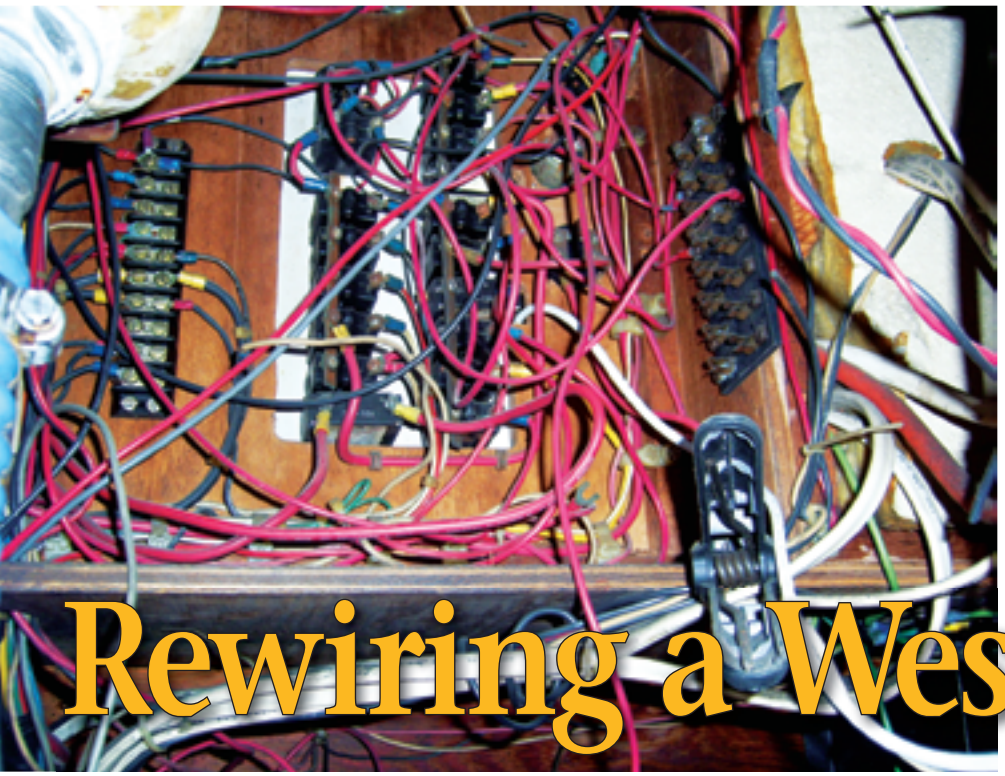


Aaron described the wiring behind the electric panel and in the engine bay as "out of control," at left. One of the previous owners told him, "It looks like a spastic spider got loose in there." The engine was in desperate need of repainting and the wiring around it was so chaotic that the decision to remove the engine for accessibility was a no-brainer, below. In any project like this one there will, inevitably, be places that are hard to get to, at left below.

Rewiring a Westsail 32

Taming an electrical nightmare to further a cruising dream

by Aaron Norland

When our boat, *Asia Marie*, a Westsail 32, acquired us in the summer of 2007, she came with a wish list of projects waiting to be started. Having owned a few boats in the past, my father and I expected everything on those lists to take at least twice as long as our best guess, and to be three times as expensive. And it was clear from the beginning that her electrical system needed serious changes — for the safety of everyone involved.

Like many boats of mid-1970s vintage, she had (and still has) a serious case of POMS (Previous Owner Modification Syndrome). On *Asia Marie*, the original electrical system was barely adequate and nearly at the limits of its expansion the day it left the factory. Since then, at least five previous owners, from the man who originally paid Westsail crews after-hours to finish the interior for half the factory cost to the gentlemen we acquired her from (a pair of retired veterans with a fulfilled desire to attempt to sail around the world), have modified it countless times. We decided to re-wire her.

