

# ambient pressure diving

A+ Pro Divers  
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Plattsburgh NY 12901

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constant  
PO<sub>2</sub>

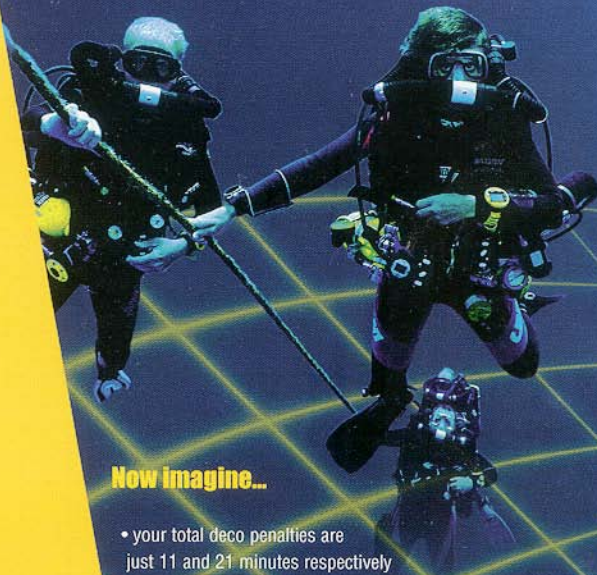
Inspiration  
CCR

NO bubbles  
20m - 170 mins - NO DECO

Less DOWNTIME - more time DOWNTIME



Photo: Reg Creighton <http://corinfa.com>



# IN

the world's  
first production  
closed circuit  
rebreather

## Imagine...

diving in the morning to  
30 metres for 60 minutes

experiencing the dive of your life:  
warm & relaxed with no worries about gas  
consumption and all the time in the world  
to explore - swimming so close to the fish  
you almost have to push them out of the way

after deco stops you surface for lunch  
and a few hours break

chill out, sunbathe and change  
the film in your camera

that afternoon, you dive again -  
30 metres for an hour

## Now imagine...

- your total deco penalties are  
just 11 and 21 minutes respectively
- no need to refill between dives  
- your gas consumption per dive  
is only about 40 bar of air and  
40 bar of O<sub>2</sub> from the two onboard  
3 litre cylinders
- no need to pre-mix gases for a  
pre-planned depth, no excessive  
cylinder carrying and no  
gas-switching during the dive
- a simple replenishment routine  
and you can do it all again  
tomorrow



# INSPIRATION

## What is a fully closed circuit system?

In contrast to conventional **scuba** or **open circuit** where most of the breathing gas is wasted on exhalation into the surrounding water, the Inspiration is a **fully closed circuit** system in which all of the exhaled breath is retained within a closed loop. It is then filtered and refreshed and recycled back to the diver for further use. Only during ascent and mask clearing are bubbles emitted.

## THE CLOSED CIRCUIT

[A] Exhaled breath leaves the diver's lungs and is directed into a one-way loop or closed circuit starting at the Inspiration's **exhale counterlung**.



1. 3 litre Oxygen Cylinder

2. 3 litre Diluent Cylinder

3. CO<sub>2</sub> Scrubber Unit

[B] It then travels, via a water-trap, over the right shoulder into the **scrubber unit** where it passes upwards through a chemical (Sofnolime) filter stack. This effectively scrubs the breathing gas of carbon dioxide.

[C] Inside the **mixing chamber**, three independent oxygen sensors (specifically developed for the Inspiration) measure the PO<sub>2</sub> of the mix enabling the electronic controller to accurately maintain a constant target level or **PO<sub>2</sub> setpoint** – by injecting pure oxygen when the oxygen pressure drops due to the diver's metabolism or ascent.

[D] Scrubbed and refreshed the breathing gas returns via another water-trap on the left shoulder into the **inhale counterlung** ready for use in the next cycle.

Exhaled Air

Oxygen

Breathing Gas

## THE DILUENT GAS

The Inspiration has two onboard 3-litre cylinders. One contains pure oxygen, the other a **diluent gas** - usually air. The diluent has several functions:

- Manually injected into the inhale counterlung on descent in order to **maintain counterlung volume**. It is also used for BCD and dry-suit inflation. Only small quantities are used – typically 30-40 bar per dive.

