Electric Watermaker Operations Manual

Contents

rainman watermakers

Rainman Technology Pty Ltd
49 Orchard Road
Brookvale, NSW 2100
Australia

www.rainmandesal.com

support@rainmandesal.com

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Introduction

This instruction manual is for our range of electric powered watermakers. 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.

More technical information can always be found on the support section of our website.

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.

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

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).

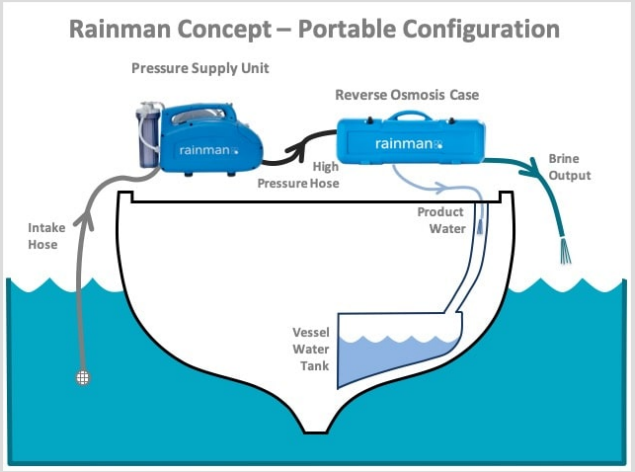
Understanding Your System

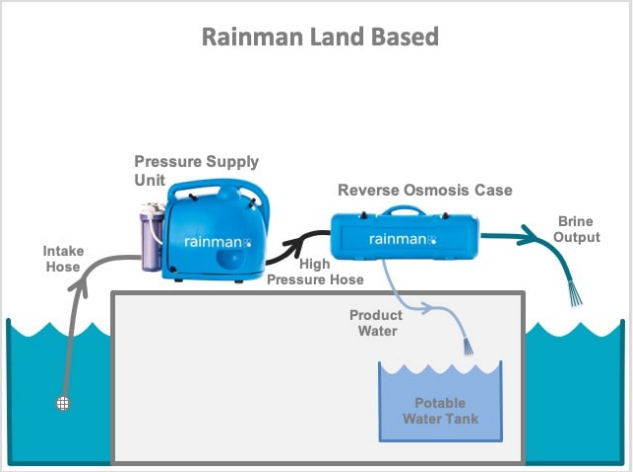
Rainman Concept

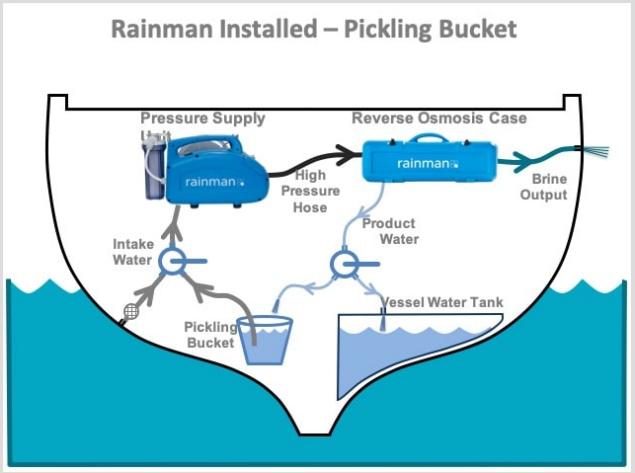
All Rainman systems consist of two main components – a pressure supply unit (PSU) and a reverse osmosis unit (RO). The PSU will lift water to the system, pre-filter it down to five microns and feed it into a high pressure pump. The RO unit is attached to the PSU via a high pressure hose. The membrane(s) 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.

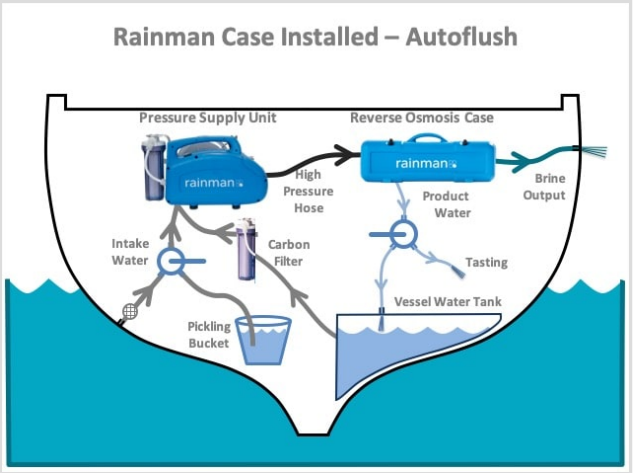
The systems can be operated as completely portable units, with hoses in the sea and water buckets, or they can be partially or fully installed into a boat or other location. It is possible to install either the traditional Rainman in a blue case or the uncased naked system. Below are six of many possibilities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

