

# DC Watermakers: Expensive but Useful for the Cruising Sailor

*Reverse-osmosis watermakers run from \$3,000 to over \$8,000, and though many are similar, close examination is required for the buyer who wants the right one for his or her onboard needs.*

**R**everse-osmosis watermakers have long been available for boats, but until a few years ago, they were bulky, power-hungry machines that were barely suitable for the typical cruising sailboat. All that has changed in the last decade or so, and relatively efficient, reasonably compact reverse-osmosis watermakers are now readily available. In the seven years since *Practical Sailor* last evaluated DC-powered watermakers, there has been slow but steady development in this niche of the marine market.

The trend today is toward higher-output, energy-efficient, more automated watermakers. At the same time, some of the original, dead-simple machines—or their lineal descendants—are still available. This look at today's watermaker market will help you decide if a watermaker is a good choice for your own boat.

## Who Needs a Watermaker?

The percentage of sailboat owners who really need a watermaker is very low. If your sailing is coastal cruising in areas with reasonable access to fresh water at rational intervals, you can get by without a watermaker. This would include virtually all North American coastal cruising.

The concept of "reasonable access," of course, is open to interpretation. Traditionally, when you went to a dock for fuel, you also filled your water tanks, usually without charge. This is still the customary practice in North America, although less so in other parts of the world, where pay-

ing for water is acceptable and expected. At virtually every marina in North America, unlimited water use is included in the price you pay for a slip. In other parts of the world, a fee for water—sometimes metered, sometimes a flat daily rate—is added onto the slip cost as a separate item, much like electricity or any other utility.

However, you can pay for a lot of water at a marina or fuel dock—even in places such as the Bahamas, where water is truly expensive—before you will come close to recouping the purchase and operating cost of any watermaker. And, if you have very small water tanks, it will probably still prove cheaper to install additional tankage than to buy a watermaker.

## How Much Water Is Needed?

This will come as no big surprise: the more water capacity you have, the more water you use. When *PS* Editor-at-Large Nick Nicholson first installed a watermaker (a first-generation Little Wonder) aboard his homebuilt, 40-foot cruising cutter *Calypso*, he was giddy with the idea of making



*The Italian-made Schenker Watermaker (above), which *PS* endorsed in the April 15, '02 issue, isn't included in this round-up of reverse-osmosis watermakers, though it is still made. Shown here is a modular unit. The smallest one can produce over nine gallons per hour.*

all the fresh water he and his partner could ever use. In the first few weeks, he remembers, he went so far as to wash down the anchor chain with fresh water.

But reality set in pretty quickly when Nicholson discovered that he was using about 15 gallons of water every time he brought the anchor aboard. That meant almost three hours of running the watermaker every time he anchored. Installing a saltwater anchor washdown pump brought that episode to a rational conclusion.

How much water do you need every day? There is no simple answer. Some 30 years ago, Nicholson and a friend lived aboard an old

