

UMBILICAL SUPPLIED REBREATHER

Model: DEEP WORKER

FEATURES

- Available in saturation dive and surface supplied versions (LP and HP umbilical, respectively)
- CE and NORSOK certified, and meets breathing performance requirements even at depth of 350m.
- Functional Safety certified to IEC 61508:2004 SIL 3 – the Gold Standard for Functional Safety standard.
- Payback period of months from helium savings compared to gas reclaim, and payback in days compared to deep open circuit.
- Safe EAC scrubber technology, up to 10 hours duration.
- Integral full gas monitoring: O2, CO2, CO, VOCs and Helium with auto-bump testing.
- Integral diver respiratory monitoring.
- Integral diver comms, x2.
- Optimal decompression.
- Slim Combined Umbilicals boost diver productivity.
- Low maintenance.
- Full diver monitoring, and telemetry, including voice and video (x2).



APPLICATIONS

Deep Worker rebreathers are available in three configurations:

1. **Sat Diver:** a LP Combi-Umbilical is used to link the diver to the bell, and the diver operates in SCR mode to keep the maximum percentage of oxygen within IMCA Guidelines.
2. **Surface Supplied:** a HP Combi-Umbilical is used to provide full pressure of gas for the rebreather and open circuit bailout from the surface. This is regulated down to a 10 bar working pressure on the rebreather.
3. **Emergency Intervention SCUBA:** fully self contained, for use with full face masks. SCUBA is not recommended for commercial diving: the configuration is supplied for emergency use only.

DESCRIPTION

The **Deep Worker** rebreathers are the product of an 8million Euro project, including sponsorship by Technip and Statoil, delivering unprecedented performance, meeting all CE and NORSOK requirements even at 350m depth. As the first dive system to meet a recognised Functional Safety standard they deliver a new era of diver safety.



The twin scrubber design, with pre-scrubber gas heating, achieves over 10 hours scrubber duration in 4C water, at high work rates (diver metabolising 1.35lpm of O2 continuously).

The Deep Worker operates using two Micropore EAC scrubbers, with parallel gas flow for the maximum dwell time and efficiency. Micropore EAC scrubbers: these are non-dusting, non-clumping and flood tolerant. The whole rebreather can be flooded and recovered from a flood underwater safely.

A technician training package is available to allow all maintenance and service functions to be carried out on-site.

A complete infrastructure package is available with video, voice, umbilicals, top side monitors, gas supply systems and training.



The Deep Worker contains a miniature gas analysis laboratory, monitoring O2, CO2, CO, VOCs, H2S and He gases as well as the diver's respiratory rate, tidal volume, and the rebreather parameters.

Digital data telemetry provides this data to a 19" surface monitor, with options for the monitor to be supplied either in Pelican case format or rack panel display (shown on left).

The rebreather logs all telemetry data, in a 4GB flash memory that does not depend on external power to maintain it.

Two channels of video with data overlay is presented on a second monitor. Two HD cameras are supported. Data overlay directs dive supervisor to safety or telemetry screens when appropriate.

