

# Rebreathers



Text & photos  
by Peter Symes

*What is it like?*

# Diving Rebreathers

*Why bother?*

Rebreathers look cool, glitzy, technical and heralded as the future of diving, right? We read a lot about their impressive performances concerning duration of dives, gas economy, extended no deco limits and what not. But isn't it a bit like watching Jeremy Clarkson from BBC's car program, *Top Gear*, whiz around in fancy Ferraris and Aston Martins with a goofy, happy grin on his face and reeling off a string of excited superlatives? Yes, they look fabulous and sound fabulous, but you're still not sure what all the fuss is all about and what's in it for you... and whether you could actually afford one.

Rebreathers aren't exactly an impulse buy, but they don't quite require the same deep pockets as a super car. So, you could actually own one if you put your mind and piggy bank pennies into it.

They do come with the same sort of built-in bragging rights and can still gather a crowd on a beach. However, the glitz factor shouldn't be the only reason for getting one—there are easier routes to impressing members of the opposite sex.

### Diving experience

The reason to go with a rebreather should be their performance in the water, and that

they provide for a much different and richer diving experience, which, in the first place, is why we go in the water ourselves rather than watching dive movies on *Animal Planet* from the comfort of our reclining chair at home. However, as we all know, there is no such thing as a free lunch in diving either. There is a trade-off, and you will have to consider if it is still worth your while despite this.

It is not merely a matter of comparing technical matters, performance and parameters when pitting rebreathers against the open circuits (regulators and tanks). It is easy to be blinded by dazzling numbers and facts on how much longer you can stay under water with no deco-obligation and so on, but consideration should also be given to the sensation and experience of diving rebreathers.

I think these subjective matters have been grossly overlooked in textbooks and articles. Yet, how can we put words to them?

### Why?

Wine connoisseurs have a whole weird vocabulary to describe all the flavours of wines, but describing diving the rebreather experience to an open circuit diver still feels somewhat like trying to describe a sunset to a blind person: "It's... *erh...* just really cool and... *uhm...*"

Any piece of equipment is just a means to an end and not the end itself. It is a means of transporting you down into



Dräger Ray semiclosed rebreather. Behind, an open Inspiration fully closed rebreather

the underwater realm so you can have an enriching experience by witnessing, first hand, this magic realm. So, as far as I am concerned, if someone invented human gills and a thin hide to cover and keep me warm, my twin-set would surely be left to rust in the attic for good.

I just want to see fish and other underwater life. I want to get as close as possible without disturbing the creatures, and for me, this is exactly



Black goby, Baltic sea

Aaah! Silence at last—and the *Unbearable Lightness of Being* starts to sink in







Up close and personal. This squirrelfish almost sat on my mask

what all the fuss and hype is about with these gizmos.

I am a photographer, so aside from the better personal experience, I can also get better pictures when I don't blow or scare all the critters away.

For me, the longer no-deco times that these units give me are great but not a prime concern.

Although, I have on more than one occasion, appreciated the fact that I could just stay down there at depth to get my shot far longer than an open system would have permitted me.

Other CCR divers may have other uses and other subjective reasons for liking their units. For instance, rebreathers have also become quite popular among some wreck enthusiasts, technical divers and cave divers.

### Hearing

Another major reason why I have a richer diving experience on my rebreather is that I can hear better—and so, can more keenly sense what is going on around me, even when I do see it directly. I have a much more acute sense of the three dimensional space around me and what is in it. But let me get back to that later.

On a rebreather, I often get the sense that I can hear what is going on behind me

### Comparison

Let's go on a dive and compare how open and closed circuits perform. In the following, I will use a fully closed system for comparison rather than the more widespread and more economically accessible semi-closed system since the fully closed systems are the thoroughbred of rebreathers, and because I am better acquainted with this type of system.

Before we even get to the water, there is the matter of transportation. If you are going to the beach in your own van, there is not much difference in hassle when it comes to transporting a scuba set with tanks and regulators or a rebreather.

