

CORE SYSTEMS

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Understanding Watermakers

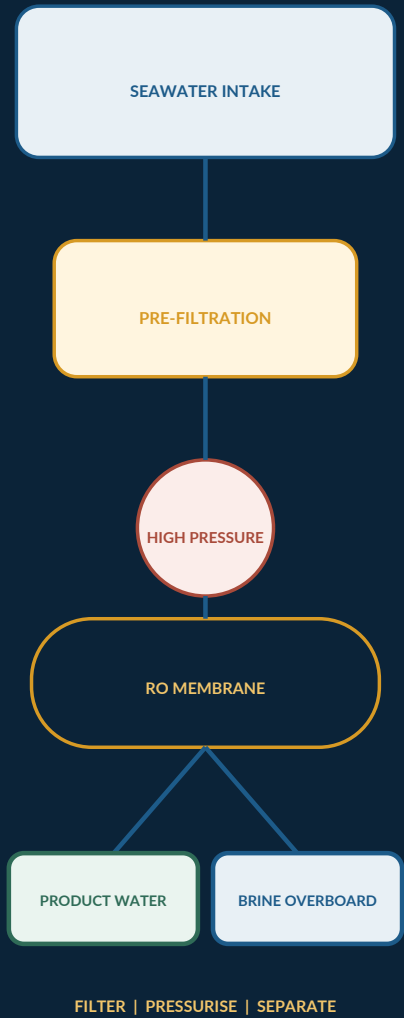
An owner's guide to reverse osmosis, product-water quality and offshore reserves

A watermaker can extend endurance.

It should never be the yacht's only credible freshwater plan.

Absolute Marine

Commercial thinking for private cruising.



GUIDE OVERVIEW

What a watermaker is designed to do

A yacht watermaker converts seawater into freshwater using reverse osmosis. Reliable production depends on seawater supply, pre-filtration, high pressure, membrane condition, product-water monitoring and correct flushing or preservation.

SCOPE

This guide covers common alternating-current, direct-current and energy-recovery reverse-osmosis systems. Individual designs differ in pressure control, flushing, automation and chemical procedures, so the installed manufacturer's instructions remain essential.

By the end of this guide, you should be able to:

- Trace seawater from the intake through filtration, pressurisation and membranes.
- Identify feed pumps, pre-filters, high-pressure equipment, pressure vessels and product-water controls.
- Recognise restricted flow, air ingress, fouling, poor product quality and preservation errors.
- Understand why automatic diversion, flushing and output figures must be verified.
- Plan stored freshwater reserves that do not depend completely on production.

CORE PRINCIPLE

A watermaker should be treated as a production system, not an unlimited source. The yacht still needs enough stored and protected water to tolerate equipment, power, seawater-supply or contamination failure.

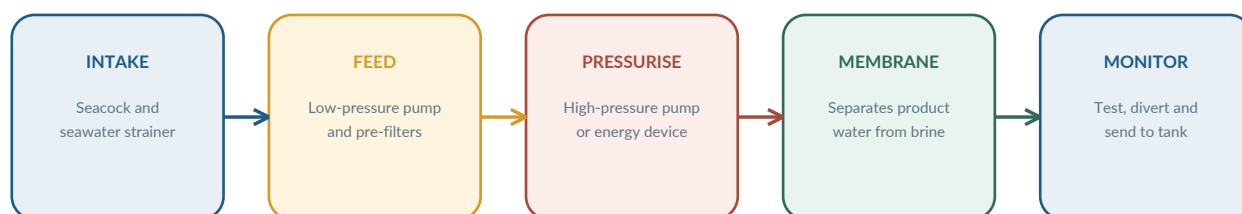
Safety

Reverse-osmosis systems contain high pressure, rotating machinery, electricity and treatment chemicals. Depressurise and isolate the system before opening it, and use the specified chemical handling and rinsing procedure.