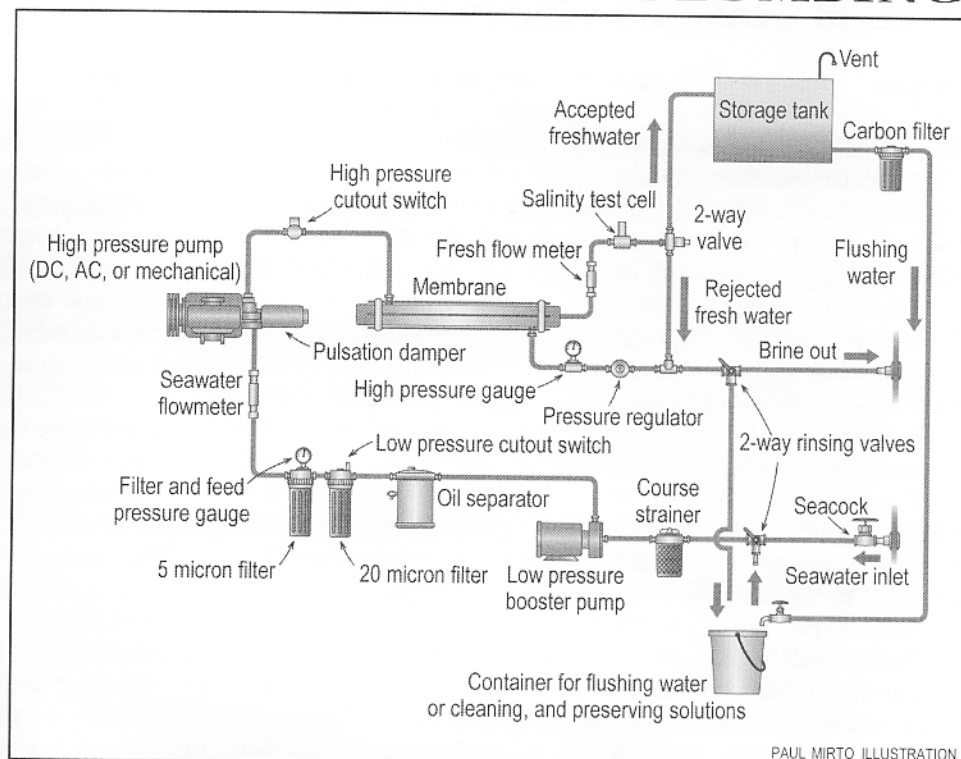
racing boat with no shower, no hot water, no pressure water, and one tiny sink with a hand pump in the galley. That vessel's 62 gallons of fresh water lasted almost exactly two weeks, meaning two people used just under five gallons a day for cooking, bathing, washing dishes, and drinking. Most of that water was lugged in five-gallon soft plastic jugs, down the dock, into the dinghy, up on deck, and into the tank.

Two decades later, during his circumnavigation, Nicholson's *Calypso* had 180 gallons of fresh water that would last just over 14 days on average at anchor or on passage, meaning that he used almost 13 gallons a day. "Were we profligate in the use of water?" asked Nicholson. "No. Did we consciously conserve? Yes, but not fanatically."

With hot and cold pressure water in the galley and head, plus a really good shower, Nicholson and his mate used a lot more water on *Calypso* than he did aboard that Spartan racing boat. In the tropics, you drink a lot of water: a gallon a day per person would not be unusual. A daily shower is also very nice in the tropics, whether you're underway or at anchor. You'll also want to wash off with fresh water after swimming. Nicholson related that he also washed dishes in hot, fresh water aboard *Calypso*.

While on board *Calypso*, Nicholson lived as close to normally as possible, keeping the boat and crew clean, healthy, and hydrated. For the sake of comparison, a typical two-person household ashore uses about 200 gallons per day, which makes *Calypso's* 13 gallons per day seem absolutely parsimonious.

What's a realistic amount of water use on a serious cruising sailboat? Figure on three to six gallons per person, per day. Anything less than that is closer to camping out than living in comfort. Obviously, the crew of a 30-foot minimalist cruiser with small water tanks is going to have to be a lot more frugal with water than those



*Though the systems created by different companies vary, a typical reverse-osmosis watermaker follows the general processes outlined above.*

aboard a luxurious 40-footer with a lot of water capacity.

### Measuring Output

If you've decided that a watermaker really is for you, the first question to ask is simple: how large a watermaker do I need?

Watermaker manufacturers typically use two standards to measure fresh water output: gallons per day, and gallons per hour. The gallons-per-day rating is ludicrous, as very few watermakers would survive very long running 24 hours per day. Likewise, if you had to live with the noise of a watermaker for more than a couple of hours per day, you'd probably toss the machine over the side.

The gallons-per-hour rating is more important. Remember, however, that there will be about five minutes worth of water discarded every time you start up the machine before the water quality reaches an acceptable standard. Likewise, if you flush the watermaker with fresh water every time

you use it—unnecessary if the watermaker is used daily, but never a bad idea—you will waste a gallon or so of fresh water each time that operation is performed. To minimize start-up and shut-down waste, it is best to make water in one multi-hour whack, if you're making water on a daily basis.

