Operations manual

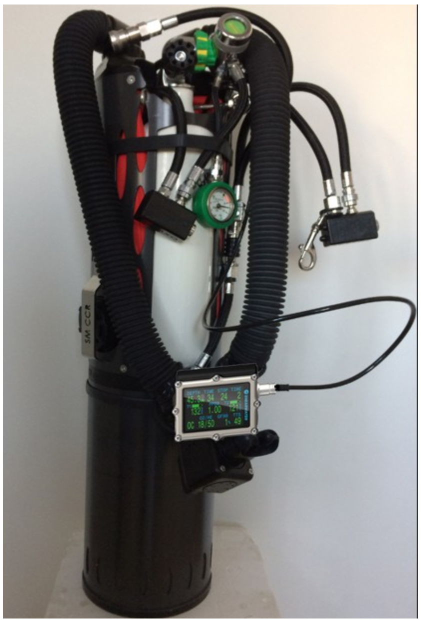
of breathing apparatus

T-REB®

DiveCAN ® by *Shearwater*

[Petrel 3 Rebreather Controller Model]

(CE Issue 1.0)



Important notes and warnings

- Never use a breathing apparatus T-REB® without achieving an appropriate level of training.
- This instruction manual does not replace the skills acquired during the training and the content contained herein shall not be treated as guidelines for diving with a rebreathing apparatus.
- Like any device, breathing apparatus may at any time and without any warning cease to function properly. It is mandatory, during every dive, to have and autonomous breathing system with an open circuit. This system must allow for safely interrupting the use of breathing apparatus T-REB® in every phase of the dive, in case of the failure of the device.
- While using the breathing apparatus T-REB®, do not neglect exercising the skills acquired during the course and constantly deepen your knowledge of diving.
- Making changes to the device results in the immediate loss of the CE certification and cannot guarantee the safety during the dive. Likewise is in the case for negligence in the handling and servicing of the device.
- Making changes to the device results in the immediate loss of the warranty and cannot guarantee the safety during the dive. Only factory service of the device, or its modified parts, can restore the factory-made condition. All activities related to the need to restore the factory-made condition will be burdened by the cost.
- Spare parts, repairs and service of the device are available only to customers that can demonstrate appropriate training certificate authorizing the use of the breathing apparatus T-REB®.
- It is of utmost importance that you carefully read the instruction manual in its entirety.
- If you do not agree with the above cautions and warnings you should not dive with the breathing apparatus T-REB®
- In countries, which are not members the European Union, there may be additional requirements for use of the apparatus T-REB. Before using the apparatus manufactured by OTHER GRAVITY Sp. z o. o., please check the current requirements in force in the country, where you intend to use it.
- The content of this manual is based on the knowledge available at the time of going to print. OTHER GRAVITY Sp. z o. o. reserves the right to introduce amendments at any time.
- Apparatus manufactured by OTHER GRAVITY Sp. z o. o. may only be used with cylinders having legalization consistent with the current requirements applicable in the country, in which you plan to use it.
- Please note that deep diving increases the risk of decompression sickness and other diving diseases. To perform deep dives, you must take special training in an applicable diving center. Apparatus manufactured by OTHER GRAVITY Sp. z o. o. ensures reliable operation to a depth of 100m. Nevertheless, the divers shall adhere to the restrictions prescribed by local regulations in force at the dive site.

Table of contents.

1. Manufacturer.

T-REB®, a rebreathing apparatus with lateral installation system, was designed and is manufactured in Poland by Other Gravity Sp. z o. o., Kineskopowa 1B lok. 33-34, 05-500 Piaseczno, Poland

1.1 CE Certificate.

Apparatus described in this manual has been subjected to a certification process in the notified body, Polish Register of Shipping S.A., and meets the requirements of Directive 89/686/EEC and the standard EN 14143: 2013 Respiratory equipment.
The CE mark indicates conformity with the requirements, and the number 1463 next to the CE mark is an identification code of the Polish Register of Shipping S.A.

1.2 DiveCAN controller.

In a closed circuit diving apparatus, it is necessary to remove carbon dioxide and supply oxygen to the breathing circuit. Carbon dioxide is removed using an absorber, soda lime, and oxygen is supplied from a pressure tank. The basic parameter controlled by all used control systems is the partial pressure of oxygen (PPO2) measured in the breathing loop.
The T-REB DiveCAN eCCR uses for this purpose an electronic PPO2 control system manufactured by Shearwater Research Inc., Canada, a leading global manufacturer of diving computers and CCR control systems.
The T-REB DiveCAN eCCR has a MiniSOLO (solenoid valve control) board integrated with the sensor head, responsible for continuous oxygen portioning to the breathing loop.
The basic rebreather controller used in the T-REB breathing apparatus is the Petrel 3 handset, an interface enabling control of PPO2 settings. It also provides data on other important diving parameters, such as temperature, time and decompression stops calculated according to the algorithms used.

The following user manual describes only those interface functions that are responsible for managing PPO2 in the breathing loop and for controlling the power supply to DiveCAN devices.

All other information on how Petrel 3 improves diving and handles dive data for the diver can be found in the Petrel 3 user manual, which can be found on the manufacturer's website: https://https://shearwater.com/pages/petrel-3-support

2. Introduction

Thank you for purchasing breathing apparatus T-REB® We believe that our device will allow you to perform unforgettable dives and will open new possibilities for underwater exploration. We believe that you will be able to enjoy the parameters of our equipment, developed with the participation of divers and produced using advanced technology.

We thank you for your choice and wish you many safe dives.

Before initial use of the apparatus manufactured by OTHER GRAVITY Sp. z o. o., please read in detail and understand all the information presented in this instruction manual. Getting acquainted, understanding and compliance with its content is a prerequisite for safe and long-term use of the apparatus shown in this instruction manual.

It is recommended to keep this manual for the lifetime of the product. OTHER GRAVITY Sp. z o. o.'s apparatus can only be used in a way that is presented in this instruction manual.

OTHER GRAVITY Sp. z o. o.'s apparatus is a precision mechanism. Due to the important role it plays during the dive, it requires care on the part of the owner / user. For the efficiency and lifetime of the apparatus to be as good as possible, please comply with the recommendations contained in this instruction manual.

The manufacturer hopes that the functional properties of the APPARATUS manufactured by OTHER GRAVITY Sp. z o. o. will give you a lot of satisfaction and make diving more enjoyable.

OTHER GRAVITY Sp. z o. o. shall not be liable for damages resulting from failure to comply with the provisions contained in this instruction manual.

The design of the device was being developed from 2013 and resulted in many hours of dives on the prototype device in various hydrological conditions. The effects of diving on the T-REB® test equipment, as well as the opinions and voices of experienced divers, encouraged us to produce a breathing apparatus that allows its use in the sidemount system (SM), and at the same time allows the apparatus to be easy to use and transport.

Developing the project, we were guided by the following objectives:

•The accuracy and robustness of workmanship thanks to high-end materials such as Delrin and aluminum.

•Integration in a single enclosure of the oxygen supply, counterlungs, radial CO2 scrubber and a system for measuring and controlling oxygen partial pressure.

•The simplicity of design guarantees it is easy to put on the equipment in all conditions.

•Excellent fusion of breathing apparatus with a diver limiting hydrodynamic resistances underwater and on its surface.

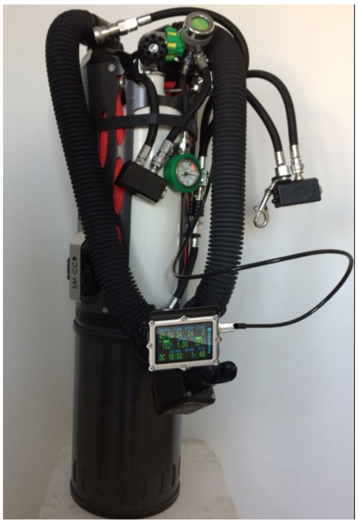
•The ability to remove the device underwater and its deposition without the need for ascent.

•The possibility of using of the device with the use of simple and reliable electronics managing partial pressure of oxygen in the breathing loop and informing the diver about the basic parameters of diving with rebreathing apparatus.

•The use of visual alarm system in the event of production of hypoxic or hyperoxic breathing gas in the breathing loop of the apparatus.

•Presentation of reliable test results of respiratory parameters of the device.