We became aware of some obvious problems upon inspecting the boat. Most of the breakers and switches on the main electrical panel did function — just not the way they were supposed to. For instance, the watermaker

breaker activated the engine start key (there was no watermaker), the engine switch turned on a few cabin lights and powered the VHF, and the bilge-pump switch sent power to the freshwater pump. Initially, we assumed all of this could be easily corrected by simply hooking the right wires to the right switches; all we'd need would be a few new lengths of wire for items we intended to add to the electrical system. Then we got the boat home and started looking into the wiring more thoroughly . . .

Dangerous situations

In addition to the circuitry being absolutely unintelligible at the panel, we found countless iffy and downright dangerous situations throughout the boat. There were hot wires extending into space, ground wires dangling inches from positive posts, dozens of wires that had no apparent use, and others that had clearly done something important but, although no longer connected to a device, were still live.

Then there was the battery hold-down system: a small piece of Dacron line with one end tied around an engine mount and the other to a wrench taped to the bulkhead. Also, half of the "breakers" in the panel were simple toggle switches from which wires ran throughout the boat unprotected by fuses. Several items had green and black wires for their DC positive leads. One wire run even had a length of household extension cord spliced into it . . . several times. Beside one of the diesel tanks was a wad of wires that had shorted and melted into a ball of coppery goo. Throughout the boat's cabin, we found wires that had been crushed by furniture and abraded by tight corners.

Connections had been made with electrical tape, duct tape, bell nuts, and the ultimate abomination of the electrical connectors: side steps. A few of these had shorted out, explaining why more than half of the devices on the boat simply did not work even after we figured out which switches were supposed to run them. As if this were not enough, the wire originally used throughout the boat was non-tinned and, after 30 years, was highly corroded. Many of the ends were brittle enough to snap off with slight pressure. Of the wires that were in good shape, most had been cut to the exact length needed, leaving no slack for making new connections.

"There was a *lot* to think about, especially for someone with limited knowledge of electrical wiring."

Clean slate

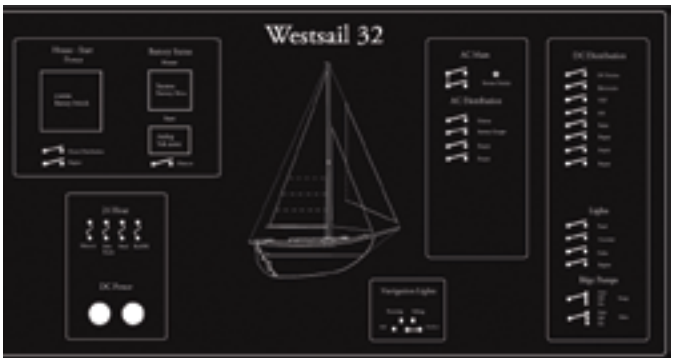
In light of these fundamental problems with our boat's electrical work, we decided to remove most of the wiring and start from a nearly clean slate. We did not remove the AC wiring as it had been recently added and was installed correctly throughout. Everything else would have to go.

Another syndrome that creeps into conversations about boat work is WIHTAS, the "While I Have This Apart" syndrome. This is guaranteed to quadruple the expected completion time of a project. While rewiring sounds like a simple enough project, it becomes infinitely more complicated once one decides to remove the engine and the fuel and water tanks. This leads to cleaning, refinishing, and modifying the areas they normally occupy. And while doing that, one always finds a few more things that are on the cusp of greatness, just waiting for their moment to be renovated. So they join the list.

Planning is the most important step in most projects. Although we started the rewiring in December, expecting naively to have it completed by mid-January, we had spent the previous months considering exactly what we wanted in our electrical system. There was a *lot* to think about, especially for someone with limited knowledge of electrical wiring. To prepare, we read the sections on electrical systems in Nigel Calder's *Boat Owner's Electrical and Mechanical Manual* and Don Casey's *Sailboat Electrics Simplified*; then we reread each, several times. Armed with this information and what we gleaned from several hundred hours browsing Internet forums, we sketched our prospective electrical system.

We spent entire days on the boat mulling over where we wanted to put

Behind the new electric panel, order reigns, at right. Aaron bundled wires tidily and used PVC pipe for raceways, below left, and wrapped wires with scrap nylon hose where they passed through furniture, below right.



