

② BANISHING WATER WORRIES

A small, low-draw desalinator proves easy to install and maintain. BY ELLEN MASSEY LEONARD

SYSTEMS

Fresh water is one of the few things the human body cannot do without. A person can survive several weeks without food but only three or four days without water. This is why the logs of explorers such as James Cook are filled with references to anchorages where rivers were found, descriptions of long days working to

replenish the ship's water supply and worried remarks about the number of casks found sour in the hold midocean. The tales of voyaging yachts, such as John Guzzwell's *Trekka* and Frank Wightman's *Wylo*, also devote paragraphs to rain-catchment and refilling the tanks in port.

This was our situation when my husband, Seth, and I set off as cash-strapped college kids to circumnavigate aboard a

vessel much more akin to the home-built *Wylo* than anything on the market today. We tried catching rain, we took seawater showers and we spent long days in remote anchorages hauling buckets of fresh water from shore to our boat.

In spring 2014, however, as we were preparing for our current voyage to the Arctic on our new-to-us boat, *Celeste*, Seth and I learned of Katadyn's PowerSurvivor 40E, an efficient, low-draw watermaker. We'd been worried about our water supply for this journey because *Celeste* carried only half the water capacity of the heavy-displacement vessel on which we'd circumnavigated and yet the Arctic is a desert — water would be expensive or even impossible to obtain there. We debated filling the bilge with gallon jugs, à la cruiser Annie Hill, but didn't want the extra weight pushing down our waterline. So, we



The drive assembly and membrane housing are the heart of every watermaker system, and some of the largest components. The membrane housing must be positioned horizontally. In the installation above, the briny discharge hose comes out of the membrane housing and makes a loop to tie into the boat's sink drain.

RESOURCES

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[Cruise RO Water
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[EchoTec
echotecwatermakers.com](http://EchoTec.echotecwatermakers.com)

[FCI Watermakers
fcwatermakers.com](http://FCI Watermakers.fcwatermakers.com)

[J. Gordon & Co.
\(Spectra, Echo Tec,
Sea Recovery distributor\)
gordonco.com](http://J. Gordon & Co. (Spectra, Echo Tec, Sea Recovery distributor).gordonco.com)

[Hydrovane \(Echo Tec distributor\)
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[Parker Hannifin \(Sea Recovery,
Horizon, Village Marine\)
parker.com](http://Parker Hannifin (Sea Recovery, Horizon, Village Marine).parker.com)

[Rainman
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[Katadyn Group
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T-fittings were used to tap into the boat's starboard tank fill plumbing, saltwater intake hose and sink drain (left), so Ellen and Seth didn't need to add any through-hulls. A three-way valve mounted ahead of the pre-filter (right) adjusts to allow the input of either seawater or membrane preservative to the system.

approached Katadyn (now called Katadyn Group, with watermakers branded under the name Spectra) with a sponsorship proposal for our Arctic voyage and were soon the owners of a new 4 amp, 1.5-gallon-per-hour desalinator that we could operate manually in the event of a power failure.

Compact and relatively lightweight, the PowerSurvivor was simple and straightforward to install. Seth and I decided to fit it in a locker in the head, and we found that we could still stow the locker's previous contents (mostly toilet paper and paper towels) without any trouble. We chose the head locker for several reasons: It was a convenient location for installation and servicing; it provided easy access to a saltwater intake and a drain; and it was a dry area free of fuel vapors or excessive heat, as stipulated by the owner's manual. Our classic cutter was on the hard when we performed the installation, although it would be simple enough to do in the water; the only difference is that you would have to close the seacocks.

