The Stowaway Series
400-800
Installation, Operation & Maintenance
The Stowaway Series
USER GUIDE & REFERENCE MANUAL

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SYSTEM START UP LOG

SYSTEM INFORMATION:

- MODEL NUMBER: __________________________________________
- SERIAL NUMBER: __________________________________________
- DATE OF PURCHASE: ________________________________________
- PURCHASED FROM: _________________________________________
- INSTALLATION DATE: _______________________________________  

START UP PERFORMANCE READINGS:

MEASURE AFTER 3 AND 24 HOURS OR PRESSURIZED TIME IN SIMILAR CONDITIONS

<table>
<thead>
<tr>
<th></th>
<th>3 Hours</th>
<th>24 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEED WATER TEMPERATURE:</td>
<td>(°F/°C)</td>
<td>(°F/°C)</td>
</tr>
<tr>
<td>FEED WATER SALINITY (IF KNOWN):</td>
<td>(ppm)</td>
<td>(ppm)</td>
</tr>
<tr>
<td>AVERAGE AMP DRAW (IF KNOWN):</td>
<td>(A)</td>
<td>(A)</td>
</tr>
<tr>
<td>FEED PRESSURE (AT PREFILTER):</td>
<td>(psi)</td>
<td>(psi)</td>
</tr>
<tr>
<td>OPERATING PRESSURE:</td>
<td>(psi)</td>
<td>(psi)</td>
</tr>
<tr>
<td>PRODUCT WATER FLOW:</td>
<td>(GPH/LPH)</td>
<td>(GPH/LPH)</td>
</tr>
<tr>
<td>REJECT WATER FLOW (IF KNOWN):</td>
<td>(GPH/LPH)</td>
<td>(GPH/LPH)</td>
</tr>
<tr>
<td>PRODUCT WATER QUALITY (IF KNOWN):</td>
<td>(ppm)</td>
<td>(ppm)</td>
</tr>
</tbody>
</table>
1.0 INTRODUCTION

SYSTEM DESCRIPTION
Village Marine Tec's (VMT) the Stowaway series are well-engineered reverse osmosis (RO) systems, designed and built for simple operations and maintenance for the cruising sailor, sport fisherman, or working vessels where space is at a premium. These self-contained AC desalination systems will produce eight to thirty-three gallons per hour (GPH) of freshwater from the sea (gallon production will vary based upon water temperature, salinity, and model of the RO system).

The Stowaway units produce water, meeting or surpassing drinking water guidelines with seawater salt concentrations as high as 32,000 parts per million (ppm).

HOW TO USE YOUR MANUAL
This User Guide & Reference Manual contains important information about the safe operation and maintenance of your Stowaway RO unit.

We advise you to please read through the entire User Guide & Reference Manual carefully to ensure you familiarize yourself with the operation of your RO system and follow the recommendations within the manual, to help make your water producing experiences trouble-free and enjoyable.

SAFETY WARNINGS
Throughout this User Guide & Reference Manual you will see many important statements or labels indicated on the product with the following words:

⚠️ WARNING Indicates a strong possibility of severe personal injury or death if warning instructions are ignored.

⚠️ CAUTION Indicates hazards or unsafe practices of product may cause minor personal injury or may cause property damage.

NOTE: Text specifies useful information.
1.1 UNPACKING AND HANDLING

The Stowaway (STW) reverse osmosis units are shipped pre-assembled. There are no special instructions towards unpacking and handling of the watermaker system. Inspect the RO unit to verify it was not damaged in transit. Also, please refer to the plumbing diagrams in Section 9.0: PLUMBING DIAGRAMS to verify all components for the watermaker are shipped prior to installation. Be sure to mark and record all hose locations for reference, if disconnection of hoses become necessary.

**CAUTION**

DO NOT EXPOSE THE RO UNIT TO FREEZING TEMPERATURES WITHOUT PROPER STEPS TO TREAT THE RO UNIT FOR SUB-FREEZING TEMPERATURES.

1.2 PERFORMANCE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw water temperature (minimum)</td>
<td>33° F (1°C)</td>
</tr>
<tr>
<td>Raw water temperature (nominal)</td>
<td>77° F (25°C)</td>
</tr>
<tr>
<td>Raw water temperature (maximum)</td>
<td>113° F (45°C)</td>
</tr>
<tr>
<td>Min. raw water inlet pressure</td>
<td>Flooded suction pressure</td>
</tr>
<tr>
<td>Max. raw water inlet pressure*</td>
<td>30 psi</td>
</tr>
<tr>
<td>Flush water recommended max. pressure</td>
<td>35 psi</td>
</tr>
<tr>
<td>Design RO element pressure</td>
<td>800 psi</td>
</tr>
<tr>
<td>Max. RO element pressure</td>
<td>1000 psi</td>
</tr>
<tr>
<td>Max. feedwater chlorine residual</td>
<td>&lt; 0.1 ppm</td>
</tr>
<tr>
<td>Cleaning solution pH range</td>
<td>10-11 (Chemical #1), 2-3 (Chemical #2)</td>
</tr>
<tr>
<td>Membrane type</td>
<td>Thin film composite</td>
</tr>
</tbody>
</table>

Table 1.0 - Performance Characteristics

* For inlet pressure greater than recommended limits, install pressure regulator.

**NOTE:** REGARDING WATER PRODUCTION:
The RO series number (i.e. STW400, STW600, or STW800) refers to gallons per day (GPD) production produced with new membranes at design optimum conditions.

To achieve optimum production:
(1) The feed flow must be unrestricted (positive water pressure at the inlet to high pressure pump).
(2) Seawater temperature at 77° F (25°C)
(3) Seawater salinity at 32,000 parts per million (ppm) total dissolved solids (TDS).

Variation of conditions (environmental, temperature, and frequency of use) and normal aging of membranes will decrease RO production. Normal membrane fouling will be partially recovered by chemical cleaning, but 100% recovery should not be expected. Production rates from membrane to membrane can vary ± 15%.

1.3 ENVIRONMENTAL REQUIREMENTS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>List (Permanent):</td>
<td>15°</td>
</tr>
<tr>
<td>Trim (Fore and Aft):</td>
<td>+ 30°</td>
</tr>
<tr>
<td>Pitch:</td>
<td>± 10° (6 sec cycle)</td>
</tr>
<tr>
<td>Roll:</td>
<td>± 30° (12 sec cycle)</td>
</tr>
</tbody>
</table>

Table 1.1 - Nominal Operating Conditions
1.4 CONSUMABLES

Table 1.2 lists the consumables required for any six month operation of the RO unit. Use ONLY Village Marine Tec approved filters and chemicals.

<table>
<thead>
<tr>
<th>Description</th>
<th>QTY</th>
<th>VMT Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Cleaning Cartridge Kit #1, #2</td>
<td>1/box</td>
<td>85-0102</td>
</tr>
<tr>
<td>Preservative Cartridge Kit, Chemical #3</td>
<td>2/box</td>
<td>85-0103</td>
</tr>
<tr>
<td>Filter, 5 micron, 10 sq-ft.</td>
<td>1</td>
<td>33-0117</td>
</tr>
<tr>
<td>Filter, Carbon, 10 sq-ft.</td>
<td>1</td>
<td>33-0311</td>
</tr>
<tr>
<td>Aqua Pro High Pressure Pump Oil</td>
<td>1 qt</td>
<td>85-0050</td>
</tr>
<tr>
<td>Pump Service Kit</td>
<td>kit</td>
<td>70-6182</td>
</tr>
</tbody>
</table>

Table 1.2 – VMT Approved Consumables

1.5 TEST EQUIPMENT

Table 1.3 lists the test equipment for performance verification and maintenance of the RO unit.

<table>
<thead>
<tr>
<th>Description</th>
<th>VMT Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kit, Calibration Singles</td>
<td>40-0017</td>
</tr>
<tr>
<td>Solution, Calibration, 300 ppm</td>
<td>90-1300</td>
</tr>
<tr>
<td>Economy Mini Water Tester, TDS</td>
<td>99-1990</td>
</tr>
</tbody>
</table>

Table 1.3 – Maintenance Equipment Table
2.0 INSTALLATION

Village Marine Tec. recommends ALL Stowaway models (as with all other VMT model RO units) be INSTALLED BELOW the vessel’s waterline, to ensure a flooded suction intake to the unit.

2.1 TO INSTALL THE STOWAWAY UNIT

Step 1: Village Marine Tec. recommends installing the RO unit in a dry sheltered location at or aft of midship, with drainage underneath (to draw off standing water when performing routine maintenance or service). Give consideration to extra space around the RO unit, allowing access for the unit’s maintenance (i.e. membrane replacement, oil change, prefilter replacement, or other service).

If the STOWAWAY cannot mount below the water line, the unit can lift to a maximum height of five feet above the water line, if boost pump is mounted separately below water line. When set up in this manner, install a check valve in the suction line to maintain adequate system priming. Please CONSULT with a VMT service dealer for further technical advisement, if necessary.

Step 2: Locate or create a $\frac{3}{4}$" dedicated through-hull for the feedwater intake of the RO unit. The through-hull must be attached with a screen and ball valve (seacock).

**CAUTION** The STOWAWAY CANNOT SHARE a through-hull feedwater intake. Village Marine Tec. recommends the Stowaway MUST HAVE its OWN dedicated through-hull, to properly feed water into the RO. Avoid connecting the inlet piping to any water line which services an engine or other equipment. Air could be drawn through the unit causing damage to the RO unit’s pumps, as well as VOIDING the RO unit’s warranty with VMT.

Step 3: Drill a minimum of four mounting holes through the frame and/or mounting base. When drilling, ALWAYS CHECK for the drill bit from puncturing/damaging any component of the watermaker and the surrounding mounting area.

Step 4: Optionally, mount and secure the STOWAWAY with four mounting supports (not supplied with RO unit). The supports (Figure 2.1) minimize noise and vibration when RO unit is in use.

---

Figure 2.0: Recommended Installation Location – ABOVE waterline.

Figure 2.1: RO Mount Support - Isometric View.
2.2 TO CONNECT PLUMBING

Step 1: Refer to PAGE 49 for the EXPANDED detailed STOWAWAY plumbing diagram.

![Figure 2.3: STOWAWAY Plumbing Diagram.](image)

Step 1: Refer to Figure 2.4 for the STOWAWAY manifold port identification.

![Figure 2.4: STOWAWAY Manifold - Right View.](image)

**FEEDWATER INTAKE**

**Step 1:** Mount the optional sea strainer BELOW the vessel’s waterline.

**Step 2:** Mount the Automatic Freshwater Flush Valve Assembly BELOW waterline. Refer to Figure 2.5 for views of the Carbon Filter and the Freshwater Flush Solenoid Valve.

![Figure 2.5: Carbon Filters with Freshwater Flush Solenoid Valve – Isometric Views.](image)

Refer to Figure 2.6 for a diagram of the Automatic Freshwater Flush Assembly.
NOTE: Village Marine Tec. recommends the Freshwater Flush Valve Assembly be installed BELOW waterline. However, the solenoid valve and carbon filter housing can be relocated at or above waterline, if necessary. It is MANDATORY for the Check Valve be installed BELOW waterline to avoid trapping air and creating a problem in the feedwater path.

![Diagram of Freshwater Valve Assembly](image)

**Figure 2.6: Automatic Freshwater Flush Valve Assembly Diagram with Hose Sizes.**

**Step 2:** Locate your RO unit's dedicated feedwater intake through-hull that is BELOW waterline.

**Step 3:** Connect a ¾" inner diameter PVC hose, from the RO's dedicated intake through-hull, into the elbow off of the freshwater flush solenoid valve MOUNTED BELOW waterline (Refer to Figure 2.6).

**Step 4:** Connect a ¾" inner diameter PVC hose from the elbow off of the Check Valve's outlet, to the tee of the Low Pressure Boost Pump (Refer to Figure 2.6).

**BRINE DISCHARGE**

**Step 1:** Locate a convenient spot in the boat to install an overboard through-hull (½" inner diameter). Discharge line is required to be ABOVE waterline. Refer to Figure 2.7.

**Step 2:** Connect a PVC hose (½" inner diameter) from the overboard through-hull, to the discharge port off the STOWAWAY. Refer to PAGE 49 or Figure 2.3.

![Diagram of Brine Connection](image)

**Figure 2.7: STOWAWAY Brine Connection to Overboard Through-Hull.**
PRODUCT WATER

Step 1: Connect a ¼” inner diameter PVC hose (or potable water hose) from the product port of the manifold, (Refer to Figure 11) to the top of the ship's Freshwater Tank (Refer to Figure 2.8).

![Figure 2.8: STOWAWAY Product Water Hose Connection.](image)

The product water hose line must go into the top of the product tank to prevent any possible backflow. Village Marine Tec. recommends teeing into the tank vent or fill line.

FRESHWATER FLUSH

Step 1: Tap into your boat’s freshwater pressure system. (Tee into the cold pressurized side).

Step 2: Run a ¾” hose from the tee to the carbon filter inlet (Refer to Figure 2.3 and PAGE 49).

![Figure 2.9: Freshwater Hose Connection into Freshwater Flush Assembly Inlet.](image)
2.3 TO CONNECT THE ELECTRICAL

**WARNING**

TURN OFF ALL ELECTRICAL POWER FOR USE WITH THE RO UNIT PRIOR TO CONNECTING TO THE RO POWER SOURCE. FAILURE TO DO SO MAY RESULT IN SERIOUS INJURY OR DEATH TO PERSONS HANDLING THE UNIT.

**NOTE:** Adhere to all electrical codes and regulations governing the installation and wiring of electrical equipment. Typical codes specify the type and size of conduit, wire diameter, and class or wire insulation depending upon the amperage and environment.

**NOTE:** The power supply should always be of greater service rating than the requirements of the RO unit. This will assure proper voltage even if power supply voltage is slightly less than required. Never connect the RO unit to a line that services another electrical device. **THE RO UNIT SHOULD HAVE ITS OWN INDEPENDENT POWER SUPPLY.**

**Step 1:** Verify all power switches and power sources are in the **OFF** position.

**NOTE:** VMT recommends use of a **25 amp** fuse or circuit breaker for **110 Volts AC** units.

VMT recommends use of a **15 amp** fuse or circuit breaker for **220 Volts AC** units.

**Step 2:** For the electrical connections, refer to Section 10.0: DRAWINGS AND DIAGRAMS for electrical schematics and wiring diagrams of the **STOWAWAY**.

Carefully refer the schematics and wiring diagrams for the **STOWAWAY** to the **CORRESPONDING VOLTAGE, PHASE, AND HERTZ** of your RO unit.

Contact your Stowaway place of purchase or dealer for further technical advisement if necessary.
3.0 GENERAL THEORY OF OPERATION

3.1 REVERSE OSMOSIS THEORY

Reverse osmosis, like many other practical scientific methods, developed from processes first observed in nature. Osmosis is a naturally occurring phenomenon in which a semi-permeable membrane separates a pure and a concentrated solution (a semi-permeable membrane is defined as one that preferentially passes a particular substance). Every fluid has an inherent potential that is directly related to the type and amount of solids in solution. This potential, referred to as osmotic pressure, increases in proportion to relative concentration of a solution. A concentrated solution, therefore, has an osmotic pressure that is higher than that of a pure solution.

In an osmotic system, the less concentrated solution will attempt to equalize the concentrations of both solutions by migrating across the semi-permeable membrane. When enough pure solution migrates across the membrane such that the inherent potential difference between the solutions in no longer higher than the osmotic pressure of the membrane, the purer solution will stop flowing. If the pressure on the concentrated solution is increased to above the osmotic pressure, fluid flow will be reversed. This condition, called Reverse Osmosis, can be established by artificially pressurizing the more concentrated solution using a high pressure pump. In this type of system, the concentrated solution (normally referred to as feedwater) will become more concentrated as pure water flows out of solution and across the membrane to the permeate side. Discounting the effects of feedwater temperature and salinity, the operating pressure normally required to produce significant amounts of pure water is at least twice the osmotic pressure of the membrane being used.

![Figure 3.0 - Simple (Reverse) Osmosis Process.](image)

3.2 APPLICATION OF REVERSE OSMOSIS

Seawater contains many kinds of solids dissolved in solution. The most prevalent is common table salt (sodium chloride). Other minerals that may be present in solution are substances that usually contain various compounds of calcium and sulfate. The sum of all of the solids dissolved in a particular sample of water is referred to as Total Dissolved Solids or TDS. Seawater normally averages 32,000 ppm (parts per million) TDS although variations of 5000 ppm are common in various parts of the world. The fundamental goal any desalination process is a significant reduction in the amount of dissolved solids in water.
In a Reverse Osmosis desalination system, most of the dissolved solids do not pass through the membrane but are instead carried along the membrane surface. This rejected water, referred to as brine, becomes increasingly more concentrated as it flows across the surface of the membranes and is eventually piped to drain. The product water that flows through the membrane is referred to as permeate. The percentage of feedwater that enters the unit converted to permeate is called the recovery rate. A higher than optimal recovery rate (which can be obtained by increasing the back pressure on the unit above the recommended range) results in greatly increased membrane fouling rates and a significant decrease in the operational life of the membranes.

