Ample Power Company

Design Considerations

When contemplating an upgrade to an existing electrical system, or starting from scratch to assemble one, there are several important considerations to be made. Take a moment to review each of the following issues before you decide on your next electrical system.

Battery Capacity

Generally, daily power consumption should only be about 25% of the available battery capacity. The general rule is to avoid discharges much below 50% of rated capacity. If daily loads are only 25% of available capacity, then charging can take place every other day. In an emergency, you'll be able to go four days without charging. Note that the term *available capacity* is used. For liquid electrolyte batteries, and some gel units, available capacity is only about 80% of rated capacity. Some gel batteries can tolerate repeated discharges of 100%, so it's safe to equate available capacity and rated capacity.

Another useful rule about capacity states that the maximum load on the batteries should only be 25% of battery capacity. That is, if you have an inverter that draws 100 Amps, then battery capacity should be 400 Amp–hours.

Often, there is not sufficient room for all the batteries desired. When space is limited, the need for top quality instrumentation is paramount. An undersized battery system can only be managed with such instrumentation. Many people mistakenly believe that systems with small batteries don't warrant extensive instrumentation . . . needless to say, they are always out of power, and blame it solely on the batteries. The closer daily consumption is to available capacity, the greater the need for accurate Amp–hour instrumentation.

Battery Configuration

A single house bank with a dedicated starter battery is preferred. For more information about this important concept, refer to the section in this *Primer* titled 'The Preferred System'.

Alternator Sizing

The main engine alternator should be 25–40% of the rated battery capacity. Liquid electrolyte and some gel batteries won't accept a high rate of charge, so an alternator about 25% of the rated battery capacity is most appropriate. When batteries have low acceptance rates, as do thicker plate liquid electrolyte units, they reach absorption voltage long before they're charged. Consequently, water loss is greater, as is corrosion of the plates.

Many engines won't accept large frame alternators without extensive engine modifications. For that reason, many systems don't have as much charging capacity as they might. Often boat designers limit space around the alternator, preventing upgrade to a large frame alternator. Consult an Ample Power dealer about your specific requirements. Ample Power alternators are made for just about every engine.

Don't make the mistake of looking only at the maximum output an alternator produces. Is the output produced at a usable RPM? Alternators can be made to produce high output at low RPM, or high RPM, but not both (except for some large frame units). When you motor for several hours at a high RPM, alternator capability isn't as important as when you want a fast charge at anchor. Here, the alternator that has good low RPM output will be more appropriate.

Alternate Charging Capability

Wind and solar energy have a definite place in the energy mix aboard any boat or vehicle, and there are Ample Power products to intelligently integrate those energy sources into the system. We have equipped engineless boats with enough solar and wind power to live completely from the environment . . . even with refrigeration!

We suggest that you supplement your energy needs from the sun and the wind. As much as 25% of your daily consumption is recommended . . . more if you have the space.

Regulation of solar panels and wind generators is required, despite the claims otherwise. Like any regulation system, the solar and wind regulator should provide battery temperature compensation, and be adjustable or programmable to suit your battery system. The Energy Monitor II includes solar and wind generator control capabilities as a standard feature.

Alarms

An alarm may save your life. If your electrical system is on the verge of collapse, wouldn't you want to know? Battery system alarms may be the most underrated safety device onboard. No one has time to continually monitor the electrical system . . . without alarms, conditions may deteriorate until

recovery isn't possible.

How are alarms useful? A high voltage or high battery temperature alarm indicates a runaway regulator. A low voltage or low capacity alarm indicates a need to charge. A high current alarm detects a system short circuit.

Alarms that can't be programmed and individually enabled or disabled can be a nuisance. Perhaps this is why alarms are so often omitted from the electrical system. Choose an alarm system that is easily adjusted, and simple to enable or disable any specific alarm. Don't let a disaster sneak up on you! Make sure your electrical system has sufficient alarms.

Amp–Hour Instrumentation

Amp–hour instruments are available in a wide range of capability and price. Not everyone needs the same level of capability, but many people select a less expensive unit because they don't understand battery capacity, and think that a simple meter may suit their needs.

The opposite is true. A true battery expert can usually manage a system quite well with just a voltmeter and ammeter. Adding a simple Amp–hour meter to such a system may seem like a luxury to the expert. On the other hand, a user not intimately familiar with battery characteristics needs an Amp–hour meter that not only displays linear Amp–hours consumed, but also Amp–hours remaining, which compensates for the rate of discharge.

The more expensive Amp–hour meters often include regulation and control options, alarms, and other features that makes their higher price warranted by the value they offer.

Before purchasing a monitoring system, look at the package. Is it watertight? Does it use mechanical switches that will wear out or get knocked apart? Are signals terminated on terminal blocks, or just left dangling? Can it be mounted easily? Will you be able to read it day and night, with adjustable backlighting?

Alternator Regulation

Standard automotive regulators do not charge deep cycle batteries properly. The reason is the fact that deep cycle batteries require a multi–step charging procedure. Many people have heard this explanation in the last few years, and, not understanding the issue, have purchased *two stage* regulators.

A regulator that makes an alternator supply full output until the battery rises to an adjustable setpoint and then holds that voltage on the battery is a two stage regulator. A standard automotive regulator is a two stage regulator, and some of the expensive regulators sold in marine catalogs are *two stage*. If the regulator isn't three or more steps, don't bother considering it for your electrical system.

Naturally, the alternator regulator should be temperature compensated. The only way to do this is to measure temperature at the battery, and change the regulation setpoints automatically. Some regulators come with a temperature chart and instructions for manual adjustment as the temperature changes. Do you really want to be bothered tweaking the regulator several times a day?

There are other considerations. Do you have halogen lights? The life of halogen lights is shortened by the higher voltages used to charge deep cycle batteries. The regulator should have a means of limiting voltage whenever the halogen lights are on.

Is the rated horsepower of your engine below 30 HP? You may want to install a regulator with current limiting ability so that precious power can be diverted from charging to propulsion in an emergency.

Will you have liquid electrolyte batteries? Your alternator regulator should allow you to equalize them periodically.

Installation

Very few people are trained to install electrical equipment. Despite the lack of training, some people can do well at installation. Others need professional assistance.

Over the years, we've seen many installations. Those who report the most problems with the *equipment* invariably have the worst wiring. Here's a sample list of problems we've seen too often.

- improper wire sizes
- terminal to wire size mismatches
- wire exposed beyond crimps
- lugs crimped over insulation
- unsealed butt splices
- wire strands dangling outside lugs
- severed wire strands
- unsecured wire bundles
- unlabelled wires
- wires joined by household wire nuts
- solid wires instead of stranded
- untinned wires
- wires mounted to screws without lugs
- burned or knicked insulation
- vibrating wires lashed to metal surfaces.
- wires shorted across terminals

Not long ago we observed a boat that needed $20,000 of interior work done after an electrical fire. The alternator wire had been cut a few inches too short . . . to reach the batteries it had to pass under the engine. It was held in place by nylon ties on either side . . . unfortunately, it rubbed against the oil pan. The system worked for a couple of years, but ruined plans for a world cruise.

The electrical system is vital. If you aren't positive you can do a first rate installation, seek help from a qualified installer . . . one who has been trained on the equipment to be installed.