2008

The Tahoe Benchmark

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Introduction

It is the third day of our scooter testing, and as I fly along the measured quarter mile, little white flags periodically appear out of the murk ahead, and slide by into oblivion. It's like I am in a dream, suspended in the water as the world slips by underneath me. All I hear is the whir of the motor, and my breathing; there's a cramp in my back from hunching my shoulders, trying to eke out every last little bit of speed, and I don't dare look up, knowing that the flat plate of my mask will generate drag. My world is simple: depth, body position, perfect trim.

The "Tahoe Benchmark" was an attempt to fill a void. To the best of our knowledge, there hadn't been an empirical, detailed, in-the-water test of scooters that attempted to remove a diver's individual influence from the results.

The morning lineup: a photographer from the Sierra Sun shoots the test scooters as they await their instrumentation package and assignment stickers. Photo by Janet Flenner

As it stands, for a diver looking to buy a scooter, there's a shortage of information with which to comparison shop. Mostly, all you have is manufacturer advertising. Some claims are ludicrous – 4 mph! (where, on Mars, with a squirrel as a pilot?) – while weights seem to have no reasonable connection to burn time. And don't ask

divers for an informed opinion. Someone that's invested north of $3,000 is going to be pretty sure that their scooter is truly the best choice, and they will do their best to convince you of that fact. "Discussions" on forums invariably deteriorate to name-calling and my-dog-is-bigger-than-your-dog. Sheesh.

So, we decided to find out for ourselves. The old-fashioned way – with lots of scooters. And lots and lots of diving.

The scooters

All the major manufacturers were invited to attend. Certified letters were sent, and most agreed to send a test article of their most popular models. Submerge, Dive-Xtras, and Torpedo all sent manufacturer-prepped samples.

Test scooters wait for use at the staging float. (L to R) Dive-X Cuda & Submerge N-19. Photo by Janet Flenner

Gavin declined to send scooter of any kind, so one was sourced from private ownership(1). Suex was unable to send a sample from Italy for the test, so similarly, a Zuexo was sourced from a private owner(2). An Oceanic Mako was obtained locally from another understanding private owner(3). Apollo was not heard from at all and did not return our calls.

Three manufacturers, Salvo, Hollis, and SeaDoo (aka Stallion products) initially indicated that they would participate. However, as of the week of the test, Hollis stated they did not have operating scooters to provide[5], and Salvo reported they had none to send[6]. SeaDoo's rep indicated that they would ship two models, but these never appeared.

Through a mistake on our part, JetBoots was not initially invited. JetBoots made strong efforts at participating[12], but sadly for the test divers (who were looking forward to trying them out) also was unable to provide an operating sample in time for the test.

Equal Opportunity Testers: Recreational scooters were tested to the same standards as the tech scooters. Photo by Janet Flenner

It's worth noting that of all the manufacturers, only two, Torpedo and Dive-Xtras, simply pulled scooters from stock and shipped them. The others did not appear to have stock on hand to so ship.

Although not really a scooter per se, Deep Sea Supply sent a copy of their Li-Ion battery for the Dive-Xtras Sierra. With the development of a new segment in the scooter market – aftermarket power sources – we wanted to see if there was more going on besides a bigger gas tank.

It was announced before testing that manufacturers which participated, by sending models for testing, would be provided a copy of all the raw data gathered from the data recorders. Any other manufacturers would not be allowed access to this data. A .zip file of the raw data was provided to Deep Sea Supply, Dive-Xtras, Submerge, and Torpedo.

The timeline given for manufacturers to provide test samples was kept deliberately short, because the testers feared the inclusion of a hot-wound scooter. All of the units tested appear to be true manufacturing samples, with neither over- or under-performing scooters.

The venue

Repeatable underwater testing demands stable water, and lacking a quarter-mile long swimming pool, we found it on the west shore of Lake Tahoe. The location, known to locals as Hurricane Bay, is blessed with no apparent current and easy beach access. We installed start and end markers, and from measuring the surface positions, pegged the length as 1322 feet.

Measured Course at Hurricane Bay: Surveyed distance 1325.5 feet. Photo by Google Earth

Last year, initial testing showed us that a single run, or portion of a run, was too vulnerable to diver and machine variations. This test used two runs, one north and

one south, for a total run of ½ mile. With this we were able to produce repeatable results with excellent accuracy.

As the date of the testing drew near, one of our test divers, a surveyor by trade, carefully measured the course at depth by hand and installed 100' markers. This precision survey, which took bottom contour into account, found the original distance to be off by 3.5 feet, for a total run of 1325.5 feet at a depth of 36’.

What we looked for

The scooters were tested for three basic performance criteria:

- Maximum speed
- Range at maximum speed
- Range at Cruise speed

Let’s face it, the first question about performance ends up being “how fast is it?” Everyone makes claims about being “faster than so-and-so” and how well they navigate current and flow. So fine, that became one of our testing criteria: demonstrated speed over two quarter-mile runs.

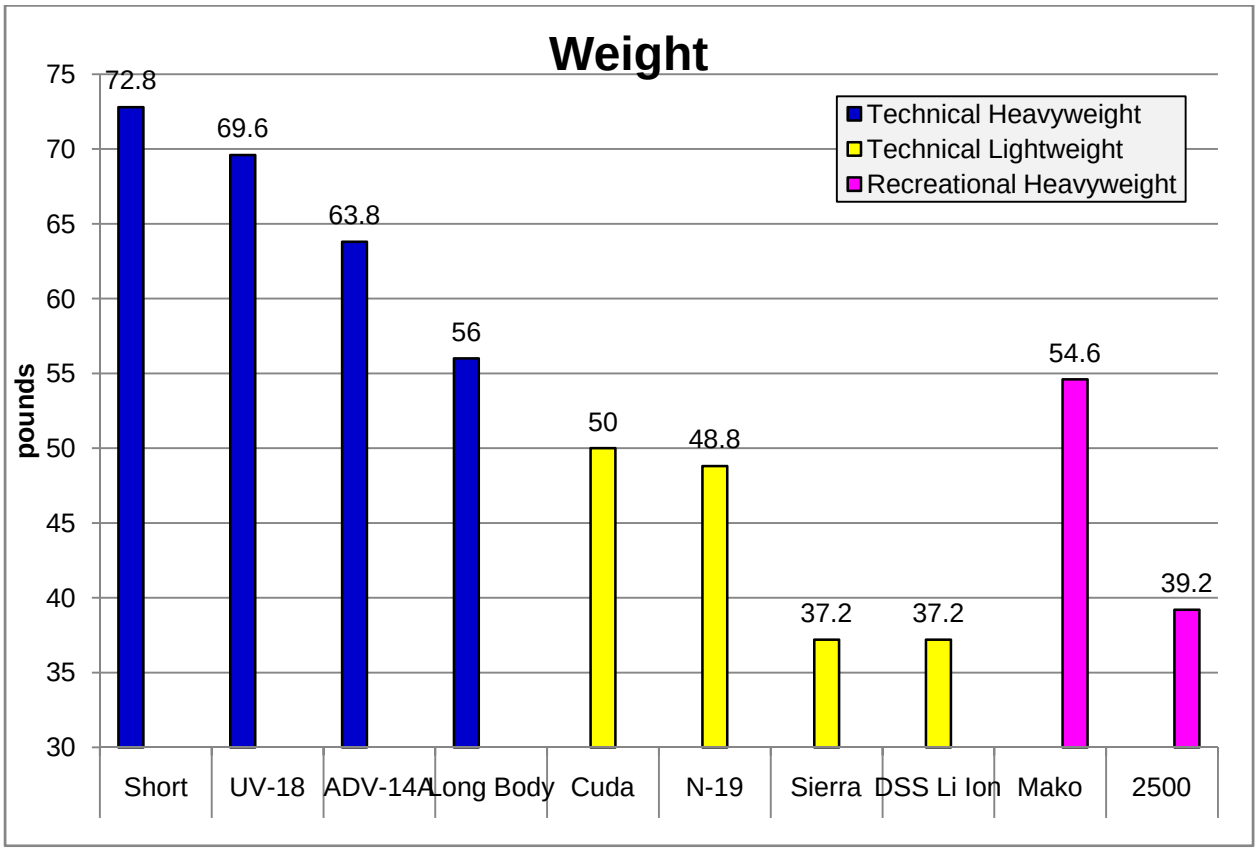
The next question is usually “how far will it go?” so we wanted to include the worst-case scenario for Range: running at maximum speed. This, it was felt, would provide the most brutal working conditions for each scooter, as motors became hot and battery voltages would drop under load.