But if you have to travel by air, we are talking about a completely different ball game. Going by plane, the open circuit diver can bring along his or her regulator and BCD, or the diver can opt to hire everything at the destination. The diver doesn't have to worry about carrying tanks either, so there is not too much excess baggage.

Rebreathers are different story.

### The check-in challenge

It isn't quite the same for the poor rebreather diver who might have to schlep quite a bit more hardware onto the plane. It is not an issue to be taken lightly these days when airlines are less and less tolerant of passengers who do not head weight limits and bring along overweight bags.

The rebreather diver must rely on the destination dive centre to fill his or her oxygen tank, and if the diver is lucky, the dive centre can also supply CO<sub>2</sub>-scrubber and rental tanks. If not, well... let's hope that overweight charges aren't an issue for you.

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### Rebreather-friendly dive centres & locations

Do check the list of so-called rebreather-friendly dive centres before you go. It could save you quite some hassle and money. You can find these dive centres on various lists, ie. online bulletin boards and web sites. For example, you could use this one at the Ambient Pressure web site: [www.ambientpressurediving.com/ccrbint.htm](http://www.ambientpressurediving.com/ccrbint.htm)

So far, it seems that open circuit systems lead closed circuit systems 4-0 in the why-bother score due to the hassle factor.

### Before the dive

OK, we are now at the waterfront with all our gear spread out, rigging up. Mr. Open Circuit mounts his BCD on a tank, regulator on top, opens the air and he is ready to dive in a minute or so, save the odd popping o-ring experience. No complications here.

Ms. Re Breather, on the other hand, has a lot more equipment assembly to do, some testing on top of this, and then some "pre-flight procedures" to undertake.

After assembling the unit, we first have to do a *negative pressure test*, where we, under eye-popping strain, suck all the air out of the unit, close the mouthpiece and watch it to see whether the counter-lungs remain deflated and squashed like vacuum-packed coffee.

After that, we then do a *positive pressure test* where we inflate the unit fully and make it look like an over-blown tire to see if it holds pressure



and remains stretched like a drum-skin. If not, we have to go over all the seals and joints once more.

The open system now leads the score 5-0.

Next, comes the fire-up sequence where the rebreather diver stares very intently upon the unit's handsets (the controllers). *Do not distract her at this time!*

The electronics on the handset are taking the diver through a "pre-flight" sequence of actions and tests, and she must respond to these accurately and observe closely that the rebreather responds correctly. By *pre-breathing* the unit, the diver makes sure that it operates properly before entering the water.

During the start-up sequence, the breathing loop is filled with 100% oxygen to calibrate the sensors, so we have to







Weight can become a real issue when travelling with your rebreather. If possible, sort it out beforehand. Sometimes you can negotiate a fair price on overweight before you go - or buy some extra allowance.

observe that the oxygen partial pressure drops down from 1 bar to stabilise at 0.70 bar partial pressure, which we have chosen as our *low set point*.

This is the oxygen level with which we start the dive. Any wrong or erratic behaviour of the oxygen sensors will show in the readings or produce an outright error-message, of which you must strive to find the cause and correct before you can dive.

Finally, we can hit the water. Upon entry, or slightly into the descent, it may be our habit to clean our masks. We let

a little water into our masks, and then clear it by an exhalation through the nose. On open systems, this is just something you do, and many divers exhale through their nose on a regular basis. On a rebreather, this is a big no-no, as it means venting precious gas out into the environment.

On rebreathers, you clear masks very carefully and sometimes in a cross-eyed manner as you try to watch exactly how much air is required to just push that last drop of water out of the mask without losing any air.

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As you descend, the increasing ambient water pressure also starts to squash your counterlungs flat. They have about the same volume as a BCD, but need a constant volume in order for you to have something to inhale.

Unless you add some more air (or *diluent*, which can also be some other breathable gas) on your way down—either by manual injection where you do a series of small bursts, not unlike what you do with your drysuit, or by the means of an ADV (Automatic Diluent Valve)—you will soon enough find yourself sucking very hard for no air... not so comfortable, so you only do that once.

