

WATERMAKERS

Right, a water-maker inlet manifold under construction. Below right, a well-laid-out system like this one will make operation and troubleshooting easier.



Building your own watermaker

STORY AND PHOTOS BY DAVE MCCAMPBELL

A look at putting together a unit from standard parts

Modern technology has brought us many new devices that make the cruising life much safer and easier. Since we are not interested in camping out while cruising, obtaining safe and clean fresh water has always been a major priority, especially overseas. The three most common ways of obtaining fresh water on a cruising boat are: 1) an effective rain collection system, 2) from shore via a hose, or 3) a watermaker. Given reasonable storage capacity and a good filtration system, a high-capacity watermaker is the most efficient — especially if you are a boonies cruiser.

A reverse-osmosis water-

maker takes clean seawater and, by pushing it through a specialized membrane (special filter) at relatively high pressure, makes fresh water. This means that no longer do we have to carry hundreds of pounds of extra fresh water just to ensure we don't run out. Also, we no longer must get up in the middle of the night to catch rainwater, or search out places ashore where we can jerry-jug water from sometimes expensive or suspect sources.

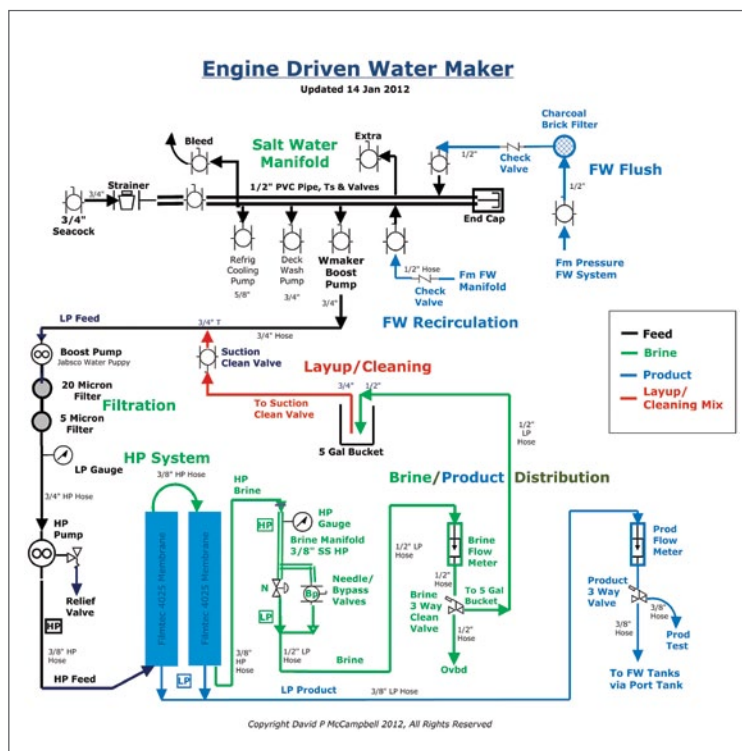
Watermakers suitable for use on a cruising boat can be obtained from a number of sources depending on your budget and tolerance for electronics gadgetry. But they all

do the same thing: make fresh water from seawater. We think that if you are going to have a watermaker aboard, it should have bulletproof — and mainly mechanical — equipment with minimal electrical and electronic parts; use common-



ly available (not proprietary) components; make the most water practical in the shortest time (40 gallons per hour is our choice); and be repairable with onboard spares, tools and skills.

As an example, we use about 50 gallons of fresh water a week for daily cooking, drinking, showering and cleaning. A 40-gph water-maker with two 40-inch membranes can make that in one and a half hours with setup and flushing time included. Smaller units can take significantly more time to do the same work, thereby seriously affecting a cruiser's free time.



The elements of an engine-driven water-maker system are shown in this schematic.

Major watermaker components

The heart of the system is the high-pressure plunger pump, similar to what is used in the car wash and other pressure-washing industries. The rpm and flow rate are important, with the ideal flow being 2.5 to 5 gallons per minute. An electromagnetic clutch is not necessary, or even desirable in my opinion. A robust commercial-quality pump is necessary. I don't like plastic, but the body does not have to be stainless steel or titanium. The latter two may last a lifetime, but that is overkill for most of us. Bronze and even brass will last for 15 to 20 years, as long as it is flushed with fresh water after each use. We use a commercial brass Hypo pump, cost-

ing about \$470, whereas a titanium or stainless-steel pump can cost \$1,500, and bronze is about \$800. This is worth considering if you are on a tight budget.

