



# VAGABOND™ WATER SYSTEM

## OWNER'S MANUAL

JANUARY 2007

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# VAGABOND™ WATER SYSTEM

## REVERSE OSMOSIS UNIT



## **WELCOME TO THE WORLD OF PURE WATER**

Today we are drinking the same water that has been on earth since its creation. It has been recycled millions of times by the Hydrologic cycle – a process whereby water is evaporated from our rivers and oceans into the atmosphere as a gas and then recycled over and over again. Rain starts out as “pure” water, but is immediately contaminated as it passes through the atmosphere and picks up airborne contaminants such as dust, mold, pollen, and carbon dioxide. When the rain water combines with carbon dioxide, carbonic acid is formed; in industrial areas where there is sulfur in the atmosphere sulfuric acid is formed. Accordingly, depending on where you live, rain water can range from slightly to very corrosive. As the rain runs over the earth’s surface, it picks up other contaminants. Even more contaminants are picked up as the water percolates down thru layers of limestone and other rock formations as it is collected in underground streams. By the time we use the water it is full of all kinds of minerals and can have bacteria or parasites such as cryptosporidium. Water softeners are used to remove hard water minerals such as calcium, iron, manganese and magnesium. These hard water minerals cause soap to be insoluble. Remember the old rain barrel our ancestors used to collect water to use with their wash? They needed good mineral free water so that they could use the pure soap they made. Today, it is more convenient to use a water softener and/or detergents to eliminate soap curd.

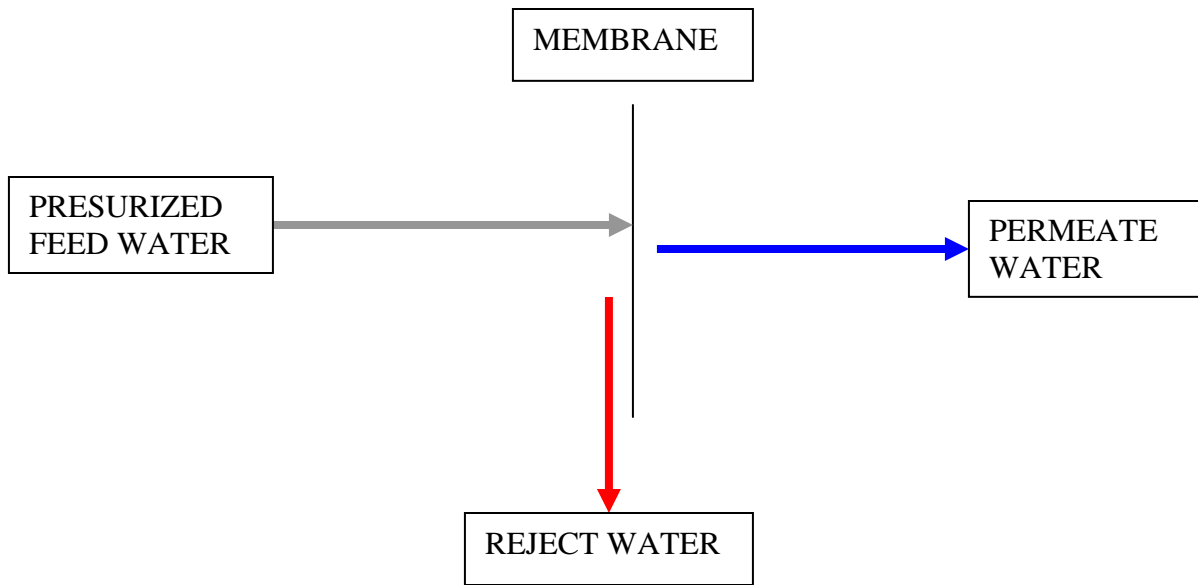
In recent years, reverse osmosis technology has improved such that it is no longer limited to large industrial applications. In fact, home units are commonly used for purification of drinking water, but “whole house” systems tend to be very costly for the average homeowner because of the volume of water being used. We have designed a system that will accommodate most RV’s, and, by eliminating the need for expensive pumps and controls, our system is affordable. You will no longer have to cart around a messy water softener, or suffer with bad tasting mineral water and the resultant soap curd and water spots.

### **What Does "RO" Mean?**

RO stands for reverse osmosis, the reverse of energy's natural flow from higher to lower levels of concentration. In normal osmosis, pure water dilutes impure water due to pure water's higher energy level. Reverse osmosis involves applying pressure (mechanical energy) to drive pure water out of impure solutions.