Some 5-6 meters down, or if you are at the bottom of a somewhat shallow coral reef, you pause and look up for the tell-tale streams of bubbles that might indicate a leak. You can also ask your buddy to look around for you.

If everything's fine, you may proceed and switch to the higher set point, where your oxygen level is kept at 1.3 bar partial pressure. Only below 3 meters at which time the ambient pres-



The Megalodon is another popular CCR-rebreather on the US market



Prism CCR from Steam Machines as it was presented at DEMA 2003

The ADV (Automatic Diluent Valve) on a Inspiration CCR, makes sure that more air gets automatically added into the breathing loop upon descent



Hovering becomes a delicate skill when diving rebreathers. You need to be far more accurate in regards to how much air you have in your wing or drysuit. But once you get it right, you will lie completely still—even while breathing in and out



A couple of worthwhile rebreather resources:

[www.therebreathersite.nl](http://www.therebreathersite.nl)  
[www.rebreatherworld.com](http://www.rebreatherworld.com)

Some manufacturers:  
[www.steammachines.com](http://www.steammachines.com)  
[www.customrebreathers.com](http://www.customrebreathers.com)  
[www.ambientpressurediving.com](http://www.ambientpressurediving.com)  
[www.ccrb.co.uk](http://www.ccrb.co.uk)

(Above list is not exhaustive)

STEFAN BESIER, WITH PERMISSION FROM STEAM MACHINES



sure is at least 1.3 bar, can the system maintain a 1.3 bar partial pressure of oxygen, hence, the need for a lower set point at the surface. (On newer rebreathers, like the Evolution, this set point switching can be set on automatic.)

It is, after all, this bother that permits the rebreather to flourish and deliver its promises. This is where it picks up on all the points leading to an enhanced diving experience.

First of all, there is this amazing tranquility—you can't hear a sound except, maybe, noises from your buddy's equipment. And this is what I treasure most on the rebreather: you regain the practical use and sense of hearing. You are not cocooned any more in cascades of bubbles and heaving, wheezing, whining valves.

You'd be amazed how much noise open circuits actually make, but it is hard to fully appreciate this before you try and experience the alternative yourself.

I haven't seen this change of noise

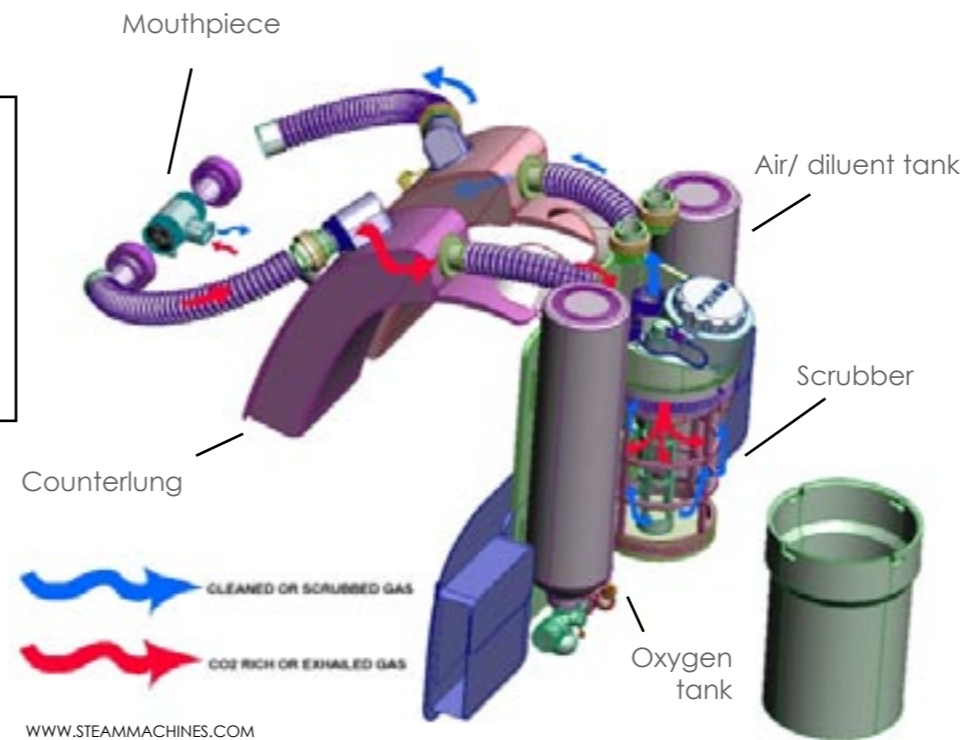
level given much mention in various text books. This feature allows you, all of sudden, to hear or sense what goes on behind you. It provides you with a 360° awareness that is not so unlike what you have on land. On land, you can usually hear when somebody enters an area you occupy even if you are reading a book and facing another direction.