It should be noted that no system is capable of removing all 100% of the dissolved solids from seawater. Designed to reject approximately 99% of the TDS, the system allows 1% of the 32,000 ppm TDS in the seawater to pass into the product water. This yields product water of less than 500 ppm, the recommended TDS for drinking water. A system such as this is said to have a salt passage of 1%.

**Figure 3.1: Simplified Schematic of an RO System.**

### 3.3 PRODUCT WATER QUALITY STANDARDS

This RO unit will produce permeate (product water) with a quality of less than 500 ppm TDS and in accordance with World Health Organization (WHO) guidelines for drinking water. General WHO specifications for acceptable drinking water quality are as follows:

<table>
<thead>
<tr>
<th>Constituent Ion / Molecule</th>
<th>Maximum Limits (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate</td>
<td>10</td>
</tr>
<tr>
<td>Fluorine</td>
<td>1</td>
</tr>
<tr>
<td>Sulfate</td>
<td>100</td>
</tr>
<tr>
<td>Magnesium</td>
<td>30</td>
</tr>
<tr>
<td>Calcium</td>
<td>75</td>
</tr>
<tr>
<td>Calcium Carbonate</td>
<td>100</td>
</tr>
<tr>
<td>Iron</td>
<td>0.1</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.05</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>500</td>
</tr>
<tr>
<td>Turbidity</td>
<td>5</td>
</tr>
<tr>
<td>Oil</td>
<td>0.1</td>
</tr>
<tr>
<td>Detergents (Anionic)</td>
<td>0.2</td>
</tr>
<tr>
<td>Phenols</td>
<td>0.001</td>
</tr>
<tr>
<td>pH</td>
<td>7.5 – 8.5 (per USPHS 1962)</td>
</tr>
<tr>
<td>Bacteria – E. Coli (per 100 ml)</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table 3.0 - WHO Drinking Water Guidelines.**
3.4 FACTORS AFFECTING PERMEATE PRODUCTION

VARIATIONS IN TEMPERATURE, PRESSURE, AND SALINITY

The following table illustrates how the quality and quantity of permeate produced by a RO system is affected by changes in temperature, salinity and pressure:

<table>
<thead>
<tr>
<th>With constant....</th>
<th>And increasing....</th>
<th>Permeate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salinity and Pressure</td>
<td>Temperature</td>
<td>Increases</td>
</tr>
<tr>
<td>Temperature and Pressure</td>
<td>Salinity*</td>
<td>Increases</td>
</tr>
<tr>
<td>Temperature and Salinity</td>
<td>Pressure**</td>
<td>Decreases</td>
</tr>
</tbody>
</table>

* If the feedwater salt concentration decreases, the product water flow rate should not be allowed to increase more than 20% above rated flow. Feed pressure may need to be lowered to maintain rated flow in brackish water or tap water applications.

** Feed pressure shall not be increased above 950 psi.

The RO system can be adjusted to maintain a constant permeate output when feedwater temperature and salinity is other than nominal. The operator can do this by controlling system pressure manually via the backpressure regulation valve located in the system brine piping. As permeate flow decreases, the operator can throttle the pressure regulation valve closed to increase system pressure. This, in turn, will increase the permeate output and mitigate the effect of a decrease in temperature or an increase in salinity. Conversely, the operator can open the pressure regulation valve to reduce pressure and permeate flow in areas of excessively high temperature or low salinity.

**WARNING**

IN FRESH OR BRACKISH FEEDWATER CONDITIONS, MAKE SURE TO REDUCE PRESSURE BY TURNING REGULATOR. SET PRESSURE SO PRODUCT FLOW IS NO MORE THAN 120% OF DESIGN FLOW TO AVOID MEMBRANE DAMAGE.
TEMPERATURE CORRECTION FACTOR

As previously described, the output capacity of any RO unit is highly dependent on feedwater temperature. In order to quantify this relationship, operational data has been utilized to develop Temperature Correction Factors (TCF). The TCF (which is compensated to 25°C/77°F) is used to determine what part of any change in system output flow is due to variations in feedwater temperature alone. This, in turn, allows the operator to establish the baseline flow for a given temperature, allowing more accurate troubleshooting. The procedure for calculating the TCF and the temperature compensated flow is as follows:

1) Measure raw water temperature.
2) Determine the corresponding correction factor from Table 3.2 based on the measured temperature.
3) Note the product flow rate at the Product Flow meter.
4) Divide the measure (uncorrected) product flow meter flow rate by the correction factor from Table 3.2 to give true system output under standard conditions (25°C).

Example:

Raw water temp: 15°C
TCF: 1.47
Uncorrected product flow: 22.7 (gph)
Calculation: 22.7 x 1.47 = 33.3 (gph)
Corrected product flow: 33.3 (gph)
(This is the normal flow for a STW 800)

<table>
<thead>
<tr>
<th>°C Factor</th>
<th>°C Factor</th>
<th>°F Factor</th>
<th>°F Factor</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>3.64</td>
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<td>0.97</td>
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<tr>
<td>2</td>
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</tr>
<tr>
<td>3</td>
<td>3.03</td>
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</tr>
<tr>
<td>4</td>
<td>2.78</td>
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<td>5</td>
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<td>6</td>
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<td>9</td>
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</tr>
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<td>41</td>
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</tr>
<tr>
<td>25</td>
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<td>50</td>
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</tr>
</tbody>
</table>

Table 3.2 - Temperature Correction Factors
PRODUCT WATER MONITORING SYSTEM

The product water (or permeate) flows past a conductivity sensor which provides a signal to the Master Control Center. Depending on the concentration of total of dissolved solids (TDS) in the permeate, the following occurs:

If the permeate TDS is detected AT GREATER than 500 parts per million (ppm), indicating POOR quality water, a signal is sent from the Master Control Center (Figure 3.2), to the three-way product diversion valve (Figure 3.3) to reroute the (high salinity) water away from your water storage tank(s) and into the reject stream.

If the permeate TDS has LESS than 500 ppm, indicating GOOD (drinking) water, a signal is sent to the three-way product diversion valve to redirect the good permeate through a flowmeter and finally into your water storage tank(s).
**MASTER CONTROL CENTER**

The Master Control Center (MCC) provides centralized control and monitoring of all important unit functions and operating parameters (Figure 3.2). This is achieved through the use of an interactive touch screen monitor.

**REMOTE CONTROL CENTER**

Installed as an option, the Remote Control Center (RCC) provides remote control and monitoring of all important unit functions and operating parameters (Figure 3.2) from a remote location. The RCC has a similar configuration as the MCC, but with the following differences outlined in Section 3.6.

**TOUCH BUTTON AND DISPLAY DESCRIPTIONS**

Refer to the numerical callouts of Figures 3.2 for reference of the following touch buttons and displays explanation of the touch screen display.

1. **SALINITY VALUE**
   Displays the salinity value of the permeate line. Has a range from 0 to 1999 ppm TDS.

2. **TEMPERATURE VALUE**
   Displays the temperature value of the permeate line. Has a range from 0 to 50 °C.

3. **HOUR METER VALUE**
   Displays the Hour Meter (or Elapse Time Meter) of the unit.

4. **TEMPERATURE**
   Allows the operator to change the permeate temperature display between Fahrenheit (°F) or Celsius (°C) by touching the unit of measure.

5. **L PMP (Low Pressure Pump)**
   Controls the operation (ON/OFF) of the low pressure boost pump. When the L PMP button changes to gold, the low pressure boost pump is running.

6. **H PMP (High Pressure Pump)**
   Controls the operation (ON/OFF) of the high pressure pump. When the H PMP button changes to gold, the high pressure pump is running.

7. **DUMP/NORM**
   Allows the operator to bypass the normal automatic operation and manually direct the permeate water. DUMP indicates when the product valve is de-energized and the product valve is directing permeate to the reject line. NORM indicates when the product valve is energized and the product valve is directing permeate to the storage tank. This button can only be pressed when the L PMP is on.

8. **FLUSH**
   Energizes the flush valve. Activates an internal time that will automatically run the LP and HP MPs for 2 minutes. After the flush, the system will turn off the L PMP and H PMP. The button can only be pressed when the L PMP is off.

9. **MENU**
   Access the menu screen for more configurations.

10. **OIL CHANGE ICON**
    The oil change icon will be displayed when the Hour Meter reaches the 50 for the first oil change, and then every 500 hours after it has been reset.
(11) **TIME**
Displays the current time.

(12) **DATE**
Displays the current date.

**OPERATIONS AND FUNCTIONS**

(1) **HIGH SALINITY**
The screen will flash red (Figure 3.4) when the permeate salinity goes above the salinity set point of 500 ppm. In addition, the product valve will de-energize and divert the permeate away from the storage tank.

Figure 3.4: Red display screen when the permeate salinity is above the set point value of 500 ppm.

(2) **LOW PRESSURE**
When a low pressure condition is present, the low pressure warning will be display (Figure 3.5).

Figure 3.5: Low pressure warning window.

Pressing the **RESET** button will reset the low pressure alarm and re-enable the system, while pressing the **SILENCE ALARM** button will silence an audible alarm that is present.
17

(3) **OIL CHANGE**

The Master Control Center continuously monitors and records the total operated hours of the high pressure pump and will indicate an OIL (see number 10 in Figure 3.2) icon when the pump needs an oil change.

The first oil change required is after the first 50 hours of use on the RO unit and every 500 hours thereafter.

Pressing the OIL icon will bring up the oil change notification window (Figure 3.6).

![Figure 3.6: Oil change notification window.](image)

Pressing the **RESET** button will reset this counter and remove the OIL icon, while pressing the **BACK** button will return back to the display screen.

**NOTE:** A display of 2000 ppm indicates the salinity of the water exceeds the detectable range for salinity. The Master Control Center has a salinity detection range of 0 ppm to 1999 ppm (0-1999 ppm).

**NOTE:** The automatic display feature is intended to provide general guidance concerning membrane cleaning frequency only. Actual membrane cleaning frequency will vary in response to changes in the seawater conditions. Refer to Section 3.4 for specific information regarding how to determine actual cleaning frequencies.
3.6 CONFIGURATION DESCRIPTION

MAIN MENU SCREEN

The main menu screen displays all the essential configurations for the system (Figure 3.7).

MCC AND RCC DIFFERENCES

<table>
<thead>
<tr>
<th>Functions</th>
<th>MCC</th>
<th>RCC</th>
</tr>
</thead>
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<tr>
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<td>X</td>
</tr>
<tr>
<td>H PMP</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>DUMP/NORM</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>FLUSH</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>MENU</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Set Permeate Salinity Offset</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Set Permeate Temperature Offset</td>
<td>X</td>
<td>X*</td>
</tr>
<tr>
<td>High Salinity Audible Alarm Enabler</td>
<td>X</td>
<td>X*</td>
</tr>
<tr>
<td>Low Pressure Audible Alarm Enabler</td>
<td>X</td>
<td>X*</td>
</tr>
<tr>
<td>Silence Alarms</td>
<td>X</td>
<td>X*</td>
</tr>
<tr>
<td>Screensaver Enabler</td>
<td>X</td>
<td>X*</td>
</tr>
<tr>
<td>Screensaver Idle Time</td>
<td>X</td>
<td>X*</td>
</tr>
<tr>
<td>Set Permeate Salinity Set-Point</td>
<td>X</td>
<td>X*</td>
</tr>
<tr>
<td>Set Flush Time</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Schedule Flush Enabler</td>
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</tr>
<tr>
<td>Set Schedule Flush</td>
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<td>Hibernate Enabler</td>
<td>Enable</td>
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<td>Enable</td>
<td></td>
</tr>
<tr>
<td>Salinity Alarm Enabler</td>
<td>Enable</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.4: Default Configuration Table.

**DEFAULT VALUES**

Table 3.4 displays the factory default values for each type of configurations. These parameters can be reset back to factory default in the system configuration screen.

**MENU CONFIGURATION DESCRIPTIONS**

Refer to the numerical callouts of Figures 48A for reference of the following configuration items.

1. **SENSOR CALIBRATION**
   The sensor calibration screen displays the configuration menu for the calibrating (offsetting) the permeate salinity and temperature value (Figure 3.8).
Figure 3.8: Calibration configuration screen.

Pressing the **SET SALINITY OFFSET** button will bring up the salinity offset entry screen (Figure 3.9). Pressing the **SET TEMPERATURE OFFSET** button will bring up the temperature offset entry screen (Figure 3.10). Pressing the **BACK** button will return to the main menu screen.

Figure 3.9: Salinity offset entry screen.  
Figure 3.10: Temperature offset entry screen.

Pressing + and – buttons will define a positive or negative offset, respectively. Pressing the arrow **UP** and **DOWN** buttons will increment and decrement, respectively. The buttons °C and °F shows which unit of measure the offset is changing. Pressing the **BACK** button will cancel any changes, while pressing the **ENTER** button will save any changes.

See Section 5.9 for steps to calibrate the salinity and temperature values.

**WARNING**  
**IMPROPER CALIBRATION WILL RESULT IN INACCURATE WATER QUALITY. IF YOU FIND THAT THE CALIBRATION IS ABOVE THE ±100 RANGE, SOMETHING MAY BE WRONG WITH THE PROBE OR THE SYSTEM.**

(2) **ALARMS**  
The alarms configuration screen displays the audible alarm enabler for the high salinity alarm and the low pressure alarm (Figure 3.11).
Pressing the **LOW PRESSURE ALARM ENABLED/DISABLED** button will toggle between enabled (BLACK) and disabled (GRAY) for the low pressure alarm. Pressing the **SALINITY ALARM ENABLED/DISABLED** button will toggle between enabled (BLACK) and disabled (GRAY) for the high salinity alarm. Pressing the **SILENCE ALARM** will silence any audible alarms present.

(3) **SCREENSAVER**

The screensaver configuration screen displays the screensaver enabler and the idle time before the screensaver activates (Figure 3.12).

Pressing the **SCREENSAVER ENABLED/DISABLED** button will toggle between enabled (BLACK) and disabled (GRAY) for the screensaver. Pressing the **SET SCREENSAVER TIME** button will bring up the screensaver idle time entry screen (Figure 3.13). Pressing the **BACK** button will return to the main menu screen.
Pressing the arrow **UP** and **DOWN** buttons will increment and decrement, respectively. Pressing the **BACK** button will cancel any changes, while pressing the **ENTER** button will save any changes.

(4) **SALINITY**

The salinity configuration screen displays the salinity set-point value that will trigger a high salinity (Figure 3.14).

Pressing the **SET SALINITY SET-POINT** button will bring up the salinity set-point entry screen (Figure 3.15). Pressing the **BACK** button will return to the main menu screen.
Figure 3.15: Salinity set-point entry screen.

Pressing the arrow **UP** and **DOWN** buttons will increment and decrement, respectively. Pressing the **BACK** button will cancel any changes, while pressing the **ENTER** button will save any changes.

(5) **FLUSH**
The flush configuration screen displays length of time a flush will be enable (Figure 3.16).

Figure 3.16: Flush configuration screen.

Pressing the **SET FLUSH TIME** button will bring up the flush time entry screen (Figure 3.17). Pressing the **BACK** button will return to the main menu screen.

**WARNING**

SETTING THE SALINITY SET-POINT ABOVE 500 IS NOT RECOMMENDED. SET AT YOUR OWN RISK.
Pressing the arrow **UP** and **DOWN** buttons will increment and decrement, respectively. Pressing the **BACK** button will cancel any changes, while pressing the **ENTER** button will save any changes.

(6) **FLUSH SCHEDL**
The flush schedule configuration screen displays the enabler for the flush schedule and the start time of the auto flush (Figure 3.18).

Pressing the **SCHEDULE ENABLED/DISABLED** button will toggle between enabled (BLACK) and disabled (GRAY) for the auto flush. Pressing the **FLUSH SCHEDULE** button will bring up the flush schedule entry screen (Figure 3.19). Pressing the **START TIME** button will bring up the flush schedule start time entry screen (Figure 3.20). Pressing the **BACK** button will return to the main menu screen.
Pressing the day buttons, **SUN, MON, TUES, WED, THUR, FRI,** and **SAT** will enable an auto flush scheduled for that day, respectively. Pressing the **BACK** button will cancel any changes, while pressing the **ENTER** button will save any changes.

Pressing the arrow **UP** and **DOWN** buttons will increment and decrement, respectively. Pressing the **BACK** button will cancel any changes, while pressing the **ENTER** button will save any changes.

