



Electric Watermaker Operations Manual

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Version 2.8

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Introduction

About this manual

This instruction manual is for our range of electric powered watermakers. Our petrol (gasoline) powered watermaker is supplied with its own specific manual. Rainman Watermakers in a case (referred to as cased from now on) can be run either portable or installed, while our naked systems are designed for installed application only. This manual covers both portable and installed use of our systems. Understanding both options will give you better appreciation of how your watermaker operates.

Several icons are used throughout the text to indicate the purpose of the particular paragraph:



The electric plug icon means the paragraph only applies to AC electric systems (either 230VAC/50Hz or 115VAC/60Hz systems).



The battery icon means the paragraph only applies to the 12VDC systems.



This icon indicates a specific warning, indicating actions to be taken to ensure safety or protection of your watermaker.

Portable

The portable icon indicates the paragraph only applies to those users running their system as portable, without installation.

Installed

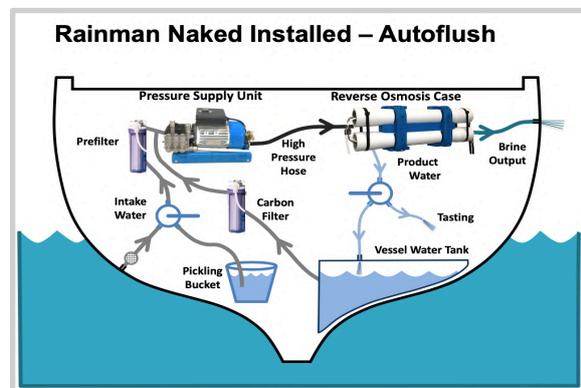
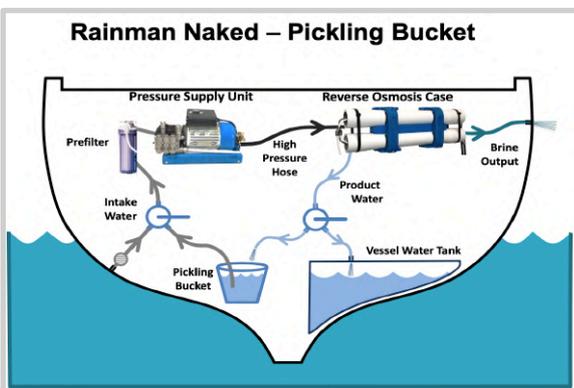
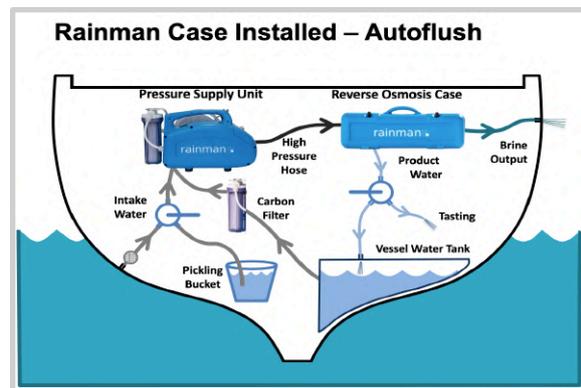
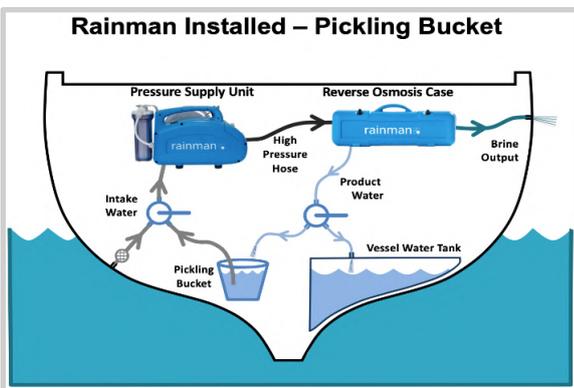
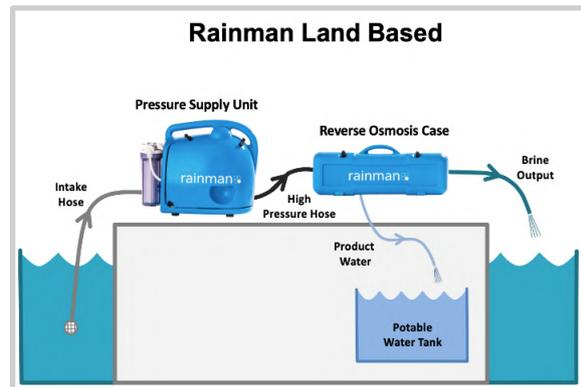
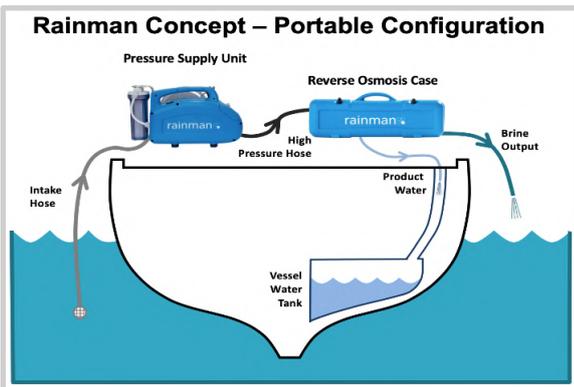
The installed icon indicates the paragraph only applies to systems that have been either fully or semi-installed. Occasions occur in the text where a photo is of a portable system in the case, but it equally applies to both portable and installed versions. For the purposes of brevity, we do not include separate sections/photos when this is obvious (eg. Preparing system for first use or High pressure pump maintenance).

Rainman concept

All Rainman systems consist of two main components - a pressure supply unit (PSU) and a reverse osmosis unit (RO). The PSU will lift water to the system, pre-filter it down to five microns and feed it into a high pressure pump. The RO unit is attached to the PSU via a high pressure hose. The membrane(s) extract a small amount of fresh water from the pressurised seawater stream and diverts it into your tank. The bulk of the seawater goes to waste as a supersaline brine output.

The systems can be operated as completely portable units, with hoses in the sea and water buckets, or they can be partially or fully installed into a boat or other location. It is possible to install either the traditional Rainman in a blue case or the uncased *naked* system. Below are four of many possibilities for operating a Rainman Watermaker.

Six common configurations for Rainman Watermakers



Getting to know your system

Desalination basics

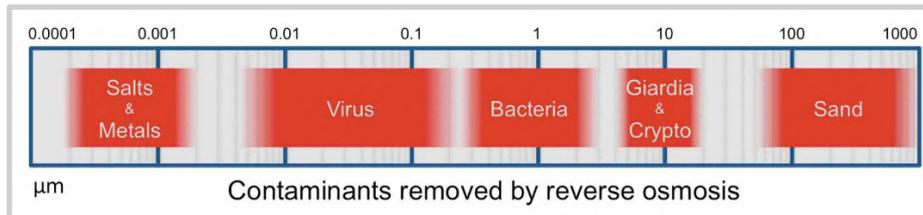
Desalination sounds complex, but it's quite simple in principle.

The Rainman watermaker operates through a process called reverse osmosis (RO). In its most simple terms, the system draws seawater up, filters out sediment and particulates, then puts the clean seawater under high pressure to pass through an RO membrane. The RO membrane is a semi-permeable polyamide thin-film composite.

A traditional filter, like our prefilter, works by passing all the water through it. The fine construct prevents larger particles from getting through and they are captured on the filter material. When a lot of particles have been captured on the filter and it's dirty, you change it.

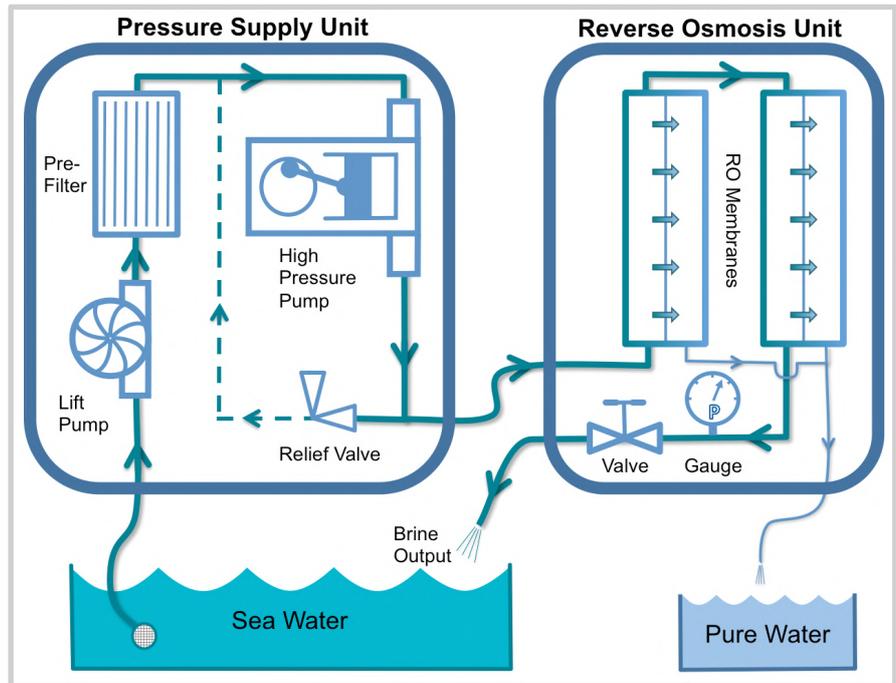
In contrast to a traditional filter, the RO process has filtered seawater passed across the membrane surface at high pressure. Keeping the description simple, the system is essentially extracting a small percentage of the freshwater from the seawater stream. The majority of the water and all of the salt continues in the flow and out the brine waste water hose. The salt does not accumulate on the membrane, which is why RO membranes do not need to be cleaned or replaced regularly.