As with many boat projects, the key to

a hassle-free installation is the preparation: It's important to configure as many of the hoses and electrical connections as possible before affixing the watermaker itself. The PowerSurvivor came with everything we needed that was not specific to *Celeste*, including valves, hoses and hose

ONLINE EXTRA

Check out a video of Ellen and Seth's cold-water desalination test at cruisingworld.com/HOS18water.

clamps. Our first step was to fit a strainer and T-valve on the saltwater intake hose. This allowed us to use the intake either for its original function of flushing the head or for the reverse-osmosis system (though you wouldn't want to do both at the same time!). The through-hull had the advantage of being at a low point on our hull, minimizing the chance of air intake while heeling or in rough conditions. It was also $\frac{3}{4}$ inch wide, satisfying the requirement of

at least $\frac{1}{2}$ inch for the desalinator, and, of course, it had a seacock for safety.

We then cut our sink's drain hose and fit another T-valve for the briny waste to exit the boat. We also mounted a three-way valve for the fresh water coming out of the desalinator. This let us run the fresh water either through a $\frac{1}{4}$ -inch-inner-diameter tube to test the water or to fill jerry jugs, or — once we'd tested the desalinated water's quality — through a $\frac{3}{8}$ -inch reinforced plastic hose to a T-valve we inserted into our starboard tank's vent.

Next came the electrical connections. Using 14-gauge tinned, stranded copper wire, we ran power from our main circuit-breaker panel to a terminal bar in the locker with the watermaker. Once we had hooked up the wires that came with the PowerSurvivor to that terminal bar, the watermaker had its own switch on the breaker panel to turn it on and off.

We then mounted the pre-filter below the pump intake, as recommended by Katadyn's engineers, to allow air bubbles to pass easily. There was plenty of room for

it alongside our pressure-water hoses and even room to mount a silt-reduction filter if we needed it for brackish or shallow water, inland waterways or areas of glacial runoff, this last being the most likely on our present voyage. The pre-filter should be mounted vertically and through-bolted with stainless-steel hardware. Its three-way valve — which allows you to

choose between seawater intake for regular operation and another hose for membrane-cleaning solution — should be sealed with nonhardening paste, such as Loctite 5331, for an airtight seal. We also mounted the pre-filter in a part of the locker that's easily accessible for maintenance, which includes inspecting and emptying the housing, cleaning the filter regularly and treating

the membrane any time we won't be using it for a week or more. In the tropics, this time frame is closer to three days, but in higher latitudes, the cold water and air keep algae growth down a little longer.

With all that completed, it was time to mount the drive assembly/pump/membrane unit. The trickiest part was holding the 25-pound device in place while Seth

CAPACITY

The amount of water you'll need to make depends on your cruising destinations, personal habits and how many people you usually sail with. Will you be offshore or in remote locations for extended periods, or near civilization where you'll have easy access to inexpensive dock fill-ups? Will you be in warm water, where reverse-osmosis systems work more quickly, or in cold? Do you wash dishes and flush the head with fresh water? Do you have a washing machine aboard? How often do you like

to shower? Also, how big are your water tanks?

There's a big difference between the minimum amount of water required for survival (two-thirds of a gallon per person per day, according to the World Health Organization), and the amount that keeps us — and our dishes, clothes, gear, etc. — comfortable, happy and clean.

"We generally recommend 10 gallons per person per day," says Annie Edinger of the Katadyn Group. "But that can go up if you bring along kids, pets, or noncruiser friends. We

also find that once a boat has a watermaker, the crew starts washing the deck and taking more showers, and their water consumption increases."

"You want a system large enough to make the water you need in a short time in order to keep your power draw low," says Marshall Lerner, of J. Gordon & Co., a Spectra and EchoTec dealer. "You don't want it to run all day." Another benefit of a higher-output watermaker is that the shorter required run time will extend the lifespan of the unit, says Darryl Hershberger, of SK

Watermakers. Manufacturers describe output in gallons per hour (gph) or gallons per day (gpd); make sure you're comparing the same unit of measurement between systems. If space for the installation is a limiting factor, look for a modular unit that has smaller individual components. A final note on capacity: For safety reasons, always carry enough fresh water aboard for your longest passage between ports; don't rely on a working watermaker for minimum hydration requirements.