## Buoyancy issues

Continuing on our journey, we swim, down a slope. As I sink, I compensate for lost buoyancy with squirts of air into my wing, and then, to halt my descent completely, I take the traditional deep inhalation, which would, if I were on an open circuit, have halted me just above the bottom. Not so on a rebreather.

This time, I most ignominiously plough straight into the muddy bottom flat on my face. The reason? My lungs and the counterlungs on the rebreather maintain a constant total volume, so when I inhale, I just empty the counterlungs with

Flow-diagram and main components of a Prism Topaz CCR-regulator. The diver's lungs and the CCR's counterlungs, scrubber and hoses has a constant total volume



no effect on overall volume and buoyancy.

Boy, does it make you feel stupid when you bite the dust this way.

Buoyancy on a rebreather is a more delicate thing. Because you can't use your lungs to fine tune your hovering, nor will your breathing disturb your position, you won't bob up and down with each breathing cycle, which is really great once you have nailed it and want to lie completely still with a pygmy seahorse in the cross hairs of your camera viewfinder.

For the very same reason, a rebreather diver will prefer to swim *around* an object rather than over or under it. Ascending means venting gas, which you lose for good.

At depth, I have several other advantages over my open circuit buddy: I won't run out of gas any time soon.

My on board gas supply will last me 10-12 hours, although the CO<sub>2</sub>-scrubber shouldn't be used more than 3 hours. And with lots of non-deco time to go around at medium depths, it also gives me peace of mind and no stress.

It is the Zen of diving. Should a school of hammerheads parade by 45 minutes into the dive when my buddy's open circuit system would be down to 40 bar,

I can still just hang around to make the most of my roll of film.

But unlike my open system buddy, I do have to watch my handsets, my controllers, at regular intervals to make sure that I am still getting the right Nitrox blends. On a closed circuit rebreather, I always have to know which gas mix I am breathing and that it can sustain life at a given depth.

On open systems, once you have the regulator in your mouth, you only have to breathe it and you are set. Not necessarily so on a (CCR) rebreather, which is a mobile nitrox mixing unit. As such—if anything goes awry, God forbid—it can serve you a gas mix too lean or too rich in oxygen for your own good.

Too little oxygen leads to hypoxia, and you will faint. Too much, and you run the gauntlet of oxygen toxicity, which brings along with it uncontrollable cramps. In either case, drowning is imminent. This is why knowing at any given time what you are breathing is one of the golden rules of CCR-diving.

If I am ever in doubt, I may first perform a strangely looking exercise called a "diluent flush", where I flush

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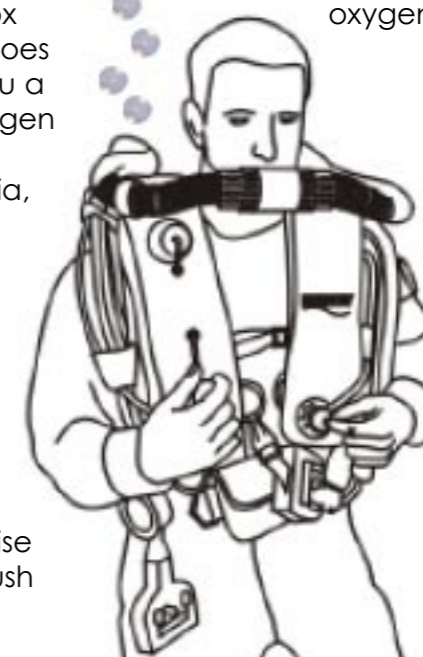
the whole breathing loop with air from my air (diluent) tank. With one hand, I keep pressing the inflator button down injecting air, while I pull the cord to keep open the over-pressure valve that is venting air. I do this for say, 10-15 seconds, after which the entire atmosphere in the breathing loop should be exchanged with air, which I know I can always breathe. Needless to say, this procedure is quite wasteful of your relatively small gas supplies.

