High Seas, High Water

In Gale Conditions off the Treacherous Grand Banks, Dirona *Takes on Water*

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HOW IT STARTED

I bolted awake at 1:15 am to a shrieking alarm. We were 50 miles south of The Grand Banks, in large seas, on passage from Newport, Rhode Island, to Kinsale, Ireland. I ran upstairs to the pilothouse and Jennifer, at the helm, said only, "High bilge water." Yuck. Better than "fire" but far from good news. I ran back downstairs and into the engine room and, yes, conditions there certainly did warrant an alarm. I hadn't even stopped to get dressed, but in the short time between the alarm's firing and my arriving in the engine room, the water had come up above the bilge. The portside pan that forms the walkway around the engine was already awash.

We have never enjoyed crossing oceans, but we neither despise them nor find them scary. We mostly do it "to get to the other side," and regard it as a necessity for seeing the world, but never for the enjoyment of being as sea. Crossing oceans is just work and rough conditions can be tiring but usually nothing more. This was the first time we've felt serious doubts–even a touch of fear–and considered turning back.

The volume of water entering the boat was simply staggering. It's amazing how alone you can feel when looking at the engine room floor awash and the water level climbing fast, while hundreds of miles from shore in difficult sea conditions.

THE SITUATION

We expected winds in the 20-knot range, but instead were seeing steady 30-35 knots with gusts to 47. This low-pressure system was worse than predicted and the sea state was unusually poor. The boat was flying around, as large and very short-period waves rolled past. Dirona was rolling 20-plus degrees and sometimes over 25 degrees, even with active stabilization. Pitch was ranging between 12 and 15 degrees and pitch is, by far, the worst of the two.

THE DIAGNOSIS

Still not dressed, I searched the engine room for the water source, but couldn't find any fitting or through-hull leak. I continued aft and found water pumping down the 2" Glendinning shore-power cord retractor pipe at the rear starboard corner of the lazarette. As I watched, I could actually see what appeared to be waves, where the flow was steady, but every few seconds, a massive amount gushed in with wave action or perhaps the boat's motion. Three or four gallons per minute may not sound like much, but it certainly catches your attention when you're in an engine room with rising bilge water.

We turned the boat 180 degrees in an effort to reduce the waves boarding the cockpit. It didn't seem to help much but we left it that way for about 30 minutes. I threw on some clothes and a life jacket, and, with Jennifer keeping an eye on me from the saloon, carefully worked my way to the starboard aft cockpit locker to find the leak. It was dark, cold, and when standing outside at waterline level, the waves towered above the pilothouse. I was standing in around six inches of water but, periodically, waves rolled slowly over the transom soaking me and filling the cockpit with more than 12 inches of water. A fuel bladder strapped down on the the cockpit sole, kept me from opening the locker door more than three to four inches, but that was enough to see that the water level was at least six inches inside the locker and roughly equal to the water height in the cockpit where I was standing.

The likely options for water getting into the storage locker were: 1) Glendinning power cord entry, 2) the right side grab rails, 3) the swim step attachment, 4) the locker drain hole, 5) the locker door, or 6) the louvers in the door. Hanging on as securely as I could manage, I looked out over the transom to the swim step, using a head lamp and a bright flashlight. It looked solid. I checked

Opposite: *This marine version of a tourniquet on the power cord entry substantially reduced the rate of water inflow.* **Above:** *The cockpit locker frequently contained several inches of water, and seawater was pouring into the lazarette through the shorepower cord standpipe.*

the external cover of the power cord, and it also was screwed on securely. Everything outside the cockpit looked great.

