Decompression Safety for Recreational Divers

But I can't be bent

— My computer says I did everything right

BENJAMIN MARTINEZ

Text by Steve Lewis, with thanks to Neal W. Pollock, Ph.D., Research Director, Divers Alert Network
Photos by Andrey Bizyukin and Benjamin Martinez

One might be forgiven for assuming that as a certified diver, one would understand the science and common-sense behind the basic guidelines governing our approach to decompression stress. After all, a good part of a diver's initial training (and, hopefully, much of the curriculum for more complex programs), explained the vagaries of breathing compressed gas underwater. However, there seems to be a huge gap between the average diver's approach to decompression stress, and that approach in a "perfect world".

The issue with diving—at least for this discussion—is that as a diver descends in the water column, he or she has no option but to breathe compressed gas. Because of this, the inert gas contained in whatever is being breathed is stored in the diver's body. This is sometimes called inert gas uptake.

At the end of a dive, on the way back to the surface, the process is reversed, the stored inert gas is released by the diver's body. This is called inert gas elimination, or more simply, decompression. These two processes are part of every dive—even seemingly benign sport dives to shallow depths for short periods of time. Every dive really is a decompression dive.

When diving, tracking and understanding how to best manage inert gas uptake and decompression within safe limits, is second only to making sure one has something other than water to breathe. If we "get it wrong" and remain at depth too long, ascend too rapidly, breathe the wrong gas, or simply have a bad-luck day, we run a higher than usual risk of suffering decompression sickness (DCS). Getting *bent*, the colloquial term for DCS, is a collection of disorders caused by a portion of the inert gas stored in a diver's body bubbling out of solution too rapidly. The consequences of being bent run the gamut from nausea, fatigue, mild joint pain and dizziness all the way through paralysis and death.

The uptake/elimination cycle is complex and quirky. For example, it's believed the speed of inert gas uptake is different (faster) than the speed of inert gas elimination; but this is theory rather than proven fact.

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authority that because of its complexity and variability, DCS is the bête noire of divers and diving. It certainly scares the bejesus out of me, and many of the men and women who are my dive buddies.

In the vast majority of recreational dives, the inert gas in question is nitrogen, but when a second inert gas is introduced into the breathing mix—helium for example—a whole new array of complications is unleased. Diving with two breathing gases—oxygen and nitrogen—presents us decompression challenges: diving with three magnifies the challenge considerably.

Dive computers

An ally in the fight for information about and a better understanding of gas uptake and elimination is the dive computer.

Personal dive computers (PDCs) have evolved astonishingly rapidly in the past 20 years. The current generation does a very good job of tracking the mathematical prediction of inert gas uptake and elimination even when the person wearing the device is diving deep, for long periods of time, and breathing multiple flavors of gas. However, a PDC offers no iron-clad safe-guard that its user will not suffer a DCS episode.

Not only are uptake and elimination most likely to NOT be lineal mirror-images of each other, several other variables are thought to play important roles in the uptake/elimination processes as well. I used the phrase, "are thought to play important roles", because the variables—the bio-physical processes at play within a diver's body—are complex and not completely understood.

In a word, the factors governing decompression safety are effectively capricious. We might say with some

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Accepting the ever-present risk of DCS and understanding the erratic character of this risk, is a pre-requisite of becoming a responsible and informed diver, regardless of whether your dives take you to 10 metres or 100 metres, or last for 20 minutes or 200.

A personal dive computer—like any computer, big or small—is very good at crunching numbers. It excels at calculating gas uptake based on depth, time and breathing mix; and, with the help of a decompression algorithm, showing users how fast or slow to ascend, where to stop in the water column, and for how long. However, this is all theoretical. Decompression theory is just that; and a decompression algorithm is simply a mathematical model that postulates what happens to in a diver's body when he or she is diving. That's right, deco theory is woven throughout with guesswork: some of it informed, some not so much so.

The shortcoming of any decompression algorithm and therefore of any dive computer is that the relevance of its calculations to you and me are limited because it cannot adequately account for the numerous biophysical variables particular to us as individual divers. You and I may be similar perhaps, but certainly we are not the same. We can wear the same brand and model of PDC and dive very similar profiles breathing the same flavor of nitrox (or trimix), but the two of us will most certainly on-gas and off-gas at different speeds and with different levels of efficiency. And those differences will vary from day-to-day, dive-to-dive.

As a direct result of this, you and I could well go diving together tomorrow morning and one of us might get bent while the other is completely free of any signs or symptoms.

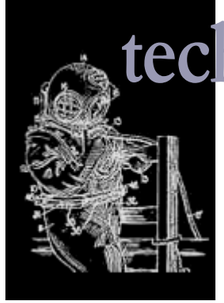
Adding yet another complication is that there are simply dozens of dive computers on the market and several substantially different decompression algorithms at their core. Indeed, some models of PDC are capable of running more than one algorithm, and often those running the same algorithm interpret its suggestions for gas uptake and elimination differently. This makes it close to impossible to give useful suggestions detailing the pros of each and how to work around the cons. Nevertheless, there are a few recommendations that apply to PDC use generally.