If I am still in doubt for some reason, the golden rule is to "bail out". That means switching to open systems, which is either a regulator connected to the rebreather's air (diluent) tank, or a completely separate system, ie. stage tanks.

If I switch, it is paramount that I remember to close the mouthpiece, otherwise water will enter the breathing loop and replace the air resulting in a very considerable loss of buoyancy.

So, what should you know and be able to do? What should your buddy, on an open system, be able to do to assist you in case you run into trouble?

A CCR rebreather diver can become unwell for all the same reasons that an open circuit diver can, plus a couple more things can happen including hypoxia, hyperoxia and hypercapnia. (too little oxygen, too much oxygen and too much CO<sub>2</sub>).



Diluent flush manoeuvre. Illustration adapted from Inspiration manual (Ambient Pressure Diving) Simultaneously pressing the diluent feeder and pulling the over-pressure valve chord allows air (diluent) to replace what-ever gas was in the breathing loop before

"Artist's impression" of the 360° awareness sensation







This little green knob is the valve to the O<sub>2</sub>-tank. Buddies should know how to check and open it

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maintenance and cleaning of the unit. Rebreathers need to be disinfected at regular intervals because the unit has recycled air that has been in and out of your lungs numerous times.

### The verdict?

It seems that you will have to endure a bit more bother and complexity when diving rebreathers. Which brings us back to the main question: Is it worth it?

Yes, it is. Rebreathers are certainly not for everyone. The ease and uncomplicated aspects of the open systems will still make open circuits a better option for many as well as a certainly more economical and accessible one, ie. when you bring your family along on a trip.

But for those who are willing to go those extra nine yards to fully appreciate what it is like being down there soundless, bubble-free, the way nature intended, the rebreather is the thing that will get you hooked for good. (Don't say I didn't warn you)

I have already mentioned the soothing silence, but the ability to be in the water and have a sense that you are truly part of the environment rather than being the noisy intruder, is the priceless part. The wildlife acts differently—your presence is somewhat accepted. I wouldn't go so far as to say that marine life acts indifferently, but the rebreather certainly lets you get far closer, and the critter behaviour seems far more natural and less apprehensive.

I have had blennies sitting right on my mask. This is the closest I have gotten to feeling like a human fish. It gives you the same sort of Zen experience as when you freedive, yet it gives you the time duration of open systems and then some.

### Footing the bill

OK, now we come to the serious question: What is this going to cost me?

The Semi-closed rebreather Dräger Ray comes—at the time of this writing—at a suggested retail price of around US\$ 2,000, making it just a little bit more expensive than a complete scuba set for open circuit diving, that is, regulator, BCD and tanks.

The fully closed rebreathers are more expensive and will, as a rough guide, come in the US\$ 5,000-10,000 range for the most popular consumer models. This is, admittedly, not exactly pocket change for the average blue collar worker, but not totally out of reach either, if you really want one.

It all comes down to a matter of priorities. Do you want to have the kitchen refurbished, or one of these great machines? Well, that is a matter for you and your partner to sort out. Safe diving! ■

The Ourosboro rebreather by Kevin Gurr is one of the newest CCRs on the market. See the New Equipment section for more information



## Deep Down the Navy Divers want the Best Do you?



Master Jacket w/ Air II Single Tank and Basic Valve



RAK18/S600



Smart Com



After a year of intense research the Royal Danish Navy decided what suits them best

