Tank Level and Pre-treatment Lockout Wiring

Some RO systems are equipped with two switch closure circuits that control the RO system. These are “no voltage” switch closure circuits. These circuits will turn the RO on and off as necessary. Standard systems use an outlet configuration tank level switch. The RO will plug into this switch and the main power is turned on and off with this configuration.

Pretreatment Lockout (not on standard systems)

1. The pretreatment lockout circuit can be used to shut down the RO if a backwashing filter or softener is regenerating and is equipped with an auxiliary switch or relay. If the RO runs while a pretreatment component is regenerating, untreated water can be fed to the RO.
2. There will be a micro-switch or a relay on the pretreatment component if applicable. This should be wired in a loop with the other components using the pretreatment lockout wires on the RO system. These wires should use the NC (opens during regeneration) circuit on the pretreatment switch or relay on the component. Please see the wiring diagram below;

IMPORTANT! Do not apply voltage to the pretreatment lockout circuit. This will damage the RO system.

Tank Level Input (not on standard systems)

There are Advanced and Premier systems that use a switch closure circuit to turn some RO systems on and off when an atmospheric tank float or pressure switch is installed. If an atmospheric tank is used, there will be a float switch. The float switch wires as follows;

The wire colors above show color coatings. However, the colors don’t matter. The circuit is a switch closure circuit so there is no voltage.

IMPORTANT! Do not apply voltage to the tank level input circuit. This will damage the RO system.

IMPORTANT! Do not apply voltage to the “Tank Level” circuit. This will damage the RO system.
1. Fill the tank with 5 gallons of clean water (preferably RO water). Add the predetermined amount of S200 anti-scalant solution for each gallon of water to the tank.

2. Install the injection check valve is in the chemical injection port on the RO system after the sediment and carbon filters. Plug the chemical injection pump into the chemical injection pump female cord on the RO system. This cord is energized when the RO system is operating.

3. Make sure the toggle switch on the pump is in the "ON" position.

4. Put the adjustment ring on the pump to "5".

The anti-scalant pump will operate when the RO is running. This pump should self prime during the start up procedure (once the pump is running). The solution tank can be topped off with RO water and the remaining anti-scalant solution once the RO system is online. Be sure to mix the solution correctly when topping off the solution tank. The mix is as follows:

<table>
<thead>
<tr>
<th>GPD RO</th>
<th>Initial: To 15 Gallons RO Water</th>
<th>Ongoing: To Each Gallon RO Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>7.5oz</td>
<td>0.5oz</td>
</tr>
<tr>
<td>1,000</td>
<td>9oz</td>
<td>0.6oz</td>
</tr>
<tr>
<td>1,500</td>
<td>11.25oz</td>
<td>0.75oz</td>
</tr>
<tr>
<td>2,000</td>
<td>13.5oz</td>
<td>0.9oz</td>
</tr>
<tr>
<td>4,000</td>
<td>32oz</td>
<td>2.1oz</td>
</tr>
<tr>
<td>5,000</td>
<td>35.5oz</td>
<td>2.4oz</td>
</tr>
<tr>
<td>7,000</td>
<td>44oz</td>
<td>3oz</td>
</tr>
<tr>
<td>10,000</td>
<td>71oz</td>
<td>4.75oz</td>
</tr>
</tbody>
</table>

Based on S-200 Anti-Scalant. 5GPD pump, 15 gallon tank.

Pump Setting "5" (50%)

Future tank fills can be done using the RO water produced by the new RO system.

**ATTENTION:** It is a good practice to mix the anti-scalant solution weekly to ensure the solution concentration stays consistent.
RO System Explanation and Definitions

The RO system is designed to operate at specified flow rates to ensure longevity of the membranes and performance. It is best to set the RO system to operate at its' designed flow rates but in some cases due to feed water temperature and TDS (total dissolved solids) level, the designed flow rates may not be achievable. Please see the definitions below to get familiar with key words used during the adjustment procedure;

Permeate – The clean water being produced by the RO system
Concentrate – The dirty water being rejected from the RO system to the facility drain
Concentrate Recycle – The rejected concentrate water that is returned to the pump inlet to be re-processed through the RO system
Rejection Rate – The percentage of contaminants being rejected by the RO system. This can be figured by taking the incoming TDS value and the Permeate TDS value and using those measurements to do an efficiency calculation. The calculation is as follows;

\[
\text{Rejection Rate} = \frac{\text{IN} - \text{OUT}}{\text{IN}} \times 100 = \% \text{ of rejection.}
\]

Recovery Rate – The amount of feed water that is being used and not wasted to the drain. This rate is fixed on standard systems. System with a concentrate recycle feature and be adjusted to a specified recovery rate. The maximum recovery rate that should be targeted is 75%.