### **HOW DOES IT WORK?**

This applied energy is normally provided by a medium to high pressure water pump, which overcomes energy differences (osmotic pressure) and drives feed water through a porous, semipermeable membrane made of polymeric material. Semipermeable means the membrane will pass pure water through, but will reject most dissolved impurities



This RO system utilizes a low pressure membrane so that a pump is not necessary; it runs on line pressure. Although the RO membrane contains very small pores, which allow pure water passage, the system is not perfect, so a slight amount of feed water impurities will pass through the membrane with the purified water. The percentage passing depends on such things as membrane polymer type, membrane condition (e.g. age, cleanliness), driving pressure (energy), and temperature, but is normally less than 5% of feed water content. That means the membrane is typically 95% efficient. If your raw (feed) water had 100 parts per million (PPM) of dissolved solids, the product (purified) water would have only 5 PPM. Because the hard water minerals are rejected along with bacteria and other contaminants, the product water is also softened as though it had passed through a water softener, so you will get the same benefits when bathing or laundering. Reducing the amount of dissolved minerals in the product water by 95% means that there are fewer minerals left to create spots as water evaporates from the surface of your appliances, fixtures, and shower glass. RO water is also commonly used in car washes to eliminate spots, so you might want to arrange a hose bib to use for washing your coach or dingy.

If we forced all feed water through the membrane, as we do a pre filter, it would rapidly become plugged up because it has such small pores. In order to prevent rapid plugging, some of the feed water is passed over the surface of the membrane to wash away the rejected solids, as in a cross flow filtration mode. Therefore, from one feed water stream, an RO machine produces one purified water stream called permeate, and a second stream called concentrate, brine, or reject.

This system restricts the amount of reject water to about twice the product water. We refer to this as the recovery ratio; in this case the recovery ratio is 33% because we use 1/3 of the feed water and reject 2/3's.

## CONTAMINATE REMOVAL

The following table shows how various equipment applications compare in removing national primary drinking water contaminate. A look at this table shows why we use reverse osmosis in the Vagabond™ System.

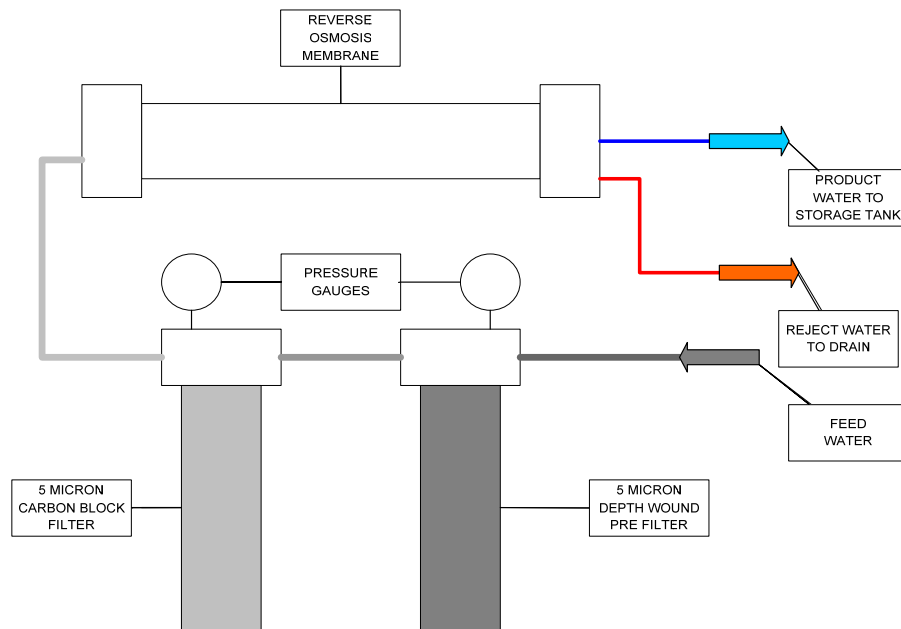
### CONTAMINATE REMOVAL APPLICATIONS

<u>CONTAMINATE</u>	<u>REVERSE OSMOSIS</u>	<u>NANO-FILTRATION</u>	<u>LOW ENERGY RO</u>	<u>CONVENTIONAL TREATMENT</u>	<u>OZONATION</u>
<b>HARDNESS</b>	○	○	○	○	
<b>RADIUM</b>	○	○	○		
<b>ORGANICS</b>	○	○	○		○
<b>ARSENIC</b>	○	○	○		○
<b>COLOR</b>	○	○	○	○	○
<b>SULFATE</b>	○	○	○		
<b>IRON</b>	○	○	○		○
<b>TOTAL DISSOLVED SOLIDS</b>	○	○	○		
<b>MTBE</b>	○	○	○		○
<b>NITRATE</b>	○	○	○		
<b>CRYPTOSPORIDIUM</b>	○	○	○	○	○
<b>VIRUSES</b>	○	○	○	○	○
<b>KEY</b>	<u>EXCELLENT</u>	<u>GOOD</u>	○	<u>FAIR</u>	○

