Spectra Watermaker Operator Notes for Cruisers

prepared by Don Wilson, S/V Tackless II
Spectra Technical Representative
(currently in The South Pacific)

In June of 1999, I installed a Spectra 180C on our CSY 44 sailboat, ***Tackless II*** and left the Virgin Islands on an extended cruise that after 4½ years has brought us to Mexico's Sea of Cortez for our second summer. Our watermaker has now run for 1506 hrs without a failure. That is not to say we have not had to fix a leak or change out a few parts, but it has never failed and we have never been out of freshwater. Because I wanted to keep it that way (in March we are scheduled to head for the South Pacific), I attended a one-week Technical School in February of 2003, at the main office of Spectra in San Rafael, CA.. Paid my money, spent a week, got my manuals, my Spectra Technical Rep. wall plaque (if I had a wall), tool kit and spare parts. Does it make me a Spectra expert? Hardly. Do I know a little more about them than the average guy? I sure as hell hope so. In the ten months since taking the course I've spent hours and hours in watermaker talk on every boat I've met, including almost every Spectra owner and lots of wannabe Spectra owners. I discovered that the questions and the problems are almost always the same. Spectra Watermakers are very reliable machines. So reliable that many users do not give them the very simple attentions they need. With very few exceptions, the problems that cost you product water, extra power or poor quality water result either from lack of attention OR lack of understanding of the basic needs of your unit. For this reason, I decided to take the time to put together this "Information Summary". All this info is in the manual (Well, almost all of it!), but maybe this will be easier to get though. So here goes-the "Cliff Notes" for Spectra or "Watermakers for Dummies."

All watermakers work basically the same way: they pump saltwater up to a pressure high enough to force freshwater out of it through a membrane while the rest of the saltwater goes back to the fish. But from this point on, each system is somewhat different.

Your Spectra has a feed pump (either one or two small 12-volt pumps or the new Vane or Super Turbine pumps) that pumps a certain amount of water into the Clark pump. The Spectra Intensifier (Clark pump) intensifies that pressure ABOUT NINE TIMES to reach and maintain the pressure needed to produce freshwater. No sales pitch needed here, you already know your Spectra takes less power to produce more water and less noise than any of the others out there.

In your diesel engine, you keep the fuel clean, change the filters, and watch the gauges for possible changes in the working parts and you can go thousands of hours with very little trouble. Your watermaker is the same. Keep the filters clean so the Clark pump and membrane get good water and keep an eye on the head pressures for any changes, and

you'll have thousands of gallons of freshwater to use for however long you PAY ATTENTION. So here is what you have to look for.

Production problems are almost always tied to feed flow. Let me repeat that-IF YOUR WATERMAKER IS NOT MAKING THE AMOUNT OF WATER IT IS SUPPOSED TO, YOUR FEED FLOW IS GENERALLY AT FAULT! Unless you have just moved into much colder water, the problem will generally be in one of the following areas.

Diagnose Your Feed Flow Problem

1. Check your sea strainer.

2. Check the prefilters. Your prefilters need to be kept clean. There is no hard rule as to how often. Some users clean their filters after every watermaking session, some every other session, others every 25 hours, and others only when the product flow begins to go down. When you aren't getting the right amount of water through your filter, even when they look fine, put in a new one.

No need to throw a used filter away! As long as there are no tears or holes in the pleats, you can clean and reuse them for many hundreds of hours. Many people drag their dirty filters behind the boat. I spray the gunk off ours carefully with our salt-water deck wash-down hose. Once clean, allow the filters to dry in the sun, then store them for your next filter change. I have heard some people swear by soaking their cleaned filters in a bucket of water with a bit of bleach (one capful in about 2-3 gallons of freshwater), rinse in freshwater after about 30 to 45 minutes in the solution and then let the bleached filters dry in the sun. Be very careful of this procedure; while chlorine (bleach) should evaporate away, always remember that chlorine is the one substance that will do in your membrane. ANOTHER word of caution, if you use chlorine-type treatments in your tanks, extra attention needs to be paid to your charcoal filter in the fresh water flush system. You DO NOT want any chlorine to reach your membrane. Change the charcoal filter every six months if you are exposing your watermaker to anything other than saltwater or the water you make yourself.