Flow Meter – There may be 2 or 3 flow meters on the system depending on the configuration. These flow meters are called rotometers. There is a stainless steel meniscus that floats in a glass block to at a specific level that can be measured using the scale on the glass blocks. The flow meters have a gallons per minute scale and a liters per minute scale. The value should be read at the top of the stainless steel meniscus.

Pre-Filter Gauges – There are two gauges on the pre-filters that are used to monitor the inlet pressure and the pressure drop across the pre-filters on the RO system. When there is a 10 PSI differential in these readings, the pre-filters should be changed. If either of these pressures fall below 30 PSI while the system is running, the system will shut down due to a low pressure fault. This is usually indicated by a red LED light illuminated or digital display indicating a pressure fault. This system should not be operated with low pressure. The low pressure switch should not be adjusted to a lower pressure or the RO booster pump could be damaged.

Pump Pressure Gauge – This gauge is on the front of the RO system and is used to determine the system operating/membrane pressure. This reading is important when adjusting the RO system.

Pump Throttle Valve – There is an adjustment valve on the RO system booster pumps. This will either be a slotted adjustment screw on the smaller systems or a gate valve on the larger systems. This valve is used to adjust the pump pressure.

Concentrate Valve – This valve is used to regulate the amount of water that is being directed to the drain

Concentrate Recycle Valve – This is the valve used to control the amount of concentrate water that is returned to the pump to be recycled through the system.

Flux Rate – The rate of flow across the membranes in the RO system. This rate must be maintained or contaminants can precipitate on the membranes and cause them to fail prematurely.
Adjusting the RO System Flow Rates

1. Be sure the pre-treatment systems have been flushed and put in service. If anti-scalant is being used, be sure to confirm the dose and mix of the solution on page #3 before starting the system.
2. Make sure the water supply is turned on and that you have a minimum of 30 PSI pressure to the system. The optimal pressure would be 60 PSI.

NOTE: This system MUST have 30-60 PSI when the pump is running at a minimum flow rate. Failure to supply the system with the proper flow and pressure will cause “low pressure” error and or destroy the membranes prematurely. This is the most common problem during startup/operation. The feed water flow and pressure MUST be supplied or the system will not work or not work optimally.

3. On the RO system inlet solenoid, there is a bypass valve that is used to bypass the solenoid and flood the RO system to remove air. Some models may have push button solenoid bypass. Bypass the solenoid and be sure to flood the system until the air in the concentrate flow meter is virtually gone. The solenoid is in bypass when the lever is bisecting the plumbing connections. The picture below shows the bypass in the service mode.

4. Open the concentrate recycle valve completely by turning it counterclockwise. Close the concentrate recycle valve (if applicable) completely by turning it clockwise. Allow the system flush until no air is being flushed from the system via the flow meters. This entire process may take 20-30 minutes.

5. When the air removed, turn on the RO system. There may be a toggle switch or a button on the screen for activation depending on the model and the configuration.
6. Turn the system on and allow 5-10 minutes to flush the remaining air out of the filters and membranes.

7. Check the running pressure feed pressure on the “Filter In” and the “Filter Out” gauges. The pressure should be between 30-60 PSI during operation to ensure the system will not shut down due to a low pressure fault.

8. Adjust the system to the designed flow rates without exceeding 150 PSI on the pump/membrane pressure gauge.

Adjusting the RO system is a balance between the “concentrate” valve, “concentrate recycle” valve (if applicable) and the “throttle” valve adjustments. It is best to adjust the concentrate and permeate flows first. If it is a standard system the concentrate and permeate flows are the only flows to be adjusted.

**Designed Flow Rates**

<table>
<thead>
<tr>
<th>System Size GPD</th>
<th>Recovery Rate</th>
<th>Maximum Operating Pressure</th>
<th>Permeate Flow Rate GPM</th>
<th>Feed Flow GPM</th>
<th>Membrane Flux Rate GPM</th>
<th>Concentrate Flow GPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>Standard</td>
<td>150 PSI</td>
<td>0.35</td>
<td>0.46</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1000</td>
<td>Standard</td>
<td>150 PSI</td>
<td>0.69</td>
<td>0.93</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1500</td>
<td>Standard</td>
<td>150 PSI</td>
<td>1.04</td>
<td>1.39</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1800</td>
<td>Standard</td>
<td>150 PSI</td>
<td>1.25</td>
<td>1.67</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2000</td>
<td>Standard</td>
<td>150 PSI</td>
<td>1.39</td>
<td>1.85</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4000</td>
<td>Standard</td>
<td>150 PSI</td>
<td>2.78</td>
<td>3.7</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5000</td>
<td>Standard</td>
<td>150 PSI</td>
<td>3.47</td>
<td>4.63</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7000</td>
<td>Standard</td>
<td>150 PSI</td>
<td>4.86</td>
<td>6.48</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>10,000</td>
<td>Standard</td>
<td>150 PSI</td>
<td>6.94</td>
<td>9.26</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>15,000</td>
<td>Standard</td>
<td>150 PSI</td>
<td>10.42</td>
<td>13.89</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>20,000</td>
<td>Standard</td>
<td>150 PSI</td>
<td>13.89</td>
<td>18.52</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

