

**SIMPLE BUT SOPHISTICATED:
AN ALTERNATIVE APPROACH TO BOAT SYSTEMS DESIGN**

World cruising has been accurately described as “fixing your boat in a series of exotic ports.” Historically, additional comfort meant increased complexity and cost—measured in the time and money spent keeping all systems operational. Yet as we considered the options for fitting out our new 47-foot Van de Stadt sloop, *Hawk*, Beth and I believed we could combine the experience we had gained from our circumnavigation with new technologies to come to a non-traditional solution to this classic cruising dilemma. We like our creature comforts too much to cruise in the extraordinarily simple, low maintenance fashion the Pardeys promulgate. We lack both the money and the mechanical aptitude required to pursue the Dashews’ high comfort and complexity lifestyle. Instead we looked for an approach that would allow us to achieve 85% of the comforts of a modern complex boat with only 10% of the maintenance.

In Durban, South Africa, three-quarters of the way through our circumnavigation, we experienced one of those rare epiphanies we all hope await us just over the horizon. After five months and 8,000 nautical miles of offshore sailing, we tied up to the International dock and started fixing the boat. We replaced a broken spreader light, rebuilt all our electric pumps, repaired our broken diesel heater, re-wired our navigation station, replaced the zincs in our refrigerator, installed the warranty replacement parts for the electric autopilot... Two weeks later, friends of ours on a 30-foot, 30-year old fiberglass boat tied up alongside us. They re-bed their forward hatch and went sightseeing. When they returned a week later, we were still fixing our boat. Just about everything we fixed, they didn’t even have aboard—and they didn’t miss it. We realized there wasn’t much that we fixed in those three weeks that we thought worth the time lost exploring South Africa. So, although we don’t want nearly as Spartan an existence as our friends, as we fit out *Hawk* we have developed a systems approach which will allow us to approximate their minimal maintenance levels while retaining most of the conveniences and comforts of a modern complex vessel.

While the details of our exact solution are tailored to our particular high latitude cruising agenda, our thought process and guiding principles illustrate a different solution to the comfort/complexity tradeoff. Our approach combines an industrial engineering systems design philosophy with a rigorous focus on the critical installation details.

Systems Design

While designing our systems we have relentlessly pursued two guiding principles: minimize moving parts and minimize power consumption. Mechanical engineers have long recognized the inverse relationship between the number of moving parts in a system and its mean time to failure. Keeping the power consumption of each individual system low reduced the complexity of the total boat from battery bank size to engine running time. By eliminating the systems we considered optional, we have been able to focus our money and efforts on installing the primary systems in a bulletproof fashion.

Fridge. Aboard *Silk*, we had an icebox and an engine-driven refrigeration system. The refrigeration required regular maintenance and 2 hours/day of engine running to keep the box cool in the tropics. Yet many islands we visited had no refrigeration ashore—and sold nothing meant to be refrigerated. Where we could buy refrigerated items, we could also buy ice. We ended up using *Silk*'s refrigerator as an icebox, and we felt the time, money and energy spent on our refrigeration system had been wasted. On *Hawk*, we have installed a high-tech R75 vacuum panel icebox. R75 equals 15 inches of foam insulation versus the 4 to 6 inches in a typical marine icebox. With just two bags of ice cubes, we've kept the box cold for up to ten days at a time. Unlike the mechanical compressors required for most refrigeration units, this system has zero moving parts and uses zero power. Unfortunately the vacuum panels have not worked out as well as we hoped. However, we have been cruising in cold enough places that we can just keep stuff cold in the bilge.

Cabin heating. After we purchased *Silk*, we installed a forced air diesel heater system at considerable expense. The manufacturer recommended running the system once a month or so to keep it in good working order. But the heater was activated by a thermostat that refused to operate in tropical temperatures, making it difficult to comply with these instructions. Each time we left the tropics and could actually run the heater, we discovered some part of the unit had failed. By the time we had fixed the heater, summer would have arrived and we no longer needed it. All that complexity and money bought us nothing but headaches. Aboard *Hawk*, we have installed a drip diesel heater with a built-in hot plate top, fed from a gravity feed diesel tank. A small, low-power fan above the heater improves the hot air circulation, but the system will still work when the fan breaks. Except for the little fan, this system has zero moving parts and consumes zero electricity as opposed to *Silk*'s forced air system with its fuel pump, fans and glow plugs.

Freshwater system. When we began our circumnavigation on *Silk*, watermaker technology had just begun to penetrate the sailing market and was far too expensive for us to consider. *Silk* carried 100 gallons of water, and we were never down by more than 50. We did learn to conserve water, but we never felt deprived. Aboard *Hawk*, we carry 200 gallons of water—enough to last us two to three months at our normal consumption rate. We prefer tankage to a watermaker because it doesn't require constant maintenance or additional power. We use foot pumps to draw fresh water from the water tanks. We have one spare foot pump installed along with the two operational ones so we can do a fast swap when one breaks. We shower with a solar shower or a tea kettle in cold weather. By not installing the pressure water system found on most cruising boats, we have eliminated several electric pumps along with the need to rebuild them every year and kept the power consumption of our freshwater system to zero.