— Eleanor Merrill

marked its position. Seth then drilled the holes in the bulkhead, after which I held up the PowerSurvivor while he fitted the first two ¼-inch stainless-steel bolts. With the desalinator firmly in place, the second two bolts were easy. We made sure to mount the desalinator with the long axis of the membrane in a horizontal position; to do otherwise would risk ruining either the drive assembly (if the pump developed a seawater leak) or the pump (if the drive assembly developed an oil leak).

Because we had installed all the hoses in advance, the only thing that remained was to plug in the unit. We connected the ¾-inch saltwater intake hose from the pre-filter, the ¾-inch freshwater hose from the end of the membrane canister to its three-way valve, and the ¾-inch briny-waste hose out to the T in the sink drain. Then, we attached the electrical wires from the drive unit to the terminal bar (with the breaker switched off, of course). The owner's manual recommends either leaving enough hose coiled next to the desalinator so that you can pull it out for manual operation without undoing your installation, or assembling a separate set of hoses so you can move it to any location for manual operation. We originally left lots of hose coiled up

but decided after the first operation to shorten our hoses to decrease the distance the intake water had to travel. We opted for assembling a separate set of hoses for emergencies.

Treating the membrane to prevent biological growth had been a mystery to Seth and me before owning a watermaker, but as it turns out, that too is easy. First, we lifted the lever on the pump's cleaning valve. According to the manual, you are supposed to use 2 quarts of desalinated water from the PowerSurvivor for the preserving process in order to avoid using chlorinated (city) water that could damage the membrane. We had neglected to keep enough water from our last use of the desalinator (and were now in the marina where we planned to keep *Celeste* for the winter and where we didn't want to run the unit), so we bought a gallon of distilled water. We prefer to use more than 2 quarts to ensure that plenty makes it through the unit, since some stays in the pre-filter. Into this we mixed — according to its instructions — the membrane preservative solution that had come with the PowerSurvivor. We positioned the three-way valve so that the product water would run through the testing

MANUAL DESALINATORS

Every prudent sailor has an abandonment bag with flares, EPIRB and other survival items. U.S. Navy and Coast Guard life rafts include manual desalinators developed by the Katadyn Group, and it's relatively inexpensive for cruisers to have these hand-operated emergency units too. There are solar-evaporation units for sale, which are, of course, better than nothing, but they produce about half a gallon per day as opposed to the 6 and 35 gallons per day made by the two Spectra models. For singlehanders and cruising couples, the manual Survivor 06 retails for about \$1,100. Larger crews should consider going with the Survivor 35 at about \$2,400, money you'll think was well spent if you ever take to the life raft.

— Ellen Massey Leonard

hose rather than into our starboard tank. Then we turned the lever on the pre-filter's three-way valve so that it would use the membrane cleaning intake hose rather than the saltwater intake. This intake hose has a small strainer attached at the end; we put this into our container

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HOW DOES IT WORK?

In the simplest terms, a watermaker pushes seawater through a series of filters that strain out successively smaller particles, starting with seaweed and critters in the first filter and ending with salt and bacteria in the final membrane. A pump or pumps are used to pull the water into the boat and build up the required pressure (about 800 psi) to force the water through a membrane — that's the reverse osmosis, or "RO," part.