It’s only fair to include the best-case scenario, endurance at a languid cruise speed. After interviewing quite a few experienced scooter pilots, we arrived at a consensus for the cruise speed number: 150 fpm. So, we tested scooters at this speed, for range.

Mostly at the request of a single manufacturer, an additional test was entertained, a max speed run in doubles with a stage. As we began the first day of testing, we realized how ambitious our testing schedule really was, and this would have added 24 dives. Thus, this test was sacrificed to allow proper completion of the three core parameters.

The categories

Scooters were divided into two categories: Recreational (depth rated shallower than 200'), and, Technical (depth rated below 200'). Furthermore, each category was split into two weight classes. On the day of the test, each scooter was weighed to within a tenth of a pound in its ready-to-dive configuration. 0.3 lbs were subtracted to account for test instrumentation.

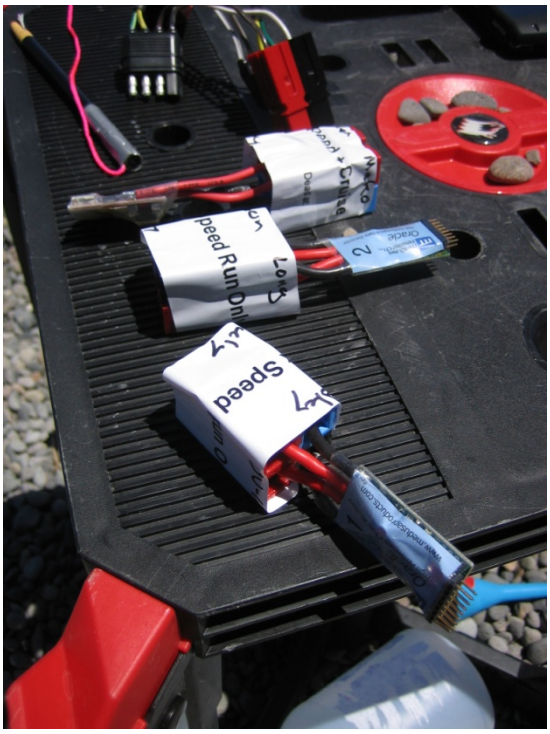


Technical scooters were either Lightweight or Heavyweight, with the dividing line at 55 lbs. We had 4 Tech/Heavyweights scooters and 3 Tech/Lightweight.

Similarly, the Recreational scooters were split as Lightweight and Heavyweight, with 25 lbs set as the split. Both of the Recreational scooters tested were Heavyweights.

How we tested

The one variable that is most difficult to overcome in testing of this kind is the diver. If you hand off a scooter from one diver to another, on the same dive, that scooter will have different max speeds, purely because of body position, equipment, and other factors. Removing this variable was the biggest hurdle the testing had to overcome, and we are very confident in the results ultimately obtained.



The test eliminated direct comparison of speeds between divers. Instead, each diver made runs on every scooter, and had their results ranked as percentages of their fastest speed. After all dives were done, the percentages were averaged. For statistical purposes, three divers were the minimum sample that was felt would produce reliable results. This resulted in 48 dives and 42 miles underwater over three days.

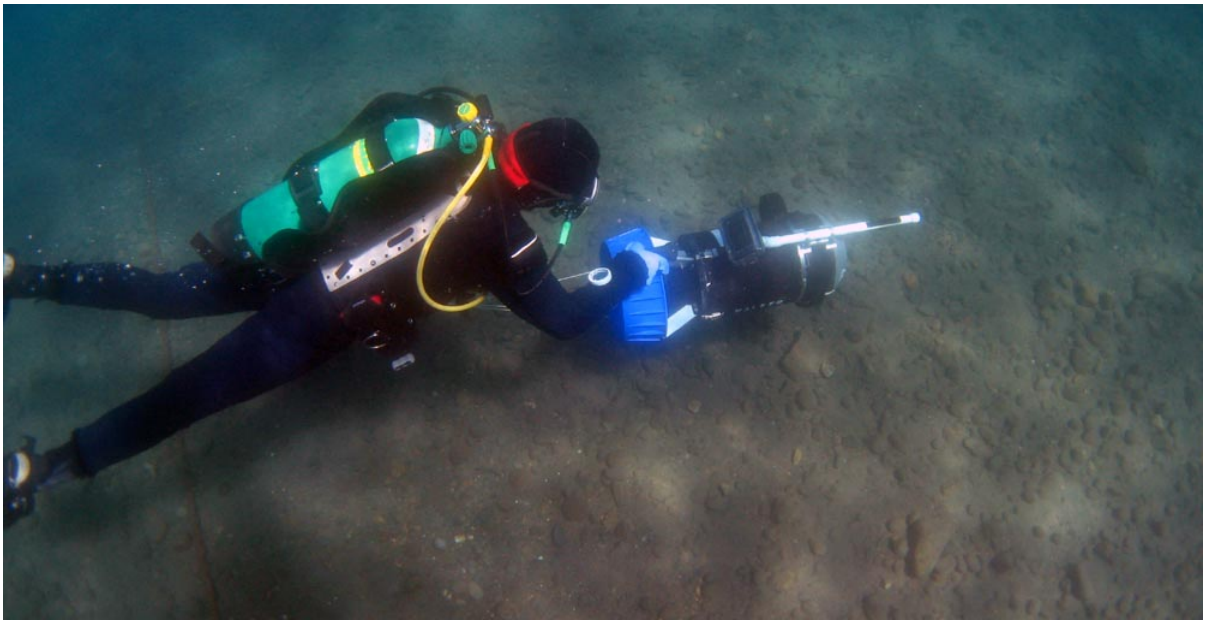
All the scooters were equipped with power recorders, which measured Volts, Amps, Watts, Watt Hours and time. Data were collected after every test dive by downloading to a laptop. The power recorders used were the Medusa Oracle and the BnB DPR-100.

Data recorders waiting for download. Photo by James Flenner

The divers wore dry suits, undergarments appropriate for all day in the 59°F water, BP/W, and a single steel 72 filled with 32% nitrox. The gear configuration was chosen for crossover of results between recreational divers and technical divers, to allow each scooter to perform at its best, and to accommodate logistics of gas, which was provided free by Adventure Scuba in Reno, NV.

Maximum speed was measured on a scooter with a full, overnight charge. After the test diver settled their trim and buoyancy using a surrogate scooter, the test scooter was run at maximum speed north on the test track. After reaching the end marker, each scooter was given a two-minute rest, then run south at maximum speed.

Range at maximum speed, nicknamed “The Enduro” by the test divers, was a continuation of the max speed run. At the conclusion of the first half mile, the diver would again pause for two minutes (every quarter mile was ended with a two-minute pause) and another ½ mile was run. With a diver change at every mile, the test continued until the scooter died. “Dead” was defined as less than 67 fpm (more than a minute and a half per 100’ marker) or the first low-voltage cutout.



A scooter is fitted with the underwater speedometer as it is adjusted for 150 fpm. To avoid drag, the actual test run was done without the meter and used lap times for verification. Photo by Janet Flenner

Cruise speed was a bit different. After making the Max Speed run, the diver used a match-grade speedometer originally designed for racing sculls, the Kestrel SpeedCoach XL1, placed into an underwater housing. Using the manufacturer-suggested method of configuring the scooter for speed, the diver made several short 100’ runs to find and confirm the settings for 150 feet per minute. For most scooters this was via prop pitch, and for several it was through use of electronic speed control. Then, the scooter was run for an additional ½ mile at cruise to view power consumption. Several scooters have identical max speed and cruise speed ranges because their top speed was less than 150 fpm.