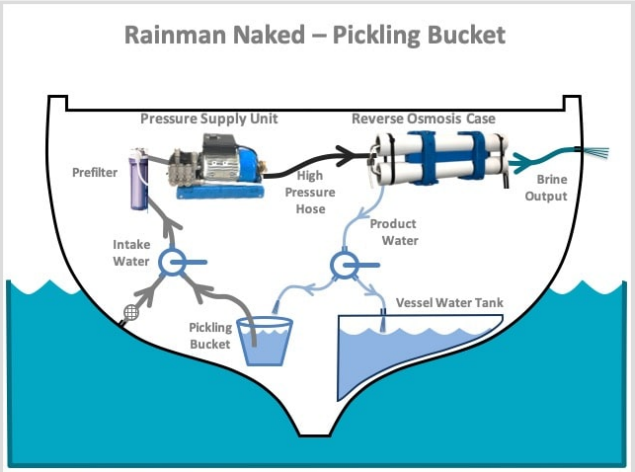
Six common configurations for Rainman Watermakers

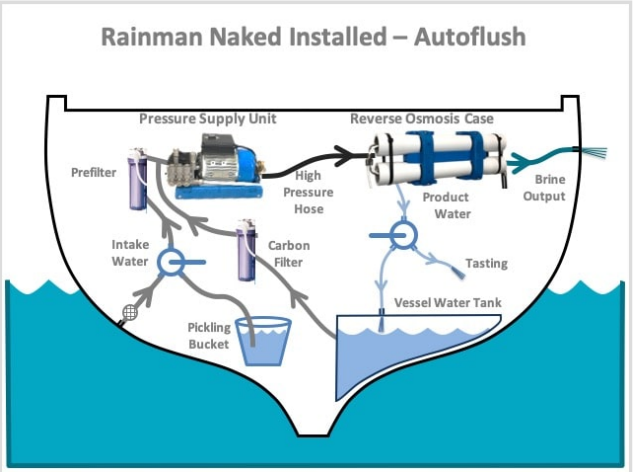












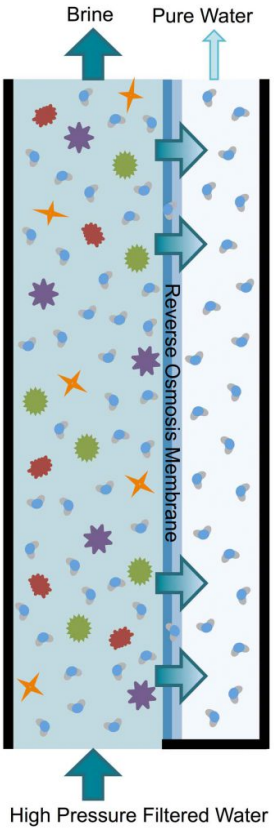
Desalination Basics

Desalination is relatively 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.

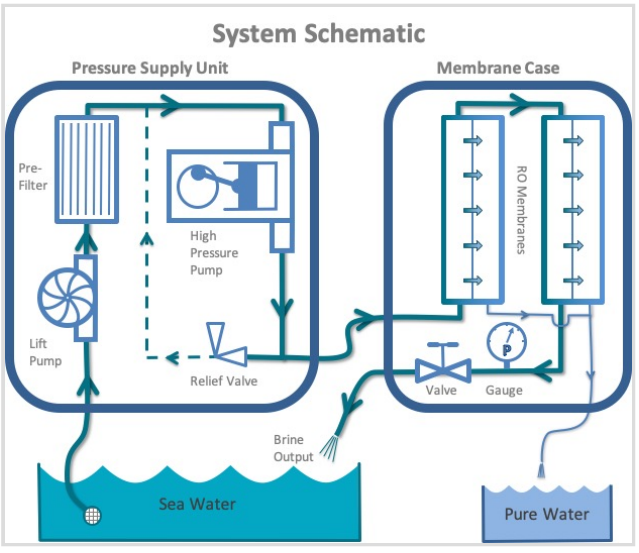
A traditional sediment filter, like our prefilter, works by passing all the water through it. The fine construct prevents larger particles from getting through and they are captured on the filter material. When a lot of particles have been captured on the filter and it's dirty, you change it.

In contrast, the RO process passes filtered seawater 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.



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 high pressure 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 or triple 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.**



Preparing System For First Use

If you plan to install your Rainman Watermaker, please consult *the 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.

Operating The Watermaker

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

Setup – 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.

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.
4. Place the intake hose in the source water.
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.

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

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

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.