SYSTEM OVERVIEW

How reverse osmosis produces freshwater

The system pushes filtered seawater across a semi-permeable membrane. Part of the water passes through as product water, while the remaining flow carries concentrated salts and contaminants overboard as brine.



Reverse osmosis produces a freshwater stream and a more concentrated brine stream; neither is created without adequate feed flow.

The main stages

- Seawater supply: A suitable intake and strainer provide continuous flow without air or heavy contamination.
- Feed and pre-filtration: The feed pump moves seawater through filters that protect the high-pressure equipment and membrane.
- Pressurisation: A high-pressure pump or energy-recovery mechanism raises pressure sufficiently for reverse osmosis.
- Membrane separation: Water molecules pass through the membrane while most dissolved salts remain in the brine stream.
- Product monitoring: Conductivity or salinity is checked before water is accepted into the freshwater tank.
- Flushing and preservation: Correct procedures limit biological growth, scaling and membrane damage between operating periods.

OWNER INSIGHT

Three figures matter together: feed pressure or flow, product-water output and product-water quality. A believable output figure alone does not prove that the system is healthy.

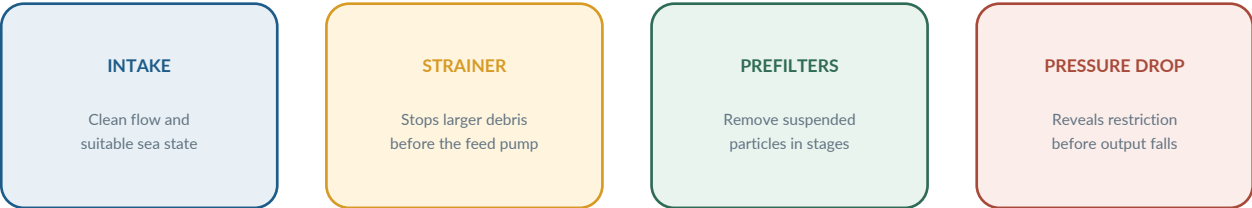
Recovery ratio

Only a portion of the incoming seawater becomes product water. The continuing brine flow is necessary to carry salts away from the membrane. Restricting that flow or adjusting pressure outside the approved procedure can damage the system.

SEAWATER SUPPLY

Intakes, feed pumps and pre-filtration

Low-pressure flow is the foundation of the system. A powerful high-pressure pump cannot compensate for a restricted intake, blocked filters, air ingress or an unsuitable operating location.



Protecting the membranes begins with reliable low-pressure seawater flow.

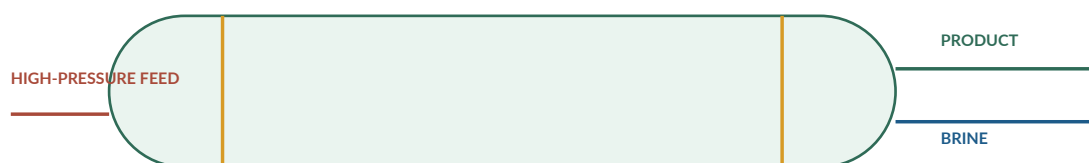
Component	Purpose	Owner focus
Seacock and intake	Provides seawater to the system.	Accessible valve, secure hose, fouling, scoop orientation, air ingestion and any shared-intake consequences.
Seawater strainer	Removes larger debris before the feed pump.	Basket condition, gasket, clear lid, flooding risk during service and evidence of air leakage.
Feed or boost pump	Maintains low-pressure flow through the pre-filters.	Prime, noise, leakage, motor current, mounting, impeller or diaphragm condition and spare strategy.
Pre-filter housings	Hold staged filter elements to protect the membrane and high-pressure pump.	Correct micron sequence, housing seals, cleanliness, bypass risk and safe filter replacement.
Pressure or vacuum indication	Shows restriction or inadequate feed conditions.	Normal clean-filter baseline, alarm settings and whether readings change under realistic output.
Chemical dosing or conditioning	May reduce scaling or biological growth on selected systems.	Correct product, concentration, calibration, storage and compatibility with the membrane.