3. Check your voltage. Battery voltage is directly related to production. Always try to run your Spectra when voltage is at its highest. Pumps are rated at 12 volts, and while they will run on a lot less they will draw more power, run hotter, not last as long and, MOST IMPORTANTLY for this discussion, not pump enough water for your desired product output.

4. Check your voltage at the pump and under load. Even if you had a small voltage drop when you installed it, it may be more now thanks to a loose or corroded connection. Check your connections regularly and keep them clean.

5. Ensure there are no new kinks or restrictions in the hose from the thru-hull to the feed pump to the Clark Pump.

Once those items have been checked and are OK, then…

6. Measure the output of the pump(s). With the Clark pump PRESSURIZED, measure the output from the discharge hose AND the product line. Use a measured container (I use a one-quart measuring cup) and a STOP watch, and do the math. On one Shurflo pump, for example, you should get 90 gallons an hour (1.5 gallons/minute) feed flow, on two pumps you should get 150 gallons per hour (2.6 gallons/minute). For every 10 gallons per hour you DO NOT HAVE coming through your system, you lose ONE gallon of product. There is no way to beat this mathematical relationship; you have to have the flow to make the water.

(Note: If your Spectra is a 200C, 380C, or Santa Cruz, your Clark pump is a 10% displacement pump. Although the outsides of all Clark pumps look the same, their displacements are different. The Ventura 150's are 7.5% pumps, the 700's and 1000's system are 15% and 20%.)

If #1-5 are good and #6 is not, then you need a NEW PUMP HEAD on one or both of your feed pumps. There is NO other answer. This is the most common problem with the Shurflo feed pumps. As the bearings wear, the pump will still run, sound and act fine, they just pump less and less water and your production will start going down. As your production starts going down, your water quality also begins to deteriorate as your PPMs slightly increase. **Spectra owners, whose systems use Shurflo pumps, should carry spare pump heads in on-board inventory.**

Pump Pressures: When you replace a pump head, you must CHECK the static feed pressure for the pump and most probably reset it. Follow the directions that come with the kit. A single pump unit needs to be set at 100 psi, double pumps need to be set at 125 psi. Each pump has to be set individually. Once the new head is installed and the system is reassembled, shut off the discharge valve (center position on the 3-way Y-valve) turn the pump on and watch the feed pressure gauge. Pressure should increase rapidly to the desired psi setting at which time the feed pump should shut off. If not, then adjust according to pump instructions. (Using an Allen wrench, turn set screw in the pump head clockwise to increase the pressure and counter-clockwise to decrease it.) Caution should be taken on the first test startup to be ready to turn the pump off manually if the pressure continues past 150 psi or so. New installs usually do not have to worry as the pressures are preset at the factory. Likewise, if you replace the whole pump and not just the pump head. However, it is a good idea and a very easy thing to check. It will not harm your system.

Periodically, you can use this procedure to check your entire system for leaks. Turn the discharge valve off, run the pressure up to the cut-off pressure and watch the gauge. If the pressure remains constant the system is good. If the pressure "bleeds off" you have a leak somewhere.

The feed pump head pressures have to be set correctly for the Clark pump to shift properly and smoothly. Too low and the pump won't have enough pressure for the pump

to shift at all. Too high will only affect the amount of pressure you put on the entire system should there be a blockage in the discharge side of the system. This is the MAIN reason to have the high side limits -- for those unforeseen acts of accidentally leaving the discharge valve closed after servicing or developing some unidentified blockage and turning the system on. YIKES!