(7) **HIBERNATE**

The hibernate configuration screen displays the hibernate enabler and the idle time before the hibernate activates (Figure 3.21).
Figure 3.21: Hibernate configuration screen.

Pressing the **HIBERNATE ENABLED/DISABLED** button will toggle between enabled (BLACK) and disabled (GRAY) for hibernation. Pressing the **SET HIBERNATE TIME** button will bring up the hibernate idle time entry screen (Figure 3.22). Pressing the **BACK** button will return to the main menu screen.

Figure 3.22: Hibernate idle time entry screen.

Pressing the arrow **UP** and **DOWN** buttons will increment and decrement, respectively. Pressing the **BACK** button will cancel any changes, while pressing the **ENTER** button will save any changes.

**SYSTEM**

The system configuration screen displays the button to restore the default configurations in Table 3.4, the touch screen’s brightness level, and the internal clock (Figure 3.23 and Figure 3.24).
Pressing the **RESTORE DEFAULT SETTINGS** button will bring up the restore default confirmation window (Figure 3.25). Pressing the arrows << and >> buttons will increment and decrement the brightness by 10, respectively. Pressing the arrows < and > buttons will increment and decrement the brightness by 5, respectively. Pressing the **BACK** button on the system configuration screen 1 (Figure 3.23) will return to the main menu screen. Pressing the **NEXT** button will navigate to the system configuration screen 2 (Figure 3.24).

Pressing the **SET DATE** button will bring up the set system date entry screen (Figure 3.26). Pressing the **SET TIME** button will bring up the set system time entry screen (Figure 3.27). Pressing the **BACK** button on the system configuration screen 2 (Figure 3.24) will return to the system configuration screen 1 (Figure 3.23).

Pressing the **YES** button will restore the default configurations in Table 3.4. Pressing the **NO** button will return to the system configuration screen 1 (Figure 3.23).
Pressing the arrow **UP** and **DOWN** buttons will increment and decrement, respectively. Pressing the **BACK** button will cancel any changes, while pressing the **ENTER** button will save any changes.
4.0 OPERATION

4.1 TO START STOWAWAY (STW) UNITS

Step 1: Verify all power switches and power sources are in the **OFF** position.

Step 2: Refer to instrument details in Figures 4.0. Turn High Pressure Bypass Valve (Black Valve) to **CLEANING POSITION**. This procedure allows release of the high pressure air trapped within the system. Verify the Cleaning Valve (Gray Valve) is positioned to **NORMAL** discharge.

**CAUTION**

FAILURE TO OPEN THE HIGH PRESSURE BYPASS VALVE, WHICH IS REQUIRED TO RELEASE ANY TRAPPED AIR, COULD RESULT IN HYDRAULIC SHOCK TO THE SYSTEM.

Step 3: Verify the seawater intake is open at the through-hull. This allows the feed seawater to flow into the unit.

Step 4: Switch **ON** the breaker at the main breaker panel to power up the unit.

Step 5: Start the Low Pressure Boost Pump by pressing the **L PMP** button located on the Master Control Center (or on the Remote Control Center). Allow the unit to prime prior to start of high pressure pump.

Step 6: Start the High Pressure Pump by pressing the **H PMP** button located on the Master Control Center (or on the Remote Control Center).

Step 7: Upon start-up inspect all plumbing connections in the unit for leakage. Varying temperatures during shipment may cause plumbing connections to seep when starting the RO unit for the first time. Secure the unit and repair any leaks before proceeding. Once leaks are repaired, open the seawater source and restart the unit.

Step 8: Observe the Brine Flowmeter, to ensuring all air and bubbles exited the RO system prior to proceeding to next step.
**MAINTENANCE**

**Step 9:** Gradually turn the High Pressure Bypass Valve (Black Valve) to **NORMAL/RO** position. The pressure gauge should rise steadily to a reading of 800 psi.

**NOTE:** When the High Pressure Bypass valve is closed, the salinity of the initial permeate produced will be relatively high and will probably activate the salinity alarm, do not be worried. Salinity should reduce in 3 to 5 minutes.

**Step 10:** Observe the system pressure on the High Pressure Gauge. During RO production, the indicated pressure should be at 800 psi. If the pressure reading is not at 800 psi, adjust the Allen key of the pressure regulator valve (Refer to Figure 4.2) using a wrench or hex key, until the reading reaches 800 psi.

**NOTE:** If the RO unit is used for other than seawater purification (in freshwater or brackish water applications), reduce pressure as necessary to achieve product flow no greater than 120% of design flow to avoid membrane damage.

**WARNING**

RO high pressure production should **NEVER EXCEED 950 psi**, doing so risks damage to RO unit, **VOIDING** factory warranty and may also risk personal injury.

**NOTE:** At initial start-up of RO unit, PRESS **DUMP** on the Master Control to keep the product water diverted from the water storage tank. IF the unit is filled with preservative storage solution, water must be kept running **AT LEAST 30 MINUTES** to clear preservative solution from system.

**Step 11:** Check the RO unit for water leakage periodically at the initial start-up. Observe Product Flow meter. Record the product flow after 48 hours of operation (use the sample log sheet provided in Table 5.3).

**NOTE:** **For Remote Control Operation:** The initial start-up of the RO unit must be followed **FIRST** prior to use of remote. Once initial start-up steps are performed, the necessary valve (HP Bypass and Freshwater Flush) positions would be set. Therefore the RO unit may now be started (or stopped) via the remote control panel for steps 5-6.

4.2 **TO SHUT DOWN UNIT**

**Step 1:** As the RO unit operates, turn the High Pressure Bypass Valve (Black Valve) to **CLEANING POSITION**. This will release the high pressure and air trapped within the RO system.

**NOTE:** **For the Remote Control Operation:** The HP Bypass Valve may be left in the RO position (FULL CLOCKWISE) during shutdown. **STEP #1** would be **OMITTED**.

**Step 2:** Press the **H PMP** button to stop the High Pressure Pump.

**Step 3:** Press the **L PMP** button to stop the Low Pressure Pump.

**Step 4:** Then turn switch **OFF** on your breaker at the main breaker panel.

The RO unit may be left in this “stand by” condition with the seawater for up to seven days or three days in hot, tropical climates. If the RO unit will be out of service for extended time periods, please refer to the Maintenance section of this manual.

**Step 5:** To restart the **STOWAWAY**, refer to instructions in Section 4.1: **TO START THE STOWAWAY (STW) UNITS**
5.0 MAINTENANCE

The service life of most system equipment is directly related to the raw water inlet conditions. Improper maintenance will also significantly reduce the life expectancy of the major unit components (such as the membranes, filters and pumps) as well as the reliability of the unit as a whole. Under normal conditions, and with proper maintenance, a reverse osmosis membrane (which is the major consumable item) should have an effective service life somewhere between 4 and 6 years.

NOTE: The RO unit must be cleaned when product water production output drops by 20%.

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<th>Task</th>
<th>Daily</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Quarterly</th>
<th>Semi-Annually</th>
<th>Annually</th>
<th>As Required</th>
<th>Labor Hours (approximate)</th>
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<tbody>
<tr>
<td>Clean/inspect micron prefilter</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
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<tr>
<td>Replace filter(s)*</td>
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<tr>
<td>Clean membranes</td>
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<td>Replace Membranes</td>
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<td>0.5</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.0: Maintenance Task Chart.

* VMT prefilter cartridges can be rinsed with freshwater and be reused up to 3 times.

** Change pump oil after first 50 hours of RO use. After the first oil change at 50 hours, change the pump oil every 500 hours thereafter or once annually which ever interval comes first.

FRESHWATER FLUSH / SHORT TERM STORAGE

Ideally, the Stowaway performs optimally when the RO unit is used regularly. The likelihood of bacterial and biological growth in the membranes increases, when stagnant seawater (in extended periods) is in contact with the membranes. A freshwater flush procedure is necessary to prevent clogging and growth of organic contaminants in the RO system and its membranes. This method pushes out older stagnant seawater (saltwater) out of the membranes and replacing it with freshwater (non-saltwater), leaving less chance of fouling the membranes. The freshwater flush procedure should be used when the unit will be placed idle or in “stand by” condition for more than several days OR idle for three days in hot, tropical climates. Although they do not attack the membranes or other system components directly, high concentrations of biological matter can block enough of the product water channels to cause a reduction of as much as 40% of the total system capacity.
PERFORM A FRESHWATER FLUSH TO THE RO UNIT WITH NON-CHLORINATED FRESH WATER ONLY. EXPOSING THE MEMBRANES TO CHLORINATED WATER WILL CAUSE IRREVERSIBLE DAMAGE AND VOID THE RO UNIT WARRANTY. THE FRESHWATER FLUSH SYSTEM USES A CARBON FILTER INLINE BEFORE SYSTEM TO CONSUME THE CHLORINE THAT MAY BE PRESENT FROM THE DOCK WATER.

5.1 TO FLUSH THE STOWAWAY (STW) UNITS

Step 1: Verify all power switches and power sources are turned OFF.

Step 2: Verify the gray Cleaning Valve is positioned to NORMAL/REVERSE OSMOSIS position.

Step 3: Turn ON the breaker at the main breaker panel.

Step 4: Verify the freshwater supply pressure on the Vacuum/Pressure Gauge, does not exceed 35 psi. Refer to Figure 5.0.

Step 5: Press the FLUSH button located on the Master Control Center on the electronic instrument panel (or the Remote Control Center, if equipped). This will automatically begin the freshwater flush cycle within the RO system. The electronic flush will automatically start the Low Pressure Boost Pump, then the High Pressure Pump, and begin the flushing process, for a period of two minutes.

After flushing the unit for two minutes, the High Pressure Pump and Low Pressure Pump will shutdown respectively and the flush window will close.

Step 6: Turn OFF the breaker at the main breaker panel.

Step 7: Leave RO unit in standing condition, for up to three weeks. Then reflush or preserve.

Step 8: To restart the STOWAWAY, refer to instructions in Section 4.1: TO START STOWAWAY (STW) UNITS.

5.2 MEMBRANE CLEANING

The membrane elements require occasional service; it is recommended to clean the membranes only when dirty. Basic procedure for all cleaning and preservative treatments are similar- a specific chemical solution is circulated through the system for a pre-determined length of time.

NOTE: All cleaning and preservation procedures should be performed with NON-CHLORINATED freshwater to optimize performance of cleaning process.

NOTE: Allow your unit’s product water to run with product to DUMP for the first 30 minutes after cleaning or upon startup after preservation.
5.3 CLEANING CHEMICALS

**CAUTION**

 CLEANING CHEMICAL #1 IS AN ALKALINE DETERGENT, USED TO REMOVE OIL, GREASE, BIOLOGICAL MATTER, AND GRIME FROM THE SURFACE OF THE RO MEMBRANES. SEE WARNING LABEL ON SIDE OF PACKAGE AND OBSERVE ALL SAFETY PRECAUTIONS ON LABEL.

**CAUTION**

 CLEANING CHEMICAL #2 IS AN ACID, A MINERAL SCALE REMOVER. SEE WARNING LABEL ON SIDE OF PACKAGE AND OBSERVE ALL SAFETY PRECAUTIONS ON LABEL.

**WARNING**

 THE USE OF CHEMICALS OR CLEANING METHODS OTHER THAN THOSE OUTLINED IN THIS MANUAL WILL VOID THE RO UNIT WARRANTY. NON-IONIC SURFACTANTS USED FOR MEMBRANE CLEANING OR ANY OTHER CHEMICALS NOT APPROVED IN WRITING BY VILLAGE MARINE TEC., WILL VOID THE RO UNIT WARRANTY.

5.4 WHEN TO CLEAN

Chemically clean the RO, when product water output drops below 80% of original production. The frequency of this occurring varies greatly upon feed water. Membrane fouling will occur with normal use.

**NOTE:**

Product water output depends on feedwater temperature, pressure and salinity. Product water output reductions from these factors are normal and may not indicate need for membrane cleaning.

For **POWDER** format chemical cleaning: Follow the procedures on pages 34-36 to clean the RO elements.

For **CARTRIDGE** format chemical cleaning: Follow the procedures on page 37 to clean the RO elements.
STEPS FOR CHEMICAL CLEANING #1: HIGH pH CLEANER

Step 1: Freshwater Flush the watermaker so it is filled with fresh water, NOT seawater. To flush the STW, refer to instructions in Section 5.1: TO Flush THE STOWAY (STW) UNITS.

\[\text{CAUTION}\]

FLUSH THE UNIT WITH NON-CHLORINATED FRESHWATER ONLY. EXPOSING MEMBRANES TO CHLORINATED WATER MAY CAUSE IRREVERSIBLE DAMAGE AND VOID RO UNIT WARRANTY.

Step 2a: Dissolve the appropriate amount of Cleaning Chemical #1 (see Table 5.1) in non-chlorinated water of prefiter capacity, to obtain a pH level of 11. Use CAUTION as a pH level above 12 may damage membranes. Verify the chemical is completely dissolved (use warm water if necessary).

Step 2b: Measure the pH level of the sample using test kit #90-0135. If the pH is LESS than 11, add Cleaning Chemical #1 to raise pH level. Add Cleaning Chemical #2 to lower pH level. Repeat 2b until pH is 11.

Step 3: Verify that the (black) High Pressure Bypass Valve is in the CLEANING (open) position.

Step 4: Place the (gray) cleaning valve in the CLEANING position.

Step 5: Remove the prefiter element from the prefiter tank and replace the micron filter with one dedicated cleaning filter (5 micron). Leave the carbon flush filter in place. A dedicated cleaning prefiter should be used to prevent fouling of the operational prefilters. When the process is complete the dedicated cleaning filter can be cleaned and set aside until the next membrane cleaning is required.

Step 6: Pour the chemical solution made from Step #2 into the prefiter tank. Reinstall the prefiter housing.

Step 7: Start the Low Pressure Boost Pump by pressing the L PMP button located on the Master Control Center (or on the Remote Control Center). Allow the unit to prime prior to start of high pressure pump.

Step 8: Start the High Pressure Pump by pressing the H PMP button located on the Master Control Center panel (or on the Remote Control Center). If pressure is not greater than 0 psi, press the gray button on the side of the flushing solenoid valve momentarily to introduce extra water into the cleaning loop.

Step 9: After circulating the chemical solution for 3 minutes, shutdown the H PMP and L PMP, respectively.

a) Remove the prefiter housing and manually sample the filter water. Measure the pH level of the sample using test kit #90-0135. If pH level is not attained, follow Step #2b to reach desired pH level and then go to Step #9b.

b) Once a pH level of 11 is achieved, re-secure the prefiter housing. Start the L PMP and H PMP respectively and allow the cleaning solution to circulate for an additional 30-40 minutes.

After 30-40 minutes, shutdown the H PMP and L PMP, respectively.

Step 10: Place the (gray) cleaning valve in NORMAL flow position.

Step 11: Open the raw water supply (seacock) to the RO unit.

Step 12: Start the L PMP and H PMP respectively. Allow both pumps to run for 5 additional minutes to flush the chemical solution from the RO.

Step 13: After 5 minutes, shutdown the H PMP and L PMP, respectively.

Step 14: Move valves back to cleaning positions.
**STEPS FOR CHEMICAL CLEANING #2: LOW pH CLEANER**

**Step 15:** Freshwater Flush the watermaker so it is filled with fresh water, **NOT** seawater. To flush the STW, refer to instructions in Section 5.1: TO FLUSH THE STOWAWAY (STW) UNITS.

**CAUTION**

**FLUSH THE UNIT WITH NON-CHLORINATED FRESHWATER ONLY. EXPOSING MEMBRANES TO CHLORINATED WATER MAY CAUSE IRREVERSIBLE DAMAGE AND VOID RO UNIT WARRANTY.**

**Step 16a:** Dissolve the appropriate amount of Cleaning Chemical #2 (see Table 5.1) in non-chlorinated of prefilter capacity to obtain a pH level of 3. Verify the chemical is completely dissolved (use warm water if necessary).

**Step 16b:** Measure the pH level of the sample using test kit #90-0135. If the pH is GREATER than 3, add Cleaning Chemical #2 to lower the pH level. Add Cleaning Chemical #1 to raise the pH level. Repeat 2b until pH is about or less than 3.

**Step 17:** Verify that the (black) High Pressure Bypass Valve is in the **CLEANING** open position.

**Step 18:** Place the (gray) cleaning valve in the **CLEANING** position.

**Step 19:** Remove the prefilter element from the prefilter tank and replace the micron filter with one dedicated cleaning filter (5 micron). Leave the carbon flush filter in place. A dedicated cleaning prefilter should be used to prevent fouling of the operational prefilters. When the process is complete the dedicated cleaning filter can be cleaned and set aside until the next membrane cleaning is required.