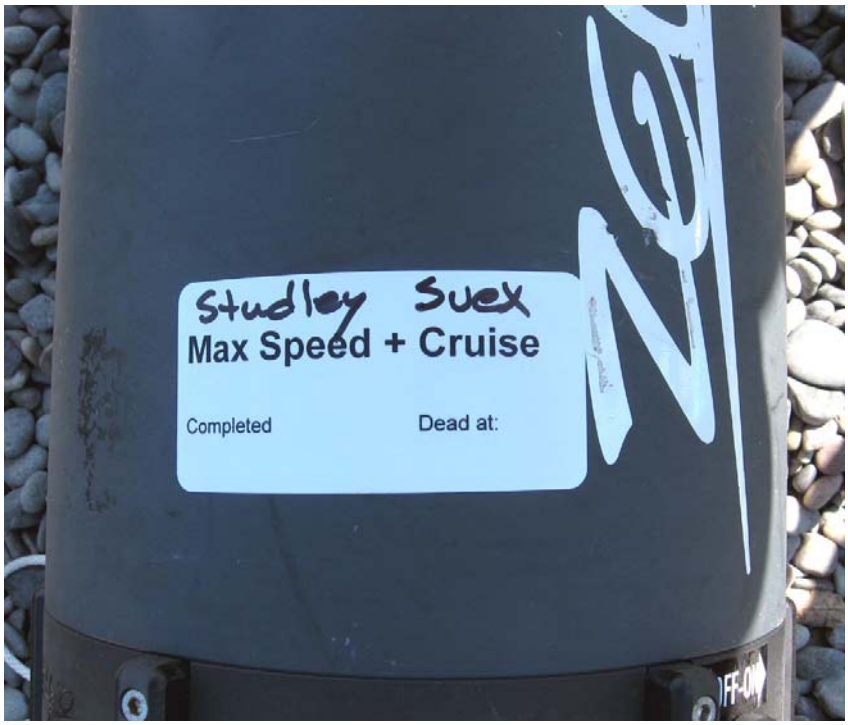
An overall testing matrix was developed that allowed each scooter to be tested with a full charge[10]. A concern was that the divers would become more adept at speed and streamlining as the days went on, so each scooter was scheduled to be tested for max speed on day 1, day 2 and day 3; this, it was felt, would allow every scooter a shot at a high-speed day 3 run, as well as a slow day 1 run.

After all data were processed, and the final paper authored, the paper was placed through peer review[14]. The reviewers approved the paper as written, with positive comments.

The test dives

The scooter pilots[4] were chosen because of their "stick time" – all exceeded 200 scooter dives – and their foolishness to say "yes" when asked. Two are X-scooter owners, one owns an N-19 and a UV-18.

Diving started at roughly 9:00 AM and ended daily about 6:00 PM. There was a published test schedule[11], broken down into diver/scooter/time, and included assignments for relief diver(s) on the enduro runs. At the beginning of the day, tyvek stickers with the dive assignments were applied to the scooters, and after data recorders were loaded and the scooters buttoned up, off we'd go.



Scooters were labeled with tyvek to keep track of assignments and results. Photo by Janet Flenner

As we'd scooter down the course, occasionally you'd hear the whine of another test diver headed in the opposite direction. You'd never see them, though, as we all were

head-down, concentrating on trim and depth, trying to wring out the best speed possible.

And we got to know that ¼ mile of underwater scenery really, really well. Or maybe I should say lack of scenery. There's the Stegosaurus tree, almost exactly halfway at 700' down the course, and dangerous because of its jutting pointy branches. The Gobi Desert, a blank, featureless expanse of sand over the last 300' before the end marker, that would make you doubt your senses. Often you'd arrive at the end marker to see another test diver waiting there, poised for the run south, staring at their wrist waiting for the exact two-minute mark. Everyone was pure business and gave their all to make every scooter perform at its best.

There were moments of levity, like when Alan came back from his max speed run on the Cuda laughing about how "I almost killed myself on Stegosaurus. I looked up and there it was! I thought I'd impaled myself and just got lucky".

James Flenner (L) and Marcus Ollom (R) discuss relief diver assignments before diving begins for the day. Keeping tight control over when relief divers entered the water prevented a scooter from having an abnormally long rest period at the end of each mile. Photo by Janet Flenner

We quickly figured out that the worst assignment was relief diver on the enduro. Sure enough, as you ran the scooter until it died, it would invariably quit at the north end of the course – a nice, long pedestrian swim home towing a scooter. The second day we added a shadow diver who would tow us home; a big thank you to James Novaes and Marcus Ollom.

And the food. Adventure Scuba offered to buy lunch for everyone on the test days, but in the flurry of in the water, out of the water, switching scooters and prepping new ones, and (oh, by the way) diving, we were just too busy to actually go and get food. The case of Snickers bars we'd brought turned into the best investment of the week…

The results

First, a word about the results. Using the Tahoe Benchmark methodology, they are true numbers for the test divers we used, in the equipment worn by the divers, and they are averages of those results by ranking. However, it would not be surprising to see manufacturers begin quoting speed numbers in terms of feet per minute or range in miles. Comparing numbers derived from a different process may not be a valid comparison – for example, we saw that speed results in the first 10% of battery use resulted in faster speeds, and the true sustainable speeds were only observed over two ¼ mile runs. Caveat emptor.

					Max Speed				Cruise (150 fpm)		
Manufacturer	Model	weight	Class		Speed	Range	Duration	Power	Range	Duration	Power
		lbs			fpm	miles	minutes	Watts	miles	minutes	Watts
Submerge	UV-18	69.6	Tech	Heavy	182	1.3	36	403	1.5	52	262
Submerge	N-19	48.8	Tech	Light	202	1.9	51	455	2.4	88	258
Gavin	Short	72.8	Tech	Heavy	166	1.3	46	399	1.5	49	318
Suex	ADV-14A	63.8	Tech	Heavy	196	1.2	32	539	1.3	43	376
Dive-Xtras	Sierra	37.2	Tech	Light	182	1.4	39	439	1.9	65	265
Dive-Xtras	Long Body	56	Tech	Heavy	192	2.6	74	519	3.8	131	264
Dive-Xtras	Cuda	50	Tech	Light	254	1.7	34	943	4.9	184	164
DSS	Li Ion	37.2	Tech	Light	195	2.5	69	565	4.0	133	274
Oceanic	Mako	54.6	Rec	Heavy	145	1.3	53	246	1.0	39	225
Torpedo	2500	39.2	Rec	Heavy	102	1.1	54	267	1.1	57	261

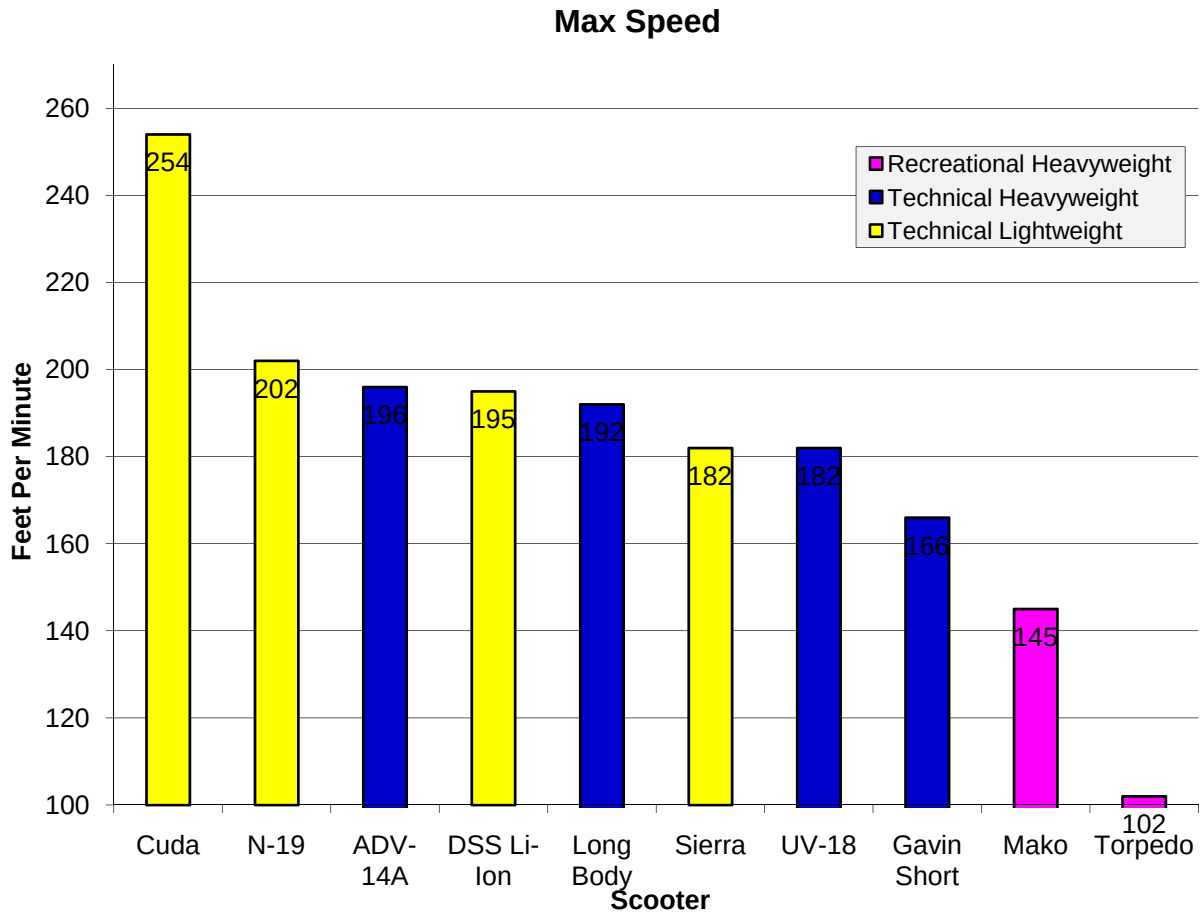
Overall data results. For red text entries, see [13] in References

