ISE Oxygen Rebreather

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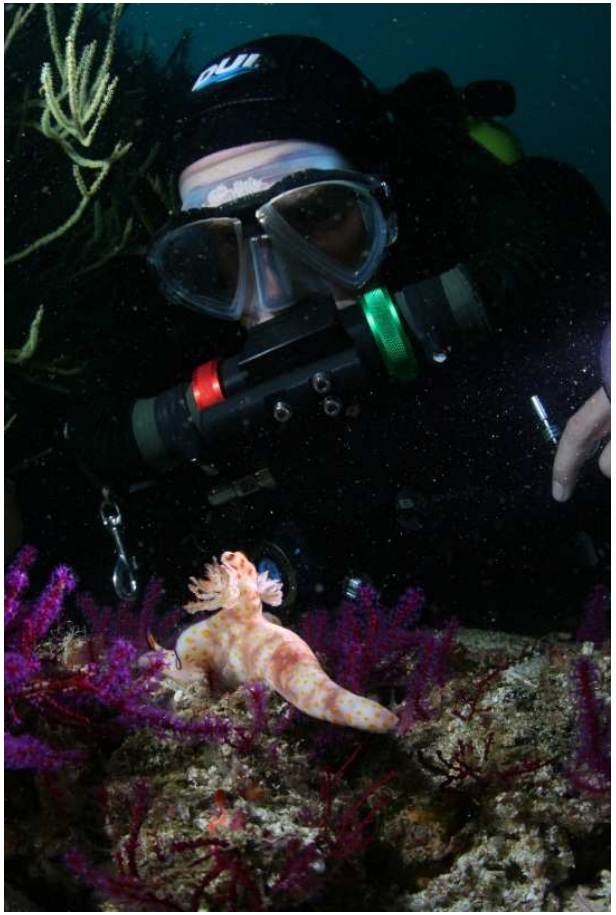
ISE Oxygen Rebreather

In loving memory of Jan-Lars who's´ enthusiasm and spirit will be missed sorely and without whom this program would have never been built.



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Disclaimer

This Manual is NOT meant for self-study but as an addition to the class held by a certified instructor from InnerSpace Explorers.

Reading this manual does NOT substitute this class or any part of it.

This manual can only be downloaded from www.is-expl.com from a registered student booked for this specific class only.

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Land Drills

Training Dives

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Introduction to InnerSpace Explorers

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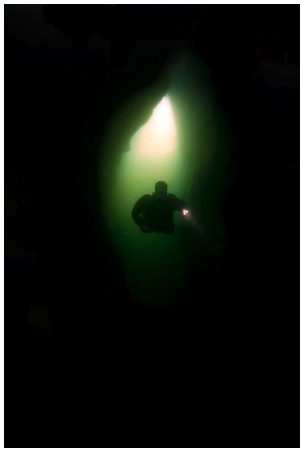
Mission Statement

Inner Space Explorers was founded to provide the highest quality training available, for all individuals sharing the common goal of underwater exploration and conservation.

The four main pillars of education, training, research and exploration builds the base line of all ISE training that greatly enhances the thrill, safety and ultimately the fun of 'Your Passion'.



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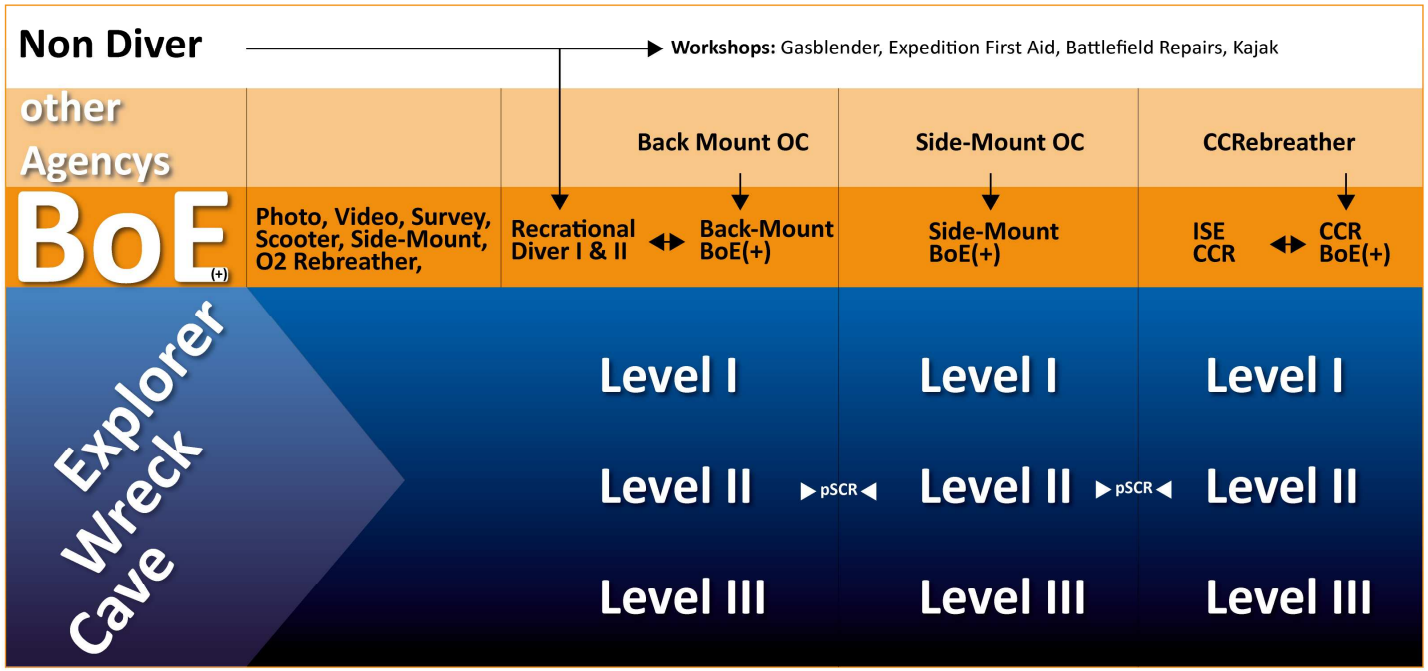
InnerSpace Explorers ClassFlowchart



Note: • Additional prerequisite for Cave / Wreck Level II is Explorer Level I • and additional prerequisite for Cave / Wreck Level III is Explorer Level II
Instructor Levels needs User certification from next Level

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Why ISE?

- **Strict global standard and procedures of the organization**
  All instructors are to follow it so as to have standardized training and procedures, as this greatly removes inconsistency in within the organization.

- **Re-qualification**
  This is to ensure divers and instructors do not jump back into the sport after long period of absenteeism hurting themselves, or greatly reducing the quality of diver training provided by ISE. Divers have to do an evaluation dive with the ISE instructor of that level of training.

- **No 'back to back' or 'bundled' courses for divers.**
  Experiences have to be gained through personal dives before progression. Such divers enjoy advance training much more and have much better chances of excelling in the advance subject.

- **Non smoking organization.**
  As the founders are active explorers, they know a healthy and fit diver will get the best out of the sport. We allow smokers to enter the foundation class, and give them the mindset that exploration brings more fun then smoking and help them quit.

- **Critical skills practice.**
  Due to strong demands around the world, we apply relavant underwater simulation drills as they are critical to a diver survival and allowing divers to understand their true limits. A 'train the way we race' approach.

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Past, Present…

- ISE was founded by active explorers and educators
- ISE have increased the quality of diver training and education
- ISE is ready to set new standards to the topics of:

  Education
  Training
  Research
  Exploration

Diver training have often been focused on getting somebody to breathe underwater fast. By doing so,
diver accidents occur at a significant rate. By redefining the four pillars of ISE, we provide a solution to these and significantly turned diving into a sport much enjoyed by all divers alike.

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Future

- Develop programs that serve certified divers in their desire to get more out of the sport.
- Develop the highest set of standards in the industry.
- Develop an international base of dedicated instructors to serve divers around the world.
- Develop dive centers around the world to support explorers in their logistics and ability to explore the aquati realm.



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Prerequisites

- Min. of 18 years
- Must have its own Oxygen Rebreather
- ISE BoE certified diver with a min of 50 dives
- Exceptions from the above rules have to be approved and signed by a member of the ISE Board of Directors.
- Must sign the evaluation form

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Introduction

- Why this course?
- Back to the basics?
- How is it going to benefit us?
- What to expect from the course?
- What are the minimum standards?
- How does ISE brings us to that level?