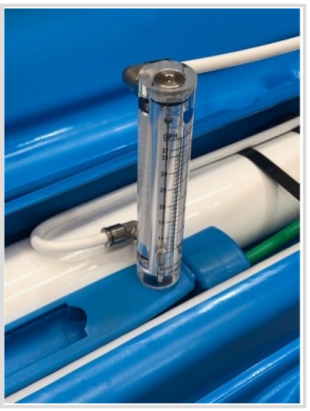
8. Ensure the pressure valve in the RO unit is in an open position (fully anti-clockwise).

9. 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.

10. 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

INST

1. 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.
2. Ensure that the brine output is free from blockage.
3. Ensure that the product water output is directed to 'test' and not to a water tank.
4. 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.

   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.

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.

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.

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

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

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

Shutdown – Installed

1. **Turn the product water 3 way valve so the product water is diverted from the tank.**
2. **Slowly turn the pressure control valve in an anti-clockwise direction until the pressure reads less than 20 bar (300 psi).**
3. **Switch off the PSU.**
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 watermaker while system is under pressure will cause pressure shock to the membranes and may damage them.

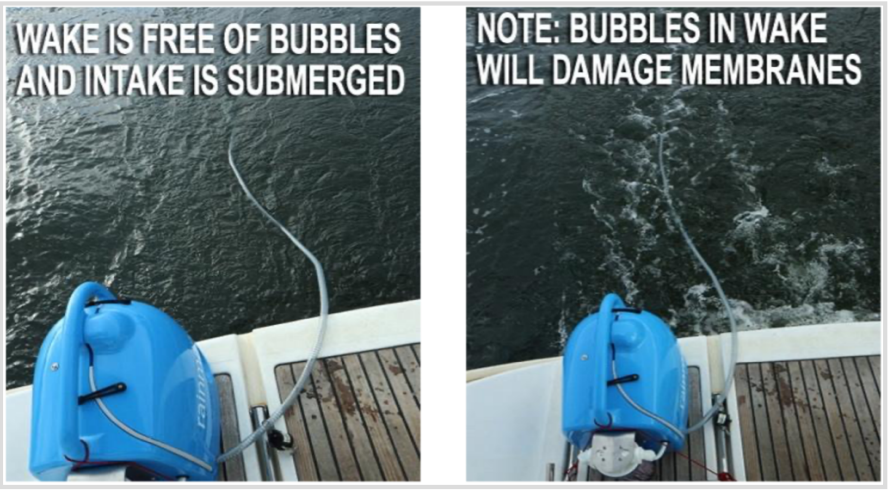
Desalinating While Under Way

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 heal 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 (2 x 40")	Compact (2 x 21")	Economy (1 x 40")
AC Electric	140lph (37gph)	70lph (18gph)	70lph (18gph)
Petrol / Gasoline	140lph (37gph)	70lph (18gph)	70lph (18gph)
12VDC	Not Compatible	Not Compatible	34lph (9gph)
AC Torrent		230lph (60gph)	

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

Care and Maintenance

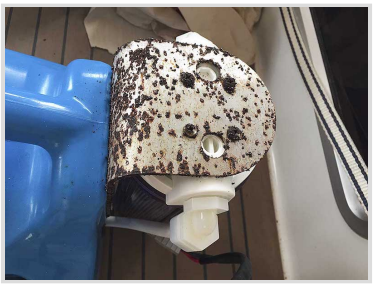
Storage

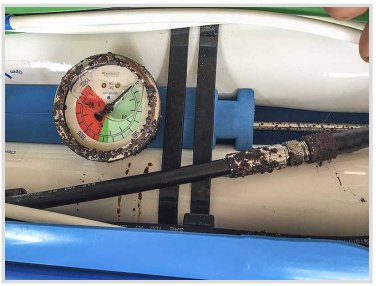
Always store your Rainman watermaker upright in a dry and ventilated area. Dry any obvious moisture off the unit before putting it away. Water can drip from the unit during storage, particularly in hot weather, and it is very important that there is sufficient ventilation to avoid creating an overly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

RAINMAN FLUSHING AND PICKLING GUIDE	
Unused for 2 days or less	No treatment necessary.
Unusued between 2 and 7 days	Fresh water flush.
Unused between 7 and 30 days	Pickle the system.
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 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.

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 climes.*

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 Climes

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.