Since bacteria and viruses are much larger than salt molecules, they stay in the main seawater stream and are passed out with the brine waste water.



Detailed schematic

1. An impeller lift pump draws seawater up to the pressure supply unit (PSU) and creates positive pressure for the high pressure pump.
2. The pre-filter removes particulates larger than 5 microns from the seawater.
3. A plunger pump pressurises the system for the reverse osmosis membranes to operate.
4. The relief valve only opens if the control valve is closed excessively.
5. A high pressure hose carries filtered seawater to the reverse osmosis membranes.
6. Multiple membranes are connected in series (double RO membrane configuration).
7. The pressure control valve at the end of the system is used to set system pressure to approximately 55 bar (800 psi).
8. Brine water is released to the sea while fresh water is routed to your drinking water tank.



Rainman models

Rainman offers multiple versions of watermakers. Various options are shown here.



Rainman AC naked PSU



Rainman AC PSU in case



Rainman 12VDC naked PSU



Rainman 12VDC PSU in case



Rainman petrol/gasoline PSU



Compact RO in case



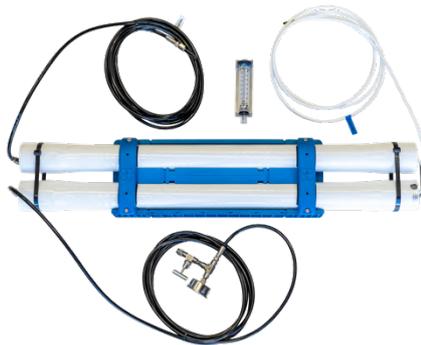
High output RO in case



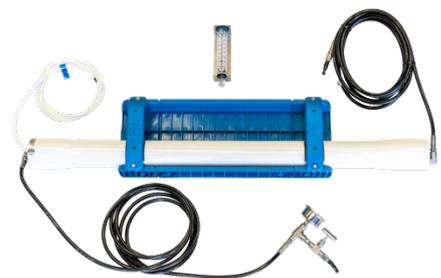
Economy RO in case



Compact naked RO



High output naked RO



Economy naked RO

Preparing system for first use

If you plan to install your Rainman Watermaker, please consult *Appendix 2 Installation Guide*.

When initially delivered, the high pressure pump will have a travel oil plug fitted to contain the oil during shipping. You will need to swap it for the oil breather plug (supplied). To swap the oil plugs:

1. Remove the high pressure pump access cover from the Pressure Supply Unit by unscrewing 2 screws and lifting upwards.



2. Remove the black travel oil plug from the high-pressure pump using an 8mm (5/16') allen key.



3. Replace with the supplied breather plug.
4. The breather plug has the world OIL on it.

Save the travel plug in case the unit needs to be shipped in the future.

Note that the breather or travel plugs may be different colour than the photo suggests.

5. Replace the high pressure pump access cover.



Failure to use the breather plug will eventually lead to oil and or water leaks in the high pressure pump as it heats up during use.

Using the system

This section explains how to operate the system on a regular basis, including set up, starting, stopping, and flushing the system.

Setup - Portable

Portable

1. Place the Rainman Pressure Supply Unit (PSU) and Reverse Osmosis (RO) unit in a stable place on the deck of your vessel. A swim platform is an ideal location.

Certain positions on some vessels will resonate causing excess noise. In this case, place the unit on a towel or foam mat.



Make sure the PSU is no more than 2 metres (6 feet) above water level. The unit will work best operating as close to water level as possible.

Do not use on a swim platform if there is any chance of the unit getting wet.

2. Open the RO unit. Remove and uncoil the three hoses. Remove the white travel plug from the quick connect on the outside of the PSU. Connect the black high-pressure hose to the PSU. Make sure the high-pressure hose doesn't chafe around hard corners.
3. Remove the plastic spiral intake hose from the PSU and remove the cap. Attach the strainer to the end of the pickup hose.



Starting the unit with the cap in place will damage the pumps.

4. Place the intake hose in the source water.



Make sure the intake hose is submerged and is not on the sea floor or among seaweed, which can cause blockage.

5. Direct the green brine hose overboard.

6. Direct the white product hose overboard. Do not put it into your water tank at this stage.



7. Ensuring the power switch is off, plug the power cord into an AC power source. If using a generator, make sure it is rated to at least 2000 Watts peak, 1600 Watts continuous power. If using a Honda portable generator, make sure the eco-throttle is off. Once the Rainman is running, you can switch the eco-throttle back on. Make sure the voltage and frequency match the unit (eg. 115VAC/60Hz or 230VAC/50Hz).



Ensuring the power switch/circuit breaker is in the off position, connect the unit to a 12VDC power supply. During startup, the 12v PSU might draw up to 40A for a brief period and will settle down to 28-32A in normal operation once the motor and crank case have reached normal operating temperature. Therefore, it is important that the 12V supply can support this current draw without a significant drop in voltage.



Cable runs should be kept to a minimum. If an extension cable is used, it must be of sufficient gauge to minimise voltage drop. Several easy to use 'voltage drop calculators' are available online.

8. Ensure the pressure valve in the RO unit is in an open position (fully anti-clockwise).

- To use the flow meter, it needs to be set up vertically. Remove it from the centre of the RO assembly by sliding it slightly to the right and lifting it up as shown.

For normal seawater use, the product water flow meter need not be used and can be left in its horizontal position in the RO assembly.

- Hold the flow meter in a vertical position to read the flow rate or place it in the stand provided in the RO assembly.



It is very important to use the product water flow meter if you are desalinating brackish water, or water that you suspect might be brackish. See the section *Desalinating Brackish Water*.



Never allow water containing chlorine to enter your watermaker. That includes town or tap water, which contains chlorine, or water from a vessel's tanks, which also may contain chlorine. Chlorine damages RO membranes.



Never run the unit dry. It will damage the pumps.

Setup - Installed

Installed

- Ensure that the intake 3 way valve is turned to 'sea water intake' position. Ensure that any other valves in the intake plumbing are open and that the strainer is free of blockage.
- Ensure that the brine output is free from blockage.
- Ensure that the product water output is directed to 'test' and not to a water tank.
- Set the pressure control valve to fully open position (anti-clockwise).

Run – Portable or Installed

1. Switch on the Pressure Supply Unit.
2. Water will start flowing out the green brine output water hose. Wait until the stream of water is free of bubbles. Upon first use, it may take up to 15 seconds to see water come out of the green hose.



The 12V Pressure Supply Unit requires considerably more time to push all bubbles through the system. The flow rate of the 12V pump is less than the AC or petrol / gasoline units, which means that a small amount of air can cause the pump to cavitate. For these reasons 12V users, particularly upon first use of the system, or when air has entered the system for some reason, should wait 2-5 minutes for all bubbles to exit the system.

3. Gradually close the pressure control valve on the reverse osmosis unit by turning clockwise until the pressure gauge reads 55 Bar (800 psi). The correct pressure is indicated by the dark green area on the pressure gauge dial. For maximum membrane life, take about one minute to build to full pressure. Within 15 seconds water will start flowing out the white product hose.



Never exceed 58 Bar (850 psi). If you over-tighten the pressure control valve, the relief valve in the PSU will release and water will recirculate within the high pressure pump. This prevents damage to the RO membranes from excess pressure. However, prolonged operation of the relief valve can damage the unit.

Note: the clear liquid inside the pressure gauge is glycerine. This is to reduce vibration inside the gauge and ensure long and reliable service. It is normal to see a large bubble inside the gauge.

If you are using your watermaker for the first time, run for at least half an hour to flush all preservatives from the system.

4. Every time you use the unit, let fresh water flow out the white product hose for approximately 60 seconds to clear water or pickle solution that may be in the system. You should test the product water at this point by taste or with a TDS hydrotester.
5. When the product water is pure, direct the product water hose into a fresh water tank and allow the system to run uninterrupted until full. Check the pressure gauge approximately every ten minutes. Although the ideal pressure is 55 Bar (800 psi), the acceptable range is between 51-58 Bar (750-850 psi). A small amount of pressure drift is normal. Adjust if necessary.
6. If you are desalinating brackish water, or water that you suspect might be lower salinity than normal sea water, check that the product water flow rate is no higher than the recommended maximum for your system using the flow meter. See the section *Desalinating Brackish Water* for more details.



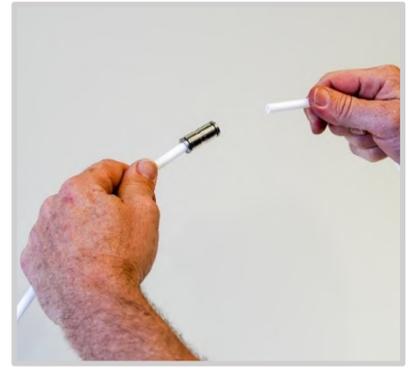
Variations in load and voltage will cause variation in rpm of the motor. This in turn causes variation in pressure. Therefore, the system pressure should be checked and/or adjusted after changes in voltage occur. These changes may occur when turning on or off an alternator, switching between battery banks, or because of gradual variations in output from solar panels and/or batteries.

Portable

7. Use the white 10 metre (30 foot) product water extension hose to fill multiple tanks without the need to move the desalination system. Use the push-fit joiner provided.