### Running Time

The decision then becomes how long you want to run the machine daily. This is a matter of personal taste, tolerance for noise, and the vessel's capacity for electrical power. We would recommend that you buy a watermaker whose rated hourly output allows making all the water your crew will use daily in no more than two hours of operation, with allowance for startup discard water and freshwater flush at shutdown. As an example, a crew of two, using 10 gallons daily and wanting to run the watermaker for no more than two hours per day, should buy a machine with a nominal output of at least six gallons per hour. Note that actual system output will vary with

## Value Guide: DC Watermakers

Models	Price	Output: gals per hour	Amps drawn at 12V	Warranty (years)	Options
<b>HRO Systems</b>					
Seafari Escape 200	\$7,150	8	13	1**	auto fresh-water flush (\$700), polished SS finish (\$600)
Seafari Escape 300	\$7,650	13	20	1**	same as above
Seafari Escape 400	\$8,150	17	22	1**	same as above
<b>Sea Recovery</b>					
Ultra Whisper 200	\$7,150	8	13	1**	auto fresh-water flush (\$700), polished SS finish (\$600)
Ultra Whisper 300	\$7,650	13	20	1**	same as above
Ultra Whisper 400	\$8,150	17	22	1**	same as above
<b>Katadyn</b>					
PowerSurvivor 40E	\$3,000	1.7	4	3***	pre-filter and 1 amp booster pump (\$275)
PowerSurvivor 80E	\$3,795	3.4	8	3***	same as above
PowerSurvivor 160E	\$4,195	6.7	18	3***	same as above
<b>SK Watermakers</b>					
LP 150	\$2,995	4 to 6	22 to 24	3	boost pump, manual flush, TDS meter (each \$150)
<b>Spectra Watermakers</b>					
Ventura 150	\$4,995	6.3	9	1	MPC 3000 auto control (\$1,500 to \$2,000)
Catalina 300	\$6,625	12.5	15	1	same
Cape Horn Xtreme	\$5,995	14	18	1	Z-Brane™ auto cleaning system (\$1,650)
<b>Village Marine Tech *</b>					
Little Wonder 160	\$4,095	7	13	5++	UV sterilizers and oil/water separators
Little Wonder 200	\$4,595	8.3	17	5++	same as above
Little Wonder 300	\$5,495	12.5	24	5++	same as above

\* available in vertical, horizontal, framed and modular versions \*\* warranty starts when membrane is installed \*\*\* on most components  
++ lifetime warranty on pump head and pressure vessel; 3 years on membrane

water temperature and salinity, system voltage, and the age and characteristics of the individual membrane.

### Noise

All watermakers require running a pump. Even the quietest of these pumps is similar in noise to the sound of a medium-sized pump for pressurized water. If the watermaker is isolated from the living spaces, the noise may not be significant. If it is mounted under a cabin settee or quarterberth, you will be quite aware that the watermaker is running. Sailboats, unfortunately, tend to resonate like a drum, with both structure-borne and airborne noise. Cruising powerboats generally have better sound insulation in machinery spaces than sailboats, since the noise of the engine is ever-present when underway. However, if you run the watermaker while the main engine is running to charge batteries, the additional noise of the watermaker will pretty much be lost in the clutter of the main engine noise.

### Water Quality

Every watermaker is capable of producing decent potable water. Potable water is typically defined as having total dissolved solids (TDS) of less than 1,000 parts per million. Most water produced by watermakers will have a TDS of 300 to 500 ppm. Once again, the salinity of the source water will have an impact on the final water quality. In the open ocean, said Nicholson, *Calypso's* water TDS was typically 400 to 425. In the high salinity of the Red Sea, that increased to 450 to 475.

It is imperative that you have a simple hand-held water tester—about \$40 at most supply outlets—to monitor water quality on a regular basis. In fact, Nicholson said that he customarily checked water quality five minutes after startup, and just before shutdown, every time he made water. Regular testing of water will enable you to monitor the health of the membrane, and is a good check on system performance.

### Power Source

There are basically three choices for powering the watermaker on a sailboat: AC electric power, DC electric power, and direct drive from the main engine. If you have a separate generator, AC power is a rational solution, but that usually means a boat over 40' to justify the space, weight, and cost of a generator.

Driving the high-pressure pump from the boat's main engine is a good way to maximize output, but it may require a fairly complex installation involving custom brackets, custom pulleys, and modifications to the engine box. Since it is not unusual for a cruising boat to already have one or two big alternators plus a refrigeration compressor belted off the engine, there may not be enough space in the engine box—or enough room on the engine—to add an engine-driven watermaker pump. In addition, the main engine may have to be run within a narrow RPM band to properly drive the high-pressure pump on the watermaker, so this is



not the system for everyone.