Electrical charging. We hate to run the engine, and we particularly hate to run the engine to charge our batteries. Aside from the heat, noise and smell, running the engine at idle shortens engine life and is a horribly inefficient way to generate 50 amp-hours or so. Aboard *Silk*, we considered a good passage one where we only had to run the engine an hour a week. We're no more eager to maintain a generator. Our approach to our electrical balance, therefore, has been to minimize electrical usage while maximizing our storage capabilities. We have installed a large 800 amp-hour battery bank of bulletproof, heavy duty wet cells, and charge them via two systems—dual high output alternators belted off the engine and a large 75-watt solar panel. The solar panel generates maintenance-free, worry-free—just plain 'free'—power (4 amps in average conditions) with zero moving parts. The dual alternators provide built in redundancy and generate a maximum amount of 'free' power when motoring. Given the large battery bank size, the solar panel and our low total energy requirements, we rarely need to run the engine solely to generate power. By minimizing the total vessel's electrical requirements, we have avoided the need for a generator—one of the highest maintenance systems (after watermakers) anyone can put aboard their boat.

Navigation gear. Lest after reading this far you think us Luddites, take a look at *Hawk's* navigation station. All these great toys meet our “no moving parts and minimal power consumption” rules. More importantly, good navigation data allows better decisions and greatly relieves uncertainty and stress on board. Our favorites are the digital Vetus Barograph which gives us a graphic picture of the weather trends and the Northstar chart plotter which does not clutter up the chart table top like a PC charting system would. Also note the comfortable chair.

Few boats have really comfortable places to sit—something you tend to notice after the 15th day at sea.

Installation Details

A boat at sea may well be the most difficult environment for equipment of all types. Constant motion chafes lines, sails, wires, hoses—even stainless shackles can chafe through and fail. Salt water and humidity cause corrosion in engines, spars, rigging, lifelines—and electronics. Small spaces and poor access discourage necessary preventive maintenance. Our installations focused on defeating these three on-board enemies by reducing chafe, minimizing exposure to water and maximizing access.

Controls out of the weather. Aboard *Silk*, we installed our instrument readouts on the binnacle and our autopilot control head by the wheel. *Silk*'s engine panel was located next to the helm as well, along with the engine stop. We replaced all of these at least once during the course of our circumnavigation. In the end, we moved the engine stop below and mounted the autopilot control head in the navigation station. We installed a remote autopilot control unit next to the companionway which we could take out on deck. Aboard *Hawk*, we have installed our instrument readouts under the hard dodger rather than the more typical helm location. They are still easily readable from the helm and are out of the sun, rain and spray. We have installed the engine panel and engine stop down below in the engine room. After just a few hours motoring, boat we learned to judge engine RPM's very accurately by ear. A loud alarm signals us if any of the warning lights come on. We have an autopilot control head in the navigation station, one under the hard dodger and a remote which we can use from anywhere on the boat including up at the bow while anchoring.

Engine access. For some unknown reason whenever I decided to change the oil, Beth would simultaneously decide to bake bread or make cookies. The two of us would collide in the galley, and a disagreement would ensue until one of us retreated to sulk in the corner. *Silk*'s engine could be accessed only from under the companionway steps. To reach the back or sides of the engine required the flexibility of a gymnast and the physique of a snake. For these reasons, a dedicated engine room that allowed complete engine access ended up high on the list of priorities for our new boat. Convenient engine access means that we will inspect the engine more frequently and keep it cleaner, and we will be able to make even complicated repairs when something goes wrong at sea. To this end we have hinged the companionway steps so that they

easily lift and latch up, providing access to most of the critical parts of the engine. The side panels on both sides of the engine box can also be removed with little additional effort. By removing the panel in the engine room, I have complete access to the fuel system and the water intake—the two areas I'm most likely to have to address at sea.

Rigging. We have followed the lead of the latest generation, singlehanded boats by replacing shackles with high-tech lashings many places on deck. These lashings don't bang around at sea like shackles do, they are lighter and stronger, and they don't wear or chafe aluminum attachment points like the toe rail and boom. When installing these lashings, make sure all the strands are uniformly tight so they share the load equally. Protect the line from UV by covering it with rigging tape or a dacron cover. Round metal corners under the lashing to prevent chafe and wear. We have used shackles when we need to frequently remove the fitting. Here we have used wire ties to keep the pin from vibrating out. In addition to its normal electrical application, we find heat shrink tubing very valuable in finishing rigging jobs, from covering Nico-press fittings to 'whipping' the tail of a knot, to providing a soft covering on a shock cord hook.

Interior stowage: To keep boat lockers aired out and fresh, they need to be well ventilated and easy to clean. To this end we have used zippered mesh fabric locker covers rather than solid locker doors, and plastic crates as drawers. The mesh fabric promotes air circulation, and I like the weight savings over doors. The plastic crates are indestructible, easy to clean, and easy to replace.

By rigorously applying an industrial engineering systems mentality and focusing on installation details, we feel we have achieved 85% of the creature comforts of a more complex boat with almost none of the up-front equipment cost or the on-going maintenance headache. Though *Hawk* is ten feet longer than *Silk*, she is a great deal simpler and will take significantly less time to maintain. Most of what we spent our time fixing in South Africa last trip we no longer have aboard. Next time, we hope we'll tie up to the International dock and head for the hills rather than for the chandlery.