Our compact 7 Ah Panasonic battery.

Electrical self-sufficiency on a Careel

By Mark Cherrington

I've written this article after some discussions with a couple of Careelers, and to satisfy my curiosity about the feasibility of using solar power to keep our battery charged up more or less indefinitely.

As we all know, space is always at a premium on a Careel – especially a C18. When we bought our boat, the previous owner told me he'd just connected up a couple of 6 Volt disposable batteries in series to give him the 12 Volts.

We decided long-term we'd be better off with a rechargeable 12 Volt battery. You can pick up a 12 Volt Panasonic 7 Ah (amp/hour) battery for about $25.

The nice thing about this battery is it's very small and light – about half the weight and size of a house brick, and easily carried in one hand. It's also sealed and leak-proof.

Many Careelers prefer the larger deep-cycle marine batteries, but these are much bulkier and heavier. If you're running any serious electrical items, such as navigation aids or even a tape/CD player, these batteries are pretty well essential.

However, all we wanted to run was our nav lights, cabin light, 27 MHz radio and phone charger – none of which uses much power.

I also went to Birkenhead Solar and bought an 11-Watt, 12-Volt USF-11 solar panel with an operating current of 0.62 amps.

Costing about $270, these flexible panels are guaranteed for 10 years and can be moved around on the boat to catch maximum sun.

I'd figured out enough to know that it *should* charge up our battery, but what I wanted to know was how just how many lights, radio, etc this little battery could reasonably handle, and if the solar panel would deliver enough power to recharge the battery after each night's use.

Having dropped out of high-school physics fairly early on, I have no understanding of electrics and electrical theory, so I called on my next-door neighbour, Steven Contos who's a network engineer with a good understanding of these things. The following explanations were provided by Steven.

One essential if you want to know what's happening with your battery, and what power's being sucked out of it, is a multimeter. You can pick these up from Dick Smith's for about $15-20, and they are very useful.

An advantage with a digital multimeter is that it is not polarity-sensitive, so you won't damage it

continued next page

Electrical self-sufficiency on a Careel *continued*

if you connect the wires the wrong way round.

The key factors to know are the capacity of your battery in amp hours (Ah) and how much current your lights, radio, etc are drawing.

This is where the multimeter comes in handy.

We already knew my battery capacity is 7 Ah, which means that a 7 amp appliance would drain it in one hour, or a series of devices totalling 1 amp would drain it in seven hours. Deep cycle batteries can be up to 65 Ah and more.

It's a simple matter to work out how much your various devices are drawing using the multimeter.

Your multimeter will have a black wire and a red wire. The plug on the black wire goes in the COM (common) hole, while that on the red wire goes in the 10DCA (direct current Amps) hole.

Having done that, disconnect one of the leads to your battery; put one wire on the battery terminal, and one on the disconnected lead, so that the circuit completes through the multimeter. I'm assuming you are using a digital multimeter, which means it doesn't matter which way around you connect the leads.

Now turn on one of your devices, and you should see a number appear on the multimeter display. For example, turning on our running lights showed a figure of 80; this is 800 milliamps (mA), or 0.8 of an amp.

Do this with each of them, and note what is displayed on the multimeter. This will show you what each draws.

To see the total, you can either add them all together, or simply turn them all on at once, and note the multimeter display.

The figures we got were 800 mA for the running lights, 550 mA for the cabin fluoro, 270 mA for the two-way and 250 mA for my mobile phone. That totals up to 1970 mA, or near enough to 2 amps.

Divide that into the 7 Ah capacity of the battery, and you'll see we'd get three and a half hours continuous running from it before we completely drained it (not a good idea if you want a long battery life).

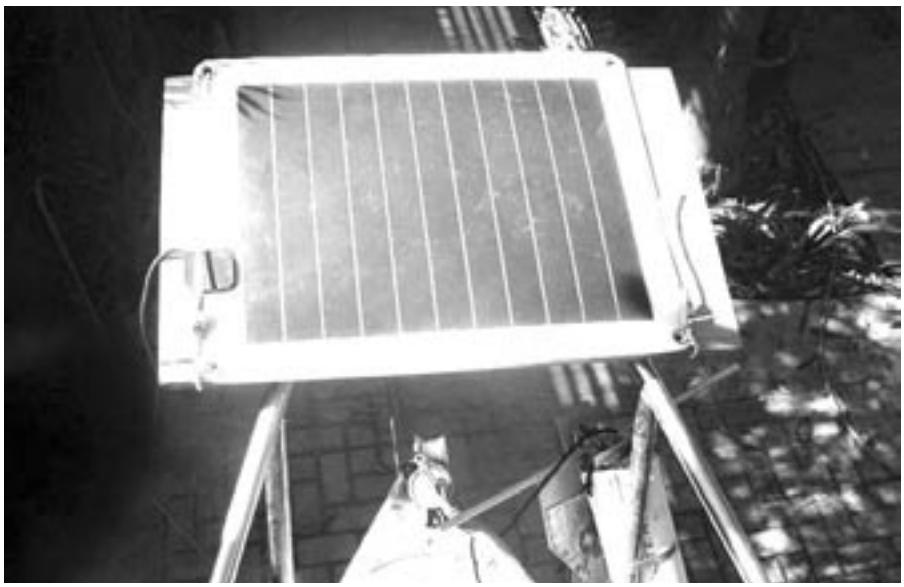
That may not sound much, but remember a few factors:

- Like most others, we'd generally only cruise in the summer, particularly for extended periods.
- Night sailing is likely to be infrequent, and not for particularly long periods (the only time we'd use the running lights).
- Because it's daylight saving, we'd only use the cabin light for a couple of hours at most.
- When just receiving, the 27 MHz doesn't use

continued opposite page

Technical article

Electrical self-sufficiency on a Careel *continued*



Above: Panasonic 7 Ah battery with solar regulator, recommended to prevent the battery from overcharging, and shortening its life.

