EXPLORER
SPORT REBREATHER
USER MANUAL

REV. 2

This is the operations manual for the
HOLLIS EXPLORER

All information contained is subject to change. Contact the manufacturer for the latest information. www.hollisgear.com

The EXPLORER is manufactured in the USA by Hollis Inc.,
2002 Davis Street, San Leandro, CA 94577. USA
Ph (510) 729-5100

EC Type approved by SGS UK Ltd. Weston-super-Mare. BS22 6WA. Notified Body No. 0120.

Testing conducted by ANSTI Test Systems. Hants.

To ensure your user information is up to date. Please check www.hollisgear.com/support.asp for updates to this manual.

For warranty information see www.hollisgear.com/support_warranty.asp

DANGERS, WARNINGS, CAUTIONS, AND NOTES

Pay attention to the following symbols when they appear throughout this document. They denote important information and tips.

DANGERS: are indicators of important information that if ignored would lead to severe injury or death.

WARNINGS: are indicators of important information that if ignored could lead to severe injury or death.

CAUTIONS: are indicators of information that if ignored may lead to minor to moderate injury.

NOTES: indicate tips and advice that can inform of features, aid assembly, or prevent damage to the product.

HOLLIS EXPLORER
SPORT REBREATHER

**WARNING:
USE OF THE EXPLORER MANUAL**

This user manual **does not, nor is it intended to** contain any information needed to safely dive with any type of SCUBA apparatus. It is designed as a guide for the proper setup, operation, maintenance, and field service of the Hollis Explorer only. It does NOT take the place of a recognized training agency instructor-led diver-training course or its associated training manual(s) and materials. This user manual is intended to be used only as a type specific addition to such training and materials, and as a user reference. This manual cannot be used as a substitute guide for any other type of Self Contained Underwater Breathing Apparatus (SCUBA).

EXPLORER DESIGN TEAM

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HollisExplorer
User Manual

Document Control Number: 12-4102
Rev. 2
Publish Date: 7/26/2013

GENERAL SAFETY
STATEMENTS + WARNINGS

WARNING: GENERAL SAFETY

No person should breathe from, or attempt to operate in any way, a Hollis Explorer rebreather, or any component part thereof, without first completing an appropriate Hollis Certified user-training course.

Further, no Explorer diver should use a Hollis Explorer without direct Hollis instructor supervision until they have mastered the proper set-up and operation of the Hollis Explorer rebreather. This includes new Explorer divers as well as Explorer certified divers who have been away from diving for an extended period of time and would benefit from an instructor-led refresher course to regain skills and mastery of the Hollis Explorer. Failure to do so can lead to serious injury or death.

WARNING: NITROX STATEMENT

The EXPLORER equipment is classified as being suitable for use with nitrogen-oxygen (Nitrox) breathing gas mixtures containing up to 40% oxygen by volume without the need for special preparation, cleaning , or component parts.

If Explorer equipment is subsequently used with equipment, or connected to an air supply system, that is not rated for Oxygen Service, it can subsequently be used with Nitrox (up to 40% O2) as long as the equipment is maintained in accordance with the procedures and parts specified in the Hollis EXPLORER Product Service Guide.

The EXPLORER was designed for use with Nitrox (up to 40% O2). **DO NOT** use gas mixtures with a higher fraction of oxygen greater than 40% with your EXPLORER.

WARNING: CAUSTIC MATERIAL

The CO_2 absorbent used in the scrubber is caustic alkaline material. Take steps to protect yourself from direct lung and skin contact. Furthermore, poor management of the breathing loop could lead to water contact with the CO_2 absorbent, causing a “caustic cocktail” (very caustic liquid). This could lead to severe chemical burns and if inhaled - possible drowning. Proper handling procedures, pre-dive checks, dive techniques, and maintenance mitigates this risk.

⚠ WARNING:
DESIGN AND TESTING

The Hollis Explorer has been designed and tested, both in materials and function to operate safely and consistently under a wide range of diving environments. You must not alter, add, remove, or re-shape any functional item of the Hollis Explorer. Additionally, **NEVER** substitute any part of the Hollis Explorer with third-party items which have not been tested and approved by Hollis for use with the Explorer.

This includes, but is not limited to, hoses, breathing assemblies, electronics, breathing gas delivery assemblies and their constituent parts, sealing rings, valves and their constituent parts and sealing surfaces, latches, buoyancy devices, inflation and deflation mechanisms and on-board alternate breathing devices.

Altering, adding, removing, re-shaping or substituting any part of the Hollis Explorer with non-approved parts can adversely alter the breathing, gas delivery or CO_2 absorption characteristics of the Hollis Explorer and may create a very unpredictable and dangerous breathing device, possibly leading to serious injury or death.

Non-approved alterations to functional parts of the Explorer will automatically void all factory warranties, and no repairs or service work will be performed by any Hollis service professional until the altered Explorer unit is brought back into factory specifications by a Hollis service professional at the owner's expense.

⚠ WARNING:
COMPUTER / CONTROLLER-SPECIFIC WARNINGS

This computer is capable of calculating deco stop requirements. These calculations are predictions of physiological decompression requirements. Calculations are for contingency use only. The Explorer in this "sport" configuration is not intended for decompression use.

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YOUR NEW EXPLORER
REBREATHER LIFE SUPPORT SYSTEM RULES

DANGER: Read and understand this list prior to using this unit. If you do not understand any or all of this section please contact your training agency or Hollis.

Rules for EXPLORER Diving

1. Always complete all pre-dive checks. Pay special attention to BOV mushroom valve tests.
2. Always pre-breathe the Explorer Sport Rebreather until the system passes its' tests.
3. Do not modify the EXPLORER without the manufacturer's written consent.
4. Do not use a full-face mask, Unless approved by Hollis for use with the EXPLORER
5. Always analyse your gas.
6. Never dive a unit you suspect is leaking and has not passed all the pre-dive tests.
7. Never leave your BOV open on the surface
8. Ensure your BC is inflated at the surface.
9. Take time to adjust your weight correctly, do not dive over-weighted.
10. Always dive with buoyancy control and buoyancy inflation.
11. Practice a skill on every dive.
12. Avoid unnecessary mask clearing.
13. Regularly sanatize the unit.
14. Never exceed the CO_2 alarms.
15. Never hold your breath
16. Never start a dive with a low battery alarm.
17. Always carry bailout gases of sufficient volume for the planned dive as per your training agency recommendations.