Product water flow will vary depending on several factors, including temperature and salinity. Warmer or lower salinity water will lead to higher levels of product water output. Natural membrane variability and other factors will play a role in product water output.

As a guideline every degree Celsius increase in water temperature, product water flow increases approximately 3%.



Shutdown - Portable

Portable

1. To switch the unit off, first slowly turn the pressure control valve in an anti-clockwise direction until the pressure reads less than 20 bar (300 psi).
2. Switch off the PSU.
3. If you intend to flush or pickle your system, refer to the *Care and Maintenance* section below.
4. Replace the cap on the intake hose to keep the unit primed during storage.
5. Replace the rubber boots on each of the other hoses to keep the system clean and prevent water dripping while stowed.
6. Wait 60 seconds for internal pressure to dissipate before disconnecting the black high-pressure hose from the Pressure Supply Unit.
7. Rinse the strainer in fresh water before storage.



Switching off the PSU while system is under pressure will cause pressure shock to the membranes and may damage them.

Shutdown - Installed

Installed

1. Slowly turn the pressure control valve in an anti-clockwise direction until the pressure reads less than 20 bar (300 psi).
2. Switch off the PSU.
3. Turn the product water 3 way valve back to the test position.
4. If you intend to flush or pickle your system, refer to the *Care and Maintenance* section below.
5. Close the sea water intake valve in accordance with your normal routine.



Switching off the PSU while system is under pressure will cause pressure shock to the membranes and may damage them.

Desalinating while under way

Your Rainman watermaker can be operated while under way. Ideally, your unit should be installed and connected to a through hull that is always underwater at all angles of heel and roll. In this case you can operate your system as per the normal procedure outlined above.

Depending on hull shape, speed, and the sea state, air bubbles can find their way to a through hull fitting even if it is well below the water. Some boats, speeds and sea states are not suitable for making water underway.

Several Rainman owners have been successful in using their portable watermaker while under way without a dedicated through hull by trailing the intake hose in the wash at the stern of their vessel. To prevent air working into the system, customers have used either weights or a down pole to hold the intake below the surface.

Slide the intake cap up the intake hose and securing it on board the vessel so that the end of the intake hose can sink sufficiently below the surface.

Do not use the detachable suction strainer when towing the intake hose.



If the intake hose is sucking air, the membranes may be damaged.

Another method of using a portable system whilst underway is by supplying it via a deckwash pump, providing that it is fed from an intake that is below the waterline at all angles of heel and has a minimum flow rate of 10 litres/min, and a maximum output pressure of 3 bar (45 psi).

If using a portable Rainman whilst underway, make sure the system is placed securely and protected from getting wet.

Desalinating brackish water

Brackish water contains some level of salt but is less salty than seawater. Examples include estuaries, harbours and saline aquifers (bore water). After heavy rain, some sources of seawater can become less saline.

The product water output levels increase when operating in this decreased salinity source water. If the product water output level goes above the maximum rated output, it may damage the membrane. When desalinating brackish water, use the product water flow meter.

To desalinate brackish water, follow the setup and run instructions as described above, however, whilst increasing the pressure, observe the flow meter. If it reaches the rated maximum product water flow for your system, stop increasing the pressure at this point. Note that in instances of very low salinity water, this pressure can be as low as 13 bar (200 psi).



When desalinating brackish water, it is important to monitor the fresh water production rate using the flow meter, so as not to exceed the maximum flow rate for the membranes.

Rated maximum outputs

PSU / RO Type	High Output	Compact	Economy
AC Electric	140 lph (37 gph)	70 lph (18 gph)	70 lph (18 gph)
Petrol / gasoline	140 lph (37 gph)	70 lph (18 gph)	70 lph (18 gph)
12VDC	Not Compatible	Not Compatible	34 lph (9 gph)



Exceeding the maximum fresh water production rate may damage the membranes.

Care and maintenance

Storage

Always store your Rainman watermaker upright in a dry and ventilated area. Dry any obvious moisture off the unit before putting it away. Water can drip from the unit during storage, particularly in hot weather, and it is very important that there is sufficient ventilation to avoid creating an overly humid environment.

Always store the pickle solution mix away from the watermaker.



Seawater and/or pickle solution in an unventilated sealed enclosure in the presence of metals can quickly become a highly corrosive environment, causing anaerobic corrosion to any metal, including marine grade 316 stainless steel.

These photos show severe anaerobic corrosion to a system that was stored in an unventilated locker with pickle solution for just 1 month.



Reverse osmosis membrane care

The Dupont Filmtec membrane or membranes in your Rainman watermaker should last between five and ten years if well cared for. The primary way RO membranes are damaged is through biological growth or 'fouling' on the surface of the membranes. This occurs if seawater is left sitting inside the RO pressure vessels for extended periods of time.

In temperate climates, growth can occur in less than two weeks, in tropical climates, growth can occur in as little as a few days. There are no precise times in which fouling can occur, only general guidelines. A conservative approach to membrane care will maximise membrane life.

Regular use of your watermaker is the most effective prevention against fouling. That means using your system at least weekly in temperate climates and every few days in the tropics.

If you are not using your watermaker frequently enough to prevent fouling, then it should be flushed with fresh water or a 'pickle' solution.

The following table is a guide to when you might need to flush or pickle:

If unused for 2 days or less	No treatment necessary
If unused for between 2 and 7 days	Fresh water flush
If unused for between 7 and 30 days	Pickle the system
If unused for 30 days +	Pickle the system, discard the pre-filter and drain the pre-filter housing. Some pre-filters can turn black if stored too long in pickling solution.

When storing the unit for more than a month, discard the pre-filter and drain the pre-filter housing. Some marine deposits can continue to decompose even when immersed in a pickling solution.

Fresh water flushing

The Rainman automatic fresh water flush system is an optional unit that automatically flushes your system with fresh water from your boats water tanks every 7 days. Instructions for the Rainman automatic fresh water flush system are in Appendix 3.

To flush your system manually:

1. After the fresh water tank is full, use the product water direct from the watermaker to fill an open container of water with approximately 10 litres (2.5 gallons) of fresh water.
2. Open the pressure control valve completely and switch off the unit. Remove the intake hose from the source water and place it in the open container of fresh water. Ensuring the pressure control valve remains open, start the unit and run the entire contents through the system. If the watermaker is installed, use the 3 way valve on the intake to draw water from the bucket.
3. When the bucket is almost empty, switch off your watermaker, leaving the fresh water in the system.



Never allow the bucket to run dry while the pump is running or the system may be damaged.



Never flush your watermaker with water containing chlorine, which will damage the membranes. That includes town or tap water, which often contains chlorine, or water from a vessel's tanks, which also may contain chlorine.

Pickling your watermaker

Pickling fills the membrane housings with a preservative that prevents fouling for up to twelve months.

The best preservative is propylene glycol. Since propylene glycol is a liquid, it is impractical and expensive to ship and store useful amounts. The most commonly used preservative is food grade Sodium Meta-Bisulphate (SMBS) mixed from powder. 1 kg of SMBS powder is supplied with your system. This section describes pickling your system. If you wish to use propylene glycol, instructions are included under the next heading, *Pickling in cold climates*.

1. To pickle your watermaker, add 3 X 29ml scoops (approx. 3 heaped tablespoons) of SMBS powder to a 10 litre (2.5 gallon) bucket of fresh water, making a 1% solution of SMBS. After opening the pressure control valve completely, switch off the unit, remove the intake hose from the source water and place it in the open container of fresh water. Start the system again, keeping the pressure control valve open and run the entire contents through the system.
2. When the bucket is almost empty, switch off your watermaker, leaving the pickling fluid in the system. Do not allow the pickling solution bucket to run completely dry while the PSU is running.

When storing the unit for more than a month, discard the pre-filter and drain the pre-filter housing.

Your watermaker is now pickled and can be stored for up to twelve months.



Do not use SMBS solution at greater concentrations than specified above. High concentrations of SMBS can be corrosive and damage your system.



Avoid inhaling SMBS dust or fumes from SMBS solution. Inhalation of SMBS dust or fumes can cause respiratory problems.



Always store SMBS in a sealed container, in a dry, ventilated place. Even small amounts of air-borne moisture in an enclosed space can react with the SMBS and create a corrosive environment.

Pickling in cold climates

If there is a chance that your watermaker will be exposed to freezing temperatures, you'll need to pickle the unit with Propylene Glycol (PG), otherwise known as potable antifreeze. This will prevent damage to the unit through freezing, as well as preventing biological growth.

There are various brands of potable antifreeze available. It is important to note the percentage of PG in the product. Potable antifreeze labelled 'concentrate' is usually near to 100% PG, however, some brands are pre-diluted.

For freeze protection to -15°C (+5°F), use a solution of 30% PG / 70% fresh water.

For freeze protection to -40°C (-40°F), use a solution of 50% PG / 50% fresh water.

Note: if your system has already been pickled with SMBS, flush this out with 10 litres (2.5 gallons) of fresh water before pickling with PG. Mixing SMBS and PG can damage your system.

1. To pickle your watermaker with potable antifreeze, fill a bucket with 10 litres (2.5 gallons) of PG/fresh water solution. With the unit switched off, place the intake hose in the open container of potable antifreeze solution.
2. Start the unit with the pressure control valve wide open. When the bucket is almost empty, switch off your watermaker, leaving the pickling fluid in the system. Do not allow the pickling solution bucket to run completely dry while the PSU is running.

Your unit is now protected from freezing and from biological growth for up to twelve months.