You are already a good diver, ISE wants to bring you up to the next level.

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Overview

- Introduction
- Paper Works
- Fees Collection
- General Overview

  Land Theories
  Land Drills
  In-water Demonstrations
  Training Dives
  Surface Debriefs
  Diver Assessment

- Diver Grading

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Index & Class Structure (sample)

Day 1	Day 2	Day 3
09:00 Theory	09:00 Theory	09:00 Theory
12:00 Lunch	10:00 Dive3	10:00 Dive5
13:00 Equipment Fitting & Prep	12:00 Lunch	12:00 Lunch
14:30 Dive 1&2	14:00 Theory & Dive4	14:00 Theory & Dive 6
20:00 End	20:00 End	20:00 End

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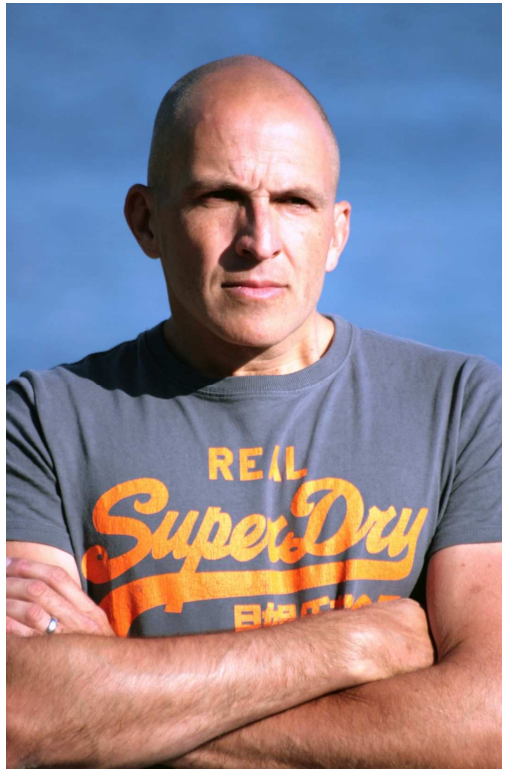
Message from the founder:

“You may ask what the heck? Why should I take this class and what is it all about? This class will show you
some facts, skills and items that in the end make your diving safer, more efficient and ultimately more fun.
The term “Exploration” is what you may have found a bit strange in the name of the class.

Well, what is Exploration? When a kid strolls through a ruin somewhere, the kid is exploring. If a Geologist wanders through a cave never seen before by human eyes, he is exploring it. If you swim through a popular reef you have never before been to, you explore it. Diving in general has a lot of potential for exploration.

Now we believe that there is a difference in how you do that. You may be able to breathe underwater and see because you have a mask, but that does not make you an explorer. An explorer is not only defined by the desire to cover new ground, but by the heart to preserve this ground, and make the knowledge gained
accessible for others, at least through a clear documentation.



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Continued:

If you have poor trim, buoyancy and fin techniques for example, you stir up silt that covers anemones or corals that might damage it. Even in clear water, you may ruin your visibility at best. In a cave, a careless fin stroke will

damage the pristine limestone formation, in which a geologist may be able to understand the history of millions of years of which nature developed.

Good skills are essential to exploration, the well prepared diver keen on diving new sites will also need some additional equipment to be prepared for the demands of the dive. Although this class can be done on a single tank, we will introduce you to the idea of doubles or at least two regulators on an H valve.

Murphy's law of what might happen, will happen gives an understanding that trouble is always around. The right equipment and skills needed to handle the situation can make a difference between a good dive, or the last dive. You will also be taught the spool – a simple tool that hold lines can be the most valuable piece of equipment ever, from sending up a surface marker, to measuring and surveying a site to doing search patterns the possibilities are endless.."

Achim R. Schlöffel
President InnerSpace Explorers

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Certification Policy

- Every level of ISE training has specific requirements that the student must meet before being awarded certification.
- These requirements include both academic knowledge as well as robust diving skills and techniques.
- The student must fulfill every skill and technique required for each step in the training before progression to the next step is possible.
- It is expected that the ISE student understands and accept the ISE Instructor obligation to deny certification if the training requirements have not been fulfilled.

Students pay for training but earns the certification.

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Types of grading

- Pass
- Fail

Pass: Student have performed well in the required skills and shown positive attitude in training.

Fail: Student is required to consult the instructor again and remedy shortcomings.

There can only be a successful or a failed exploration

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“I heard there is a resident Napolean Wrasse somewhere at the first rock off the shore, I want to see it.”

“The government wants to know where does water from the caves flow to in case of pollution. Shall our team volunteer to check it out?”

“Have you been to the deep wrecks of the HMS Repulse or the HMS Prince of Wales?”

What does exploration means to you?

- Curiosity
- Purpose
- Excitement
- Research
- Share

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HOW DO WE ACHIEVE

THE QUALITIES OF AN EXPLORATION

GRADE DIVER?

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By primarily receiving the right education!

By selecting the specific equipment to support our dives!

We have to dive to gain experiences, and once we have a concrete foundational support…

We inherit the qualities through constant practice!

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Oxygen Rebreather - Overview

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Why Oxygen Rebreathers?

Certain diving situations call for special solutions. There is a number of groups that have a perfect solution for their needs with an oxygen rebreather:

Ichtyologists, other scientists, moviemakers and photographers often need to be silent under water to get closer to animals.

Eight out of ten women asked, state that they do not like to dive deep, prefer to watch fish and hate the weight of conventional scuba gear..

Elder people, who do have issues with the weight of scuba but are fit to dive in general but also do not want to go deep any more.

It is a great leisure diving tool. Lightweight for shallow diving, simply enjoying nature. Diving remote locations often calls for logistical compromises. Oxygen Rebreathers are small and lightweight and great to transport on planes and in small boats. The tanks are small and the amount of gas needed is minimal. Oxygen is available all over the world, either thru medical supplies or thru welding supplies.

In addition ISE offers a Cajac-Workshop which, in combination with the Oxygen Rebreather makes an amazing tool for shallow exploration or a nice trip to combine on- and underwater activities.

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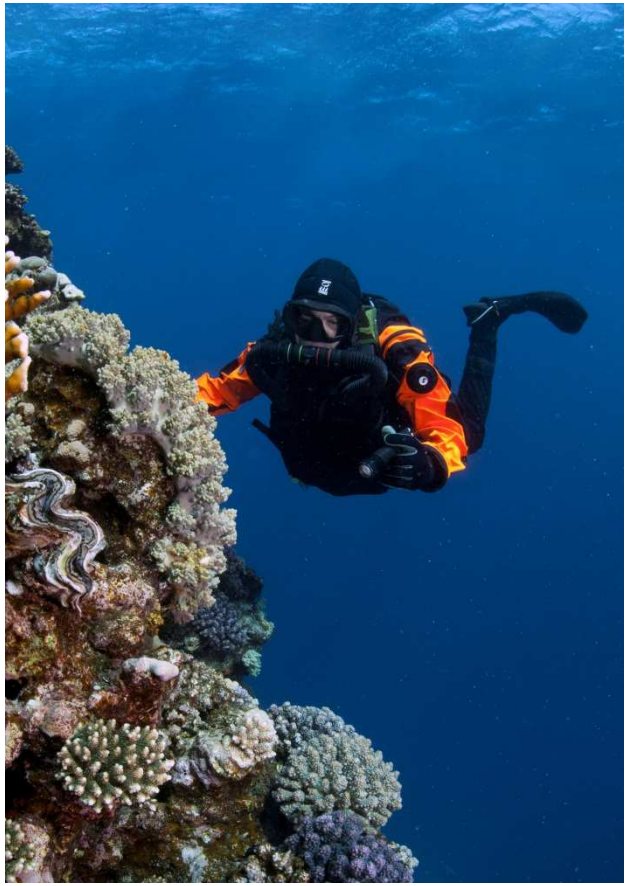
What to look for:

- Minimalist approach
- No Pendulum Breathers
- Streamline configuration
- Rugged design
- Safe and simple / intuitive
- Easy to maintain

Recommended Reading:
„Tauchen mit Sauerstoff- Kreislaufgeräten
von J. Hilbert & W. Boczek
ISBN-10: 3768824225