IF IN DOUBT BAIL OUT!

BATTERIES

The EXPLORER uses Lithium Polymer batteries. These rechargeable batteries are very efficient and provide many years of reliable operation.

Rechargeable Lithium batteries can be recharged at any time and do not have a significant memory affect, which would otherwise cause unreliable battery operation. The batteries are UL listed (flight safe) and are double sealed to reduce the chance of leakage to a minimum.

As extra confidence, the LSS Module battery pack includes 3 separate batteries to ensure operation even under multiple battery failure scenarios.

During diving the battery reserve alarm will indicate when there is still sufficient battery to allow a return to the surface with a small reserve. The unit MUST then be charged prior to diving again.

The handset has its own battery that is charged from the EXPLORER Module automatically.

The user should keep the batteries recharged and topped up to ensure there is always maximum capacity for any dive.

A fully charged battery pack will display 1000 minutes of battery life.

DANGER: The battery estimate is based on current temperature, light usage on the handset, DCP setting and other variables. Changes in conditions (i.e. cold water) may shorten burn times. Plan dives accordingly, and always monitor the HUD and Wrist Displays for system operation status.

NOTE: The EXPLORER must be fully charged before its first use. Always dry the Optocon charge connector before attaching the charging connector. Damage may result if this is not done.

Check that all parts of the charger are kept dry and only used indoors. Battery level alarms will activate when the batteries get low. When Battery level alarms will activate when the batteries get low. When a battery low alarm is activated this will be displayed on the Status screen.

WARNING: DO NOT dive a battery level, which is less than twice your expected dive time for the next dive.

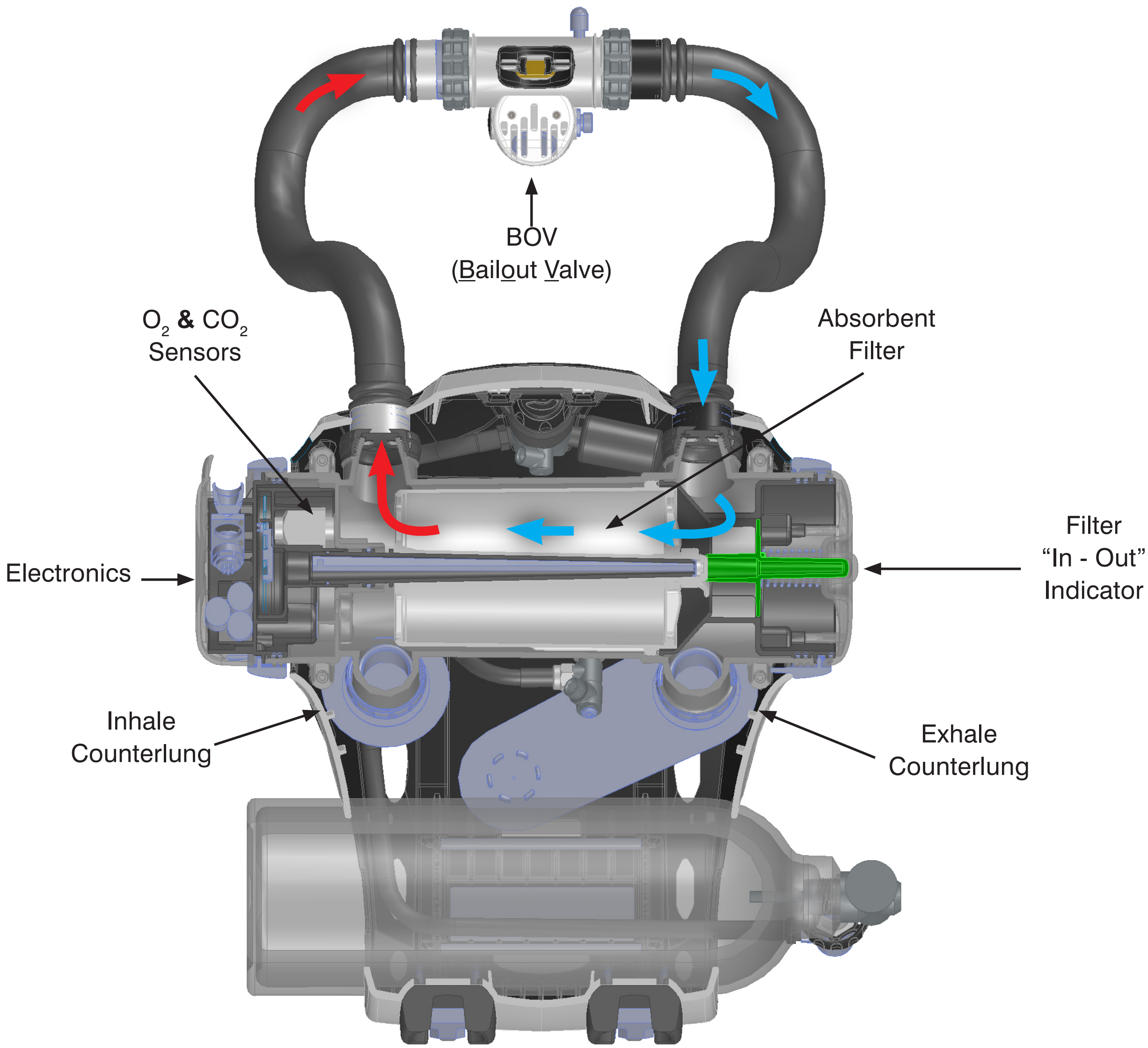
ASSEMBLED UNIT

COVER REMOVED

GAS FLOW

As the diver exhales gas flows through the hose (blue arrow) and over the right shoulder. It then enters the absorbent filter and flows across the Oxygen and CO_2 sensors in the Sensor Module and through the inhale hose (red arrow) and back to the mouthpiece.

Gas also naturally flows in and out of the exhale and inhale counterlungs.



MECHANICAL FEATURES

The EXPLORER is an electro-mechanical rebreather. Over time certain software and hardware optional extras and/or software upgrades will become available. Please check www.HollisGear.com for details.

HARNESS/BCD

EXPLORER uses a custom bolt fitting, backplate, Solo webbing harness, and Hollis C45LX Wing. There is an optional EXPLORER BCD available.

COUNTERLUNG

The EXPLORER comes complete with dual back-mounted counterlungs (BCL). These are attached to the canister by a screw threaded O-ring fitting.

