Open the manual flush valve and flip the toggle switch to service so the pump runs at low speed during he flush. Flush the system for 5-6 minutes. Flip the toggle switch back to Auto and close the flush valve.

Note if the system knocks during the flush cycle you can adjust the Pearson pump speed up or down to smooth it out.

Prefilter check

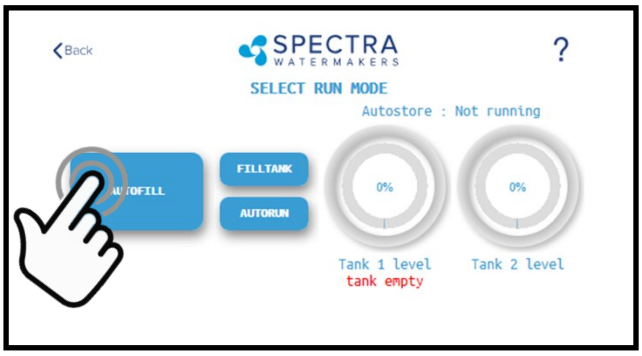
The pressure drop across the media filters should be <5psi, if it is more do a backflush.

If the pressure drop across the filters is more than

Other Operating Modes

Auto Fill Mode

If using the Tank Low and Tank Full switches, **and both are enabled in the system settings**, then your Start Menu will allow the system to be operated in Auto Fill mode.

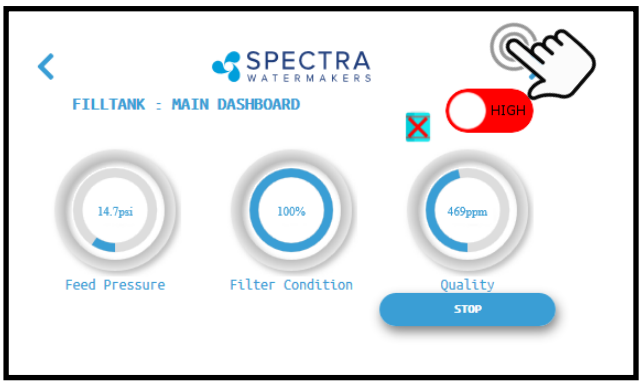


In Auto Fill Mode the Spectra Connect will automatically fill your water tank, stop itself, fresh water flush, return to auto store mode with the flush interval timer running and then turn itself on again to fill the tank as soon as the water level drops below the Tank Low Switch with no additional user commands.

Run Low Mode

You can toggle back and forth between Run High Mode and Run Low Mode by tapping the 'High' toggle button.

Run Low Mode may be selected to reduce power consumption, lower the membrane pressure, or prolong filter life.



Note: The system will automatically drop to Low Mode when it senses high membrane pressure, or low boost (feed) pressure.

Note: When operating in Low Mode it may be necessary to adjust the Feed Pressure to prevent the high pressure pump from knocking.

Auto Store

Warning! Proper understanding of the Spectra flush system and the fresh water system is mandatory for extended use of Auto Store.

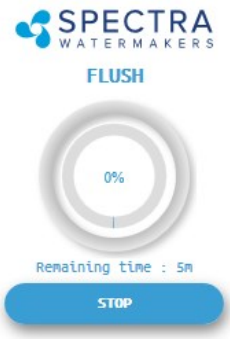
The Auto Store function flushes the system at programmed intervals. As long as the system is flushed with fresh water every 5 days you need not store the system with chemicals.

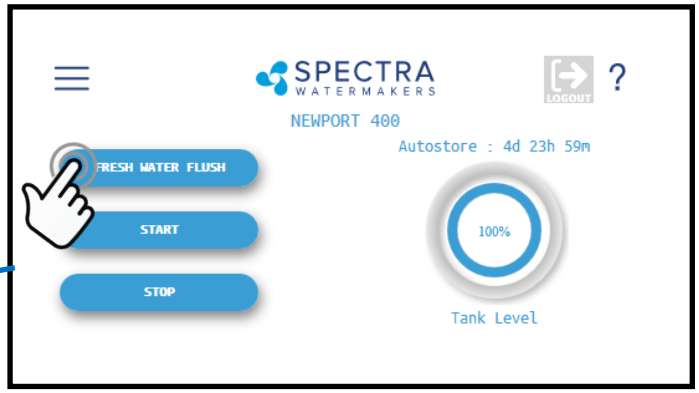
The Containerized unit is designed to be connected to a pressurized fresh water source (<50 psi) and has a carbon filter included to remove chlorine for the flushing cycle.

Note: If the system runs out of water the pump(s) will be damaged.

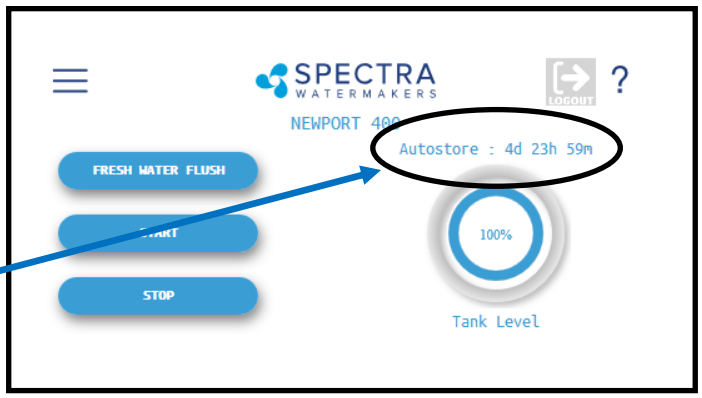
- Make sure the pressure relief valve on the Pearson pump is closed.
- **The system must be continually powered on during the Auto Store mode.** Turning off the power will disable the automatic fresh water flush and damage may occur.

Pushing the fresh water flush button flushes the system with fresh water and activates the auto store cycle:





Shows Autostore: time to next flush cycle.



Long Term Storage Procedures

Desalination systems are best run frequently as biological growth in the membrane is the leading cause of membrane fouling. A warm environment will cause faster growth than a cold environment. The fresh water flush system will greatly reduce biological growth but may not stop it completely in certain conditions.

System Storage for up to 6 months, "Pickling"

If the system is to be left unused for more than 2 weeks, perform the following storage procedure. The procedure introduces a chemical compound, SC-1, into the system that prevents biological growth.

Spectra SC-1 is a special storage compound used by the US Navy. It is formulated to be compatible with the modern engineering plastics and composites in the Spectra pumps. Do not use any substitute except Propylene Glycol.

Caution! Avoid contact with skin, eyes, or lungs with the storage chemical.

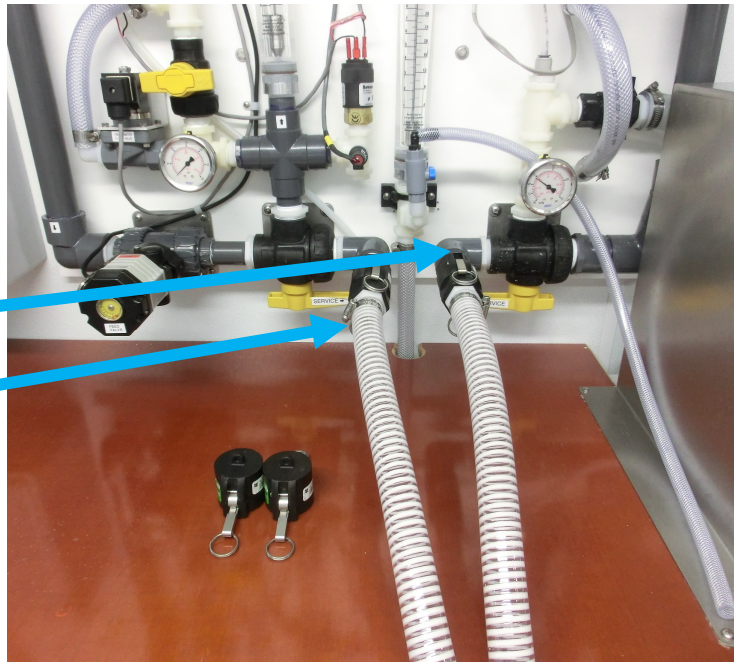
Long Term Storage Procedures

Storage Procedure: SC-1 powdered preservative (good for 6 months):

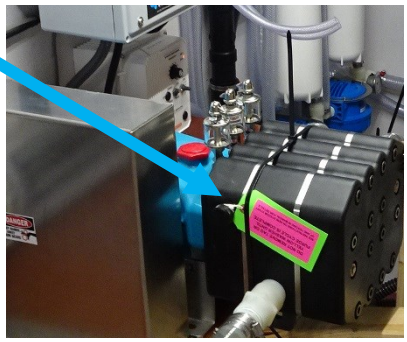
1. Fill a bucket with 4 gallons (15 l) of fresh unchlorinated water, leaving at least 4" (10cm) to the top of the bucket. Mix 2 lbs (1kg) SC-1 storage chemical compound into the water in the bucket. Note that it will take about an hour for most of the chemical to dissolve.

2. Perform two fresh water flushes to prepare the system for cleaning.

3. Install the service hoses from the service kit onto the service inlet and outlet quick connections and put the other end in the bucket with the SC-1. Turn the yellow service valves so they point at the service fittings.



4. Confirm the pressure relief valve on the high pressure pump is open one full turn.



5. Flip the toggle switch on the main control box to "Service" to turn on the pump and circulate the storage chemical in the system for at least 20 minutes.

6. After 20 minutes flip the service switch off.

Clean Up:

- Turn the service valves to the off position (half way)
- Remove the service hoses and replace the dust caps.
- Remove the filter bowls, rinse with the storage solution and reinstall with clean dry filters. This should be a clean operation so you do not introduce bacterial into the filter bowls. Wear clean disposable gloves if available and/or wash your hands before starting
- Discard the remaining storage liquid in the bucket to a suitable drain.
- Turn off the power to the system.