The next most expensive parts are the membranes and their tube housings. Again, quality is important; the industry standard 40-inch Filmtec 2540 membranes cost about \$200 each. I bought our original Codeline fiberglass tubes for about \$50 each at a used marine parts store. Purchased new, the price is about \$250. There are other options, but stainless-steel end fittings are best and used tubes must be free of defects and leaks.

The remaining parts include a

rugged 12V boost pump to make sure the high-pressure pump never runs out of salt water. Jabsco's Water Puppy is suitable, which is what I use.

Two stainless-steel, oil-filled gauges are necessary. One is a high-pressure gauge for keeping track of the feed water pressure through the membranes (about 800 psi). The other gauge is a low-pressure gauge for monitoring filter feed water pressures (about 10 psi). Both gauges should be supplemented with flow meters to help determine when it is time to clean or replace membranes and filters.

We use two flow meters, one for the saltwater brine flow out of

the membranes and one for the freshwater product flow. For longest life, it is important not to produce more than about 20 gph through each membrane. So, on a two-membrane system, the product flow should be kept to no more than 40 gph while operating.

Finally, there is the high-pressure regulating valve, several three-way "Y" valves, numerous stainless-steel and plastic fittings, and both high-pressure and low-pressure hoses to suit your installation. No rocket science is required; just time and common mechanical/electrical skills to do basic plumbing and maintenance work.

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An engine-driven pump

Because the power needed to run this volume through the membranes is more than 2 hp and a 12V motor won't handle that, we have chosen



Above, membrane tube end fittings.

Below, a watermaker Hypro pump mounted on a slide under the engine crankshaft pulley.

to belt our watermaker pump to our main engine on our last two boats. This is similar to an alternator arrangement. You can drive a watermaker pump with a generator, but using only a generator puts another expensive, sometimes cantankerous and complicated



piece of mechanical/electrical equipment between you and fresh water. If the generator fails, as they sometimes do, you are back to spending hours per week manually collecting fresh water from rain or shore.

We most often run the watermaker when underway and moving the boat. Infrequently, we run it at anchor and sometimes just flush it with fresh water to satisfy the once-a-week run requirement that prevents biologic buildup on the membranes.

We average less than 10 hours per year in the tropics using the engine just to operate the watermaker.

If you decide to make your own watermaker, there are several sources of information on the Internet, including my guide. Fifteen years ago, it took me quite a bit of time to engineer the specifications, develop a parts list, and then find and purchase the equipment. By that time, I had seen two successful DIY units, so I knew it could be done. I used a mix of some used and some new parts, mainly because I was on a tight budget. Since then, I have refined the unit somewhat, installed two units on our boats and helped several other cruisers do their own using my information.

Extensive engineering details are on our website under "CSY Workshop," and we have a PowerPoint slideshow in our "Presentations" section. There

Watermaker parts list

- HP pump: Hypro 2345B-P, 4.7 gph, 3/4" shaft; ~\$470
- Boost pump: Jabsco Water Puppy 18660-121 (12V self-priming, 6-7 gpm); ~\$120, Amazon.com
- Membrane housings (x2): 40" long, 2.5" diameter (Codeline or A&M Composites); ~\$250 used, \$400 new
- Membranes (x2): Filmtec SW30-2540; ~\$200 each
- Pressure relief valve: Nupro Purple Spring
- Water filter housings (x3): 3/4" fittings
- Water filters: 5- and 20-micron and charcoal
- Flow meters: Dwyer VFB-81-SS, 6-60 gph; Dwyer VFB-86-SS, .5-5 gpm
- Pressure gauges: oil filled, all stainless steel; high pressure, 0-1400 psi; low pressure, 30-70 psi
- Bypass valve (1/4 turn): Aquapro or McMaster, rated for 1000 psi
- Three-way valves: SMC 1/2" FNPT branch; 1/2" FNPT three-way ball valve, model #22152
- High-pressure hose: 1000 psi, size and length appropriate for your boat (see diagram); stainless-steel fittings
- Low-pressure hose: Size and length appropriate for your boat (see diagram); stainless-steel fittings
- Electromagnetic clutch for high-pressure pump (optional)
- Pulley for high-pressure pump
- Intake strainer: Vetus, Shurflo, etc.
- Swagelok or Yor-Lok fittings
- Needle control valve

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is also a Seven Seas University webinar I did for SSCA a couple of years ago, with the slideshow narrated.