Maximum Speed

In the max speed results, we saw a cluster of great performing scooters, with the N-19 leading this group at 202 fpm. Having never piloted a Suex ADV-14A before, we found our in-water impressions of solid performance backed up with a speed of 196 fpm, closely matched by the Deep Sea Supply Li-Ion battery. Rounding the pack out was the Dive-Xtras Long Body at 192 fpm.

The next grouping was a tie. The pair of scooters, the Dive-Xtras Sierra and the Submerge UV-18, both turned in respectable performances at 182 fpm.

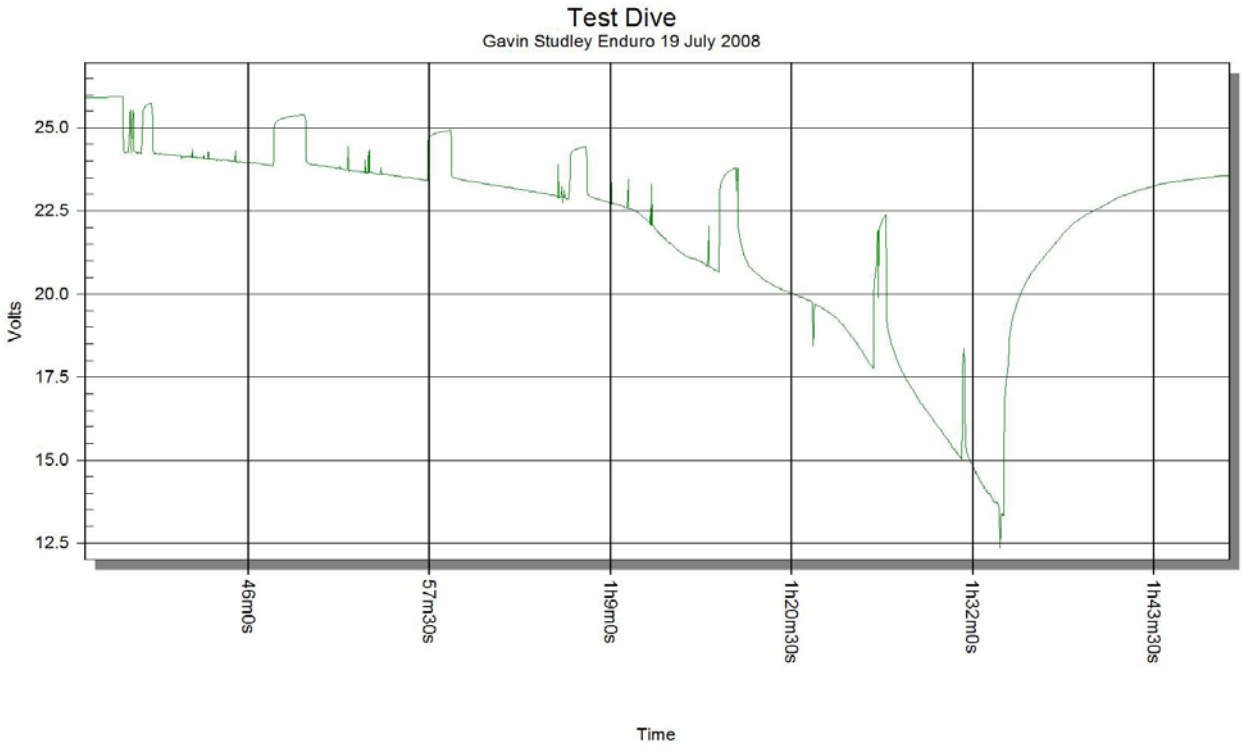
Surprisingly lagging behind came the Gavin Short Body at 166 fpm and then the recreational scooters, with the Mako at 145 fpm. The least expensive scooter tested was the Torpedo 2500 at 102 fpm.



The fastest scooter tested was the Dive-Xtras Cuda. Clocking in at a whopping 254 fpm, this is a machine that felt as if it had endless power. The difference between 200 and 250 fpm is a far different thing than the jump from 150 fpm to 200. The jump from 150 fpm to 200 fpm is a very satisfying feeling of solid pull. During the jump from 200 fpm to 250 fpm, however, the rushing water becomes a tangible force, and the perceived speed increase seems far in excess of the extra 50 fpm, and you have serious doubts about your sanity and ability to handle this scooter.

The sharp-eyed will have noticed some disparities. Some well-respected scooters, the UV-18 and the Gavin, turned in surprisingly slow times. What's up?

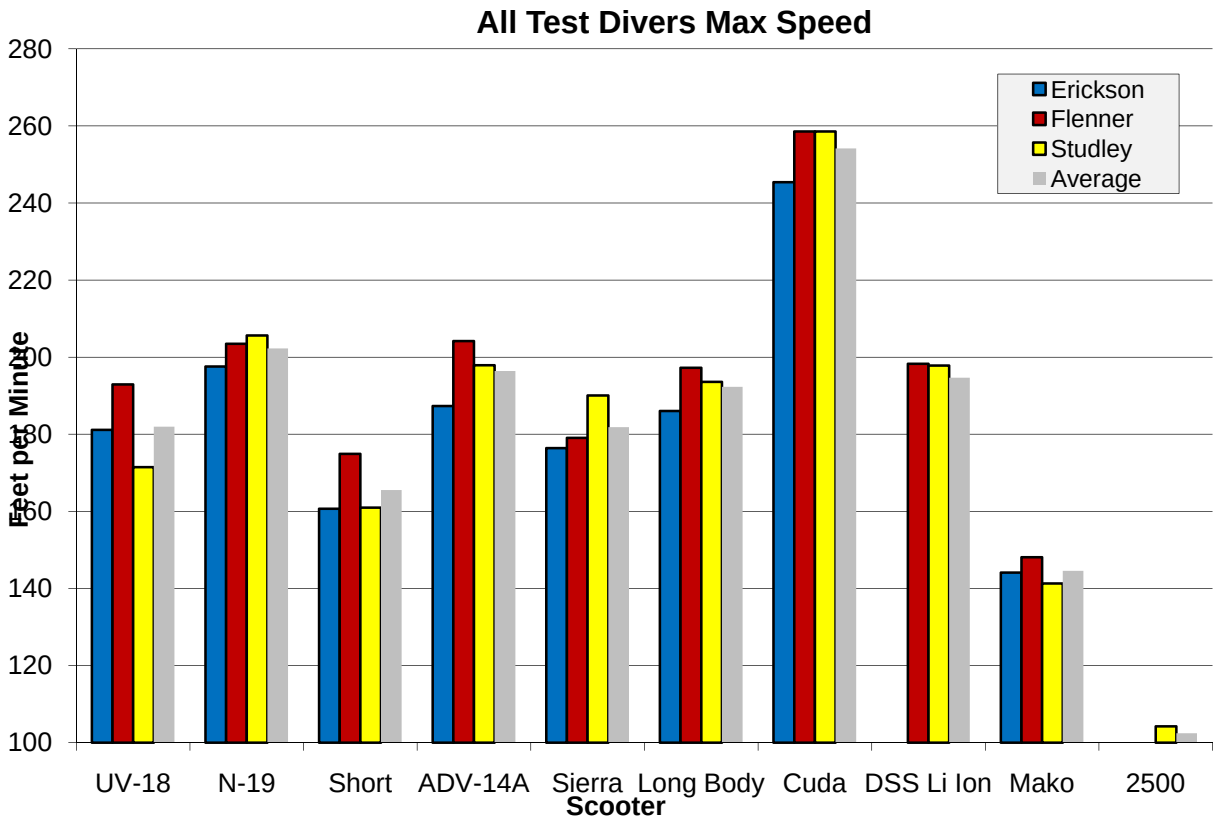
The reason, it turns out, is voltage. Or lack of it. The max speed test, deliberately designed to show up any weakness, placed a large, continuous draw on the battery. As the voltage drops, so does RPM, and thus speed. These scooters would start out with a lurch of speed that would quickly dissipate within several hundred feet of the starting line, after which they would enter a steady-state speed as seen in the results. If there had been a long body Lead Acid scooter in the test, with more battery resources to call on, we would have expected to see faster times, at the cost of significant weight.