LEAVE THE PRESSURE RELIEF VALVE OPEN 1 FULL TURN AND LEAVE A NOTE ON THE SYSTEM SHOWING THAT IT IS FULL OF STORAGE SOLUTION AND THE DATE. ALSO MAKE A NOTE IN THE LOG BOOK.

Maintenance

General

Periodically inspect the entire system for leakage and chafe on the tubing and hoses. Repair any leaks you find as soon as practical. Some salt crystal formation around the Spectra-Pearson Pump blocks is normal. Wipe down any salt encrusted areas with a damp cloth.

Prefilters

Service the prefilters as soon as the Boost Pressure drops 10psi from when new filters were installed.

To service the filters shut off the system including the feed water supply pump. Open the housings and discard old filters. Clean out the housing bowls, check and lubricate the O-rings with silicone grease and reassemble the housings with new 5 micron filter elements. Leave dry until next startup. Do not tighten the retaining rings for the filter bowls with the wrench, only hand tighten. The ring does not need to be tight for the O-ring to seal.

Use only Spectra approved pleated polyester filters or you may void your warranty.

Boost Pump maintenance

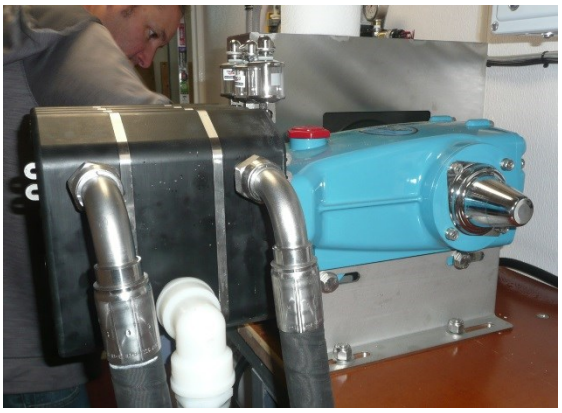
Routinely inspect the basket strainers integrated with the Boost Pumps. If these strainers become clogged, the pumps can be damaged.

Inspect the pumps daily for leaks and address leaks immediately.

See the boost pump manufacturer's manual for detailed instructions.

Maintenance - Cont.

SP-20 pump



The oil in the SP-20 pump crankcase should be changed every 5000 hours or if it becomes dirty, or contaminated with water (milky). As with all high pressure pumps the seals in the Pearson Pump need to be replaced from time to time.

Inspect the pump daily for leaks at the high and low pressure fittings, and at the mating surface between the black manifold layers and the blue crankcase.

Frequency	Parts Required	Description
Daily	N/A	Inspect for leaks, confirm Boost Pressure, check belt tension, plunger oilers
2500 hours of operation, or when leaks occur	KIT-SP20-35R2K5	Install Seal Rebuild Kit
5000 hours of operation; when the oil is dirty or milky, or annually	PP-CC-CCO, or source ISO 68 petroleum oil locally	Oil Change
10000 hours of operation, or when recovery ratio changes by 5%	KIT-SP20-35R10K	Full pump rebuild kit

Media Filters

The media filters should be backwashed prior to each use, or when the pressure drop across them increases by 5-10psi. See media filter manual for detailed instructions.

Replace the media every 10 years, or when the media filters lose effectiveness.

Maintenance - Cont.

Seal / Ceramic Oilers

The Pearson Pump comes with drip oilers which are used to extend the service life of the seals. Allow the system to run for at least one hour before allowing the seal oilers to drip. Use the same gearcase oil as used in the Pearson Pump crankcase. Only fill the reservoirs half way, do not overfill.

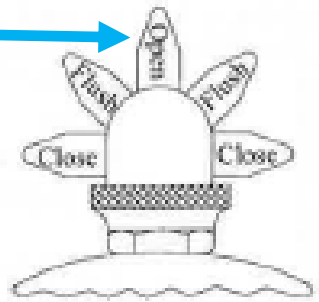
Following this procedure will dramatically increase the seal life.

Warning! Over- oiling can foul the membranes.

There are two methods to oiling and either one is acceptable;

Each time you start the watermaker open the oiler lever (pointing up) and allow 4-5 drips to fall.
Unscrew the top of the oiler to increase the drip rate.
Be sure to close the valve to limit the amount of oil

Used so the membranes are not fouled.



The oilers will drip when opened, which can be seen in the window below the reservoir.

The other option is to leave the drip valve open and add two pumps to each oiler once per week from the supplied oil can (1/3 oz. or 8-10 ml).

Either option is acceptable, but make sure one of them becomes part of the regular maintenance schedule.

Warning! Do not use more than the recommended amount of oil as damage to the membranes may result.

Maintenance - Cont.

The Chlorine Injection System will require filling every 1-2 weeks based on the default settings as described on page 25.

The level of residual chlorine required based on local conditions and should be monitored at least weekly. Normally chlorination of 0.5 to 1 ppm after 1 hour (in the tank) is adequate., however if the containers used to transport the water are of questionable cleanliness it may be a good idea to increase the chlorination level and/or set up a cleaning/sanitation station for containers.

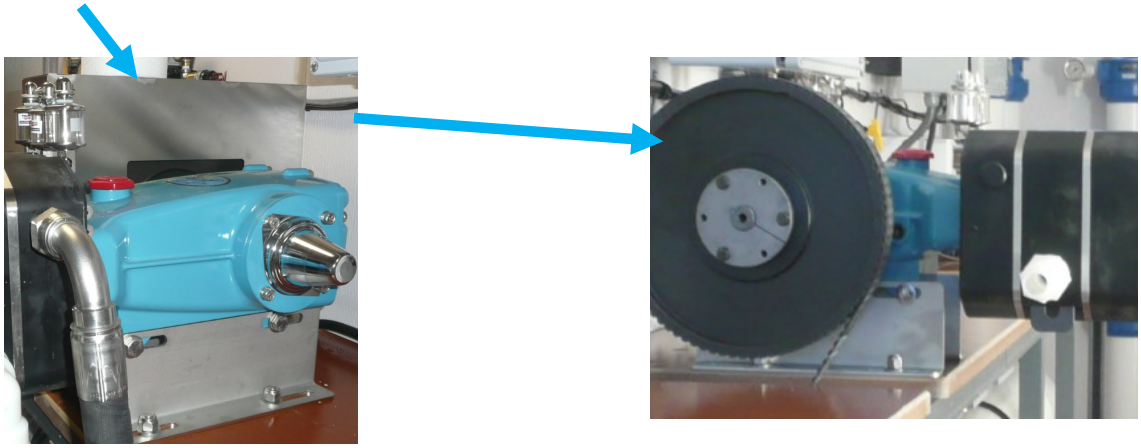
The cartridge valves will need to be replaced every 6-12 months based on usage and duty cycle.

There are test strips that should be used on a regular basis (daily while learning how the system responds to local conditions) to test the chlorination level.

There is also a section in the binder with the manual for the chlorine injector.

Tensioning the Drive Belt

Remove the stainless steel belt guard to expose the large pulley and belt.



Loosen the 4 Nyloc Nuts that hold the pump down to the bench.

Slide the pump forward to tension the belt until the belt can be twisted almost 90°. Be sure the pump is square to the pulley. Tighten the bolts to fix the pump in place.

Cycle the pump quickly to confirm the belt is in the middle of the pulley track after adjusting. The belt will jump which sounds like the pump is knocking if is it is not tight enough.

Maintenance - Cont.

The Membranes

The membranes need to be cleaned only when operating pressures have risen more than 10% or the product quality degrades noticeably.

The leading cause of fouling is from biological growth that occurs when the system is left unused without flushing or pickling. Fouling from mineral scaling can happen during operation under certain sea water conditions, and from rust.

Monitor the product salinity and feed pressure for higher than normal readings for the conditions. Colder water or higher salinity can also cause high pressure. If the system pressure is increasing and production is dropping off it is likely the membrane is becoming fouled. Keeping a log of the basic operating parameters can help show a problem before a critical shutdown occurs.

There are two types of cleaners: acid and alkaline. The acid cleaner (SC-3) will remove mineral scaling. The alkaline cleaner (SC-2) is used to remove biological by-products, oil, and dirt particles that get past the prefilters. If membrane performance is reduced and they have not been pickled recently, cleaning with both chemicals is recommended. The acid cleaner should be used first.

If the membrane fails to respond to both cleanings, this is an indication of another problem with the system, or that it is time to replace the membranes. Contact Spectra Watermakers before removing a membrane.

If known bio-fouling is present, the SC-2 may be used first. Use warm water if possible, up to 120° F (45°C) is recommended as it greatly enhances the effectiveness of the cleaners.

If the history of the system is unknown or has been left “unpickled” for an extended length of time and biological growth is present, it is recommended that the system is cleaned with SC-2, using an alternate source of unchlorinated fresh water before the system is run under pressure.

Before running the system, remove the prefilters and examine their condition If the housings are full of smelly discolored water, the system was not properly stored. Install clean prefilters.

Next check the membrane. Attach the brine discharge service hose and lead to a bucket. Open the pressure relief valve one turn, and manually run the system for 30 seconds. Examine the brine water: if it’s discolored and smells bad, perform an SC-2 cleaning with an alternate source of unchlorinated water before running the system pressurized.

If the brine is fairly clean, the system can be purged, run normally, and checked for performance. Clean the membranes only if performance is reduced.