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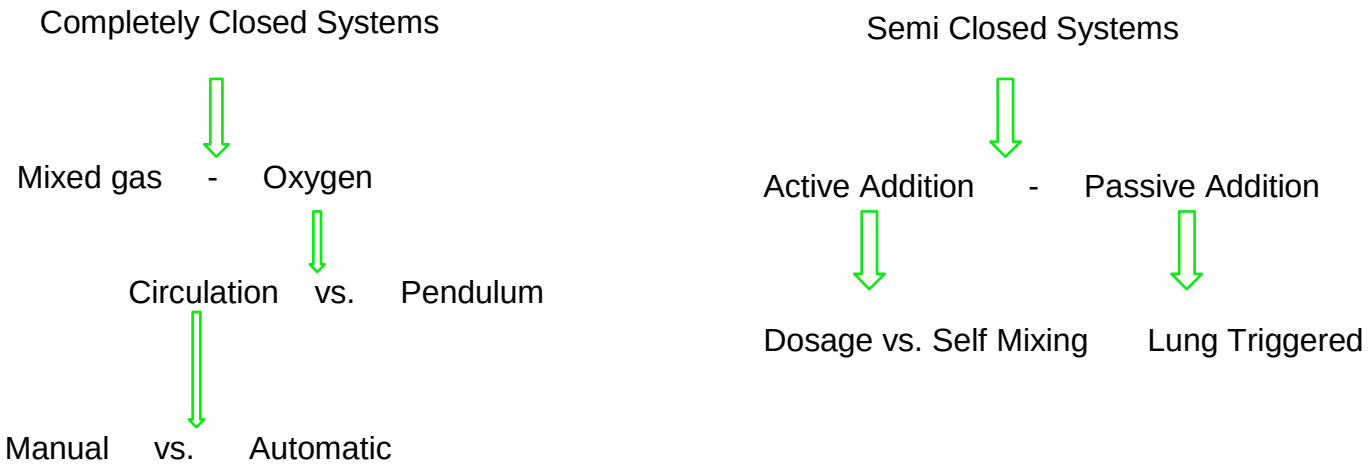
Rebreather Basics



In this course we use completely closed Oxygen Rebreathers, Circulation type, manual and automatic. The manual is based on the OMG Castoro C96 Pro.

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Oxygen Rebreathers – Benefits and Disadvantages

Benefits:	Disadvantages:
Lightweigt	Limited depth
Small	Higher cost than OC
Long Duration	Longer preparation and after dive maintenance
Noiseless	More care and maintenance in general
No Bubbles	Availability of lime might limit use

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Components

- Mouthpiece
- Hoses with directional valves
- Neckstrap
- Counter lung with “Drool”-Pad
- Absorbent canister
- O2-Tank with SPG
- OPV Valve with bubble diffusor
- Manual or automatic addition valve

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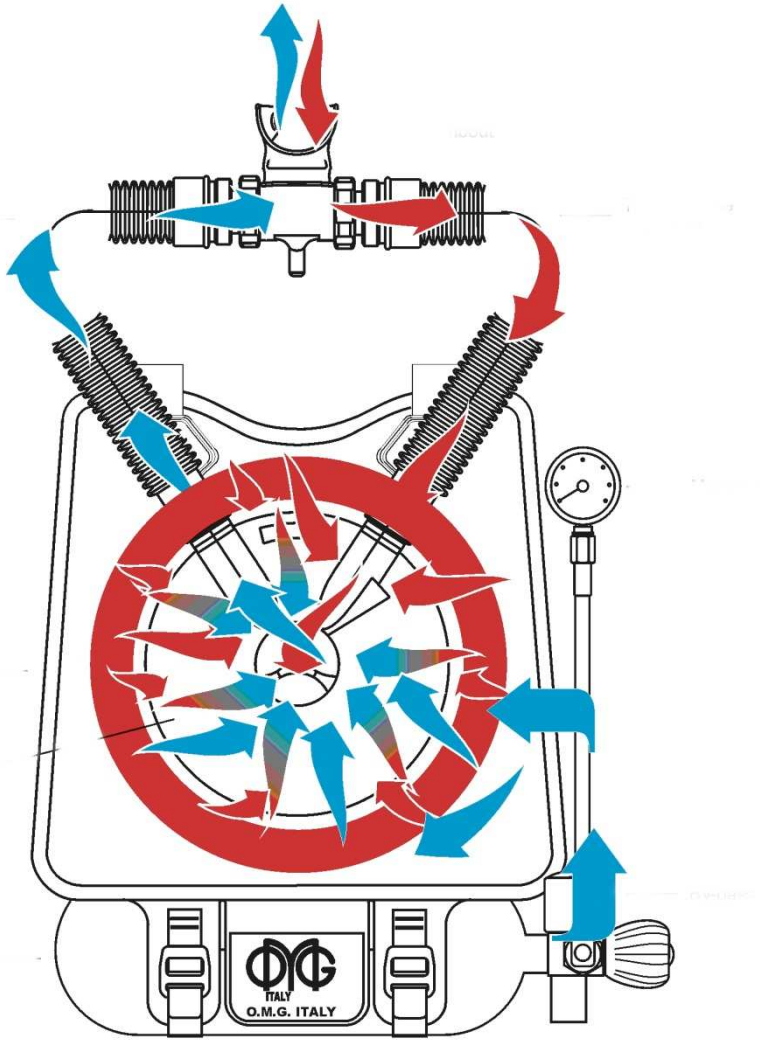
How does it work



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Some History

<-- PROTO Siebe Gorman Oxygen Rebreather – GB (1913)

courtesy http://www.therebreathersite.nl collection J.W. Bech

The famous Hans Hass Rebreather Dräger 138 (1942) -->

courtesy http://www.therebreathersite.nl collection J.W. Bech

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Some History

<-- Desco B-Lung (1944)
courtesy http://www.therebreathersite.nl collection J.W. Bech

A Cressi Oxygen Rebreather from 1950 -->
courtesy http://www.therebreathersite.nl collection J.W. Bech

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Some History

The Author wearing a Russian IDA76 Oxygen rebreather (1976)
courtesy of InnerSpace Explorers

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Some History

And a modern
Dräger LAR VII
from 1994
courtesy
http://www.therebreathersite.nl
collection J.W. Bech

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Oxygen Rebreather - Components

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Mouthpiece (with directional valves)

- Robust Design
- Unbreakable
- Easy to switch

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Hoses

- Good to breath (Diameter)
- Flexible but rugged
- Correct length

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Neckstrap

- Holds Mouthpiece in place)
- Safety in case of O2-Problems
- Correct length

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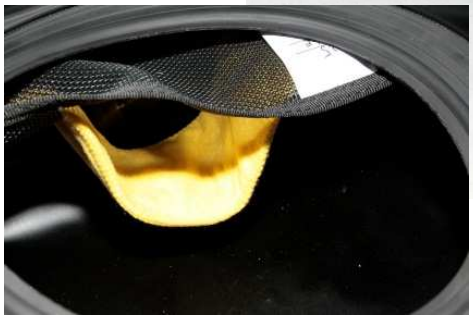
Counter Lung

- Size
- Material
- Access
- One or two
- Position
- “Droll” Pad



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Lime Cansiter

- Concept (radial vs. linear)
- Size
- Material
- Watertrap

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O2-Tank

Size
Material (aluminium / steel / compound)

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OVP Valve with Diffusor

Position

Adjustable

Diffusor

Attention!!

Not every O2 Rebreather has an OPV, which can cause severe issues with expanding gas during rapid ascents.

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Gas addition

Manual or automatic

Benefits and dissadvantages

.

.

.

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Proper Weighting

- Placement of lead
- Harness vs. integrated
- How much?

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Additional Gear

- Lead Bag
- Transportation Bag

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Nice to have

A HUD (Head Up Display) Mask like the Oceanic Data Mask can be a great supplement especially when engaged in serious activities or harsh environments

A Navigation Board is the perfect tool for longer distance navigation but also occupies your hands..

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Oxygen and the Physiology

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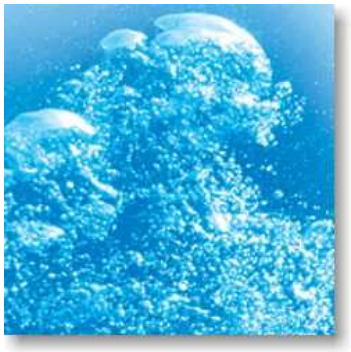
Oxygen

Although Oxygen is essential for life it can be one of the most tricky gases we have to deal with.
Lets divide this discussion in two chapters. Oxygen in relation to the human body and Oxygen as a gas in technical applications.



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Oxygen and the human Body

Oxygen does NOT trigger our breathing but Carbon dioxide is doing this. .