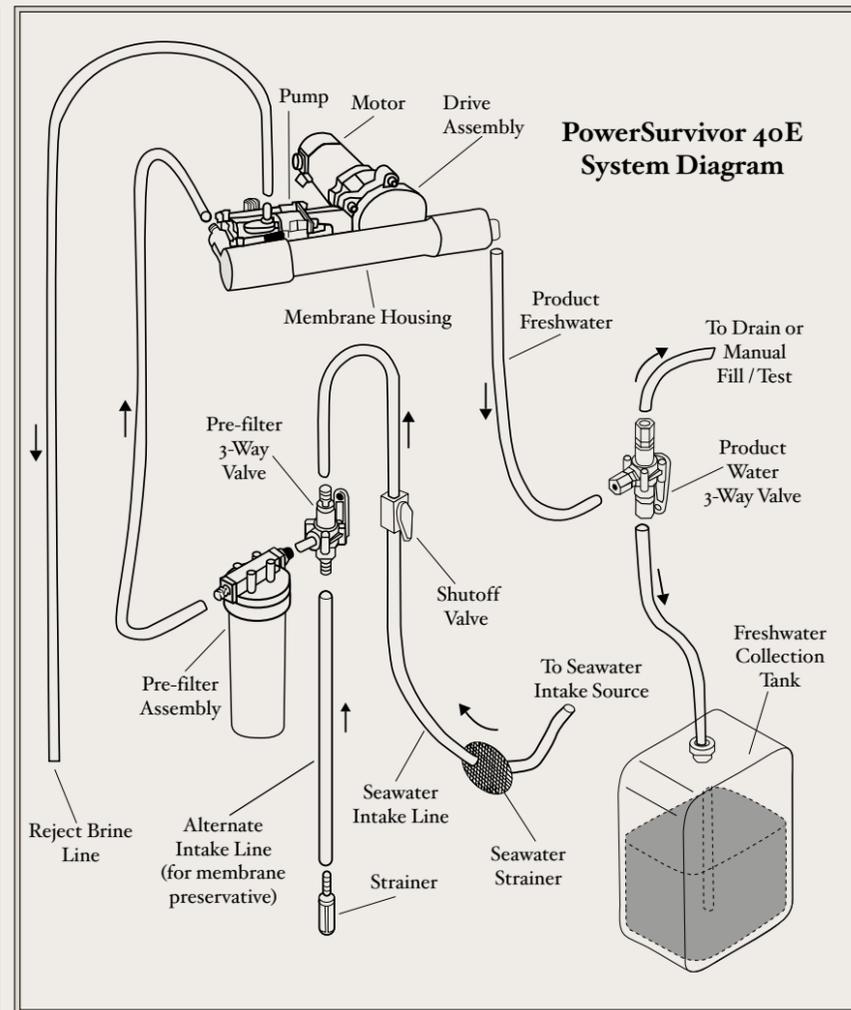
A typical watermaker has two hoses coming out the back: one for the purified fresh water (called "product water"), which is about five or 10 percent of what was pulled in, and the other for the salt left behind, which gets flushed out by the rest of the water as a briny discharge. A smaller product-water percentage makes for a longer membrane life-span, according to Daniel Forest, of AquaMarine. One through-hull is needed for the seawater intake (this one must be below the waterline even when heeled), and another to drain the discharge; Ellen and Seth were able to use existing through-hulls for these.

There is a big range in the complexity of the systems available, and how high-tech you go is a matter of personal preference. Ellen and Seth chose the Katadyn PowerSurvivor 40E — now sold as Spectra — because it is one of the smallest and simplest on the market, appropriate for *Celeste's* small tank capacity, and because at a mere 4-amp draw they are able to run it off their solar panels.

Robert Valenzuela, of Parker Hannifin's Water Purification division, says his company's Horizon Reverse Osmosis brand includes more basic, manually operated units for those looking for a very simple device, while the Sea Recovery brand watermakers have more electronics and automated features. Similarly, Spectra has various systems including both analog (mechanical controls) and automatic choices, the latest incorporating a Web app for smartphone monitoring. Most watermakers can be customized with extra features, such as a float switch to turn off the unit when the water tanks are full or an option to have the system automatically flush its membranes with fresh water after use.

— Eleanor Merrill

of distilled water and membrane preservative. Then it was a simple matter of running the desalinator until all the preservative solution had been drawn through and foamy water was coming out the reject-brine hose. Because we were leaving *Celeste* in the Aleutian Islands, we



The PowerSurvivor installation diagram includes the basic components of all watermakers: a saltwater intake hose, pre-filter, membrane housing, and hoses to bring briny waste out and freshwater to the tank.

continued to run the watermaker until air was coming through the brine hose as a precaution against freezing conditions.