3. T-REB® – description of the apparatus



Architecture of the breathing apparatus T-REB® is shown on page 42

3.1 T-REB® – construction and functionality

•Body of the apparatus is made of high-quality, hard, sea water corrosion-resistant aluminum, additionally coated with a layer of ceramic surface with a Teflon surface coating. The remaining structural components were made from high quality Delrin and stainless steel 316L. Counterlungs have a capacity of 4.6 liters, a 3D shape and are covered with polyurethane on the inside, which prevents colonization of the surface by microorganisms.

•The apparatus consists of breathing hoses with mouthpieces, containing the loop directional valves and a dive surface valve (DSV), shutting off the breathing loop from the environment. Apparatus in the upper part of the body contains two counterlungs (exhalation with an overpressure valve (OPV), a manual addition valves (MAV) for diluent and oxygen, an automatic oxygen supply solenoid valve, a female quick connector for diluent, 2l cylinder for compressed oxygen. Both MAV's are with the inflator pins allowing connecting gas from an external supply line. The head with the connections to the breathing hoses has a sidemount attachment system to the "bungee" on the right side of the diver. A removable electronic head head a head with oxygen sensors and MiniSOLO board by Shearwater, which is also the part where loop is separated. The radial flow CO_2 scrubber with its housing is the site where the "snap bolt" of a simple mounting system is attached.

•You can monitor the composition of the gas in the breathing loop on the display mounted on the forearm. Monitoring of the parameters of the oxygen partial pressure in the breathing gas of the loop is done via the Petrel 3 rebreather controller by Shearwater. Oxygen is added to the loop automatically via the solenoid valve or manually by means of MAV.
Additionally, a wire transmitting the analog signal of the three oxygen sensors is placed within the head. The cable is provided with a universal Fischer 7 pin connector or industrial AK 4pin

•Communication between electronic devices is done digitally with use of the DiveCAN implemented hardware.

3.2 Technical data:

Dimensions	H x W = 750 x 175; Weight netto 17 kg, brutto 19,5 kg
Container with the scrubber	Type: Radial Soda lime: approx. 2.5 kg (Sofnolime 797, 1.0 mm-2.5 mm) Usage time: 180 min Operating parameters: 40 l / min. of air, 1.6l / min. of CO2, 4°C
Scrubber	Sofnolime 797, 1.0 mm-2.5 mm Molecular Products
Oxygen cylinder	2 liters, steel (200 bar)
Diluent cylinder	Unintegrated external supply minimum 5l, 200 bar
Consumption of gases	Oxygen: Under normal conditions, the oxygen consumption by the diver is 0.7l / min which allows for the theoretical oxygen consumption for 570 min. Taking into account the 30% margin of safety, the oxygen will be sufficient for 400 minutes. 2lx200bar=400l – 30%=280l/0.7l/min=400min Diluent: diluent consumption depends on the technical profile of the dive
Batteries Petrel 3	45h, 60h, 130h, AA 1,5V Alk., 1,5V Li, SAFT LS14500
Batterie MiniSOLO	9V Energizer Lithium Ultimate
Capacity of the counterlungs	2x 2.3 liters
The permissible depth of the dive	40m with air 100m with trimix **NOTE:** It is strongly recommended not to exceed END = 30 **WARNING:** Diving deeper than 100m is possible, but involves additional risk
Purity of the gases	Air: DIN EN 12021:2014-08 Oxygen: >99.5% (medical oxygen) Helium: >99.996 (Helium 4.0)
1st stage	DIN M26x2, operational pressure 6 ± 1 bar
Oxygen sensors	NaNS01 Oxygen Sensor
Oxygen alerts	Low ppO2: ≤0.4 bar High ppO2: ≥1.6 bar
Temperature ranges	Diving: from +4°C to 34°C Brief exposure to air: from -10°C to + 50°C Storage: +5°C to +28°C
Safety purge valve	12 bar

3.3 Temperature conditions of diving

Diving with the use of breathing apparatus T-REB® can only be performed in the temperature of the surrounding water from +4 to +34 degrees Celsius. Dives beyond this temperature range can lead to transient disturbances of the process of diving.

3.4 The physical effort during the dive

Breathing apparatus T-REB® is designed as a device for respiration during recreational and technical dives in the water without making a physical effort other than the change of depth and calm, horizontal movement. Breathing apparatus T-REB® can be used in conditions of increased physical activity, however, one should take into account all the risks that are its consequence. In particular, increased oxygen consumption, increased excretion of CO2, the extension of the reaction zone of the scrubber, increasing the breathing resistance and the possible CO2 retention in the lungs and its physiological effect. With this in mind you should always have an adequate margin of safety resulting from the knowledge of the capabilities of your own body. It should be remembered that the risk of dangerous course of the dive with increased physical effort increases with depth.

3.5 Visibility

On the surface and during the dive, the diver has the ability to monitor the indications on the display by placing it on the forearm or wrist on the side on which the apparatus is mounted. This means that at any moment it is possible to monitor the basic parameters of the dive. In extreme cases of the lack of visibility, the breathing gas and setpoints parameters may remain unread. Therefore it is recommended to dive in conditions of not less than 30cm. No possibility of reading the indications of the instrument constitutes an enormous operational risk for the dive.

3.6 Oxygen under high pressure

Breathing apparatus T-REB® is designed as a breathing device in which existing breathing mixture is supplemented with the oxygen stored in a high pressure tank. The device is adapted to such conditions and is in compliance with oxygen purity. Take extra care when filling the tanks with oxygen and keep all components in oxygen purity. Repair and maintenance of parts exposed to high pressure oxygen values can be performed only by the relevantly authorized services. Failure to comply with these instructions may result in fire or explosion, which can lead to a bodily injury or death.

3.7 The expected concentrations of respiratory gases

The DiveCAN electronic system of the breathing apparatus T-REB® is designed as a device for breathing in which existing breathing mixtures is supplied with the oxygen up to the partial pressure between 0.4 and 1.6 bar.

3.8 The high partial pressure of oxygen

The breathing apparatus T-REB® is designed as a device for breathing in which existing breathing mixtures is supplied with the oxygen up to the maximum partial pressure 1.6 bar.

3.9 The expected concentration of gas in the respiratory mixture of the loop

As mentioned, the partial pressure of oxygen in eCCR of T-REB® is between 0.4 and 1.6 bar (high and low). In this respect, it is also possible to set the setpoint value. Defined and set oxygen partial pressure will result in varying its concentration depending on the depth.
The following table shows the values of selected parameters to a depth of 100m.

Depth	Pressure	Setpoint	PPO2 (bar)	O2 (%)	PPN2 (bar)	N2 (%)
0	1.0	0.7	0.7	70	0.3	30
3	1.3	1.3	1.3	100	0	0
6	1.6	1.3	1.3	81	0.3	19
10	2.0	1.3	1.3	65	0.7	35
20	3.0	1.3	1.3	43	1.7	57
30	4.0	1.3	1.3	32	2.7	68
40	5.0	1.3	1.3	26	3.7	74
50	6.0	1.3	1.3	21	4.7	79
60	7.0	1.3	1.3	18	5.7	82
70	8.0	1.3	1.3	16	6.7	84
80	9.0	1.3	1.3	14	7.7	86
90	10.0	1.3	1.3	13	8.7	87
100	11.0	1.3	1.3	12	9,7	88

As can be seen the concentration of nitrogen will be increased along with the depth. In order to maintain END = 30m at the greater depths, it is necessary to use breathing mixtures containing helium. Such dives require additional training and refined skills.