OPERATING LOCATION MATTERS	Avoid producing water where the intake may draw fuel, sewage, harbour contamination, heavy sediment, oil, chemicals or concentrated biological growth. Pre-filters do not make every source acceptable.
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HIGH-PRESSURE SECTION

Pumps, pressure vessels and membranes

The high-pressure side performs the separation work. It must remain clean, correctly pressurised and free from leaks, corrosion, vibration and unsafe adjustment.



Pressure drives water through the membrane; salts and much of the dissolved material remain in the brine stream.

Component	What it does	Owner focus
High-pressure pump	Raises filtered seawater to membrane operating pressure.	Oil or lubrication where applicable, seals, pulsation, noise, leakage, drive condition and pressure stability.
Energy-recovery device	Uses brine pressure to improve efficiency on suitable systems.	Noise, cycling, seals, manufacturer service limits and sensitivity to air or contamination.
Pressure regulator or control valve	Controls operating pressure and brine flow.	Correct setting, free movement, no unauthorised adjustment and safe depressurisation.
Pressure vessels	Contain the membrane elements under pressure.	End caps, retaining hardware, corrosion, leakage, mounting and replacement procedure.
Membrane elements	Separate product water from dissolved salts and other material.	Age, output trend, salt rejection, cleaning history, storage condition and chemical compatibility.
High-pressure hoses and fittings	Carry pressurised seawater and brine.	Chafe, corrosion, support, rating, movement, leakage and replacement history.

DO NOT CHASE OUTPUT WITH PRESSURE

Low production may result from cold water, high salinity, fouling, restricted feed or worn equipment. Increasing pressure beyond the approved limit can damage membranes, vessels, hoses or the pump.

PRODUCT-WATER QUALITY

Monitoring, diversion and storage connection

Product water should not enter the yacht's freshwater tanks until quality has stabilised and the monitoring arrangement confirms that it meets the system's acceptance condition.



The automatic diversion valve is only useful when the sensor, calibration and plumbing are correct.

Area	What can go wrong	Owner focus
Conductivity or salinity sensor	Drift, fouling, wiring or poor calibration can make a believable reading incorrect.	Calibration or test method, clean cell, reference result and alarm history.
Automatic diversion valve	May stick, be plumbed incorrectly or default to the wrong position.	Observe actual discharge route during start-up, poor-quality simulation and shutdown.
Manual product-water test	Taste alone cannot verify quality and may miss non-salt contamination.	Use the manufacturer's recommended test and additional potable-water testing where appropriate.
Tank connection	A wrong valve position or cross-connection can contaminate stored water.	Clear labelling, non-return protection, isolation and confirmation of the receiving tank.
Post-treatment	Mineral, carbon or ultraviolet equipment can be bypassed, overdue or unsuitable.	Know its purpose and limitations; maintain it independently from the RO membrane.
Poor source-water contamination	Some chemicals, fuel, sewage by-products or biological contamination may not be managed safely by the system.	Avoid unsuitable locations and obtain professional advice after a contamination event.

AUTOMATIC DOES NOT MEAN VERIFIED	A green light or automatic valve position is not independent proof of product-water quality. Owners should know how the instrument is checked and how poor product is physically prevented from reaching the tanks.
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FLUSHING AND PRESERVATION

Protecting membranes between operating periods

Seawater left stagnant in the system can support biological growth and deposit salts or contamination. The correct response depends on how soon the watermaker will be used again.



Membranes are damaged by poor lay-up practice as easily as by heavy use.

Situation	Typical requirement	Risk if handled badly
After normal operation	Freshwater flush using the installed approved arrangement.	Seawater remains in filters, pumps and membranes, encouraging growth and odour.
Regular short-term use	Operate or flush within the interval set by the manufacturer.	A yacht that is used often may still exceed the safe stagnant period between runs.
Extended lay-up	Preserve with the specified chemical, concentration, clean water and sequence.	Wrong chemical or concentration can damage membranes, seals and metals.
Freezing conditions	Use the manufacturer-approved winterisation procedure.	Residual water can freeze and rupture housings, pumps, valves or membranes.
Return to service	Flush, inspect, run to waste and verify product quality before tanking.	Preservative, stale water or poor product may enter the freshwater tanks.