Voltage (green line) decline in the enduro event.

Generally, NiMH batteries contain cells that are chosen to sustain a high power draw, and so do not depress their voltage as easily. This is seen in the good performance of the N-19. And merely doubling the battery resources of the Dive-Xtras scooter gave the Long Body a 10 fpm advantage over its 37 pound sibling, the Sierra, using the same tail section and motor (during the tests, it was indeed the same exact tail, with a different nose snapped on).

Some might argue that this wasn't fair to the lead acid designs. However, we weren't interested in leveling the playing field for battery types – it was a test of complete scooters, with the engineering tradeoffs inherent in their design.

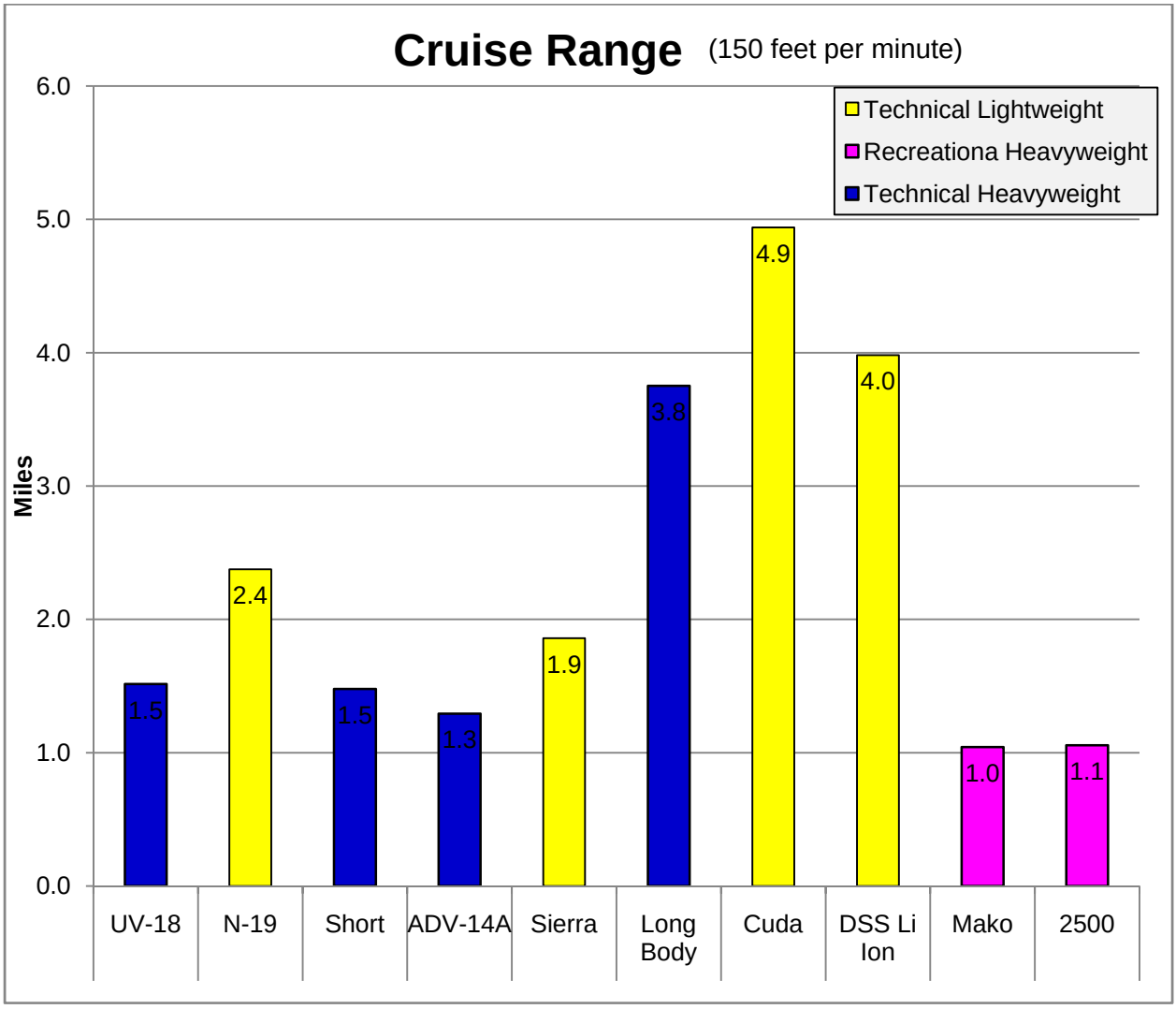


Although most of the test divers had performance scores that were quite close, two scooters were a surprise: the Dive-Xtras Sierra and the Submerge UV-18. Test divers Erickson and Flenner are Sierra owners, and it was expected that they would turn in fast times in that scooter. Instead, test diver Alan Studley, owner of a UV-18, beat them handily on the Sierra. When it came to the UV-18, these results were again a surprise, as Studley, a UV-18 owner, lagged well behind. We speculate that this is because the test divers relaxed when riding their familiar scooter, and emphasized the need for three divers in the test regime.

Range at Cruise

Everyone agreed this was one of the most important parameters. Unlike Range at Max, where a scooter's speed works against it when generating range, in this test every scooter was configured for the same speed, 150 feet per minute, so comparisons between scooters are quite valid.

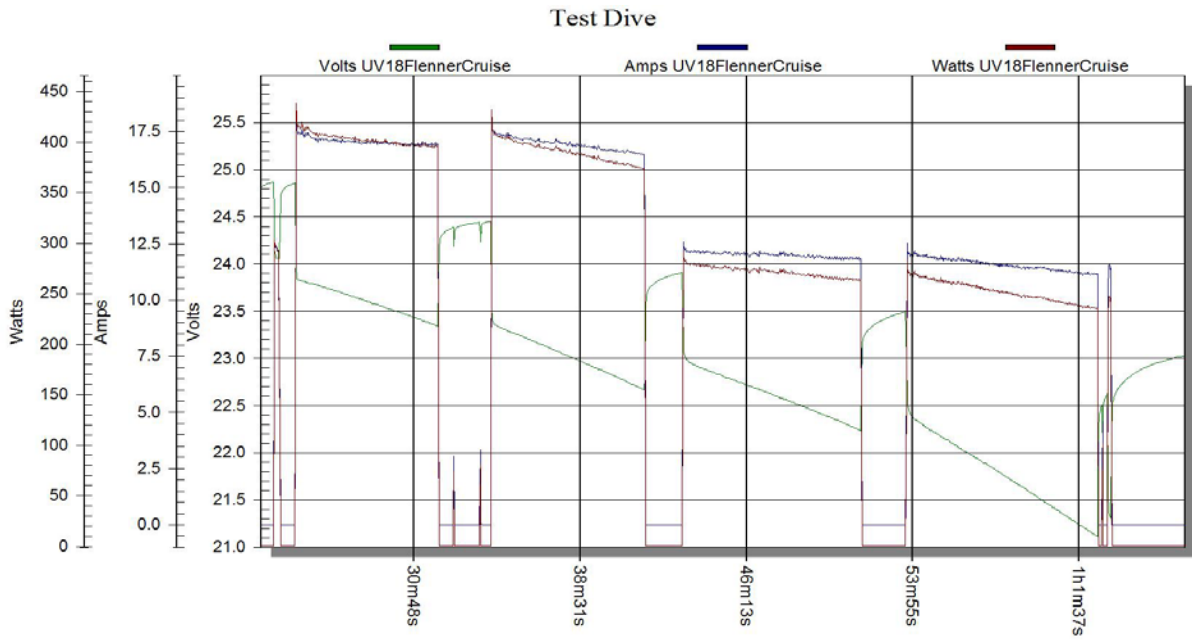
Here we used the observed power consumption at 150 fpm, and used the worst-case scenario for battery capacity (obtained from the Max Speed Enduro) to generate a Cruise Range. We used data from a scooter that actually was run to exhaustion[8], at cruise, to verify that this methodology was based in fact. The results matched to 6%.