Aaron used a computer program to make a sketch of the electric panel to Mobile Marine Electrical Systems (MMES), at left. MMES made suggestions and, after exchanging a few drafts with Aaron, assembled a panel that met all the Norlands' needs with room for future additions, at right.

lights, DC outlets, fans, and other fittings. Other days we were at home, drawing wiring diagrams, determining whether there might be a simpler way to do a particular run, and ensuring that every device would receive the juice it needed.

Simple system

Since we are fairly traditional, our electrical system is quite simple: no refrigeration, air conditioning, or other power-hungry, complicated systems. We did, though, consider future owners and the need for later expansion. It's a good idea to plan for something you may want to do later. That may mean leaving a few vacant slots on the panel for breakers or running wire for systems you can't afford at the outset. It would never be easier to run wires for something than while rewiring, so we ran wires for a fridge, radar, SSB, TV, speakers, and a few other things, even though we don't have them.

Central to the planning of a boat's electrical installation is the means for charging the batteries. We read about many options, including the main engine's alternator, solar panels, wind generators, water generators, and built-in or portable generators. While we wanted a simple system, our plans for long-distance cruising demanded a self-sufficient power supply that could be unplugged from shore indefinitely. We decided to base our installation around a shorepower battery charger powered by a Honda EU2000i portable generator. In addition, a 110-amp alternator fitted to the main engine could be used in case the Honda went on the fritz. As we intended to cruise in the tropics, we also planned to add two 65-watt solar panels to limit the amount of time we would have to manually intervene in the charging. For our small, simple electrical system, these options would ensure our house and starting battery banks would stay well charged and maintained.

Available options

During our planning we searched for electric panels that would serve the needs of our system. Many pre-fabricated options are available from Blue Sea Systems, Paneltronics, Seadog Line, and others. We wound up with a custom panel made by Mobile Marine Electrical Systems. At first, we avoided this route as we assumed it to be expensive, but the total cost was not quite $100 more than equivalent prefabricated panels. That seemed a fair price for a custom-made panel that looked great and was exactly what we wanted.

Finally, when we had agreed as to how, what, and where things would be installed, and how it would all be powered and charged, we quadruple-checked our plan and began the installation.

Since it had been scary to discover how much wire in the previous installation was hidden, our goal was to keep all wiring and connections accessible and within arm's reach to ensure a secure and clean installation and permit regular inspections. Rather than running wires above the headliner, for instance, we put them underneath the easily removable trim boards and used wiring tracks to surface-mount leads going to lights. Instead of snaking wires in blind spots behind bulkheads, we chose to cut large holes where wires could be protected from chafe and easily examined by eye and touch. Further, the only wires near the bilge are those going to the bilge pumps and depth finder. Everything else runs at hip level.

I cannot over-stress the importance of planning and considering all options and opinions during this process. If you embark on a similar project, remember that the more time you spend planning, the easier it will be to install and use your electrical system. Be cognizant of the different methods for doing the same thing (such as push-button circuit breakers powering similar toggle switches, rather than individual breakers for each item). Most important, ensure that the system you build will be safe today and 20 years from now.

Like all boat deadlines, that for the engine slipped and we did not get it reinstalled until mid-May of 2008. Our original budget of $1,500 exploded and, though I am afraid to add up the

Resources

Blue Sea Systems
http://bluesea.com

Mobile Marine Electrical Systems
www.wewireboats.com

Paneltronics
www.paneltronics.com

Pacer Marine
www.pacermarine.com

Seadog Line
www.sea-dog.com

Sun Electronics
http://sunelec.com

Books
Boat Owner's Electrical and Mechanical Manual, by Nigel Calder; *Sailboat Electrics Simplified*, by Don Casey.