CYLINDER

EXPLORER uses a 5L/40cuft cylinder with an inline valve. Dives over 18 m/60 ft requires that an additional bailout cylinder of a minimum capacity of 3 L/20 cuft be used in conjunction with the 5L/40 cu ft cylinder.

USA Only Cylinder Options Chart

	Capacity		Working pressure	
Manufacturer	WC (L)	WC (CU/FT)	BAR	PSI
Beever (Eurocylinders)	5	41	232	3410
Luxfer (US)	4.9	40	204	3000
Catalina	4.3	35.26	204	3000
Faber	5	41	232	3410
Faber	6	49	232	3410

NOTE: The Explorer can accomadate a maximum 5.5 in/14 cm diameter tank.

EU Only Cylinder Chart

	Capacity		Working pressure	
Manufacturer	WC (L)	WC (CU/FT)	BAR	PSI
Faber	5	41	232	3410
Beever (Eurocylinders)	5	41	232	3410

OUTER CASE

The outer case is made from high impact plastic.

OVER-PRESSURE VALVES

EXPLORER uses a combined water release and balanced Loop Control Valve (LCV). The balanced valve ensures that, the underwater release pressure is near-constant in any orientation. When the unit vents it also removes any water from the exhale counterlung. This is best conducted in a heads up position.

In addition there is a master (high flow) over pressure release valve that is set to 40mb to help control ascents.

BOV (BAILOUT VALVE)

EXPLORER comes with a BOV. The BOV attaches to the on-board nitrox circuit. The BOV is designed as the primary bail out (providing a sufficient/planned volume is carried).

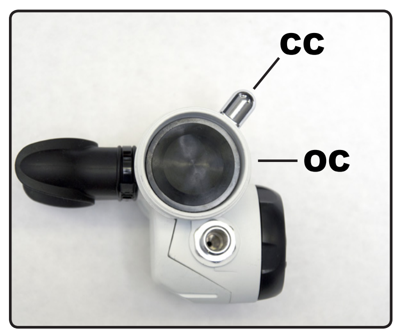


Fig. 1.1

The BOV has two modes *(Fig. 1.1)*:
- OC (Open Circuit Position)
- CC (Closed Circuit Position)

When the mouthpiece is open, the BOV is in the closed circuit position and when the mouthpiece is closed it is open circuit position.

INTELLIGENT HUD (HEADS UP DISPLAY) & BUD (BUDDY UNIVERSAL DISPLAY)

The Intelligent HUD (Heads Up Display) is attached to the BOV in the divers line of sight. There is also a BUD (Buddy Universal Display) display in the EXPLORER Module for Dive Buddy/Instructor use.

These displays give full alarm status at all times using a visual and a tactile alarm system.

SENSORS

The EXPLORER uses 3 oxygen sensors and one gaseous CO_2 sensor. It also uses a wireless HP sensor.

All sensors are automatically calibrated by the electronic control system.

OUT OF THE BOX
INITIAL ASSEMBLY

The parts to assemble your EXPLORER include:

1. The Front Case
2. The Back Case
3. The Canister (pre-assembled in the Case Front)
4. The Sensor Module (Pre-assembled into the Canister)
5. The Life Support System (LSS) Module (Pre-assembled into the Canis ter) secured in the system case
6. The Right Hand End Cap (Pre-assembled into the Canister)
7. The Regulator First Stage (Pre-assembled in the Case Front)
8. The Buoyancy Control Device (BCD)
9. The 5L/40cuft SCUBA cylinder and valve
10. Two Breathing Hoses
11. The combined Dive-Surface Valve (DSV) and Bail-out Valve (BOV)
12. The Absorbent Filter (pre-assembled into the Canister – User Pack version only)
13. One Exhale counterlung
14. One Inhale counterlung
15. One Loop Control Valve (LCV) counterlung port/tube
16. Three Oxygen Sensors
17. One CO_2 Sensor - Optional
18. One power charger

ASSEMBLY

Step 1.
Remove all parts from the split top box.

Step 2.
Undo the rubber latches at the base of the Case Front/Back assembly and lift up the Case Back until the hinge at the top is free *(Fig. 2.1)*. Place to one side.

Fig. 2.1

Step 3.
Open the box with the Oxygen and CO_2 sensors in it. Remove the sensors from the box and open up the airtight bags.

DANGER: All sensors must be allowed to sit in an AIR atmosphere for at least twelve hours prior to use in the EXPLORER. The Sensors can be immediately assembled into the Sensor Module but this module should not be fully installed for at least 12 hours after unsealing the sensors packages.

WARNING: After an initial calibration and dive the sensors should be calibrated again after 24 hours.

Fig. 2.2

Step 4.
Remove the LSS Module by turning the lock ring ½ turn counterclockwise. Note the orientation in the Canister.

Visually* inspect the large sealing O-rings for damage *(Fig. 2.2)*.

Pull the Sensor Module out from the Canister.

Fig. 2.3

Remove the yellow and black CO_2 sensor filter cap as shown below *(Fig. 2.3)*. This is a simple O-ring push fit and is retained in place once the Sensor Module is assembled into the Canister, as are all the oxygen sensors.

Push the three oxygen sensors and one CO_2 sensor onto their respective connection points as shown in the picture below.

NOTE: Ensure the oxygen sensors are installed with the white membrane facing up, as shown.

Fig. 2.4

Inspect the the yellow membrane in the CO_2 sensor cap to ensure it's flat in the holder. Then replace the Sensor Module, and refit the cap *(Fig. 2.4)*.

** The O-ring pick is used in the photo for illustration purposes. It is not necessary to remove the O-ring before every dive.*

Step 5.
Move the LSS module to one side and peel the Optocon charging/download connector protection cap off as shown *(Fig. 2.5)*.
Plug in the power charger. You will need to rotate the cable end connector until the key way aligns. Then push it in and tighten up the black lock ring. The lock ring will spin freely once the connector is fully assembled. Once connected and power is applied then a red light will appear on the Electronic Head.

To remove unscrew the ring (which will rotate freely until pulled back to start the thread) and pull out the connector.

When charging, a Red light appears on the LSS Module. It turns Green when the LSS Module if fully charged. A full charge takes approximately 10 hours.