For those of you with the new Mag-drive Vane pumps, (Catalina 300's) pressure will increase to about 140 psi and the head will "decouple", the pump will continue to run and it won't sound pretty. There is no bypass valve as the pump simply decouples. Long periods of running decoupled will weaken the magnetic coupling magnet that will cause the system to decouple at lower pressures. Units with the MPC will alarm SYSTEM STALLED when this happens. The Newport 400 bypass is set at 150 psi. To set this, block the brine discharge, remove the SS cap nut on the pump head, and turn the slotted head clockwise to increase and counter-clockwise to decrease the set pressure. Set the bypass at 150 psi. The Newport 700 should be set at 200 psi and the Newport 1000 at 250 psi.

For the twin pump systems, if one pump is set too low, it may shut off completely as the other pump reaches the "shift pressure". Not only does this affect the production of the system, it sounds like hell. Get them both set at 125 psi. This will not only keep the production up where it should be but help the Clark Pump shift much more smoothly.

Lastly on the pressure setup side, the **system accumulator tank** needs to be set at 65 to 70 pounds for all systems. This will help the Clark pump shift more smoothly by keeping the system feed pressure as constant as possible. Some adjustments might be needed to make this work as smoothly as you would like. It's fine-tuning and tanks are preset at the factory, but if the shift pressures start to change much, then it is the first thing to check. Remember the shift pressures are measuring the change from one side of the pump to the other. In an engineer's perfect world the pressures would be exactly the same on both sides (all pieces of the puzzle would be perfectly equal), but since that will never happen, we shoot for no more than 10 pounds difference for a balanced system. If shift pressures exceed that by very much, then we need to look at the accumulator pressure, the head pressures and lastly, the Clark Pump for some kind of wear.

Spectra Intensifier (Clark Pump)

The Spectra Intensifier (current name for the Clark Pump) is the backbone of the whole system and IS THE DIFFERENCE between Spectra and any other watermaker. It is the magic key to Spectra's high output for low amperage draw. Spectra has made numerous changes and improvements over the years and even over the last few months, and I'm sure that there will be more changes and improvements as time goes on. The bottom line here is that if you keep the prefilters clean and do regular freshwater flushes, there is very little that can or will go wrong with the pump itself. Of all the systems I worked with this summer in the Sea, there were only two Clark pumps that had failed, and only one which failed to the point that it would not make water at all! (That failure was due to a broken reversing spool, a part that has been redesigned and is replaced in every pump that we

find.) Production may go down, it may leak or the quality of the water may go down somewhat, but almost NEVER will the Clark Pump QUIT working.

However, since the pump is a mechanical piece of equipment with moving parts, pieces do wear and occasionally break. Here are the most common problems currently found.

1. Should your pump completely "lock up", there is generally only ONE thing that can cause this. Your reversing spool has broken. This spool was originally built in 3 pieces and screwed together. It is now machined as one solid piece. Any pump that has been remanufactured or opened up by ANY factory rep where these "old style" spools have been found will have had this part replaced. SHOULD you be caught out with a broken spool valve, it can repaired by drilling a hole through it and screwing it together with a flat head #10 wood or sheet metal screw about 1 ½" long. Works great!

You can check your pump's spool very easily by taking one of the end blocks off your reversing assembly (top block of pump). Remove the four end bolts and lift the block away from the pump. If you see a "threaded hole" in the end of the spool, you have the older style. This does NOT mean your pump WILL fail, it just means it has a "suspect part" that has been known to fail in the past. I would recommend you obtain a replacement spool in the event you should need it in the future. When you replace the end block, care should be taken to make sure the large o-ring is in place on the piston opening. Using soapy water on all o-rings and surfaces, it is best to place the large o-ring on the end block side of the assembly, making sure that both of the small o-rings are still on the valve (center) block assembly. Push the retaining ring of the end block into the center block and tighten all four bolts evenly.