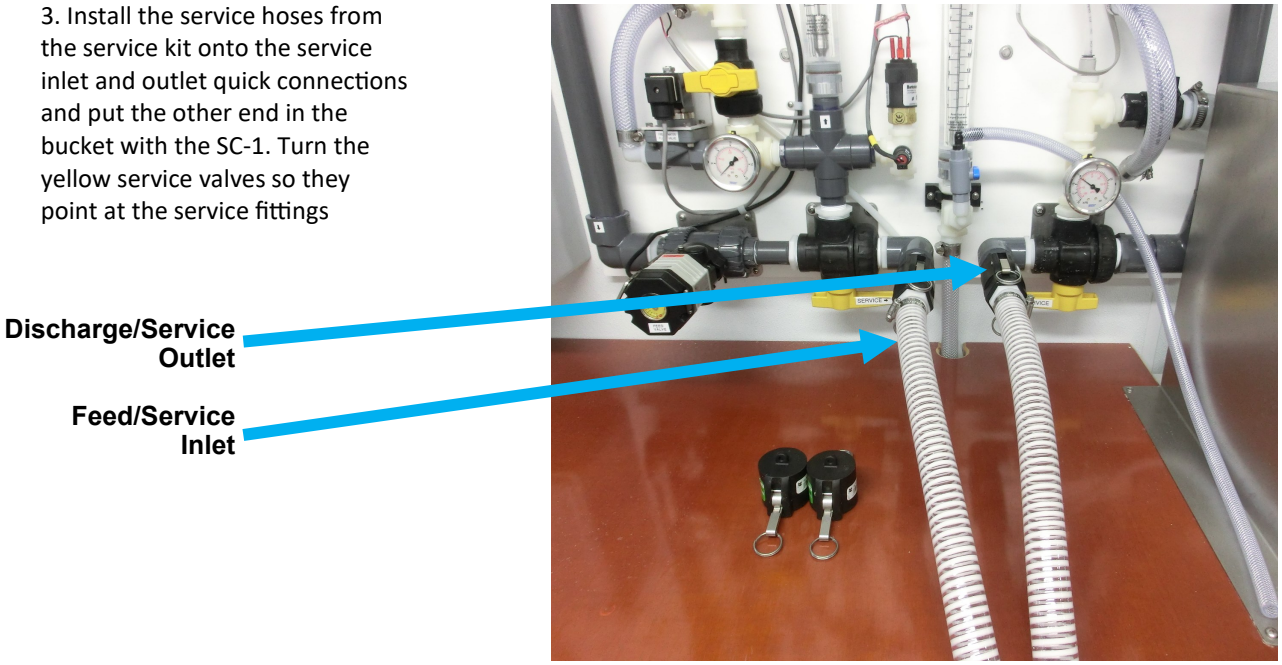
Membrane Cleaning Procedures

The Procedure is the same for SC-2 and SC-3

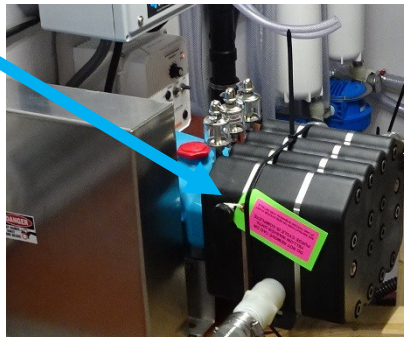
1. Fill a bucket with 4 gallons (15 l) of fresh unchlorinated water, leaving at least 4" to the top of the bucket. Mix 2 lbs. (1kg) cleaning chemical compound into the water in the bucket.

2. Perform two fresh water flushes to prepare the system for cleaning.

3. Install the service hoses from the service kit onto the service inlet and outlet quick connections and put the other end in the bucket with the SC-1. Turn the yellow service valves so they point at the service fittings



4. Confirm the pressure relief valve on the high pressure pump is open one full turn.



5. Flip the toggle switch on the main control box to "Service" to turn on the pump and circulate the storage chemical in the system for at least 20 minutes.

6. After 1 hour turn the service switch off. If the cleaning solution cannot be heated to 110°F (43°C), then allowing the solution to soak for several hours or overnight will increase effectiveness

Clean Up:

- Turn the service valves to the off position (half way)
- Remove the service hoses and replace the dust caps.
- Remove the filter bowls, rinse with the storage solution and reinstall with clean dry filters. This should be a clean operation so you do not introduce bacterial into the filter bowls. Wear clean disposable gloves if available and/or wash your hands before starting
- Discard the remaining cleaning liquid in the bucket to a suitable drain.
- Turn off the power to the system.

THE SYSTEM SHOULD BE PURGED WITH THE PRESSURE RELIEF VALVE OPEN FOR AT LEAST 30 MINUTES BEFORE PRESSURIZING AND MAKING WATER. THE SAME START-UP PROCESS AS IF IT WAS STORED WITH STORAGE CHEMICALS. ALSO MAKE A NOTE OF THE CLEANING IN THE LOG BOOK.

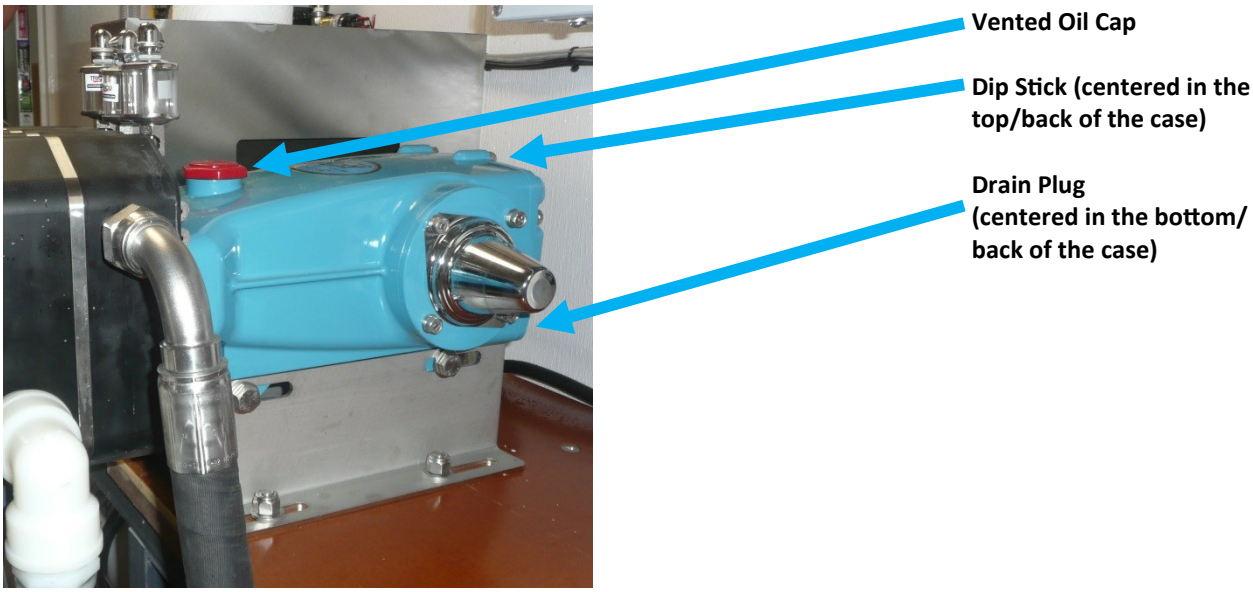
Oil Changes

GEARCASE LUBE OIL

Use only Spectra PP-CC-CCO, or source ISO 68 petroleum oil locally
Spectra-Pearson Pump crankcase. Do not overfill the crankcase with oil. Check oil condition and level frequently and it should be changed every 5000 hours of operation or annually, whichever comes first.

The Spectra–Pearson Pump comes mounted on a CAT™ crankcase. **Inspect the oil level and condition often.**

The oil in the crankcase should be changed every 5,000 hours or when the oil appears milky. Note that if the oil appears milky it is time to change the seals as water is getting into the crankcase from the pump head. There is a dip stick at the back of the crankcase to check the oil level.



