Diving Performance – Beyond Drag

Part 4 of 4

By Ron Evan Smith

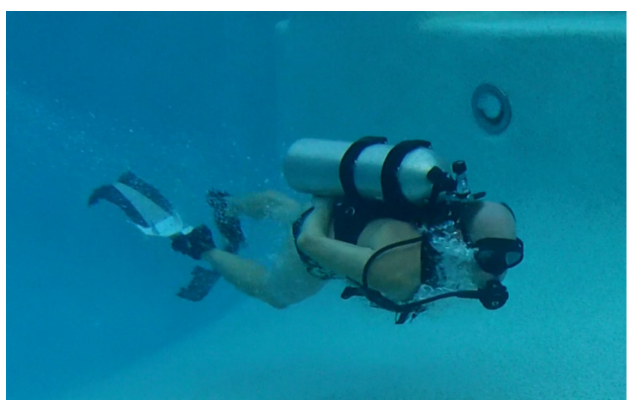
In part 1, we identified that ocean conditions are driving swimming speed requirements for divers that are well beyond the speeds that current scuba gear and diving techniques can deliver. Whereas most divers can achieve sustained speeds of about 1 knot and sprint at about 1.5 knots, the ocean conditions require speeds more along the lines of 3 knots sustained and 5 knots in a sprint. We also noted that while the deviance between required and realized swimming performance is very large, it has become normalized within the diving culture, and as a result, little has been done to rectify the situation.

In Part 2, we were able to show that it is possible for a diver to achieve a sustained cruise speed of 3 knots. We identified that this requirement can be met if we can incorporate a diving fin system that is at least 70% efficient at converting leg energy into net forward thrust and also reduce the diver's overall drag to less than 22% of the normal drag of a recreational scuba diver. Both of these things are technically possible, but it will require developing gear that streamlines the diver as well as the scuba equipment, and the completed system may look more like the fusiform shape of a cetacean than a 4 limbed person.

In part 3 we saw an example of how easy it can be to achieve some pretty impressive results without completely changing the look and feel of the traditional scuba kit. Hopefully, this experiment will inspire you to take a close look at what you can do now to improve your own swimming performance.

What You Can Do Now

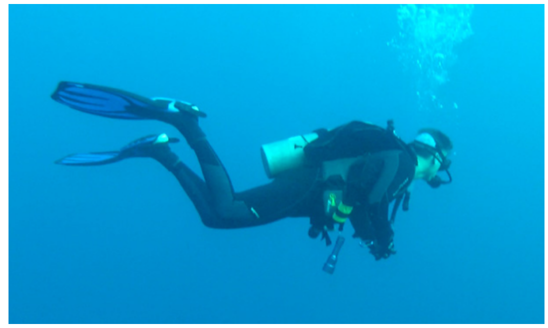
The technology to meet the 3 and 5 knot speed requirements doesn't exist for recreational sport diving. To date, no one has bothered to make it. The deviance has been normalized. However, scuba divers have the power to change this. All it requires is to denormalize the deviance. Say that it is not okay, and start demanding solutions that move in the direction of meeting the speed requirements of the oceans we want to dive in. The industry will follow the money. So, if you start buying and using swimming optimized gear, the manufacturers will follow suit and start finding ways of earning your business. They must, if they want to survive.



Good Fins and a Simple Kit Can Go a Long Way
https://youtu.be/QKuq0kHnREU

The equipment you use is important, but you can start with training and techniques. Remember that every pound of drag you can eliminate is a pound of thrust your legs don't need to generate.

- The common recommendation that you cross your arms in front of your body while diving is counterproductive to any recreational diving that involves swimming. It adds a lot of drag for no reason. If your hands are not otherwise occupied, put your hands at your side and out of the slipstream when you are swimming.
- Learn a proper kicking technique. Many divers have adopted a swimming technique that places the lower half of the leg up and near perpendicular to the swimming direction. This technique is useful for using fins with poor thrust efficiency in silting conditions as it gets the off-axis waste momentum from the fin's stroke away from the silt resting on the bottom. Efficient fins will necessarily have very little off-axis waste momentum which makes silting with them much less of an issue. If you are swimming in open water and are using efficient fins, this strange swimming technique has no benefit and kills swimming efficiency. Your legs should be straight, and there should be only limited knee bending allowed in the kick cycle. The kick amplitude should be relatively small. Large kick amplitudes will break your body's streamline position and create increased in drag.