EXPLORER has 3 battery status displays with the charger connected:
1. Battery Charging (Empty) *(Fig. 2.6)*
2. Battery Charging *(Fig. 2.7)*
3. Battery Charged *(Fig. 2.8)*

Once fully charged the LSS Module can be refitted to the Canister.

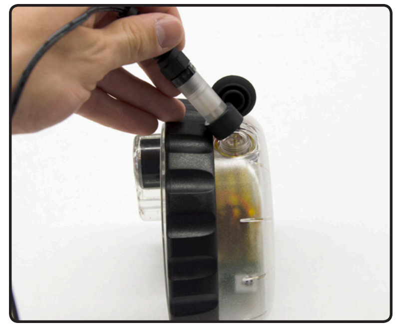


Fig. 2.5

Fig. 2.6

Fig. 2.7

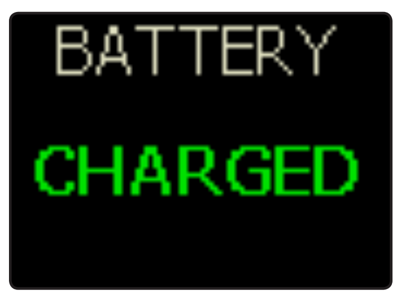


Fig. 2.8

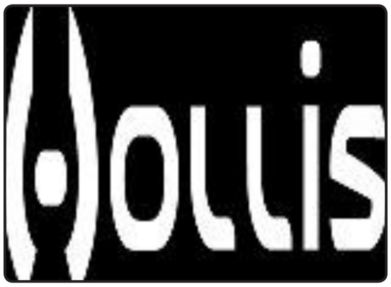


Fig. 2.9

To view the charge status of your EXPLORER, do the following:

1. Remove the charger (if attached).
2. Do a long hold of any button on the handset and the Hollis splash screen *(Fig. 2.9)* will display. This screen will timeout after 3 seconds and the "Do Predive" screen *(Fig. 2.10)* will display.
3. Continue to do a short push of the either button until you see the central window change to battery status *(Fig. 2.11)*.

Fig. 2.10

WARNING: DO NOT start a dive with a battery minutes display of less than twice the dive time you intend to do. The Pre-dive sequence will fail if the battery minutes are too low.

Fig. 2.11

Step 6.
If required attach the BCD to the Case Front using the screws supplied. Connect the LP inflator hose.

Step 7.
Inspect the mushroom valves in the BOV and make sure they are in place. Put the BOV into the CC (Closed Circuit) position *(Fig. 2.12)*. Look into one side of the BOV at the mushroom valve. If you can see daylight through the other side of the BOV then the valve is not seated correctly.

With the BOV lever in the Closed Circuit position, breathe off the BOV and ensure the mushroom valves function correctly as per the instructions in the 'BOV Assembly' subsection in the "Complete Disassembly & Reassembly" Part of this manual.

Fig. 2.12

Attach the regulator LP hose to the BOV and gently tighten the nut to the hose inlet *(Fig. 2.13, item C)*. After inspecting the hose end O-rings, attach the breathing hoses to the BOV. Ensure the white hose end goes to the inhale side *(Fig. 2.13, item B)* of the BOV.

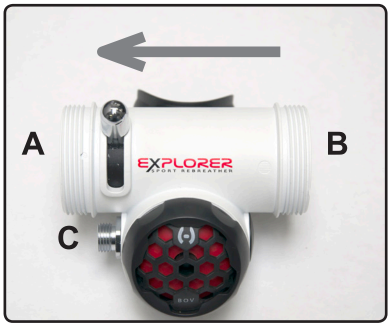


Fig. 2.13

Fit the breathing hose alternate ends to the Canister. Ensure the white hose end goes to the white coded Canister port.

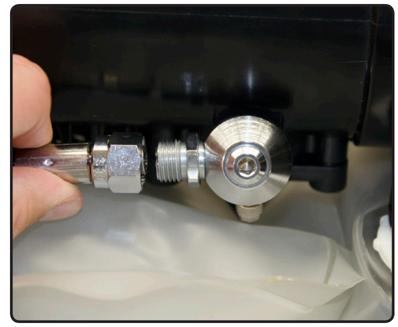


Fig. 2.14

Confirm the ADV LP feed hose is fitted correctly and tightened to a torque of 50-60 in-lbs/5.6-6.7 N-m *(Fig. 2.14)*.

Step 8.
Remove the Counterlungs from the packaging. Visually inspect them for damage.

Fig. 2.15

The Exhale counterlung *(Fig. 2.15)* is the one with the mushroom valve in the base (this valve is seated in the LCV port).

The LCV port cap is removed by a ¼ turn counterclockwise. This gives access to the mushroom valve. Inspect the mushroom valve and LCV port O-ring and the Canister port O-rings for damage *(Fig. 2.16)*.

Fig. 2.16

Attach the LCV port cap to the counterlung. Twist the cap until it clicks shut.

If not already installed, attach the LCV tube open end to the LCV on the Canister, using the clip provided *(Fig. 2.17)*.

Fig. 2.17

Inspect the Canister port O-rings on the Inhale counterlung and attach the counterlung to the Canister. The assembled orientation of the Counterlungs and the LCV tube should be as shown *(Fig. 2.18)*. The LCV tube is on the underside of the counter lung in the figure and is not visible.

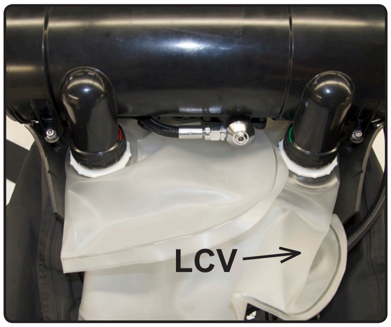


Fig. 2.18

Step 9.
Remove the Right-hand End Cap by twisting the lock ring ½ turn counter-clockwise and visually* inspect the sealing O-ring *(Fig. 2.19)*.

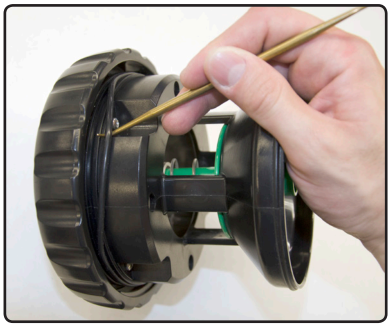


Fig. 2.19

EXPLORER can be used with two types of absorbent filter:

- Professionally pre-packed
- Single use Pre-packed

The Professionally pre-packed version can be filled with granular absorbent by a qualified dive professional (see you Instructor or Hollis dealer for more information).
The Single Use pre-packed version comes in a sealed bag and the filter **CANNOT** be taken apart or refilled.