Results were very polarized, with two distinct sets of ranges. One group of three scooters was impressive, placing ranges of greater than 3¾ miles. Two of these, the Dive-Xtras Long Body (3.75 miles) and the Deep Sea Supply Li Ion / Sierra (4 miles) were somewhat expected, having prodigious battery reserves to call on. However, Dive-Xtras Cuda generated range numbers that had everyone sit down in surprise: 4.9 miles at cruise speed.

The next group was scattered loosely from 1.3 miles (Suex) to 1.9 miles (Dive-Xtras Sierra) to the Submerge N-19 being the best of this group at 2.4 miles. The recreational scooters turned in surprisingly good results with both placing at 1 mile.

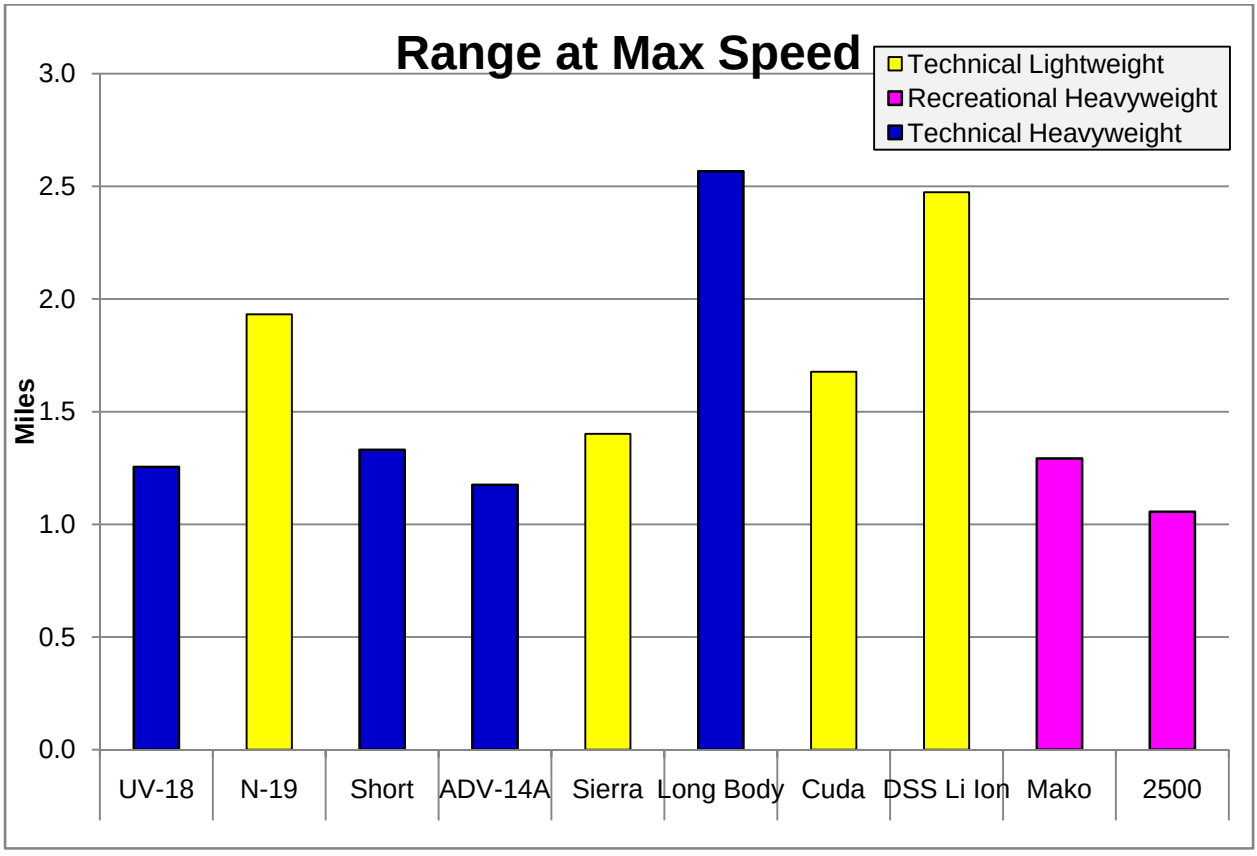
A voracious appetite was the Achilles Heel for the Suex. At 376 Watts, its gearbox had the highest cruise power consumption, and the Gavin was next most hungry at 318 Watts. Amazingly, all the rest had power consumption that was very close, approximately 260 Watts. The big exception was the Cuda, easily the most adept at converting electricity into motion, with a miserly power consumption of 163 Watts, a key to having the best range.



A data printout from a typical cruise test dive. Note the two high-speed segments followed by two runs at 150 fpm.

Range at Maximum Speed

This test can be deceiving. Run at maximum speed, faster scooters are penalized, whereas slower scooters get an advantage; it's pretty obvious that a faster scooter burns more juice[(9)]. However, comparisons are valid when made between scooters with a similar top speed. Still, when planning your ultimate use for a scooter, range (in this worst-case scenario) is an important piece of information.

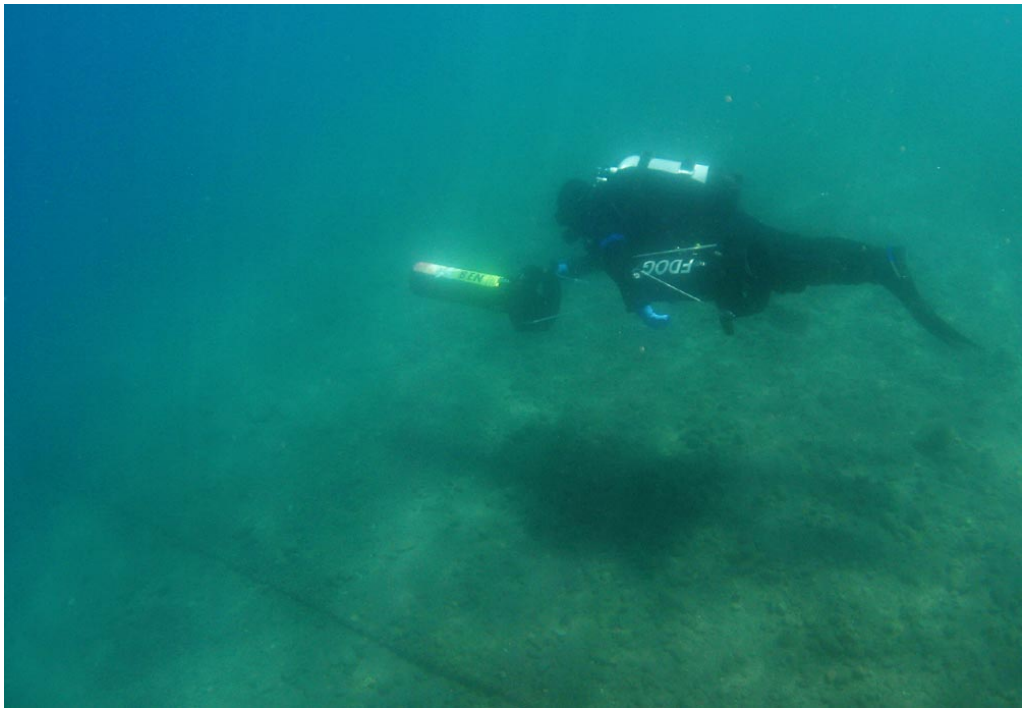


With the scooter running at maximum speed, the unexpected standout was the Dive-Xtras Long Body at 2.6 miles. Close behind was the Deep Sea Supply Li-Ion-powered Sierra at 2.5 miles.

The next best performers were the Submerge N-19 at 1.9 miles, and then the Dive-Xtras Cuda at 1.7 miles.

From there it's a cluster of scooters, with the Gavin, UV-18, Mako and Sierra all grouped at 1.3 to 1.4 miles.

A surprise here was the Suex – we'd all been impressed with the scooter's strong pull and good speed, and some eyebrows were raised over its relatively poor 1.17 miles. Again, this was probably due to the scooter's appetite, with a power consumption of 540 Watts versus the N-19's 455 Watts.