Changing the pre-filter

Pre-filters should be changed when they become visibly fouled.

1. To change the pre-filter, place the Pressure Supply Unit (PSU) on the deck of your vessel. Use the supplied filter wrench to remove the clear filter housing.
2. Replace the cartridge.
3. Fill the housing with water before screwing it back on. This will aid the priming of the pump.



Note: the correct type of cartridge is a 'sediment' or 'particle' type cartridge with a 5 micron rating. Do not use a carbon cartridge. Some carbon cartridges also function as sediment filters, and therefore may be labelled as 'sediment' cartridges and have a 5 micron rating. These are NOT suitable for use with your Rainman watermaker as they will restrict flow rates and cause problems with your high pressure pump.

High pressure pump maintenance

We recommend you change the pump's crankcase oil annually. It is important to check the oil level from time to time, particularly if you have had oil leak or spill from the pump at any time.

The correct oil to use is SAE 30 oil. Any grade that ends in 30 is suitable i.e. 5W-30, 10W-30 and 15W-30 are all suitable. These are the most common grades of automotive engine oil. The equivalent ISO oil grade is ISO100.

1. Crankcase oil can be drained by removing the stainless hexagonal plug on the underside of the high-pressure pump.



2. To refill the crankcase oil, remove the high pressure pump access panel by undoing 2 screws and then remove the breather plug on the top of the high-pressure pump. Using a funnel as shown, add 330ml (11.2 ounces) of oil.



3. Oil levels can be checked through the hole in the end of the case. The oil level should be visible in the clear window.



Lift pump service

The impeller in the brass lift pump is a consumable item. We recommend inspecting the impeller for signs of wear or cracking every 12 months or 500 hours and replacing if appropriate. The photo on the right shows a heavily worn impeller.

As a matter of preventative maintenance, replace the impeller every 2 years or 1000 hours.



The lift pump impeller can be accessed through the triangular port after removing the pre-filter bowl.

1. Using a 7mm socket, remove the 3 bolts and the triangular plate.
2. The impeller can then be removed with needle-nose pliers.



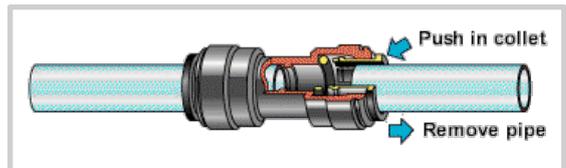
3. Replace impeller with needle-nose pliers using a rotating motion to bend the fins and align the cross-screw with the slot in the shaft.



Push-fit instructions

Rainman watermakers use push-fit connectors for brine waste and product water.

To connect, simply press the hose firmly into the connector. To remove a hose from the Push-fit, press in the collet as shown in the diagram.



Shipping

To prepare the unit for shipping:

1. The travel plug must be in the high-pressure pump.
2. The machine should be put inside a plastic bag before it is packed.

Service

If your watermaker exhibits any of the following problems, stop the unit immediately and consult a qualified technician:

- Unusual noises or vibration.
- The system pressure will not reach 55 bar (800 psi).
- With the unit running, there is no water flow through the green brine output water hose.
- The white product hose continues to make salty tasting water after several minutes at 55 bar (800 psi).
- Major leaks of water in the PSU or the RO unit.

Warranty

Rainman watermaker are guaranteed to be free of manufacturer defects and to perform within the published specifications for a period of two years from the date of shipment to the original purchaser.

In the event of a warranty claim, Rainman Technology will inspect the defective component and repair or replace at our discretion. Shipping charges are the responsibility of the purchaser to and from our facility in Sydney, Australia.

The warranty is void if the system was mis-handled, abused, or not operated/maintained as directed by the user manual. Consumable items, such as the filter cartridges, lift pump impeller, high pressure pump oil, high pressure pump packings, or RO membranes are not covered under the terms of this warranty.

Rainman Technology's liability under this warranty is limited to repair or replacement of our systems to the original purchaser. Under no circumstances is Rainman Technology liable for consequential damages related to failure of the system to perform.

Appendix 1 - Troubleshooting

Symptom	Possible Cause	Resolution
HP hose vibration, and/or Excessive pressure fluctuation, and/or System unable to come up to 55 bar (800 psi)	HP pump is starved of water and is cavitating	A black high pressure hose vibration or the system inexplicably failing to come up to pressure is usually a simple issue to resolve. 95% of the time the issue is due to a blockage or flow restriction upstream from the high pressure pump, causing it to cavitate. Several possible causes exist and there are a number of things to explore. You are looking for items that can restrict flow to the high pressure pump, so you are searching upstream from there. Check the following:
		1. Replace the pre-filter if dirty. A dirty filter can block flow, starving the high pressure pump of water supply. Do not just clean it as sometimes it can look clean but is still clogged.
		2. Ensure the pressure supply unit is within 2 metres (6 feet) of sea level. The system being too high can make the lift pump work too hard and decrease its effectiveness. This can starve the high pressure pump of water supply.
		3. If you recently changed the pre-filter, did you leave any small parts of the plastic wrapping on it, which may now be clogging the flow in the filter housing?
		4. Ensure the pre-filter cartridge is only a particle filter, not a combination carbon and particle filter. Some carbon or dual carbon/particle cartridges are labelled with micron ratings and look like particle filters. These can restrict flow and cause cavitation.
		5. The seawater end of the intake hose has a check valve. If something gets in there, it can jam and restrict flow. It is easy to disassemble and check, but be careful of small parts. Turn both sides of check valve counter clockwise against each other and it will separate in the middle. Inspect for items that are small enough to get through the strainer and clog the valve.
		6. Is the intake hose damaged and sucking air in? This could be from continual rubbing against a part of the boat that wore a small hole in the hose. If so, this hose needs repair or replacement.
		7. If you have installed your Rainman system, check all items upstream from the pressure supply unit to see if something is starving the Rainman of free flowing water. We recommend all fittings on the intake side should be a 3/4' inner diameter. The Rainman system should have exclusive use of the through hull while in operation.
8. Inspect the impeller on the lift pump for wear. Replace if necessary.		

Symptom	Possible Cause	Resolution
		<p>9. Sometimes an air bubble or small debris can get stuck in the high pressure pump, causing cavitation. It can often be cleared simply by restarting the system and increasing/decreasing pressure a few times.</p> <p>10. A small amount of air in the prefilter is fine, but excessive air that won't go away (>1' from top) indicates a likely air leak in the system. Check gasket in prefilter housing.</p> <p>11. If there are no blockages, then it is possible the high pressure pump packings need replacement. This is extremely rarely the case. Experience has proven that most people getting to this step have missed a blockage in one of the above steps.</p>
Salt water drip under HP pump	HP pump packings are worn	Replace HP pump packings.
AC - Generator trips when starting	Inadequate power source	Try running with a stronger power supply to isolate whether the problem is with the Rainman system or power supply.
	GFCI (ground-fault circuit interrupter)	Speak to your electrician about replacing or bypassing this. Some GFCI's do not work well with induction motors.
	Run capacitor	<p>An AC induction motor requires a run capacitor to keep the voltage and current in phase with each other. If the capacitor burns out, they get out of phase with each other and the 'power factor' decreases causing decreased efficiency. The motor starts drawing more current from the generator to do the work that is required to operate at the required pressure and flow rates. This has two effects. First, it increases the current draw of the motor above specifications, which may trip a breaker or generator. If it does not trip the breaker, then the motor will heat up due to increased current, eventually burning out the windings, causing motor failure. If you are interested in further technical information on this, try googling for videos 'ac induction motor run capacitor power factor' or similar. If the capacitor has only recently blown out, and the breaker has been tripping, there is a good chance we can simply change run capacitors in the motor. If it has been running for a while with the capacitor blown out, the motor may need to be replaced. There motor is not particularly expensive, but because of the through shaft to hold both pumps, it would need to come from Rainman.</p> <p>The simplest way to check if the system is running okay is by using a current meter. A 230VAC system should be operating at approximately 6 amps, while the 115VAC system should be about 12 amps. Alternatively, you can inspect the capacitor box and a burned run capacitor will usually be blackened. This means removing the plastic shell to inspect it.</p>
AC - System is using more power than expected	Run capacitor	See explanation under 'AC - generator trips when starting'.

Symptom	Possible Cause	Resolution
12VDC - Current draw higher than expected	Battery voltage low	Ensure batteries are fully charged.
	Battery lead too long causes excessive voltage drop	Move PSU closer to source and shorten battery leads.
Water tastes salty, TDS increasing unexpectedly	Worn membrane	The TDS (total dissolved solids) readings will vary throughout the life of your system. In general, the TDS should be increasing slowly over several years. Most people change the membranes once they get to about 700-800 ppm (parts per million) of TDS. Conditions that can cause TDS to vary include source water TDS, source water temperature, operating pressure (typically lower pressure during brackish water operation), or operating flow rates. If you have a two membrane RO unit, you should split the joiner of the product water hoses and test each membrane separately. It is normal for the first membrane to have slightly higher flow rate and slightly lower TDS than the second membrane.
	Cracked RO membrane or spigot	This is an extremely rare failure. If the TDS level is increasing rapidly over a matter of weeks, it may be possible that the membrane spigot is failing. The membrane should be replaced immediately.
	Pressure vessel O-ring failure	It is not normal for an O-ring on the pressure vessel to spontaneously fail. If there are problems, it is typically after changing the membrane.
Difficult to insert HP hose into PSU fitting	Worn O-ring inside female side of HP quick connect fitting	Acquire a replacement O-ring. The correct ring is a -110 (3/8' ID, 3/32' section). Using a sharp point, e.g.: a large needle or sharp piece of wire, pierce the old O-ring and pull one side of it out of the groove. Now you can hook it out with a small hook, made from a paperclip would be ideal. To put the new O-ring in, push it down with a small flat head screwdriver or similar, until you can push one side into the groove. You should then be able to push the other side down until the whole o ring pops into the groove.
Liquid bubble is in pressure gauge	This is normal.	No action required. Liquid filled gauges are the highest quality and most durable ones available. The air bubble is part of design and exists to allow the glycerine fluid to expand and contract as the temperature fluctuates. The purpose of the glycerine fluid is to dampen needle movement.
Impeller is swollen	It is more than a year old or stored in too strong of pickle solution	If the system is pickled in a strong solution for an extended period, it will cause the impeller to swell. This impedes the performance of the impeller and it should be replaced.