We metabolize around 4% of the O2 in our breathing gas per breathing cycle

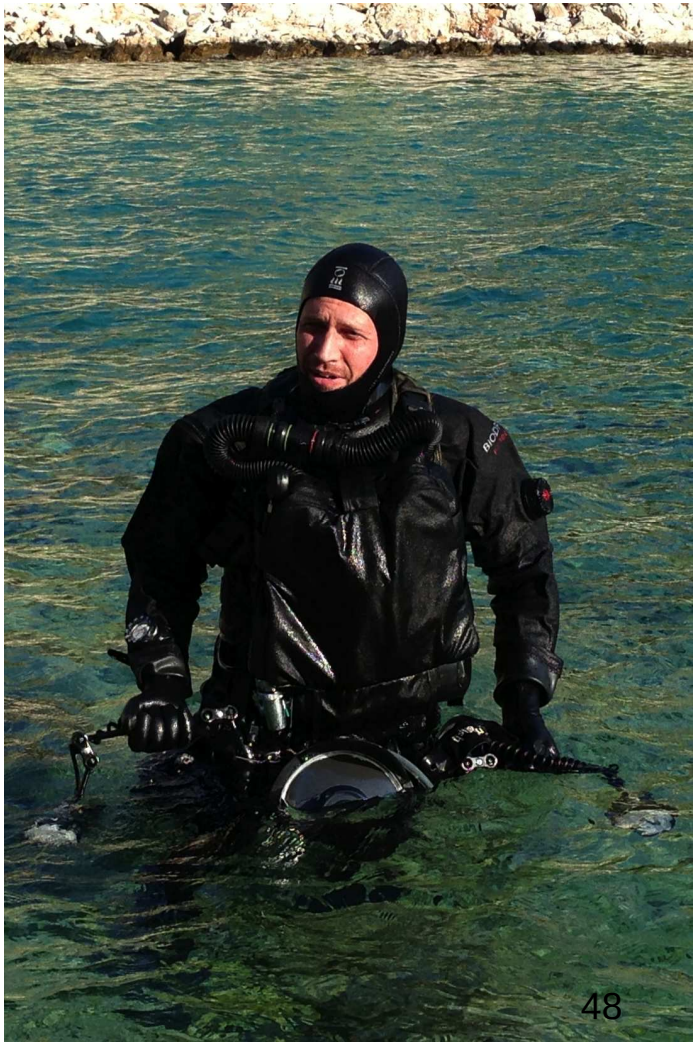
Hypoxia starts below 0.18 PO2 under workload and below 0.16 under rest 0.1 is lethal

Hyperoxia is connected to the time and the PO2. The limit is 1.6 Bar PO2 for 45 Min

The Human body uses between 0.3 and 4 Liters of Oxygen / Minute depending on the workload. As a rule of thumb You can calculate with around 1 Liter / min for a relaxed diver.

Oxygen Toxicity is divided into CNS-Toxicity and Pulmonary Oxygen Toxicity. While CNS is tracked by the so called CNS Clock, Pulmonary O2 is tracked by OTUs.

CNS Toxicity leads to convulsions and is very likely to be lethal in water, Pulmonary Toxicity leads to a reduction in vital capacity and is a long term effect.



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Physiology

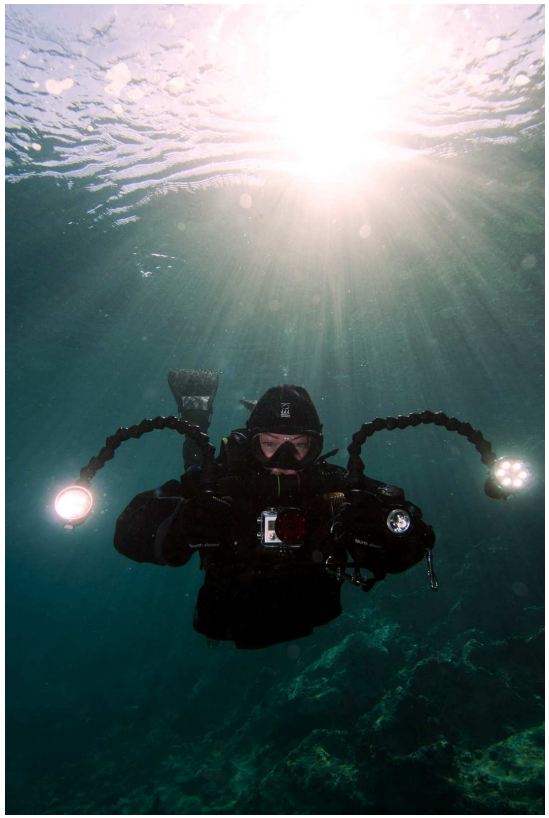
Hypoxia

Symptoms:

Dizziness – Nausea - Reduced judgment - Blueness (cyanosis) -

Reduced muscular control – Unconsciousness – Euphoria - Light tingling sensation - Visual disturbance - Loss of coordination – Fatigue - Weakness

0.21 bar – Surface exposure
0.18 bar - ability to work hard is reduced
0.16 bar – hypoxia : first syptoms occur
0.12 bar – Sypmtos get serious
0.10 bar – Unconsciousness
< 0.10 bar - Death



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Physiology

Hyperoxia

CNS Symptoms (by the book – in reality there might be no prewarings at all!):

Vision, *ANY* disturbance including *tunnel vision* etc
Ears, *ANY* changes in normal hearing function
Nausea, severity may vary and be intermittent
Twitching, classically manifested in facial muscles
Irritability, personality shifts, anxiety, confusion etc
Dizziness, vertigo, disorientation

Pulmonary Symptoms:
Dry cough
Breast pain /irritation
Shortness of breath
Reduction of the Vital capacity

> 2.0 bar Convulsions, drowning, death
2.0 bar - Elevated CNS oxygen toxicity danger
1.6 bar - Max exposure during decompression
1.4 bar - Max exposure during recreational diving
1.2 bar - Max exposure during technical diving
0.5 bar -Threshold for pulmonary oxygen toxicity (theoretical)
0.21 bar - Normoxic oxygen level

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Physiology

Variation of O_2 tolerance

" The variation of tolerance between individuals, the variation of tolerance of each individual, the impairment of tolerance with work and underwater exposure, all make diving pure oxygen below 25 feet (7.6 meters) of sea water a hazardous gamble. " - Donald, 1944

The obove statement by Kenneth Mc Donald basicly says it all. In fact all the number we use to measure Oxygen exposure and as well the limits we set are theoretical and can vary not only from Inividual to individual but also from day to day on the same individual.
This is affected by serveral factors, some within our influence some not. Factors are age, fitness level, hydration, enviroment, stress, mixture of gas and many more.

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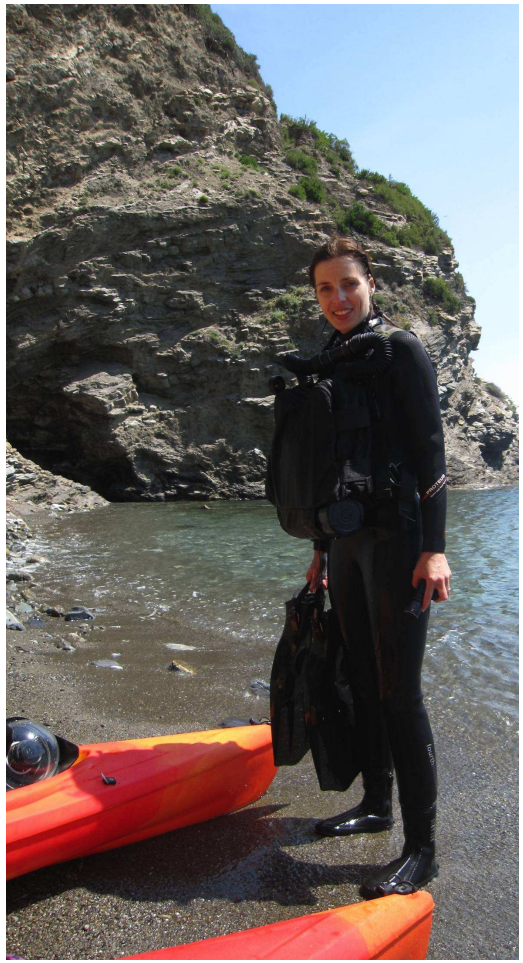
Physiology

The CNS% Clock

Dr. Bill Hamilton defined that at a PO2 greater than 0.5 bar the oxygen tracking beginns. The following table shows the maximum exposure times for the given PO2s.

