

# Determining Range on your Sailboat

So you've installed an electric drive system on your boat. Congratulations! I bet you're wondering how long can you motor for!

To find your usable range we need to know a few variables but **Current Draw** is more helpful than just looking at **battery voltage**. Current Draw varies primarily from motor speed, but also from wind and water conditions, prop design and vessel weight. Unfortunately, depending on where you're at the wind and water conditions can play a huge role in power consumption and if that is true for you, a current meter is very helpful. On our Pearson 30 at similar speed, the power used was Twice as much when going against the current and wind in the SF Bay.

If you know how much power the system is using, figuring out the run time is pretty easy. You can find the power consumption with current draw (**Amps**) on the Clearview Display or with other meters like the JLD404 meter or a Cycle Analyst. Use your run time and speed to find your range.

For an example: If you have a battery pack rated at **100 amp hours** and your system is using **25 amps** on average, we can then tell that only ideally you could run for 4 hours at 25 amps to use up all 100 amp hours in your pack. Unfortunately, most lead acid batteries capacities are rated at a very slow discharge, around 5 amps or so. When discharging in a vehicle at a higher rate, the actual usable energy is less due to the "Peukert Effect" that says the higher your rate of discharge the less usable energy you get. This can mean that we only get about 55% of the rated capacity for lead acid. This is why it's important to check the voltage as well.

For many sealed lead acid batteries a fully depleted battery will have a **resting voltage of 12v**. That's correct, a 12v battery should be considered totally dead at 12v; they will charge to a max between 13.5 and 14.7v on average, then rest back down around 13v. **\*\*For clarity, even though you probably have 4 100ah batteries, the capacity does not add when they are in series, only the voltage does.\*\***

It is not recommended to use this info as concrete fact for motoring and you should still check your battery voltage to confirm your predictions are correct. To do this you have to find out how much energy you use during a specific amount of time motoring (or during your regular route in or out of the slip) by checking how much voltage you've lost in that time.

If we fully charge the pack to 100% and then motor for half an hour at a set speed, we then look at the battery voltage after the system has been off for at least 30 minutes. Referring to our manufacturers information on state of charge for this specific AGM chemistry we can see that reading a resting voltage of 12.24v per battery means we then have dropped to 50% State of Charge. This is a good time to call it quits for long battery life, but you could keep going as low as ~11.9V. So what we now know is that we can motor for approximately 30 minutes at this set speed under these ocean conditions. You must have been motoring very fast! Try slowing down for comparison; you'll be surprised how much longer you can go by decreasing your speed by just one knot.

<b>AGM STATE OF CHARGE AS A FUNCTION OF OPEN-CIRCUIT VOLTAGE</b>					
<b>STATE OF CHARGE (%)</b>	<b>SPECIFIC GRAVITY*</b>	<b>CELL</b>	<b>6 VOLT</b>	<b>8 VOLT</b>	<b>12 VOLT</b>
100	1.295	2.14	6.42	8.56	12.84
75	1.245	2.09	6.27	8.36	12.54
50	1.195	2.04	6.12	8.16	12.24
25	1.145	1.99	5.97	7.96	11.94
0	1.095	1.94	5.82	7.76	11.64

If you need more run time you can add batteries in parallel or you can bring a generator to power your battery charger. Turn it on as soon as you start motoring and it can greatly extend your range. Compare the energy being used by the energy going in to the batteries to find your overall gain or loss of power. If the charger is putting out 25 amps you can then motor at 25 amps indefinitely; motoring at 50 amps would then mean you're using 25 amps from the batteries.

If you're in protected waters where conditions are often very similar, knowing your average run time can be predictable and useful. When conditions are constantly in flux you'll need to check your voltage and current draw more regularly.