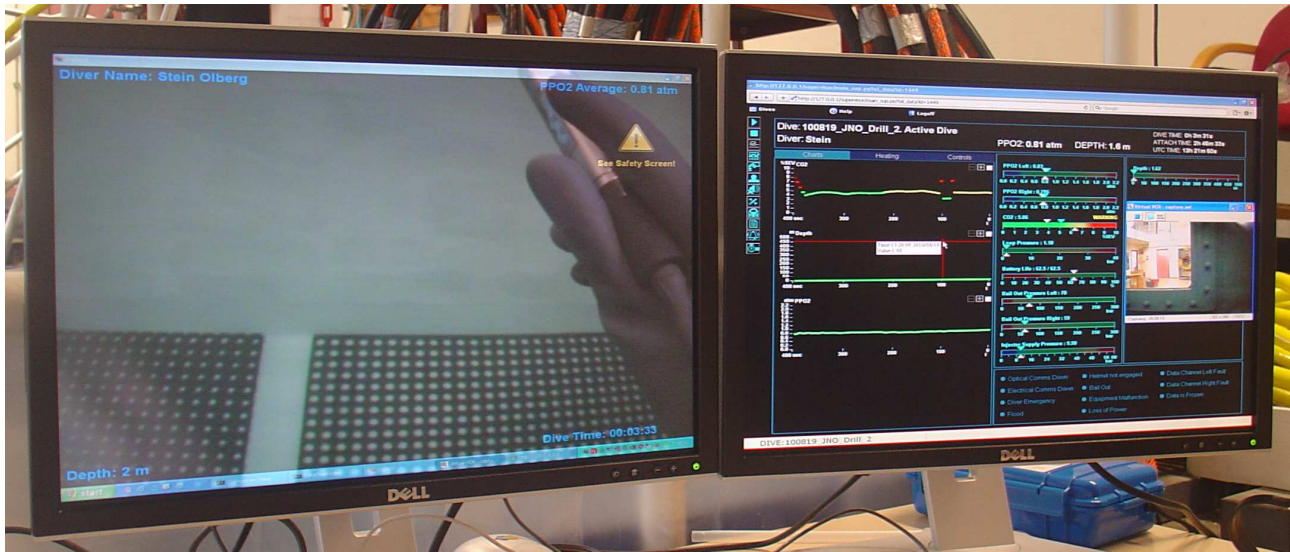


A quick connect stab plate links the rebreather to the diver's helmet. A quick attach plate on the AR Vest supplied allows the diver to don or doff the system quickly when dressing.

The Deep Worker provides full bail-out functionality, including automatic bail-out to Open Circuit (supplied from umbilical gas), automatic bail-out to SCUBA rebreather (on loss of umbilical gas), and has provision for off-board bail-out systems.

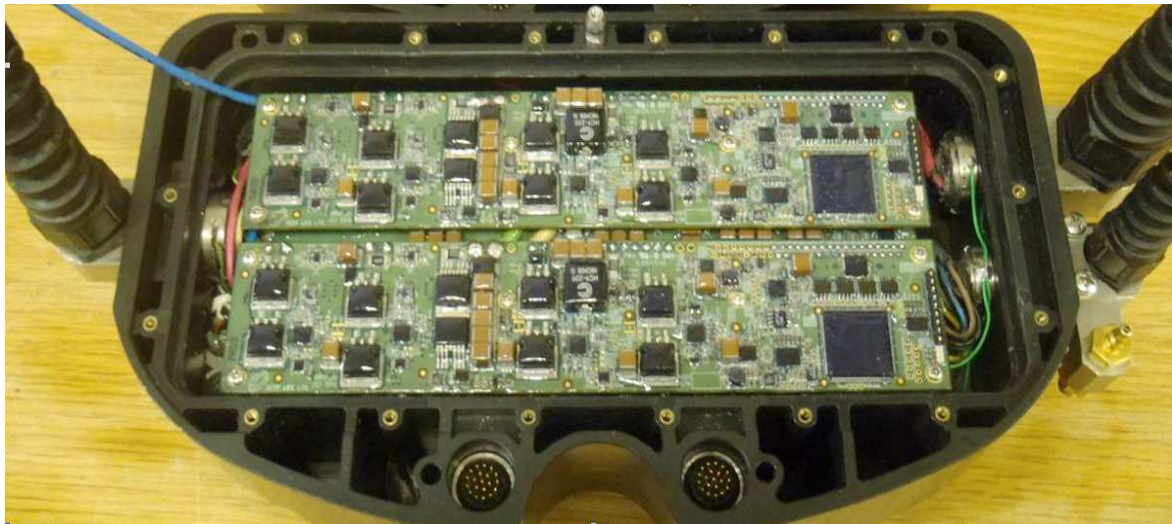
IMPROVED DIVE MONITORING

Voice communications are provided by active microphones, using the same ultra-reliable mic capsule used by Russian tank crew, fighter pilots and manned space missions, with spectral processing to correct for the distortion in oro-nasal masks, and a fully digital output.