Seven scuppers dump water out of the cockpit and walkway, but waves were rolling over the transom every few minutes. Each brought in hundreds of gallons of water and soaked me while I worked at the transom. The deck drains also became geysers when waves hit the side of the boat so, rather than serving as drains, they were acting as fillers. The scuppers are designed to let water out efficiently and to slam shut when the water is higher on the other side. They do this reasonably well, but water still sprays in and the cockpit sole always has lots of water when we are in rough seas. As long as the water doesn't find a way into the boat, having a layer of water in the cockpit is not a concern. Rarely, I've seen the cockpit filled to the top and, the fuller it is, the faster it drains. From my perspective, the design is perfectly safe. On the other hand, the drains in the cockpit lockers open into the cockpit. Like all drains in rough seas, they allow water in and, if the water gets below the height of the drain, can also let water out. This design just about guarantees that the cabinet will be full of water when operating in rough conditions.

The cockpit lights were on, I was wearing a headlamp, and I had a flashlight, giving me ample light, but night made the entire situation more difficult. Every tenth wave sprayed over the transom, and I was soaked in cold sea water. Inside the locker, I could see water flowing down the standpipe that feeds the shorepower cord below. What prevents water ingress on this path is a one-inch-high collar around the hole. Until the water gets above the collar, nothing goes into the lazarette. The problem was the water line in the locker was frequently above the height of the collar, so it was pouring into the boat. In fact, in these conditions, water is almost always above the collar, and it's eye-opening how much water can flow down the pipe. The weather strip on the locker door looks fine, but two design points effectively allow free flow of water from the cockpit to the locker and then into the lazarette below: 1) a one-inch unobstructed drain hole in the bottom of the locker that allows water to flow out but, in rough water, it also allows water to flow in, and quickly; 2) the door has an open grill for ventilation. I love locker ventilation but I'm even a bigger believer in keeping water out of the boat.

We put a rubber plug in the locker drain, greatly slowing the inflow, but it still was running ahead of the main bilge pump. Every five to seven minutes, we needed to get the emergency hydraulic pump back on, but this pump is so fast that it evacuates the bilge in less than 15 seconds. This pump will lose prime if the water is completely evacuated, and it will fail quickly if it runs dry,so I have to be down below, ensuring it has prime while Jennifer is in the pilothouse turning the pump on and off.

FATIGUE SETS IN

It was just past 3 am, and we had been at this for two hours. Investigating the leak was taking longer than it should, partly because of the rough seas, and working at night is always harder.

I was tired and also seasick. Jennifer applied a scopolamine patch, and we continued to assess and manage the problem.

Working in the lazarette, I jammed foam insulation into the power-cord entrance hole, but the pressure from the several inches of water above rendered my foam stoppers useless. I then used a screw driver to force rags into the hole to fill small gaps, and this began to show some promise. Finally, I wrapped a towel around the entire assembly and compressed it tightly, using rope and a couple of heavy-duty wire ties. This marine version of a tourniquet substantially reduced the flow. Nearly four hours had passed since the alarm sounded, and having to operate the emergency bilge pump was distracting and nerve-wracking. The rate of water ingress was now only what could soak through the towels–fairly minimal and required running the emergency bilge pump only every 15 minutes or so. But something must also be wrong with the main bilge pump, because it should easily be able to handle that level of flow.

FIGURING IT OUT

At this point things were closer to under control so I took a short break to think things through. The water wasn't flowing in fast at all and yet the main pump couldn't catch up. Of course! The main bilge pump strainer must be plugged. Massive inflows can free up debris and plug the strainers, so I cleaned the strainer and restarted the pump. It started properly and quickly filled the strainer, so it was clearly working but we were still falling behind and needed to stop a few times every hour to run the emergency bilge pump. Something still was wrong.

I tested the bilge pump with the bilge-water strainer removed, but that made no difference. The main bilge pump was still falling behind even with the current small water inflow rate. I took another break and Jennifer and I talked it over. Something must be restricting the output of the main bilge pump. We knew the strainer was clear and we could see the pump drawing water so, for sure, it was working. The pump may not have been able to keep up with original flow, but at this point the rate of ingress wasn't that large and just about any cheap pump should be able to handle what we had coming in. We decided to change the pump.