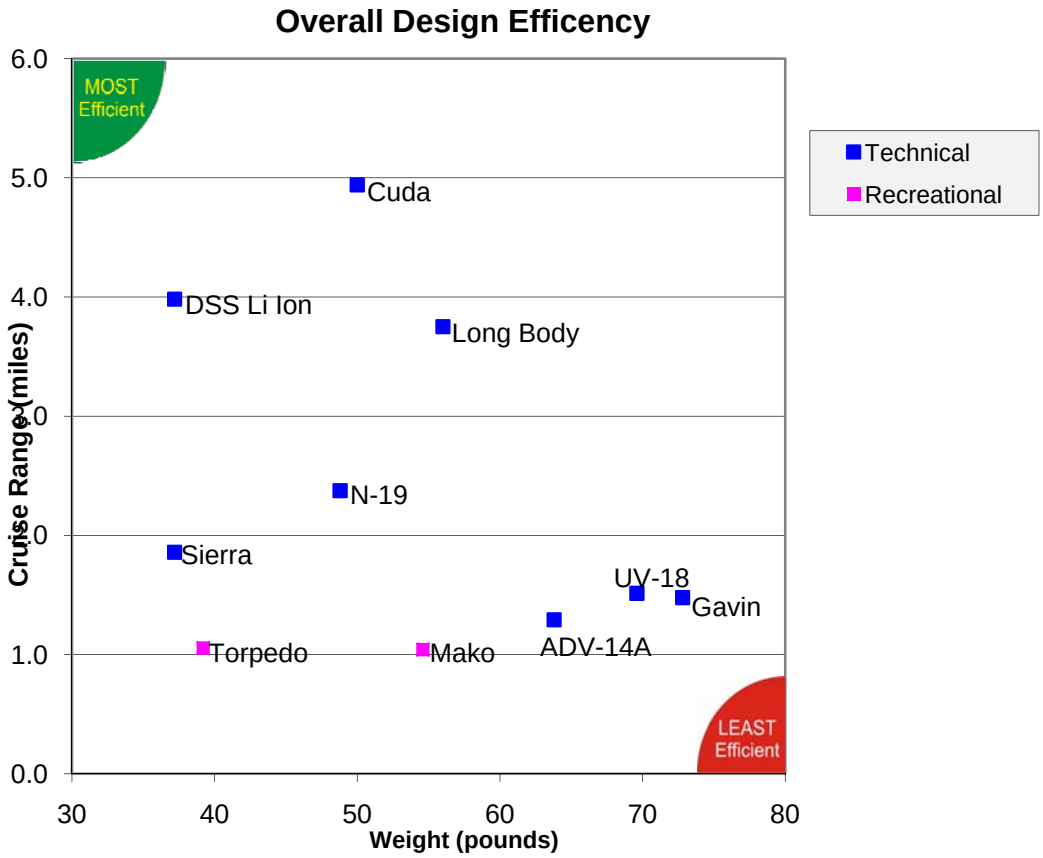


Taxi service: support diver James Novaes heads down the racetrack to retrieve a test diver during the enduro event. Photo by Janet Flenner

What's not seen in these ranges is speed. For example, the Cuda sprinted its 1.7 miles in a mere 34 minutes, while the Mako ground out 1.3 miles in 54 minutes.

Design Efficiency

So, what's the best scooter? A yardstick that emerged from the testing was Design Efficiency[7], or, how much range a scooter could extract from its weight. Sure, you can build a 10-mile scooter, but is it well-engineered if it weighs 200 lbs? Just how well did the designer use the materials given to produce power?



The surprise winner in this was the aftermarket Deep Sea Supply Li-Ion battery, powering the Dive-Xtras Sierra, a combination that has been available for 2 years. While some may debate the merits of the Li-Ion battery that made this possible, it performed admirably in our testing.

By a very thin margin, the next-closest finish was the Dive-Xtras Cuda. The Cuda uses reliable "conventional" NiMH batteries, but uses a very advanced motor and

electronics package for its efficiency. Its high finish here shows the impact of cutting-edge technology.

It's worth noting on the graph that the remaining scooters, using NiMH batteries, all are roughly equivalent in design efficiency. The old-skool Lead Acid scooters are all in the corner together, driven by their comparatively short ranges and high weights. Is this a glimpse of the future? Only time will tell.

Final Thoughts

So back to that "best scooter" question. It is all too tempting to place reliance on cold, impersonal numbers, and point to those numbers as the ultimate arbiter of what is best. One thing I learned from this testing is just how truly different each scooter is; they handle differently in the water, have different ergonomics, and are each very different in ease-of-use out of the water. These are all things that can't be quantified by numbers laid out in fpm or Watt-hours, and are well beyond the scope of this test.

Each of the four parameters measured in this test – Weight, Speed, Range, Efficiency – has its own coin. Here are some guidelines for what to place emphasis on:

- Weight: Boat diving or shore diving
- Speed: Diving in current or heavily loaded
- Range: Long dives with a rebreather or large gas supply
- Efficiency: Pick two from above

I would like to extend a personal word of gratitude *("thank you"* does not say nearly enough) to the test divers, surface support staff, and the recovery divers. Everyone worked hard, to the point of hung-head exhaustion in some cases, for no gain besides making a contribution to the diving community.

I know that I, personally, have been given a gift by being able to dive so many diverse scooters and compare them in such subtle ways. Every scooter has a strength, just as every scooter has a weakness, and it's up to the consumer to decide what is the best for their needs. Try before you buy.

Last man out of the pool: Test diver Alan Studley finishes the final test dive Saturday evening. Photo by James Flenner

Anyone think they're fast? You are all welcome to come to Lake Tahoe and give the racetrack a whirl. By the way….the time to beat is 5 minutes, 4.152 seconds for the standing quarter-mile….

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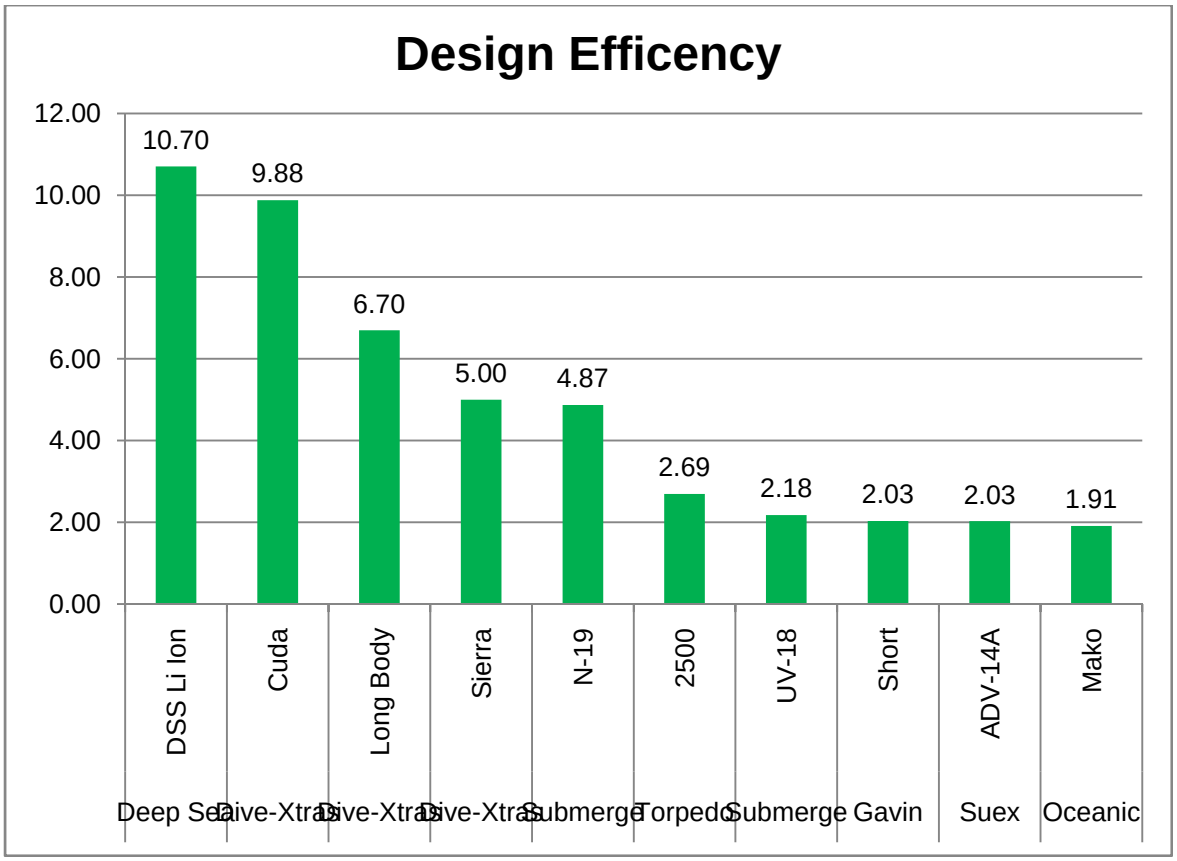
References