## HOW IS THE SYSTEM CONSTRUCTED?

Your RO system consists of two pre filters and the RO vessel. It will be installed so that you may connect a water source to it via an available connecting hose to the inlet of the first pre filter housing. The first pre filter is a 5 micron depth filter. The depth filter is made of spirally wound fibers in a manner such that larger particles are trapped at the surface, while the smaller particles are allowed to penetrate to the center of the filter, hence, the name “depth” filter. This filter is very important as it prevents particles larger than 5 microns from getting into and plugging up the RO membrane. The second pre filter is a 5

micron carbon block filter that eliminates chlorine. If chlorine is allowed to contact the membrane its life will be seriously shortened. After being filtered twice, the feed water is run through the RO membrane; the product water will then be diverted to your storage tank and the reject water will be routed to the drain.



## WHAT KIND OF WATER CAN I USE?

This system is designed to be used on potable (drinking) water only. You can feel comfortable using water in most RV Parks as it is clean with the exception of minerals.

If you feed the RO system dirty (visibly turbid) water you will plug up the filters rapidly and diminish the efficiency of operation. Subjecting the system to iron bearing water will foul the membrane and shorten its useful life. The best policy is to use clean drinking water only.

## WHAT MAINTENANCE IS REQUIRED?

Maintenance will vary according to usage of the system; however, you should change the filters whenever there is a 5psi drop in pressure between the inlet gauge and the post filter (outlet) gauge. Such a drop is an indication that the filters are getting loaded with sediment. Typically, changing the 5 micron depth filter only will correct a pressure drop situation if you catch it early. If, after replacing it, you still have a pressure drop, you will need to change the carbon block filter also. We recommend you replace both filters annually. The system comes with a filter wrench to make the job easier.

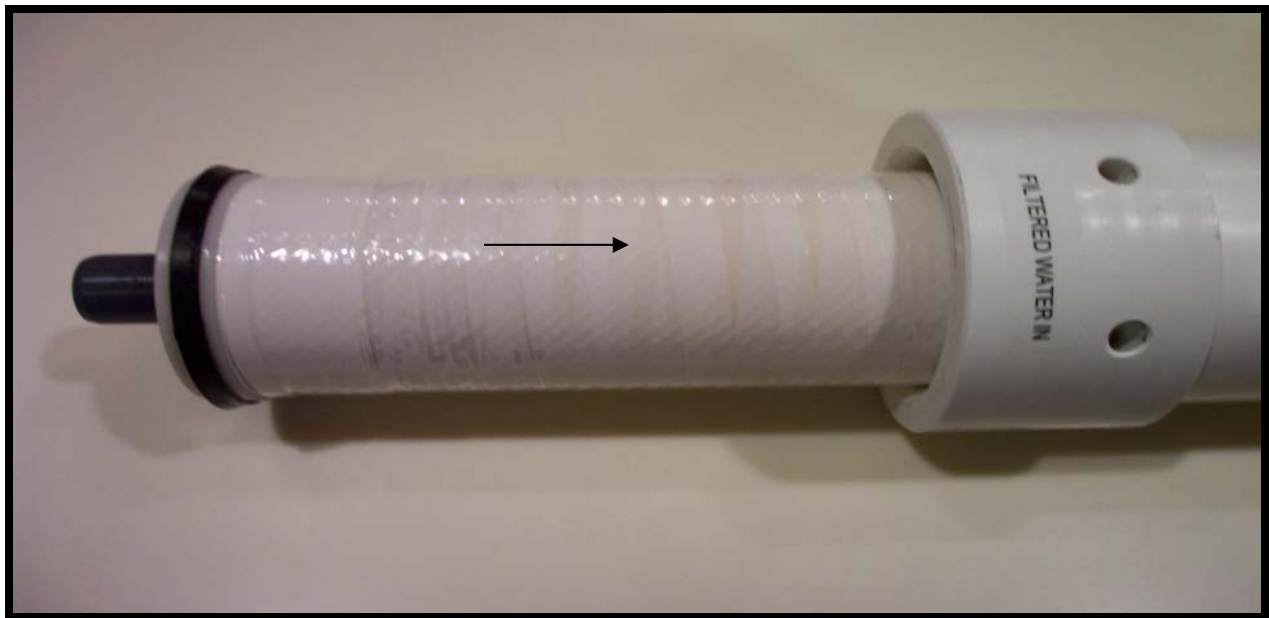
## HOW DO I KNOW THE RO SYSTEM IS WORKING?