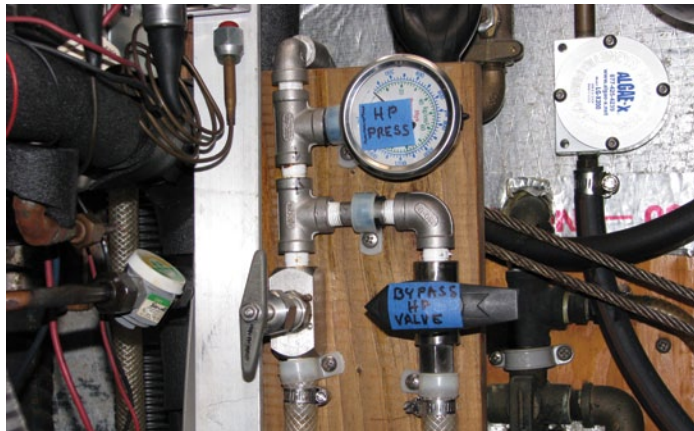
Better than the WHO standard

My first unit on *Soggy Paws*, our CSY, was still in service after eight years when we sold the boat in 2016. It had the original pumps, membranes and fittings, and was belted to our 60-hp Perkins. It was still producing fresh water that tested to about 250 ppm (parts per million solids content). The World Health Organization standard is 500 ppm.

Because I was careful never to run my watermaker in dirty or silty locations, in addition to having two pre-filters, I never had to clean the membranes in eight years.

The second installation on our catamaran is now belted to a 27-hp Yanmar 3GM30. It has a different mounting configuration, and after four years of use still produces water

A watermaker high-pressure manifold. Note how Dave McCampbell has labeled the system elements, which allows new crewmembers to more easily learn the system.



at less than 200 ppm.

There are many ways to mount a pump to an engine; you just need to be able to tightly tension the belt drive around the crankshaft pulley. You want to use an appropriately sized pulley to run the watermaker at near full rpm from an engine running around 50 percent of its maximum rpm.

Once you have all the parts, any competent cruiser should be able to install a watermaker in a week. It

took me two weeks — but then I never claimed to be competent, just thorough.

As with ground tackle, we think bigger is better, within reason. So if you don't have a watermaker yet, consider easing your cruising workload and making the crew happy by obtaining a watermaker. Then you can wash dishes in fresh water, take freshwater showers every day, and not worry about using too much water — just like normal people. ■

Dave McCampbell is a retired U.S. Naval diving and salvage officer with over 40 years' cruising and eight sailboats' worth of maintenance experience. He and wife Sherry, currently cruising in Southeast Asia, spent eight years crossing the Pacific via Easter Island, Hawaii and Micronesia. Prior to that, they circumnavigated the Caribbean over four years. Their most recent excursion was a 7,000-nm journey from the Philippines to the lower Solomons via eastern Indonesia and Papua New Guinea. Four years ago they sold Soggy Paws, their CSY 44 monohull of 19 years, and moved to the "enlightened side," purchasing a new Soggy Paws, a St. Francis 44 catamaran. Their extensive website is at SVSoggypaws.com.

Watermaker pricing

Rough pricing for a range of 40-gph units is as follows:

- High-tech machines with sophisticated energy recovery pressure pumps now cost about \$20,000 and use a number of proprietary, electronic and plastic parts.

- Standard, commercially produced marine units sell for \$10,000 to \$15,000.

- Modular or kit units are available from several

sources for about \$6,000.

These companies provide all the parts necessary, as well as installation guidance. Some have assembled and tested modules, making assembly and installation easier. These are a great option if you can't source all the parts yourself and want installation guidance. Just be sure you compare prices for all the parts you need, as some units are pretty basic.

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- A 40-gph, do-it-yourself project can be completed for as little as \$3,000. Making your own unit involves sourcing and assembling components from the Internet, your local hardware store, marine flea markets or other sources.

None of the above prices include installation labor, which is required for all units.

Dave McCampbell