Symptom	Possible Cause	Resolution
Oil drips from HP pump	Seals in the HP pump have failed	1. This is usually a result of not changing the travel plug to the breather plug when commissioning the system. When the pump warms up and there is no breather plug, the air inside expands and forces oil out through the seals. The issue may resolve itself by installing the breather plug.
		2. The plunger oil seals are worn and need replacing.
HP hose casing cracked or worn	HP hose vibrating against an edge or other object.	The black casing is cosmetic and will not affect performance. The HP hose can be replaced if it is near failure.
Product water flow is unexpectedly high	RO membrane has failed	Check salinity of product water. If salinity is high, follow options above for increasing TDS.
	You are in brackish or fresh water	Brackish water is salty water, but lower salinity than seawater. When you go into brackish water, the product water output increases. If you go above the specified output of your system, you should decrease the operating pressure until you are within the spec. See section in manual on brackish water.
Other issue not listed in table		Contact your dealer or Rainman at support@rainmandesal.com



Rainman Watermaker Installation Instructions

(Appendix 2 of General Instruction Manual)

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Version 3.3

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Installation Overview

The Rainman installation system consists of parts that will allow you to install your AC electric or 12VDC watermaker. This is a guide only. Installation will vary from vessel to vessel.

All electric Rainman systems can be installed. The systems in the traditional blue case can be either installed or run as portable. The Rainman Naked systems are specifically designed for a minimum footprint installation. The plumbing hardware described in this manual is included with a Rainman Naked system, or available as an optional item for the classic Rainman system in a blue case.

A system installation can be divided into the physical installation process and then plumbing the system into your vessel.

Physically Mounting Your Watermaker

The mounting system is moulded from rugged fiberglass filled nylon and has been designed to make the physical installation of your system as quick and easy as possible. The white blemishes that may exist on some parts are normal residual from the moulding process.

Mounting Naked Pressure Supply Unit (PSU)

The mounting system for the Naked PSU has three parts. The mounting seat on the base and two mounting frames on each side.



The PSU needs to be correctly oriented when placed in the mounting assembly. The embossed diagram on the seat shows the correct orientation. The two side frames are labelled A or B, and must be used on the correct sides of the base seat. There are notches to prevent you from installing them on the incorrect side.



When selecting a suitable mounting position, consider the following points:

- The mounting kit should be secured to a level surface and positioned in such a way that there is a minimum 100mm (4") of clearance on one side to allow for working space to complete the assembly.
- Each hose run between the PSU and the pre-filter should be no more than 2 meters (six feet).
- Ensure that both the high pressure output fitting and the on/off switch are accessible.
- The motor on PSU is air cooled and has a fan to push air over the motor. The motor is rated to stay under its max operating temperature in a max surrounding air temperature of 40C (104F). If the unit is mounted in an enclosed space without adequate ventilation, the air in the space will heat to over 40C (104F) very easily. If you are mounting the PSU in an enclosure with other machinery (e.g. in an engine room), it is very important to ensure that the ambient temperature remains below 40C (104F) whilst your watermaker is running concurrently with other machinery.

Instructions

1. Before you fasten the mounting seat to the surface, attach the frame to the seat on the side that will have the least clearance when the unit is installed. Use two of the countersunk M6X20mm machine screws supplied for this.



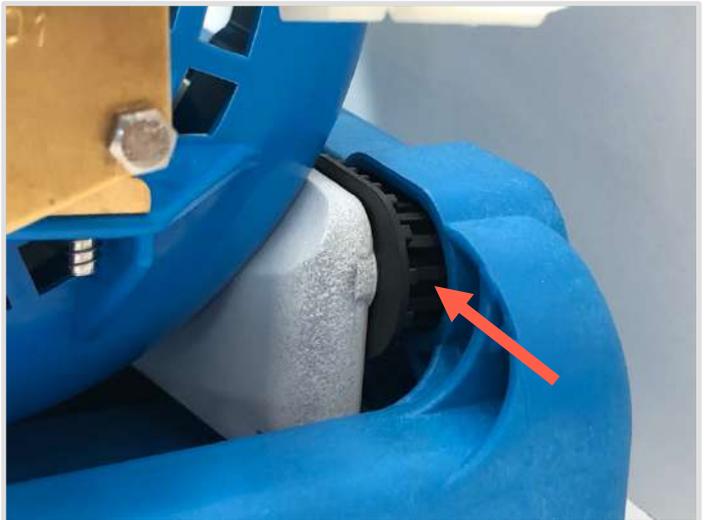
2. Fasten the mounting seat to a level surface using all four holes. Use the self-tapping screws provided, or your choice of alternate fastener.



- Slide the PSU into the mounting seat as shown. Ensure the PSU orientation matches the embossed diagram on the mounting seat.



- As you place the unit in the mounting seat, taking care to align the black rubber vibration isolators on the PSU with the corresponding holes in the side frame.



- Slide the other mounting frame onto the mounting seat, taking care to align the holes in the frame with the black rubber vibration isolators on the PSU. This may require lifting the PSU slightly.



- Fasten the side rail to the mounting seat using the remaining two countersunk machine screws.

7. Mount the prefilter bracket as close to the PSU as possible, not exceeding two meters (six feet). Before installing the prefilter, consider how you will run the tubing to the 'IN' and 'OUT' sides of the prefilter. It is very important that the tube from the brass lift pump runs to the "IN" side and the tube from the "OUT" side runs to the high pressure pump.
8. Using the white ½" tube supplied, connect the 'IN' side of the prefilter to the corresponding fitting on brass lift pump on the PSU. Now connect the 'OUT' side to the push fitting on the side of the high pressure pump.

Mounting Cased Pressure Supply Unit (PSU)

The cased PSU can be mounted using the mounting seat and strap provided.



When selecting a suitable mounting position, consider the following points:

- The mounting seat should be secured to a level surface.
- Ensure that both the high pressure output fitting and the on/off switch are accessible.
- The motor on PSU is air cooled and has a fan to push air over the motor. The motor is rated to stay under its max operating temperature in a max surrounding air temperature of 40C (104F). If the unit is mounted in an enclosed space without adequate ventilation, the air in the space will heat to over 40C (104F) very easily. If you are mounting the PSU in an enclosure with other machinery (e.g. in an engine room), it is very important to ensure that the ambient temperature remains below 40C (104F) whilst your watermaker is running at the same time as other machinery.
- The PSU should be placed in the mounting assembly in the correct orientation. The embossed diagram on the mounting seat shows the correct position.

Instructions

1. Fasten the mounting seat using all four holes with the self-tapping screws provided or your choice of alternate fastener.
2. Slide the strap through the slot on the underside of the mounting seat.
3. Place the PSU in the seat.

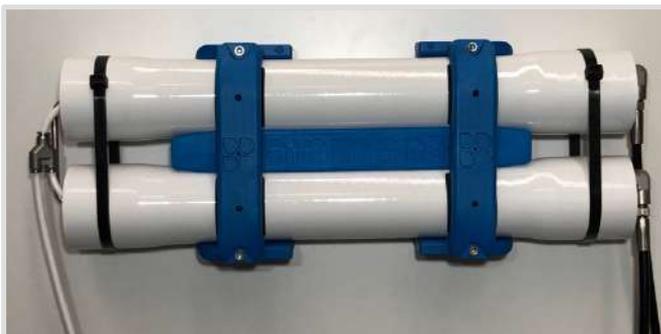
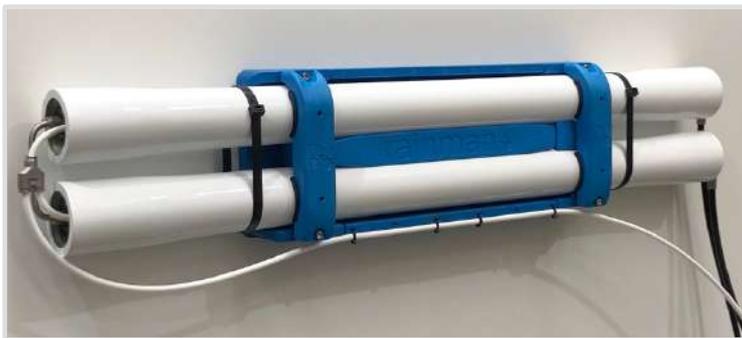
4. If the pickup hose is coiled in the side pocket, pass the strap outside the pocket. If the pickup hose is not in the side pocket, pass the strap through the pocket. The external pocket of the case can be removed if desired to slightly reduce size.
5. Tighten the strap.