You must have a total dissolved solids meter in order to measure the dissolved solids in the feed and permeate water to compare the two or calculate % rejection. A portable meter will cost \$65.00 to \$95.00, or, as an alternative, you can use the B&A TDS meter; this neat little device will measure the TDS of the incoming and product water at the same time and give you a comparative read. If the membrane performance falls below 80%, a red warning light appears.

## HOW DO I WINTERIZE THE SYSTEM?

Winterizing is easy.

- Remove the filters (rotate counterclockwise as viewed from the bottom – a filter wrench is provided), drain the housings and replace the housings without the filters. The filters may be discarded if you follow our advice to change them annually, or you may store them in a zip lock bag in a refrigerator (to prevent bacterial growth).
- We recommend you remove the membrane/housing assembly as a unit and store it in a refrigerated environment. The RO membrane and housing must be drained of all water. To drain water from the housing, stand it on end until all water has run out.



**PHOTO SHOWING MEMBRANE BEING INSERTED INTO HOUSING.**

Note the tetra seal on the left end of the membrane; it must be lubricated and, because of its shape, it will only go into the housing in one direction (see arrow). You should also lubricate the PVC ends of the membrane, as they fit inside of “O” rings in the end plugs.



**PHOTO OF END PLUGS AND A “U” PIN**

Note the end plug on the right has only one fitting in it; this is the plug for the incoming water (filtered water in). The plug with two fittings is for the permeate/waste water. Permeate comes out the 90 degree elbow, while reject water comes out the straight fitting.

### **MANUAL INSTALLATION INSTRUCTIONS**

- Find a convenient bulkhead near the water service panel and mount the system with the filters in a vertical alignment. There are two mounting holes in the aluminum mounting bracket; drill two #7 holes and tap the bulkhead with a ¼-20 tap and use the two stainless ¼-20 X ¾ hex head bolts and washers provided. Note the arrows in the photo below.
- All of the connections are made with 3/8ths inch poly tubing. We have included ten feet of each of three colors for you. The feed water is to be connected with the natural poly; connect the permeate water with blue poly and the reject water with the red poly.
- Drill and tap the holding tank for a tube fitting (blue permeate). You will need a 7/16ths inch drill bit and a 1/4 inch NPT tap for this and the following operation. The location of the hole really doesn't matter, but you will find it more convenient to drill into the upper portion of the tank – above the water level. Try to keep shavings out of the tank.
- Drill and tap the waste water dump line for the reject (red reject). We recommend drilling into the grey water line after the dump valve so that you can run the RO unit without filling the grey water tank. Drill into the top side of the line so that debris won't clog the fitting.
- In line check valves are included for both permeate and reject water lines; be sure to observe the directional flow arrow when installing these valves (they may be installed in any convenient location on the respective lines).





**PHOTO SHOWING TYPICAL MANUAL INSTALLATION**

## **SYSTEM OPERATION**

Prior to leaving home for a trip, you will want to make some purified water for use when traveling and upon your initial stop at a camp site.

- Connect your hose to the inlet of the RO system.
- Make sure the cap is removed from the waste water discharge so that the reject water will have an escape route. There are no contaminants in this water, so don't worry about letting it run onto the street. RO reject water is simply a concentrated version of the feed water and is perfectly safe to use for irrigation, etc.
- Check your on board water system level indicator for the water storage tank to see the progress being made to fill it. You can fill it to the level that suits you before leaving on a trip. If you let it over fill, you will see the excess water running out the overflow as a reminder that you're full.
- You are now set to use the purified water; simply turn on your water pump and enjoy the fresh tasting, good feeling, and spot free water.

When you set up your coach at a camp site, you will:

- Connect the water supply to the RO system instead of the normal water connection.
- Be sure you have the waste water line connected so that the reject water can go to drain
- You can either watch the level indicator or wait for the overflow as a signal that you're full.

- As before, you will need your water pump turned on.
- You will need to make more purified water every few days, depending on your rate of consumption and the size of your storage tank.

## **AUTOMATIC OPERATION**

While the manual Vagabond™ System will provide you with plenty of purified water, a fully automatic system is far more convenient and may be realized by adding the optional “Automatic Upgrade Kit” as discussed on the following pages.