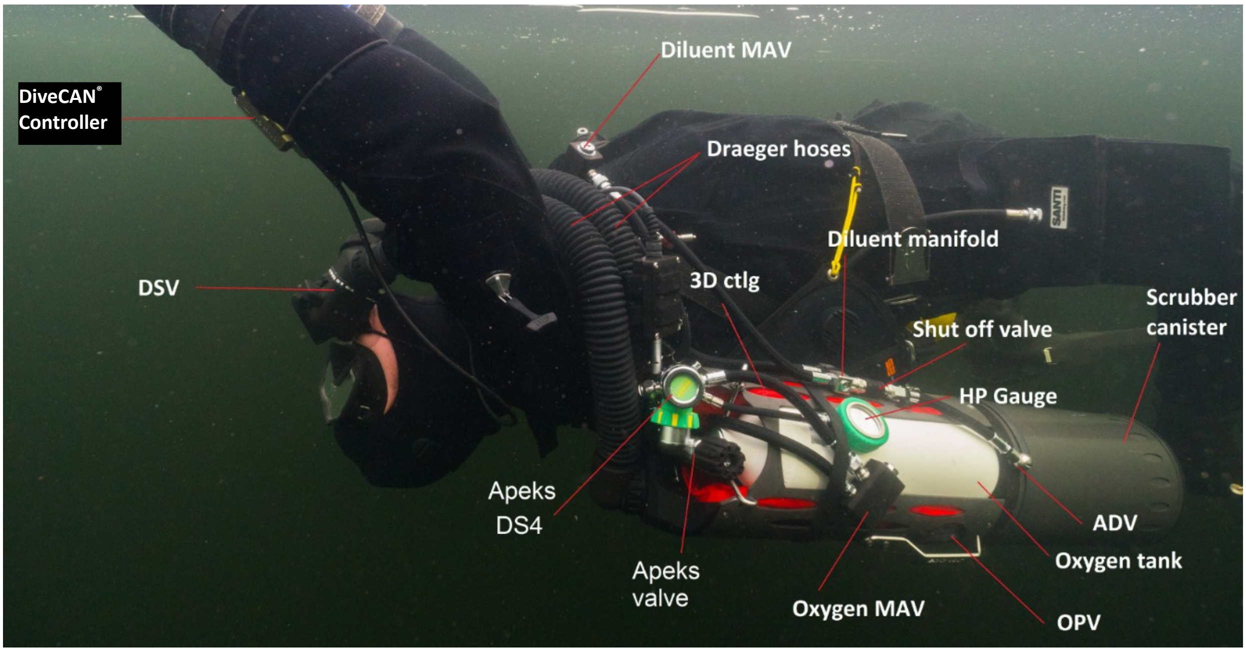
3.10. The use of high concentrations of oxygen in the respiratory mixtures

The human nervous system is susceptible no oxygen's toxicity that is caused by a combination of pressure and exposure time. Prolonged exposure to pressures above 0.5 bar results in oxygen toxicity of the lungs. Exposure to the elevated partial pressure of the oxygen can be monitored by means of the so-called oxygen toxicity units (OTU). One unit is equivalent to breathing pure oxygen for one minute at a pressure of 1 bar. You should not exceed the value of 300 OTU per day.

There can also occur oxygen toxicity, which directly affects our nervous system, leading to the loss of consciousness and uncontrolled seizures. While diving with the breathing apparatus T-REB®, you should avoid exposure to high partial pressures of the oxygen.

4. Construction of the apparatus

In this chapter we will discuss the essential components of the apparatus. Our intention is to acquaint the user with the possibility of assembly, disassembly of the elements of the apparatus.



4.1 Body.

The body of the apparatus consists of two cylindrical parts, upper and lower. The lower part has a bottom, and a clamp with a "snap bolt" type carabiner attached to it for attaching to any diving harness. In its form, it is a container for the scrubber, as well as the basis for the entire device. It is connected to the upper part by the bayonet connector, secured with a closure button in the head of the upper body. The top part is an openwork cylinder and constitutes a cover for the counterlungs and the oxygen cylinder. From the top and the bottom, the cylinder is limited by the functional heads made of POM-C.

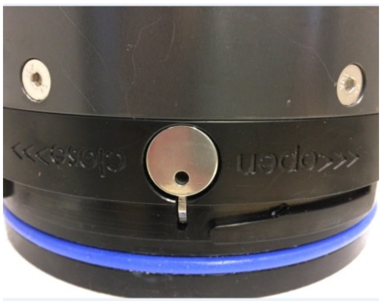
Attachment points

4.2 Heads of the upper body

The functionality of the apparatus is primarily affected by structural components of the heads limiting the light of the main body.

The upper head has connectors for the breathing hose with bayonet mounts that prevent the reverse connection of hoses. In addition, there is an opening in the head, through which the oxygen cylinder is mounted to the body between the counterlungs. The head contains an output of the communication cable connecting the display with the electronics, which control the solenoid valve of the oxygen. The body of the head also contains a connection for the LP hose, which supplies diluent to the inhalation part of the apparatus. On this head, there is also a mounting system for "bungee" of the side system.

The lower head has a bayonet connection to the lower body and has an integrated antycollapse system (ACS/ADV; automated diluent valve) and the oxygen solenoid valve. In its bottom part, the head constitutes a socket for the electronic system of the apparatus, which simultaneously



act as a passage for the gas without carbon dioxide following the scrubber.

Both the upper and lower head have counterlungs bayonet connections with the possibility of dismantling.

4.3 Oxygen cylinder and oxygen supply for the breathing apparatus

Breathing apparatus T-REB is equipped with a single 2 liter oxygen cylinder placed inside the upper body between the counterlungs. The oxygen supply is performed by the first stage of the diving automatic breathing supply with the M26x2 connector, through two hoses that supply the electronically controlled solenoid and oxygen MAV. The oxygen pressure in the system does not exceed 7 bar. The I st. stage regulator has a relief valve enabling opening at a pressure of 12 bar to prevent rupture of LP hoses.

4.3.1 Breathing gas supply system for the breathing apparatus

Breathing apparatus T-REB is equipped with a breathing gas supply system having an oxygen content from 1% to 50%. The system is built from a quick connector, a manifold, a shut-off valve of the gas supply to the ADV system, and a diluent MAV. The system may have a relief valve enabling opening at a pressure of 12 bar to prevent rupture of LP hoses.

4.4 Counterlungs.

Breathing apparatus T-REB is equipped with two counterlungs with a total capacity of 4.6 liters. Counterlungs are made of ballistic nylon and the interior is covered with an integrated layer of polyurethane with properties that protect this environment against the development of microorganisms. Counterlungs are attached to the heads by a bayonet locking system. Inside the counterlungs, there are polyethylene spirals, which prevent them from completely collapsing in case of the pressure difference at the ends. The exhalation counterlung is provided with a water trap, from which it is possible to remove the fluid through a relief SiTech valve, additionally protected by a steel spur. Counterlungs have 3D design which greatly reduces breathing resistance of the system.

4.5 CO2 scrubber.

CO2 scrubber in apparatus T-REB is poured into a container designed to allow radial flow of the gas. The container holds up to 2.5 kilograms of Sofnolime 797 lime with grain size of 1.0mm - 2.5mm. This is an amount sufficient for 180 minutes of dive. Container shall be filled with the above quantity of lime and evenly tapped for optimal arrangement of crystals against each other. The container is filled at a time when it is possible to mount the bayonet cover. The amount of lime, with the aforementioned parameters, poured into the container should be strictly adhered to.

4.6 DSV and breathing hoses

Breathing apparatus T-REB has a mouthpiece, which contains an integrated shut-off valve between the inhalation loop and the DSV environment. The valve has two extreme positions. Open and closed. Breathing in the loop should only occur at the extreme opening of the valve. The mouthpiece can be removed from the mouth only at the extreme closure of the valve. This rule must be strictly observed. In the water or under its surface, with the closed valve of the mouthpiece, breathing loop may be taken only after emptying the mouthpiece from the water through a strong exhalation and then turning the valve to the extreme open position. Another procedure may result in flooding the system with water.
The mouthpiece contains integrated directional valves of the loop, which provide a directed gas flow. Before every dive, you should check their condition and correct installation.
The mouthpiece has breathing hoses connected using bayonet connectors, which constitutes the physical connection to the apparatus


4.7 Sensors compartment and enclosure for electronics and power supply of the apparatus

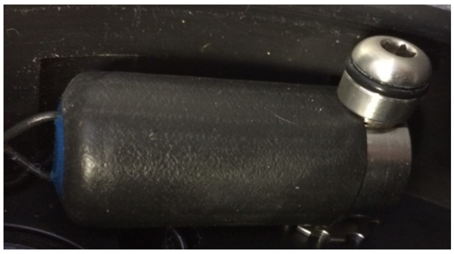
Breathing apparatus T-REB comes with a compact, easily removable socket for three NaNS01 Oxygen Sensors. This socket, together with sensors, can be stably integrated with the enclosure for electronics and the power supply of the apparatus The sensors are connected to an electronic inspection system using cables with gold-plated SMB connectors. Electrical system is fully built-up and sealed. Solenoid controller board of DiveCAN® is powerded by 9V battery placed in a sealed compartment.


Body of the system's electronics is firmly mounted on the lower head of the breathing apparatus, from the side of the scrubber, and the digital communication with the display and the electrical communication with the solenoid valve is done by gold-plated spring contacts not placed in a dedicated slot.