Above: the supervisor display from a diver using the Deep Worker rebreather.

Below: Communication options include RS485, fibre optics and through water comms.



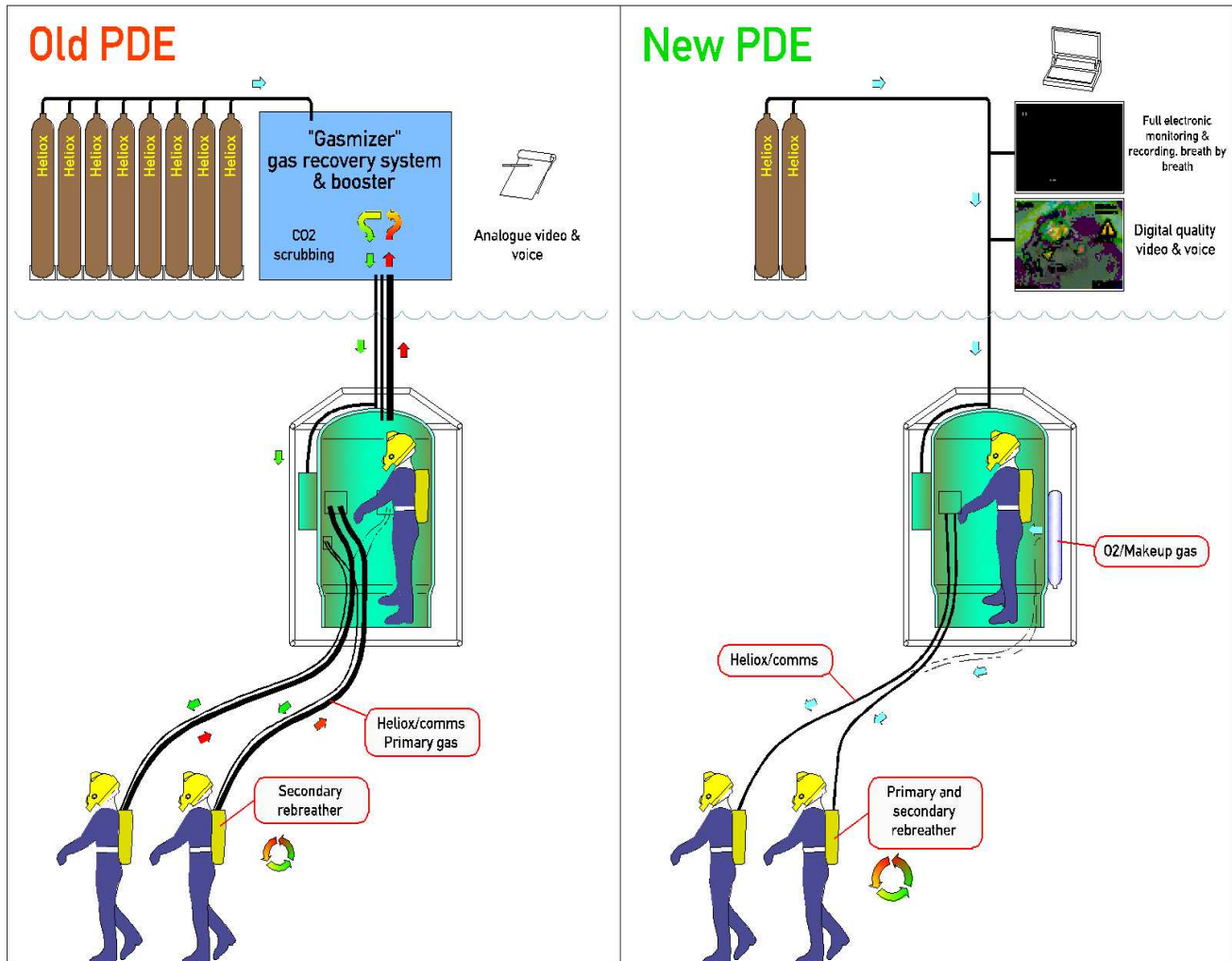
The Deep Worker provides the diver with dual redundant mobile laboratory on his back, monitoring every aspect of his safety, from PO₂, end-of-tidal PCO₂, VOCs, temperature, breathing rate etc. Combined with video and voice channels, these are sent to the top surface via optical fibre using the unit below. An RS432 copper alternative to the optical fibre is available.