## **AUTOMATIC OPTION KIT**



**SYSTEM SWITCH BOX**



**DOUBLE FLOAT SWITCH ASSY.**



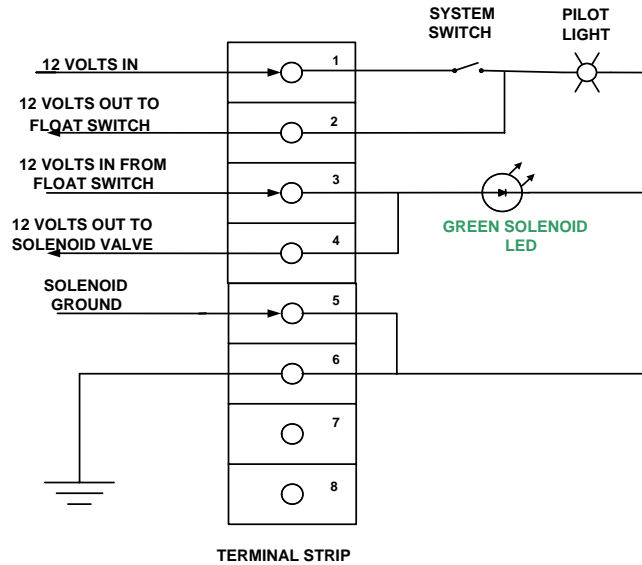
**SOLENOID VALVE ASSEMBLY**

## AUTOMATIC INSTALLATION INSTRUCTIONS

### SYSTEM SWITCH BOX

- The system switch box includes the lighted master “ON - OFF” switch, a green led indicator, and an internal terminal strip. A schematic of the electrical connections follows:

#### SYSTEM SWITCH BOX



- Mount the system switch box in a conveniently accessible location. The coach service panel is a good spot; however, you will want to consider accessibility to power and keep it away from water hazard. Once you have the location determined, you can cut a hole for the required wires and install the included grommet.
- Run a fused 12 volt DC power line and connect it to terminal #1. Connect a ground connection to terminal #6. Please note that jumper strips are in place between terminals # 3 & #4 and #5 & #6. If you want to run a remote switch or indicator light to the interior of the coach, now is the time to do it; just connect the remote items in parallel with the switch and led in the switch box. In so doing, you will be able to control the system from inside the coach.

## SOLENOID VALVE ASSEMBLY

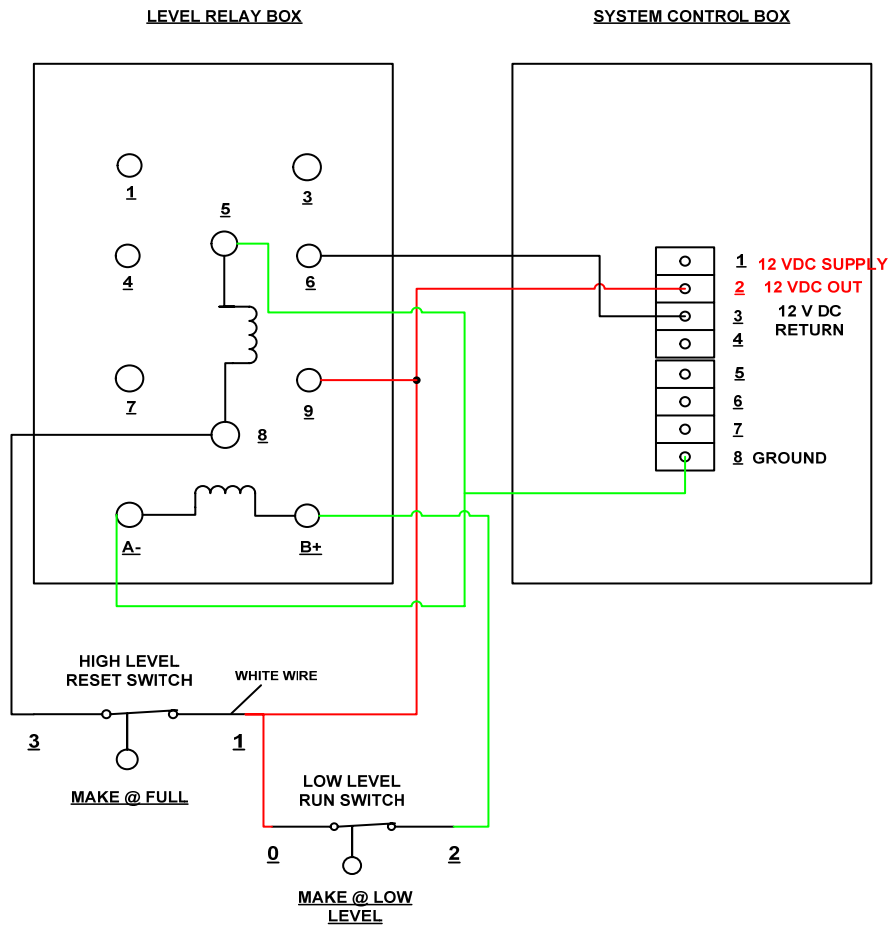
- Install the solenoid valve assembly on the feed water line in front of the pre filter. Connect the wires from the solenoid valve to terminals #4 and #5 in any order. It doesn't matter which wire goes where.