To confirm that the spool has in fact broken, unpressurize the pump and turn it on. The pump should run, shift and sound normal. Then pressurize the pump. The pressure should build steadily until the feed pump cutoff pressure is reached at which point the system will stall. There is nothing else that will cause this behavior, and there is no remedy except a new spool valve.

2. If your pump starts to develop a large shifting differential - that is, if the pressures change more than 10 pounds with each shift - then you are getting an asymmetrical shift (one side is different from the other). There are generally three or four things that can cause this. The first we have already mentioned is the static pressure of the accumulator tank. The second could be the head pressure set on one or both of the feed pumps, if you have a two-pump system. Beyond those there are a couple causes to look into:

- First is a worn "lip seal" on the piston rod. To check this, simply remove the plug from the test port on the backside of the center block of the pump. Once the plug is out, turn the pump on. If no water (or only a few drops) comes out of the test port, the seals are fine. If water comes spurting out, however, shut the pump off and call your Spectra Tech Rep. You need new lip seals. This repair requires the pump to be completely (well, almost completely) taken apart.

- The next probable cause is the annular rings in the reversing block assembly. These rings do wear (accelerated by infrequent freshwater flushes) and can pit or crack. They can be replaced by removing the top assembly, removing the end blocks and gently driving the annular rings out with a soft flat "punch" (just like bearing races). Should you not have replacements, remove one at a time, carefully turn them over and replace in the valve block. This could get you by until new rings are available.

- Anything further with the pump shifting, you are not likely to be able to remedy without a rebuild kit and a manual.

- It is important to realize that if your pump does start this "uneven shifting," you are still making water, but generally only half as much as usual since only one half of the pump is working. However, you are still getting good water and should be able to get by till repairs can be done.

3. Leaks. As with any watermaker, leaks are not your "friends".

- On those systems where the black high pressure lines to and from the Clark pump and the membrane may be long, the SS fittings may work loose over time. As the pump shifts, you might be able to see the lines "jump" a little. If you hold on to these lines as the pump shifts, you will notice a lot of the noise of the shift is reduced or gone. Wire tie (no hose clamps) these lines to something solid along the run if possible. Not only will you eliminate the noise, but also the small vibration on each connection will all but be eliminated. When these connections have started to leak or "weep", just disconnect them, clean salt and rust deposits away, coat lightly with silicone and refasten (using two wrenches, of course).

- In some cases the end caps have cracked on both the Clark pump and membrane housing. In the past this was generally cased by the wrong chemical used for pickling (this is a LONG story in itself), but this is not a factor currently as long as the SC-1 you use on your system has a COLORED DOT on its lid. If it does not, and it is not dated 3-6-01 in the lower right hand corner of the label, DO NOT USE IT FOR PICKLING YOUR SYSTEM! Should your end caps start to leak, contact your Spectra dealer for replacements. In the older pump bodies, the high pressure fittings were straight NPT fittings and they used Teflon tape to seal the SS fittings to the pump. In some cases, too much tape and too many turns on tightening have caused cracks and leaks in these fittings. New pumps and rebuilt pumps have new o-ring type fittings and cracks are no longer an issue. Again, should your pump have a crack, contact your dealer or Spectra for the solution. NOTE: Should you be out of touch for replacement parts, some success has been had using a hot knife or soldering iron to seal these small cracks. I personally have not had to do that yet, but I do have the hot knife on board!

Membrane

Membranes seem to be like computers: every once in a while you've got to ask, "What the hell happened?" Everybody has stories of what their buddy did or didn't do and the good or bad results. All I can tell you is: "Do what we are told to do with them and you SHOULD be all right." So what are we supposed to do???

1. Keep the feed water as clean as possible (clean prefilters). I have seem several 380C and Santa Cruz systems this summer with only the 5 micron prefilter. I strongly suggest adding the 20 micron filter in front of the 5 micron for additional filtering. Remember: that twin pump system is sending 150 gallons an hour through that 5 micron filter. In some areas it may only take a few hours to clog that single filter.