PO2 in Bar	Max exposure time in min.
1.6	45
1.5	120
1.4	150
1.3	180
1.2	210
1.1	240
1.0	300

Note: The accumulated CNS reduces by 50% every 90min.



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Physiology

The OTU (Oxygen Toxicity Unit) Table

Dr. Bill Hamilton defined that 1 bar of Oxygen for 1 Minute is 1OTU.
The following table indicates the maximum dose one can tolerate.

Multi day exposure	Daily dose limit	Total operational limit
1	800	850
2	700	1400
3	620	1860
4	525	2100
5	460	2300
6	380	2520
7	350	2660
8	330	2800
9	310	2970

Note: The accumulated OTUs reset after 24 hrs.

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Carbon Dioxide and the human Body

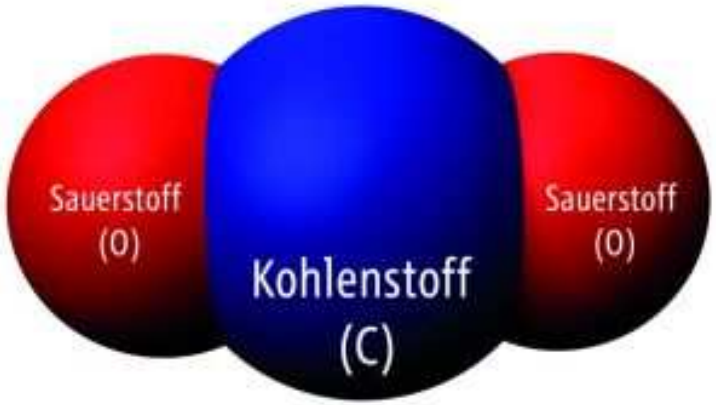
Carbon Dioxide triggers our breathing

CO2 is highly toxic and has a numbing effect

CO2 poisoning leads to: Headache, fast, shallow breathing, unconsciousness

CO2 is an ever-present evil in Rebreather diving

CO2 poisoning can happen due to: channeling in Sodalime, old Lime, shallow breathing, failure in circuit (one-way valves!)



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Oxygen in technical applications

Handling Oxygen in technical applications requires some care and caution as Oxygen is a very reactive gas.

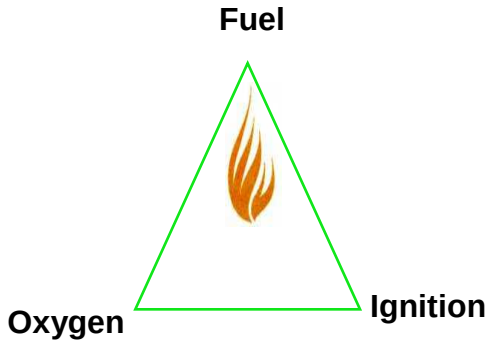
Although frequently said – Oxygen can not burn but supports fire extremely.

Oxygen clean does necessarily not mean Oxygen compatible:
Equipment in O_2 service = O_2 Cleaned + O_2 Compatible + Designed to be used with O_2

A Fire-Triangle consists out of O2 / Fuel / Heat. If one of the three is missing there will be no fire

Flowrates need to be SLOW to avoid heat whenever filling or pumping O2. Pressure should increase less than 5-7 bar per minute. Rule of thump: You should not feel the tank getting warm.

Use medical Oxygen whenever possible.



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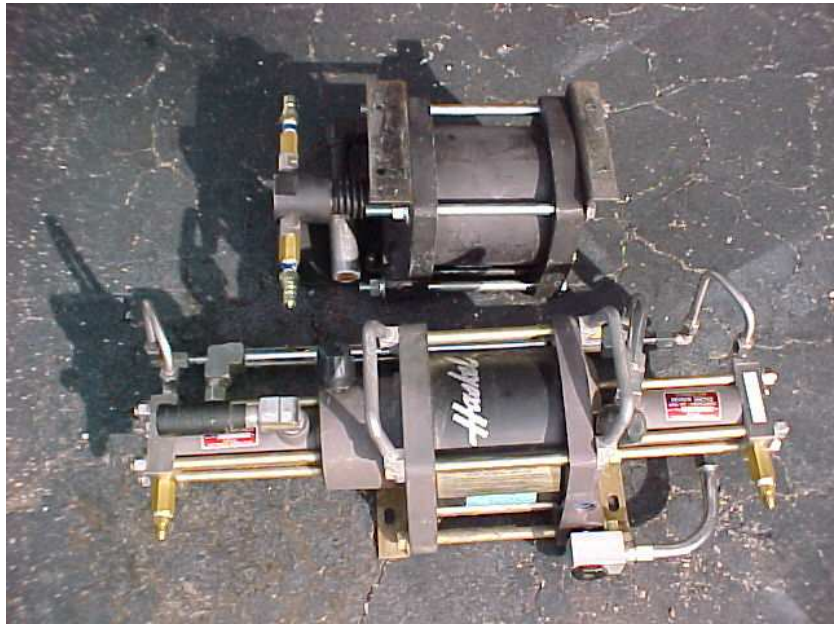
Filling Oxygen (only to be done by certified Gasblenders!!)

Filling Oxygen for diving Oxygen Rebreathers is rather easy as we only deal with small tanks. Nevertheless care needs to be taken and the safety procedures for handling pure Oxygen at high pressure needs to be followed.

O2-Rebreather Tanks can either be filled thru a fill whip from a bigger tank. This is easy and only requires a appropriated filling whip and a storage tank with enough pressure.

The other solution is to pump Oxygen thru either a special Compressor (very rare and very unlikely that You find on) or thru a booster pump. Booster Pumps can either be manual (very rugged, simple and easy), electrical-, or gas driven

In any case – don't use homemade equipment and let the filling be done by certified personnel only.



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Diving Oxygen Rebreathers

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Diving Oxygen Rebreathers

Preparing a Rebreather is critical – take You time and do not let anybody put You under stress while working on the unit

Do all the critical checks that will be described in the following slides carefully

Flush the unit prior to the dive and during the dive in a set interval and when You ascent

Check Your buoyancy that is different than with open circuit gear. Avoid rapid ascents

Dive within safe Oxygen Limits regarding Po2 and CNS.

Calculate with the use of 1 bar of the tank pressure / min on relaxed dives and 2 bar / min on demanding dives. Take 20 Bars as the reserve that You want to surface with.

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Diving Oxygen Rebreathers – the 6 Meter Myth

There are some mystic stories around O2-Diving. You can for example frequently read that the general limit for O2 diving is 1.6 PO2 while the limit for the military is 2.0 PO2.. Hm – You might wonder why this is the case and why some humans seem to be different. The explanation is simple. The depth limit for military O2-diving is 10 meters. Someone did the math and figured that 100% O2 at 10 Meters is 2.0 PO2.. So far so good – but in fact there are no 100% O2 in the O2 Rebreather but only around 80% (we will see why in a minute).

0.8 x 2 = 1.6bar PO2.. So it is not the military personal can stand O2 better than You - it is just some jerk at a desk who did not know what he was writing about..

But now lets find out what is the reason for this reduction in O2% in our unit

UNDERSTAND THAT BELOW 6 METERS YOU ARE ALWAYS EXPOSED TO THE RISK OF A FATAL O2 HIT

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Diving Oxygen Rebreathers – O2 percentage in the Lungs

When You start Your O2 Rebreather your lungs are filled with air as well as Your tissues are saturated with the gas that is surrounding us. The breathing bag (counterlung) of Your rebreather is empty. So when You exhale in Your rebreather and inhale again the rebreather adds only that amount of O2 that Your body uses for metabolism.
Depending on whether your unit is manual or automatic the addition is based on the volume of the breathing bag and you have a good chance of becoming hypoxic before the volume is small enough to trigger the mechanism or Your finger on the button.
For that reason You need to „flush“ the unit at least 3 times (that's what the manufactures say) or better up to 9 times (that's what our tests say..)
What means „flushing“. Flushing describes the method of exhaling gas thru the nose and therefore flush it out of the system and add fresh gas from the storage tank into the system. By doing so You make sure the air of Your lungs is gone and the system is full of fresh Oxygen.

The more clever method is, to vacuumize the rebreather, with the DSV closed empty the lung as much as you can and then, with the DSV open inhale while you press the O2-Inlet button till you have a full breath. This way you have pure O2 in the circuit and also achieved the optimal breathing volume at the same time.