## FLOAT SWITCH ASSEMBLY

- You will need to drill and tap two holes (for the upper and lower float switches) in the side wall of the water tank using a 11/16" **hole saw** and a 1/2" pipe tap. It is critical that these holes be "round" so that you get a good seal; hence, use a hole saw. The upper hole should be as high as possible without hampering the movement of the float inside of the tank and the lower hole should be about three inches below that. The object is to get the tank as full as possible before shutting down and turn it back on again after you have used some water; the result will be a near endless supply. Please note that the floats are clearly marked "upper" and "lower" and that they are also marked for correct orientation. It is critical that the float switches are installed in the correct vertical plane and that they are in their respective locations. The upper float switch is connected with connectors numbered 1 & 3; the lower float switch connectors are numbered 0 & 2. **Do not** install the switches yet.
- The level relay box has two bundles of wires in grey sheaths coming from it. One set obviously goes to the float switches; the other goes to the system switch box. The black, red, and green wires go to terminals # 2, #3, and ground (#6) respectively and are numbered accordingly. There is plenty of length so that you can locate the relay box where you want it. Secure it with the provided Velcro.
- Once all the wiring connections are made, you can hold the float switches in your hand and manipulate them to see how they work. Turn on the system switch. Both floats will be in the "down" position. Lift the lower float switch up so simulate water filling; then lift the upper float to simulate water at that level. When the upper float closes contact it will reset the relay and turn off the solenoid valve and green led. Now simulate water being used by lowering the upper float followed by the lower. When the lower switch makes contact, it will energize the relay, the solenoid valve, and the green led to indicate the system is filling.
- When you're happy with the electrical operation, install the float switches in the water tank; be sure to use plenty of Teflon tape and re-connect the wires as numbered if you disconnected them during installation.

Your Vagabond™ System will now work automatically so long as you keep it connected to the water supply. Enjoy the convenience.

## LEVEL CONTROL RELAY CONNECTIONS





**PHOTO OF FULLY AUTOMATIC INSTALLATION**

The photograph above is of a fully automatic installation. The optional switch box, and solenoid valve assembly with by-pass valve are shown. Note the “T” in the product line (upper arrow); water flows to the right to the storage tank (a check valve is hidden from view behind the bulkhead) and to the left to a sample valve where the water quality may be tested. Make your tubing runs as short and neat looking as possible.

**OPTIONAL EQUIPMENT**

- If you’re interested in seeing what’s happening with the “recovery ratio”, you might consider the optional panel mounted flow indicators. The following picture shows a typical installation of the flow indicators in a service panel. Note the extra bulkhead fitting (arrow) that has been installed to supply feed water to the RO system. Also, note that the flow indicator on the right side has a knob that is used to throttle the flow of the reject water so that the proper recovery ratio can be achieved. If you want to install these indicators, you will remove the fixed restrictor that comes with the system and rely on the throttle valve shown to adjust the recovery ratio. Again, we want a 2:1 ratio of reject to permeate. This is a better set up than a fixed restrictor because of the variable temperature and line pressures you will experience. It will also enable you to see if the membrane’s permeate flow is diminishing, which is a good sign that the filters need changing or that the membrane is either plugged or ruptured.

- If you want the ultimate convenience, you may want to add a Glendinning “Hosemaster” electric hose reel with 35’ of ½” hose. This item comes with a switch box and will electrically rewind the hose. A remote control is also available to operate the “Hosemaster” and will also operate the “Cablemaster” if you already have one of them. Check the optional items section for pricing.



### PHOTO SHOWING FLOW INDICATORS AND BULKHEAD CONNECTION FOR RO

The Reverse Osmosis unit comes with John Guest quick disconnect fittings. They are designed to be fool proof and leak proof. Simply cut the tubing with a sharp knife so that the tube end is clean and straight; then push the tube into the fitting as far as it will go. There is an “O” ring inside of the fitting end that will seal the connection, and “grab rings” prevent the tube from coming out. Once the tube is seated, insert a red locking clip between the grab ring and the fitting housing as shown in the photo below. You may have to pull out on the tubing to make space for the locking clip.