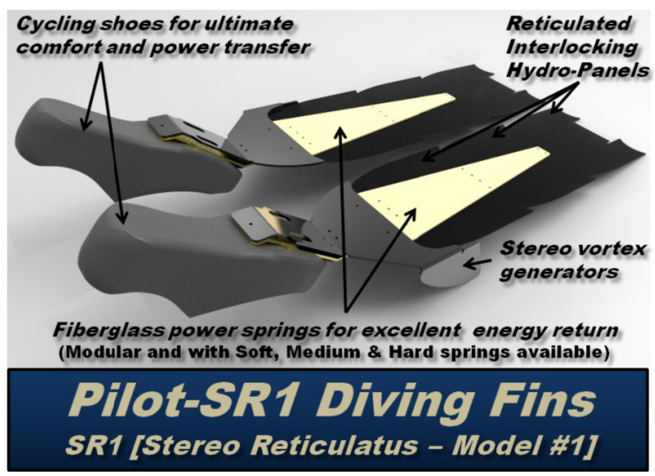
- Learn to weight yourself properly for both weight and trim. Poor weight management is one of the most common sources of unnecessary diver drag. If your feet are too heavy and pulling you out of trim, your drag profile will be increased. You may need to use a neck weight to get your trim right. Note the diver in the picture below. Her trim is off causing her to swim with her feet hanging low. Low hanging feet cause the thrust from the fins to be directed down, which will cause her to rise unless she also carries extra weight to counteract the lift. Thrust directed down can also cause silting problems in certain conditions. Too much weight overall will require inflating your BC, and an inflated BC creates more drag than an empty one. If you are not wearing more than 3 mm of neoprene, you probably don't even need a BC. One of the most bulletproof ways to learn proper weighting is to dive minimalist with no BC. This will force you to learn how to get your weight right. If you try it, you may find you really like it. I do!

Equipment Considerations:

- Instead of spending $500 on a jacket BC or a spiky “Tech” looking BC, consider diving with a basic single tank backplate, or harness. They are cheap and streamlined. Favor backplate designs that are low profile and keep the tank close to your body for reduced drag. If a BC is needed, you can still add a small narrow profile wing BC for those dives that require it. Also consider if buddy breathing is okay for your style of diving. You can potentially eliminate the octopus regulator and the BC inflator hose and the BC, along with all the drag they produce. More is not necessarily better when it comes to diving equipment. Shown here is an example of a DiveRite harness with a nice low-drag hose arrangement. The harness’s D-rings are counterproductive to streamlining, but the harness itself is a good design. This setup uses a 48” hose to the second stage. Notice how all the hoses extend down from the first stage and hug the body to keep them in the flows boundary layer. This is a good hydrodynamic hose arrangement.

Good Hose Arrangement with 48” 2nd Stage

- Consider putting that $500 normally spent on a BC toward a good pair of fiberglass long blade fins with the right stiffness to match your leg strength. Good fins are not a one size fits all solution and you will need to do a little research to figure out what will work best for you. Just because a fin feels more powerful, that doesn’t mean that it is more powerful. I made my Pilot-SR1 fins with three different blade stiffnesses to accommodate divers with different leg strengths. The stiffest fin feels more powerful to me than the medium stiffness. However, pool testing has confirmed that I am actually faster with the medium stiffness because I can kick it more rapidly. It is a better match for my leg strength. It also feels better to me when I’m swimming slowly. A dive buddy of mine prefers the hard fin blade. He is a cyclist and he has stronger legs. Against the stiffer fin blade, he can kick more effectively than me.
    - Swim by with Pilot-SR1 prototypes: https://youtu.be/bfCcEuCwnbQ
    - Pilot-SR1 prototype fins with standard scuba equipment: https://youtu.be/QKuq0kHnREU



- Use low profile gauges and keep them close to your body. I like using a wrist mount dive computer and a mini tank pressure gauge on a high pressure line that I keep tucked into my tank harness when I’m not looking at it.