CHANGING THE OIL

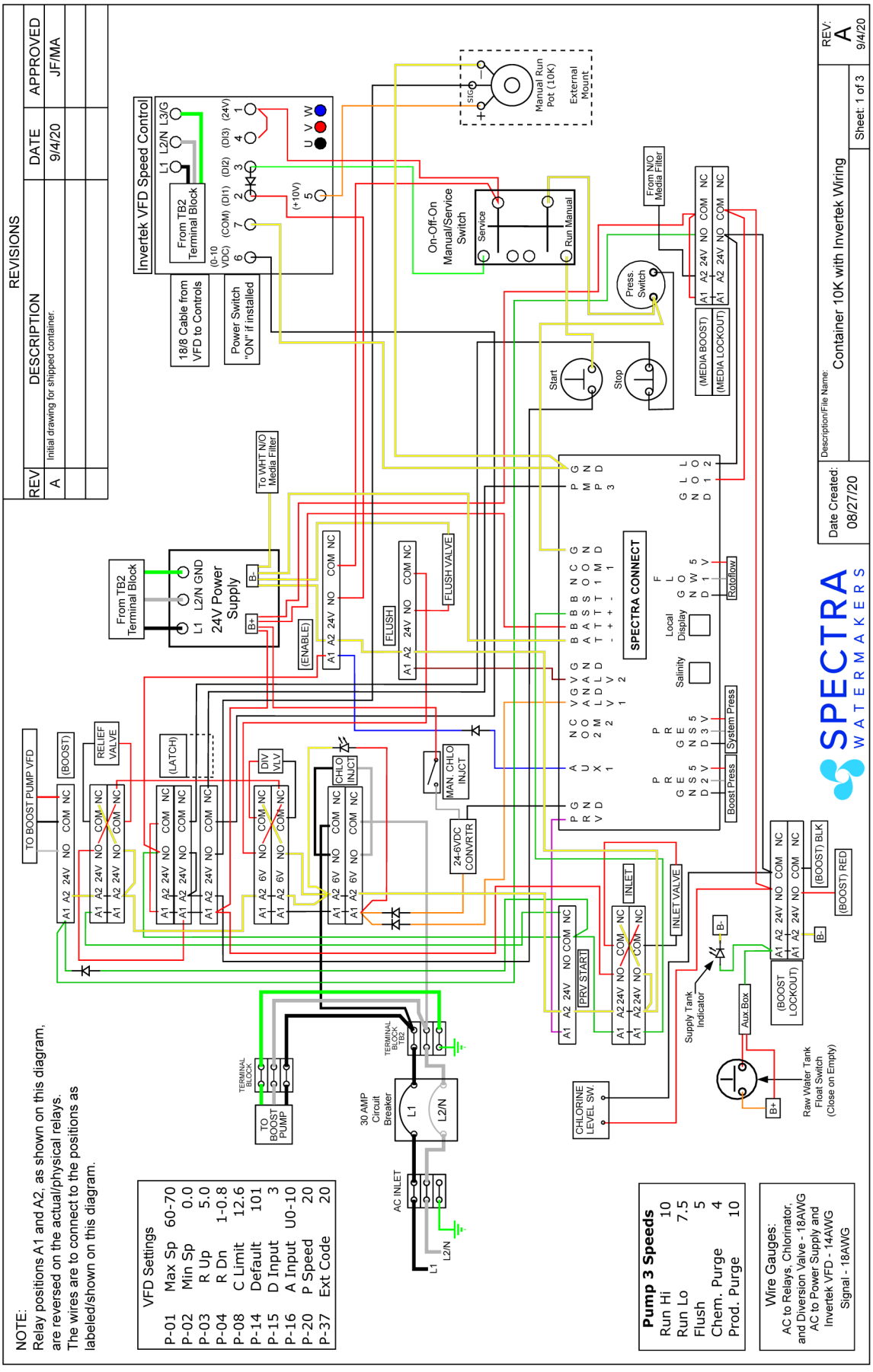
1. The oil will drain better if it is warm, after the system has been running for a few hours.

2. Find a suitable container to drain the oil into, remove drain plug.

3. Replace drain tube and refill with 2-1/2 quarts (2.5 liters)
   PP-CC-CCO, or source ISO 68 petroleum oil locally

Please dispose of used oil responsibly.

Electrical Schematic



Terminal Block Connections (inside control box)

REV	DESCRIPTION	DATE	APPROVED
B	No change this page	4/5/20	JF
C	Updated per final testing.	6/25/20	SN/MA
D	Updated to match shipped container.	7/07/20	JF/MA

TB 3

Flush Valve Relay (RED)	1	Flush Valve RED (Code BLU)
-24V (YEL) & Relays A1 (YEL)	2	(Code PUR) Pressure Switches BLK/ Flush Valve BLK (Code BLU)
Boost Lockout COM (bottom relay on drawing)	3	Pressure Switches RED (Code PUR)
Diversion Valve Relay (WHT/RED)	4	Diversion Valve RED (Code BLK)
Diversion Valve Relay (WHT/BLK)	5	Diversion Valve BLK (Code BLK)
Press.Relief Valve Relay (RED/GRN)	6	Press.Relief Valve BLK (Code ORG)
Press.Relief Valve Relay (RED/BLK)	7	Press.Relief Valve RED (Code ORG)
Inlet Valve Relay (ORG/RED)	8	Inlet Valve RED (Code WHT)
Inlet Valve Relay (ORG/BLK)	9	Inlet Valve BLK (Code WHT)
24VDC+	10	24VDC+/ Aux Box 5 ORG-YEL

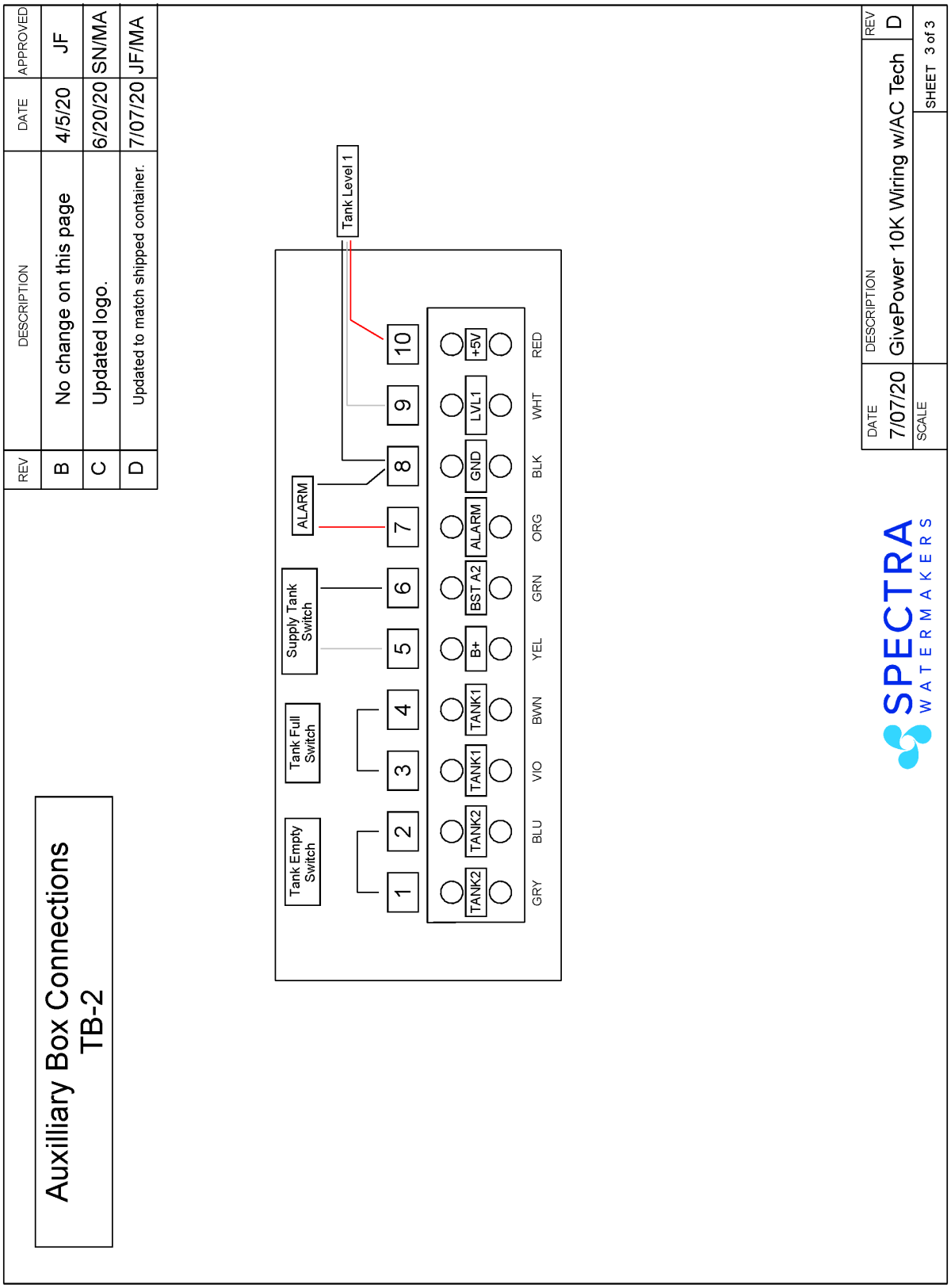
TB 4 (Chlorinator/UV, Media Filter)

COM- Boost Interlock & Media Lock Relays/ Connect LO1		1	To Chlorine Level Switch RED (Code GRN)
N/O-Boost Interlock & Media Lock Relays/ Connect LO2		2	To Chlorine Level Switch BLK (Code GRN)
Not Used		3	Not Used
220VAC From Chlorine Relay/	GND	4	A/C To Chlorinator
	L1	5	
	L2	6	

SPECTRA WATERMAKERS

DATE	DESCRIPTION	REV
7/07/20	GivePower 10K Wiring w/AC Tech	D
SCALE		SHEET 2 of 3

Auxiliary Box Connections



Troubleshooting Spectra Connect Alarms

Symptom	Cause	Resolution
Pump Knocks Loudly	Incorrect Boost Pressure	Increase or Decrease boost pressure as appropriate Check Pre-filtration for blockages
	Inadequate Feed Water Supply	Check Supply Pump for proper operation and adequate flow through pre-filtration system
Belt Skipping Teeth on Gear-End	Belt Too Loose	Tighten Belt
	Motor Turning Wrong Direction	Run motor in reverse direction by swapping T1 and T2 out VFD Output terminals.
Permeate Flow Decreasing	Permeate Flow Meter Not Calibrated	Calibrate permeate flow meter
	Worn High Pressure Seals	Replace seals
	Worn Damper Piston Seal	Replace Damper Piston and Seal
	Worn Piston Seals	Replace Pistons and Seals
	High Membrane Pressure	Check membrane pressure against nominal system parameters.
Recovery Ratio Increasing	Worn Pistons	Replace Pistons and seals
	Permeate Flow Meter Not Calibrated	Calibrate permeate flow meter
High Power Consumption (Decreased Energy Efficiency)	High Membrane Pressure	Check membrane pressure against nominal system parameters
	Low Boost Pressure	Check Supply Pump for proper operation and adequate flow through pre-filtration system
	Motor Problems	Test motor with a megohmeter, replace if necessary
	Gear End Problems	Change oil Replace Gear-End
Pump Won't Run	Motor Problem	Check VFD for error codes Check all wiring
	VFD Problem	Check all wiring Check VFD for error codes