**Step 20:** Pour the chemical solution made from Step #16 into the prefilter tank. Reinstall the prefilter housing.

**Step 21:** Start the Low Pressure Boost Pump by pressing the **L PMP** button located on the Master Control Center (or on the Remote Control Center). Allow the unit to prime prior to start of high pressure pump.

**Step 22:** Start the High Pressure Pump by pressing the **H PMP** button located on the Master Control Center panel (or on the Remote Control Center). If pressure is not greater than 0 psi, press the gray button on the side of the flushing solenoid valve momentarily to introduce extra water into the cleaning loop.

**Step 23:** After circulating the chemical solution for 3 minutes, shutdown the **H PMP** and **L PMP**, respectively.

a) Remove the prefilter housings and manually sample the filter water. Measure the pH level of the sample using test kit #90-0135. If pH level is reached, reattach prefilter housing and go to Step #24. If pH level is not attained, follow Step #16b to reach desired pH level and then go to Step #23b.

b) Once a ph level of 3 is achieved, re-secure the prefilter housing. Start the **L PMP** and **H PMP** respectively and allow the cleaning solution to circulate for an additional 30-40 minutes.

After 30-40 minutes, shutdown the **H PMP** and **L PMP**, respectively.

**Step 24:** Place the (gray) cleaning valve in **NORMAL** flow position.

**Step 25:** Open the raw water supply (seacock) to the RO unit.

**Step 26:** Start the **L PMP** and **H PMP** respectively. Allow both pumps to run for 5 additional minutes to flush the chemical solution from the RO.

**Step 27:** After 5 minutes, shutdown the **H PMP** and **L PMP**, respectively and close the raw water supply.

**Step 28:** Remove and replace the prefilter with the operational filter. Store the cleaning prefilter for future use. Move valves to normal operational positions as in Sections 4.1: TO START STOWAWAY (STW) UNITS.
5.5 LONG TERM STORAGE / PRESERVATION PROCEDURE

During periods when the RO unit is to be shut down for an extended period of time, it is necessary to re-flush the unit every three weeks OR to circulate a preservative solution through the membrane to prevent the growth of biological organisms. Use the following procedure to preserve the RO elements:

**NOTE:** You should allow your unit’s product water to run to DUMP for the first 30 minutes after cleaning or upon startup after preservation.

5.6 STEPS FOR PRESERVATION CHEMICAL #3

**Step 1:** Freshwater Flush the watermaker so it is filled with fresh water, NOT seawater. To flush the SPW, MPW, or STW, refer to instructions in Section 5.1: TO FLUSH THE STOWAWAY (STW) UNITS.

**CAUTION** FLUSH THE UNIT WITH NON-CHLORINATED FRESHWATER ONLY. EXPOSING MEMBRANES TO CHLORINATED WATER MAY CAUSE IRREVERSIBLE DAMAGE AND VOID RO UNIT WARRANTY.

**Step 2:** Dissolve the appropriate amount of Preservative Chemical #3 (see Table 5.2) in non-chlorinated water (enough to fill the micron filter bowls). Verify the chemical is completely dissolved (use warm water if necessary).

**CAUTION** PRESERVATIVE CHEMICAL #3 IS A FOOD GRADE PRESERVATIVE. SEE WARNING LABEL ON SIDE OF PACKAGE AND ADHERE TO ALL SAFETY PRECAUTIONS ON LABEL.

**Step 3:** Verify that the (black) High Pressure Bypass Valve is in the CLEANING open position.

**Step 4:** Place the (gray) cleaning valve in the CLEANING position.

**Step 5:** Remove the prefilter housing and pour in the preservative solution prepared in Step #3.

**Step 6:** Start the Low Pressure Boost Pump by pressing the L PMP button located on the Master Control Center (or on the Remote Control Center). Allow the unit to prime prior to start of high pressure pump.

**Step 7:** Start the High Pressure Pump by pressing the H PMP button located on the Master Control Center panel (or on the Remote Control Center). Verify the Vacuum Pressure Gauge reads more than zero (0 psi). If pressure is not greater than 0 psi, press the gray button on the side of the flushing solenoid valve momentarily to introduce extra water into the cleaning loop.

**Step 8:** Allow the RO to run for than 10 minutes to allow the chemical solution to circulate through the RO.

**Step 9:** Shutdown the H PMP and L PMP, respectively.

**Step 10:** The system is properly conditioned and may be left idle for an extended period of time. This preservation procedure should be repeated at least every 4 months during the shutdown. In colder climates the interval between preservation cycles may be extended to 6 months. Remember to flush out old preservative before re-preserving.

**Step 11:** To restart the STOWAWAY, refer to instructions in Sections 4.1: TO START THE STOWAWAY (STW) UNITS.

**NOTE:** For resuming normal RO operation (un-preserving or “un-pickling”), install a FIVE MICRON filter into prefilter housing and fill it with NON-CHLORINATED WATER. Begin system Start Up Procedures by referring to Sections 4.1: TO START THE STOWAWAY (STW) UNITS.

* IF RO unit storage time is to exceed FOUR months, then it is NECESSARY to FLUSH (PUSH OUT) the existing chemical out of the unit and re-preserve at EVERY FOUR MONTH INTERVAL.
### STEPS FOR CLEANING CHEMICALS #1, #2, AND #3 (CARTRIDGE FORM)

<table>
<thead>
<tr>
<th>Single Use Cleaning Cartridges: Chemical #1 and Chemical #2</th>
<th>Single Use Preservative Cartridge: Chemical #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1. Prior to cleaning the RO, complete a freshwater flush to the system. (REFER TO SECTION 5.1)</td>
<td>Step 1. Prior to preserving the RO, complete a freshwater flush to the system. (REFER TO SECTION 5.1)</td>
</tr>
<tr>
<td>Step 2. Remove 5 micron prefilter from housing.</td>
<td>Step 2. Remove 5 micron prefilter from housing.</td>
</tr>
<tr>
<td>Step 3. Place cleaning filter Chemical #1 (Blue Stripe) into prefilter housing and fill with unchlorinated water. Screw housing back into place.</td>
<td>Step 3. Place preservation filter Chemical #3 (Green Stripe) into prefilter housing and fill with unchlorinated water. Screw housing back into place.</td>
</tr>
<tr>
<td>Step 4. Place High Pressure Bypass Valve into Cleaning position.</td>
<td>Step 4. Place High Pressure Bypass Valve into Cleaning position.</td>
</tr>
<tr>
<td>Step 5. Turn cleaning valve to clean/re-circulate position.</td>
<td>Step 5. Turn cleaning valve to clean/re-circulate position.</td>
</tr>
<tr>
<td>Step 6. Start RO unit and let unit run for 30 minutes, in the re-circulate mode. Pushing the button on the side of the flushing solenoid valve helps purge air from the cleaning loop.</td>
<td>Step 6. Start RO unit and let unit run for 30 minutes, in the re-circulate mode. Pushing the button on the side of the flushing solenoid valve helps purge air from the cleaning loop.</td>
</tr>
<tr>
<td>Step 7. Turn Unit OFF after running for 30 minutes; Place cleaning valve to overboard position; Remove the cleaning chemical cartridge from the prefilter housing; Install a 5 micron prefilter cartridge in housing and re-secure housing place.</td>
<td>Step 7. Turn Unit OFF after running for 30 minutes.</td>
</tr>
<tr>
<td>Step 8. Open the inlet seacock and flush with water overboard for 5 minutes at 0 psi.</td>
<td>Step 8. Leave all valves in position they are now in.</td>
</tr>
<tr>
<td>Step 9. If necessary to use Cleaning Chemical #2 (Red Stripe) return to Step 1 to follow steps used for Chemical Cleaning #1.</td>
<td>Step 9. Remove and discard Chemical Cartridge #3 from prefilter housing. Then secure the prefilter housing empty with no micron filter.</td>
</tr>
<tr>
<td>Step 10. Remove the 5 micron prefilter (not necessary to discard, designate that as the cleaning prefilter for next use at Step 7) from the prefilter housing. Then secure the prefilter housing with a NEW 5 micron filter.</td>
<td>Step 10. Unit is now preserved.</td>
</tr>
<tr>
<td>Step 11. Return RO to Normal Conditions.</td>
<td></td>
</tr>
<tr>
<td>Step 12. Record production flow rate before and after cleaning to determine effectiveness.</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** For resuming normal RO operation (unpreserving or “unpickling”), install a FIVE MICRON filter into prefilter housing and fill it with UNCHLORINATED WATER. Begin system Start Up Procedures by referring to Section 4.1.

**NOTE:** IF RO unit storage time is to exceed four months, then it is NECESSARY TO FLUSH (PUSH OUT) the existing chemical out of the unit and re-preserve at EVERY FOUR MONTH INTERVAL.
5.7 **OIL CHANGE PROCEDURE**

An oil change is recommended after the first 50 hours of RO use. Subsequent oil changes are to be performed every 500-hour intervals OR changed annually. Change oil any time moisture is detected or if oil is cloudy. For additional pump information, refer to **Section 12.0: MANUFACTURER’S LITERATURE** in back of this manual.

**CAUTION**

**NOTE:** Prior to the oil change, it **MAY** facilitate the oil replacement process by running the RO unit to heat the oil. Heating the oil reduces the viscosity allowing it to be more fluid to travel through the pump.

**THE STOWAWAY UNIT OIL CHANGE PROCEDURE**

**Step 1:** Turn off all power sources and switches.

**Step 2:** Before changing the oil, obtain a container (i.e. a small bucket, bottle, or catch basin) to collect the oil drainage.

**Step 3:** Remove the oil hose from the bulkhead fitting (Refer to Figure 5.1) and direct the oil drain hose to a catch basin or bottle. Allow the oil to drain empty.

**Step 4:** Reconnect the oil drain hose. Then unscrew the oil cap and refill oil to fill line (Refer to Figure 5.2). Check for leaks and re-secure oil cap.
## 5.8 RO MOTOR LUBRICATION

<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Pressure Pump</td>
<td>Village Marine Tec. Pump Oil, P/N #85-0050</td>
</tr>
<tr>
<td>High Pressure Pump Motor</td>
<td>Chevron SRI Grease - NGLI 2</td>
</tr>
<tr>
<td></td>
<td>ExxonMobil PolyrexEM Grease</td>
</tr>
<tr>
<td></td>
<td>Shell Oil Dolium R - NGLI 2</td>
</tr>
<tr>
<td></td>
<td>Texaco Premium RB</td>
</tr>
<tr>
<td>O-Rings and Gaskets</td>
<td>Glycerin or Silicone Lubricant</td>
</tr>
</tbody>
</table>

Table 5.2: Motor and H PMP Lubrication Requirements.

- **Step 1:** Locate the grease fittings on the motor (Refer to Figure 5.3). Use a clean cloth to wipe fittings clean.

- **Step 2:** Remove filler and drain plugs. Free drain hole of any hard grease if present (use a piece of wire if necessary).

- **Step 3:** Add 2-3 strokes of grease using a low pressure grease gun (see Table 5.2 for grease type).

- **Step 4:** If the motor is equipped with a motor drain plug, start RO unit and let it run for approximately 20 minutes prior to replacing drain plug.

- **Step 5:** Secure the RO unit, wipe off any of the drained grease and replace the fill and drain plugs, as required. The motor is now ready to resume operation.

![Electric Motor - Grease Fitting Locations.](image)
5.9 CLEANING THE SALINITY PROBE

Step 1: Unscrew the salinity probe from the manifold. Refer to Figures 5.5 for visible location of the probe.

Step 2: Clean the probe with a soft cloth and mild detergent. Continue to clean until the probe prong surfaces (Refer to Figure 5.6) are clear and bright. If required, gently scrub with emery paper (or known as wet-sand paper) or warm vinegar to aid in the removal of difficult scale and film deposits. Clean the salinity probe port of the manifold also.

NOTE: When cleaning the salinity probe, be careful NOT to force the salinity sensors out of alignment (Refer to Figure 5.6). Doing so may negatively affect its calibration.

NOTE: Steps 3 to 5 are optional, but highly recommended to ensure that your unit is reading the correct level of ppm and temperature. You will need a calibrated solution and a calibrated thermometer, or a calibrated salinity meter.

Step 3: Insert the probe into calibration solution.

Step 4: Measure calibration solution with a calibrated thermometer.

Step 5: Adjust the Salinity and Temperature Offset to match thermometer temperature.

Step 6: Clean any residual pipe sealant from the probe’s screw threads and then rewrap it with Teflon tape (2-3 turns). Reinstall the probe in the manifold and carefully tighten the probe until taut. Do not force to overtighten the probe into the manifold, as this may cause the probe body to crack.
<table>
<thead>
<tr>
<th>Date</th>
<th>Total Hours</th>
<th>H PMP Inlet Pressure</th>
<th>RO Array Pressure</th>
<th>Product Flow GPH</th>
<th>Brine Flow GPH</th>
<th>Prod water TDS, ppm</th>
<th>Water Temp, °C</th>
</tr>
</thead>
</table>
MEMBRANE REPLACEMENT

6.0 MEMBRANE REPLACEMENT

6.1 PRESSURE VESSEL DISASSEMBLY

Step 1: Disconnect plumbing from pressure vessel for disassembly.

Step 2: Remove the six fasteners and cap ring holding each end plug with an allen wrench. Place a mark on each end plug to be removed, place a corresponding mark on each end collar. This will ensure proper orientation during assembly. Refer to Figure 6.1.

Step 3: Locate the screwdriver slots located on opposite ends of the pressure vessel end collar (Refer to Figure 6.0). Place an appropriate sized slot screwdriver in each slot. Twist both screwdrivers until the end plug breaks loose from the pressure vessel. The screwdrivers can now be placed between the end plug and collar. A prying motion on both sides of the end plug with the screwdrivers will quickly remove it. Use this procedure for both end caps.

Step 4: Note which end of the pressure vessel the brine seal is visible from. The brine seal is a black u-cup seal on the membrane outer diameter near one end (Refer to Figure 6.2). This is the feed end of the pressure vessel. When reinstalling the RO membrane the brine seal must be located at the feed end of the pressure vessel.

Corresponding marks allow the user to replace the end plug in the correct position with ease. The importance of marking the end plug and collar is because there are several incorrect ways the end plug may fit onto the end collar and only one correct way to allow the membrane to work properly.

Step 5: Once membrane is released from product O-Ring, pull membrane from brine end until completely free of vessel.
NEVER FORCE A MEMBRANE OUT OF A PRESSURE VESSEL BY APPLYING PRESSURE ON THE PRODUCT WATER TUBE (CENTER TUBE), AS THIS WILL DAMAGE THE MEMBRANE. IF MEMBRANE IS DIFFICULT TO REMOVE, USE A 2" DIAMETER PLASTIC PIPE (PVC) TO APPLY PRESSURE ON THE PROTECTED END OF THE MEMBRANE.

6.2 PRESSURE VESSEL ASSEMBLY

Step 1: Replace O-Rings if there is visible damage. Inspect all O-Rings; product O-Rings, end plug O-Rings, and Brine seal. The product water O-Rings are internal O-Rings, inside the center hole in the end cap. Refer to Figure 6.1.

Step 2: Clean all parts thoroughly.

Step 3: Lubricate O-Rings and entrances to pressure vessel with glycerin or silicone lubricant. **Locate discharge end of pressure vessel. Install discharge end plug** by lining up with the holes of the pressure vessel, paying attention to the reference mark. Position end cap ring and insert fasteners by hand.

**CAUTION** NEVER USE ANY TYPE OF LUBRICANT CONTAINING OIL ADDITIVES. OIL CAN DAMAGE YOUR UNIT AND REDUCE MEMBRANES PERFORMANCE.

Step 4: Lubricate brine seal and product water tubes of RO membrane with glycerin or silicone lubricant. Align the membrane so the end **without** the brine seal enters the feed end of the pressure vessel first. Slide membrane into pressure vessel until resistance is felt. Continue applying pressure until the product water tube sits into the end plug.

Step 5: Install the remaining end plug (align end plug holes with mounting studs properly), use the reference mark made in step 3 for correct assembly.

Step 6: Tighten the six fasteners for each end cap. It is recommended that fasteners be torqued to 25 in-lbs.

Step 7: Reconnect plumbing to pressure vessel(s).

**NOTE:** Do not apply Teflon tape or sealant to SAE fittings such as those used on High Pressure assemblies and their adapters.

**NOTE:** For replacement parts call numbers, refer to Parts Reference section at the end of the manual and for additional information about the membranes and the pressure vessel, refer to the Manufacturer’s Literature section at the back of this manual.