NOTE: If the unit is supplied with a Professionally pre-packed absorbent Filter then this will be assembled inside the Canister. Reach into the Canister and pull out the Filter by grasping the central (yellow) pull-tab.

Inspect the Filter quad-ring for damage. Clean the ring groove and the ring and lightly grease the ring before refitting *(Fig. 2.20)*.

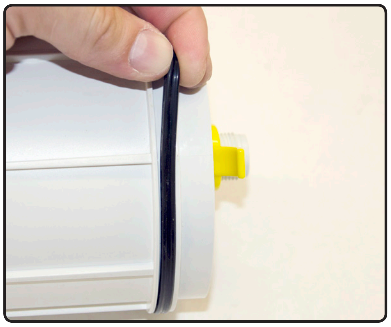


Fig. 2.20

WARNING: This Quad Ring should be replaced every 30 hours of dive time or annually whichever comes sooner.

NOTE: The Single Use Pre-packed Absorbent Filter comes supplied in a sealed bag and is available from your Hollis dealer. This also has a quad ring fitted, which must be inspected prior to use.

For Professionally pre-packed systems, pack the Absorbent Filter as per instructions.

Insert the scrubber into the canister, and seat it by pressing it into position. Then refit the end cap by aligning the tab on the end cap and pressing in

** The O-ring pick is used in the photo for illustration purposes. It is not necessary to remove the O-ring before every dive.*

on the clear center. While pressing firmly, twist the lock ring to 3 O'clock with your fingers until fully closed as shown *(Fig. 2.21)*.

NOTE: The Case Back will not fit and lock properly if the end cap lock rings are not in the correct orientation.

Step 10.
Fit the SCUBA cylinder. Ensure the HP hose fits into the slots in the case under the cylinder. Tighten the cam strap.

Inspect the HP DIN wheel O-ring for damage and attach the DIN wheel.

Step 11.
Attach the HUD to the HUD bracket and fit the hose wraps as shown *(Fig. 2.22)*.

Fit the LP hose wraps as shown *(Fig. 2.23)*.

Step 12.
Refit the Case Back and secure the two clips at its base *(Fig. 2.24)*.

WARNING: Ensure that the counterlungs are not pinched during installation of the Case Back. Pinching counterlungs could puncture or cut the counterlungs, leading to flooding and risk of drowning.

Step 13.
Turn on the wrist display by doing a long hold of either buttons.

Complete the pre-dive sequence as instructed.

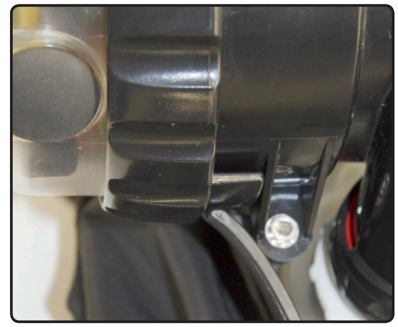


Fig. 2.21

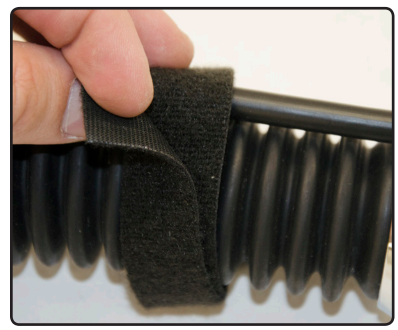


Fig. 2.22

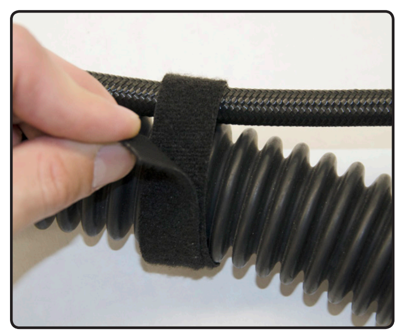


Fig. 2.23

Fig. 2.24

LIFE SUPPORT SYSTEM (COMPUTER)
GENERAL OPERATION

The EXPLORER Life-Support System (LSS) is designed around a breathing loop, high pressure gas sources and electronics control system - all highly integrated to give an intelligent but simple display of status to the diver while providing life-support.

This gives the user a simple "Check-and-Dive" functionality that makes the EXPLORER the easiest Rebreather to prepare for diving, while ensuring system integrity and improving safety.

It uses intelligent monitoring and design experience to determine the appropriate tests and checks that the diver needs to perform to get the EXPLORER ready for use.

Any problems are described clearly on the STATUS screen with the required action.

The integrated system design means that failures or problems with any part of the system are communicated to the diver, either in pre-dive checks and procedures, or as data values/graphics or instructions. There is significant background analysis that produces a warning system sensitive to changes in expected levels, but intelligent enough to not confuse and over load the diver with information and situations that may be routine during a dive. These electronic alarms combined with varying levels of mechanical user controls ensure the LLS is maintained.

Examples:
• PPO_2 changes that may normally cause PPO_2 alarms to be triggered are inhibited if they are of the correct characteristic expected during a descent or setpoint change.

• There is a significant amount of mechanical design required to achieve a moisture tolerant breathing loop that reduces distortion of the readings from the PPO_2/CO_2 sensors to a minimum. The reliability of the PPO_2 readings is further improved by employing a voting algorithm for the PPO_2 sensors that can ignore data from rogue sensors.

The EXPLORER design is simple to use but this simplicity does not mean that the system is simple in terms of data processing or control analysis. The EXPLORER includes many levels of warning and system analysis, simplified through experience and intelligence to provide a straightforward human interface that does not routinely overload or annoy with status or false warnings.

It takes considerable system intelligence and design experience to ensure the warnings do not overload or falsely advise the user of problems. If falsely warned too many times, then there is a reduced likelihood of the diver responding correctly to a truly dangerous and potentially life-threatening situation.

Mechanically it is vital that simple mechanical tasks required to set up the EXPLORER are not ambiguous and prone to user error.