Troubleshooting Spectra Connect Alarms

SYMPTOMS	PROBABLE CAUSE	REMEDY
Pump runs constantly, will not turn off	• Toggle switch on control box to RUN MAN or SERVICE	• Turn switch on control box to RUN AUTO • Replace Speed Control
Pump runs with loud noise	• Low or high Boost pressure • Intake blocked • Air in system	• Adjust Boost pressure • Check prefilters • Clean intake • Find leak on intake side of boost pump
No lights or display, system does not operate	• Display has gone to sleep • Remote display not connected • No power to control box	• Touch the screen to wake it up • Check display cable connections at back of display and at control box • Check and reset main DC supply breaker • Check for voltage control box, check 20A fuse on control board. • Try manual switch on control box: If pump runs, then control or display may be defective
Display activates, but pump will not run	• Loose or broken pump wire connection • Tanks are full (if equipped with tank switch) • Speed control overheated	• Check wiring at terminal block inside control box • Check tanks– system cannot be started if tanks are full. • Improve cooling
System runs, no product water delivered to water tanks, Product volume gauge good, Diversion valve shows activated on display	• Diversion valve inoperative or wiring fault. • Disconnected or broken product tubing • Diversion valve plunger stuck	• Check wiring at diversion valve and inside control box • Check product tubing • Exercise diversion valve by pressing the manual button top, retest. • Replace diversion valve.
System runs, no product water delivered to water tanks, Product volume gauge good, Diversion valve shows deactivated on display	• Poor product water quality diversion valve open • Salinity probe out of calibration or defective, bad cable • Chlorine damage to membranes • Pressure relief valve partially open	• Check for low feed pressure • Check for leaks at high pressure hoses • Test product water with hand-held tester– if over 500 PPM for 1 hour, see ‘Poor Product Quality’ on p.50 • Close pressure relief valve

Troubleshooting Spectra Connect Alarms

SYMPTOMS	PROBABLE CAUSE	REMEDY
"System Stalled" alarm is caused ty the rotoflow not reading properly, if no product flow the system alarms "System Stalled"	• Pressure relief valve open • Air in intake • No signal from Rotoflow meter	• Close pressure relief valve • Find air leak on suction side of feed pump • Check wiring, confirm roto-flow is spinning, clean or re-place Rotoflow meter
"High Pressure"	• Blocked brine discharge or product line • Fouled membrane	• Check brine discharge • Clean membrane
"Re-starting"	• No signal from Rotoflow meter at startup. • System airlocked	• See remedy above for "system stalled"
"Service Prefilter"	• Clogged filters • Loose or defective pressure sensor wires	• Install new filters • Check sensor wiring • If the error persists, follow Prefilter Calibration instruc-tions.
"Salinity High"	• High product water salinity • Chlorine damage to mem-branes • Defective salinity probe or cable, cable disconnected	• Check for low feed pressure • Check for leaks at high pressure hoses • Remove and clean probe contacts. Check calibration • Check cable connections • Clean membrane
Pretreatment Lockout	• Feed tank low • Chlorine tank low • Media filter backflushing	• Why is feed tank low? • Refill chlorine tank • Wait for media filter to back-flush.

Troubleshooting Spectra Connect

SYMPTOMS	PROBABLE CAUSE	REMEDY
Tank Level not accurate	• Tank Level not calibrated • Domestic water pump running • Water tanks sloshing while underway, no baffles in tanks • Tank sensor failed	• Calibrate tank level according to calibration instructions • Stop domestic water pump and check tank level • Re-check tank level accuracy while vessel in in port and sea state is calm • Replace sensor
Tank Level shows ‘ ! ‘	• Tank Level sensor disabled in Settings	• Verify tank level sensor is installed, and enable the tank level sensor
Device IP in Support Menu reads ‘NIL’	• Control board not connected to router or switch • Control board not receiving IP address from router or switch	• Connect the control board to a router or switch according to the Networking instructions • Cycle power on the watermaker with the network cable connected
“Can’t Connect to Watermaker from Web Browser”	• Device (phone/tablet/ computer) not connected to same network • Router/Switch turned off • Watermaker turned off • Connecting to wrong web address	• Check the wireless network on your mobile device or computer • If using a wired connection, confirm you are connected to the same net-work. • Make sure Router/switch has power. • Restart Router/Switch • Make sure watermaker is powered on • Confirm Device IP address matches address typed into browser

Spectra Connect Settings

Your new Spectra Connect is designed to make your watermaker easier than ever to operate, maintain and enjoy. This section will guide you through some of the more advanced settings options available.

Always use caution when changing any factory default settings, as serious damage can occur.

The Spectra Connect automatically monitors the operation of the system to ensure a long and trouble-free service life. If an operating parameter changes, the Connect can switch operating modes, shut itself down, or automatically store itself in order to protect your watermaker.

It includes advanced calibration sequences to make proper setup and maintenance of your watermaker easier than ever.

The onboard clock feature allows for temporary power interruptions without detrimental effects on the system. In some cases your watermaker will continue to function in its last known operating state.

The Spectra Connect has built-in data logging, allowing for easy access to historical operating data—which can indicate a wearing component or spares to be carried along before a failure occurs.

Built-in warnings for preventative maintenance automatically alert a user of pending maintenance items, helping to keep your watermaker's up-time to 100%! Advance warnings are pre-programmed for Prefilter Life, Pump rebuilds, membranes, Z-Ion reactor rod life, and carbon filter life. These warnings are resettable, allowing you to perform the maintenance before a catastrophic failure, then reset the interval—so you're always on top of the maintenance cycle!

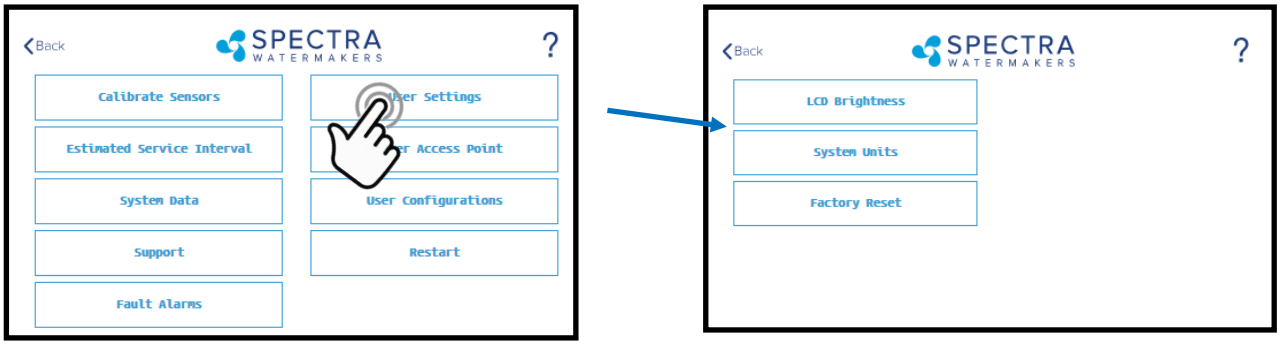
Access the Data Log file
Obtain the Spectra Connect IP address, as shown earlier in this manual

Using an internet browser on a Smart Phone, Tablet or Laptop type the address below:
<*Device IP Address*>/dataviz.php

Ex: 192.168.0.1/dataviz.php

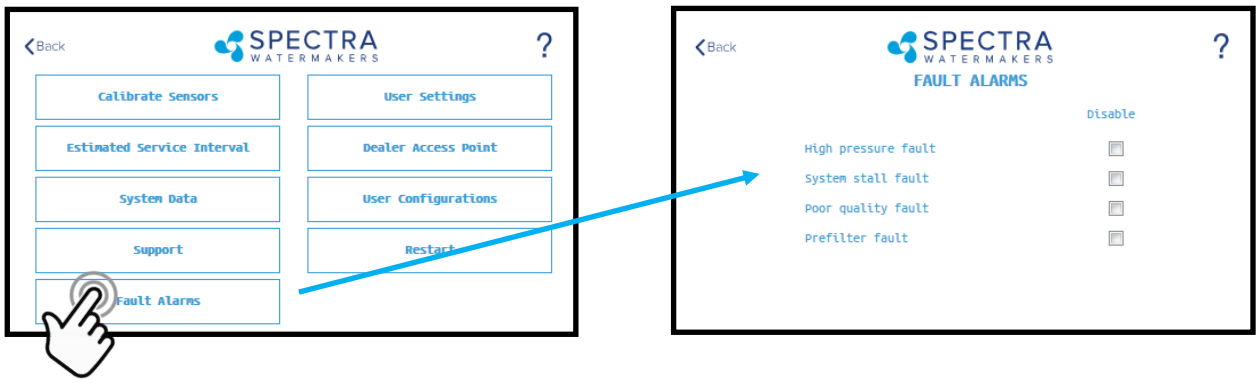
Spectra Connect Settings - Cont.

User Settings



LCD Brightness: Set brightness of the hardwired display(s) from 10-100%
System Units: Change from US Standard units to Metric
Factory Reset: Resets any changed parameters a user has made back to the factory defaults for that configuration.

Fault Alarms



CAUTION! Never disable a Fault Alarm without being certain that the issue is with a bad sensor. Disabling a fault and running the system can cause serious damage or injury.

High Pressure Fault: Disables the 'High Pressure' shutdown fault in the event of a feed pressure sensor failure.

System Stall Fault: Disables the 'System Stalled' shutdown fault in the event of a failed rotoflow sensor. System stalled alarms occur when the control board does not sense any product water being produced, and shuts down to protect the pump from running dry.