Both the electronic components and the accumulator are completely separated from the system and the sealing used protects the system against humidity and changes in ambient pressure. Replaceable battery can support the authonomic PPO2 controlling system up to 130 hours. Electronics compartment is sealed and cannot be opened otherwise than by the service of Other Gravity Sp. z o. o.

4.8 Solenoid valve.

The solenoid valve is characterized by very low power consumption and high refinement. For safety reasons, it is in a de-energized state, the position is always closed and uncontrolled increase in the oxygen pressure in the system is unable to open it. The valve is not to be disassembled and in the event of a malfunction is to be replaced only by the service of Other Gravity Sp. z o. o.



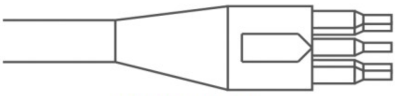
4.9 Oxygen sensors

Three oxygen sensors, NaNS01 Oxygen Sensor, required for correct operation of the DiveCAN® system of the breathing apparatus T-REB are mounted on a separate adapter and do not require tools for installation.

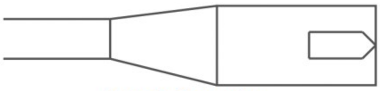
Adapter with sensors mounted in the head allows them to be connected with the cables in such a way that the sensors get positions 1, 2 and 3 on the controller, clockwise.

5. Controllers of DiveCAN® system.

Self contained breathing apparatus T-REB is equipped with a DiveCAN® system to control the partial pressure of oxygen in the loop and, and in addition, with a AK 4-pin or Fischer 7-pin cable that allows to read the sensor readings on the dedicated decompression instruments (e.g.: manufactured by Shearwater)
The SOLO system (electronic solenoid valve and oxygen), which manages the partial pressure of oxygen in the breathing loop and controls the operation of the oxygen injection solenoid valve, works with two types of setpoint controllers, the Petrl 3 DiveCAN® Setpoint Controller and the NERD 2 DiveCAN® Setpoint Controller. These systems recognize each other automatically when switched on and communicate digitally. Calibration data is not stored in the controllers, but in the SOLO control system, which is located in the sensor head. Data on the duration of the dive comes from the controllers. If the connection between the controller and the ppO2 control system is interrupted before reaching 0 m depth, the ppO2 setting automatically changes to 0.7 and the oxygen injection is controlled without the controller. The controllers are connected to the SOLO electronics using miniature industrial connectors, which are waterproof to a depth of 600 m.



Male Connector



Female Connector

In the T-REB breathing apparatus, the controller enables depth and decompression control, manages the CO2 absorber consumption time, enables calibration of sensors to a selected gas with a specific oxygen content, setting two values of oxygen partial pressure that can be quickly selected during the dive. On the surface and during the dive, the DiveCAN® system monitors the set oxygen partial pressure, informs about the readings of three sensors, about the dive time and has advanced decompression computer functions described in appendices 1, 2 of this manual. In the event of exceeding the ppO2 limit values (below 0.5 and above 1.6) in the breathing loop, the DiveCAN® system activates alerts.

Initial screen after proper recognition of DiveCAN® - MiniSOLO board

Buttons

Two titanium piezo-electric buttons are used to change settings and view menus.

All Petrel 3 operations are simple single button presses.

MENU (left) button

SELECT (right) button

Don't worry about remembering all the button rules below.

Button hints make using the Petrel 3 easy.

MENU (left) button

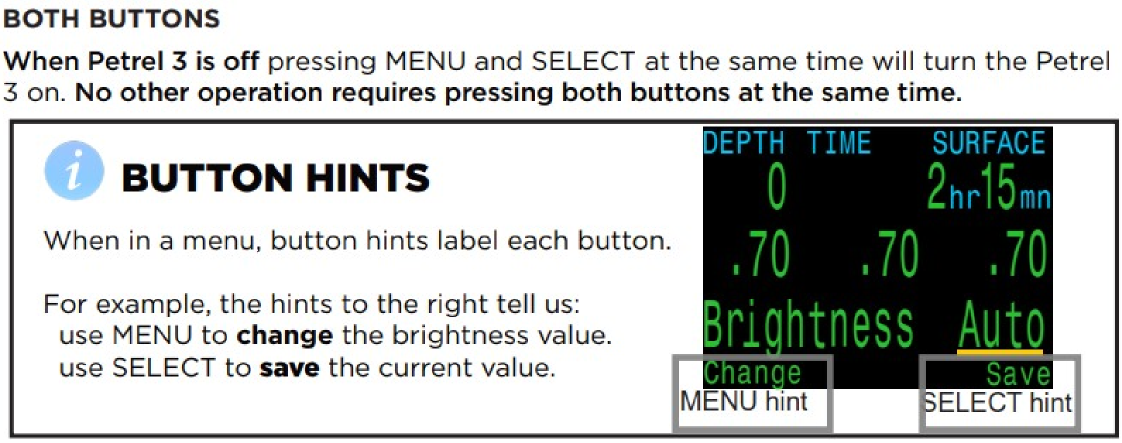
From main screen	Brings up menu
In a menu	Moves to the next menu item
Editing a setting	Changes the setting's value

SELECT (right) button

From main screen	Steps through info screens
In a menu	Performs command or starts editing
Editing a setting	Saves the setting's value

BOTH BUTTONS

When Petrel 3 is off pressing MENU and SELECT at the same time will turn the Petrel 3 on. **No other operation requires pressing both buttons at the same time.**


BOTH BUTTONS

When Petrel 3 is off pressing MENU and SELECT at the same time will turn the Petrel 3 on. **No other operation requires pressing both buttons at the same time.**

BUTTON HINTS

When in a menu, button hints label each button.

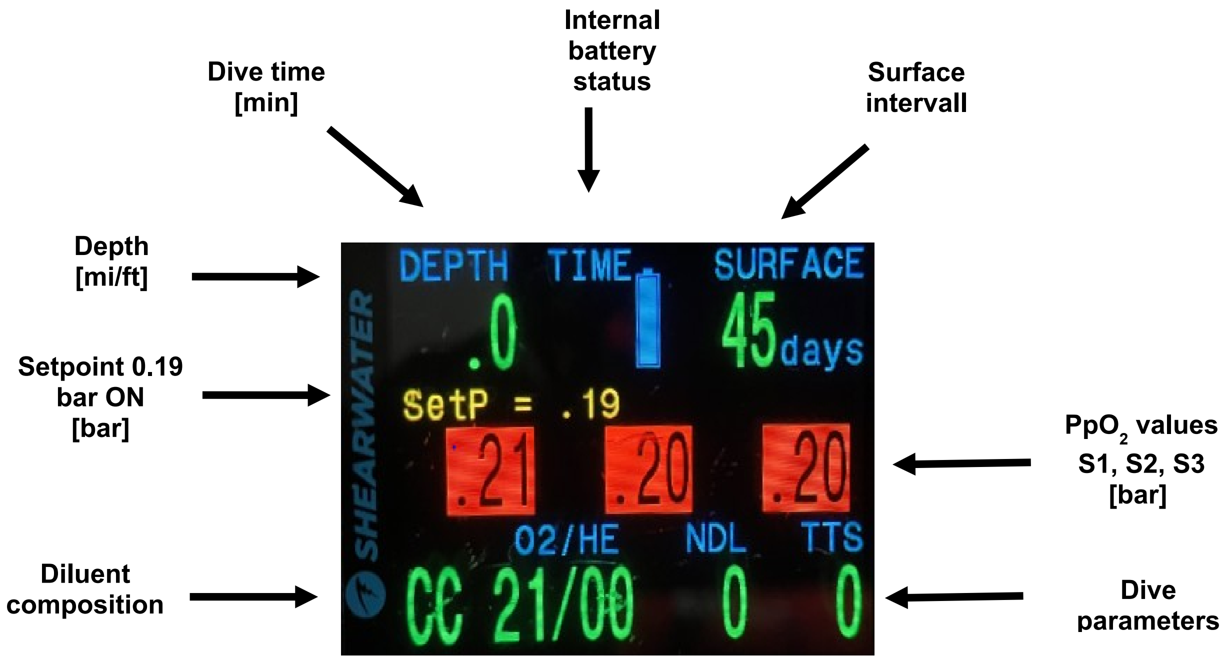
For example, the hints to the right tell us:
use MENU to **change** the brightness value.
use SELECT to **save** the current value.