Do's and don'ts

1. Read the user's manual. Have the computer beside you as you do so. Get to know what your new tool is capable of and how to activate any bells and whistles it may be fitted with. Learn what button does what and how to access the type of information that is going to help you stay safe on your dive. Absolutely have as an end goal of your "getting to know you" session, understanding what algorithm your computer uses, how to adjust its conservatism factors, and the potential effects of more or less conservatism on you and your health.

2. Use it according to the guidelines in the user manual and whatever common-sense you have been gifted with. In attempts to reset their PDC because of a recent transgression (usually something that came close to getting the user bent), I have witnessed divers pulling out batteries, hanging computers in the water "to decompress," and even leaving their PDC on the boat for a dive to "cool off." None of this is a good idea. Seriously.

3. All late generation dive computers deliver warnings when their users mis-



behave. These take the form of audible alarms (bells and buzzers) or visual warnings flashing colors, changing colors on output screens, symbols or messages. Some combine both visual and audible warnings. However yours is designed to deliver cautions to the diver, take note of what it "says" and modify your behavior accordingly.

I once shared a decompression station and an annoyingly long stop with someone whose PDC chirped ceaselessly at him (and anyone else within earshot). He had NOT read the user's manual before the dive, and therefore was unable to switch it to make adjustments to the ascent schedule for any of the three decompression gases being used on the dive. While the whole dive team was hanging out at six metres or so, his computer wanted him to return to 30 metres and start a whole new decompression schedule.

4. Understand that a PDC, even one with a four figure price tag, is not a panacea. At most, and following the best possible scenario, all a dive computer can supply its user with is an approximate guide to their decompression status, and a rough guess at their proximity to decompression stress.

What the experts say

Paraphrasing Dr Neal Pollock, Research Director at Divers Alert Network and a researcher at the Center for Hyperbaric Medicine and Environmental Physiology at Duke University Medical Center, a computer, even when used correctly, provides no more than superficial protection from DCS—just the very first-level of information. We need to dig a little deeper into what affects decompression, and understand a little more about our PDC than when to change its battery if we want to mitigate the risks of decompression sickness.

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Essentially, Pollock's research underscores the difficulty of producing a "magic silver bullet" capable of protecting us completely from DCS. He also suggests that often divers who suffer DCS look for some way to shift blame.

They tell us their incident was "unearned." "Hey, I did everything right... exactly the same as many times before." They express surprise that their computer did not warn them they were on a collision course with a chamber ride.

In fact, one often hears a diver express confusion because their dive computer did not get bent and they did. Dive computers are not magic and are incapable of making allowances for every one of the factors Pollock identifies as influencing factors in decom-

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pression stress.

He says if we fail to recognize errors in our own behavior, our pre-dive preparations, or the influence of our personal makeup and fitness to dive, "and we refuse to take personal responsibility," the learning process breaks down. In essence, he is saying that it's not our computers that are wrong, it's us.

Pollock explains that many of us focus on only a small part of the overall picture regarding decompression safety. He uses the example of hydration. Divers routinely blame poor hydration for causing their DCS, but few have a realistic handle on what constitutes good hydration, and fewer yet on the many other factors that contribute to deco stress.

"Proper hydration MAY play a role in decompression safety, but throwing back a half-litre of water immediately before diving does nothing except make you pee," he explains. "The "hydration" goes right through without any appreciable effect."

So where does this leave you and me?

It's not our computers that are wrong, it's us.

If your diving exposures are mild, you are certified to use and indeed use the appropriate nitrox for your dives, you behave responsibly and cautiously, and follow the best practices suggested by organizations such as DAN, the chances are good you will never experience DCS.

If your diving is a touch more radical, and you routinely conduct staged decompression dives, the advice is to dive especially conservatively. Research and understand all the many factors that may have an impact on your safety, and plan accordingly.

Most of all, take responsibility for your actions and don't make a challenge out of who can get out of the water fastest. Better to enjoy a slightly delayed post-dive beverage with your mates than spend hours in the chamber wondering why it is you're bent but your computer isn't. □

Author's note: Tremendous thanks to Dr Neal Pollock for his research, without which we would all be floundering around in the dark, and for his help putting together this short treatment on the subject of decompression safety. This piece first appeared in slightly different form on the Techdivertraining blog.

Steve Lewis is a British diver, instructor, dive industry consultant and author based in Canada. He teaches and lectures at home and abroad. His main focus is to dive safety and to make each of us aware of the things that will make us better divers than we are now. His latest book, Staying Alive: Risk Management Techniques for Advanced Scuba Diving, *is available through Amazon. For more information, visit* ***www.techdivertraining.org*** *or* ***www.ccrcave.training****.*