Mounting Naked Reverse Osmosis (RO) Unit

The mounting system for Rainman RO High Output (twin 40" membranes) or Economy (single 40" membrane) are the same and consist of three parts. One back bracket and two mounting saddles. The Compact unit (twin 21" membranes) consists of four parts, including two abbreviated back brackets and two mounting saddles.



The RO units can be mounted either horizontally or vertically.



For most mounting surfaces, a total of four fasteners will be adequate. More mounting holes have been provided for placing up to 12 fasteners. 4 x 14 Gauge countersunk self-tappers are provided in the kit.

Instructions

1. Fasten the back bracket using the appropriate fasteners. It is usual to mount against a wall, but the back bracket also has angled holes for mounting on a floor if desired. If you have a Compact RO unit (2 x 21" membranes), the abbreviated back brackets should be mounted 250mm (10") apart as in the photo above.



2. Ensure all four rubber pads are in place.



3. Place RO assembly in the back bracket. Note that the Economy RO unit (single 40" membrane) will only occupy one slot in the mounting bracket.



- Secure the RO unit by attaching the two saddles firmly using the four M6 x 40 cap screws provided.



- Use slots on the back bracket with zip ties to tie off hoses, keeping the set up tidy.

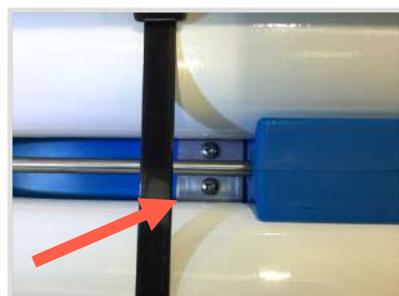
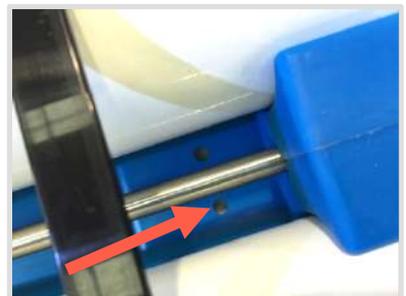


Mounting Cased Reverse Osmosis (RO) Unit

The cased RO units include plates and screws to assist with mounting the systems while in the case.

Instructions

- Place each mounting plate inside the case, over the two holes in the rear. Use double sided tape or other adhesive to hold the plates in position during installation.
- Fasten the unit to the surface using the screws provided, or your choice of appropriate fastener.



Mounting Pressure Control Valve / Gauge Assembly

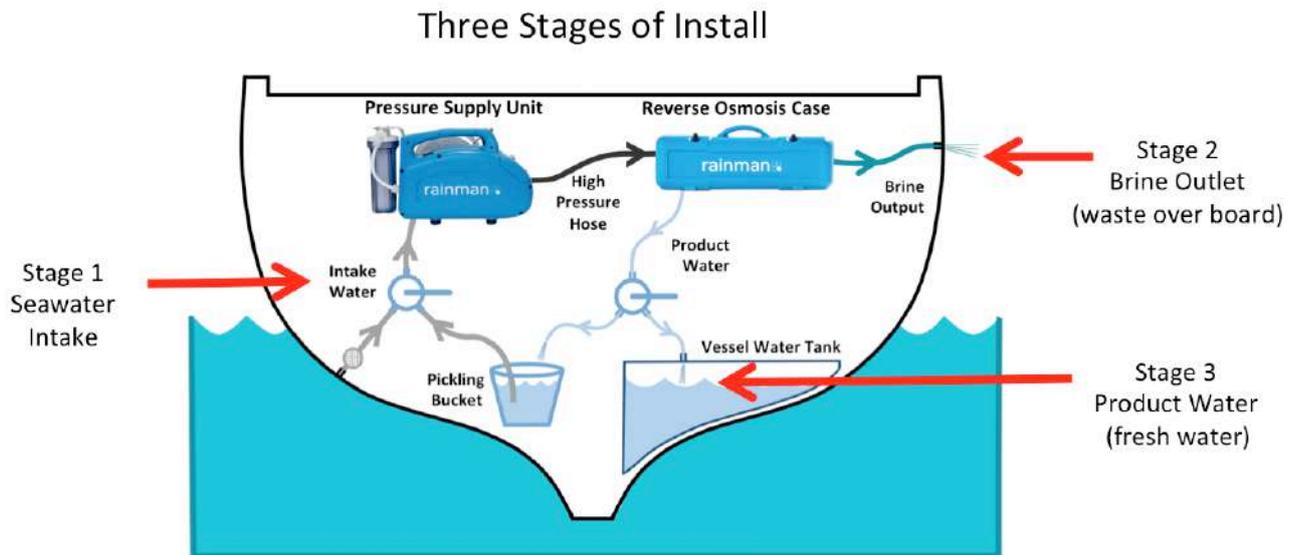
The Rainman remote control consists of a simple pressure control valve / gauge assembly that can be mounted up to 5 meters (15 ft) away from the related RO unit. This configuration allows for a minimalist installation or integration with a broader control function. It has significant flexibility on how to physically install the assembly, as per sample photos below.



Plumbing Watermaker Into Your Vessel

Regardless of whether you have a Rainman Naked system or the traditional Rainman in the blue case, the process of plumbing it into your vessel is the same. The plumbing installation is broken into 3 stages.

1. Seawater intake
2. Brine outlet (waste over board)
3. Product (fresh) water connection to fresh water tank



Stage 1 - Seawater Intake

- 5 x 3/4" hose barbs
- 1 x 3/4" BSP tee female
- 1 x 3/4" BSP 3 way valve 316 S/S with reversable handle sleeve
- 12 x Hose clamps
- 1 x 1/2" hose barb
- 1 x 1/4"-1/2" hex nipple



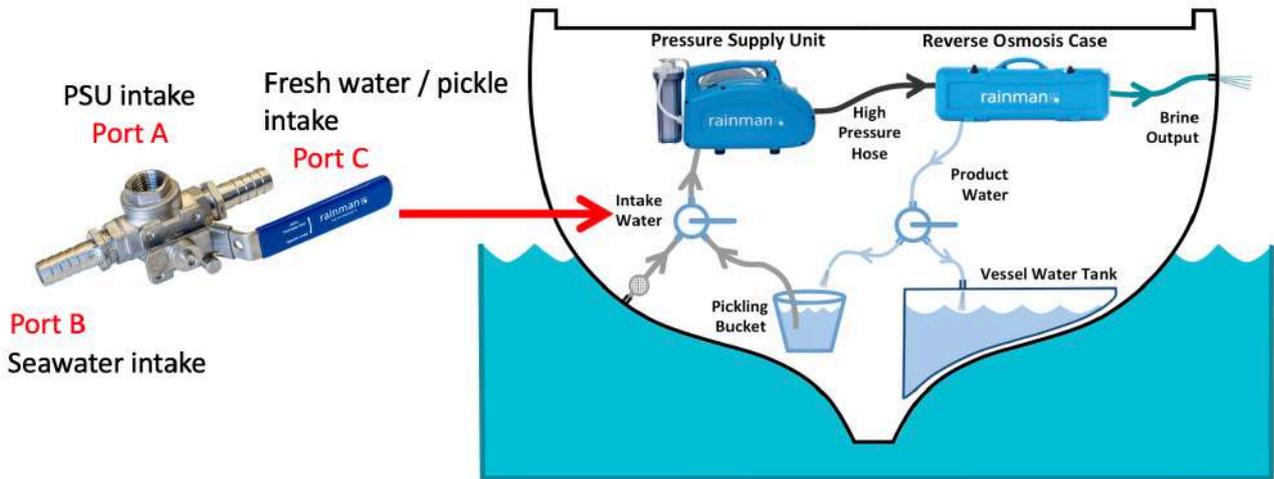
The installation kit provides enough hose clamps to double clamp each hose barb. You will need to use sealant (example SikaFlex or similar) on each hose barb before connecting hoses.

Option 1 - Dedicated Through Hull

If you already have a spare through hull or plan to install a new 3/4" through hull fitting with valve for your Rainman seawater intake, follow these steps to complete the intake install.

1. Make sure the through hull fitting and valve are 3/4" inner diameter.
2. Connect the intake hose non-return valve from the PSU to the middle port (Port A) of the 3 way valve. Use thread sealant to ensure no leaks.
3. You will need a sea strainer fitted directly to or off the 3/4" valve. (not supplied by Rainman)
4. Plumb the 3/4" 3 way valve supplied from the sea strainer to the seawater intake port of the 3 way valve (Port B).
5. Connect a loose hose to the fresh water / pickle intake. (Port C)