Changing the pump involved moving six, five-gallon pails of oil, our waste oil container, and assorted other containers and spares. In these conditions, oil containers are like small 35-pound missiles, so they needed to be secure. Moving them directly behind the engine solved the problem.

I shut down the main bilge pump to make the change, and with it no longer pumping, we needed to stop even more frequently to run the emergency bilge pump. Even though I know the emergency bilge pump hardly needs to run at all, it just feels wrong to have the main bilge pump apart while taking on water. So I was working as fast as I could.

CHANGING THE PUMP

On this pump, it's faster to change the valves than change the pump, so I removed the four bolts that expose the bellows and valves. With the pump apart, I could see that the outlet check valve had corroded and that the rivet holding the valve in place had failed. Likely this happened about five minutes prior to the high-water alarm going off, since it was previously cycling frequently but keeping up with the inflow.

Prior to this incident, I felt the Jabsco model #34600-0010 was a good primary bilge pump, but have since have concluded it has sufficient quality and volume problems that it should not be counted on for more than routine bilge dewatering. Besides rivets that corrode, another weakness is that the bakelite pump base can crack if over-tightened or if tightened unevenly. The second is easy to avoid but the first can fail at any time. Testing the pump is good practice, but even after diligent testing, there is still no assurance it'll be there when you need it: It could fail five minutes after the last successful test. To be on the safe side, the valves need to be replaced at least every year or two.

We have a high-water bilge pump backing up the primary unit, but the high-water pump doesn't even turn on until the main bilge is nearly 3 feet deep. It's just tough to look at that much water in the bilge and feel like things are under control. It's entirely possible, in fact likely, that the high-water pump could have controlled the flow at the worst and, for sure, it could control the flow after we had reduced the rate of water ingress. The high-water pump needs to pick up lower in the bilge to be effective in these situations.

I reassembled the main pump and started it up. Man, it was nice to hear the pump start and then take on load as it pulled in water. The weird thing is it still didn't solve the problem. In fact, it actually seemed that it might be making the problem worse. Unbelievable. I had put the valves in backward. This is an inexplicable rookie mistake, but by then it had been more than five hours of working on the problem, and I had only had two hours of sleep in the last 36. Perhaps I should have just changed the pump.

We fired up the emergency pump to clear the bilge yet again, and I went back to putting the valves into the main pump correctly. I was annoyed with myself because this is a simple job and it's weird that I made that kind of mistake. It's a five-minute job and the pump was now close to back together the second time. I was moving along quickly since I really hate not having that pump operating while we are taking on water. And wouldn't you know it, that's when I dropped one of the four pump bolts.

Opposite: *The rivets holding the valves in place on the Jabsco model #34600-0010 pump can corrode and fail at any time. The pump should not be counted on for more than routine bilge dewatering.* **Above:** *This was the first ocean crossing where we've felt serious doubts—even a touch of fear—and actually considered turning back.*

Really? Even more annoying, the boat's motion rolled it to an impossible-to-reach location.

We wasted a ton of time trying to retrieve the bolt, but there was simply no way. We then wasted more time searching through our bolts for one that would fit. I really didn't want to run the pump with only three bolts since uneven load on the fragile bakelite case will almost certainly crack it. We reluctantly decided to dig out the spare pump. In retrospect, we should have just gone straight there, but it's in an area that is the most difficult to access on Dirona. Making it considerably more difficult to reach, we were still swinging side-to-side 20 degrees and pitching 15 degrees. Clearly not an ideal storage location for the backup bilge pump, although I eventually concluded that the backup bilge pump should be installed on the boat rather than installed in a easy-to-access location.

We got the bolt from the spare pump, I installed it, and put the pump back on line. Seconds later, it was humming away and caught up with the leak in about five minutes. I never would have thought that seeing the bilge pump light going off would be a reason to celebrate but, wow, it sure was nice to see. After seven hours, we finally felt out of danger.