THE HEADS UP DISPLAY

The Heads Up Display (HUD) is an ergonomic addition for the diver, as it gives a simplified and quick to follow view of the status of the EXPLORER. The HUD as 3 main warning levels:

• Flashing Red plus vibration alarm - warning is activated when a dive should be aborted on open circuit or not started.
• If diving, the diver should switch to the bailout gas.
• The HUD vibration alarm will vibrate every ¼ second for 10 seconds, and then repeat the 10-second alarm every minute.
• Flashing Green and Blue Leeds - warning is activated when a manageable error situation is in place. The correct response is to ascend slowly on closed circuit monitoring the Primary display.
• Solid Green - means there are no detected problems

! **WARNING: If any other light sequence or a 'no light' scenario is experienced then the diver should refer to the wrist display for information.**

! **WARNING: If no wrist display is seen the diver MUST switch to open circuit and ascend.**

The LED states are configured for color blind as well as highly stressed divers. The positions of the LED's, the flashing or solid state, provide conditions that cannot be confused with one another. Also, during stressful dive scenarios, the position and status is quick to comprehend and therefore intuitively the desired response is performed.

PRE-DIVE CHECKS

With current technology, not all aspects of the safety and working nature of the EXPLORER system can be performed or determined automatically. Therefore, when turning on the EXPLORER, there are a series of pre-dive checks that must be performed. The EXPLORER also gives guidance in performing these checks. These checks are displayed in sequence on the EXPLORER wrist display unit. Some of these checks rely completely on the diver to perform them correctly – i.e. Close/open mouthpiece. Other tests can be positively checked for by the electronics control system and the user needs to confirm that these are OK to dive with – i.e. that the high pressure cylinder is adequately filled.

Information regarding the current status of EXPLORER and all available resources can be reviewed prior to conducting Pre-Dive Checks using the STATUS screen.

DATA LOGGING

EXPLORER has a sophisticated data logging system that not only records all the units' sensors (depth, time, PO_2; etc.) but also records any alarms and error messages (such as missed Pre-dive checks). This information can be retrieved through the data download software and is available in detailed form to Hollis Service Technicians.

Users can obtain dive download software from http://hollis.com/support.asp.

STATUS SCREEN

The EXPLORER has two levels of detailed information available to the diver. The primary method is via the STATUS screen. There is an additional set of STATUS screens in service mode, described in the section 6 of this chapter.

The STATUS screen shows as soon as the EXPLORER is turned on *(Fig. 3.1)*.

Fig. 3.1

In addition, it can be viewed at any point on the dive by pressing any button and selecting STAT from the pop-up menu using a short push of the right button. It can also be accessed in service mode by selecting STAT (a short push of both buttons) from the Startup screen. Note that in both cases the STAT button indication is colored blue, as are all button indicators modified by service mode.

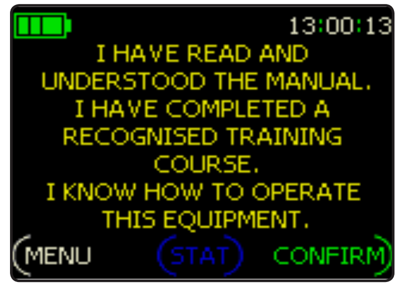


Fig. 3.2

Once in the STATUS screen, a short press of the left or right button scrolls round the information options. These are:

a. PPO_2 (average of the 3 sensors)
b. CO_2 sensor
c. HP gas
d. Battery life
e. No Decompression Limit (NDL)
f. Decompression Information
g. Filter (CO_2 filter)
h. CNS
i. A general Warnings Window (the ACTION Panel) detailing any alarm in progress. This mostly displays ‘SYSTEM OK’ or ‘DO PREDIVE as in the above example unless there is another fault to report.

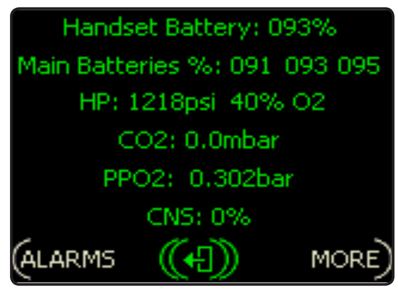


Fig. 3.3

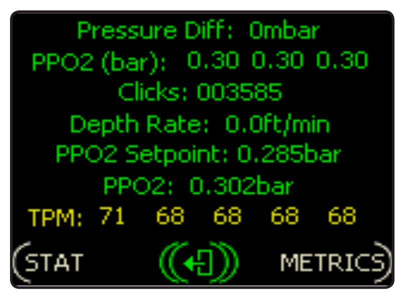


Fig. 3.4

SERVICE MODE

Service mode is accessed in the Setup Menu.

With this mode set, each pre-dive screen shows additional text information relevant to the test being performed.

Also, it enables an extra (blue) STAT button on the Startup screen *(Fig. 3.2)*, which if selected with a long push of both buttons (not indicated), will allow access to detailed service sub-screens. Your Hollis dealer will use information on these screens to assist with any servicing required. A short push of STAT will just display the STATUS screen and relevant resources as during a dive.

To enable fault diagnosis put the EXPLORER into Service Mode. Having selected STAT with a long hold of both buttons from the Startup screen you will access two extra screens *(Fig. 3.3, 3.4)* (plus alarm and metric screens, not shown).

During Pre-dive additional information will be displayed on each Pre-dive screen such as the PO_2 and internal loop pressure *(Fig. 3.5)*.

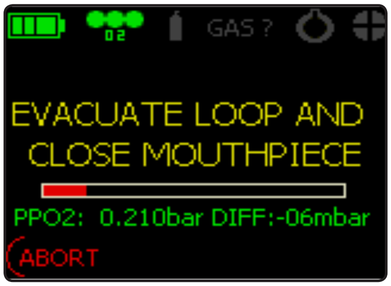


Fig. 3.5

Your Hollis dealer may need access to this information to help with any issues. Please see the separate EXPLORER Service Manual for details.

STATUS SCREEN COLORS

There are four color states of the STATUS screen. Each color provides additional information. The four color states are:

Green - No problem with the information

Yellow - The system is informing you of a low level alarm such as low HP gas supply. The STATUS Screen's Action Panel will give information regarding the warning or action to be taken and in the case of the low HP gas example, the value in the HP window will also be in yellow. This will result in a flashing Green/Blue HUD

Magenta - indicates unreliable data on the reading being taken. This could be caused by a failed sensor (such as a low wireless HP battery). This will be coupled with an action to be taken displayed on the STATUS Screen's Action Panel. This will result in a flashing green/blue or red.