- As a 'diluent' or dilutant it **dilutes the gas mix** so that it is safe to breathe at depths greater than 6m.

- The third and extremely important function is that it provides a reserve gas supply for either a 'diluent flush' or open circuit bailout if needed. (See Safety & Bailout)

If trimix / heliox is used instead of air as the diluent supply and modification is made to the bailout contingency, the Inspiration can be dived to depths of 100m. However, it must be stressed, such advanced closed circuit diving should only be carried out by suitably experienced Inspiration divers who have achieved the appropriate advanced qualification with one of the recognised training agencies.

*"It's the most rugged and user-friendly unit I've seen to date"*

Craig Budden, Canadian mixed gas sat diver and MD of Aquasport, Eilat

## THE ADVANTAGES

### Dramatically Increased No-Stop Times

The significance of diving with an oxygen-rich breathing gas is that the percentage of inert gas is considerably lower. Consequently, the time allowed to dive before decompression is required – no-stop time – is dramatically increased.

Down to 30m these benefits are huge. For example you could stay for nearly 3 hours at 20m without requiring deco compared to just 36 minutes on open circuit.

Below 30m the Inspiration significantly extends no-stop time – typically twice the dive times at air-range depths currently dived on open circuit.

### Greatly Reduced Deco

If you do stay down long enough to incur deco penalties, these obligations are greatly reduced with the Inspiration. To give just one example:

A dive to 30m for an hour will incur only 11 minutes stop time compared to about 74 minutes deco on open circuit air.

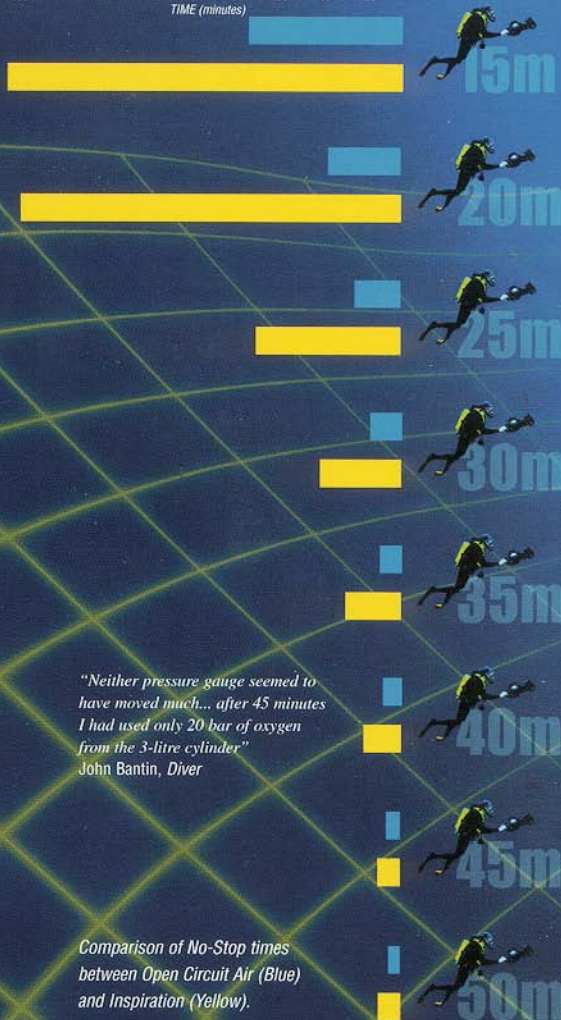
### Decreased Gas Consumption

One of the most significant advantages of fully closed circuit diving is the massive increase in gas efficiency.

Open circuit SCUBA is extremely wasteful of gas and this waste increases dramatically with depth. At 30m a typical open circuit diver breathes at the rate of 100 litres per minute; 98.9% of which is just volume make-up and is simply bubbled away - every minute!