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**Item Description**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vessel - 2538</td>
</tr>
<tr>
<td>1</td>
<td>Vessel - 2519</td>
</tr>
<tr>
<td>2</td>
<td>Membrane - SW 2538</td>
</tr>
<tr>
<td>2</td>
<td>Membrane - SW 2519</td>
</tr>
<tr>
<td>3</td>
<td>End cap</td>
</tr>
<tr>
<td>4</td>
<td>End cap ring</td>
</tr>
<tr>
<td>5</td>
<td>Brine Seal</td>
</tr>
<tr>
<td>6</td>
<td>Product O-rings</td>
</tr>
<tr>
<td>7</td>
<td>End Plug O-ring</td>
</tr>
<tr>
<td>8</td>
<td>Fasteners</td>
</tr>
</tbody>
</table>

---

*Figure 6.2 - Exploded View of Pressure Vessel with Membrane.*
7.0 FREEZE PROTECTION

There is a high probability of damaging your RO by exposing it to severe cold or icy conditions. Therefore protecting your RO against freeze damage is recommended. The following information provides steps towards safeguarding your RO and extending its plumbing life against freezing temperatures.

**WARNING**

DO NOT USE ETHYLENE GLYCOL (FOUND IN AUTOMOTIVE ANTIFREEZE PRODUCTS) TOWARDS FREEZE PROTECTING YOUR RO. ETHYLENE GLYCOL IS A TOXIC SUBSTANCE AND MUST NOT BE INGESTED NOR COME INTO CONTACT WITH YOUR RO SYSTEM.

**WARNING**

USE ONLY FOOD GRADE NON-TOXIC PROPYLENE GLYCOL. DO NOT USE PROPYLENE GLYCOL BLENDED WITH SUPPLEMENTARY ADDITIVES.

**FREEZE PROTECT YOUR RO UNIT**

Adhere to the packaging label directions of the food grade propylene glycol, for the amount of propylene glycol to be mixed based on the level of temperature protection required. Use non-chlorinated freshwater and make up sufficient solution to fill your prefilters housing.

**Step 1:** Close inlet seacock and flush unit with fresh water. Refer to Sections 5.1: TO FLUSH THE STOWAWAY (STW) UNITS

**Step 2:** Remove the micron filter from the prefilters housing and empty the prefilters housing.

**Step 3:** Pour the winterizing solution into filter housing and reattach the prefilters canister.

**Step 4:** Turn the black High Pressure Bypass Valve to CLEANING POSITION. This procedure allows release of the high pressure air trapped within the system. Verify the gray Cleaning Valve is positioned to CLEANING.

**Step 5:** Switch ON the breaker at main breaker panel to power up unit.

**Step 6:** Start the Low Pressure Boost Pump by pressing the L PMP button located on the Master Control Center (or on the Remote Control Center). Allow unit to prime prior to start of high pressure pump.

**Step 7:** Start the High Pressure Pump by pressing the H PMP button located on the Master Control Center panel (or on the Remote Control Center). Verify the Vacuum Pressure Gauge reads more than zero (0 psi), if not more than 0 psi recheck the valve positions from Step #1 or perform another Freshwater Flush to release any remaining trapped air in the system.

**Step 8:** Allow the RO unit to run for at least 15 minutes to circulate the winterizing solution into the membranes, hoses, fittings, and pumps.

**Step 9:** Shut off the unit. Unit can be left in standby mode for up to 6 months.

The freeze protection solution is now circulated throughout the feed and reject sides, including the membrane and the pumps. To protect the product side, open the blue hoses and drain out the water from the membrane outlets, the product solenoid valve, the product manifold, the product flowmeter, and product relief valve, if equipped.

**Step 10:** Then switch OFF at your breaker at the main breaker panel.
TO FLUSH WINTERIZATION SOLUTION FROM THE RO UNIT

To return your machine to operating condition after freeze protecting it, adhere to the following steps.

**Step 1:** Turn **ON** your water pressure and watermaker breakers on main electrical panel. Turn the High Pressure Bypass Valve to **CLEANING** (ensuring zero pressure in system). Verify the gray Cleaning Valve is positioned to **NORMAL/REVERSE OSMOSIS** position.

**Step 2:** Open the micron filter housing(s) and put new 20 and 5 micron filters (depending on RO model) inside. Fill the prefilter housing(s) with non-chlorinated freshwater.

**Step 3:** Verify the raw water intake to the RO is open.

**Step 4:** Start the Low Pressure Boost Pump by pressing the **L PMP** button located on the Master Control Center panel of the electronic instrument panel. Allow the unit to prime prior to start of high pressure pump.

**Step 5:** Start the High Pressure Pump by pressing the **H PMP** button located on the Master Control Center panel of the electronic instrument panel.

**Step 6:** Flush unit with raw seawater for 20 minutes.

**Step 7:** After raw water flushing the unit for 20 minutes, shut down the **H PMP** and **L PMP** respectively.

**Step 8:** Turn **OFF** the breaker at the main breaker panel.

**Step 9:** To restart the **STOWAWAY**, refer to instructions in **Section 4.1: TO START THE STOWAWAY (STW) UNITS**.

ALTERNATIVE FREEZE PROTECTION METHOD

Instead of applying propylene glycol to the RO system, an alternative method to freeze protect the RO is available.

**Step 1:** Perform a Chemical #3 preservation to the unit. To preserve the **STW**, refer to instructions in **Section 5.6: STEPS FOR PRESERVATION CHEMICAL #3**

**Step 2:** Remove membrane vessels from the boat, placing caps over the fittings.

**REMINDER:** Membranes must be kept wet with preservative solution.

**Step 3:** Store the membranes in an environment protected from freezing.

**Step 4:** Refresh the preservative every 6 months as recommended.

**Step 5:** Drain the entire RO of all water.
TROUBLESHOOTING

8.0 TROUBLESHOOTING

It is a good idea to always practice safety when troubleshooting issues. Most minor issues can be solved by doing the following:

1. Check for proper valve configuration for each of the operation modes selected.

2. Always check for loose connections or broken wires when checking electrical parts. Checking for continuity and solid contact can prevent hours of wasted effort.

3. Always inspect and test equipment or apparatus for probable cause of malfunction before performing replacement.

For any troubleshooting that cannot be resolve by referencing this manual, please contact any Parker Hannifin Corp., Racor Division-Village Marine Tec., Service Department.

CORP. SALES OFFICE/MANUFACTURER
2000 W. 135th St., Gardena, CA  90249
(800) 421-4503 / (310) 516-9911
Fax: (310) 538-3048
http: www.villagemarine.com
e-mail: villagemarine@parker.com

SAN DIEGO, CALIFORNIA
2820 Shelter Island Drive
San Diego, CA 92106
(800) 774-9292 / (619) 226-4195
Fax: (619) 226-4199

FT. LAUDERDALE, FLORIDA
802 S.E. 17TH Street Causeway
Fl. Lauderdale, FL 33316
(800) 625-8802 / (954) 523-4900
Fax: (954) 523-2920

WEST PALM BEACH, FLORIDA
155 Blue Heron Blvd.
Riviera Beach, FL 33404
(866) 881-4168 / (561) 844-3320
Fax: (561) 844-2276

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Portsmouth, VA 23707
(888) 512-3167 / (757) 399-1350
Fax: (757) 399-144

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1540 N.W. 46TH Street
Seattle, WA 98107
(888) 847-7472 / (206) 788-9595
Fax: (206) 788-9590
10.0 DRAWINGS AND DIAGRAMS

10.1 VAC COLOR REFERENCE

Wiring follows the IEC standard. If you are familiar with the NEC standard, please use the following charts to reference the appropriate wire.

<table>
<thead>
<tr>
<th>Function</th>
<th>Label</th>
<th>Color (IEC)</th>
<th>Color (NEC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line</td>
<td>L</td>
<td>Brown</td>
<td>Black</td>
</tr>
<tr>
<td>Neutral</td>
<td>N</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>Protective earth</td>
<td>PE</td>
<td>Green-yellow</td>
<td>Green</td>
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</table>

Table 10.1 – Single Phase AC wiring color codes.

<table>
<thead>
<tr>
<th>Function</th>
<th>Label</th>
<th>Color (IEC)</th>
<th>Color (NEC)</th>
<th>Color (NEC) 120V/208V/240V</th>
<th>Color (NEC) 277V/440V</th>
</tr>
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<tbody>
<tr>
<td>Line</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>L1</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>L2</td>
<td></td>
<td>Black</td>
<td>Red</td>
<td>Orange</td>
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<td>L3</td>
<td></td>
<td>Gray</td>
<td>Blue</td>
<td>Yellow</td>
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<td>Blue</td>
<td>White</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protective earth</td>
<td>PE</td>
<td>Green-yellow</td>
<td>Bare, Green, or Green-yellow</td>
<td></td>
<td>Green with yellow stripes</td>
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</table>

Table 10.2 – 3 Phase AC wiring color codes.

10.2 VDC COLOR REFERENCE

<table>
<thead>
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<th>Function</th>
<th>Label</th>
<th>Color (IEC)</th>
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<tr>
<td>Positive</td>
<td>L+</td>
<td>Brown</td>
<td>Red</td>
</tr>
<tr>
<td>Negative</td>
<td>L-</td>
<td>Gray</td>
<td>Black</td>
</tr>
<tr>
<td>Protective earth</td>
<td>PE</td>
<td>Green-yellow</td>
<td>Bare, Green, or Green-yellow</td>
</tr>
</tbody>
</table>

Table 10.3 – 2 wire ungrounded DC wiring color codes.

<table>
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<th>Label</th>
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<th>Color (NEC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive (negative grounded)</td>
<td>L+</td>
<td>Brown</td>
<td>Red</td>
</tr>
<tr>
<td>Negative (negative grounded)</td>
<td>M</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>Positive (positive grounded)</td>
<td>M</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>Negative (positive grounded)</td>
<td>L-</td>
<td>Gray</td>
<td>Black</td>
</tr>
<tr>
<td>Protective earth</td>
<td>PE</td>
<td>Green-yellow</td>
<td>Bare, Green, or Green-yellow</td>
</tr>
</tbody>
</table>

Table 10.4 – 2 wire grounded DC wiring color codes.

<table>
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<th>Function</th>
<th>Label</th>
<th>Color (IEC)</th>
<th>Color (NEC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>L+</td>
<td>Brown</td>
<td>Red</td>
</tr>
<tr>
<td>Mid-wire</td>
<td>M</td>
<td>Blue</td>
<td>White</td>
</tr>
<tr>
<td>Negative</td>
<td>L-</td>
<td>Gray</td>
<td>Black</td>
</tr>
<tr>
<td>Protective earth</td>
<td>PE</td>
<td>Green-yellow</td>
<td>Bare, Green, or Green-yellow</td>
</tr>
</tbody>
</table>

Table 10.5 – 3 wire grounded DC wiring color codes.

1 – Light Blue is preferred.
2 – Green-yellow color shall be in a ratio of 3:7, with either color on the dominate portion for any given 15mm.
10.3 **FLOWMETER CONVERSION TABLE**

These tables provide a quick reference to the flow conversions between LPH, LPM, GPH, GPM.

<table>
<thead>
<tr>
<th>Litres per hour</th>
<th>Gallons per hour</th>
<th>Litres per minute</th>
<th>Gallons per minute</th>
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<tbody>
<tr>
<td>1</td>
<td>0.264</td>
<td>0.017</td>
<td>0.004</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Litres per minute</th>
<th>Gallons per minute</th>
<th>Litres per hour</th>
<th>Gallons per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.264</td>
<td>60</td>
<td>15.850</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gallons per hour</th>
<th>Litres per hour</th>
<th>Gallons per minute</th>
<th>Litres per minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.785</td>
<td>0.017</td>
<td>0.063</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gallons per minute</th>
<th>Litres per minute</th>
<th>Gallons per hour</th>
<th>Litres per minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.785</td>
<td>60</td>
<td>227.125</td>
</tr>
</tbody>
</table>
11.0 PARTS REFERENCE
708 TITAN SERIES
High Pressure Titanium Positive Displacement Pump
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INTRODUCTION

Aqua Pro Pumps “708 Series” High Pressure Pumps are the product of our years of experience in the water treatment industry, and have been specifically designed and engineered for corrosive and high-pressure applications. Your new Aqua Pro Pump is made with dependable and proven technology to meet your highest demands.

SPECIFICATIONS

Specifications subject to change without notice.

Pump type: Reciprocating Plunger

<table>
<thead>
<tr>
<th></th>
<th>708-1 (15 GPH)</th>
<th>708-1 (22 GPH)</th>
<th>708-1 (29 GPH)</th>
<th>708-3 (2.3 GPM)</th>
<th>708-3 (3.5 GPM)</th>
<th>708-5 (8 GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Plungers:</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Bore:</td>
<td>.707&quot;</td>
<td>.707&quot;</td>
<td>.707&quot;</td>
<td>.707&quot;</td>
<td>.707&quot;</td>
<td>.707&quot;</td>
</tr>
<tr>
<td>Stroke:</td>
<td>.2&quot;</td>
<td>.3&quot;</td>
<td>.4&quot;</td>
<td>.276&quot;</td>
<td>.512&quot;</td>
<td>.625&quot;</td>
</tr>
<tr>
<td>Oil Capacity:</td>
<td>6 oz</td>
<td>6 oz</td>
<td>6 oz</td>
<td>19.5 oz</td>
<td>19.5 oz</td>
<td>32 oz</td>
</tr>
</tbody>
</table>

Oil Type: Village Marine Tec. High Pressure Pump Oil
(Part No. 85-0050-quart size)

Maximum Inlet pressure: Flooded to 60 PSI

Maximum Fluid Temperature: 120 degrees Fahrenheit (82 degrees Celsius)

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Capacity</th>
<th>Inlet Port Size</th>
<th>Discharge Port Size</th>
<th>Dimensions L x W x H</th>
<th>Weight</th>
<th>Shaft</th>
</tr>
</thead>
<tbody>
<tr>
<td>708-1</td>
<td>15 GPH</td>
<td>.50 NPT</td>
<td>.25 NPT</td>
<td>9.125&quot; x 5.5&quot; x 4&quot;</td>
<td>11 lbs.</td>
<td>Ø.625</td>
</tr>
<tr>
<td>708-1</td>
<td>22 GPH</td>
<td>.50 NPT</td>
<td>.25 NPT</td>
<td>9.125&quot; x 5.5&quot; x 4&quot;</td>
<td>11 lbs.</td>
<td>Ø.625</td>
</tr>
<tr>
<td>708-1</td>
<td>29 GPH</td>
<td>.50 NPT</td>
<td>.25 NPT</td>
<td>9.125&quot; x 5.5&quot; x 4&quot;</td>
<td>11 lbs.</td>
<td>Ø.625</td>
</tr>
<tr>
<td>708-3</td>
<td>2.3 GPM</td>
<td>.75 NPT</td>
<td>.5&quot; MS16142-8</td>
<td>7.5&quot; x 6&quot; x 4.5&quot;</td>
<td>18.9 lbs.</td>
<td>Ø.650</td>
</tr>
<tr>
<td>708-3</td>
<td>3.5 GPM</td>
<td>.75 NPT</td>
<td>.5&quot; MS16142-8</td>
<td>7.5&quot; x 6&quot; x 4.5&quot;</td>
<td>18.9 lbs.</td>
<td>Ø.650</td>
</tr>
<tr>
<td>708-5</td>
<td>8 GPM</td>
<td>.75 NPT</td>
<td>.5&quot; MS16142-8</td>
<td>11.5&quot; x 9.5&quot; x 5.5&quot;</td>
<td>27.6 lbs.</td>
<td>Ø.938</td>
</tr>
</tbody>
</table>
INITIAL START-UP INFORMATION

WARNING

This is a positive displacement pump. A properly designed pressure relief safety valve must be installed in the discharge piping. Failure to install such a relief mechanism could result in personal injury or damage to the pump or system. Aqua Pro Pumps does not assume any liability or responsibility for the operation of a customer’s high-pressure system.

The performance of the pump depends on the entire fluid system and will operate best with the proper installation of plumbing, operation, and maintenance of the pump.

LUBRICATION

It is recommended that pump be filled with Village Marine Tec’s specially blended high pressure pump oil. To check the oil level, ensure the pump has stopped running. Then look into the sight glass in the side cover. Oil level should be level with the mark on the sight glass (Fig.1).

![Oil Level Sight Glass Detail](image)

*Fig. 1: Oil Level Sight Glass Detail.*

NOTE

Change the original oil that came in the pump after running the pump for 100 hours. After the initial oil change, the oil should be changed at 500-hour service intervals.