Chemical cleaning

- Cleaning should respond to diagnosed fouling, not become an automatic substitute for correct operation.
- Acidic, alkaline or specialist cleaners address different deposits and may have different temperature limits.
- Incorrect sequence, concentration or contact time can permanently reduce membrane performance.
- Cleaning results should be judged against pre-cleaning pressure, flow, output and quality readings.

LABEL THE SYSTEM STATUS	After preservation or cleaning, record the date, chemical used, valve positions and the required recommissioning steps. The next operator should not have to guess what remains inside the system.
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PERFORMANCE

Why output changes with operating conditions

Published production figures are achieved under stated test conditions. Real output and quality change with feed-water temperature, salinity, pressure, filter condition, fouling and available power.

Condition	Likely effect	Owner response
Cold seawater	Lower membrane flow and reduced product-water output.	Use a temperature-corrected expectation rather than increasing pressure blindly.
High salinity	More pressure is required and output may fall.	Confirm the system is designed for the operating area and pressure remains within limits.
Blocked filters or fouled intake	Feed pressure falls, pumps may cavitate and output becomes unstable.	Stop and restore low-pressure flow before damaging the high-pressure section.
Fouled membrane	Output, salt rejection or required pressure changes over time.	Trend readings and diagnose the fouling type before cleaning or replacement.
Low electrical voltage or limited supply	Motors may overheat, trip or fail to reach normal performance.	Verify generator, inverter, cabling and breaker capacity under real load.
Air in the feed	Causes noise, unstable pressure, loss of prime and possible pump damage.	Check intake depth, hose connections, strainer seals and sea-state effects.

Record a healthy baseline

- Feed pressure or vacuum and filter differential where available.
- High-pressure operating value and any pulsation.
- Product-water output over a measured period.
- Product-water conductivity or salinity.
- Seawater temperature, approximate salinity and generator or electrical load.
- Noise, vibration, leaks and automatic diversion behaviour.

COMPARE LIKE WITH LIKE

A lower output in colder or saltier water may be normal. Trend performance under similar conditions before concluding that the membrane or pump has failed.

SHARED DEPENDENCIES

Power, seawater supply, cooling and automation

A watermaker may appear independent while relying on the same generator, inverter, seawater intake, freshwater flush tank or control network as other essential services.

Dependency	Why it matters	Questions to resolve
Electrical source	Pumps, controls and flushing valves may require a generator, inverter or dedicated DC supply.	What starts and runs the unit after one generator, inverter or battery-bank failure?
Seawater intake	A shared intake or strainer may also serve cooling or another system.	Could watermaker fouling, air or isolation affect propulsion, generator or air-conditioning cooling?
Freshwater flush	Automatic flushing normally uses stored freshwater and control power.	What happens after low tank level, pump failure, power loss or a stuck flush valve?
Control and sensors	Automation may manage pressure, diversion, alarms and flushing.	Is local manual control available, and what is the safe state after sensor or network loss?
Drain and overboard discharge	Brine and rejected product require clear routes overboard.	Could a blocked or wrongly valved line create pressure, flooding or backflow?
Freshwater storage	Production only adds endurance when the receiving tanks and distribution system remain healthy.	Can poor product or a tank leak remove both production and stored reserve?

Energy planning

- Confirm starting and continuous electrical demand under real operating conditions.
- Include generator fuel, cooling, maintenance and noise in the cost of producing water.
- Low-energy systems may reduce electrical demand but still require clean feed flow and specialist components.
- Running the watermaker only when surplus generation is available may improve efficiency, but production must still meet the passage plan.