In contrast, the Inspiration diver's breathing volume normally only needs to be made up once and the metabolised oxygen replaced as the dive progresses (average metabolic consumption = about 1 litre/min) - reducing the gas demands to a fraction of open circuit levels. **Greater gas endurance, smaller cylinders, less visits to the filling station and cheaper fills** (particularly when using Trimix) are just some of the benefits of Inspiration diving.

180 160 140 120 100 80 60 40 20  
TIME (minutes)



*"Neither pressure gauge seemed to have moved much... after 45 minutes I had used only 20 bar of oxygen from the 3-litre cylinder"*  
John Bantin, Diver

*Comparison of No-Stop times between Open Circuit Air (Blue) and Inspiration (Yellow).*

## Dive Duration

Dive Duration is limited by the CNS oxygen toxicity clock, the life of the CO<sub>2</sub> scrubber and the gas supply.

Oxygen exposure limits are laid down by NOAA and according to their Exposure Limits dive duration at the default setpoint of 1.3 bar is limited to 3 hours (or 3 1/2 hours per day). This will vary if a different setpoint is selected.

The duration of a Sofnolime fill depends upon factors such as the individual diver's CO<sub>2</sub> production rate, water temperature and work rate. In the third party testing for CE certification the Inspiration's **scrubber duration** was **3 hours in cold water** (4°C). The tests simulated a continual breathing rate of 40 litres per minute RMV and a CO<sub>2</sub> production rate of 1.6 lpm.

The onboard oxygen cylinder charged to 200 bar will provide 3 x 200 = 600 litres O<sub>2</sub>. **At the average 1 litre/min consumption rate - this gives 10 hours of diving!** Even if you had to work really hard on a series of dives and doubled your usual metabolic rate (to about 2 litres/min) – you would still get 5 hours or so from the one 3 litre.

## Safety and Bail-out Features

### Diluent Flush and Bailout Options

As gas consumption is so low – typically only 30-40 bar per dive – a large proportion is available for either a diluent flush of the loop or open circuit bailout.

#### Diluent Flush

The diluent gas provides a key safety option – the diluent flush. That is, it can be manually injected into the inhale counterlung to immediately supply gas which is both instantly breathable and a 'known' mixture – allowing the diver to check and validate his oxygen sensor readings.

#### Manual Flight

Both handsets display the PO<sub>2</sub> measured by the 3 sensors in real-time and can be used as a simple monitor, if necessary, allowing the diver to maintain the PO<sub>2</sub> level in the loop by the manual operation of the oxygen or diluent valve.

#### Open Circuit Bailout

If there is still any doubt about continuing the dive on closed circuit the Inspiration has the facility to bailout to open circuit. An Auto Air – emergency demand valve / inflator (EN250 quality) is fitted as standard and the bailout procedure is to simply close the Inspiration mouthpiece and swap it for the Auto Air to breathe directly from the diluent cylinder. Alternatively, an octopus regulator may be fitted to the diluent cylinder (provided it is a downstream type).

#### Pure O<sub>2</sub> Bailout at 6m or above

Another option is to fit an oxygen clean 2<sup>nd</sup> stage (with isolator valve) for emergency breathing of pure O<sub>2</sub> from the oxygen cylinder at 6m and shallower.

The volume of bailout gas is as much a limiting factor to your dive planning as the gas configuration selected. Proper pre-dive planning is essential to ensure that you have sufficient volume of respirable bailout gas for the type of dive intended to allow a safe ascent on open circuit at any stage.

## Quality, Testing and Safety

In 1997, after years of intensive R&D, the Inspiration underwent rigorous and exhaustive testing by the Royal Navy at the Defence Evaluation & Research Agency (DERA) at Alverstone. S.G.S. International Certification Services, an independent third party, carried out a series of manned and unmanned tests so that the Inspiration could achieve the desired and obligatory CE Approval. Both sets of examiners were suitably impressed and the Inspiration was approved with flying colours, in many cases setting new standards for the industry.