For the typical cruising sailboat under 45', that leaves DC power—the ship's main battery bank—to run the watermaker. Fortunately, that's a very good option. There's a nice variety of 12 V and 24 V watermakers out there, from extraordinarily simple (but not cheap) to extraordinarily complex (but not cheap) models.

## Maintenance

Ironically, the more you use a watermaker, the less maintenance it requires. A watermaker that is used almost daily essentially requires no maintenance, other than occasional replacement of the pre-filter cartridge on the inlet side of the system. According to Nicholson, the longest period of time that *Calypso's* watermaker was in commission was from January through August, or eight months. During that time, the boat covered, about 8,000 miles from Bonaire in the Caribbean to New Zealand, and made over 2,000 gallons of water.

Nicholson took on water at Balboa at the Pacific end of the Panama Canal, and at Raiatea in French Polynesia. "Otherwise, we made every drop of water consumed aboard during that period. We replaced a failing feedwater booster pump and a few pre-filter cartridges in that period."

Current thinking is that it may be less harmful for a watermaker to be flushed with fresh water regularly during long-term storage than the traditional solution of "pickling" the membrane with a sodium bisulfite solution. However, on an unoccupied boat, that means that a fairly sophisticated electronic controller system must be employed to automatically run the flush system on a weekly basis. This also means, of course, that the boat's battery system must be kept on all the time as well. This is all well and good if the boat is plugged into shore power or has a solar panel system to keep the batteries up when the boat is unoccupied. (Note that long-term storage of the watermaker in this fashion is not possible during periods where the

temperature may drop below freezing.)

In any case, a watermaker that is not used regularly must either be pickled—which must be repeated about every six months if it remains unused—or flushed with fresh water every five days or so. While automatic flush systems make this less onerous, any electronically-controlled system carries with it the risk of component failure.

## Unexpected Advantages

Racing boats carry watermakers for an entirely different reason than cruising ones: to save weight. A gallon of fresh water weighs just over eight lbs. The 180 gallons of water that Nicholson carried aboard *Calypso* added almost 1,500 lbs. to her departure displacement. While this extra weight is not a major consideration for most cruising boats, it's a big deal on modern racing boats, and will affect the performance of any boat.

The new Volvo 70s—some of the fastest monohull sailboats in the world—weigh about 30,000 lbs. The longest legs of the Volvo race will have the boats at sea for about four weeks, during which time the nine crew members on board each boat will consume a lot more than 180 gallons of water.

Instead of having big water tanks, each Volvo 70 carries at least one power watermaker with a rated output of no less than 20 liters per hour, plus two manually-operated watermakers. The 20-liter-per-hour output was chosen to permit the installation of low-voltage watermakers (Volvo 70s utilize 24-V DC systems) incorporating a single 20" membrane. In fact, most Volvo 70s that *PS* has examined utilize watermakers with slightly higher output. Machinery installations are highly proprietary at this stage, and their proper functioning is critical to success. We will report on how these watermakers perform in a later issue as that event gets underway and progresses.