Poor Quality Fault: Disables the 'High Salinity' shut down fault in the event that the salinity probe has failed or cannot be calibrated within range. **NOTE: The diversion valve will always be active when this fault is disabled. ALWAYS VERIFY PRODUCT QUALITY BEFORE DRINKING. Serious health risks may occur.**

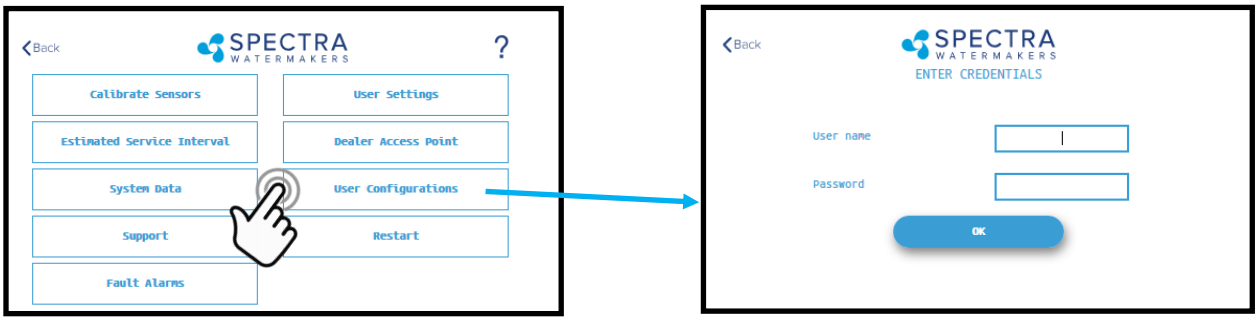
Prefilter Fault: Disables the 'Service Prefilter' shut down fault in the event that the boost pressure sensor has failed or cannot be calibrate within range. **CAUTION! Permanent damage to the feed pump can occur if this fault is disabled, use caution when operating this system with this fault disabled.**

Dealer Access Point - Settings

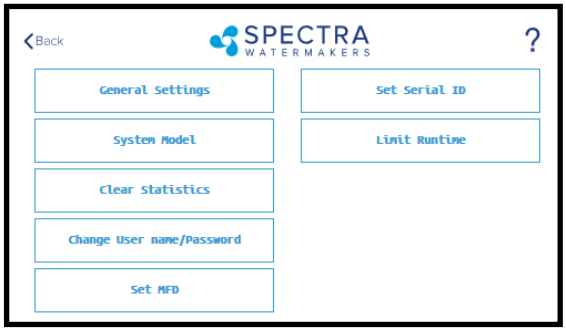
Dealer Access Settings

It is highly recommended that users consult with a factory trained technician before altering any settings behind the 'Dealer Access Point'. **Changing this settings without understanding the full effect of each change can void the warranty of your system, and cause irreparable damage.**

If any settings are inadvertently changed, they can be reverted back to the defaults by using the 'Factory Reset' feature.



Default Login: admin
Default Password: admin



System Model: Configures the Spectra Connect for a different system model from a preset list of options.

Clear Statistics: Resets all of the Estimated Maintenance Intervals back to 100%. This feature should only be used on a brand new system.

Change Username/password: Changes the default username and password. If you forget your changed username and password, a Factory Reset will revert back to the default username and password.

Set MFD: Changes the Manufactured Date on the system. This should only be adjusted if a control board is being replaced on an older system.

Set Serial ID: Changes the Serial Number recorded in the Spectra Connect. This should only be adjusted if a control board is being replaced on an older system.

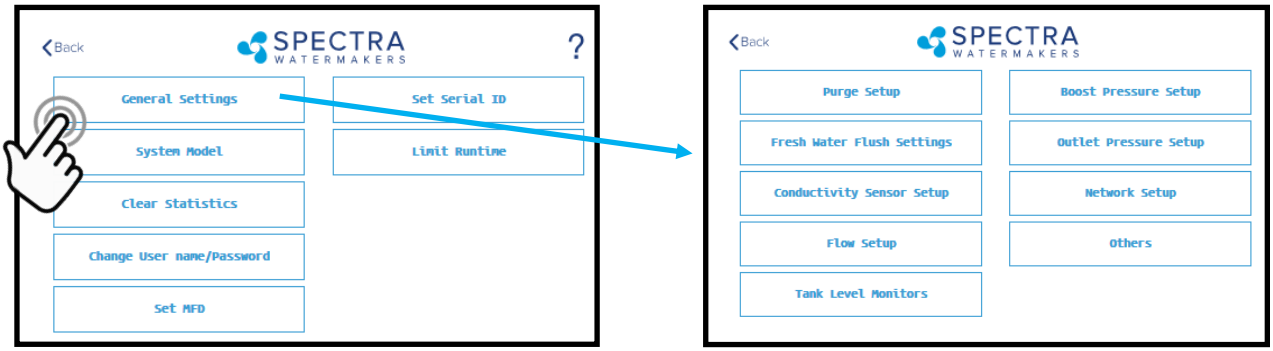
Limit Runtime: Limits the maximum run time for the system before shutting down and fresh water flushing. Disabling this setting allows the watermaker to be operated 24/7.

Dealer Access Point - Settings, Cont.

Dealer Access Settings

It is highly recommended that users consult with a factory trained technician before altering any settings behind the 'Dealer Access Point'. **Changing this settings without understanding the full effect of each change can void the warranty of your system, and cause irreparable damage.**

If any settings are inadvertently changed, they can be reverted back to the defaults by using the 'Factory Reset' feature.



Purge Setup: Adjusts the time and maximum feed pressure allowed for the Purge Mode. **CAUTION: Permanent damage to the membrane can occur if this setting is adjusted. Consult the factory before making any adjustments.**
Fresh Water Flush Settings: Allows adjustment of the fresh water flush duration and the interval between flushes. If the Z-Ion is installed, the Flush Interval should be changed to 30 days.
Conductivity Setup: Allows for enabling or disabling conductivity sensors on the feed water and product water. Set the threshold for the diversion valve to divert water to the tanks.
Flow Setup: Allows the user to adjust the flow sensor settings, or disable a flow sensor circuit altogether. **DO NOT USE THIS SETTING TO CALIBRATE THE PRODUCT FLOW.** Follow instructions on calibrating the flow sensor in this manual.
Tank Level Monitors: Enable and disable the Tank Level Sensors, which read the % remaining in the tank, and the tank switches, which allow the system to turn on/off automatically.
Boost Pressure Setup: Enable alternate Boost Pressure sensors, change the Low Vacuum Limit, or Boost Pressure Setpoint. **CAUTION: Permanent damage to the pump can occur if this setting is adjusted. Consult the factory before making any adjustments.**
Low Vacuum Limit: The minimum boost pressure required at the inlet to the pump. This setting prevents the pump from getting damaged by running under high vacuum. Adjusting it to a lower number in creases the risk that the pump will suffer damage during normal operation.
Boost Pressure Setpoint: During startup the controller turns on the boost pump and waits for the Boost Pressure to reach the Boost Pressure Setpoint. If the boost pressure fails to reach this setpoint, then the main pump won't turn on. Reducing the Boost Pressure Setpoint may cause the system to start, then immediately shut down due to low boost pressure.
Outlet Pressure Setup: Set High Pressure Limit, enable alternate high pressure sensors, select pressure sensor scaling. **CAUTION: Permanent damage to the pump can occur if this setting is adjusted. Consult the factory before making any adjustments.**
Network Setup: Enabling the Spectra Connect Wireless access turns on a Power Over Ethernet feature on the wired connection. **ENABLING THIS FEATURE CAN CAUSE SERIOUS DAMAGE TO YOUR SHIP'S NETWORK. DO NOT ENABLE THIS FEATURE WITHOUT CONSULTING A QUALIFIED TECHNICIAN OR THE FACTORY.**

Dealer Access Point - Settings, Cont.

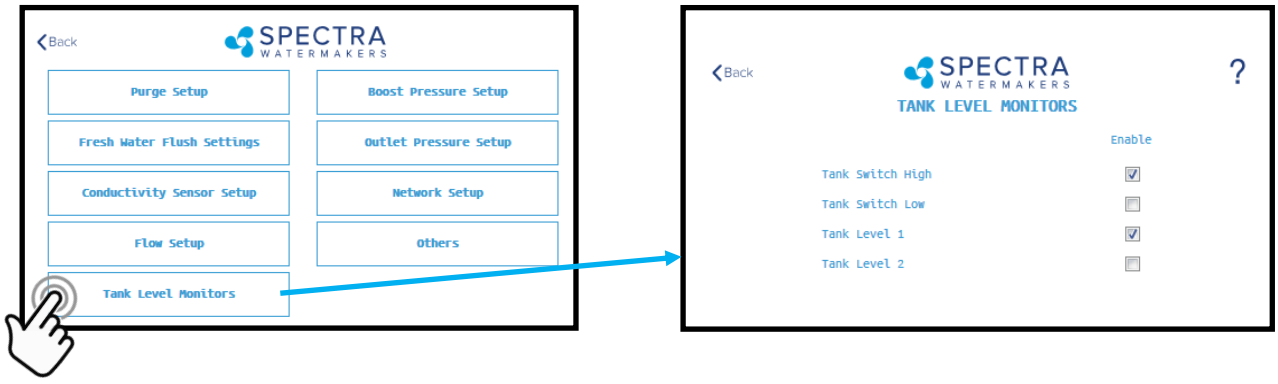
Dealer Access Settings

It is highly recommended that users consult with a factory trained technician before altering any settings behind the 'Dealer Access Point'. **Changing this settings without understanding the full effect of each change can void the warranty of your system, and cause irreparable damage.**

If any settings are inadvertently changed, they can be reverted back to the defaults by using the 'Factory Reset' feature.