Photo: Reg Creighton <http://icertinfo.com>



*"For me, it's a beautiful unit because it opens up the door to recreational rebreather diving with mixed gas."*  
Maurizio Mongelli, Italian 3 Star CMAS Instructor and TDI Course Director

# INS

## OXYGEN CONTROL

Developed specifically for the Inspiration, the O<sub>2</sub> controller is unique. It features a variable O<sub>2</sub>-inject time depending on the variance of the O<sub>2</sub> level from the chosen PO<sub>2</sub> setpoint: the further from the setpoint, the longer the valve opens. So even during fast ascents or periods of high workload, the controller is easily able to maintain the setpoint without manual intervention by the diver. **The Inspiration is unique among closed circuit systems in that it's oxygen controller holds the O<sub>2</sub> pressure at the mouthpiece within an extremely tight tolerance band – typically  $\pm 0.02$  bar.**

**The Inspiration has two independent control systems:** one Master (primary control) and one Slave (back-up control) each with it's own power supply. All three O<sub>2</sub> sensor readings are displayed in real-time on both Master & Slave handsets. This allows you to compare sensor values and validate or 'sanity-check' the displayed readings before and during the dive against known values. The controller software also carries out sensor comparison and an audible warning will sound, together with a flashing display, if sensors stray abnormally, giving you time to assess the problem and take appropriate action. In the event of the Master shutting down the Slave will instantly take over and control the PO<sub>2</sub> in the loop.

## Super Nitrox Diving

### Constant Partial Pressure of Oxygen (PO<sub>2</sub>)

The Inspiration maintains a constant PO<sub>2</sub> at the chosen setpoint throughout the dive. This gives the advantages of oxygen-rich diving at every stage of the dive down to 50m.

### How does this work?

On open circuit scuba the gas mix is constant (approx. 21% O<sub>2</sub> in air) at all depths while the PO<sub>2</sub> is variable – i.e. 0.21 bar at the surface, 0.42 at 10m, 0.63 at 20m and so on.

With the Inspiration it is the opposite case: the PO<sub>2</sub> is constant and the mix or fraction (FO<sub>2</sub>) is variable. The PO<sub>2</sub> is held at the chosen setpoint by the controller injecting oxygen into the breathing loop. The result is that the FO<sub>2</sub> varies with depth.

This can be understood if you imagine a diver ascending from 50m...

At 50m the ambient pressure is 6 bar. The Inspiration controller maintains the PO<sub>2</sub> at the chosen default setpoint of 1.3 bar.\* - so, the fraction of oxygen in the loop is  $1.3 \div 6 = 0.21$  or 21%. As the diver ascends the ambient pressure drops but oxygen is injected by the controller so that the PO<sub>2</sub> is held at 1.3bar. Therefore the percentage of oxygen in the mix rises. For example: at 30m (4 bar) he would breathe  $1.3 \div 4 = 32\%$ , at 16m : 50%, at 6m : 81% and at 4m : 93% O<sub>2</sub>.

**In other words, the Inspiration delivers super nitrox – the optimum oxygen-rich mix at every depth throughout the dive and a super-O<sub>2</sub>-rich mix during decompression.**

\*The Inspiration has 2 default setpoints: 0.7 bar used at the surface and the descent and 1.3 bar for the dive. Both setpoints are user adjustable (underwater if necessary): the lower from 0.5 to 0.9 bar and the higher from 0.9 to 1.5 bar.

# INSPIRATION

## The INSPIRATION closed circuit rebreather

The Inspiration ccr is the world's first production rebreather and the first to gain CE certification: approved to 50m (40m recommended) with air as the diluent and 100m with trimix / heliox.

The Inspiration offers *super nitrox diving*. That is, the unit's oxygen controller automatically maintains a constant partial pressure of oxygen (PO<sub>2</sub>) in the breathing loop and thereby delivers a variable fraction of oxygen (FO<sub>2</sub>) – in other words, the **optimal gas mix at every depth** – an oxygen-rich mix throughout the dive and a super-rich mix during decompression.

This means **unprecedented versatility**: deep wreck or shallow reef – the same prepped unit will give you the best mix at every depth – offering all the no-stop time, depth and deco advantages of nitrox but without the pre-planning of target-depths, pre-mixing gases, excessive cylinder carrying or gas-switching during the dive.