The interesting part no is that there is a pressure difference between the tissues and the lungs caused by the Partial pressure of the different gases. (on the surface: 1 bar of O2 in Your lungs with 0.79bar of N2 and 0.21bar of O2 in Your tissues). Now as gases have the tendency to equalize pressure the N2 from Your tissues will make its way into Your lungs while the O2 from Your lungs will substitute the N2 in Your tissues. The result is a reduced O2 percentage in Your lungs / Rebreather. Due to log term testing You can say that it is very unlikely that You have more than 80% of O2 in the system. Of course only an O2-Measuring devise can give You the correct information to make a safe decision regarding depth and PO2. if you dive without a O2 gauge we recommend a max depth of 6 Meters to be on the safe side at all times.

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Diving Oxygen Rebreathers – Exposure Times

"How long can I stay how deep with my Oxygen Rebreather" ? is a question that arises frequently. The bad thing is that there is no bulletproof answer.

Lets have a look on it: On Page 52/53 we talked about the oxygen limits regarding CNS / Pulmonary O_2 Poisoning. All of this works fine when you have a Oxygen monitor and know exactly what you breath. Usually, diving Oxygen rebreathers, this is not the case. When we start, with a freshly flushed lung, we are close to 100%. The percentage then drops down to levels as low as 50%, depending how long you stay on the loop without a flush or more gas added then what you metabolize. Therefore you never really know what you have in your lungs and it becomes difficult to connect it to a number from any sort of table, regarding CNS, depth, etc.

Of course people tried to find rules and created tables, all of which we do not really like because of what we just discussed.

The US Navy for example came up with a table in 1983 based on something like 465 man-dives, 46 of them ending with CNS symptoms, 5 with convulsions.

The result was:

6 m => 240 min
9 m => 80 min
10 m => 25 min
12 m => 15 min
15 m => 10 min

ATTENTION!! THIS IS FOR THEORETICAL DISCUSSION ONLY AND WILL MOST PROBABLY KILL YOU IF YOU TRY!

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Diving Oxygen Rebreathers – Exposure Times

A simple guideline with a good safety record to follow is:

1) Suggest 80% of O2 in your loop.
2) Stay in the 6 meter range and never exceed a max of 9 meters
3) Do not stay longer then 120 minutes on a single exposure and 60 min on multiple dives (3 hrs surface time in between dives)

Please be aware that even this is not guarantee you, that you will not get a hit. It is just a very proven guideline – comparable to the decompression tables.

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System Checks before the dive

Visual Check:
carefully check all Rebreather components for damage, wear and other problems. Do not dive a unit that is not 100% ok.

Gas Check:
analyze Your Gas. The analyzer should be calibrated with 100% O2. The reading should be not less than 98% O2. Check that the O2-Tank is filled to the rated pressure.
(if you calibrate with air you may have readings as low as 95%)

Lime:
Make sure the lime is not overdue and from a fresh canister. It needs to be dry. Make sure the canister of the Rebreather is filled with the required amount of lime and the lime is set properly to avoid channeling. Use the absorbent recommend by the manufacturer of your rebreather.

One-Way-Valve Checks:
Check one way valves of hose or Mouthpiece (depends on design). (cheek test). Make sure the lever on the mouthpiece works.

Vacuum & Overpressure test
Both test assure that the rebreather is sealing properly. If You conduct the vacuum test and it is ok – You are fine. Only if the unit does not hold Vacuum, You perform a overpressure test to see where the leak is.

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Buoyancy

First of all it is essential to understand that buoyancy control by the lungs as You know it from OC diving is not possible with a rebreather as You do not change Your buoyancy when You shift gas from Your lungs to your counter lungs..
Buoyancy control with an oxygen rebreather is archived by adjusting the amount of gas in the counterlung.

How dos it work?

- Fill Counterlung to an amount that allows you to take a deep breath. .
- Add weight till almost neutral (slightly positive)
- exhale some gas through the nose so you descent.
- When descending add gas to maintain neutral buoyancy
- When ascending remove gas from loop by exhaling thru nose.

The metabolization of Oxygen in the counterlung will affect your buoyancy if the unit is not equipped with an automatic gas addition valve!!

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Using a Drysuit

Diving an Oxygen Rebreather that is chest mounted with a drysuit calls for some modification. The Inlet Valve on the chest has do be removed and plugged and the Inlet has to be relocated - best on the left thigh. (See Picture).

Additionally a small tank around 6cf has to installed somewhere on the gear – a small pocket also on the left thigh is a great idea.

On top of that You need more weight and you have to be careful to not forget the drysuit becomes part of our buoyancy but should not be part of your buoyancy control..

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Absorbent

Absorbent is used to filter CO2 from the breathing gas. There are plenty of different brands and qualities on the market. Please follow the recommendation of the manufacturer of your Rebreather.

Lime needs to be sealed and within valid date.

Different sizes of grain affect the work of breathing as well as the efficiency of the absorption

Wet lime can cause serious injuries to chemical burns of the respiratory system.

Avoid dust by filling the canister from some height in a ventilated era

Don’t use “the rest” from the box as it is more dust than lime

Don’t use the lime over the max time the manufactures has set

Dispose the old lime in a environmental safe way

Keep Lime away from animals and children!!

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Absorbent

The recommended absorbent is: **Sofnolime L-Grade 2.0-5.0 mm**

One filling is: **2.05 kg** (Castoro C96 Pro)

Duration of use: (according to EN14143:2003): ca. **240 min @ 20℃** and ca. **130 min @ 4℃**

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Post Dive Maintenance

Visual Check:
carefully check all Rebreather components for damage, wear and other problems. Fix eventual problems at once using only manufacturer approved spare parts.

Lime:
if not used for more then 50% of its max. time, pack in sealed bag and store for no longer then 24 hours. Otherwise dispose in an environmental safe way.

Cleaning:
Disassemble unit and rinse thoroughly with fresh water. Remove drool-pad and clean with extra care. Let dry in the shadow in a high ventilated area.

Disinfect:
From time to time, before storage or whenever someone else has used the unit, disinfect properly using a disinfect suitable for rebreather disinfection.

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Potential Problems and their Solutions

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Potential Problems & their Solutions

Loss of Gas

Loss of gas can be some small bubbles or a terrible, sudden noise – in any case your life-support is draining and You need to react immediately.

We recommend the use of an alternative gas source. Based on the fact of the maximum depth you dive to with a Oxygen Rebreather something like a “Spare Air” will do nicely.

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Potential Problems & their Solutions

Too fast Ascent

The Problem with Rebreathers in General is, that if the diver ascents too fast, the gas in the counterlung might expand more than the OPV can release (if there is one at all) . In this scenario the diver cant exhale into the counterlung and needs to vent gas thru the nose – otherwise he is risking a overpressure injury of the lungs.

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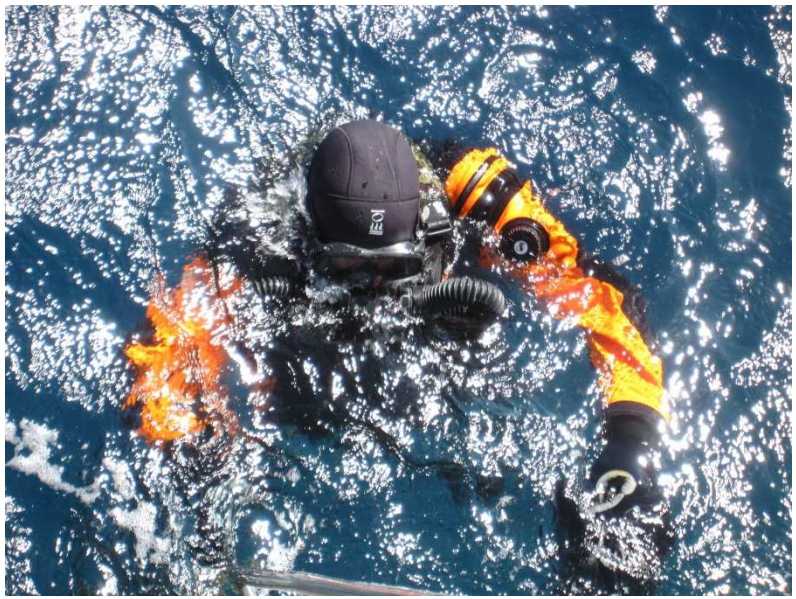
Potential Problems & their Solutions

Flooded Loop

In case the Rebreather gets flooded You receive a caustic cocktail and cant breath from the unit any more. A controlled ascent to the surface while exhaling thru the nose is the solution. Otherwise the previously discussed Spare Air is an easy way out.