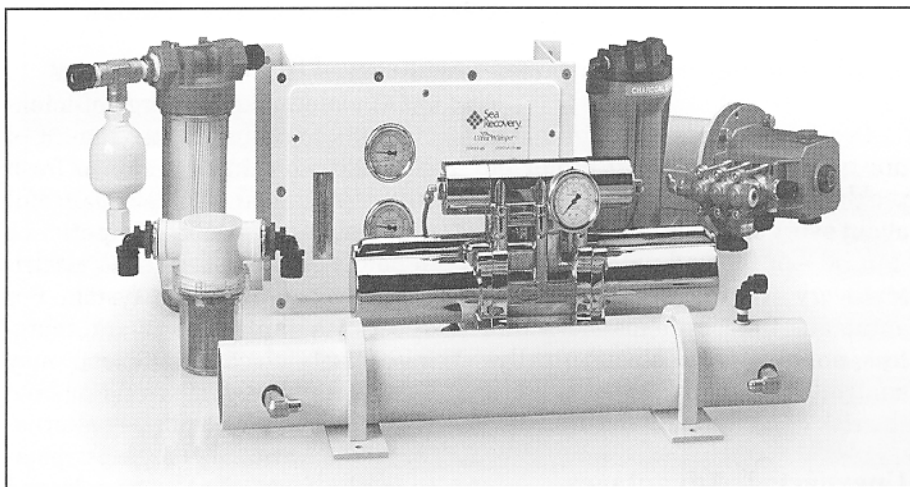
## Energy Efficiency

A DC watermaker's energy efficiency is the measure of the amount of electricity consumed per unit of fresh water produced. This is a useful number, but its actual importance depends on the boat's entire electrical energy management system. For a boat with limited battery and charging capacity, electrical efficiency may be a paramount concern. For a boat with a big battery bank, big alternator, and additional charging capacity in the form of solar panels and wind generator, electrical efficiency may be significantly less important.

Traditional watermakers use a simple single-piston or three-piston pump to generate the 800 lbs. or so of pressure required to push salt water through a semi-permeable membrane to make fresh water. Whether the pump is powered by an AC motor, DC motor, or by direct-coupling to the main engine or generator, it takes a fair amount of power to run the system.

Over the years, various patented pump designs have been developed to employ the pressurized waste brine [created by the reverse osmosis process] to reduce the energy required to operate the system. Originally, this idea was employed by PUR in the development of efficient manual desalinators such as the Survivor series for military use. Variations on the employment of waste energy are the principles underlying the Clark pump used by Spectra watermakers, and the EfficientSea system used in HRO's Seafari Escape systems. The original Spectra was, indeed, a breakthrough in energy-efficient DC watermakers, and Spectra watermakers are still among the most energy-efficient systems available on an amp-hour-per-gallon basis.

Village Marine, maker of the Little Wonder, which was the first commercially-viable high-output DC watermaker, has significantly increased energy efficiency through the use of a different membrane configuration and a more efficient DC motor. Whereas the original Little Wonder had a nomi-



*Sea Recovery's UltraWhisper (modular version shown above), is identical to HRO's Seafari Escape, only the labels differ. These are among the heaviest reverse-osmosis watermakers available, weighing well over 100 lbs.*

nal output of six gallons per hour while drawing about 16 amps, the newest configuration draws 13 amps while producing a little more than eight gallons per hour—roughly a 50% increase in electrical efficiency. We should point out that we can verify the output and energy consumption figures for the original Little Wonder, but are using the factory-supplied figures for the new version, which we have yet to test.

Just how important is energy efficiency? Let's put this in perspective. Take two relatively efficient watermakers, one requiring 12 amp hours of 12V DC power to produce 10 gallons of water, and another requiring 17 amp hours to produce the same amount. That's a difference of five amp hours of energy consumption per day. If you're keeping your batteries charged with solar panels, that will be a significant number.

If, however, your primary charging source is a 100-amp alternator on the main engine, you're talking about another three minutes or so of engine operation daily, which may be of less concern. This is particularly true if the main engine is also running an engine-driven refrigeration compressor at the same time the batteries are being charged and water is being made.

As a significant consumer of power, the watermaker must be part of the boat's entire energy balance sheet,

with battery size and charging sources playing a prominent role in the final configuration of the system, and thus any purchase decision.

### Installation

Installing a watermaker is not a decision to be taken lightly. First, you need to find a suitable location, and space is always in short supply on a sailboat. Fortunately, many DC watermakers come in both frame-mounted and modular configurations. The frame-mounted system secures all components to a pre-plumbed, pre-wired, drop-in chassis, making for a straightforward, neat installation. The modular configuration separates the bulky components, allowing you to fit them into more limited or irregular spaces. On the downside, with a modular system you may have to spend a fair amount of time fabricating mounting arrangements for the various components, as well as having more wiring and plumbing to complete. Although often more time-consuming to install, modular watermakers greatly outsell self-contained frame-mounted systems in the sailboat market.