FALSE REDUNDANCY

A watermaker and a large freshwater tank are not independent if one failed generator, seawater intake, control supply or contamination event can remove both usable production and stored water.

FAILURE AWARENESS

Common weaknesses and warning signs

Watermaker failures usually begin as changing pressure, reduced output, poor product quality, repeated filter blockage, air, leakage or a flush/preservation problem.

Symptom	Possible cause	Why it matters
Feed pressure low or unstable	Blocked intake, dirty filter, air leak, weak feed pump or poor prime.	High-pressure equipment may cavitate or operate without adequate cooling and flow.
High pressure rises abnormally	Brine restriction, fouled membrane, incorrect valve position or control fault.	Hoses, vessels, seals and pump can be overloaded.
Product output falls	Cold water, high salinity, restriction, fouling, worn pump or internal leakage.	The passage may rely on production that is no longer achievable.
Product quality deteriorates	Damaged or aged membrane, sensor error, seal bypass, excessive recovery or contamination.	Poor product can contaminate the yacht's stored freshwater.
Frequent filter blockage	Dirty operating area, biological bloom, poor intake location or inappropriate filter staging.	Consumables can be exhausted rapidly and the system may become unusable.
Pump noise, vibration or leakage	Air, cavitation, worn bearings, damaged seals, drive issue or poor mounting.	A developing mechanical failure may spread contamination or cause flooding.
System will not flush or preserve correctly	Valve, pump, control, low tank level, blocked line or incorrect procedure.	Membrane deterioration may occur while the system appears safely shut down.

DO NOT NORMALISE IT

A system that always needs another filter, produces water only after repeated resets or shows a familiar salinity alarm has an unresolved defect. Familiarity does not restore reliability.

Immediate response to poor product

Divert product away from the freshwater tanks, stop the system if the cause is uncertain, protect the stored reserve and investigate the sensor, membrane, plumbing and source water before accepting further product.

OFFSHORE READINESS

Failure response, buyer questions and readiness checklist

The most important watermaker question is not its advertised litres per hour. It is whether demonstrated production, stored water and crew response remain credible when conditions or equipment change.



Questions worth resolving

- What output and product quality have been demonstrated in representative seawater?
- How many days of stored water remain without running the watermaker?
- What intake, power, flush and control dependencies can remove production?
- Can poor product be kept out of the freshwater tanks after a sensor or valve failure?

Area	Questions for purchase or survey
Model and support	Is the unit supported, are parts available, and does capacity suit the intended crew and cruising area?
Installation	Are intake, filters, pumps, vessels, drains, product plumbing and electrical supply accessible and credibly installed?
Condition and records	Are hours, membrane age, cleaning, preservation, alarms and output trends documented?
Performance and quality	Does it reach stable pressure, output and product quality, and does diversion prevent poor product entering tanks?
Offshore resilience	Are stored reserves, spares, consumables and a reduced-water plan credible after loss of production?

Quick readiness check

	Readiness statement
	The seawater path through filters, pumps, membranes and discharge is understood.
	Normal feed pressure, high pressure, output, quality and electrical load are known.
	There are no unresolved leaks, alarms, unstable readings or repeated filter problems.
	Diversion, freshwater flushing and preservation have been verified.
	Membrane age, cleaning history, filters and specialist parts are documented.
	Stored freshwater supports a period without production.
	Poor product can be kept out of the yacht's tanks.
	More than one person knows the start, stop, flush, preserve and failure response.

KEY TAKEAWAY	A dependable watermaker combines clean feed flow, controlled pressure, healthy membranes, verified product-water diversion, disciplined preservation and enough stored water to tolerate loss of production.
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Guidance to consult

Use the installed manufacturer's operating, chemical, flushing, preservation and service instructions, plus applicable electrical, pressure, potable-water, flag, class and yard requirements.

Understanding Yacht Systems

Practical guides for owners, buyers
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AMTG-011

Understanding Watermakers

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absolute-marine.co.uk

info@absolute-marine.co.uk