Other Setups—Default is all disabled
Automatic PRV: Enables an optional Automatic Pressure Relief Valve, after it is installed. This setting should remain off unless you are certain that you have this feature installed on your system.
Power Sensor: Enables or disables an optional power sensor, after it is installed.
PH/ORP: Enables an optional pH or ORP meter, after it is installed.
Z-Ion: Enables or Disables the optional Z-Ion system, after it is installed. If the Z-Ion is enabled, you should also adjust the Flush Interval to 30 days.

Tank Level Monitors



Tank Setup - Enable/disable tank sensors.
Enable Tank Switch High - Enable/disable tank high switch high. If this is disabled Auto Fill and Fill Tank run modes will not be available.
Enable Tank Switch Low - Enable/disable tank high switch low. If this is disabled Auto Fill mode will not be available. Both High and Low tank switches must be enabled for Auto Fill mode.
Enable Tank Level 1 - Enable/disable tank level sensor 1. If this is disabled there will be no tank level reading and tank level gauge will read "!".
Enable Tank Level 2 - Enable/disable tank level sensor 2.

Handling Spectra Connect Alarms or Faults

Faults are (potentially hazardous) conditions that might occur during running of your watermaker. The control board has the ability to monitor these faults in real time and take necessary actions to prevent damaging your equipment.

HIGH PRESSURE FAULT

High pressure fault is triggered if

Outlet pressure (Feed/Membrane pressure) > Pressure Limit

If a high pressure fault is triggered, the system goes to low production mode if it is running in high production mode, or stops the operation if it is already running in low production mode. Then the system will begin the Auto Store mode.

Resolutions

Check for kinked or blocked hoses.
Confirm "#3 Sensor PSI High limit" and "#3 Sensor PSI Offset" options on Outlet Settings.
Clean membrane.

SYSTEM STALL FAULT

System stall fault is triggered if

There is no product flow for 1 minute continuously.

If system stall fault is triggered, machine will stop the current run cycle and will prompt to restart. If restarted it will retry the previous running mode. If the stall condition persists even after restart, the system will begin the Auto Store mode.

Resolutions

Confirm product water at membrane endcap.
Check intake line for restrictions, blockages or air leaks.
Close Pressure Relief Valve on Pump.
Confirm controller settings correct.

SERVICE PREFILTER FAULT

The Service Prefilter fault is triggered if

Inlet Pressure(boost pressure) < Low Vacuum Limit

If the Service Prefilter fault triggers, the system goes to low production mode if it is running in high production mode or stops the operation if it is already running in low production mode. Then the system will begin the Auto Store mode.

Resolutions

Change prefilters and the sea strainer screen.
Confirm adequate boost pressure in inlet pressure settings.
Check for obstructions in intake line.
Check sensor for proper operation

POOR QUALITY FAULT

The High Salinity fault triggers if

The Salinity of the product water is above the threshold (measured salinity > Salinity 1 threshold) for more than 8 minutes.

If the High Salinity fault is triggered, the machine will stop the current run cycle and will prompt to restart. If restarted it will retry the previous running mode. If the High Salinity fault condition persists even after restart, the system will begin the Auto Store mode.

Resolutions

Check pump operation - Clark Pump (pressure relief valve closed), Feed Pump (moving water).
Confirm product water quality.
Membrane damage - clean or replace.
Salinity probe out of calibration.
Clean or replace salinity probe.

Operation and Repair Bulletins

The following documents are sections of our complete service bulletin set available on our website Spectrawatermakers.com. Technical Support, - Service Bulletins.

MB-2 MEMBRANE CARE

Membrane life is affected by a large number of factors and is somewhat unpredictable, however five or six years of use is typical. The biggest killers of membranes are lack of use, chlorine damage, and improper storage.

Don't let membranes sit around with sea water or stale fresh water in them. Biological growth will occur in the membrane. At our manufacturing center, we frequently get back membranes for inspection that reek of hydrogen sulfide (rotten eggs). This odor is produced by anaerobic bacteria that live in an unused membrane, feeding on whatever animal or vegetable matter is trapped in it from the plankton that gets through the system. Membranes badly fouled in this way can seldom be saved. These bacteria are always present but are inhibited by the oxygen in sea water while the unit is in frequent use. If you won't be frequently using your membrane you can prevent biological growth by Fresh Water Flushes or by pickling your membrane. Keeping the prefilters clean is also important in preventing bio-fouling. If your prefilters are allowed to become a breeding ground for bacteria the contamination will spread throughout the system. When we cut open failed membranes we also often find mildew, another form of bio fouling, probably due to long term storage with no biocide or stale biocide.

After many hours of water-making mineral deposits will form and must be dissolved away with an acid cleaner. Alkaline cleaners are used for bio-fouling.

Chlorine destroys a membrane in minutes. It attacks the material that the membrane is made from. Always use product water or water filtered through a charcoal filter for flushing and chemical treatments.

Oil clogs the membrane. We have brought back oil fouled membranes with dish soap (See MB-5 Cleaning with Detergent.)

For storage, we recommend using SC-1 or propylene glycol potable water system antifreeze if available. Propylene glycol can safely be left in the system for one year and will keep things from freezing in cold conditions. It is hard to find in warm climates, and takes up a lot of room on a small boat, so our SC-1 is best for tropical cruising.

Even if given good care a membrane will eventually start to slowly fade away. The feed pressure may rise and/or the ppm go up.

Poor Product Water Quality

With any product water quality issue, you must ensure accurate calibration if you are using a salinity meter. For general quality evaluation, your taste is always good enough.

Membranes are not an exact science and two identical systems can have different product quality. World health standards deem water of up to 1000 PPM of total dissolved solids acceptable for drinking. We consider any thing below 750 PPM acceptable, and anything below 500 PPM excellent. Factors that could affect water quality are addressed below.

LOW SYSTEM FLOW OR PRESSURE will equate to lower product quality (higher PPM).

DAMAGE TO THE MEMBRANE by chlorine contamination. Flushing the system with chlorinated water will irreparably damage the membrane. Charcoal filters are used to absorb any chlorine which might be present in flush water. They must be of proper specification to be suitable. There is no test for chlorine damage except the process of elimination of other causes.

DIRTY OR SCALED membranes. A dirty (foreign material), scaled (mineral deposits), or contaminated (bacterial growth) membrane can result in poor water quality and abnormal operating pressures. If operating pressures are above normal, then cleaning is indicated. If the system pressures are within normal operating range, cleaning may have little result. Low water quality after storage with propylene glycol can usually be remedied by flushing with the pressure relief valve for seral hours or if that is not effective a SC-2 cleaning.

MECHANICAL LEAKAGE within the membrane pressure vessel. This is an unlikely but possible cause of poor water quality. A pinched or damaged O-ring within the pressure vessel, a scratch on the product tube on the membrane, a scratch within one of the end caps, or a seal fouled by contamination could allow sea water into the product water.

MB-5 Membrane Cleaning With Detergent

If the membrane has been fouled with oil it may be possible to save it by cleaning with dish soap such as Joy, but do not use anything that contains bleach. You will need a lot of chlorine free fresh water. If using shore water run it through a charcoal filter at a rate of not more than 1.5 gallons (6 liters) per minute.

Use the “Membrane Cleaning Procedure”

Fill a bucket with fresh water and mix in a couple squirts of the detergent. Run the system unpressurized (with pressure relief valve open) with the watermaker drawing water from the bucket and discharging overboard. When about half the water is gone from the bucket stop the unit and let the membrane soak for a few minutes. Restart and pump the remaining solution overboard. Repeat until the discharge appears clean.

After most of the oil is cleaned out you can put the brine discharge into the bucket and run the system with the soapy water circulating as you would for the other cleaning chemicals. Run the Fresh Water Flush cycle to clean membrane, then flush for twenty minutes using sea water. Pressurize and test.