If it becomes necessary to remove the tubing, follow this procedure:

- Grab the tube with one hand and with the other hand, hold the fitting while pushing in on the ring as shown in the photo. Pull the fitting off of the tube.





## REPLACEMENT PARTS

<u>DESCRIPTION</u>	<u>PART #</u>	<u>PRICE*</u>
FILTER WRENCH	RC144877	\$ 2.70
DEPTH WOUND POLYPROPYLENE FILTER - 5 MICRON	RC155071-43	\$ 6.96
10" CARBON BLOCK FILTER	RComb934XF	\$17.50
2.5"X21" R.O. MEMBRANE - 300GPD @ 107PSI	RCAK2521TF	\$124.80
3/8 X 1/4 MPT JOHN GUEST FITTING 90 DEGREE	RCC1481222W	\$ 3.32
3/8 X 1/4 MPT JOHN GUEST FITTING STRAIGHT	RCC1011222W	\$ 2.14
3/8 X 3/8 CHECK VALVE	RCSCV	\$ 10.60
3/8 X 3/8 JOHN GUEST UNION CONNECTOR	RCC10412W	\$ 2.50

### OPTIONAL ITEMS

B&A TDS METER		\$60.00
PANEL MOUNT FLOW METER - 22GPH PRODUCT	RC5828-121	\$ 91.92
PANEL MOUNT FLOW METER - 44GPH WASTE	RC5829-125	\$116.10
INLET SOLENOID VALVE ASSEMBLY		\$102.38
DOUBLE FLOAT SWITCH ASSEMBLY		\$263.92
SWITCH BOX WITH INDICATOR LIGHT	RCRBRGIL	\$ 50.00
HOSEMASTER 35' 1/2" ELECTRIC HOSE REEL	RC05501-R	\$375.00
REMOTE CONTROL FOR HOSEMASTER	RC04155	\$275.00

\*\*\*\*\*PRICES SUBJECT TO CHANGE\*\*\*\*\*

## PHOTO GALLERY



**FULLY AUTOMATIC UNIT IN ALPINE COACH**



**FLOW METER KIT**



**B&A TOTAL DISSOLVED SOLIDS METER**



**AUTOMATIC SYSTEM IN TRAVEL SUPREME SELECT**

**NOTE THE FLOW METERS, CONTROL BOX, HOSE BIB FOR WASHING THE RIG, GLENDINNING HOSE REEL, SOLENOID VALVE ASSEMBLY, AND A 180° VALVE THAT ALLOWS SELECTION OF REVERSE OSMOSIS WATER OR SHORE WATER; FLOAT VALVES ARE VISIBLE AT THE UPPER CORNER OF THE WATER TANK**



**DOUBLE MEMBRANE SYSTEM INSTALLED IN THE TRAVEL SUPREME  
TWO MEMBRANES DOUBLE PRODUCTION WITHOUT AN INCREASE OF WASTE  
WATER**