5.1. Preparing the DiveCAN® system for operation.

The preparation of the DiveCAN® system consists of assembling the electronics housing with the upper part of the T-REB breathing apparatus body. As a result of this operation, the system can communicate with the controller and the voltage from the oxygen sensors appears on the Fischer analogue connector.

+

The powered controller allows you to activate the system using buttons. It is activated by pressing both buttons simultaneously, which will activate the system in surface mode. The controller will also automatically activate the system when in water. The controller buttons are also sensors that activate the system in diving mode when submerged in water. The display will show parameters such as depth, battery status, time since the last dive, partial pressure of oxygen in the system measured by three sensors and the set value for the partial pressure of oxygen.



5.1.1. Turning On

To turn the Petrel on, press both the MENU (left) and the SELECT (right) buttons at the same time.

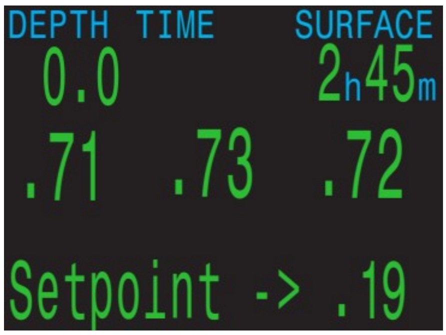
Auto-On
The Petrel will automatically turn-on when submerged underwater. For rebreather controller models, this is based on the presence of water. The Petrel 3's buttons act as wet contacts. All other versions of the Petrel are only activated by pressure, not the presence of water.

Switching DiveCAN® ON activates visual alarm when PPO2 is below 0.4 bar or above 1.6 bar. PPO2 flashes red.

After turning on the system, the oxygen partial pressure control setting of 0.19 bar is automatically activated in the breathing loop. A small drop in oxygen partial pressure can in this case lead to the creation of a hypoxic mixture which, when used for breathing, is a lethal threat. The setting of 0.19 is only for use in preparing the breathing apparatus for work and for transport purposes.xygen in the system measured by three sensors and the set value for the partial pressure of oxygen.

Save your life! NEVER breath on the loop when setpoint is 0.19

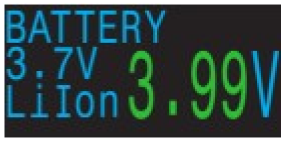
Setpoint 0.19
Pressing SELECT when this menu is displayed changes thePPO2 setpoint to 0.19. This menu is only available when on the surface.



This feature is provided as a convenience to prevent the solenoid from firing when setting up the rebreather on your workbench. There is very little room for error with a 0.19 setpoint, so it should never be used when breathing on the loop.

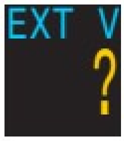
If a dive begins on the 0.19 setpoint, the setpoint is automatically switched up to the low setpoint.

5.1.2. Batteries



Battery

The Petrel's internal battery voltage. Displays in Yellow when the battery is low and needs replacement. Displays in Flashing Red when the battery is critically low and must be replaced as soon as possible. Also shows battery type.



External Battery (EXT V)

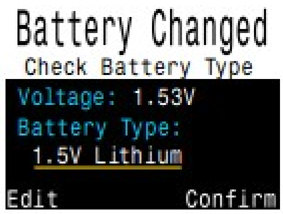
The voltage of the external battery used to fire the solenoid. Flashing Red when the battery is critically low and must be replaced as soon as possible.

Only sampled when solenoid is fired, so if solenoid has not yet fired, value is unknown and displays as a Yellow '?'.

Battery Type Selection

After changing the battery, select the battery type used. The Petrel 3 attempts to guess what type of battery is being used. If the battery type is incorrect, it should be manually edited.

The Petrel 3 can accept most AA sized (14500 size) batteries that output a voltage between 0.9 V and 4.3V. However, some batteries are better than others.



- Not all batteries support vibration.
- Battery types that support the fuel gauge feature will give more warning before the computer dies.
- Some battery types perform better in cold water.

Shearwater recommends using Energizer Ultimate Lithium batteries for best performance.

Supported battery types:

BatteryType	Approx. Battery Life	Vibration Support	Fuel Gauge	Cold water Performance
1.5V Lithium **Recommended**	60 hours	Yes	Yes	Very Good
1.5V Alkaline	45 hours	No	Yes	Ok
1.2V NiMhRechargeable	30 hours	No	No	Poor
3.6V SaftLS14500	130 hours	No	No	Poor
3.7V Li-Ion Rechargeable	35 hours	Yes	Yes	Good

Battery life is based on medium brightness.

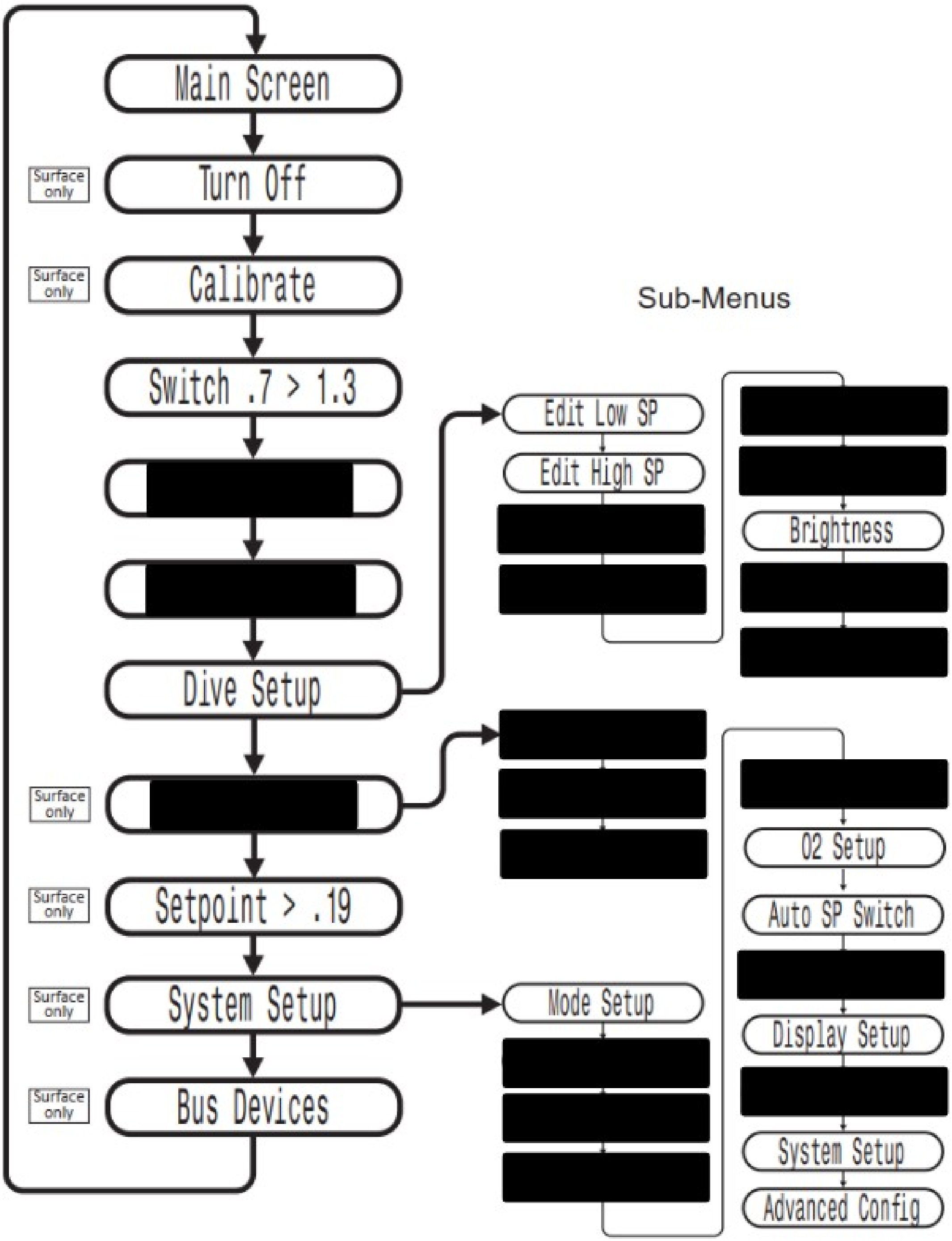
Alkaline batteries are especially prone to leaking.

This is a leading cause of dive computer failure.

Alkaline batteries are not recommended.

