

POWER ONBOARD

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A BATTERY MONITOR will help you to intelligently manage your battery usage and achieve the maximum life as well as knowing how much energy you have so the lights and TV don't go out during your favourite program and the beer is always cold.

Firstly, some basic terms. Voltage is the potential available between the terminals of the battery and for a fully charged battery this is typically 12.7 or 12.8 volts. Current is the flow rate of energy from the battery and is measured in amps.

Deep cycle batteries are rated in amp-hours as opposed to starting batteries which are rated in CCA (cold cranking amps). If you use 1 amp for 20 hours, or 20 amps for one hour, that equals 20 amp-hours for both consumption rates. However, the effect of these two rates will have a different effect on the amount of energy which is left in the battery, depending mainly on the size of the battery.

The amp-hour rating of a battery is usually at the C20 rate. That means if you have a 100Ah battery and draw 5 amps for your lights, the battery will do that for 20 hours.

If you draw 20 amps from the same battery, it will do that for about four hours instead of the expected five hours. In each of these cases the battery would be flat which is not good for the battery. The general rule is to discharge to about 50% of the battery's amp hour rating and recharge the batteries again as soon as possible.

How do you know to what level you have discharged and when you are fully charged?

A voltmeter can give a rough indication of the battery condition only when there has been no load on the battery for some time, or when the battery has not been charged for some time. When there is a fridge and TV running, the voltage will be lower by some

amount depending on battery size and current draw. Similarly, when charging, the voltage will be higher and depending on charger size, the voltage can be the same when the battery is still flat or almost full.

An ampmeter shows how many amps are flowing into or out of a battery at a particular instant. While this can be useful for showing consumption of the loads that are switched on at the time and for showing charge rate, it does not show the state of charge.

Fortunately, the development of the micro-computer chip has enabled electronic engineers to design many smart instruments such as the battery monitor. A battery monitor will measure battery voltage and amps flowing into and out of a battery. Most importantly, it will calculate the amp-hours used during discharging and during charging it will compute the amp-hours returned to the batteries. At any time, you can read on the display the nett state of charge of the batteries in amp-hours.

There are several different forms in which battery monitors display the amp-hour

information. Some display the nett amp-hours used so if you see a figure of - 150 displayed, you need to know and remember the capacity of your battery bank. If the capacity is 200Ah then the batteries are already 75% discharged and should be recharged immediately. If capacity is 400Ah then you may need to consider recharging soon.

Other instruments will display the amp-hours remaining. When the instrument is installed, the battery capacity is set via the front panel. So if you use 150Ah and you have a capacity of 400Ah, the monitor displays 250Ah as the remaining capacity.

There is no need to remember battery capacity, although there will be a minimum number of amp-hours remaining which you should not go below depending on your battery capacity.

The more sophisticated battery monitors can display the percentage of battery capacity remaining. This is very easy to understand as anybody can comprehend a number between 0 and 100. There are also LED bar graphs based on percentage amp-hours



remaining. If you want to read the actual amp-hours used, then this can be done with the push of a button.

It is also possible to read some other useful information about your batteries such as the following:

- Time remaining - which shows how long the battery can be used at the present rate of discharge until it is empty.
- Average discharge depth - which is useful to check if the battery capacity is sufficient to meet the typical load requirements.
- Deepest discharge - is useful to know because if your battery is discharged frequently below this level, premature failure of the battery can be expected.

How does the battery monitor do all this and how does it fit into your electrical system?

As stated earlier, the monitor computes the amp-hours. It does this by measuring the current (amps) which flows through a shunt that is installed in the negative connection to your battery bank. Any current consumed from the batteries or put back as charge, will flow through the shunt and be counted, as will be the duration of that current on a continuous basis.

In simplistic terms, the current (amps) is multiplied by time (hours) to give amp-hours.

However, there are several other factors about the battery to consider for the monitor to make an accurate calculation.

Firstly, if you take 100Ah out of a normal wet lead acid battery, you need to put about 120Ah back in to regain full charge. This is called the charge efficiency and is an indication of the losses which happen when the electrical energy from the charging source is converted back into battery stored energy.

Wet lead acid batteries have a charge efficiency of about 80% and for AGM & Gel batteries this is about 90%. The charge efficiency improves slightly after the first five or 10 cycles but then starts declining very slowly for the rest of the battery's lifetime. For this reason, older batteries need more charging and should be replaced when efficiency becomes low.

Another important factor which the battery monitor needs to consider is Peukert's exponent. This is named after the German



scientist Dr Peukert who in 1897 found that a battery will provide less amp-hours when it is discharged at a faster rate.

This gives an indication of how old battery technology is and how little wet batteries have changed in over 100 years yet many people today are unaware of Peukert's exponent or the effect on Ah capacity.

The typical capacity of a deep cycle wet battery at various discharge rates is as follows:

Hours to discharge	Capacity achieved
20	100%
10	89%
5	78%
3	66%
1	45%

Another way to think of your batteries is that as you discharge your batteries more rapidly, the effective size in amp-hours shrinks. For this reason, systems with large inverters need to have adequate battery capacity to avoid low efficiency use of batteries.

The battery monitor takes all of the above into account and computes the amp-hours remaining in the batteries. You don't need to understand all the calculation process, just read the number displayed.

In addition, you know if other sources of charge such as solar panels and engine alternator are working as the monitor reads these currents. So the instrument can be used to determine if any of the charging sources have failed, or if there is a problem

with associated wiring and solenoids. So, why do you need a battery monitor?

Would you sail your yacht or motor your cruiser around Australia without a fuel gauge and risk being stranded without fuel somewhere? The same principle applies to your batteries. Without a battery monitor the battery can run out of energy before you realise what is happening.

With batteries it is not just the possibility of running the batteries down until they are flat, but it is also the inconvenience this may create. The life of batteries is reduced considerably when they are fully discharged or discharged to a low level frequently. Then, when batteries are charged, how do you know if they have been properly charged?

Our experience has been that most people without battery monitoring have no idea of the battery energy being used, and inadequate charging of the batteries can result in sulphation of the plates and also shorten the life of the battery.

For your best possible chance to achieve the maximum energy and lifespan from your batteries, a good quality detailed monitor is a must. If you need further advice, discuss your situation with an equipment supplier or marine electrician who is knowledgeable in inverters, battery chargers, monitors and correct battery charging characteristics.

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