Gear On Test


James Turner – with a bit of help from Sarah Pain – investigates new battery technology, unravels the mystery of NMEA2000 and assesses oilskins, a VHF, a dinghy, an electric outboard and a nifty set of laminated cockpit cards.

Lithium-Ion boat battery £5,405

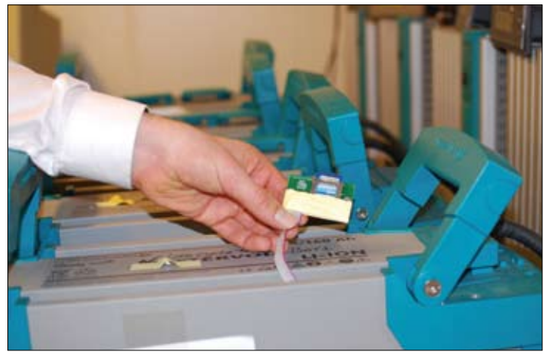
We look at a five grand Mastervolt boat battery and explore the technology. Can it really make sense?

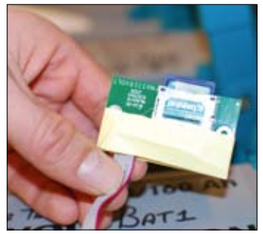
At first glance you'd have to say 'no' or something more robust, but there's more to this subject than meets the eye. Before we get into the financial analysis, however, let's take a look at what Lithium-Ion batteries can give you.

Most of us know of Lithium-Ion (Li-Ion) batteries because we use them in cameras and in some models of hand-held VHF radios. You may have noticed they are very light when compared with conventional batteries. You may also have noticed that they charge very quickly. This works both ways, in fact, because they can be discharged just as quickly as they are charged, whereas traditional lead-acid or gel batteries like to discharge and charge quite slowly, due to the resistance to change inside the battery cells.

Li-Ion batteries are basically quite simple, but in order to work most effectively they need a built-in management system, because they can suffer if exposed to over voltage and a few other things. Therefore, inside the battery are not just the cells where power is stored, but a whole host of electronics to babysit the cells and make sure the battery works at its best, balancing the input to and from each individual cell. In the Mastervolt there's even an SD card – just like you have in a digital camera – to record all the goings on in the battery's life, which helps Mastervolt give a five year warranty on the product.

Now let's look at the power of the battery. As I write this, the only model on the market is 24V 160 Ampere/Hour (Ah), but a 12V 320Ah model will be available by the time you read this, so I will focus on that model for technical comparison. A lead-acid or gel battery generally doesn't get filled right to 100 per cent capacity by the boat's engine. It normally only goes up to about 90 per cent. Only if you are connected to mains in a marina, for a long slow trickle charge, can you expect to go to 100 per cent. When you use the battery, you discharge as much as 50 per cent of its capacity, so unless you start out from a base with shore power you will only get 40Ah out of a 100Ah battery. The Mastervolt Li-Ion battery charges to 100 per cent with no problem, due to the very low internal resistance. You can readily discharge it to 20 per cent capacity, so for every 100Ah battery capacity, you can use 80Ah before charging. What's also very interesting is that it only takes one hour to charge – but more about that later.





Right: Every battery undergoes a rigorous automated test procedure. Top: Among the electronics that control the individual cells is an SD card for recording battery use. Above: Detail of SD card.

Voltage comparison

The voltage in a lead-acid or gel battery goes down as the battery is used up. It is recognised that the transmit power on a VHF radio is reduced as input voltage drops. Lower transmit power equals shorter range, so if you transmit from a depleted lead-acid battery you reduce range. This isn't an issue with Li-Ion batteries, because their voltage is almost constant regardless of the state of charge.

Next, a look at the life cycle of the battery. This is not primarily dependent on the age of the battery, but the number of times it has been depleted then recharged. Manufacturers' figures vary, but most lead-acid and gel batteries have a life of between 500 and 700 cycles. For our comparison later, we'll take the average as 600 cycles. The Mastervolt Li-Ion battery, however, will give you up to 2000 cycles.

The very quick discharge/recharge rate can give big benefits in other areas. If you're going blue water cruising and want a generator, you can make do with a smaller one, because DC can be inverted to AC and synchronised with the generator, so on the occasions you need absolute maximum AC power you combine the two sources. This is particularly useful running equipment like air conditioning, which has a heavy starting load – due to huge resistance in the air conditioning components – but once it is running requires much less current.

The 12V 320Ah Li-Ion weighs in at 48kg, which is 6.66Ah per kg. The equivalent AGM batteries from Mastervolt – 4 x 160Ah weigh a total of 172kg. I have said four AGM batteries, not two, because the 'usable capacity' of the Lithium-Ion batteries is twice that of the AGMs – 80 per cent against 40 per cent.

Top: The Mastervolt factory outside Amsterdam, Holland. Left: Detail showing PCBs buried beneath the surface of the battery. Above: The handles fold flat.

The maths

The Mastervolt 12V 160Ah AGM batteries cost £380.70 each or £1522.80 for four.

The Lithium-Ion battery costs £5405, but has a lifespan three times that of the AGMs, so if you divide the price by three it comes to £1801.66. It's more expensive, but not by much.

Now look at the problem of charging when you're away from marinas. Assuming you have a huge alternator you can charge the Li-Ion battery in one hour, whereas the other batteries take up to eight hours.

Factor in the noise, the cost of diesel and wear and tear when running the engine to charge lead-acid batteries and the price gap shrinks, because you will spend more on diesel to charge the lead-acid battery than you would have spent on the Li-Ion battery, which charges to 100 per cent capacity in a fraction of the time.

Clearly, if you deep cycle your batteries only twice a year, it's going to be hard to justify the cost of a Li-Ion battery, but if you really use your battery's stored capacity often, particularly if you don't always have mains power available for the final top-up trickle charge, Li-Ion looks like a sound option.

There's one final technical point in favour of Li-Ion batteries and it's one that will begin to drive them out into mainstream applications. Lead-acid, AGM and gel batteries will only deliver the stated capacity provided they are discharged at a slow rate. A very fast discharge rate uses more of the battery up. Li-Ion batteries can be discharged in one hour, making them much more suited to heavy current use, for example driving the boat with a hybrid-drive system.

JT

WE LIKE

- Weight saving
- Quick charging
- Large capacity
- Constant voltage

WE DON'T LIKE

- The price

VERDICT ★★★★☆

Li-Ion batteries are beginning to make sense for blue water cruisers. The short charge time (to full capacity) and deeper cycling capability make that clear and significant fuel savings can be had, but for boats not exposed to constant use, it's probably better to wait till prices drop a little further. The good news is that the price trend is downwards.

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