5.2. Surface operation mode of the DiveCAN controller

Starting from the main screen (Pg. 20), pressing the MENU (left) button steps through the menus. When all menus have been viewed, pressing MENU again will return to the main screen.Pressing the SELECT (right) button when a menu is displayed, either performs that action or enters a sub-menu. If no buttons are pushed for 1 minute, the menu system will time-out, returning to the main screen. Anything that had been previously saved will be retained. Anything that was in the middle of editing will be discarded. Scheme ilustrates only functions The diagram shows only the functions that are important for controlling the partial pressure of oxygen in the breathing loop.

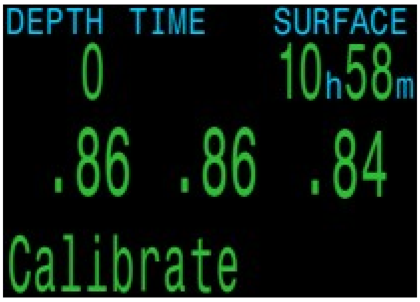


5.2.1. Turning of the DiveCAN controller

The "Turn Off" item puts the computer to sleep. While sleeping, the screen is blank, but the tissue contents are maintained for repetitive diving. The "Turn Off" menu item will not appear during a dive. It will also not appear after a dive until the End Dive Delay time has expired to allow for a continuation dive.

5.2.2. PPO2 Calibration

The Calibrate menu will only appear when in CC mode and on the surface. This menu calibrates the mV output from the oxygen sensors to PPO2.



Upon selecting the calibration menu, the screen will show:

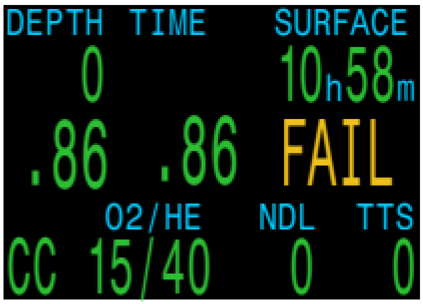
- Top row: Millivolt (mV) readings from the 3 O2 sensors.
- Middle row: PPO2 values (using the previous calibration).
- Bottom row: The calibration gas fraction of O2 (FO2).

If you need to change the calibration gas FO2, do this in the System Setup⇨O2 Setup menu.

After flooding the breathing loop with the calibration gas (typically pure oxygen), press the SELECT button to perform the calibration.

Good sensors should be in the range of 35 - 65 mV at sea level in 100% oxygen. A sensor will fail calibration if not in the range of 30mV to 70 mV. This allowable range scales automatically
with changes to FO2 and barometric pressure. If outside the allowable range, a millivolt reading is shown in yellow.

Once the calibration completes, a report will be shown. This shows which sensors passed calibration, and the value of the expected PPO2 based on barometric pressure and the FO2.



Back at the main screen, the displays should now all read theexpected PPO2. For example, if FO2 is 0.98 and barometric pressure is 1013 mbar (1 ata), then PPO2 will be 0.98. If any display shows FAIL, the calibration has failed because the mV reading is out of range.
The "Calibrate" menu item will not display during a dive.

5.2.3. PPO2 calibration problems

One sensor displays FAIL after calibration

This could indicate a bad sensor. It has failed because the mV output was not in range. The sensor could be old or damaged, and should be inspected. Damage and corrosion to wires or connectors is also a common problem. Fix the problem and recalibrate before diving.

All sensors display FAIL after calibration

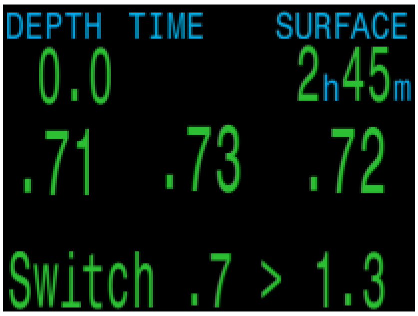
This could be caused by an accidentally unplugged cable or a damaged cable or connector. Also, accidentally performing the calibration in air or without a proper oxygen flush could cause this problem. A failed calibration can only be fixed by performing a successful calibration.

PPO2 does not show 0.98 after calibration

If the Altitude setting in the Display Setup menu is set to Auto, then the PPO2 after calibration may not be exactly equal to the F02.
This is because weather causes minor changes in barometric pressure. For example, say a low-pressure weather system has reduced the normal (1013mbar) barometric pressure to 990mbar. The PPO2 in absolute atmospheres is then 0.98 * (990/1013) = 0.96. The 0.96 PPO2 result is, in this case, correct. At high altitudes, the difference between FO2 and PPO2 will be even larger. To see the current pressure, start at the main screen and press the SELECT button a few times (displays as Pressure mbar NOW). If you are at sea level, and want the calibrated PPO2 to exactly match the FO2, then change the Altitude setting to SeaLvl. Only do this when actually at sea level, and also be aware that using this SeaLvl setting is actually introducing error into the PPO2 measurements.

5.2.4. Switch Setpoint

During a dive the “Switch Setpoint” menu item will be the first item displayed, since the “Turn Off” and “Calibrate” displays are disabled when diving.



Pressing SELECT when this menu is displayed changes the PPO2 setpoint from the low setpoint to the high setpoint or vice-versa. To redefine the PPO2 value of a setpoint, use the Dive Setup menu.

This menu item performs a manual switching of PPO2 setpoint. Automatic setpoint switching can be setup in the System Setup > Auto SP Switch menu. When auto setpoint switches are enabled, this menu item is still available to provide manual control.

6. Editing PPO2 Setpoint in Dive SETUP

All of the Dive Setup menus are available both on the surface and when diving. The values in Dive Setup can also be accessed in the Systems Setup menu, but the System Setup menu is not available when diving.
Pressing the right (SELECT) button will enter the Dive Setup sub-menu.

6.1. Editing Low Setpoint

This item allows you to edit the low setpoint value. Initially it will display the currently selected value.

Press the right (Edit) button to open the edit display. Press the left (Change) button to increment the setpoint.

Values from 0.4 to 1.5 are allowed. Incrementing past 1.5 returns the value to 0.4. Press the right (Save) button to lock in new low setpoint.

6.2. Editing High Setpoint

Works in exactly the same way as the Edit Low Setpoint function above

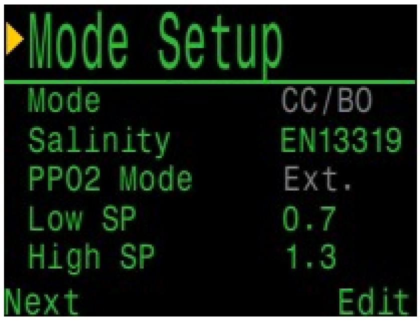
7. System Setup Reference

System Setup contains configuration settings together in a convenient format for updating the configuration before a dive.

System setup cannot be accessed during a dive.

All of the settings available in Dive Setup are available in System Setup which can be accessed during a dive. However, not all settings in System Setup can be edited in Dive Setup.

7.1. Mode Setup



The first sub-menu of System Setup is Mode Setup.

Mode
Rebreather controllers are locked in Closed Circuit mode with external sensor monitoring.

Salinity
Water type (salinity) affects how the measured pressure is converted to depth.

Settings:
- Fresh
- EN13319 (default)
- Salt

Density of freshwater and saltwater differ by about 3%. Saltwater, being denser, will display a shallower depth for the same measured pressure versus the Fresh setting.

The EN13319 value is between Fresh and Salt. It is from the European CE standard for dive computers, and is the Petrel 3’s default value.

Note that this setting only affects the depth displayed on the computer and has no impact on decompression calculations which rely on absolute pressure.

PPO2 Mode
On the Petrel 3 DiveCAN Controller Models this value is always “ext.” (Externally measured PPO2).

Low and High Setpoints
Each setpoint can be set from 0.5 to 1.5.
The setpoints can also be edited, even during a dive, in the Dive Setup menu.

7.2. O_2 Setup

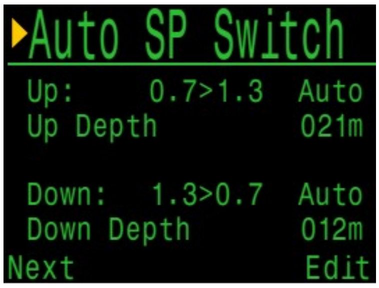
Cal. FO2
This setting allows you to set the fraction of oxygen (FO2) of the calibration gas.