1. Short Body Gavin. Several email contacts were made with Mr. Irvine, and he chose not to send a manufacturer sample. There are several Short Gavins in the area, all with hot wound motors. Use of these scooters was felt could skew the data. The ultimate source of our loaned scooter was Mr. McGeever of Dive-Xtras with a 7-year-old sample. After receipt, the scooter was equipped with new batteries and tested against the specs as provided by Mr. Irvine, and although on the low side, was within spec.
2. Suex Zuexo ADV-14A. Cost was prohibitive to have a sample shipped from Italy. A Zuexo was known to be owned by Mr. McGeever, and again, was gracious enough to provide it for testing.
3. Oceanic Mako. This 6-year-old sample has been lightly used, and well maintained, by Mr. Ollom of Reno, NV. Mr. Ollom is the owner of Adventure Scuba in Reno, which provided support for this test.
4. Vic Erickson (owns a Dive-Xtras Sierra), James Flenner (owns a Dive-Xtras Sierra and CSI), and Alan Studley (owns a UV-18 and N-19, and is a dealer for Submerge)
5. Telephone conversation with David Burroughs of Hollis, 14 July 2008
6. PM via The Deco Stop from Barry Miller
7. Design Efficiency: defined as $= \frac{(Range\ in\ miles) \times 100}{(Weight\ in\ pounds)}$



8. 18 Nov 2007, Dive-X Sierra
9. Power (watts) varies as the cube of velocity. For example, doubling speed will increase Watts by 8 times. This has been shown to be experimentally true in testing at the Lake Tahoe racetrack, Oct-Nov 2007, James Flenner and Victor Erickson researchers.

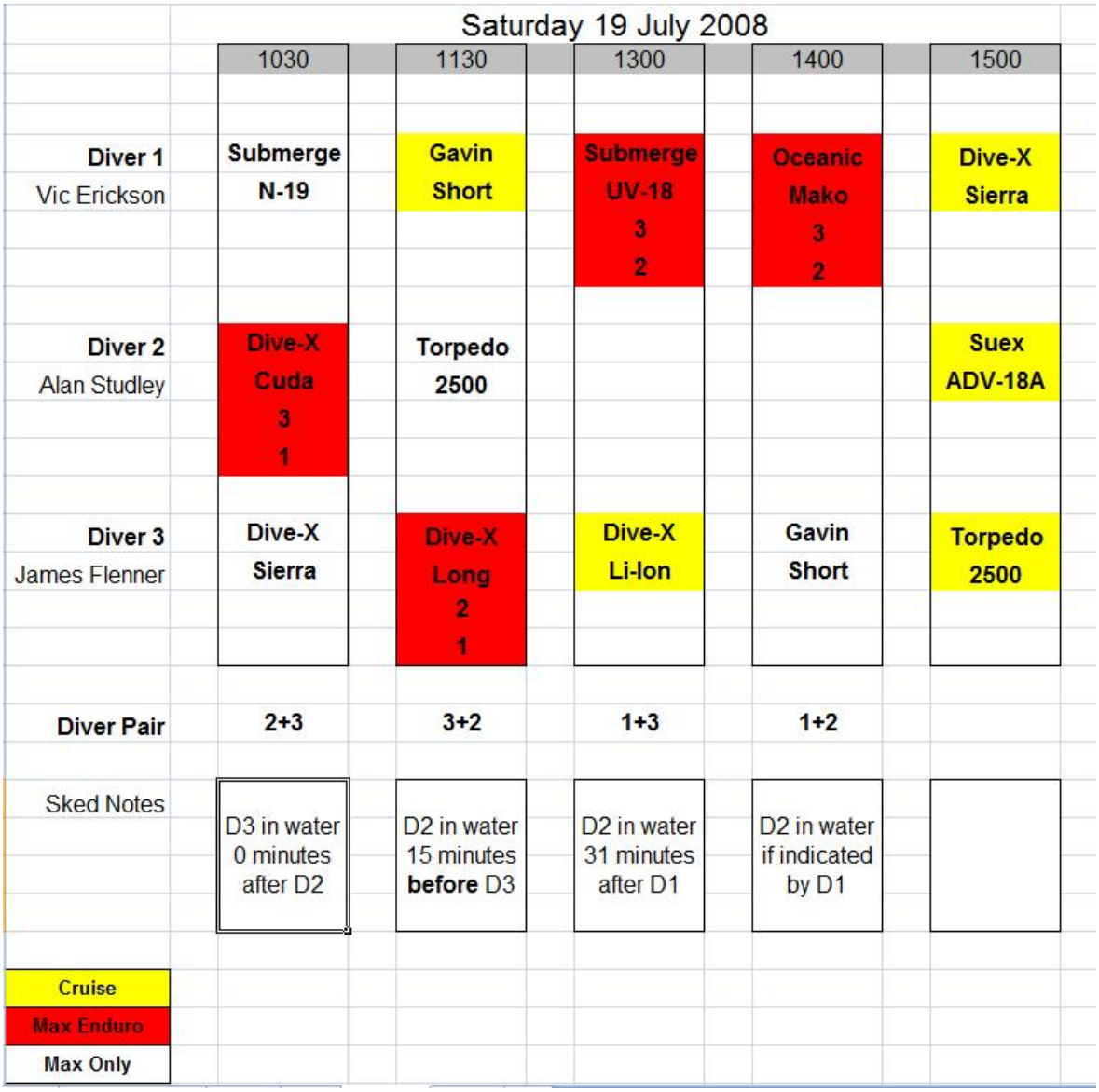
10.

	Dive-X Sierra	Dive-X Long Body	Dive-X Li-Ion	Dive-X Cuda	Suex ADV-18A	SeaDoo Explorer	Gavin Short	Submerge N-19	Submerge UV-18	Torpedo 2500	JetBoots J-DPS	Oceanic Mako
Diver 1	1	1	1	2	2	2	3	3	3	2	3	3
Vic Erickson			Diver 3			Diver 3			Diver 3			Diver 3
			Diver 2			Diver 2			Diver 2			Diver 2
Diver 2	2	2	2	3	3	3	1	1	1	3	2	2
Alan Studley	Diver 1			Diver 3			Diver 1			Diver 3		
	Diver 3			Diver 1			Diver 3			Diver 1		
Diver 3	3	3	3	1	1	4	2	2	2	4	4	1
James Flenner		Diver 2			Diver 2			Diver 2			Diver 3	
		Diver 1			Diver 1			Diver 1			Diver 3	

Cruise
Max Enduro
Max Only

The initial testing matrix. Some scooters were scheduled that never arrived.

11.



	Saturday 19 July 2008				
	1030	1130	1300	1400	1500
Diver 1 Vic Erickson	**Submerge N-19**	**Gavin Short**	**Submerge UV-18 3 2**	**Oceanic Mako 3 2**	**Dive-X Sierra**
Diver 2 Alan Studley	**Dive-X Cuda 3 1**	**Torpedo 2500**			**Suex ADV-18A**
Diver 3 James Flenner	**Dive-X Sierra**	**Dive-X Long 2 1**	**Dive-X Li-Ion**	**Gavin Short**	**Torpedo 2500**
Diver Pair	**2+3**	**3+2**	**1+3**	**1+2**	
Sked Notes	D3 in water 0 minutes after D2	D2 in water 15 minutes **before** D3	D2 in water 31 minutes after D1	D2 in water if indicated by D1	

Cruise
Max Enduro
Max Only

An example of the daily schedule.

12. Ben Mazin of JetBoots went so far as to make hotel reservations, with every intent to participate.
13. The Torpedo did not arrive until the second day of testing, forcing all data to be from a single enduro run by Test Diver Alan Studley.
14. Peer review by Tony Alba, owner of a Submerge N-19, and Dr. Harry Wong, owner of a Gavin Short and Long.