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Too Deep

Although this might seem strange in the first place it is an issue for someone not yet very firm with controlling the buoyancy with the counterlung. In case of dropping too deep stay calm, do NOT add more gas to the lung and swim up. If You would add fresh gas the O2 level would rise even more. By swimimg up, the gas in the lung will expand and give lift while the O2 will drop.

If You are significantly too deep switch to your Spare Air.

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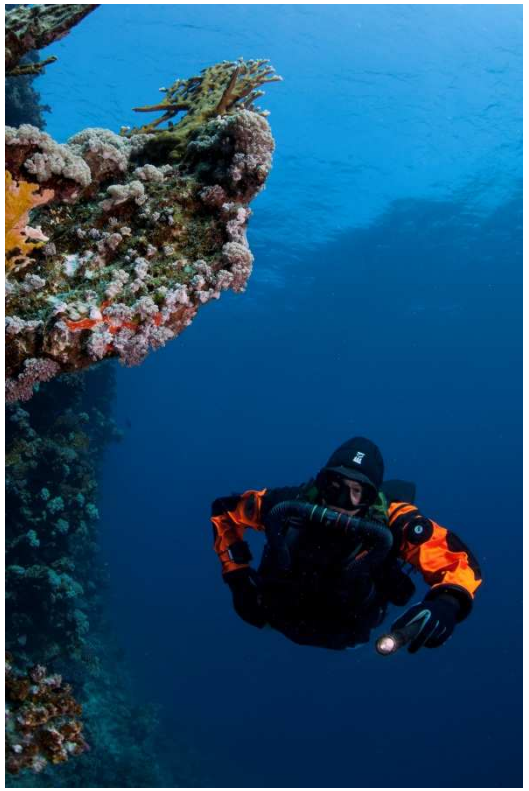
Potential Problems & their Solutions

Hypercapnia

CO2 poisoning can happen if the lime is not absorbing either thru channeling or due to age. Symptoms are shortness of breath, the feeling of not getting a good breath, along with headaches and nausea.

Abort the dive at once, if available switch to Spare Air and ascent.



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Potential Problems & their Solutions

Buddybreathing an Oxygen RB

You might wonder why this is listed under “Problems” and not under solutions..

We do this as an exercise in the class as it is a great exercise to learn how to control the unit but we do not recommend it as a bail out solution!!

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Training Dives

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Training Dives

#1 (Pool or confined water)

- Prepare unit and perform all checks

-Check unit of Your buddy

-Check alternative gas source if available

-First breath on surface.

-Descent

-Buoyancy

-Close, drop, retrieve Mouthpiece

-Ascent

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Training Dives

#2 (Pool or confined water)

-Prepare unit and perform all checks

-Check unit of Your buddy

-Check alternative gas source if available

-Buddy Breathing

-Loopings and turns

-Buoyancy

-Mask clearing

-Ascent

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Training Dives

#3 (Pool or confined water)

-Prepare unit and perform all checks

-Check unit of Your buddy

-Check alternative gas source if available

-Mask Removal

-Alert Marker

-Bail out

-Buddy Breathing Ascent

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Training Dives

#4 (Pool or confined water)

-Prepare unit and perform all checks

-Check unit of Your buddy

-Check alternative gas source if available

-Additional gear

-Line work

-CoB*

-Alertmarker

-Ascent with closed Tank

*CoB:

1) DSV
2) OC Bail Out
3) DSV Back
4) Mask

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Training Dives

#5 (Pool or confined water)

-Prepare unit and perform all checks

-Check unit of Your buddy

-Check alternative gas source if available

- Handling of Toxic & Unconscious Diver

-Throw Ballast

-Emergency Ascent

-Remove Unit in Water & Exit

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Training Dives

#6 (open water)

- Prepare unit and perform all checks
- Check unit of Your buddy
- Check alternative gas source if available
- Fun Dive using all learned techniques and skills

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Final Words

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Conservation & Environmental Protection

ISE with its “Explorer Mindset” and the strong believe that all of us have to share the responsibility for our environment and the duty to preserve the natural resources for future generations is happy to introduce our members and students to Brad Robertson from Ondine Escape.
An Australian native with a long history in diving industry and experience all around the world, Brad settles in Mallorca were he runs Ondine Escape and organizes conservation project and works tireless on the building of a community to preserve Mallorca's aquatic habitats.

In the following Brad talks a bit about conservation and offers some inside views. Brad is an active explorer, environmentalist and a fond member of InnerSpace Explorers.

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Introduction

Conservation and Improving of local marine ecosystems.
As divers we have the ability to enjoy many different and exciting ecosystems, but simply looking and enjoying is not enough these days. Gone are the days when Jacques Cousteau dived into the Mediterranean and was amazed by the variety of life, the majority of marine life in the Mediterranean has now disappeared due to overfishing, human development and pollution. This sad fact is not restricted to the Mediterranean, it is a world wide problem. Hence understanding, protecting and even improving local marine ecosystems should be on the top of every divers To Do list.

Who is responsible.
Ultimately YOU are responsible for the health of our Sea´s and Ocean´s.
As a diver, as a consumer and as a human being with a conscience. As a diver you receive many pleasures from enjoying time underwater such as photography, encounters with majestic whales and impressive sharks. Imagine the pleasures you would enjoy if you were involved in preserving and improving your local marine ecosystems. Don't wait for governments to do anything. It is up to us, the worldwide diving community to get involved and make a difference.

Why is it so important.
Preserving our local marine ecosystems is beneficial to local communities both economically and socially. Healthy marine environments managed in a sustainable and practical way generate millions of dollars around the world annually. In fact, should you get to the stage of working with your local government, showing them the benefits of conservation in a financial sense may just be the key to get them involved. Show them the money! Socially and culturally the sea has been a huge influence in many parts of the world, a healthy sea. Allowing our sea´s and oceans to die a not so slow death is adding to the decline of centuries old sustainable cultural practices and limiting the social enjoyment of the sea. A dirty, unhealthy sea is not inviting for anyone.

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Understanding local Ecosystems – sience base

Any conservation project needs to be science based, dreams don't work alone.
We need to have dreams and ideas to begin this process of global marine conservation; we need dreams and ideas at a local level with international attention that inspire more people to take more initiatives. These dreams and ideas must have a scientific base to them otherwise they lack the clarity and direction they require as well as lacking real beneficial objectives.

Importance of local experienced marine biologists.
The most important people you could possibly involve in any size marine research and conservation project are experienced local marine biologists, these people are imperative! You can be the best diver in the world with the best intentions in the world but without local knowledge and professional attitudes you will achieve very little in comparison. Contact your local aquarium, local department of fisheries, local marine research facility and let them know what you have planned. If you don't get the response you were after, then try again, you will eventually find someone who is interested in your project. With a scientific base and objectives with the best possible outcomes you will be building a base for success.

Utilizing and connecting with local authorities and scientific research centers.
Accumulated and shared knowledge is the way forward, starting from scratch in many circumstances is time consuming and counter productive, hence, connecting with your local scientific bodies is a must to succeed at studying and conserving local marine ecosystems. Most aquariums have a conservation department, most scientific institutes have a website and contact form, the hard work is gaining respect and having people open themselves and their knowledge to you. This does take a little time. If you have the drive and the stamina it will happen.

Merging science and the rest of us.
This is the key to large scale success, we need to bridge the gap between science and the community, we need to make science fun, interesting and most of all available to the masses. Involving volunteer divers in your projects will get people like you and me right in amongst the scientists as they work. Beginning the process of a larger understanding of science, which really is just understanding nature in detail.

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Establish a solid team

Each individual role needs to be filled with the most capable professional available.
Like every great team, we need individuals to fulfill certain roles, each of these roles need to function on an individual basis and on a team basis.
If you are the one with the ideas but lack experience in building a team then that is the first person you need to find, the team builder and leader. Whoever leads your projects needs a great ability to find the right people for the job.

Importance of good leadership and a functioning team
Once your team has been established you will need to ensure it runs like the well oiled machine it is, this can only be done with great leadership, motivation and genuine interest in each individuals role as well as the larger objectives of the project. If you are genuinely interested in the subject you will surprise yourself with your ability to lead!!!

Communication within the team
Open & clear communication will allow your team to evolve, work more productively and be creative with ideas. Being able to communicate in a way that is not offensive and allows people to clearly express themselves is a great place to start.