PUMP FLOW DESIGN

To drive the pump to give the desired discharge volume for your specific application equation 2.1 is to be used.

\[
\text{Desired Pump RPM} : \frac{\text{Rated GPM}}{\text{"Desired" GPM}} = \frac{\text{"Desired" RPM}}{\text{Rated RPM}} \quad (2.1)
\]

PULLEY SELECTION

It is essential that an appropriate pulley size be selected to meet your application needs. Based on the required pump discharge volume (in GPM), the correct pulley size can be selected using equation 2.2.
CAUTION

Pulley should be sized to not exceed the maximum pump RPM rating.

\[
Pulley Size: \frac{\text{Motor Pulley O.D.}}{\text{Pump RPM}} = \frac{\text{Pump Pulley O.D.}}{\text{Motor RPM}} \quad (2.2)
\]

MOTOR SELECTION

To ensure desired pump output, the motor or engine driving the pump must possess sufficient horsepower to maintain full RPM when the pump is under load. Using equation 2.3 an appropriate electric motor can be sized for the application. This motor sizing approach is based on pump discharge volume and maximum pump discharge pressure. The constant in the equation accounts for drive and system losses, which implies a mechanical efficiency of 85%. Consult the manufacturer of a gas or diesel engine for selection of the proper engine size. Refer to Table 1 for sample horsepower applications.

\[
\text{HP Required}: \frac{\text{GPM} \times \text{PSI}}{1460} = \text{Electric Brake HP} \quad (2.3)
\]

<table>
<thead>
<tr>
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<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>800</td>
<td>1000</td>
</tr>
<tr>
<td>15</td>
<td>734</td>
<td>.14</td>
<td>.17</td>
</tr>
<tr>
<td>14</td>
<td>686</td>
<td>.13</td>
<td>.16</td>
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<tr>
<td>13</td>
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<td>.15</td>
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<td>12</td>
<td>588</td>
<td>.11</td>
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<td>29</td>
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<td>4</td>
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<td>3</td>
<td>1148</td>
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</tr>
<tr>
<td>2</td>
<td>765</td>
<td>1.10</td>
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<td>6</td>
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<td>3.29</td>
<td>4.11</td>
</tr>
<tr>
<td>5</td>
<td>940</td>
<td>2.74</td>
<td>3.42</td>
</tr>
</tbody>
</table>

MOUNTING THE PUMP

The pump should be located as close to the source of supply as possible. Mount the pump on a rigid, horizontal surface allowing easy access for crankcase oil draining. The pump should also be mounted in such a way that inspection can be done with ease.

Ensure drive belt is adequately sized for system and shaft bearings. Pulley alignment is critical to the proper operation of the system. To check for proper alignment, place a straight-edge, square, or rule against the pulleys to make sure they
are in line. Proper alignment of the drive pulleys will minimize crankshaft bearing and belt wear. Over tensioning of the drive belt may cause pump crankshaft bearing damage.

If the pump will be in service in an environment with a high debris presence or in a humid environment, it is recommended that the pump be enclosed. Do not store or operate in excessively high temperature areas without proper ventilation.

**DISCHARGE PLUMBING**

**CAUTION**

Start system with all valves open or with minimal flow restriction to avoid deadhead overpressure conditions and severe damage to the pump or system. Discharge regulating devices should be at minimum pressure setting at start-up.

In installations utilizing a Pulsation Dampening device, the device should be mounted directly to the discharge line. Consult dampening device manufacture for optimum pre-charge.

A reliable pressure gauge should be installed near the discharge outlet of the manifold. This is extremely important for adjusting pressure-regulating devices; and when appropriate, for sizing of the nozzle or restricting orifice. The pump is rated for a maximum pressure; this is the pressure measured at the discharge manifold of the pump.

A pressure relief or unloader valve must be installed to prevent over-pressure in the event that the discharge or downstream plumbing becomes restricted or is turned off. Severe damage to the pump will result if this condition occurs without a relief valve in the line.

**CAUTION**

**FAILURE TO INSTALL A SAFETY RELIEF VALVE WILL VOID THE WARRANTY ON THE PUMP.**

On fittings not using o-ring seals, use PTFE liquid sparingly, or tape to connect accessories or plumbing. Do not wrap tape beyond the last thread to prevent tape from becoming lodged in the pump or accessories. This condition will cause a malfunction of the pump or system.

**PUMPED FLUIDS**

Some fluids may require a flush between operations or before storing. For pumping fluids other than water, contact your supplier or Village Marine Tec.

**CAUTION**

**DO NOT RUN PUMP WITH FROZEN FLUID. DO NOT RUN PUMP DRY.**

**STORAGE**

For extended storage or between uses in cold climates, drain all pumped fluids from pump and flush with antifreeze solution to prevent freezing and damage to the pump.
INLET CONDITION CHECKLIST

Review this checklist before operation of system. It is critical that all factors are carefully considered and met.

INLET SUPPLY

Inlet supply should be adequate to accommodate the maximum flow being delivered by the pump.

1. Open inlet valve and turn on supply to avoid starving the pump.

   **CAUTION**

   **DO NOT RUN PUMP DRY.**

2. Avoid closed loop systems, especially with high temperature, ultra-high pressure or large volumes. Conditions vary with regulating/unloader valve.
3. Low vapor pressure fluids, such as solvents, require positive heads to assure adequate inlet supply.
4. Higher viscosity fluids require that the pump be flooded to 60 PSI to assure adequate inlet supply.
5. Higher temperature fluids tend to vaporize and require positive heads to assure adequate inlet supply.
6. When using an inlet supply reservoir, size it to provide adequate supply of fluid to accommodate 6-10 minutes retention time at the rated GPM (however, a combination of system factors can change this requirement). Provide adequate baffling in the tank to eliminate air bubbles and turbulence. Install diffusers on all return lines to the tank.

INLET LINE SIZE

Inlet line size should be adequate to avoid starving the pump. Pump suction should never operate in a vacuum.

1. Line size must be sufficient to allow free flow of influent fluid at the pumping flow rate. Minimize the use of thick-walled fittings, tees, 90-degree elbows, or valves in the inlet line of the pump to reduce the risk of flow restriction, vacuum, and cavitation.
2. The inlet line MUST be a FLEXIBLE hose, NOT a rigid pipe, and REINFORCED ON SUCTION SYSTEMS to avoid collapsing.
3. The simpler the inlet plumbing, the less the potential for problems. It is recommended to keep the length, number of joints, and the number of inlet accessories to a minimum.
4. Use pipe sealant as appropriate to ensure airtight positive sealing pipe joints.

INLET PRESSURE

Inlet pressure should be between flooded (zero) to 60 PSI.

1. High RPM, high temperatures, low vapor pressures, or high viscosity reduces inlet pressure. The pump may require a pressurized inlet to maintain adequate inlet supply.
2. Optimum pump performance and service life is obtained with 20 PSI (1.4 BAR) inlet pressure. With adequate inlet plumbing, most pumps will perform with flooded suction. Maximum inlet pressure is 60 PSI (5 BAR).

3. After prolonged storage, the pump should be purged of air to facilitate priming. With the pump not running, disconnect the discharge port and allow fluid to pass through pump, then reconnect the discharge port.

**INLET ACCESSORIES**

Inlet accessories are designed to protect against over pressurization, control inlet flow, contamination or temperature and provide ease of servicing.

1. An inlet/supply shut-off valve is recommended to facilitate maintenance.
2. A standpipe can be used in some applications to help maintain a positive head in the inlet line.
3. Inspect and clean the inlet filters on a regular schedule, if applicable.
4. A vacuum/pressure gauge should be installed to monitor the inlet pressure. A gauge should be mounted as close to the pump inlet as possible. Short term, intermittent cavitation will not register on a standard gauge.
5. All accessories should be sized to avoid restricting the inlet flow.
6. All accessories should be compatible with the solution being pumped to prevent premature failure or malfunction.
PREVENTIVE MAINTENANCE SCHEDULE

The Required Maintenance Schedule specifies how often you should have your pump inspected and serviced. It is essential that your pump be serviced as scheduled to retain its high level of safety, dependability, and performance. Not performing these tasks could result in catastrophic failure.

<table>
<thead>
<tr>
<th>TASKS</th>
<th>DAILY</th>
<th>WEEKLY</th>
<th>FIRST 100 HRS.</th>
<th>EVERY 500 HRS.</th>
<th>EVERY 1500 HRS.</th>
<th>PLAN FOR EVERY 3000 HRS.</th>
<th>EVERY 10000 HRS.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INSPECTION TASKS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Clean Filters*</td>
<td>X</td>
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<tr>
<td>Water Leaks</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Oil Level</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Pulley</td>
<td>X</td>
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<td>Belts</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Inspect Plumbing</td>
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<td></td>
<td></td>
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<tr>
<td><strong>SERVICE TASKS</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump Oil</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routine Service Kit</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crankcase Rebuild Kit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Manifold Rebuild Kit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Crankshaft Bearings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

* If applicable for system
MAINTENANCE RECORD

Keep record of all maintenance below to ensure maintenance is performed. Note trends and increase maintenance as necessary.

<table>
<thead>
<tr>
<th>HOURS**</th>
<th>RECOMMEND SERVICE</th>
<th>ACTIONS / NOTES</th>
<th>ACTUAL HOURS</th>
<th>SIGNATURE</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1500</td>
<td>Service Kit, Oil</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>Oil</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2500</td>
<td>Oil</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3000</td>
<td>Service Kit/Full Kit*, Oil</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3500</td>
<td>Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4000</td>
<td>Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4500</td>
<td>Service Kit, Oil</td>
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<td></td>
<td></td>
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<tr>
<td>5000</td>
<td>Oil</td>
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<td>5500</td>
<td>Oil</td>
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</tr>
<tr>
<td>6000</td>
<td>Service Kit/Full Kit*, Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6500</td>
<td>Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7000</td>
<td>Oil</td>
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</tr>
<tr>
<td>7500</td>
<td>Service Kit, Oil</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>10000</td>
<td>Crankshaft Bearing, Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Replace HP seal only in case of failure (see low-pressure troubleshooting, pg.9). Hours are for reference only (for maintenance planning purposes).

** Oil changes are mandatory at the specified hour intervals.
# TROUBLESHOOTING

Use the troubleshooting table below. If problem persists, contact your dealer.

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>PROBABLE CAUSE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Pressure</td>
<td>Belt slippage</td>
<td>Make sure the correct belt is used. If the correct belt is used and the belt is slipping, then tighten. Replace belt if worn.</td>
</tr>
<tr>
<td></td>
<td>Leaky discharge hose</td>
<td>Check connections. Replace hose if worn or cracking.</td>
</tr>
<tr>
<td></td>
<td>Pressure gauge inoperative or not registering correctly.</td>
<td>Check pressure with new gauge and replace as needed.</td>
</tr>
<tr>
<td></td>
<td>Air leak in inlet plumbing</td>
<td>Use PTFE liquid or tape to seal the threads. Make certain that the PTFE does not go beyond the last thread. Doing so may damage the pump.</td>
</tr>
<tr>
<td></td>
<td>Inlet suction strainer clogged or improperly sized</td>
<td>Clear the obstruction, or use adequate size for inlet pump connection and fluid being pumped.</td>
</tr>
<tr>
<td></td>
<td>Relief valve stuck, partially plugged or improperly sized</td>
<td>Clean and reset relief valve to system pressure and correct bypass. Check supply tank for contamination.</td>
</tr>
<tr>
<td></td>
<td>Worn or dirty valves</td>
<td>Clean valve or replace with a rebuild kit.</td>
</tr>
<tr>
<td></td>
<td>Worn high-pressure seals; abrasives in pump fluid, severe cavitation; inadequate water supply; stressful inlet conditions.</td>
<td>Replace seals with manifold rebuild kit(not service kit). Install and maintain proper filter, check line size and flow available to pump</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pulsation pump runs extremely rough, pressure low</th>
<th>Faulty pulsation dampener (if a pulsation dampener has been installed.)</th>
<th>Check pre-charge. Check manufacturer’s literature on recommended pressure.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Restricted inlet, or air entering inlet plumbing</td>
<td>Be sure that inlet hose is the proper size. Check filters and clean as needed. Check fittings and use PTFE liquid or tape for airtight connection.</td>
</tr>
<tr>
<td></td>
<td>Valve or spring damage</td>
<td>Clean or replace valve and spring, check inlet supply tank for contamination</td>
</tr>
<tr>
<td></td>
<td>Seal damage</td>
<td>Replace seals with manifold rebuild kit(not service kit).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Slight water leakage from under the manifold</th>
<th>Possible condensation</th>
<th>No fix needed.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Worn low pressure seals</td>
<td>Replace seals with Manifold Service Kit (not Rebuild Kit), check inlet pressure and inspect ceramic plunger for damage.</td>
</tr>
<tr>
<td>Excessive oil leak between crankcase and pumping section</td>
<td>Worn crankcase oil seals</td>
<td>Replace crankcase oil seals.</td>
</tr>
<tr>
<td>PROBLEM</td>
<td>PROBABLE CAUSE</td>
<td>SOLUTION</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Oil leaking in the area of the crankshaft</td>
<td>Worn crankshaft oil seal</td>
<td>Replace damaged oil seals. (Purchase crankcase rebuild kit, not service kit)</td>
</tr>
<tr>
<td></td>
<td>Bad bearing</td>
<td>Replace bearing.</td>
</tr>
<tr>
<td></td>
<td>Cut or worn o-ring on bearing case</td>
<td>Replace o-ring on bearing case.</td>
</tr>
<tr>
<td>Water in crankcase</td>
<td>Humid air condensing into water inside the crankcase</td>
<td>Change oil every three months or 300 hours</td>
</tr>
<tr>
<td></td>
<td>Worn or improperly installed crankcase oil seals</td>
<td>Replace seals; follow proper installation procedure.</td>
</tr>
<tr>
<td></td>
<td>Excessive water leaking through low pressure seals</td>
<td>Replace seals with manifold rebuild kit(not service kit).</td>
</tr>
<tr>
<td>Excessive play in the end of the crankshaft</td>
<td>Worn bearing</td>
<td>Replace bearing.</td>
</tr>
<tr>
<td>Oil leaking in the rear portion of the crankcase</td>
<td>Damaged or improperly installed crankcase cover, crankcase cover o-ring, drain-plug, or drain-plug o-ring.</td>
<td>Replace crankcase cover o-ring or drain-plug o-ring.</td>
</tr>
<tr>
<td>Loud knocking noise in pump</td>
<td>Pulley loose on crankshaft</td>
<td>Check key and tighten setscrew.</td>
</tr>
<tr>
<td></td>
<td>Restricted Inlet</td>
<td>Clear obstruction or replace valve.</td>
</tr>
<tr>
<td></td>
<td>Worn bearing, connecting rod or crankshaft.</td>
<td>Consult supplier for crankcase servicing.</td>
</tr>
<tr>
<td></td>
<td>Worn belts</td>
<td>Replace belts.</td>
</tr>
<tr>
<td>Frequent or premature failure of the seals</td>
<td>Running pump dry</td>
<td>NEVER RUN THE PUMP WITHOUT WATER.</td>
</tr>
<tr>
<td></td>
<td>Abrasive material in the fluid being pumped</td>
<td>Install proper filtration on pump inlet plumbing.</td>
</tr>
<tr>
<td></td>
<td>Excessive temperature of pumped fluid (120 degrees F max.)</td>
<td>Reduce fluid inlet temperature to specifications.</td>
</tr>
<tr>
<td>PROBLEM</td>
<td>PROBABLE CAUSE</td>
<td>SOLUTION</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Strong surging at the inlet and low pressure</td>
<td>Foreign particles in the inlet or discharge valve or worn inlet or discharge valves</td>
<td>Check for smooth surfaces on inlet and discharge valve seats. If signs of wear or damage are present return to factory for service.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check supply tank for contamination, regularly clean filter. Do not pump abrasive fluid.</td>
</tr>
<tr>
<td>Restricted fluid flow</td>
<td></td>
<td>Check the Inlet Conditions Checklist.</td>
</tr>
</tbody>
</table>
SERVICE

An authorized technician should perform all service.

Ensure pump is disconnected from the motor or any driving devices. Service the pump in a clean, dirt-free environment.

Pump rebuild kits are available for seal overhauls. Contact your dealer for ordering information.

INTRODUCTION

All tasks should be performed in a clean environment, free from dust and debris. It is imperative that utmost cleanliness be maintained during the rebuild of your Aqua Pro Pump. The numbers following the parts are call out numbers. They correspond to the parts on the drawings.

READ THE INSTRUCTIONS COMPLETELY BEFORE ATTEMPTING TO PERFORM ANY SERVICE.

Before assembling any parts, clean all parts to make free of oil, grease, dirt, and lint. Use a lint free cloth to wipe any part of the pump.