- Dive wet. Wetsuits have much less drag than a drysuit, and they are also much cheaper (usually about 1/3 to 1/4 the cost). If you need a good warm suit, I recommend using a freediving two piece suit with a built in hood, and that has open cell neoprene against the skin. You will need to use a suit lubricant to put the suit on, but that makes it really easy to put on even if the suit is still wet from a previous dive. This style of suit design is very comfortable and very warm with basically no water transfer making it about equivalent to a basic neoprene drysuit for warmth. There are no zippers in this design to leak cold water into the suit when you move. I can dive my wetsuit for hours and still have suit lube inside the suit at the end of the dive; there is that little water transfer. (FYI: Suit lube is just hair conditioner mixed with water)
- If you must dive dry, consider using a drysuit with a stretch fit over-layer like the Fusion One, or a neoprene drysuit. To get the best swimming performance, avoid baggy dry suits like tri-lams that form a lot of creases and wrinkles unless there is a good reason that your diving requires that type of material.

If you want to do better than can be achieved with currently available gear and want to support efforts to either bring some of the technology to market from my experiment shown in part 3 of this series, or to develop gear that will make a real effort of getting that speed capability of a 3 knot cruise and a 5 knot sprint, please contact me and let me know. If there is enough interest, we can crowdfund hardware development ourselves and not rely on the likes of Aqualung, Scuba Pro, or Mares to make what we need. Sometimes, these things are better when developed by independent divers rather than large corporations anyway, and I have already shown that I can develop designs that will work. The only missing ingredient at this point is commitment.

Conclusion

In the early days, rebreathers killed a lot of their users, or maybe it is more appropriate to say that many divers managed to kill themselves with their rebreathers. While today's rebreathers are significantly safer than the early systems, rebreather diving is still generally considered to be about 10 times more dangerous than open circuit diving for conducting recreational dives. While they have a lot of performance capabilities beyond that of open circuit scuba, those capabilities come with costs, both technically and logistically. Due to the costs and complexities of rebreathers, most divers will never use them or benefit from the performance advantages a rebreather can bring to their diving.

However, basic hardware changes and some simple technique changes to recreational open circuit scuba diving can also result in a significant advancement in diving performance. These performance advantages may be experienced by just about any recreational scuba diver and can make dives more fun, relaxing and safe. There is little reason for not making such changes the new normal in recreational scuba diving.

Building scuba equipment that will make scuba divers true nektons, capable of navigating the oceans currents is also within the realm of possible. We should be striving to make these technologies a reality. A sustained cruising speed of 3 knots and sprint speeds of 5 knots is possible and within reach. To achieve this, we must be open to some new ideas and concepts that will be very different from the equipment we are accustomed to seeing. Think about what it would be like to cruise at three knots, speeds that are faster than the fastest DPV tested in the last Tahoe Benchmark. Think about easily cruising at 3 knots with no noise, no batteries and no heavy DPV either. This technology could make it easy to keep up with whale sharks, cetaceans and other nektons of the open ocean, such that we can actually swim with them for extended periods of time. The idea is simple elegance, and the changes will be disruptive to the way scuba dives are conducted and what dives are even possible to attempt.

I hope I have gotten you to think about diving differently from the way you thought about it before reading this series. I see a large disconnect between requirements for swimming performance and what has become accepted performance, and I hope that you can see that disconnect as well. These problems are solvable. Contact me if my experimental hardware is something you may want to support, or if you may be interested in supporting a crowdfunding campaign to develop equipment to attempt to reach a 3 knot cruising speed.

About The Author: Ron Evan Smith

Ron is the CEO and Chief Engineer at Smith Aerospace Corp. where he designs, developes and markets hydrofoil based monofins for freediving and scuba diving applications. He holds an Aeronautical & Astronautical Engineering degree from the University of Washington (B.S. 1995).

Ron is an award winning aerospace engineer and inventor with more than a decade of professional experience, specializing in fluid dynamics, control systems design, simulation development and system performance prediction.

Ron forged a passion for freediving at a young age that has only intensified over the years. He has been a certified diver for over 20 years and holds several advanced diving certificates through IANTD.