2. Run for as long a time as possible, Two or three hours every three days is better for the system than one hour every day.

3. Freshwater flush after EVERY use. OK, OK, I know that takes some of the water you just made, but let me explain why you want to "invest" that freshwater in your watermaker. First of all, your Clark pump is made of plastic (that's the non-tech term) and o-rings. Your best (finest) prefilter is a 5-micron filter. There is still foreign matter that can get through it (as your cleaned and recleaned filters get thinner and thinner, more gets through). Most all such matter passes right on through and back out into the sea, but there can be/is a small amount that wants to builds up around some of those o-rings and edges of the two sets of plastic pistons in the pump. As those deposits continue to build up, they start working like fine sandpaper and can create small grooves in your cylinder walls. This is NOT a good thing for the long-term life of the pump. Also, when you shut your system down WITHOUT a freshwater flush, you leave your membrane sitting in saltwater that has this same "fine" foreign matter which can and will settle on the membrane surface causing some blockage in the passing of the water through it in future running. The freshwater flush helps eliminates BOTH of these problems.
TIP: Personally, if I'm making water two days in a row (e.g. laundry day), then I do not flush on the first day, I wait till tanks are filled up. But I never make water more than 3 days in a row without a flush. Additionally, for those of you that have twin-pump systems, you do not have to run both pumps during the flush. Also, remember to leave the product valve open, since as the fresh water is shoved back through your membrane you will be able to recover 10% of it just like the first time! Follow the procedure in the manual for the freshwater flush-it only takes three minutes.

4. If you do not make water within five days, then do another freshwater flush and you'll be good for the next 5 days. For those of you that think this is too much work, please email or talk to me about the new MPC 3000 one-touch computer control and you will never have to do your own five-day flush again. (Ok, so I do try and sell something once in a while.)

Additional INFO:

1) There is no reason not to make water at the dock. I know, I know, you would never do it, but THERE IS NO REASON NOT TO. If your membrane is working and giving you good water at your favorite anchorage, then it will still give you good water at the dock. Unless there has been a major oil spill and the surface is churned up, any petroleum product that might be in the water will float well above the intake points of most installations. All the other bad stuff you are afraid of getting in your drinking water and tanks is eliminated through the reverse osmosis process. No kidding. However, you may have to clean your prefilters a little more often. There is more information available on this; if you really want to know, email me. Generally speaking it is much better for the unit to make water than sit for weeks without being run. So either make water, freshwater flush every 5 days or lastly pickle for long periods of inactivity.

2) Extended down times. If you have extended stays ashore and do not run the unit at the dock, then you still need to flush every 5 days. If you want to use the shore water, make sure that you have a charcoal filter in line and that the filter is not more that 6 months old.

3) Pickling. Avoid pickling the system as much as you can. Every time you introduce chemicals to the membrane, it takes a hit out of its useful life. If it is possible to have someone flush for you while you are gone, it is, in my opinion, well worth the effort. Use your own "Spectra" water for the flushes, or, if you must use dock water, be sure the water has passed through a charcoal filter to remove any chlorine that may be added.

During long on-the-hard stays or even in-water storage periods, however, it may become necessary to pickle. Follow your manual's instructions, and, under no circumstances use any chemicals not obtained from Spectra. REMEMBER: Your Spectra has a "plastic" pump different from any other system on the market. I don't care how many of the "others" can use the same stuff-YOU CANNOT!! Make sure that the SC-1 solution that you have has a COLORED DOT on the top or has a date of 3-6-01 in the lower right hand corner of the label. If it does not, you CANNOT use it for a storage pickle treatment.

4) Unpickling. Upon return, remember to leave the pump unpressurized for at least 30 minutes to flush the chemical out before making water. Longer is even better. I recommend several hours of unpressurized flushing if possible.