This allows the supervisor to see what the diver sees in high resolution, with two cameras, speak with the diver over the best quality voice link, and see all rebreather parameters visualised. To reduce overhead

on the supervisor, the safety data is overlaid on the video to direct the supervisor to the appropriate screen and provide a summary of the rebreather status.

LOGISTIC SAVINGS

As well as the helium costs, the logistical costs where large amounts of gas have to be stored on a vessel are substantial. The old Personal Dive Equipment (PDE) and new with Open Safety's Deep Worker Umbilical Rebreather, are compared below.



HELIUM COST SAVINGS

Compared with legacy gas reclaim systems, the Deep Worker greatly reduces costs and the supply infrastructure.

Compared with legacy gas reclaim systems, the Deep Worker greatly reduces costs and the supply infrastructure. Instead of an 85% gas efficiency for gas reclaim, the Deep Worker is almost 100% gas efficient – efficiency is with reference to open circuit, which means that 15% of Open Circuit gas is a vast volume of gas – usually helium. In helium cost savings alone, the Deep Worker can break even in as little as 3 months use.

Helium is a precious resource that is rising in cost. The helium cost per diver, per bell run, for open circuit is tabulated on the right. Even using legacy gas reclaim systems, the cost is still 15% of this. The cost of acquiring Deep Worker rebreather systems can break even in as short as three months when it replaces gas reclaim, or in days using open circuit.

Table: Helium cost per diver, open circuit for 7 hour shift. Gas reclaim reduces cost by 85%, Deep Worker reduces cost by 99%.

Depth (MSW)	Helium Price			
	\$18/m ³	\$20/m ³	\$22/m ³	\$24/m ³
50	\$1,814	\$2,016	\$2,218	\$2,419
100	\$3,326	\$3,696	\$4,066	\$4,435
150	\$4,838	\$5,376	\$5,914	\$6,451
200	\$6,351	\$7,057	\$7,763	\$8,468
250	\$7,862	\$8,736	\$9,610	\$10,483
300	\$9,373	\$10,416	\$11,458	\$12,499
350	\$10,866	\$12,096	\$13,306	\$14,515

TECHNICAL SPECIFICATION

Parameter	Value or Description
Dimensions (L, W, D) cm, ready to dive	65 H x 53 W x 22.5 D Diver (100kg weight, 55cm wide at shoulder) wearing rebreather and KMDS helmet can pass through 600mm diameter trunking.
Weight, ready to dive	31kg including helmet DSV, scrubbers, gas, comms, umbilical quick disconnect.
Power requirements	12V to 24V DC for USR itself, 12W.
Limits of scrubber duration.	If the gas heating is off, then the CE certified scrubber endurance is 3 hours at depths from 0 to 40msw, 1 hour 50 minutes at all depths from 40msw to 100msw. If the gas heating is maintaining 32C+/-5C scrubber inlet temperature, then the CE certified scrubber endurance is 10 hours regardless of depth or gas mixture to 250msw, and 4 hours 30 minutes from 250msw to 350msw, at a work rate metabolising 1.35lpm of O2.
Advisory Depth limit	Deep Heliox: 250msw to 350msw Heliox, 4.5 hours with gas heating, 30 minutes without gas heating Routine Heliox: To 250msw Heliox, dives up to 1.5 hours without gas heating, 6 hours with gas heating as specified in this manual (absolute maximum of 10 hours duration). Nitrox: 30msw advisory for Nitrox (Narcosis limit), 40msw max safe limit using air make-up-gas, for up to 10 hours duration with gas heating.