Intake hose installation – 3 way valve Dedicated through hull



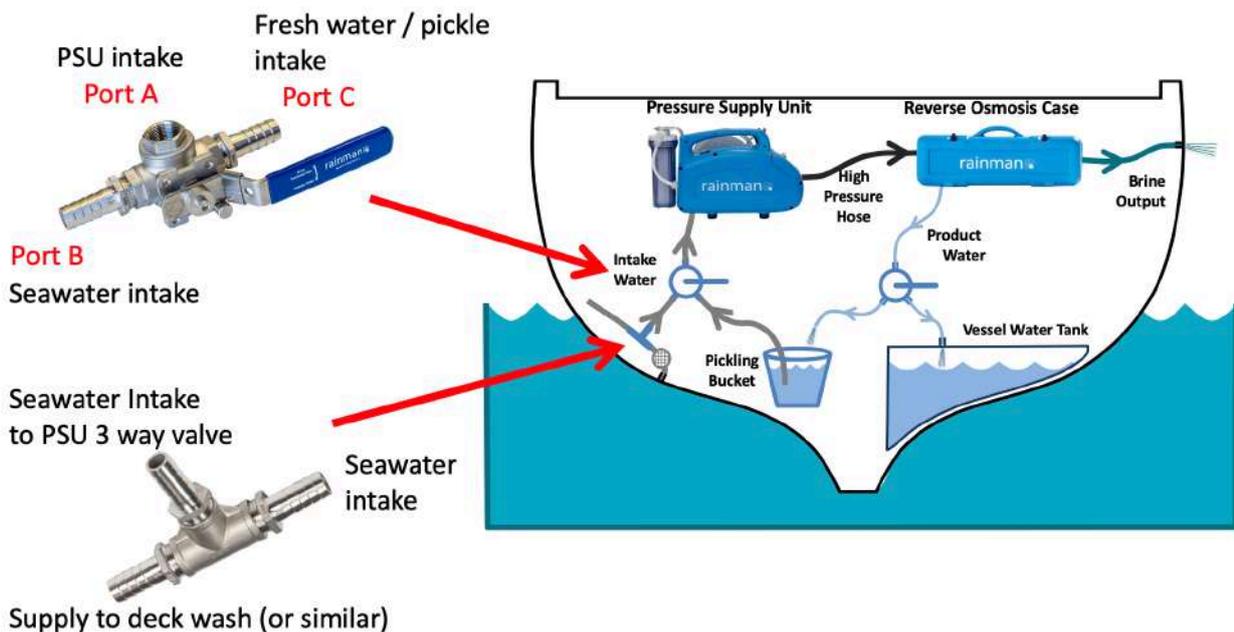
Option 2 - Shared Through Hull

If you do not plan to install a new through hull or have a spare 3/4" through hull fitting and valve, you can also explore teeing into a seawater supply hose that already exists. For example, teeing into the 3/4" supply hose for a deck water pump or similar.

Ensure your Rainman system is not competing for water while running with a shared through hull.

1. Cut the existing 3/4" supply hose (example: deck wash pump) and add the tee piece supplied.
2. Connect the intake hose non-return valve from the PSU to the middle port of the 3 way valve (Port A). Use thread sealant to ensure no leaks.
3. Plumb the tee piece to the seawater inlet of the 3 way valve. (Port B)
4. Connect a loose hose to the fresh water / pickle Inlet. (Port C)

Intake installation hose – 3 way valve Tee connection to existing 3/4" hose



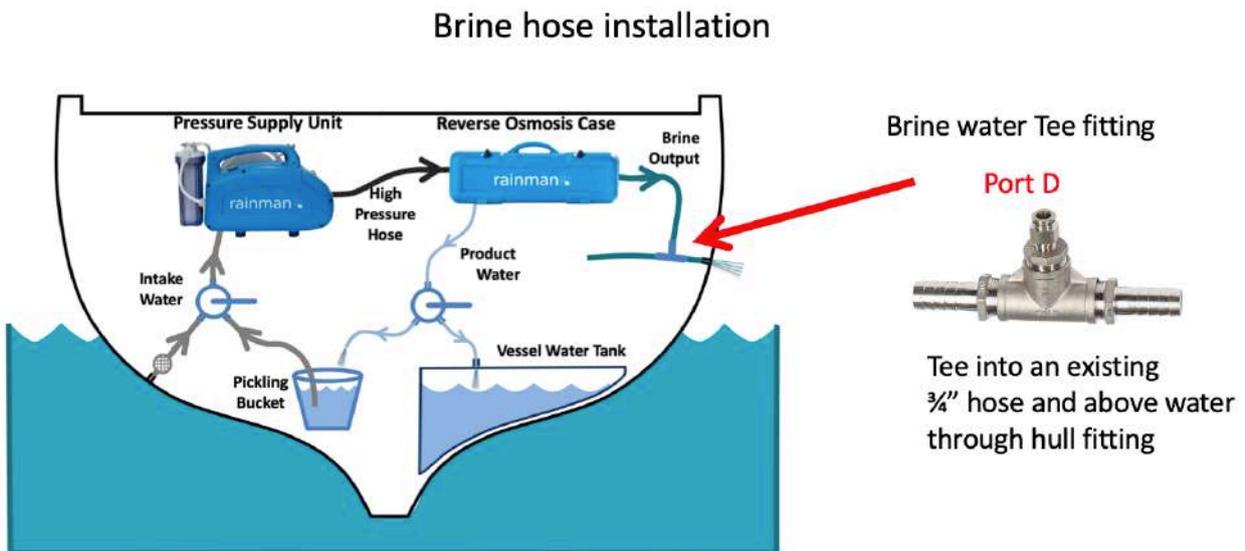
Stage 2 - Brine outlet (waste overboard)

- 2 x 3/4" hose barbs
- 1 x 3/4" BSP tee female
- 1 x 3/4"-1/4" bush
- 1 x 1/4" - 10mm push-fit
- 4 x Hose clamps

The brine waste water hose will come from the RO unit in the traditional blue cased version of the system. If you have a Rainman Naked system, the green brine hose will come from the remote pressure control valve / gauge assembly.

Run the green brine hose from the RO unit to an above water through hull fitting, cable tying along the way to secure. Parts are supplied so you can easily connect to an existing 3/4" hose connected to an above water through hull fitting. Tee into the existing 3/4" hose with the tee supplied and plug the green brine hose into the brine push-fit (Port D).

If you have a spare above water through hull fitting, you may need to source parts to connect to the 1/4" - 10mm push-fit.



Stage 3 - Product (fresh) water connection to fresh water tank

- 1 x Plastic 3 way valve (diverter valve fresh water tank and for testing)
- 1 x 8mm push-fit

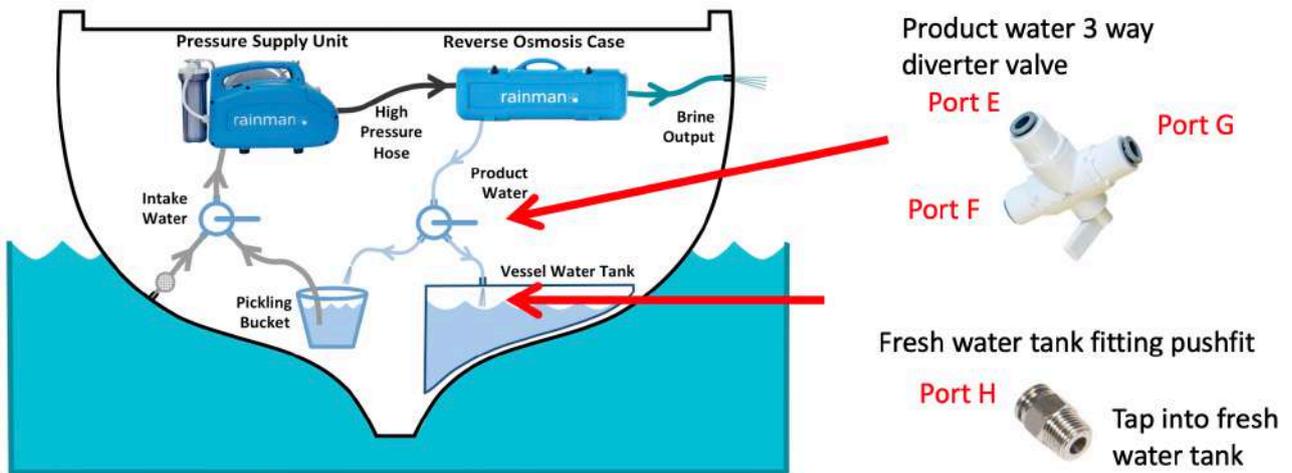
1. Run the white product water hose from the RO unit to your fresh water tank, cable tying along the way to secure.
2. Tap the 8mm push-fit into the tank and push the end of the white product water hose into the push-fit (Port H).
3. In a convenient place, cut the white product water hose and install the 3 way valve by pushing one side of the hose into the "in" (Port E) and the other side into the "out" (Port F) port. In the other out port (Port G) connect a loose hose (this loose end will become your testing hose).

Use a sharp knife to cut the white product water hose. Make sure the hose is cut straight to ensure correct fitting into the push-fit fitting.

The white product water hose can be plumbed different ways, such as:

1. Direct to your fresh water tank by tapping the supplied fitting as described above.
2. Connecting it to the filler hose to your fresh water tank.
3. Leave the white product water hose loose and manually putting it into your deck filler each time you use your Rainman watermaker.

Product water hose installation



Extra items you may need

There are some items you may require for your installation that are not part of the plumbing installation kit.

