



by Bjarne Hansen
Freya, Vogel 30 Cutter

Editor's Note: A number of years ago, my Currents editing partner, Terry Fuller, and I introduced a technical column, which we dubbed 'All Hands on Tech'. I'm happy to reintroduce this column, with Bjarne Hansen's description of the pros and cons of operating an electric outboard motor over the more conventional gas motor.

If you have an item to share in this column, please send it to currents@bluewatercruising.org, with 'Technical Article' in the subject line.

Electric Outboard Motor

For 11 years, including two in the South Pacific, we used a 2HP Johnson two-stroke of late 1970s vintage to get us around. It was a challenge to keep running and certainly modern four-stroke outboards are much quieter, fuel-efficient, and reliable. When 'EvilRude' was stolen off our stern last year, we didn't lament its loss and researched various replacement options. We relate here our experiences to help anyone considering purchasing a new outboard.

In May 2011 we purchased 'Stealth', a Minn Kota 55/12 Volt electric outboard (<http://www.minnkotamotors.com>). The motor weighs 27 lb (12.5 kg) and provides 55 lbs maximum thrust. Folks at the May or August Rendezvous may recall seeing us silently gliding about in our dinghy. Quiet operation is our favourite feature of 'Stealth', with no exhaust fumes or oily discharge to worry about. We have been approaching sea lions, seals, bears, and birds closer than with our old outboard.

Our second favourite feature is one of safety; we no longer carry gasoline on board nor deal with mixing, storing, and filling a fuel tank. Instead we store and recharge the batteries that power the engine. We carry



'Stealth' and battery

two 35 AHr (amp-hour: a measure of battery capacity) sealed lead-acid batteries, which cost about \$110 each retail or \$75 on-line. At 11.5 kg (25 lbs) each, we chose ones slightly smaller than recommended for the outboard in order to easily lift them in and out of the dinghy. (Compare this to a full 5-gallon fuel tank, which weighs about 36 pounds.) Two downsides to smaller batteries are a reduced range and a lower top speed (the battery can't supply enough current to reach peak thrust of the motor). We're okay with these compromises.

So how far and fast can we go? Our range with one battery before recharging is about 3.6 nautical miles when we use a 2-knot moderate speed. When we expect to go further, we bring along the second battery, otherwise we leave it aboard *Freya* for charging. Our 50-watt solar panel recharges a mostly-drained battery in about a day, although usually we swap batteries before reaching such a low level of charge. 'Refueling' with sunlight is a big advantage for extended stays in remote locations with expensive or no gasoline (e.g., Penrhyn and Fanning Islands).



A range of about 3½ miles with one battery

Peak speed with one battery is 2.6 knots, in our soft-bottomed inflatable with two persons plus gear aboard. When 'EvilRude' was working well, it would move us perhaps 20% faster. We haven't tried 'Stealth' in a hard-bottomed dinghy but as anyone who has rowed both types knows, the top speed should be significantly faster in a rigid hull. As mentioned earlier, our smaller battery limits the top speed, since the motor is unable to draw the full current it needs at full throttle. Throttle settings past about 60% do not result in any speed increase. As an experiment, we ran the speed test again in the same dinghy but with both batteries connected in parallel to the motor. The speed then topped out at 3.0 knots, at about the 90% throttle setting.

The three-bladed plastic propeller has been robust so far. It has snagged in weeds and very occasionally touched a sandy bottom, but the resulting few small notches in the leading

edges have not noticeably affected performance. It may be a good idea to bring a spare prop on an extended cruise, unless you fancy carving out a wooden prop.

Minn Kota indicates that the electronics are potted (sealed) and that exposed metal is stainless or aluminum. Their engines have a two year warranty, there are no recommended maintenance requirements, and we don't rinse ours off after use. Our previous experience with 'EvilRude' included dunking it at a beach, where it rolled around in the sand and surf. This was followed by a day of disassembly, rinsing and reassembly. I suspect 'Stealth' would survive such rough treatment with more aplomb. Note that Minn Kota also sells a freshwater version (this is the one Canadian Tire distributes) without potted electronics and stainless steel. These are about half the price of the saltwater versions but are recommended to be rinsed in fresh water after each use. It is likely a good idea to pay for the extra robust construction.

A couple of disadvantages should be explained. The shaft length of 91 cm (36 inches) is longer than needed for most dinghies. A quick-release collar allows one to slide the prop up higher for better bottom clearance, but this positions the control grip higher than preferable. However, the shaft can be shortened by cutting it carefully - several folks have described this procedure on the web.

Minn Kota makes several models with less thrust that are less expensive than the \$611 (total, including taxes and shipping) we paid for 'Stealth'. If you research engine sizing (www.Cabelas.com, for instance, has a good *Trolling Motor Buyer's Guide*) you will see that 55 pounds thrust should be fine pushing a 2,000-pound boat around. Smaller Minn Kota models regulate speed by switching resistors located in the submerged power head in and out of the motor circuit. This reduces the voltage applied to the motor, but at the cost of wasting energy by heating the resistors. It is particularly inefficient at slow speed settings when the resistance is highest.



When racing competitively, 'Stealth' offers a lot less drag than a gas-powered outboard!

A much more efficient way to regulate speed uses transistors to regulate the power applied to the motor in short bursts (pulse width modulation). Minn Kota's Digital Maximizer™

speed control claims to run up to 5X longer per charge at slow speeds. The model we bought is the smallest that has the Digital Maximizer speed control.

Besides Minn Kota, there are two other electric outboard manufacturers whose motors we researched. Aquawatt (<http://www.aquawatt.at>) has some very high power (up to 30 HP equivalent) outboards, but they require higher than 12V to run, which means always carrying several batteries. We also didn't need that much power. Torqeedo (available from www.humberboats.ca) includes the battery in the control head, which eliminates the inconvenience of a separate battery and cables running to it. They appear to be a very high quality outboard, using a high-efficiency motor and electronics package. We passed on this brand as it is about 2X more expensive and obtaining a replacement battery would be more difficult than with a standard lead-acid type.

Our opinion is that an electric outboard is a viable solution for someone who values quiet and ease of use over speed. If you want to plane around the anchorage or get to your dive site quickly, then a gasoline-powered outboard (or an Aquawatt) is more likely suited to you, but if you are the kind of person who will occasionally use the oars simply to experience some peaceful moments, then you can still retain those moments with a lightweight, small electric outboard. If you are in the market for a new means of propulsion, you could give an electric motor consideration. We'll be happy to answer any questions you may have, or if you are in the Victoria area and want to try out our 'Stealth', drop us an email.

In summary, here are the pros and cons that we have come up with based on our experience:

Advantages:

- quiet
- lightweight
- no winterization
- no tune-ups or maintenance
- no gasoline
- refuel using sunlight or wind
- batteries can be used for other purposes aboard the mother ship (multiple use items are always preferable)
- less attractive to thieves than a modern gas outboard
- salt-water version won't corrode
- instant start/stop

Disadvantages

- spare parts harder to obtain
- outboard motor technicians not likely to be familiar with electric motors
- slower than a well-running gas outboard
- plastic prop
- prop shaft is longer than needed