Red - A major alarm Indicating that information/resource has now become critical forcing, an open circuit bailout. OC Bailout will be displayed on the STATUS Screen's Action Panel and the HUD will flash red and a vibrating alarm will sound in the mouthpiece

From the Main Dive Screen a double press of the right button will bring up the STATUS screen *(Fig. 3.6)* so that the user can determine at a glance the status of the system while doing a check. This can be useful to determine why a check is not working correctly.

Fig. 3.6

AUTOMATIC TURN ON

FAILSAFE FEATURE

Normal practice and training is for the user to turn the EXPLORER on by-hand and go through the pre-dive checks. The following failsafe additions are to reduce diver error, where the EXPLORER is turned off prior to breathing on the unit. The basis for the auto-breathe software is to reduce the chance of accidental injury or death by breathing on an EXPLORER that is in off/sleeping state.

EXPLORER uses detection of a diver breathing the unit to automatically turn the unit on.

BREATHING DETECTION TURN ON RULES

The EXPLORER will turn on if PPO_2 drops to 0.17bar. Therefore even with the unit incorrectly assembled (gas not turned on), the system will detect the fall in PPO_2 and will activate. It will then alarm and force the user to properly complete the pre-dive sequence.

Once turned on the unit will attempt to maintain a breathable PPO_2 based on the DCP (Dive Control Parameter) setting and the supply gas expected.

If sensors are removed or read 0.00 then the unit will only turn on with depth or by the user pressing a switch. This feature is included to conserve battery power when the user takes out PPO_2 sensors for storage or during transport. Other current rebreather designs and CE approvals require a reduced safety margin than achieved even with this power save scenario. In other words, the chance of the user taking out the sensors and accidentally not turning the unit on before breathing falls into user set-up error that should not routinely occur due to training and a good pre-dive check regime. Other errors such as failing to turn on cylinders, etc. are much more likely, and should be reduced by proper training and the intelligent alarm systems as in the EXPLORER.

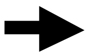
If the diver does not have HP gas turned on, alarms on the HUD (forwards and rear facing HUD) and Primary display will occur as soon as auto turn-on occurs. Hence this method provides increased warnings whenever loop PPO_2 is breathed when the unit is off.

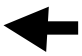
Breathing the loop, in all circumstances where the unit is breathable and PPO_2 sensors operative, will cause a safe turn-on.

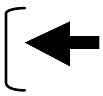
DANGER: The additional safety features described in this section should NEVER be used as routine. The user should ALWAYS turn on the unit and pre-dive checks carried out as required in training and the operations manual.

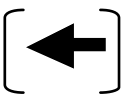
DISPLAY SYMBOLS

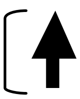
Most screen commands (soft buttons) are actually the written word (in English) but movement commands are expressed using icons.

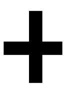

Moves the cursor to the next field to the right to edit or moves the STATUS display one window to the right.

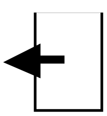

Moves the cursor to the next field to the left to edit or moves the STATUS display one window to the left.

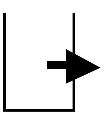

A single bracket indicates a short push of the button to perform the action (in this case move left)

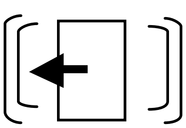

A double bracket indicates a short push of both buttons to perform the action (in this case move to left)


Moves the cursor up to the next option (as in a menu list). In this case a short push of the left button. A down arrow moves the cursor down.


A short push increments the information by 1 digit. A long push increments the information in multiples. A minus sign (-) decrements the digit.


EXITS to the previous page and SAVES the information.


ENTERS the selected item/page


A double bracket around a function indicates a long push of both buttons. In this case to exit the page.

SCREEN ICONS

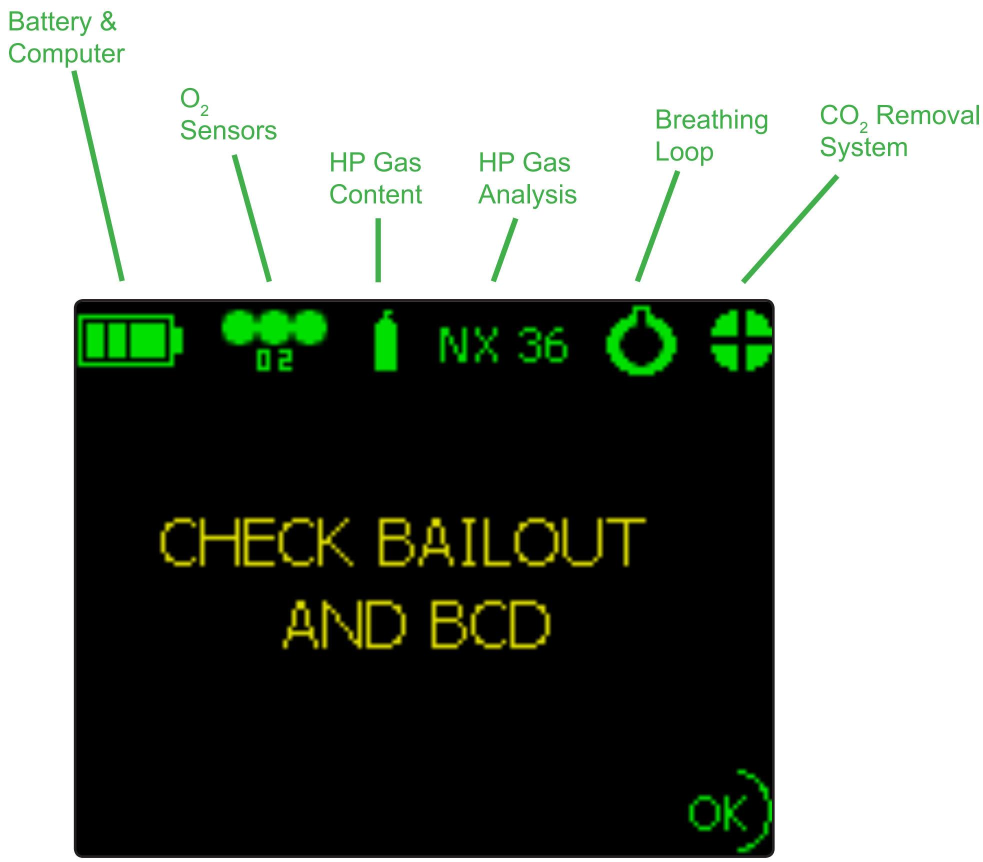
During the Pre-dive tests icons appear across the top of the screen starting on the left.