**AUTOMATIC SYSTEM IN COUNTRY COACH MAGNA 630  
GLENDINNING HOSE REEL, CONTROL BOX AND FLOW METERS ARE SHOWN**



**AUTOMATIC SYSTEM IN ALPINE LIMITED SE**

**NOTE THE PANEL MOUNT PRESSURE GAUGES, FLOW METERS, HOSE BIB AND CONTROL BOX**



**MEMBRANE LOCATION IN ALPINE LIMITED SE**



**CLOSE UP OF ACCESSORIES IN ALPINE LIMITED SE**



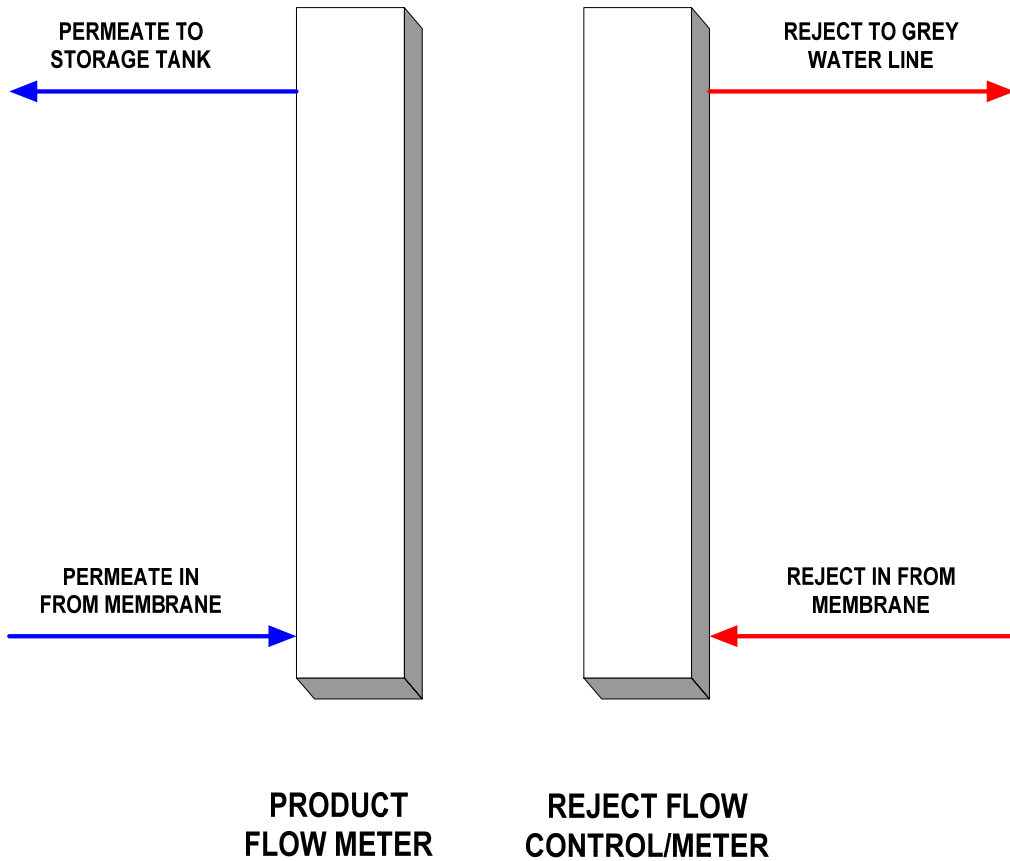
**INSTALLATION IN ALPINE HYDROHOT BAY**

**NOTE OVERHEAD LOCATION OV SOLENOID VALVE ASSEMBLY**

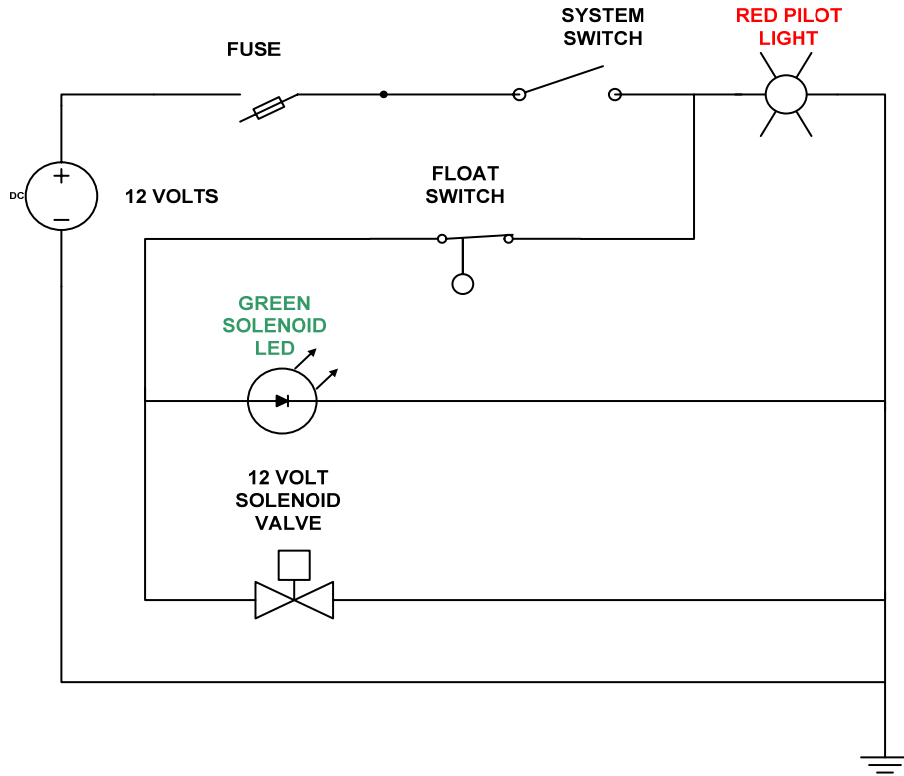


**SERVICE BAY OF SAME ALPINE**

## SYSTEM FLOW METER CONFIGURATION



# ELECTRICAL SCHEMATIC AUTOMATIC OPERATION





# SYSTEM FLOW DIAGRAM