NOTE

A light coating of Anti-Seize Lubricant (PN. 85-0094) should be applied on all threaded parts, unless otherwise stated. Only silicon grease (PN. 21-1122) should be used on all o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

TOOLS NEEDED

Table 2: Tool List for Pump Service

<table>
<thead>
<tr>
<th>Tool</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/16” Allen Wrench</td>
<td>Phillips Head Screwdriver</td>
</tr>
<tr>
<td>1/4” Allen Wrench</td>
<td>Pick</td>
</tr>
<tr>
<td>7/16” Socket/ Wrench</td>
<td>Snap Ring Pliers</td>
</tr>
<tr>
<td>9/16” Socket/ Wrench</td>
<td>Torque Wrench (220 in.-lb.)</td>
</tr>
<tr>
<td>1/2” Socket/ Wrench</td>
<td>Weep Ring Removal Tool (PN 91-3827)</td>
</tr>
<tr>
<td>3/4” Socket/ Wrench</td>
<td>Dead Blow Hammer</td>
</tr>
<tr>
<td>7/8” Socket/ Wrench</td>
<td>Flat Head Screwdriver</td>
</tr>
<tr>
<td>7/8” Combination Wrench</td>
<td></td>
</tr>
</tbody>
</table>
DETACHING THE MANIFOLD FROM THE CRANKCASE

You will need these tools and parts to do the following:
- 9/16” Socket/Socket Wrench (for 708-5)
- 1/2” Socket/Socket Wrench (for 708-3)
- 3/16” Allen Wrench (for 708-1)
- Dead Blow Hammer

Remove the two manifold bolts (58) with a 9/16” socket wrench for the 708-5, with a 1/2” socket wrench for the 708-3, or the 4 socket head bolts with the 3/16” Allen wrench for the 708-1. Loosen the manifold assembly by lightly tapping off the manifold using the dead blow hammer, as seen in Fig. 2. Tap the manifold from both sides to apply even force to the manifold. Failing to do so can result in damage to the Ceramic Plungers. Set the manifold assembly aside in a clean work area. If the manifold assembly locating dowel pins (53) fall out, reinsert them into the manifold alignment pin holes.

Fig. 2: Manifold Assembly Removal

ROUTINE SERVICE KIT

The following are the part numbers for the 708 Series Routine Service Kits.
708-1 Routine Service Kit (PN. 70-6181).
708-3, 2.3 Routine Service Kit (PN. 70-6182).
708-3, 3.5 Routine Service Kit (PN. 70-6183).
708-5 Routine Service Kit (PN. 70-6184).

The Manifold Assembly must be detached from the crankcase to do the following service.

VALVE ASSEMBLY ROUTINE SERVICE

You will need these tools and parts to do the following:
- 7/8" Socket Wrench or Combination Wrench
- Pick
- Spring, Valve (45): PN. 70-6003
- Valve, Standard, 708 Series (44): PN. 70-6093 (For 708-1 & 708-3 2.3)
- Assembly, Valve, Heavy Duty, 708 Series (44): PN. 70-6104 (For 708-3 3.5 & 708-5)
- O-Ring, Valve Plug (46): PN. 70-6002
- Silicone Grease Lubricant: PN. 21-1122
- Anti-Seize Lubricant: PN. 85-0094
- Lint-Free Cloths
When the manifold assembly has been removed from the crankcase assembly, place the assembly on a clean work surface. Remove all of the valve plug assemblies from the manifold assembly using a 7/8" socket wrench or combination wrench. Remove the valve (44) from the assembly, followed by the valve spring (45). With the aide of a pick remove the o-ring (46) from the valve plug.

NOTE

Valve plugs (47) will be reused.

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

Clean and inspect all valve plugs (47) prior to reassembling. If there is a problem, contact your dealer. Once all valve plugs (47) are clean and dry, install new valve plug o-ring (46) onto valve plug (47). Install the valve spring (45) onto the valve plug (47), it should now be attached to the plug. Press the valve (44) onto the valve spring (45). Complete valve assembly shown in Fig. 3.

![Valve Assembly](image)

Fig. 3: Valve Assembly
(NOTE: There are two different valve plug designs)

NOTE

A light coating of Anti-Seize Lubricant (PN. 85-0094) should be applied on all threaded parts, unless otherwise stated.

Inspect the manifold (38) for debris or other fouling and clean if necessary. Inspect the valve seat surface in the manifold. If there is a problem contact your dealer. Reinstall all the valve plug assemblies with a 7/8" socket wrench or combination wrench and tighten.

MANIFOLD SEAL ROUTINE SERVICE

NOTE

Pump manifold assembly must be detached from the crankcase assembly to service the seals.

You will need these tools and parts to do the following:
- Flat screw driver
- Seal, LP (45): PN. 70-6009
- Silicone Grease Lubricant: PN. 21-1122
- Lint-Free Cloths
For manifold seal servicing purposes the manifold must be placed with the valve plugs sitting on a flat surface and the plunger bores facing upward. This will facilitate service technician access to the seals for removal and installation, as shown in Fig. 4.

![Fig. 4: Orientation for Manifold Seal Servicing](image)

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

With a flat screwdriver remove the low-pressure seal (43). Ensure that the low-pressure seal spacer (39) was not accidentally removed when the low-pressure seal was removed and press in the new low-pressure seal (43).

**CRANKCASE SEAL ROUTINE SERVICE**

Remove the seal retainer (29) and set aside. Remove the plunger retainer bolt (28) with a 7/16" wrench, set aside. There is no need to remove the plunger retainer washer (28) or plunger retainer o-rings (27) from the plunger retainer bolt (28). Remove the ceramic plunger (26). Remove the slinger (25) and the outer washer (6). With the aid of the pick remove the plunger rod oil seal (7) from the crankcase. Inspect the seal retainer washers (8) for damage, if none evident then reuse, if damage is evident consult the factory.

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

Insert new plunger rod oil seal (7) into crankcase making sure that the seal is fully seated, place outer washer (6) on seal. Place slinger (25) onto the plunger rod (9).

**NOTE**

Examine the ceramic plungers (26) for cracks, heavy scoring, or unusual wear. If there is a problem, contact your dealer.

Slide ceramic plungers (26) onto plunger rod and insert the plunger retainer washer (28) into the plunger. Clean the plunger retaining bolt’s (29) threaded area. If they were removed replace the o-rings (27) onto the plunger retainer (29). Slide the plunger retaining washer (28) onto the plunger retainer (29).
Apply Red Loctite # 262 to retainer bolt (29) threads. Reinstall the plunger retainer bolt (29) and torque to 100 in. lb, using a 7/16" socket.

**NOTE**

Be CAREFUL not to get the red loctite on any other components.

Apply Aqua Pro’s special Ceramic Lubricant (PN. 90-1604) to the ceramic plungers (26). Slide the seal retainer over the ceramic plungers (26). Make sure that the flanged side is close proximity to the manifold assembly, and that hole is oriented downward ensuring that the seal retainer has adequate water drainage.

**Fig. 6: Seal Retainer**

Routine service is now complete.
SERVICING THE CRANKCASE

The following are the procedures for servicing the crankcase assembly using the
708-1 Crankcase Rebuild Kit (PN. 70-6113).
708-3 Crankcase Rebuild Kit (PN. 70-6112).
708-5 Crankcase Rebuild Kit (PN. 70-6107).

The manifold assembly must be detached from the crankcase to do the following service.

OIL DRAIN PLUG O-RING REPLACEMENT

You will need these tools and parts to do the following:
- 7/8” Socket/ Socket Wrench
- Pick
- O-Ring, Drain Plug (4): PN. 30-1286
- Anti-Seize Lubricant: PN. 85-0094
- Silicon Grease Lubricant: PN. 21-1122

Remove the oil drain plug with a 7/8” wrench and drain the crankcase oil. Clean the drain plug (5), remove the o-ring (4) with the aide of the pick if necessary. Replace with the new one supplied in the kit. Apply anti-seize lube to the threads of the drain plug (5) and reinstall.

PLUNGER ROD SEAL REPLACEMENT

You will need these tools and parts to do the following:
- 7/16” Socket/ Socket Wrench
- Torque Wrench
- Seal, Oil, Plunger Rod (7): PN. 70-6018
- Washer, Plunger Retainer (27): PN. 70-6035
- O-Ring, Plunger Retainer (26): PN. 70-6012
- Slinger Barrier (24): PN. 70-6015
- Ceramic Lubricant: PN. 85-0087
- Silicone Grease Lubricant: PN. 21-1122
- Red Loctite # 262
- Lint-free Cloths

Remove the seal retainer (29) and set aside. Remove the plunger retainer bolt (28) with a 7/16” wrench, set aside. Remove the plunger retainer washer (28) and remove the ceramic plunger (26). Remove the slinger (25) and the outer washer (6). With the aide of the pick remove the plunger rod oil seal (7) from the crankcase. Inspect the seal retainer washers (8) for damage, if none evident then reuse, if damage is evident consult the factory.

NOTE

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

Insert new plunger rod oil seal (7) into crankcase making sure that the seal is fully seated, place outer washer (6) on seal. Place slinger (25) onto the plunger rod (9).
Examine the ceramic plungers (26) for cracks, heavy scoring, or unusual wear. If there is a problem, contact your dealer.

Slide ceramic plungers (26) onto plunger rod and insert the plunger retainer washer (28) into the plunger. Clean the plunger retaining bolts (29). With the aide of a pick, remove the plunger retainer o-ring (27). Replace the o-ring (27) with the new one supplied in the kit as shown in Fig. 6. Slide the plunger retaining washer (28) onto the plunger retainer (29).

Apply Red Loctite # 262 to retainer bolt (29) threads. Reinstall the plunger retainer bolt (29) and torque to 100 in. lb. using a 7/16" socket.

Be CAREFUL not to get the red loctite on any other components.

Apply Aqua Pro’s special Ceramic Lubricant (PN. 90-1604) to the ceramic plungers (26). Slide the seal retainer over the ceramic plungers (26). Make sure that the flanged side is close proximity to the manifold assembly, and that hole is oriented downward ensuring that the seal retainer has adequate water drainage.

BEARING SIDE PLATE O-RING/SEAL REPLACEMENT

You will need these tools and parts to do the following:
- 3/16" Allen Wrench
- Philips Head Screw Driver
- Pick
- Seal, Oil, Crankshaft (18): PN. 70-6038 (708-1, 708-3) 70-6061 (708-5)
- O-Ring, Bearing Side Plate (15): PN. 70-6039
- O-Ring, Sight Glass (22): 70-6082
- Silicon Grease Lubricant: PN. 21-1122
- Anti-Seize Lubricant: PN. 85-0094

Remove the 4 socket head cap screws (19) with a 3/16” Allen Wrench from each of bearing side plate (16), (17), this applies to the 708-1, 708-3 3.5 GPM, and the 708-5 pumps. With the aide of a pick remove the o-rings from the grooves, remove the crankshaft oil seal (18) from the pulley side bearing cap (17). For 708-3 2.3 GPM pumps with direct drive, uncouple the pump from the motor. Remove the 4 Philips head screws (36) holding the bell housing (34) to the pump. Now remove the bearing side plate (17), o-rings and seal can now be replaced.

Remove the sight glass retainer (24) from the bearing side plate (16). With the aide of a pick remove the sight glass o-ring (22). Replace o-ring with the one provided in the kit.

**CAUTION**

Crankshaft oil seal is press fit at the factory, care is to be exercised during removal so damage does not occur to sealing surface.

**NOTE**

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

Press new crankshaft oil seal (18) into pulley side bearing cap (17), install o-ring (15) in o-ring groove on the crankshaft bearing caps (16), (17) and reinstall caps on pump.

**NOTE**

A light coating of Anti-Seize Lubricant (PN. 85-0094) should be applied on all threaded parts, unless otherwise stated.

Install the 4 socket head cap screws (19) onto each of the bearing side plates and tighten with a 1/4” Allen Wrench. This applies to the 708-1, 708-3 3.5 GPM, and the 708-5 pumps. For the 708-3 2.3 GPM pump, reinstall the bell housing (34) by installing the 4 Philips head screws (36).

**CRANKCASE COVER O-RING REPLACEMENT**

In this procedure you will replace the o-rings on the crankcase cover as provided in the rebuild kit.

You will need these tools and parts to do the following:
- 3/16” Allen Wrench
- Philips Head Screwdriver
- Pick
- Silicone Grease Lubricant: PN. 21-1122
- Red Loctite # 262
- Anti-Seize Lubricant: PN. 85-0094
Unscrew the crankcase cover screws (19) with the 3/16” Allen wrench. With the aide of the pick remove the crankcase cover o-ring (20).

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

Install the new crankcase cover o-ring (20) provided with the rebuild kit.

A light coating of Anti-Seize Lubricant (PN. 85-0094) should be applied on all threaded parts, unless otherwise stated.

Reinstall the crankcase cover and tighten the crankcase cover screws (19) with the 3/16” Allen wrench.

CRANKSHAFT BEARING, CONNECTING ROD-PISTON ASSEMBLY SERVICE

It is recommended that any service to the crankshaft bearings (16) or to the connecting rod-piston assembly be done by the factory. Due to the high precision required only factory trained personnel are recommended for this service. Performing any maintenance other than rebuild and service kits voids the warranty if not performed by factory trained personnel.

SERVICING THE MANIFOLD

The following are the procedures for servicing the crankcase assembly using the 708-1 Manifold Rebuild Kit (PN. 70-6079).
708-3 2.3 GPM Manifold Rebuild Kit (PN. 70-6110).
708-3 3.5 GPM Manifold Rebuild Kit (PN. 70-6111).
708-5 Manifold Rebuild Kit (PN. 70-6105). 8 GPM Pump Manufactured After Feb 2002
708-5 Manifold Rebuild Kit (PN. 70-6108). 7 GPM Pump Manufactured Before Aug 2002

The manifold assembly must be detached from the crankcase to do the following service.
INLET/DISCHARGE ADAPTER O-RING REPLACEMENT 708-3 & 708-5

You will need these tools and parts to do the following:
- 3/4” Socket/ Socket Wrench
- Pick
- O-Ring, Discharge Plug Adapter (48): PN. 30-1286
- Silicone Grease Lubricant: PN. 21-1122
- Anti-Seize Lubricant: PN. 85-0094

Remove the Discharge/Plug (50) and (49) adapters from the manifold assembly with the 3/4” Socket/ Socket Wrench. With the aide of a pick remove the o-rings (48) from each of the adapters.

NOTE

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

Install the new o-rings (48) provided with the kit onto each of the adapters.

NOTE

A light coating of Anti-Seize Lubricant (PN. 85-0094) should be applied on all threaded parts, unless otherwise stated.

Reinstall each of the adapters onto the manifold assembly, tighten adapter with 3/4” Socket/ Socket Wrench.

VALVE ASSEMBLY SERVICING

You will need these tools and parts to do the following:
- 7/8” Socket Wrench or Combination Wrench
- Pick
- Spring, Valve (45): PN. 70-6003
- Valve (44): PN. 70-6093
- O-Ring, Valve Plug (46): PN. 70-6002
- Silicone Grease Lubricant: PN. 21-1122
- Anti-Seize Lubricant: PN. 85-0094
- Lint-Free Cloths

**NOTE**

Valves may be serviced while the manifold assembly is attached to the crankcase assembly.

If manifold assembly has been removed from the crankcase assembly, place the assembly on a clean work surface. Remove all of the valve plug assemblies from the manifold assembly using a 7/8” socket wrench or combination wrench. Remove the valve (44) from the assembly, followed by the valve spring (45). With the aide of a pick remove the o-ring (46) from the valve plug.

**NOTE**

Valve plugs (47) will be reused.

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals. Use of any other type of grease may result in o-ring or seal failure.

Clean and inspect all valve plugs (47) prior to reassembly. If there is a problem, contact your dealer. Once all valve plugs (47) are clean and dry, install new valve plug o-ring (46) onto valve plug (47). Install the valve spring (45) onto the valve plug (47), it should now be attached to the plug. Press the valve (44) onto the valve spring (45). Complete valve assembly shown in Fig. 9.

![Fig. 8: Valve Assembly](image)

(***NOTE: There are two different valve plug designs***)

**NOTE**

A light coating of Anti-Seize Lubricant (PN. 85-0094) should be applied on all threaded parts, unless otherwise stated.

Inspect the manifold (38) for debris or other fouling and clean if necessary. Inspect the valve seat surface in the manifold. If there is a problem contact your dealer. Reinstall all the valve plug assemblies with a 7/8” socket wrench or combination wrench and tighten.
MANIFOLD SEAL SERVICING

NOTE

Pump manifold assembly must be detached from the crankcase assembly to service the seals.

You will need these tools and parts to do the following:
- Snap Ring Pliers
- Tool, Weep Ring Puller, 708 Series: PN. 91-3827
- Flat screw driver
- Seal, HP (40): PN. 70-0071
- Ring, Snap (42): PN. 70-6010
- Assembly, Weep Ring (41): PN. 70-3018
- Seal, LP (43): PN. 70-6009
- Silicone Grease Lubricant: PN. 21-1122
- Lint-Free Cloths

For manifold seal servicing purposes the manifold must be placed with the valve plugs sitting on a flat surface and the plunger bores facing upward. This will facilitate service technician access to the seals for removal and installation, as shown in Fig. 10.