The PowerSurvivor has been a big success for us so far. It takes up hardly any storage room, it's easy to operate and maintain, the water is as pure as it should be and the desalinator produces its promised 1.5 gallons per hour at an average of 4 amps. The manufacturer warns that it might require more power upon first operation (we found that it did not) and that its output might decrease in water below 57 degrees Fahrenheit. The chart in the owner's manual shows capacity dropping to about 90 percent at 55 degrees and 60 to 80 percent in water below 40 degrees. In our first summer with the desalinator — during which the coldest water temperature we experienced was 49 degrees, in the Bering Sea — we did not see any noticeable drop

in output or increase in current draw, and thus found the watermaker to be very reliable in normal circumstances. In summer 2015, we tested the machine at the edge of the polar pack ice, at 71.4 degrees N in the Arctic Ocean above Barrow, Alaska. With the sea temperature at 37 degrees, we did find a modest decrease in output: 5 liters per hour instead of the usual 6, which equates to 83 percent of normal and thus better than the engineers' predictions. In other words, the PowerSurvivor has more than lived up to our expectations.

Having sailed long distances both with and without a watermaker, I'm now convinced that the half-day project of installing the PowerSurvivor and the minor task of servicing it when needed is well worth it. We no longer spend our first day after a passage hefting buckets of water. During our summer in the

POWER

The three most common categories of watermakers are defined by what type of power source is used to drive them: AC current, DC current or a belt connected directly to the engine. Which one to choose is dictated by your cruising style and your boat's setup.

Belt-driven watermakers are directly connected to the engine, which means you will need to have space in the engine compartment for the installation. These are a great choice if you run your engine regularly, because they have some of the highest output of all the water-maker types. That said, engine trouble could hinder water-making abilities. (Read about an engine-driven water-maker installation at cruisingworld.com/water-water-everywhere.)

If you have a genset or inverter aboard that you use to run systems such as refrigeration or air conditioning, you may want to also plug your watermaker into the AC

power. AC-driven units can often purify more water per hour than DC-driven ones, allowing a shorter run time for the same amount of water. AC-driven watermakers are a great choice for boats that run a generator regularly.

DC-driven watermakers, usually using 12- or 24-volt power, are likely the most common choice for smaller cruising boats because they draw less juice than an AC unit and don't require the complicated installation of an engine-driven one. You don't have to have an engine or generator going to run them, but making water while the engine is running is an efficient way to top up the tanks. If your solar panels are generating extra power midday, that's also a good moment to run a DC watermaker.

"We usually have the engine going when entering a new anchorage, and that's a perfect time to run our 12-volt DC watermaker," says Will Curry, of Hydrovane, an EchoTec distributor. "When we sailed our Beneteau First 405 from Mexico to Australia, we got plenty of water by

running it about twice a week for an hour and a half to two hours."

Spectra and Schenker watermakers use energy-recovery pumps to increase efficiency. Water pressure from the briny discharge is transferred to the raw water coming in, lowering the power consumption up to 75 percent from conventional systems. This makes for quieter systems that may be able to run off of a solar array or wind generator.

There's another option available as well: In addition to its AC- and DC-driven watermakers, Rainman now makes a portable system that can be run on gasoline, thanks to a small Honda engine. The pull-start unit uses a quarter gallon of gas to make 37 gallons of fresh water in an hour and 10 minutes, says Christopher Burton, of SeaTask, a U.S. distributor of Rainman products. If you don't have the space to install a watermaker permanently, or only want to bring it aboard some of the time (something racers might find appealing), this could be a viable alternative. —Eleanor Merrill

Arctic, we didn't refill our tanks from shore for seven weeks and yet we never rationed ourselves — in fact, we took frequent freshwater showers. Now, if we want to anchor and avoid tying up to a

dock, we can. If we doubt the quality of the shore water, we don't have to fill up with it. And all this with only the power produced by our solar panels. Capt. Cook would have loved it.

Ellen Massey Leonard and her husband, Seth, have circumnavigated the globe and cruised extensively in Alaska and the Arctic. Ellen chronicles her adventures at gonefloatabout.com.

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