You will need to install a dedicated inlet seacock, as well as a non-metallic through-hull fitting above the waterline for waste brine discharge. And you'll need to build a manifold

system that allows diversion of product water either overboard or into the boat's water tanks. The manifold system must be readily accessible, and it should include the capability of diverting product water to an outlet at a sink for testing water quality.

Of course you will also need a dedicated high-capacity DC electrical circuit protected by a suitable circuit breaker, with heavy wiring to the watermaker's motor.

Accessibility to all components for service is critical. You will be replacing pre-filter elements on a regular basis, and you may also need access for pickling the membrane if the unit is to be left in storage.

At the very least, we recommend monitoring product water flow and system pressure with simple analog gauges and flow meters, which may be remotely mounted on a control panel if the watermaker is installed in an out-of-the-way part of the boat.

### Weight

Except for lightweight multihulls or racing boats, the weight of a watermaker is not a consideration. The smallest, lightest DC watermaker—Katadyn's PowerSurvivor 40E—weighs about 25 lbs. A typical high-output DC installation, including all plumbing and wiring, will weigh from about 75 to around 150 lbs. At the most, that's equivalent to the weight of about 18 gallons of water.

### Automation

The biggest tendency in today's watermakers is toward automation of the water production and maintenance processes. This level of convenience is a decidedly mixed blessing.

On startup, the automatic system monitors output water quality. When TDS drops to an acceptable level, the water is automatically diverted to the water tanks. At shutdown, some automatic systems flush the membrane with fresh water. The more sophisticated systems can then be programmed to automatically back-flush the system at regular intervals so that the membrane does not have to be chemically preserved, a sometimes

messy and tedious process.

This, of course, all assumes that the electronics function properly, and that the boat's batteries stay charged in storage so that periodic automatic flushing doesn't run the batteries down.

These are, in our opinion, a lot of assumptions to make. Electronically controlled management systems fly in the face of the cruising sailor's "keep it simple, stupid" philosophy, and should only be employed by those to whom absolute ease of operation is the overriding concern. Just remember, it's a long, long way across the ocean, and getting a new electronic control module shipped to a remote location—much less finding an installer—may not be a simple matter.

Generally, automatic control systems can be bypassed for manual operation in case of a failure. If you have an automatic system with manual backup, make sure you understand its operation before you set off cruising.

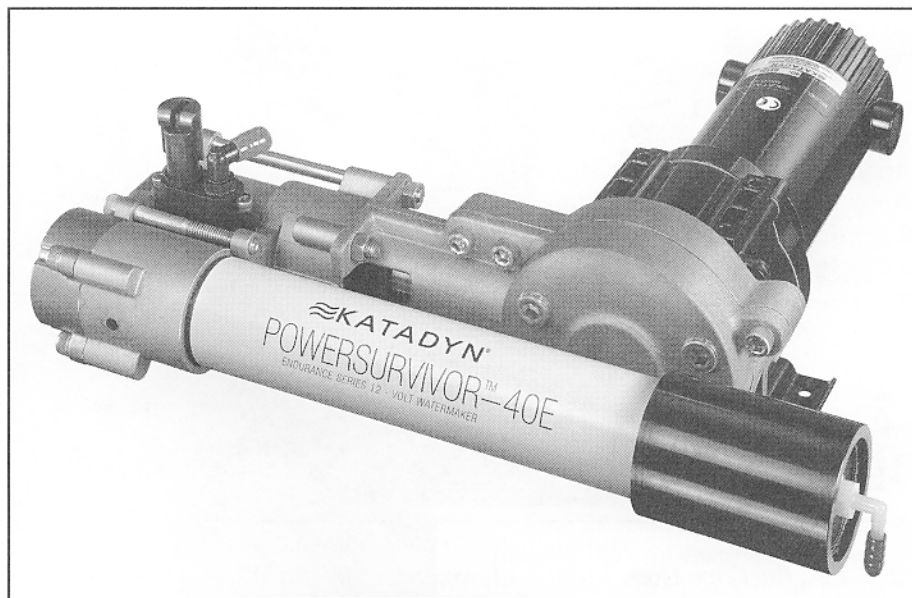
The typical electronic management system adds about \$1,500 to \$2,000 to the price of a manually-controlled watermaker. If you want convenience, you're going to pay for it.

