

## **Electrical Systems: Battery, Alternator, Lights, Monitors – Some ideas for consideration.**

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More skippers are forced to drop out of the Solo Mackinac Challenges by electrical and autopilot problems than by any other mechanical problem, by far. Most electrical issues come from running the batteries dead. Then you cannot start your engine to recharge, your auto pilot and navigation instruments may be dead, your ships radio, alas...even your refrigeration is now down. Surely this is something we want to avoid.

There are many solutions to these issues and each skipper will choose the set of tradeoffs that they are most comfortable with and that fit their particular situation. The goal of this article is to offer up some ideas that might be useful as you consider how to optimize your electrical systems for long distance sailing.

If you sail a fairly heavy boat, with plenty of storage space you may choose the path of large battery banks and heavy backup systems. A lighter boat or one with less room may choose to focus on reducing power consumption to allow for smaller battery banks and charging systems. The best solution will be unique to each boat. No matter what boat you sail, a key will be designing a system with redundancy, careful monitoring, isolation of key systems, efficiency in the use of power with a battery bank and charging system capable of delivering the power needed throughout a multi day event. Let's look at some ideas for each.

### **Redundancy:**

- In case the alternator fails, a small 1,200 Watt generator could be used to power your 120v shore powered battery charger.
- If you do manage to run the engine start battery dead, a jump-start battery pack available at any auto parts store for under \$100 might be able to get your engine running and the batteries charged.
- In case you lose your main instruments, a navigation package on an iPad (a \$50 app including charts for all the great lakes) can be a great stand in. A hand held GPS, paper charts and a hand held compass will still get you up the lake.
- In case the main radio fails, a portable VHS radio can serve. You have added protection if you carry this radio with you at all times as you could potentially call for help if you ever became separated from the boat.
- Many skippers have found using a portable generator can serve as the main charging source for the batteries and they can sail a multi day event without ever starting the main engine. One creative skipper rigged up mount for his generator off the stern pulpit on his T-10 with great success.

### **Careful Monitoring:**

- Carefully watching your current state of charge using a device like a Link Meter (which will track net power consumed from a battery through charge and discharge

cycles) can provide great information on the state of your batteries and current loads.

- A simple digital volt meter will also tell you a lot. If it rises to 13-plus volts after you start your engine, you know your alternator is charging. A lighted volt meter will be a great reassurance in the middle of the night. As Don Casey says: "When in doubt, trust your digital voltmeter, not your fancy 'battery fuel gauge.'"

- A simple volt meter will also give you a rough idea of charge. With most standard 12V batteries, if you are not drawing a heavy load from the battery, a rough rule of thumb is if your battery voltage is:

12.8V or more you are fully charged.

12.5V roughly 75% charged

12.2V roughly 50% charged

11.9V roughly 25% charged

11.6V or less you are pretty dead.

It is hard on even deep cycle batteries to run below 25% of capacity, and many of your shipboard systems will be unhappy if the voltage drops below 12V, so it is a good rule of thumb to recharge if you are nearing 12.2 to 12.1V or so. If your autopilot is running when you drop to 12.2v, your batteries will actually have more charge than is shown on your digital voltmeter. That's OK, charge anyway.

-Monitor the health of your batteries when you launch in the spring. Years ago it was necessary to spend 24 hours or so to load-test a battery. Not today. Any decent marina will have a digital load tester which can tell you within a couple of minutes whether each individual battery has a dead cell. If your yacht has more than one battery in the house bank, this can be hard to detect when the batteries are wired together. Separate them, have the marina test each one, and replace any bad batteries now at the start of the season.

Isolation:

-For the battery bank itself, it is wise to have a dedicated, isolated, starting battery for the engine. With this design, a dead house bank will not stop you from starting the engine, which can charge the house bank.

A few desperate skippers run down the batteries in bank 1, and then bank 2, and then tie them together to start the engine. This just ensures that the two banks reach the same low voltage. It would be far safer to keep one battery fresh and isolated to start the engine. Some skippers even go so far as to isolate their jump-start battery pack by storing it in a forward locker.

Lower the current loads:

- Switching from 12 volt, 1 amp standard type running light bulbs to LED bulbs will save you about 22 amp hours a day (assuming 8 hours of darkness and three bulbs). Over a three day race, this is one fully charged group 24 battery worth of power.

- Reducing the use of mechanical refrigeration, and high draw electronics can also make a huge difference in power consumed. The difference in current drawn by an

iPad navigation package compared to a Raytheon radar and chart plotter can be over 120 amp hours per day (assumes the Raytheon is drawing 6 amps and the iPad is ½ an amp). The refrigeration, running lights, Nav System and Auto Pilot are typically the 4 main power consumers. It is hard to do much about the auto pilot, but it is sometimes possible to greatly reduce the power requirements of the other systems.

Take care of your engine:

- Most skippers use their yacht's main engine to charge their batteries. Although diesel engines want to run under load, no great harm will come from doing this over a three or four day race. However, many types of diesels, especially Yanmar diesels, should not be run when the yacht is heeled more than about 15 degrees. If you are on a hard beat for many hours and need to charge your batteries, heave-to for an hour to level the yacht rather than ruin your engine. Then check your oil.

- It is wise to consider the weather, and charge the batteries ahead of any fronts or other potential heavy weather so you can charge when the boat is level and things are not as hectic.

- Carry enough fuel, obviously.

By monitoring where your loads are and how much power each key system uses, you will know what you can conserve on and how much power you need each day. This is critical to ensuring you have sized your battery banks to handle the loads, and you will know how often you can expect to have to recharge. By ensuring you have the backups needed to survive single system failures, you increase your chances of a smooth event. By isolating your engine start battery you know that you will have the power to start your engine, no matter what has happened to the house bank.