1. Sea strainer
2. Extra 3/4" hose
3. 3/4" through hull fitting and valves



Rainman Autoflush Instructions

(Appendix 3 of General Instruction Manual)

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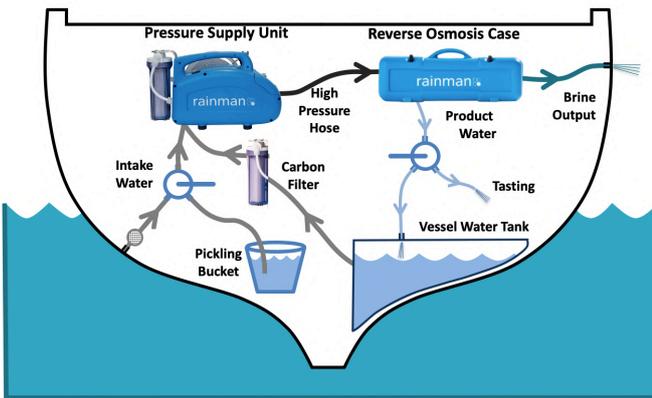
Version 1.3

Introduction

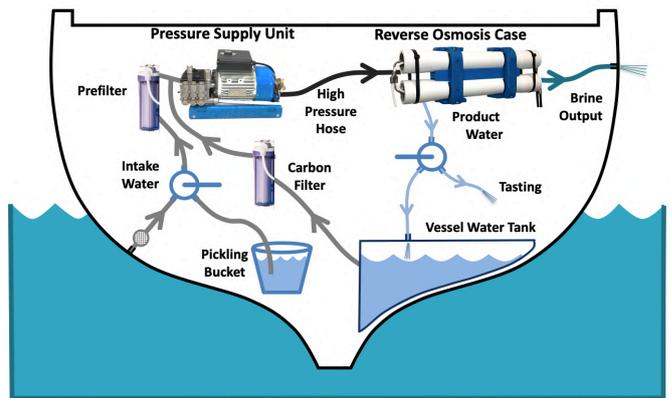
The Rainman autoflush kit is an optional accessory for customers that have installed their Rainman watermaker. It is designed so that owners do not need to pickle their system, but instead pumps fresh water through the watermaker every seven days. This prevents fouling of the reverse osmosis membranes.

The system utilises the boat's main water pump, a Rainman flush timer box, a motorised valve, and an activated carbon filter (neutralises chlorine that may be in your water tank) to force fresh water through your watermaker for several minutes every seven days. The flush timer has a simple one button programmable capability for ease of use. Below are conceptual schematics of how the system might look when installed.

Rainman Case Installed – Autoflush



Rainman Naked Installed – Autoflush



Included Parts

The following image shows the parts that are included in your Rainman Autoflush kit.

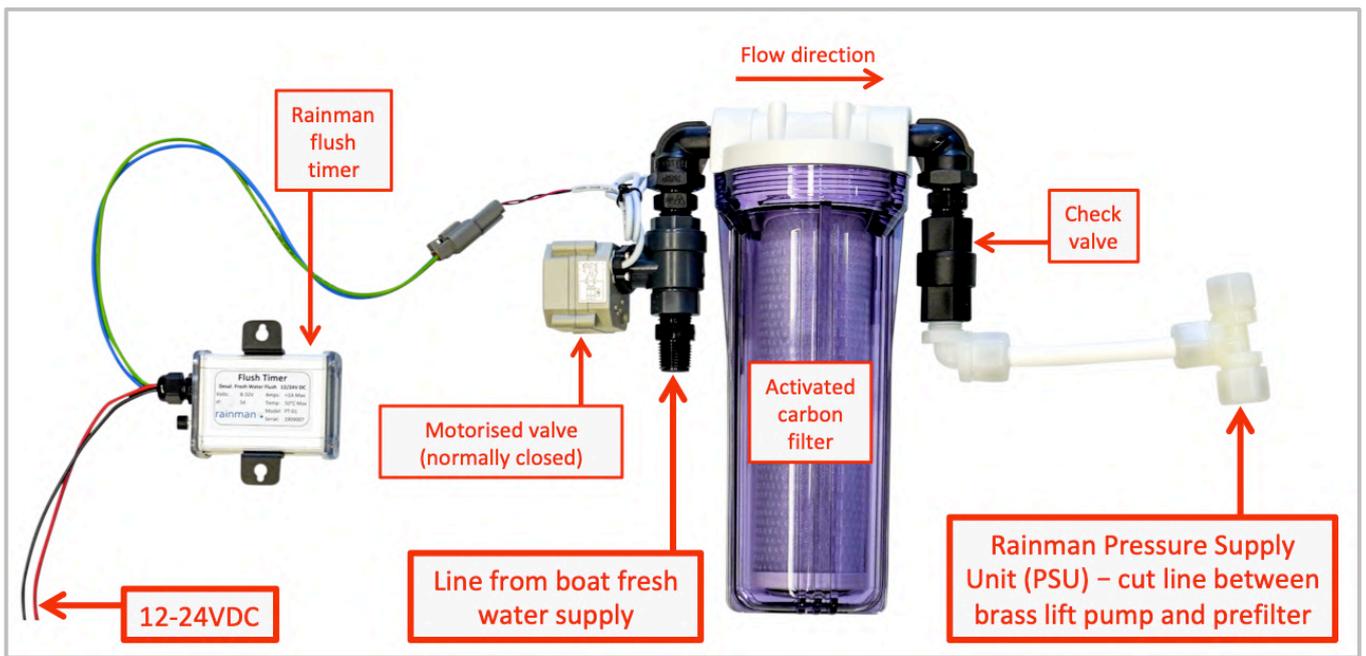


Electric Wiring

- Red (+ positive) & black (- negative) wires from the Rainman flush timer connect to 12V or 24V.
- Blue and green wire from the Rainman flush timer is fitted to the two pin Deutsch connector.
- Connect the Deutsch plug into the mating socket fitted to the motorised valve.
- The mounting feet of the timer can be positioned anywhere along the side slot. Relax the retaining screw and slide the foot along the side slot.
- When supplying power to the Rainman flush timer, consideration should be made for power shutdown when disabling your system. For example, it may have its own circuit or be wired to your fresh water pump circuit.

Plumbing

- The inlet side of the motorised valve connects to the fresh water supply.
- The outlet side of the motorised valve connects to an activated carbon filter to neutralise chlorine that may be in the tank water supply.
- The T fitting after the activated carbon filter is to be spliced in to the Rainman pressure supply unit between the brass lift pump and the prefilter. When looking at the prefilter, this hose should be on the right side.
- The motorised valve will normally be in the closed position and should be on the input side of the carbon filter.
- The check valve should be on the output side of the carbon filter.
- The elbows in the diagram are not mandatory and may be omitted if geometry warrants it.



Operation

On initial power up, the Rainman flush timer will run a power up and system check and flash the blue LED six times over fifteen seconds. The motorised valve will return to the closed position if not already closed. The Rainman flush timer will then initiate a flush cycle and open the motorised valve. During the flush cycle the blue LED will remain on. At the end of the flush cycle the motorised valve will close. The flush duration may be set for 2, 4, 6, or 8 minutes. See below for programming instructions. The timer will wait seven days and then initiate the next flushing sequence. While in countdown mode the blue LED will flash a number of times, indicating how many days until the next flush cycle.

Pressing the button will trigger a flush cycle, and reset the seven day counter. If the button is pressed during the flush cycle, the flush will be cancelled and the counter reset to seven days.

While the Rainman flush timer is idle, a blue LED will flash a count of days left before the next flush cycle. For example, if there are three days before the next flush, the blue LED will flash three times then pause, and repeat. This informs the user that the flush timer is powered and counting down the seven day period before the next flushing cycle. When the system is actively flushing, the blue LED will be constantly on.

Warning: Avoid running the watermaker when the flush cycle initiates. If the blue LED is showing single flashes, the flush cycle will start within one day. Press the flush timer button twice to initiate and then cancel a flush cycle, resetting the cycle for seven days. This ensures the flush cycle will not initiate while making water.

On resumption after power cut, the timer will wait fifteen seconds, initiate a flush cycle, then restart the seven day count down.

Warning: If leaving your boat for a period of time with the Rainman Autoflush system activated, ensure there is sufficient water in the tank. There is no built in protection in this system if the tank runs dry. If leaving your system for extended periods, Rainman recommends pickling your system to ensure the tank does not empty.

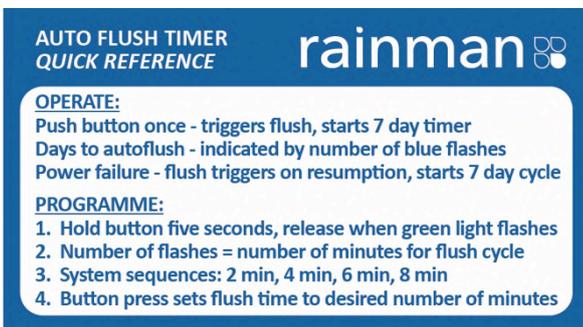
A good practice would be to trigger a flush cycle after you have completed a water making cycle. This will flush your watermaker and start the seven day autoflush cycle.

Programming Flush Time

The flushing time is adjustable from two to eight minutes in two minute increments. To adjust the time press and hold the button for 2.5 seconds then release. This will activate the flush time adjustment program. A green LED will quickly flash sequence for one second then turn off for one second, and the blue LED will be OFF during this setup. The green LED will then flash twice for two minute flush time, four times for four minutes, six times for six minutes and eight times for eight minutes. While the green LED is flashing 2, 4, 6, or 8 times, pressing the button will select this flush time. The flush time selector sequence will repeat three times; then will revert to the wait time countdown sequence.

You will want approximately ten litres (~2.5 gallons) of water to be pushed through on each flush cycle. The best way to determine this is by measuring the brine discharge during a flush cycle and programme the timer accordingly.

A quick reference card summarising these instructions is attached to the Rainman flush timer.



Example: To set a four minute flush time

1. Long press the flush timer button for 2.5 seconds.
2. The green LED will quickly flicker for one second, then off for one second.
3. The green LED will start its flashing sequence, wait for the four flashes to appear, press the trigger button.
4. The green LED will again quickly flicker for one second, then off for one second.
5. The flush timer will respond by flashing the green LED four times, then a pause, then flash four times again. This allows the operator to verify the new setting is correct.
6. The Rainman flush timer will now switch back to normal operation, and the seven day counter is not reset.
7. To test the new flush time, press the push button again to activate a cycle. This will then reset the seven day timer.