Maximum dive duration	12 hours to 50m depth. After 50m depth, gas heating is used: duration is 10 hours with gas heating on at 100m, 4 hours at 350m depth. 6 hours with gas heating off (1.35lpm of CO2) at 100m depth. 1.8 hours any 100m depth at 1.82lpm of CO2 at 21C gas, 4C water temperature, gas heating off.
Work of Breathing at 75 lpm.	WOB limit using Heliox is 350msw (2.75J/L or 25mbar breathing resistance) at NORSOK 90lpm RMV. Corresponding limit to CE respiratory limits occurs at 450m depth. 1.44 J/L @ 40ms on air. WOB depth limit 100msw using air (narcosis limit on air is 40msw, and advisory working limit on air is 30msw).
Oxygen dosing	Automatic Demand and variable orifice valve with monitoring by laser imaging.
PPO2 control safeguards	Automatic bail out if rebreather set point is not controlled adequately by diver.
Bail out valve	Automatic with 15 second warning, fitted as standard.
Maximum back mounted cylinder size	2 x 3 litres
Loop flow	Right to left. Different flapper valve spiders prevent reversal.
Scrubber Type	Micropore EAC 125mm diameter, large bore, 2.2kg, 2 off
Flood Clearance Capability Underwater	Yes, full.
Gas Analysis	O2, CO2, Helium, CO+VOCs all with automatic calibration check using auto-bump testing prior to the start of each dive.
PPO2 Monitoring	PPO2, solid state and galvanic sensors
CO2 Monitoring	Expired CO2, 0 to 7kPa, dual channel, dual phase IR based. Respiratory rate monitor. Scrubber health monitor.
Helium accuracy	+/-3%
Narcosis alarm	Yes
Diver attention monitoring	No
Battery duration	30 hours in use, 3 months storage
Recharge cycles	2000
Display type	Dual colour TFT, voice annunciation and LED

Peripheral Field Display	Fitted as standard, with LED and voice annunciation
EN61508 SIL Level	Managed by a fully certified IEC EN 61508 process to SIL 3. Product is certified to IEC EN 61508:2004 SIL 3 (corresponding to US SIL B).
Operating temperature	4C to 34C
Storage temperature.	0C to 50C with sensors fitted, and -30C to 50C without sensors.
Primary Compliance	CE EN14143:2003 NORSOK U-101:1999 Functional Safety EN61508:2004 SIL 3
Notified Bodies	CE Design Type Approval Certification is by SGS United Kingdom Ltd, Weston-super-Mare, BS22 6WA. UK. Notified Body No: 0120". Production Surveillance is by BSI Ltd. Copy of certification certificates and a declaration of conformity is supplied with every product.
Diver requirements	Divers must pass a manufacturer-approved training course on this UBA. Divers should be fit and have an up-to-date satisfactory diver's medical certificate.

ORDERING

Model	Brief Description	Max Dive Duration
Deep-Worker USR-350	Surface Supplied Commercial Diving Dual scrubber eCCR+eSCR rebreather, including helmet interface, communications to surface and HP umbilical, gas heating. Fully CE Certified and Functional Safety Certified.	12 hours at 50m 10 hours at 100m 4 hours at 350m
Deep-Worker- SatDiv-350	Saturation Diving Dual scrubber eCCR+eSCR rebreather, including KMDS Mk37 helmet interface, dual channel video and voice communications to surface and LP umbilical, gas heating. Fully CE Certified and Functional Safety Certified.	2 hours at 50m 10 hours at 100m 4 hours at 350m
Deep-Worker- Searcher 350	SCUBA Dual Rebreather back mounted trimix eCCR+eSCR rebreather for emergency intervention use. FFM Interface. Fully CE Certified and Functional Safety Certified.	7 hours at 100m 4 hours at 350m