### The Bottom Line

For the world-cruising sailboat without a generator, a DC powered watermaker is a viable option. In light of the difficulty you can sometimes have in finding potable water in out-of-the-way places, a watermaker can make a big difference between cruising in comfort, and cruising as a borderline survival exercise.

Without a watermaker, you may spend a lot of your cruising time searching for sources of fresh water. In many parts of the world, the water that comes out of the tap isn't suitable for drinking, and even the locals may collect rainwater or use bottled water for human consumption. With a reliable watermaker whose operation and maintenance you understand, the search for potable water can be largely a thing of the past.

However, watermakers are expensive. They're among the most expen-



*The PowerSurvivor 40E from Katadyn, above, is the only watermaker available that can be converted to manual pump operation in case of a power failure.*

sive pieces of equipment you can put on a boat, and they can be maintenance-intensive. A DC watermaker will set you back anywhere from \$3,000 to over \$8,000, just to buy the equipment. Professional installation can easily increase that by 50%. Having a watermaker is somewhat akin to acquiring a pet, albeit a useful one. Once you have it, you may enjoy its company, but you are also obliged to take care of it regularly.

Now let's take a quick look at some of the most available DC watermakers on the market today. Note that most DC watermakers are available in 12 or 24-V models, reflecting the current tendency to higher DC voltage systems on boats. Although the models listed here are those of primary interest to the average sailboat owner, other higher-output models, including engine-driven and AC-powered models, may also be available from most manufacturers.

PS invites comments from readers who own any of these systems, particularly regarding power consumption, output, and reliability.

### HRO Systems, Sea Recovery

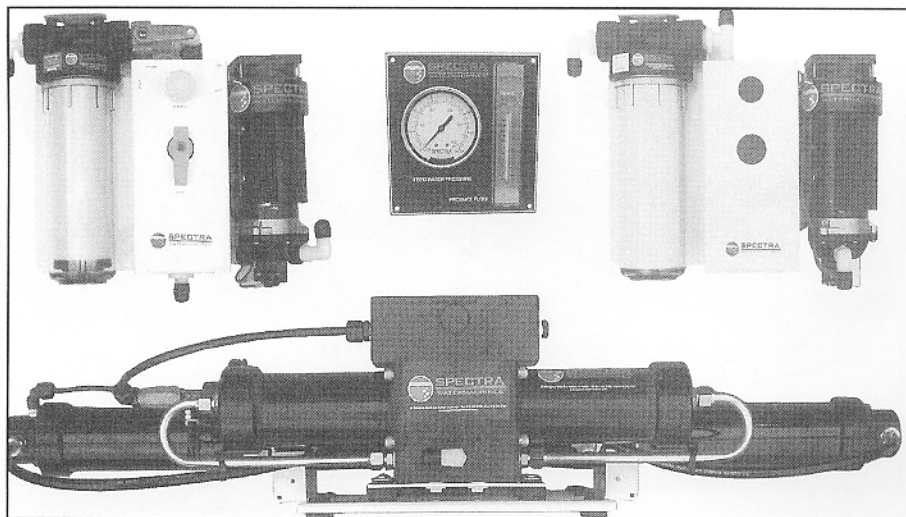
Horizon Reverse Osmosis and Sea Recovery share common ownership and a common manufacturing facili-

ty. Their DC watermakers are identical—only the labeling is different. Their energy-efficient DC models—named Ultra Whisper for Sea Recovery, and Seafari Escape for the HRO-labeled version—feature a stainless steel energy recovery type pump that is conceptually similar to the composite Clark pump used by Spectra. They are available in both modular and fully self-contained configurations.