![Manifold Seal Servicing](image)

*Fig. 9: Orientation for Manifold Seal Servicing*

With a flat screw driver remove the low-pressure seal (43). Manually remove the low-pressure seal spacer (39). With the snap ring pliers remove the snap ring (42). Using the weep ring extracting tool remove the weep ring assembly (41) as shown in Fig. 11.

NOTE

Extraction of the rings is accomplished by inserting tool in relaxed state into the inner diameter of the rings, then tighten the expansion bolt to grip the ring. Install the extraction stand and nut, tightening nut will extract to weep ring and isolating ring from manifold.
With a flat screwdriver remove the high-pressure seals (40). Manually remove the high-pressure seal spacer (40).

You must clean and inspect the following parts for re-use:
- Spacer, High-Pressure Seal (39): PN. 70-6016
- Spacer, Low-Pressure Seal (39): PN. 70-6016

Insert the high-pressure seal spacer (39) into the bore.

**NOTE**

A light coating of silicon grease (PN. 21-1122) should be used on all new o-rings and seals.
Use of any other type of grease may result in o-ring or seal failure.

Insert the high-pressure seal (40) into the bore until the seal is fully seated on the high-pressure seal spacer (39).

Insert the weep ring (41) into the bore after the installation of the high-pressure seals (39). Install the snap ring (42) using the snap ring pliers.

**NOTE**

Ensure that the snap ring (42) is fully seated in the snap ring groove before continuing.

Insert the low-pressure seal spacer (39) and press in the new low-pressure seal (43). The manifold seal servicing is complete.

**ATTaching the Manifold to the Crankcase**

You will need these tools and parts to do the following:
- 9/16” Socket/Socket Wrench (for 708-5)
- 1/2” Socket/Socket Wrench (for 708-3)
- 3/16” Allen Wrench (for 708-1)
- Dead Blow Hammer
- Dead Blow Hammer
- Manifold Bolt (58): PN. 70-6055 (for 708-5)
- Manifold Bolt (58): PN. 70-6008 (for 708-3)
- Manifold Screw (58): PN. 70-6046 (for 708-1)
- Ceramic Lubricant: PN. 85-0087
- Anti-Seize Lubricant: PN. 85-0094
If a crankcase seal rebuild was not performed at this time then ensure that the dowel locating pins (53) are pressed into their corresponding hole. Ensure that ceramic lubricant is applied to the ceramic plunger assemblies and that the seal retainers are installed with the flange located away from the crankcase assembly.

NOTE

A light coating of Anti-Seize Lubricant (PN. 85-0094) should be applied on all threaded parts, unless otherwise stated.

Align manifold assembly to crankcase assembly and tighten the two manifold bolts (58) with a 9/16” socket wrench for the 708-5, with a 1/2” socket wrench for the 708-3, or the 4 socket head bolts with the 3/16” Allen wrench for the 708-1.
708-3 DRAWINGS
NOTES:
1) ASSEMBLY PART NUMBERS ARE AS FOLLOWS:
   70-6124 ASSY.CRANKCASE, 708-3, 2.3 GPM
   70-6125 ASSY.CRANKCASE, 708-3, 3.5 GPM
   70-6122 KIT, REBUILD CRANKCASE, 2.3/3.5 GPM
   70-6182 KIT, ROUTINE SERVICE, 708-3, 2.3
   70-6183 KIT, ROUTINE SERVICE, 708-3, 3.5
2) ITEMS 9, 10 AND 11 MAY BE PURCHASED UNDER THE FOLLOWING PART NUMBER.
   70-6128 ASSY.DRIVE, 708 SERIES PUMPS

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   70-6119 ASSY, MANIFOLD, 708-3, 3.5 GPM
   70-6110 KIT, REBUILD, MANIFOLD, 708-3, 2.3 GPM
   70-6111 KIT, REBUILD, MANIFOLD, 708-3, 3.5 GPM
   70-6182 KIT, ROUTINE SERVICE, 708-3.2.3
   70-6183 KIT, ROUTINE SERVICE, 708-3.3.5
NOTES:
1. ASSEMBLY PART NUMBERS ARE AS FOLLOWS:
   70-6076 PUMP, 708-3, 2.3 GPM, LEFT CRANKSHAFT
   70-6126 PUMP, 708-3, 2.3 GPM, RIGHT CRANKSHAFT
   70-6072 PUMP, 708-3, 3.5 GPM
AquaPro® Sea Water RO Membranes

Contact Information:

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phone: 310 516-9911
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email: racor@parker.com
www.villagemarine.com

www.parker.com/racor

AquaPro® thin film composite reverse osmosis membranes deliver high salt rejection while maintaining high production rates to obtain the energy efficiency demanded by plant operators.

By selecting the highest grade of materials and thoroughly testing performance, Racor Village Marine Tec. is able to offer the highest quality products.

Aqua Pro’ membranes are designed for use in Parker Village Marine Tec. pressure vessel housings as well as other brand housings.
AquaPro®
Sea Water RO Membranes

Recommended Operating Limits:

- Maximum Operating Pressure: 1000 psi
- Maximum Operating Temperature: 113°F (45°C)
- Maximum Feed Turbidity: 1 NTU
- Free Chlorine Tolerance: 0 PPM
- Maximum Feed Silt Density Index: SDI 5
- pH Range:
  - Continuous Operation: 4-11
  - Short-term for Cleaning: (30 minute duration) 2.5-11

Notes:
- Keep elements moist at all times
- Permeate obtained from first two hours of operation should be discarded
- To prevent biological growth during storage, shipping, or system shutdowns it is recommended that elements be immersed in a protective solution. The standard solution for long or short term storage should contain 1.0 percent (by weight) sodium metabisulfite (available as VMT p/n 85-0103, 85-0038, 85-0044 or 85-0049)
- Standardized test conditions are 32,000 ppm NaCl at 77°F (25°C), with 800 psi feed. Production rates for individual elements may vary +/- 20% and rejection may vary +/- 0.4%

* All 19” and 38” elements come with a 2” removable extender so that the stocked size also fits 21” and 40” housings
** Elements are specially designed for low feed flow applications. Use only with certain Sea Quencher and Little Wonder watermakers.

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<td>220 - 0.83</td>
<td>99.4</td>
<td>19/48</td>
</tr>
<tr>
<td>33-3000 **</td>
<td>2519</td>
<td>150 - 0.57</td>
<td>99.0</td>
<td>19/48</td>
</tr>
<tr>
<td>33-3001**</td>
<td>2519</td>
<td>105 - 0.40</td>
<td>99.0</td>
<td>19/48</td>
</tr>
<tr>
<td>33-0238</td>
<td>2538</td>
<td>550 - 2.08</td>
<td>99.4</td>
<td>38/96.5</td>
</tr>
<tr>
<td>33-3002**</td>
<td>2538</td>
<td>210 - 0.80</td>
<td>99.0</td>
<td>38/96.5</td>
</tr>
<tr>
<td>33-0440</td>
<td>4040</td>
<td>1200 - 4.54</td>
<td>99.4</td>
<td>40/101.6</td>
</tr>
<tr>
<td>33-0036</td>
<td>6040</td>
<td>2500 - 9.47</td>
<td>99.4</td>
<td>40/101.6</td>
</tr>
</tbody>
</table>

To maintain peak performance always use genuine Parker-Racor/Village Marine Tec. replacement parts.
We reserve the right to change our specifications or standards without notice.

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Print Reorder Number 7897 Rev-  6-18-2010

ENGINEERING YOUR SUCCESS.
Pressure Vessel Assemblies
For Seawater Elements

Racor Village Marine RO membrane pressure vessels feature non-metallic wetted surfaces for excellent corrosion resistance. Simple end plug design allows quick removal for element servicing. If the size you require is not shown please contact us for custom builds.

Key Features:
- Operating Pressure: 1000 psi/68 bar
- Shell: Filament Wound fiberglass
- Collars: 6061 T-6 Powdercoated aluminum
- End Plugs: Thermoplastic
- End Ring:
  - 6061 T-6 Anodized aluminum on 2.5” and 4” size
  - SS316 on 6” size
- Fasteners: SS316

Contact Information:
Parker Hannifin Corporation
Racor Division/Village Marine Tec.
2000 W. 135th St.
Gardena, CA 90249

phone: 310 516-9911
800 C-Parker
fax: 310 538-3048
email: racor@parker.com
www.villagemarine.com

www.parker.com/racor
# Pressure Vessel Assemblies
For Seawater Elements

![Diagram of a pressure vessel assembly](image)

## Part Numbers:

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity per Assembly</th>
<th>2.5” x 19”</th>
<th>2.5” x 38”</th>
<th>4” x 40”</th>
<th>6” x 40”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vessel Assembly**</td>
<td></td>
<td>32-2519</td>
<td>32-2537*</td>
<td>32-0444</td>
<td>32-6040</td>
</tr>
<tr>
<td>2</td>
<td>Product O-ring</td>
<td>4</td>
<td>32-2116</td>
<td>32-2116</td>
<td>32-2116</td>
<td>32-2229</td>
</tr>
<tr>
<td>3</td>
<td>End Plug O-ring</td>
<td>2</td>
<td>32-2228</td>
<td>32-2228</td>
<td>32-4342</td>
<td>32-0640</td>
</tr>
<tr>
<td>4</td>
<td>End Plug</td>
<td>2</td>
<td>32-2513*</td>
<td>32-2513*</td>
<td>32-4012</td>
<td>32-6012</td>
</tr>
<tr>
<td>5</td>
<td>End Ring</td>
<td>2</td>
<td>32-4013</td>
<td>32-4013</td>
<td>32-4014</td>
<td>32-0096</td>
</tr>
<tr>
<td>6</td>
<td>Capscrews</td>
<td>***</td>
<td>86-0106</td>
<td>86-0106</td>
<td>86-0123</td>
<td>86-0136</td>
</tr>
<tr>
<td>7</td>
<td>Shell</td>
<td></td>
<td>32-0025</td>
<td>32-0026</td>
<td>Please Call</td>
<td>Please Call</td>
</tr>
<tr>
<td></td>
<td>White</td>
<td>1</td>
<td></td>
<td></td>
<td>32-00099</td>
<td>32-0001</td>
</tr>
<tr>
<td></td>
<td>Gray</td>
<td>1</td>
<td>32-0098</td>
<td>32-0099</td>
<td>32-4001</td>
<td>32-0001</td>
</tr>
<tr>
<td></td>
<td>Weight (lbs/kg)</td>
<td></td>
<td>5/2</td>
<td>7/3</td>
<td>22/10</td>
<td>45/20</td>
</tr>
</tbody>
</table>

### Notes:

*End Plug 32-2517 is also available for 2.5” vessels, which offers straight, coarse thread feed/reject port used on some VMT PW watermakers. Use of coarse thread end plug changes the vessel assembly p/n to 32-2538

**Membrane not included. For applicable membrane elements see bulletin No. 7897 (Aqua Pro RO Membranes)

*** Capscrews:
Order 6 per end plug on 2.5” size
Order 8 per end plug on 4” size
Order 10 per end plug on 6” size

To maintain peak performance always use genuine Parker-Racor/Village Marine Tec. replacement parts. We reserve the right to change our specifications or standards without notice.
The Village Marine Tec. line of pleated filters are designed specifically for the RO watermaker industry and are superior to wound or polyspun cartridges to give you a longer filter life as well as increasing flow rates and keeping cartridge size down.

Available in a wide arrange of sizes and micron ranges to ensure that every type of watermaker filter need is taken care of. Stock sizes fit most standard filter housings, if the size you need is not shown please contact us with the dimensions required.

Single use Cleaning and Preservative Cartridge Kits are designed specifically for small RO Systems. The Cartridges allow for easy and effective membrane maintenance.

The Cleaning and Preservative Cartridge Kits eliminate the trouble and mess of measuring powdered chemicals and ensuring correct chemical concentrations. The Chemical cartridges fit directly into 2.5” x 10” housings and contain the correct amount of chemical for a single use.

Contact Information:

Parker Hannifin Corporation
Racor Division/Village Marine Tec.
2000 W. 135th St.
Gardena, CA 90249

phone: 310 516-9911
800 C-Parker
fax: 310 538-3048
email: racor@parker.com
www.villagemarine.com
www.parker.com/racor
Pleated Filters and Filter Cartridge Kits

**Features:**

**Pleated Filters**
- Polypropylene pleated construction
- Longer service life over wound or polyspun cartridges
- Easily cleaned and reused
- Chemically compatible with a wide range of alkalies, most acids and saline solutions
- 0.5, 1, 5, and 20 micron ranges available
- Pliable plastisol ends ensures filter seal to eliminate bypass
- High packing density reduces filter size while keeping flow rates up
- Filter bands on large diameter elements keep filter shape during system pulsations

**Filter Cartridge Kits**
- Cartridge with Blue stripe contains cleaner #1, a biological cleaner to remove algae, fungi and bacteria
- Cartridge with Red stripe contains cleaner #2, an acidic cleaner to remove scale from the membrane
- Cartridge with Green stripe contains the preservative. This chemical is used for pickling the membranes
- Cartridges are capable of being used in any housing that takes a standard 2.5” (64mm) x 10” (254mm) filter cartridges

**Pleated Sediment Elements**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Microns</th>
<th>Filter Area ft²/m²</th>
<th>Diameter inch/cm</th>
<th>Length inch/cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>33-0118</td>
<td>20</td>
<td>10/0.93</td>
<td>2.75/7</td>
<td>9.75/25</td>
</tr>
<tr>
<td>33-0117</td>
<td>5</td>
<td>10/0.93</td>
<td>2.75/7</td>
<td>9.75/25</td>
</tr>
<tr>
<td>33-0053</td>
<td>20</td>
<td>18/1.67</td>
<td>4.5/11.4</td>
<td>9.75/25</td>
</tr>
<tr>
<td>33-0052</td>
<td>5</td>
<td>18/1.67</td>
<td>4.5/11.4</td>
<td>9.75/25</td>
</tr>
<tr>
<td>33-0020</td>
<td>20</td>
<td>30/2.79</td>
<td>8.63/22</td>
<td>7.75/20</td>
</tr>
<tr>
<td>33-0005</td>
<td>5</td>
<td>30/2.79</td>
<td>8.63/22</td>
<td>7.75/20</td>
</tr>
<tr>
<td>33-0058</td>
<td>20</td>
<td>35/3.25</td>
<td>4.5/11.4</td>
<td>20/51</td>
</tr>
<tr>
<td>33-0057</td>
<td>5</td>
<td>35/3.25</td>
<td>4.5/11.4</td>
<td>20/51</td>
</tr>
<tr>
<td>35-0020</td>
<td>20</td>
<td>35/3.25</td>
<td>6.12/15.5</td>
<td>11.9/30</td>
</tr>
<tr>
<td>35-0001</td>
<td>5</td>
<td>35/3.25</td>
<td>6.12/15.5</td>
<td>11.9/30</td>
</tr>
<tr>
<td>33-0172</td>
<td>100</td>
<td>100/9.29</td>
<td>8.63/22</td>
<td>24.3/62</td>
</tr>
<tr>
<td>33-2100</td>
<td>20</td>
<td>100/9.29</td>
<td>8.63/22</td>
<td>24.3/62</td>
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<tr>
<td>33-5100</td>
<td>5</td>
<td>100/9.29</td>
<td>8.63/22</td>
<td>24.3/62</td>
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<tr>
<td>33-1100</td>
<td>1</td>
<td>100/9.29</td>
<td>8.63/22</td>
<td>24.3/62</td>
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<td>33-1105</td>
<td>0.5</td>
<td>100/9.29</td>
<td>8.63/22</td>
<td>24.3/62</td>
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</tbody>
</table>

**Carbon Flushing Filters**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Diameter inch/cm</th>
<th>Length inch/cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>33-0311</td>
<td>2.75/7</td>
<td>9.75/25</td>
</tr>
<tr>
<td>33-0315</td>
<td>4.5/11.4</td>
<td>9.75/25</td>
</tr>
<tr>
<td>33-0083</td>
<td>4.5/11.4</td>
<td>20/50.8</td>
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</table>

**Cartridge Filter Kits**

<table>
<thead>
<tr>
<th>Description</th>
<th>Part Number</th>
<th>Contents</th>
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</thead>
<tbody>
<tr>
<td>Cleaning Kit</td>
<td>85-0102</td>
<td>One Blue stripe cleaner #1 plus One Red stripe cleaner #2</td>
</tr>
<tr>
<td>Preservation Kit</td>
<td>85-0103</td>
<td>Two Green stripe preservative</td>
</tr>
</tbody>
</table>

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