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Finding Objectives

<u>What are you wanting to achieve</u>

This is something that should be clear from the beginning, particularly when you are starting out with local projects. Beginning with a project that has a foreseeable end and foreseeable success is a great way to build your foundations. Having achievable goals ensures your success which in turn will increase your credibility and chances of success in the future.

As discussed above, talking to local scientists will give you a clear idea of what needs addressing in your local area. Dive centers are also a good source of local information.

<u>How are you going to do it</u>

Now you have your objectives you will need a plan of action. If you have successfully built a solid team then delegation of respective jobs is the most productive way to get moving. Each individual has their part to play, hence allowing them to create their own plan means their own understanding of their role and the experience they have should produce a solid plan. When you have all the different aspects done you will collaborate all the plans to make your final proposal. Its pretty simple really. Breaking the whole project up into different sections allows individual input into a team production.

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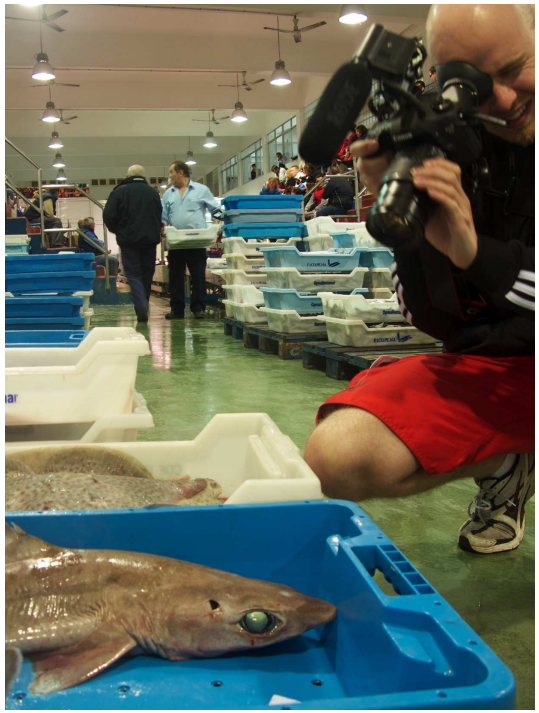
Don’t expect anything but hard work

Gaining respect
This will come in time if you truly believe in what you are doing, if you do it in a positive way, if you do it in a professional way and if you really get your teeth stuck into it. You may need to create a project yourself, obviously with a scientific base but with the majority of work done by YOU. This will show commitment, interest and if done well will also show your level of professionalism.

Start small
Don’t bite off more than you can chew! As we mentioned earlier, having a first project that will succeed is crucial for your longevity and the health of your local marine ecosystems. Little by little is the key!

Involve as many established organizations as possible
Unless you have a limitless supply of money then you are going to need to be creative in your marketing and publicity. Involving established and respected companies and organizations will, if done correctly, benefit your projects with both public awareness and sponsorship. It will also accelerate the building of your reputation, which is another crucial aspect for successful projects in the future.



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Looking for Sponsorship

Finalize your proposal
Once your proposal is complete ask a few people you know to have a look over it, make comments and suggestions. Brainstorming at this stage is still a productive way forward. Should there be any small alterations, make them and then prepare to write an accompanying letter to possible sponsors.

Utilize the contacts you already have
You would be surprised at who may take up an opportunity to sponsor a marine research or conservation project, particularly if you live in an area where there is very little being done. People like to feel good about themselves, give them the opportunity to join you. It will benefit them directly.

Expand your horizons
Think outside the box, if you are looking for a sponsor try to create a link between them and what you are doing, a natural and obvious link will do the trick.

Never give up
When you believe in something it will happen. The combination of hard work, determination and belief will lead to success of your projects. If you feel like giving up, think again! If thinking again should fail then contact me… Brad@OndineEscape.com or Brad@asociacionondine.org. I am just like you, a diver that cares and doesn't mind a little hard work.

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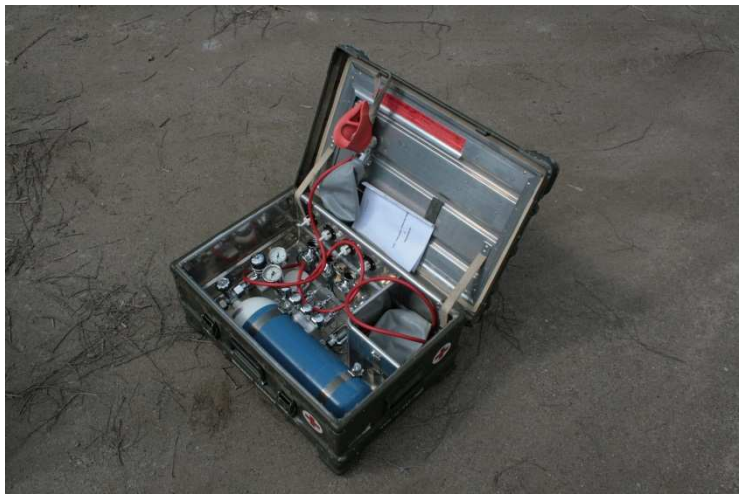
Emergency Oxygen – A MUST

It is barely understandable how divers can spend thousands for training and gear but fail to understand that the - compared to the rest of their gear – cheap Oxygen Set may safe their live or the live of fellow divers.
Divers Emergency Oxygen can be the classical set up like from Wenol or a budget solution using ex commercial stuff like seen on the pictures.
No matter what, the importance is to create the awareness amongst divers that having their own Emergency Oxygen Kit on the dive site without having to rely on others in case of ..



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Thanks for your attention!!!

Please fill out and sign the O2 RB sheet with your Instructor.

Now let‘s go diving! ☺

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Credits

Produced by:
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Appendix

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SIEL
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CCIAA Torino No. 617776 - C.F. e Partita Iva 04201240019

InnerSpace Explorers – ISE
Freidankstrasse 3a
81739 Muenchen
Germany

Date: 02/11/2011
Our ref : PP1240/11
Subject : Trainer Certification
Att : Mr. Achim R. Schloeffel

CERTIFICATION

SIEL Srl company confirms that InnerSpace Explorers – **ISE** represented by Mr. Achim R. Schloeffel is hereby licensed to train, teach and certify divers in the use of our CASTORO C96 PRO CE apparatus and issue certification under the ISE's name

ON BEHALF OF SIEL SRL

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know what, know how

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O_2-Rebreather Evaluation Form

Has to be printed out and signed by the student before the end of the class!

Are you certified as a diver or equivalent with a minimum of 25 dives? Yes/no

Did your instructor cover the following?

Theory

Hypoxia	YES / NO
Hyperoxia	YES / NO
Hypercapnia	YES / NO
PPO2s	YES / NO
CNS Toxicity	YES / NO
OTUs	YES / NO
Did you receive and read the manual?	YES / NO

Unit maintenance

Direction of gas flow	YES / NO
Water traps	YES / NO
Mouthpiece	YES / NO
Counterlungs	YES / NO
Hoses	YES / NO
Sofnolime (packing/changing/lifetime)	YES / NO
1st stages	YES / NO
Second stages (bail-outs)	YES / NO

Cleaning of the unit

Boddy Clean	YES / NO
Disinfecting	YES / NO

Use of the unit

Pre-dive checks	YES / NO
Checking sofnolime	YES / NO
Contents of oxygen	YES / NO
Bailouts (when to)	YES / NO
Low and high PO2s	YES / NO
Warnings	YES / NO
Bubble check	YES / NO
Buoyancy on ascent	YES / NO
PO2 checking (frequency of)	YES / NO
Pressure gauge checking	YES / NO

Swimming Pool

Was your instructor present all the time? YES / NO

Estimated pool time.

Please list your exercises.

Open Water

Was your instructor present all the time? YES / NO

How many dives did you do?

Total in water time.

Please list exercises.

Do you think you can dive the CASTORO C 96 PRO CE on your own? If no, why not? YES / NO

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WATCH YOUR PO2s ALL THE TIME

WATCH YOUR O2 CONSUMPTION ALL THE TIME

I UNDERSTAND THAT IF I DIVE ANY OXYGEN REBREATHER AT AGREATER DEPTH THAN 6 METERS I EXPOSE MYSELF TO THE RISK OF A SPONTANOUS & FATAL OXYGEN HIT. I UNDERSTAND THAT IN FACT IT IS VERY LIKELY TO HAPPEN AND I WILL THEREFORE NOT DIVE ANY OXYGEN REBREATHER DEEPER THAN 6 METERS AT ANY TIME!!

I _____ have completed and understood all the above

DATE _____

Witness_____

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