The calibration gas FO2 can be set from 0.70 to 1.00. The default value of 0.98 is for pure oxygen, but assumes about 2% water vapor due to the diver's breathing on the loop during the flushing process.

NOTE: This setting value is the fraction of oxygen, not the partial pressure of oxygen. When the calibration is performed, the Petrel measures the ambient barometric pressure to determine the PPO2. If you are at sea-level, and do not want small variations in barometric pressure changing the calibrated PPO2 result, there is an option to set the Altitude to a SeaLvl.

Sensor Disp
Sets the sensor display mode on the center row of the main screen. The available settings are:
- Large: the PPO2 text is the normal large font.
- Giant: the PPO2 text is larger.

7.3. Auto Setpoint Switch



This page sets up automatic setpoint switching. The dive computer can be set up to auto switch the setpoint up only, down only, both, or neither.

First, you set whether the "Up" switch occurs automatically or manually. If "Up" is set to "Auto", then you can set the depth at which the auto switch occurs.

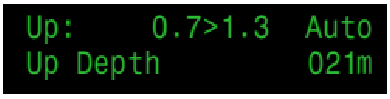
The menu options are the same for the down setpoint switch.

When a switch is set to "Auto", you can always manually override the setting at any time during the dive.

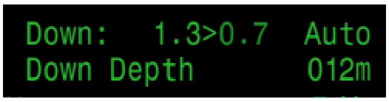
The automatic switches only occur when crossing the specified depth. Say for example, the switch up depth is set to 15m. You start the dive on the low setpoint, then as you descend past 15m, the setpoint automatically switches up to high. If at 24m you then manually switch back to the low setpoint, the setpoint will remain low. If you ascend shallower than 15m then re-descend deeper than 15m again, the automatic setpoint switch will occur again.

The Petrel 3 enforces a 6m (20ft) gap between switch up and switch down depths to prevent rapid automatic switching between setpoints for small depth changes.
The values 0.7 and 1.3 are shown as examples only. Other values for the low and high setpoint can be adjusted in the Dive Setup or Mode Setup menu.

Auto setpoint switch example:

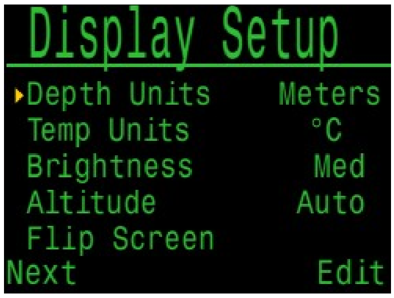


The settings displayed to the right would cause the computer to behave as follows.
The low to high auto setpoint switch is enabled at a depth of 21 meters.
The dive starts at the 0.7 setpoint. As you descend past 21m, the setpoint switches "up" to 1.3.



You finish your bottom time, then begin ascending.
The high to low auto setpoint switch is enabled at a depth of 12 meters.
When you ascend above 12, the setpoint switches "down" to 0.7.

7.4. Display Setup



Depth and Temperature
Depth: Feet or Meters
Temperature: °F or °C

Brightness
See brightness options in section 10.8.3.

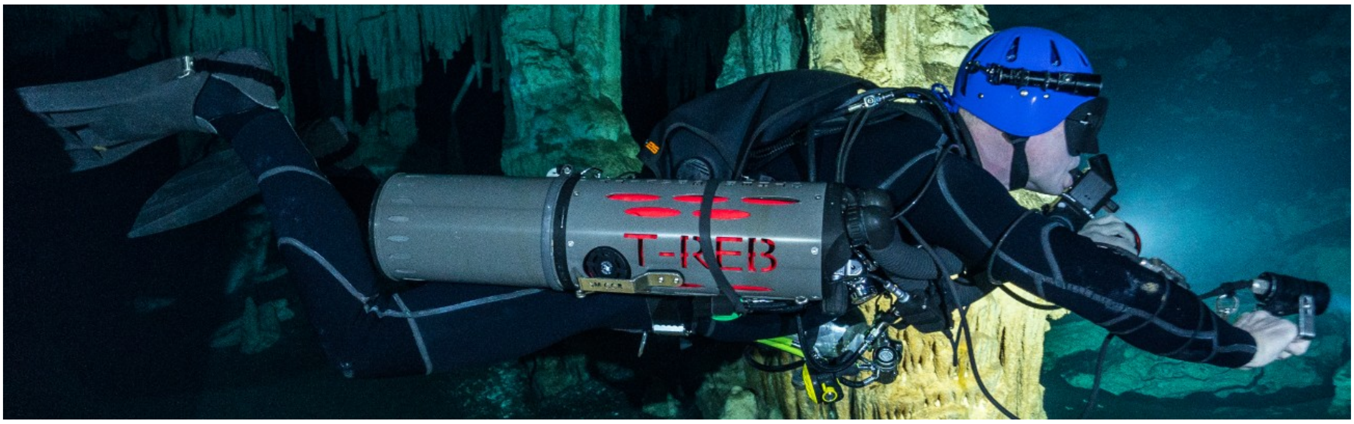
Altitude
The altitude setting on the Petrel 3 is set to Auto by default. In this mode the computer will automatically compensate for pressure changes when diving at altitude. If all your diving is at sea level, then setting this to 'SeaLvl' will assume that surface pressure is always 1013 mbar (1 atmosphere)
Further, when diving at altitude, you must turn the computer on at the surface. If the auto-on safety feature is allowed to turn the computer on after a dive has started result in incorrect decompression calculations.

Flip Screen
Displays the contents of the screen upside down. This is useful if you wish to wear your controller on the right arm.

8. Preparation for usage, putting on and adjusting the apparatus

Safe use of the apparatus is possible only by ensuring appropriate level of care for the equipment. The apparatus should be stored, transported and used under conditions which prevent physical damage to any of its components.

T-REB was intended for usage with sidemount diving systems



8.1 Inspection of the apparatus before the dive.

1. You should be absolutely sure that the container with the CO2 scrubber contains fresh lime, ensuring the implementation of the dive for the planned time.
2. Analyze the contents of the selected diving oxygen cylinder and the contents of the adopted diluent.
3. Prepare and check the open circuit gas resources prepared for the dive.
4. Connect the oxygen cylinder to the apparatus.
5. Put the container with lime into the lower canister of the apparatus.
6. Connect two canisters and make sure that the bayonet connector is fully closed.
7. Verify that the oxygen cylinder is fixed firmly and the automatic system is installed properly.
8. Check the operational direction of the directional valves of the loop.
9. Connect the breathing hoses to the body of the apparatus.
10. Remove the oxygen and diluent cylinder, and check the cylinder pressure on the control gauges.
11. Measure the intermediate pressure of the oxygen and diluent. Oxygen may exceed 7.0 bar, diluent must have the pressure of 9.0-10.0 bar.
12. Connect the diluent to the apparatus with quick connector.
13. Check the operation of the MOV and MDV inflation valves, as well as ADV.
14. Disconnect the diluent from the apparatus and leave the MDV under pressure.
15. Check the operation of the DSV valve.
16. Perform a leak test with closed OPV relief valve by inflating the apparatus with the exhaled air. Keep the overpressure in the apparatus for 5 minutes.
17. Check the operation of OPV. When loosening, gas should escape from the apparatus. Tighten the valve back.
18. For 5 minutes perform the leak test in negative pressure. Remember that ACS/ADV should be cut off from gas supply (disconnected diluent quick connector). Using the mouthpiece suck all the gas in the loop until the full collapse of the counterlungs and close the DSV. Later, with the re-opening of DSV, you should hear a clear hiss of the gas sucked in from the environment.
19. Turn on the DiveCAN® system controller.
20. Breathe from your apparatus until you determine the PPO2 setpoint.
21. Close the DSV.
22. Turn off the controller.
23. Turn off the oxygen tank.

8.2 Inspection of the apparatus directly before the dive

1.Unscrew the oxygen cylinder valve.

2.Manually add oxygen until gas begins to escape through the OPV valve.

3. Wear the apparatus on in a lateral position.

4. Tcheck if the DiveCAN system controller is ON.

5. Check the PPO2 setpoint.

6. Set up and the diluent cylinder.

8.3 Inspection of the apparatus immediately after entering the water.

1. Plug in the diluent cylinder with previously opened valve

2. Breathe from the apparatus, dive to a depth of 6m and check the display indications.

3. Check the indications of the decompression controller if it is used.

4. Check the water-tightness of all systems. "Bubble Check"

9. Handling during the dive.

The most important rule during the dive is to control the PPO2 in the breathing loop. The apparatus T-REB contains two independent controllers. While diving, you should keep an eye on any signs of internal unrest and investigate their source. Apparatus T-REB allows for comfortable diving in many positions and breathing resistance is one of the smallest in this type of devices. Whenever possible, you should consciously and manually keep the PPO2 slightly above the set value.