Left: Our solar panel mounted on the pulpit of our C18, keeping it off the deck and out of the way.

much power.

- Unless you are talking, most mobile phones don't use a lot of power.
- Assuming we had the 27 MHz radio on mostly during the day, when the solar panel is delivering recharging the battery, more power is still coming in than going out.

In other words, the amount of battery power that we'd be likely to use over 24 hours is unlikely to be that excessive.

If you felt your daily electrical drawings were getting near the limit of this little battery, you could always connect up a second one in parallel (negative-to-negative, positive-to-positive).

Note that connecting old batteries in parallel with new ones can shorten the life of the newer one. It is better, if possible, when using two or more batteries in this manner to use batteries of similar ages.

For $80-90 you can also get an 18 Ah battery, which is about the same size and weight as the two 7 Ah batteries but with a greater capacity. Of course, for that price, you could also pick up a marine deep cycle battery -- but which would take up more space and weigh a lot more.

Solar recharging

That leads us to the next point: recharging the battery.

The key specification to look at with a solar panel is the operating current, which tells you how the rate at which your battery is being recharged.

Our solar panel delivers 0.62 Ah. We already know the battery is a 7 amp/hour battery. That means if it were fully discharged, it *should* take 11.3 hours to recharge it (divide the amp/hours of the battery (7) by the amp/hours (0.62) delivered by the solar panel).

However, charging a battery is less than completely efficient, so you should allow for approximately 150% of the rated capacity of the battery to recharge it.

This would mean you need 10.5 Ah to recharge a 7 Ah battery, or 17 hours of sunlight.

A few factors to be aware of:

- That delivery rate of 0.62 Ah is in conditions of pretty much full sun. A few days of dull, miserable weather, and you mightn't be achieving that -- but you might well be thinking of packing up and going home anyway.
- With the electrical set up on our particular boat, as mentioned earlier, we would be unlikely to be draining the battery every day/evening, so it only needs to be partly recharged. Even dull, overcast weather should be sufficient to recharge it.
- If the battery were being fully discharged every day, it would have a considerably shortened life.
- It's a good idea to also fit a solar regulator,

continued opposite page

Electrical self-sufficiency on a Careel *continued*

which prevents the battery being overcharged by the solar panel (and shortening its life).

In summary, these calculations indicate that with our current modest electrical drawings, battery and solar panel, we have enough recharge power to be electrically self-sufficient almost indefinitely.

Measuring battery discharge

If you're worried about the drawings of your electrical system, you may want to measure how much your battery is being discharged.

Again, your multimeter is essential to carry out this operation.

To measure battery capacity, you will need to change one of the leads around on the multimeter.

Keep your black wire in the COM hole on the multimeter, but this time plug the red wire into the VOLT hole. In addition, switch your multimeter dial around to the Voltage Range side, and select the voltage range immediately above 12 Volts (likely to be 20 V).

Now all you need to do is touch the red wire to the positive terminal and the black wire to the negative terminal, and you should get a voltage readout on the multimeter.

If the battery has just been fully charged (and it's best to wait a few minutes after unplugging the charger before checking the battery charge). Readings will vary depending on whether the battery is "on-load" (appliances drawing power) or "open circuit (neither appliances nor solar panels connected)..

As a guide:

On load: The battery voltage will drop to 12.2-12.0 V once power is being drawn from it, assuming it is fully charged to start with. The voltage falls slowly at first, then faster until it reaches 10.5V. At this point, there is virtually no power left.

Open circuit: A fully charged battery will show 12.8-13.2V, depending on its age. Any battery at 11.5V or below is completely flat. A middle-aged battery will start at 13.0V, show 12.75V at 80% capacity, 12.5V at 60%, 12.25V at 40%, 11.95V at 20%, and 11.7V when exhausted.

The reason for these voltage changes is that, towards the end of the charge, the internal chemistry changes, increasing resistance and lowering the voltage.

As an indication, on our little 7 Ah battery, with our maximum drawings of about 2 amps, we should expect to get about 3 hours' worth of power before the battery reading starts to drop below 12 Volts.

Conclusion

Hopefully this article may be useful to others looking at using solar power to make themselves self-sufficient to a degree on their Careels.

The principles outlined above apply equally to any battery/electrical system/solar panel combination. It's just a matter of keying the figures in on your calculator.

Using a solar panel on a Careel in conjunction with a deep-cycle battery powering higher-drawing electrical devices, such as navigational aids, CD and tape players, etc, is unlikely to give you self-sufficiency indefinitely.

That's purely due to the lack of space on a Careel to put sufficiently large panels to recharge the battery -- and they are not cheap.

However, a solar panel in conjunction with a deep-cycle battery would certainly allow you to extend your battery charge for at least a few more days. Just to what extent depends on how much your electrical system is drawing, and the capacity of your solar panel(s).

Useful website: *http://www.birkenheadsolar.com.au/* (includes solar panel specifications and price lists).

Use our free advertising service!

Have you got any surplus gear (sails, radio, various parts and attachments) you'd like to sell or swap?

Is there some item you're looking for?

Perhaps you're looking for a crew for racing, or you'd like to crew (skippers are always looking for crew).

Use our free advertising section for anything you'd like to buy, sell, swap, borrow, etc to do with your Careel.