9. Turn the concentrate valve clockwise unit there concentrate flow meter is reading minimum concentrate flow rate. The flow can be read at the top of the meniscus (top of the floating stainless steel cylinder). MAKE SURE to watch the pump pressure and make sure it doesn't exceed 150 PSI.
10. Once the concentrate flow is at the minimum, check the permeate flow. It should be at the design flow rate. If the permeate flow is lower than the design flow rate, adjust the pump throttle valve/screw to increase the pump pressure to get the design permeate flow rate. DO NOT exceed 150 PSI pump pressure. If the permeate flow rate is higher than the design flow rate, reduce the pump pressure to bring the permeate flow to the design rate.

11. Once the permeate flow and the concentrate flow are at the designed flow rate the recycle flow rate can be adjusted.

12. The concentrate valve and the concentrate recycle valve can be used to adjust the recycle and concentration flows to achieve 75% recover.

13. Adjust the concentrate recycle valve to design recycle flow rate and adjust the concentrate valve to the design concentrate flow rate at the 75% recovery.

14. Be sure to check the membrane pressure and permeate flows and adjust the throttle valve/screw if necessary.

NOTE: This is truly a balance between all three adjustment valves to achieve the designed flow rates without exceeding 150 PSI on the pump pressure. In applications where the feed water is very cold, the permeate flow rate cannot be achieved at 150 PSI. Once the membrane/pump pressure is at 150 PSI, the permeate flow is at its' maximum potential.
The bottom of this page explains how the flow rates are figured. If you cannot achieve the designed permeate flow rate at 150 PSI, the following equation can be used to figure the 75% recovery flow rate at a lessor permeate flow. This can also be used to figure a lesser recovery rate if desired.

**NOTE:** The system should never be adjusted to recover more than 75%. This will destroy the membranes. A lesser recovery rate is acceptable but it should never exceed 75% recovery.

The concentrate recycle flow rate and the concentrate flow rate must equate to the minimum flux rate or higher in high flow feeds or damage to the membrane may occur.

Once the flow rates have been adjusted, put the bypass on the inlet solenoid to the service position. Monitor the system over the first two weeks and make fine adjustments to maintain the proper flow rates. When there is a change in the feed water TDS level or temperature, the flow rates may need to be re-adjusted.

Once the adjustments are made the system is operational.

**IMPORTANT!** Be sure to flush the storage tank as the initial water the RO makes during adjustment is not up to quality. This can usually be done by letting the tank fill for about 50 gallons and emptying the tank twice. DO NOT forget to put the bypass lever in the service position when startup is complete.

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### RO System Start-up

**Recycle Flow Rate Explanation**

The recycle flow rate can be determined using the desired Recovery Rate (75% maximum) and the Permeate Flow Rate. The equation to determine this is as follows;

$$\text{RO System GPD Rating} / \text{1440 mins (mins in a day)} = \text{Permeate Flow Rate GPM}$$

$$\text{Permeate Flow GPM} / 75\% (0.75) = \text{Total Flow GPM}$$

$$\text{Total Flow GPM} - \text{Permeate Flow Rate GPM} = \text{Concentrate Flow GPM}$$

$$\text{Minimum Flux Rate (determined by membrane size/diameter see below) GPM} - \text{Concentrate Flow Rate GPM} = \text{Recycle Flow Rate GPM}$$

- 2.5” Membrane Minimum Flux Rate = 1.0 GPM
- 4.0” Membrane Minimum Flux Rate = 3.0 GPM

**Example:**

4000 GPD System

$$4000 \text{ GPD} / 1440 \text{ Mins} = 2.78 \text{ GPM Permeate Flow}$$

$$2.78 / 0.75 = 3.71 \text{ GPM Total Flow}$$

$$3.71 \text{ GPM} - 2.78 \text{ GPM} = 0.93 \text{ GPM Concentrate Flow}$$

$$3 \text{ GPM (min 4” Membrane Flux)} - 0.93 \text{ GPM} = 2.07 \text{ GPM Recycle Flow}$$

These numbers are rounded to nearest full value.