10. Handling after completing the dive, maintenance and storage

10.1 Handling after completing the dive

1. Close the DSV.
2. Disconnect the diluent from the apparatus.
3. Turn off the eCOiS® system controller.
4. Tighten the gas cylinders.
5. Disconnect the breathing hoses from DSV, from the upper head.
6. Remove the condensate from the hoses.
7. Remove the condensate from counterlungs by upending the apparatus.
8. Separate the canister with the scrubber and remove the lime container.
9. Separate the controller with sensors.
10. Leave the container with the scrubber and controller with sensors to dry.
11. Take care of hygiene of all elements of the apparatus.

10.2 Storage

- APPARATUS should be stored in a dry, well-ventilated place, away from heat sources, not exposed to direct impact of sunlight or chemicals,
- APPARATUS should be protected from the fumes of gasoline, oil, alcohol and other chemicals,

- components of the apparatus should lay free, especially the hoses should be loosely packed, without bends and twists,
- both during storage and during operation, the apparatus must be protected against mechanical damage, especially against impact,
- you should avoid crushing, which deforms breathing hoses and mouthpiece, and other flexible parts of the apparatus.
- parts of the apparatus subject to the wear and tear process must be replaced every year, regardless of the frequency of use.

10.3 Maintenance

- after diving, the apparatus should be rinsed in clean, fresh water,
- parts of the apparatus can be washed with warm water
- Maintenance of parts of the apparatus should be performed with an oxygen-compatible lubricant,
- during repairs and maintenance, only the original spare parts should be used,
- APPARATUS must be subject to annual technical inspections carried out by an authorized service
- after a prolonged period of intensive exploitation (APPARATUS may need more frequent service, depending on how often and in what environment it is used), it is recommended to perform and inspection and maintenance of the systems of the apparatus, combined with control of basic operating parameters,

IMPORTANT

Any periodic inspections, repairs and work that affects the operation of the device should be ordered from the manufacturer or a service authorized by the manufacturer. It is not permissible for the disassembly and assembly of components and elements of the device to be performed by persons not authorized to perform such activities.

11. Warranty

When submitting warranty claims, you should always show proof of purchase issued by the authorized dealer and the warranty card that contains a record of annual inspections.

OTHER GRAVITY Sp. z o. o. warrants to the original purchaser that the product will be free from defects in scope of materials and workmanship, provided that the user complies with the recommendations for use, maintenance and service, subject to the following limitations.

The warranty shall be invalid in the case of misuse, neglect, modification, or unauthorized service of the product.

The scope of the warranty is limited to repair or replacement of the product, depending on the decision made by OTHER GRAVITY Sp. z o. o.

IMPORTANT
Self-performed repairs will result in loss of warranty and can lead to loss of life or health.

WARRANTY CARD

of breathing apparatus T-REB® manufactured by

OTHER GRAVITY Sp. z o.o.

OTHER GRAVITY Sp. z o.o. provides 1-year warranty to the original owner for the correct operation of the apparatus.

In order for this warranty card to be valid, you must meet the following conditions:

- purchase must be made at an authorized shop of OTHER GRAVITY Sp. z o. o.,
- the owner of the apparatus is a person registered in the warranty card,
- service operations must be performed with appropriate service sets authorized by OTHER GRAVITY Sp. z o.o. service,
- The recommendations on the use, operation and maintenance of the apparatus must be complied with.

IMPORTANT

Loss of warranty shall occur as a result of any repair and adjustment performed by persons unauthorized to service the equipment manufactured by OTHER GRAVITY Sp. z o. o., and also as a result of improper use of the product and mechanical damage.

Performance of inspections or services by unauthorized persons will void your warranty.

Full name of the owner...

Address ………………………………………………………………………………………

Model ………………………………………………………………………………………

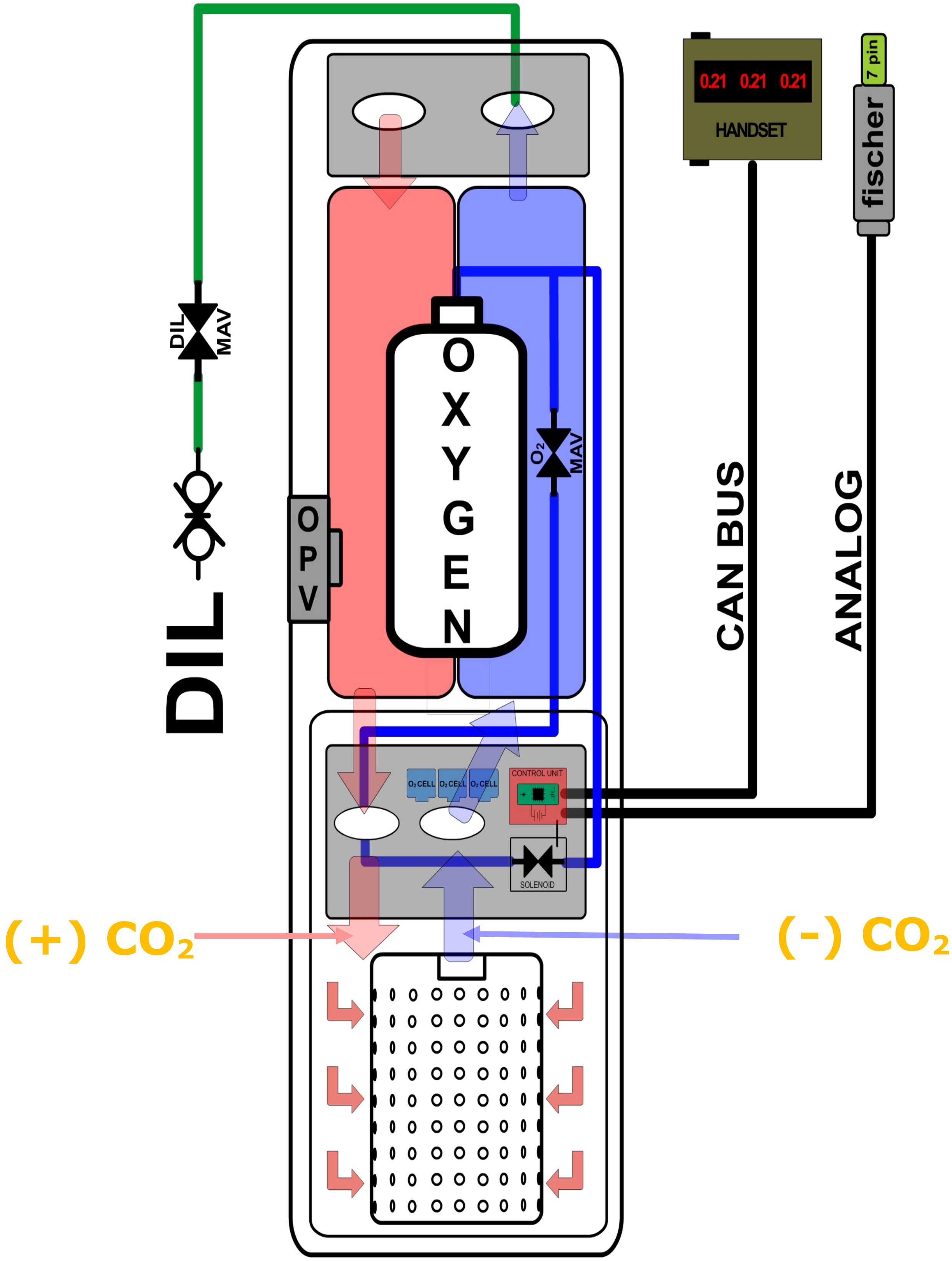
………………… ………………………………….

Date of sale Stamp and signature of the dealer

INSPECTION SHEET

Review date	Technical state assessment	Surname of the service engineer	Signature and stamp

T-REB – Architecture



12. Notes

………

………

………

………

………

………

………

………

………

………

………

………

………

………

………

………

Manufacturer's details

Other Gravity Sp. z o.o.
Kineskopowa 1B, lok. 33-34, 05-500 Piaseczno
Mob.: +48502124354
e-mail: info@othergravity.com