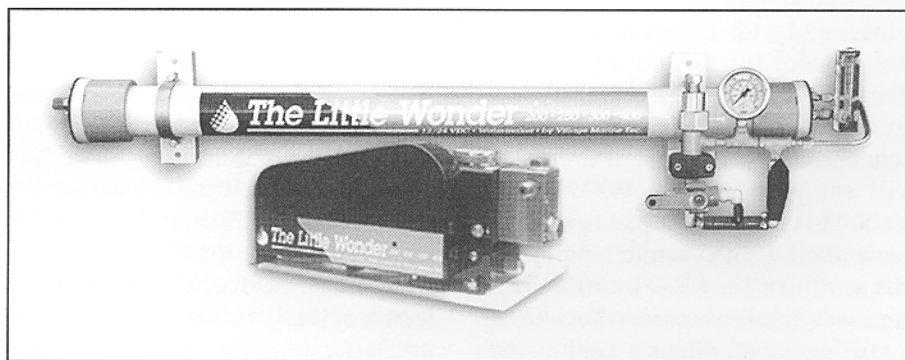
The stainless steel pump housings, while robust, make these among the heaviest DC watermakers, with weights from 130 to 145 lbs. Full electronic management, including automatic freshwater flush for long-term storage, is an option for both brands right now, but will become standard this fall. A company spokesman also told us that there will be new models introduced this fall that will differentiate the two product lines. Higher-output 24-V DC versions of these watermakers are also available. Both companies also market a more conventional high-pressure DC-powered watermaker, but the efficient energy recovery system watermakers are the more interesting products.

HRO and Sea Recovery watermakers are sold through a traditional dealer system.





At 65 lbs., the Cape Horn Xtreme, above, from Spectra Watermakers, is roughly twice the weight of the company's popular Ventura 150, but it's capable of cranking out 14 gallons per hour compared to the Ventura's six.



With a 5-year warranty, Village Marine's Little Wonder (modular version shown with pressure pump), has been a PS favorite in past tests (see PS Jan. 1, '98). The smallest model can produce eight gallons per hour.

### Katadyn's Powersurvivors

The Powersurvivors are the current versions of the original PUR products. They are compact, which means they're useful for a variety of installations, but they also lack any monitoring instrumentation or adjustment. Essentially, these are the most basic DC watermakers around, as well as being among the lightest. The 40E has the distinction of being the only DC watermaker that is convertible for hand operation in the event of power failure. The various Powersurvivor models are widely available through retail outlets such as West Marine. We found the 40E online for \$3,000.

### SK Watermakers

SK is a small company whose primary business is AC-powered watermakers. The DC 150 is available in frame-mounted and modular configurations. These are not energy-efficient watermakers, but they are rugged and nicely made. Since they are sold directly by the manufacturer, they are also the least expensive DC watermakers for their output on the market.

### Spectra Watermakers

By a slight margin that has decreased with the introduction of new or re-designed models by other manufacturers, Spectra watermakers are the most energy efficient available. These are semi-modular

units requiring separate component installation. The MPC 3000 automatic controller offers automatic operation and maintenance, but at a price. The new Z-Brane system, another option on some models, is designed to permanently eliminate chemical cleaning and preservation, prolonging membrane life. Spectra watermakers are available from selected retail dealers and distributors. The new Cape Horn Xtreme has been chosen by several of the Volvo Ocean Race teams to supply water needs for a crew of nine on this 30,000-mile ocean race.

### Village Marine Tec.

The Village Marine Little Wonder was the original high-output DC watermaker. Still in production after more than a decade, the Little Wonder has undergone significant upgrades in both output and energy efficiency, and offers models with outputs of seven to 12.5 gallons per hour at 12-V DC. All Little Wonder watermakers are supplied complete with pre-filters, manual freshwater flush, and low-pressure boost pump (the latter adds about one amp to the total current consumption).

Both modular and frame-mounted configurations are available in most models, but modular systems outsell framed versions eight to one, since relatively few sailboats have room for the enclosed, self-contained models. Electronic control packages are available only for AC-powered models.

Village Marine sells through factory outlets around the country, and a few selected dealers. ■

**HRO Systems**, 800/366-4476,  
[www.hrosystems.com](http://www.hrosystems.com)

**Sea Recovery**, 800/354-2000,  
[www.searecovery.com](http://www.searecovery.com)

**Katadyn North America, Inc.**, 800/  
755-6701, [www.katadyn.com](http://www.katadyn.com)

**SK Watermakers**, 800/489-0852,  
[www.skwatermakers.com](http://www.skwatermakers.com)

**Spectra Watermakers**, 415/526-2780,  
[www.spectrawatermakers.com](http://www.spectrawatermakers.com)

**Village Marine Tec.**, 800/421-4503,  
[www.villagemarine.com](http://www.villagemarine.com)