5) Is your Membrane Healthy? OK, so now you have done everything you were supposed to do to keep your membrane healthy, how do you tell if it is working.

- Product quality will be excellent (500ppm or below), and quantity will be right where it is supposed to be. (Spectra considers anything less than 750ppm good water.)

- Monitor your head pressures, both unpressurized and pressurized. Single pump pressure should be 15 to 20 psi unpressurized and 65 to 70 pressurized; twin pumps 35 to 40 unpressurized and 75 to 80 pressurized. If your pressures are

INCREASING, then you are starting to get a restriction in the discharge side of the system. A partially closed thru-hull, partially closed service valve, barnacles in the thru-hull, something fallen on the discharge hose in the locker, all COULD cause the problem. BUT, if these are all clear, you have a problem starting to build in your membrane.

6) Solution(s)

- Run for several hours unpressurized. If you are at the dock, fresh water would be good, but make sure it is filtered through a charcoal filter that is not more than 6 months old. (TIP: Many times as we are motoring about and the tanks are full, and the power high, I run the watermaker unpressurized to flush the membrane surface. This is preventative only and has no scheduled interval, just when we have the extra power and I think of it.)

- As a long shot, you can pull the test port out of the backside of the Clark pump to see if a lip seal has rolled up and is dragging the pump down, but this NOT very likely. By the way, after you pull that plug, turn the pump back on. There should be very little if any water coming out. If you do get water pumping out, then shut the pump off and call me. I can fix it. Seriously, this means you have a failed lip seal and the pump needs to be taken apart and the seal replaced. (See above.)

- Next step to lower the pressures to the right level is a cleaning with SC-3 (a.k.a. the old SC-1 without the colored dot). Follow the instructions in your manual. I can't add much to them, except that I like to use longer soak times (two hours instead of one) even when I use heated solution. I have a hot plate and use my wife's large cooking kettle and deep-fry thermometer for this process (generally when she is not around). It works very well. If you can't heat the solution, let it sit overnight before you do the second circulation period. Don't forget to change the prefilters before you pressurize the system to make water. You can also watch your unpressurized readings to see if improvement has been made with the cleaning before you try and make water again-that, of course, is if you have made a note of what it was BEFORE you started. My experience has been very good with SC-3, it will lower the head pressure and get the PPMs back on track.

- However, if the pressures do not come down into the right ranges, then you will be forced to use the SC-2 for the next cleaning. I have not had totally good success with the SC-2. It has always brought the head pressures in line, but the membrane has a tendency to go into "shock". PPMs seem to go very high and may or may not come back down. Long unpressurized running is recommended, and then you will need to run pressurized 10 to 15 or more hours in hope of getting the quality back to where you are happy.

The bottom line here is that when it comes to cleaning the membrane, it is a "crap shoot". I recommend having the cleaner on board. Should you have a pressure problem, then you are prepared to something about it, but bear in mind the end may be near for the membrane. Give some thought to how you can acquire a new one if the cleaning fails to get you back on track.

NOTE: In many cases of high head pressures, the quality of the water is still fine. To continue to run with the higher head pressures will cause excessive wear on your feed pumps. However, turning one pump off will lower the total head pressure, allowing you to continue to make water until you can reach port, find a dealer, clean your membrane or get a new one shipped in. Running with higher head pressures is only for the SHORT term: the longer you keep running, the more it is going to cost you in the future.

These are for the most part the most common and easily remedied problems that I have come across. As in anything that is mechanical, it is impossible to know what will ever or never happen to anything.

Should you have any other problem not mentioned in this handout, refer back to the troubleshooting guide in your manual.

So that's about it. Take care of your watermaker from the beginning, and you will have very few problems. Keep the filters clean and the voltage up for happy pumps; flush it often, and your Spectra watermaker will provide you with plenty of reliable fresh water in the remotest of locations.

Don Wilson
sv ***Tackless II***