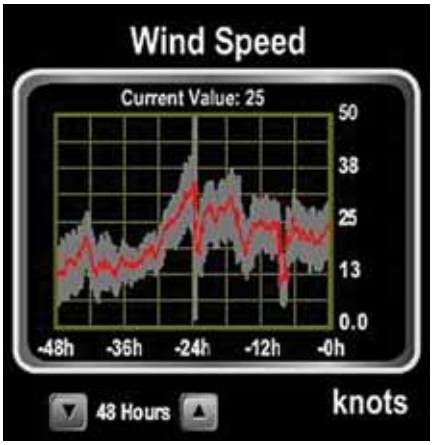
The emergency hydraulic pump was easily able to handle the flow and could have easily handled as much as ten times more. We also have an additional high-volume gas-driven backup pump that we never needed. Since we came nowhere near to using our full pumping capacity, it really shouldn't have been that big a deal. The past seven hours were far from relaxing.

LESSONS LEARNED

Rough water is normally not a big deal. We actually don't see much of it and, when we do, we are doubly careful not to slip and fall. Otherwise, it's not really a problem. Dealing with a serious water leak transforms what should only have been a bit of rough water to a much more dangerous situation. At sea, it's surprisingly easy to get nervous, stop thinking as clearly, and I found it was too easy to make small mistakes that cost us precious time.

In thinking through why this water ingress problem was so bad, part of the problem is the fuel bladder has a slight diagonal twist to it on the cockpit floor. The two corners close off a small area in the corner of the starboard cockpit locker. This dams a small amount of water in the after corner of the boat. A deck drain and a scupper there normally allows water to run out from that area but, whenever we get hit with big waves, water geysers up from that deck drain and runs the water level up at the locker door. When waves roll over the transom, almost the entire volume falls into this area with only a single scupper and deck drain. It's not much water but it's a small area so there is 12 to 18 inches of water just about constantly in such conditions. I suspect with bladders or without, these conditions would definitely be bringing water into boat, but the bladder placement exacerbated it.

When water inside the cabinet gets higher than the outer



Above: *The fuel bladder placement likely exacerbated the water ingress through the cockpit locker.* **Left:** *We expected winds in the 20-knot range, but instead were seeing steady 30-35 knots with gusts to 47.*

Glendinning pipe, it will flow unobstructed into the boat below. It's not usually much water, does no damage, and the main bilge pump water quickly removes it. But I still hate that the design brings on water and, since it's not uncommon to have considerable water in the cockpit, it will leak at this location in storm conditions. The fuel bladders take up half the volume of the cockpit, so it takes less water to get a given depth. The boat is also a couple of inches lower in the water at the stern when carrying fuel on deck. When the fuel bladders are on deck, a nuisance leak becomes a much larger problem under certain wave conditions and boat directions.

We have considerable backup bilge pump capacity installed on Dirona, including a high-volume hydraulic pump and a high-volume Honda emergency dewatering pump (see Fighting Water Ingress), but generally I don't like any water inside the boat and never want the main pump on more than once during a shift. Normally the main bilge pump only turns on briefly in rough seas and it often goes many months without cycling at all.

The changes we will put in place as a consequence of this experience are:

1) Install a one-way valve in the cockpit locker drain to allow water out, but prevent unrestricted flow in.

2) Put a parallel emergency hydraulic bilge pump switch at the bilge pump to allow single-person operation from the engine room. We will also leave the pilot house switch in place for operation from the helm.

3) Install a second automatic bilge pump just above the primary bilge pump to fully back it up and ensure that pump faults don't allow high bilge water. We could move down the Rule 3700 that is mounted about three feet above the bilge bottom but, instead, we'll leave that pump in place and install a Rule 4000 just above the primary pump.

4) Warnings on excessive bilge pump cycling. We have bilge pump cycle counters, but we will not install warning lights to draw immediate attention to excessive cycling. ■