Bad Smelling Product Water

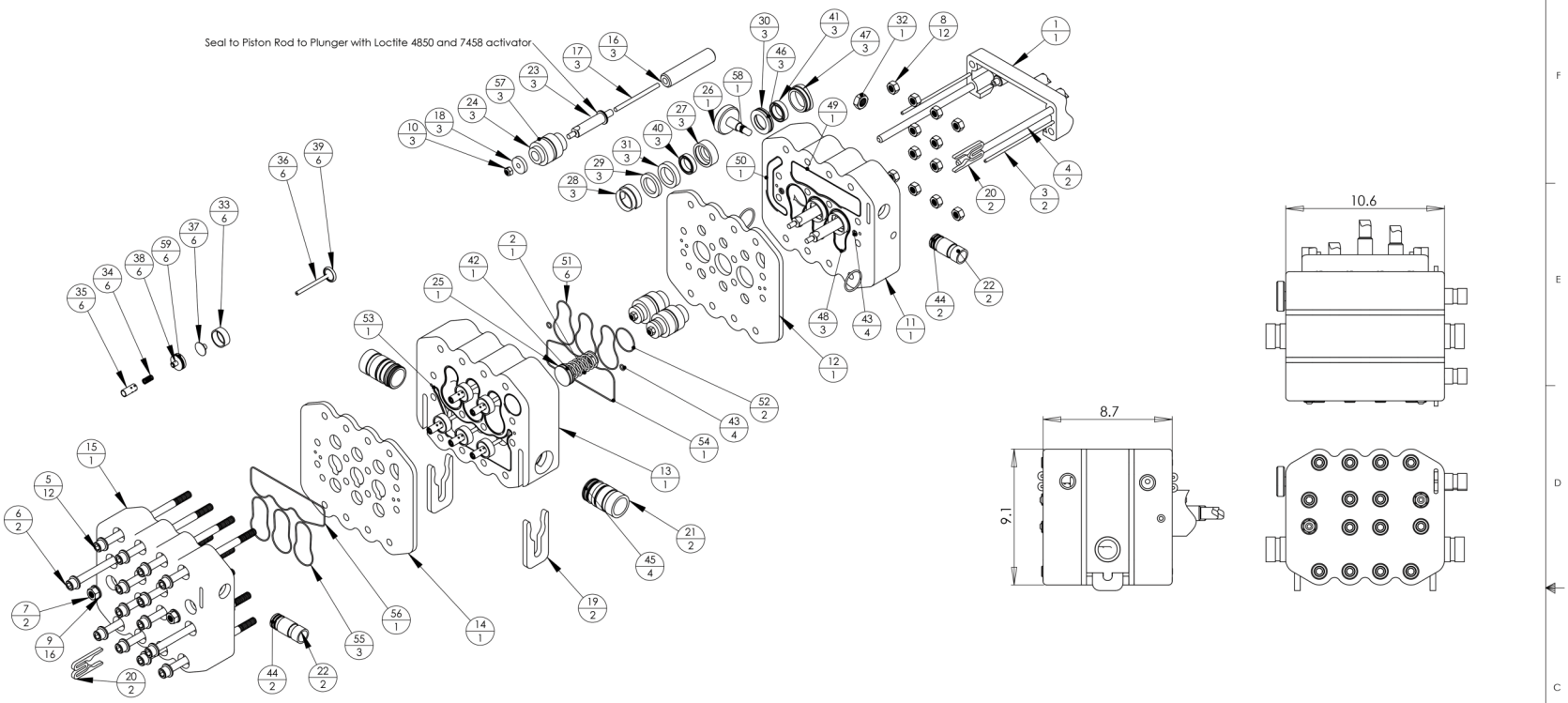
The reverse osmosis membrane is permeable by many gases including hydrogen sulfide, the gas that causes rotten egg smell. If there are bad odors in the feed water they will go through the membrane and the product water will be affected. Usually the source of the odor is from the decay of plankton trapped in the sea strainer and prefilters. These tiny oxygen loving creatures soon suffocate and die inside the prefilter housings when the unit is shut down and begin to decay. Once this decay starts the only solution is to rinse the prefilter and let it dry completely (to kill the bacteria) or just replace it with a new filter. If the system is making smelly water, it will likely be the prefilters that are the source of the problem. In cold climates this process of decay and take weeks, but in very warm waters this can happen overnight. These bacteria can spread throughout the watermaker, and begin to grow on the membrane, causing poor water quality and high feed pressures.

Flushing the system with fresh water after every use greatly slows this process, allowing the automated spectra units to operate with less frequent prefilter changes, but units operated for only an hour or so a day will probably need to have the filters changed due to odor before they are dirty enough to restrict water flow. After shutting down the unit remove the used prefilters and install a clean set. Leave the housings full of air until the next use.

If the rotten egg smell does not go away after operating the watermaker for 6 or 8 hours it may be time to clean the membrane with SC-2. Typically the smell will go away with use, but if it persists cleaning may be indicated.

The Z-ION was created to eliminate this problem by disinfecting the system during each fresh water flush, disinfecting the filters and the membrane.

More on this subject is available on our website at www.spectrawatermakers.com.



ITEM NO.	PartNo	TITLE	QTY.	Change
1	PP-20-CC-CCA	PP20 Crankcase Cat 25 Frame	1	
2	PP-20-DP-SPR	PP20 Damper Spring	1	
3	PP-20-DW	PP20 Dowel Rev A	2	Larger chamfers
4	PP-20-HWR-LYS	PP20 Layer Stud Rev A	2	New
5	PP-20-HWR-M1221	Screw Skt Cap M12x1-75 210 long 316SS Grade 70	12	
6	PP-20-HWR-M1223	Screw Skt Cap M12 x 1-25 FINE 230 long 316SS Grade 70	2	Was 4ea
7	PP-20-HWR-M12FNB	Nut Hex M12x1-25 FINE Bronze	2	New
8	PP-20-HWR-M12NB	M12 x 1.75 Hex Nut Bronze DIN934	12	Was 316SS
9	PP-20-HWR-M12WS	Washer M12 316SS DIN125	16	
10	PP-20-HWR-M8AT	PP20 M8x1.75 Hex Nut Nyloc 316SS	3	
11	PP-20-LY1	PP20 Layer 1 Rev A	1	All P section grooves
12	PP-20-LY2	PP20 Layer 2 Rev A	1	Now as 50% Layer 2
13	PP-20-LY3	PP20 Layer 3 Rev A	1	All P section grooves
14	PP-20-LY4	PP20 Layer 4 Rev A	1	
15	PP-20-LY5	PP20 Layer 5 Rev A	1	
16	PP-20-PG-30PG	PP20-30 Plunger 25 x110mm Cat 48535	3	
17	PP-20-PG-STD	PP20 Plunger Stud 316SS M7 x 103mm Cat 48679	3	Was x 83mm
18	PP-20-PG-WS	PP20 Plunger Top Washer Rev A	3	Now as 50%
19	PP-20-PL-FC11/4	PP20 Fitting Clip 1 1-4 in LP Rev A	2	
20	PP-20-PL-FC3/4	PP20 Fitting Clip 3-4in HP Rev A	2	

ITEM NO.	PartNo	TITLE	QTY.	Change
21	PP-20-PL-FT114VS	PP20 Fitting Tube 1 1-4 in LP Victaulic SS Rev A	2	Was PVC now 316
22	PP-20-PL-FT3/4	PP20 Fitting Tube 3-4in HP Rev A	2	
23	PP-20-PT-30PTR	PP20-30 Piston Rod Rev A	3	New for 103mm stud
24	PP-20-PT-30PTS	PP20-30 Piston Rev A	3	
25	PP-20-PT-DPPT	PP20 Damper Piston Rev A	1	
26	PP-20-RS	PP20 Relief Valve Screw Rev A	1	Larger handle
27	PP-20-SEAL-3HSC	PP20-30 HP Seal Case Rev A	3	
28	PP-20-SEAL-3HSR	PP20-30 HP Seal Retainer Rev A	3	New for 30/50% Layer 2
29	PP-20-SEAL-3HSW	PP20-30 HP Seal Washer Rev A	3	
30	PP-20-SEAL-3LSC	PP20-30 LP Seal Case Rev A	3	
31	PP-20-SEAL-3RBW	PP20-30 HP Seal Rubber Washer Rev A	3	
32	PP-20-VLV-RVN	PP20 Relief Nut 5-8x11 3-8 H 15-16 AF Nylon 6-6	1	
33	PP-20-VLV-SLV	PP20 Valve Sleeve Rev A	6	
34	PP-20-VLV-SPR	PP20 Valve Spring Rev A	6	
35	PP-20-VLV-VCG	PP20 Valve Cage Rev A	6	
36	PP-20-VLV-VLV	PP20 Valve Rev A	6	
37	PP-20-VLV-VPB	PP20 Valve Plug Bottom Rev A	6	
38	PP-20-VLV-VPT	PP20 Valve Plug Top Rev A	6	
39	PP-20-VLV-VS	PP20 Valve Shoe Rev A	6	
40	SO-PP20-30HPS	PP20-30 HP Seal SKF Economos S06-P 25x35x8 H-ECOPUR Rev A	3	

ITEM NO.	PartNo	TITLE	QTY.	Change
41	SO-PP20-30LPS	PP20-30 Seal LP Cat 44086	3	
42	SO-PP20-DPPT	PP20 Damper O Ring -320 NBR Sh70A	1	
43	SO-PP20-FLUSH	PP20 O Ring Flush -011 NBR Sh70A	4	
44	SO-PP20-HPF	PP20 O Ring HP Fitting -020 NBR Sh70A	2	
45	SO-PP20-LPF	PP20 O Ring LP Fitting -126 Viton Sh90A	4	
46	SO-PP20-LPS	PP20-30 O Ring LP Seal -030 NBR Shore 70A	3	
47	SO-PP20-LPSR	PP20 LP Seal Retainer CAT 110672	3	
48	SO-PP20-LY1CYL	PP20 O Ring L1 Cylinder -038 NBR Sh70A	3	
49	SO-PP20-LY1HP	PP20 O Ring L1 HP In -049 NBR Sh70A	1	
50	SO-PP20-LY1RV	PP20 O Ring L1 Relief -044 NBR Sh70A	1	
51	SO-PP20-LY3CYL	PP20 O Ring L3 Cylinder -038 NBR Sh70A	6	
52	SO-PP20-LY3DPP	PP20 O Ring L3 Damper -030 NBR Sh70A	2	
53	SO-PP20-LY3LPI	PP20 O Ring L3 LP In -562 NBR Sh70A	1	
54	SO-PP20-LY3LPO	PP20 O Ring L3 LP Out -049 NBR Sh70A	1	
55	SO-PP20-LY5CYL	PP20 O Ring L5 Cylinder -038 NBR Sh70A	3	
56	SO-PP20-LY5HPO	PP20 O Ring L5 HP Out -050 NBR Sh70A	1	Was -550: typo?
57	SO-PP20-PT	PP20 O Ring Piston -324 NBR Shore70A	3	
58	SO-PP20-RV	PP20 O Ring Relief Valve -012 NBR Sh70A	1	
59	SO-PP20-VLV	PP20 O Ring Valve -021 NBR Sh70A	6	

Remove all burrs and sharp edges, max radius 0.010"

Material					
Surface Finish					
Dimensions	Inches				
Tolerances			A	140605	SP16 30% Assembly Exploded Rev E plus changes as BOM above
SCALE:1:10	Do not scale	Third Angle Projn.	Rev	Date	Purpose & Changes

SP20-30 Pump Assembly Rev A

Contact	Colin Pearson
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Drg No.	SP20-50	Size C	Sht 1 of 1