Recommissioning After Being Pickled

After the system has been pickled, it is important to clear it of the preservative before making water. The following procedure should be executed:

1. **If the system has been pickled for more than one month, install new prefilter.**
2. **If the system has been pickled for more than six months, install new impeller.**
3. **Set up the system as per normal operation.**
4. **Run the system unpressurised for five minutes. All water going out to brine waste.**
5. **Pressurise the system as per normal operation, with product water diverted to waste.**
6. **Make water for at least five minutes with product water diverted to waste. Even if you use the optional control panel and the product water quality LED shows green, you should still run for five minutes before sending the product water to your tank.**
7. **Test / taste water quality. Pickle solution is distasteful, but not harmful when simply tasted on the tongue.**
8. **When water quality is good, send product water into the tank for use.**

Changing The Prefilter

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.**

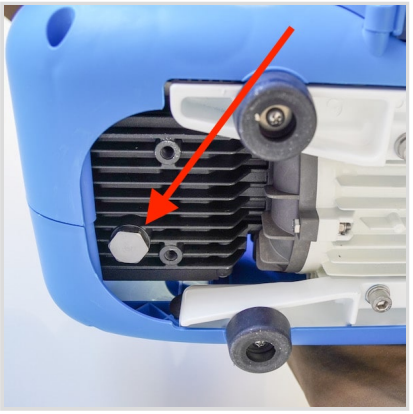
The correct type of cartridge is a 'sediment' or 'particle' type cartridge with a 5 micron rating. Do not use a carbon cartridge. Some carbon cartridges also function as sediment filters, and therefore may be labelled as 'sediment' cartridges and have a 5 micron rating. These are NOT suitable for use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

High Pressure Pump Maintenance

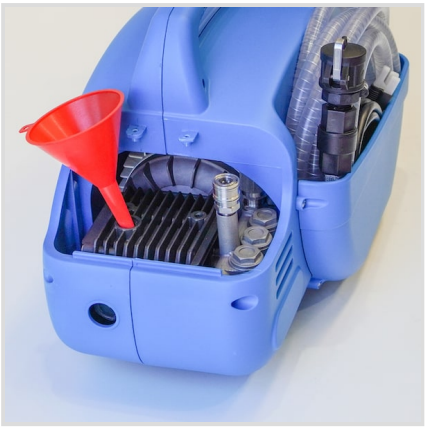
We recommend you change the pump's crankcase oil annually. It is important to check the oil level from time to time, particularly if you have had oil leak or spill from the pump at any time.

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.**

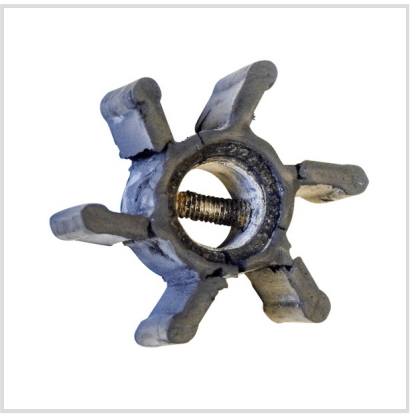


3. **Oil levels can be checked through the hole in the end of the case. The oil level should be visible in the clear window.**

Lift Pump Service

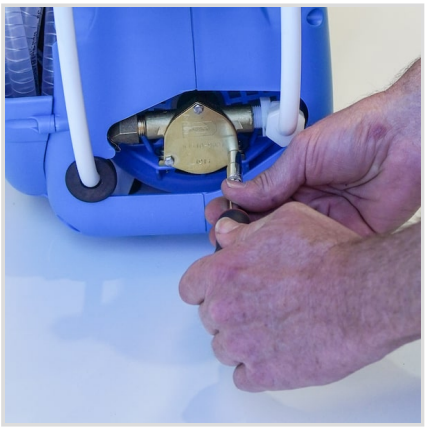
The impeller in the brass lift pump is a consumable item. We recommend inspecting the impeller for signs of wear or cracking every 12 months or 500 hours and replacing if appropriate. The photo on the right shows a heavily worn impeller.

As a matter of preventative maintenance, replace the impeller every year or 500 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.

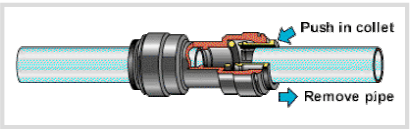


2. The impeller can then be removed with needle-nose pliers.
3. Replace impeller with needle-nose pliers using a rotating motion to bend the fins and align the cross-screw with the slot in the shaft.

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 your Rainman dealer:

- 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.

Alternatively, you can contact Rainman directly for support at www.rainmandesal.com/support-request

Warranty

Rainman watermakers 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. All shipping charges are the responsibility of the purchaser to and from our office in Sydney, Australia.

The warranty is void if the system was mishandled, abused, or not operated / maintained as directed by the user manual. Consumable items, such as pre-filter cartridges, lift pump impeller, high-pressure pump oil, high-pressure pump packings, high pressure hose, engine lubricant, 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 the failure of the system to perform.

Troubleshooting

For troubleshooting the operation of your Rainman, we have a dedicated page in the support section of our website.

Rainman Troubleshooting Guide