For more related products and services
www.goodoldboat.com/resources_for_sailors/suppliers_directory

receipts, I have no doubt we edged past $5,000. The wiring alone consumed 600 feet of 16-, 14-, 12-, 10-, and 1-AWG wire, 300 or 400 ring terminals, bags and bags of wire ties and mounts, 100 feet of chafe-protecting nylon hose, and a bazillion supporting screws. On top of that, we purchased 2½ gallons of epoxy, 3 gallons of Interlux Brightside paint, a new water tank, a new muffler, a few parts for the engine, new batteries, Racor filters, diverters, hose, bilge pumps, propane line, some more zip ties, and 26 six-packs of beer. But it was worth the time and the cost and the several hundred hours of work.

Do not be daunted by the cost of products required to rewire your boat. We set up a wholesale account through Pacer Marine, a company in southern Florida that makes high-quality electrical products and sells them at prices about a third of those at West Marine. Similar generic companies can be found around the United States and abroad.

A few tips:

- Buy a ratcheting crimping tool; it greatly eases the application of terminals. We cringed at the $65 price tag but now agree it was one of the best investments we made.
- When in doubt, use chafe protection. If a wire goes through a bulkhead, crevice, nook, or shadowy area, put some ½-inch or ¾-inch nylon hose around it. Throughout the boat, we found areas of original wiring where the protective jacket had been chafed through.
- Label, label, label! Write on wires, use wire-marking tags and heat-shrink labels or any means you can to keep track of wires. We used very fine permanent markers to label wires every 3 or 4 feet and anywhere we thought it was possible that someone might see a wire and wonder, "What wire is that?"
- Use blue-jacket boat wire for all DC wiring. Also, use yellow wire for all DC ground wires. We used white jacket with black/red, but have since realized that it makes it difficult to distinguish between AC and DC wires. Remember, DC = Blue, AC = White. Nigel Calder says this in his book. Listen to him.
- Use heat-shrink terminals for all connections. A dab of dielectric grease on all terminal blocks, power posts, and on the ends of wires before applying crimp terminals will prevent corrosion for many years.
- Don't be afraid to make your own hardware; we saved a significant amount of money by constructing our own bus bars and terminal blocks using scrap pieces of StarBoard with stainless-steel bolts countersunk for posts.
- Support your wires judiciously. Books suggest every 18 inches, but 12 inches is often better, especially if the loom contains many wires. Unsupported wires flex and chafe. When possible, run like wires (DC or AC) in a loom within a hose or something that doubles as chafe protection and support. In the engine bay, we ran wires inside PVC pipe to protect them from oil, which can damage wire.
- Leave service loops for every wire so you can make modifications without running new wires. We left at least a foot of wire for most connections. It looks a bit odd but, coiled and bound, it can be supported out of the way. You will thank yourself later, whether it is 10 minutes (I did a lot of modifications 10 minutes later) or 10 years.
- Make a good wiring diagram before, for planning, and after, showing what you actually did. Don't wait long after you complete your project; it's surprising how quickly specifics leave your mind.

"*Asia Marie* has a completely fresh electrical system that we are confident is of high quality."

Despite the gross overruns in time and cost, we are very satisfied with the end result. *Asia Marie* has a completely fresh electrical system that we are confident is of high quality. Flipping a switch on our pretty electrical panel and knowing it will work, as well as how it works, is very fulfilling. Above all, the time I spent with my father — creating, arguing, and working — was priceless and worth the project by itself.

Removing the engine, fuel tanks, and wiring (and the projects that ensued) added to the work list, but the clean engine bay was well worth the effort.

Postscript

*While we were preparing Aaron's article for this issue, he provided us with an update. He did warn about "modifications." Well, instead of the Honda generator, they fitted two 130-watt solar panels and a Blue Skies MPPT charger and matching monitor/controller. The main reason, he says, was cost — the price of solar dropped from $6.50/watt to $2.08/watt (the price they paid for SUN brand panels purchased from Sun Electronics in Miami, Florida) so they ended up with a less expensive (and quieter) charging system. "I have seen my 260-watt panels put 90 amp hours back into the batteries," Aaron says. "Plenty for my current needs." –**Eds.***

Aaron Norland has USCG Master and Mate licenses and has taught sailing aboard several tall ships. He just completed a degree in trumpet performance from the University of Miami. He hopes to play trumpet with a major symphony orchestra and cruise his Westsail 32 in the off season.