**Super nitrox Inspiration diving** gives dramatically **increased no-stop times**, greatly **reduced deco obligations** and **outstanding gas efficiency** (becoming *super efficient* at depth compared to open

circuit – a major advantage for tech divers). With other significant benefits, such as low gas costs, less bulk and clutter, perfect buoyancy control, warmer, quieter diving and no bubbles to scare off the wildlife – **the Inspiration is the future of diving now**, offering a whole new experience to sport, technical and commercial divers alike.

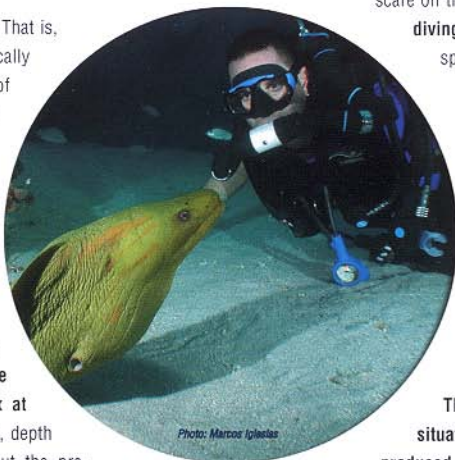


Photo: Marcos Iglesias

**Closed Circuit Rebreathing has been around for over a hundred years** – much longer than conventional scuba. However, until now it has been the exclusive preserve of specialist military, commercial or 'home-build' pioneers – with equipment manufactured in limited numbers at considerable cost.

**The Inspiration has revolutionised that situation** – being the world's first commercially produced, affordable unit – it has sold to sport, technical and professional divers in over 40 countries.

Rigorously tried, tested and approved by third party agents in the UK and US, the Inspiration is manufactured to routinely regulated QA standards of production, build quality and spec and offers all the advantages of a premium after-sales service and factory spares supply.

*"My conclusion, the Inspiration could be the most significant development in diving since Cousteau invented the aqualung."*

John Bantin, Diver

## Maintenance and Consumables

At the end of the day's diving you will need to change the Sofnolime fill – the chemical granules that absorb CO<sub>2</sub> in the scrubber. The Inspiration will need to be washed out thoroughly with fresh water as you do with all kit, and at the end of the trip, sterilised with an appropriate disinfectant such as BUDDYClean, which is made specifically chosen for dive equipment. BUDDYClean is effective against bacteria, fungi and viruses including Legionella, Weils Disease, HIV and TB. Sofnolime and BUDDYClean are available direct from Ambient Pressure Diving or any well-stocked dive centre.

Batteries will need changing after approximately 20 hours of diving and the oxygen sensors every 12 to 18 months depending on use and how well the unit is maintained. Full factory servicing is available.

## Training and Experience

The Inspiration is a specialist piece of equipment and will only be sold by APD to certified divers who have successfully completed an Inspiration-specific course with one of the recognised training agencies. It is absolutely essential that the type of diving practiced should always be appropriate to the level of training and experience achieved.

Worldwide training is available from Inspiration Diver through to Trimix Inspiration, and Instructor levels. For further information contact the factory: +44 (0)1326 563834 or visit the website: [www.apdiving.com](http://www.apdiving.com).

## Accessories and Parts

A wide range of accessories are available including: the Nexus oc/cc dive computer, Inspiration weight & cargo pockets, an Inspiration kit box, cylinder band kits, pony-cylinder bands, air-filling tools, pressure gauge options, and the superb BUDDY smb range, pocket reel and jon-line.

A complete stock of individual replacement parts and service materials are readily available to registered owners.



Ultimately versatile - from deep wreck to shallow reef - Constant PO<sub>2</sub> delivers the optimal gas mix, whatever the dive



CE approved to 50m (40m rec.) with air as the diluent and 100m with trimix / heliox



Worldwide training available with the leading agencies



Sold to sport and technical divers in over 40 countries



Premium after-sales service and factory spares supply

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