As each level of Pre-dive is completed successfully a green icon appears indicating the test has passed successfully.

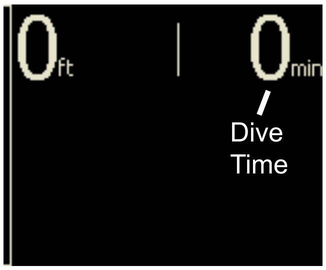
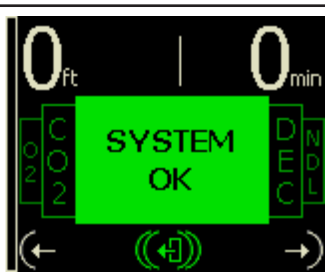
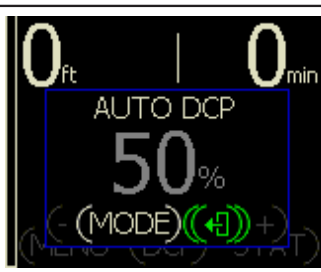
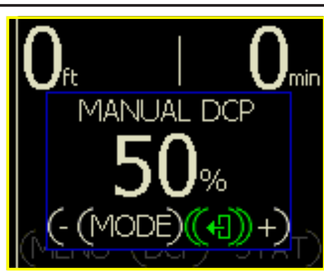
Note that all icon colors, as with any numerical displays, match the alarm severity – yellow indicates a blue/green HUD state. In addition, a grey icon indicates a test not yet performed.

WARNING. A red icon means a failure of the test/alarm which if ignored would make EXPLORER unsafe to dive.

The icons are:



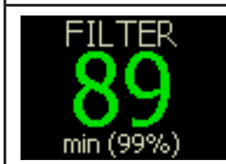
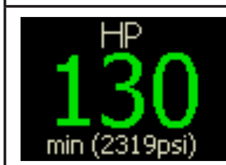
DIVE SCREENS

Screen	Description
	Dive Screen (when ascent rate bar is ½ full then rate is 30 ft/min *10 m/min*)
	Dive Screen with menu bar (accessed by a single push of any button)
	Status Screen (accessed by a short double push of the right button)
	DCP Auto Mode (short push of both buttons to change modes)
	DCP Manual Mode (short push both buttons to change modes, 1% increment change by short push of either button, 10% increment change by long push of either button)

STATUS SCREENS

The Status (STAT) screens show all key resources in a simple format. The screen is accessed from the main screen by a short double push of the right button, and then a short push of either the left or the right button moves around the screen. The Status screen also incorporates a color coded Action Panel to give instructions.

The items that can be displayed are:

Screen	Description
	Battery time in minutes
	CNS oxygen toxicity time in minutes
	Partial pressure of carbon dioxide in millibars
	Carbon dioxide absorbent filter estimated remaining time
	High pressure nitrox gas supply remaining in minutes, at current depth and workload
	Any decompression information

NOTE: The Status screen disappears after 5 seconds of inactivity (if no alarms) or 30 seconds if an alarm is present. Alternatively a long press of both buttons will ‘Hide’ the screen.

MAIN MENU SCREEN *(FIG. 3.7)*

The EXPLORER has a simple menu system which is available while at the surface. To access the Main Menu short press any button.

Fig. 3.7

MENU NAVIGATION

Action	Button Press
Enter Highlighted Menu Item	Short push both buttons
Exit	Long push both buttons
Scroll Down	Short push right button
Scroll Up	short push left button

MAIN MENU OPTIONS

SETUP

Setup is a basic settings menu. See the following Setup Menu section for further details.

Fig. 3.8

NDL PLAN

It is a dive planner based on current tissue state, surface interval, and a DCP setting for the next dive *(Fig. 3.8)*.

PC LINK

This screen is a gateway to updating the internal software and downloading the log information to a PC *(Fig. 3.9)*. Further details can be found in the Internet Reprogramming section of this manual.

Fig. 3.9

LOGBOOK

The Log Book screen is where you access recorded information on previously completed dives *(Fig. 3.10)*.

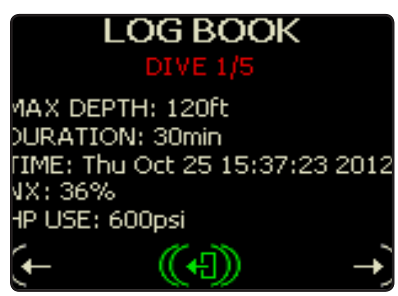


Fig. 3.10

ABOUT

This screen shows information about the software installed in the EXPLOR-ER, the serial number of each connected element, and information that may be required by your service center. Software updates for the EXPLOR-ER are available from http://hollis.com/support.asp. Please check regularly for updates. Once a new update has been installed, this screen will report the new version of software installed *(Fig. 3.11)*.

Fig. 3.11

TURN OFF

This selection shuts down the Explorer electronics.

SETUP MENU

MAIN MENU SCREEN *(FIG. 3.12)*

The EXPLORER has a simple menu system which is available while at the surface. To access the Main Menu short press any button.

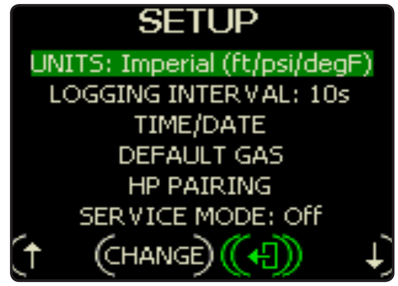


Fig. 3.12

MENU NAVIGATION

Action	Button Press
To Make A Change (enter the modification screen)	Short push both buttons
Exit The Menu	Long push both buttons
Scroll Down	Short push right button
Scroll Up	short push left button

SETUP MENU OPTIONS

UNITS

This option allows for the switching between metric and empirial unit modes.

LOGGING INTERVAL

This option allows for the selection of how frequently the computer takes a snapshot of dive data, stored for later download. Using a shorter interval results in more data points per dive and fewer stored dives for download data respectively. Longer data intervals result in fewer data points (less detail) but the space to store more dives.

TIME/DATE

This is the clock and calendar setting *(Fig. 3.13)*.

NOTE: When the EXPLORER is first powered up from a flat battery you will be asked to update the date and time.

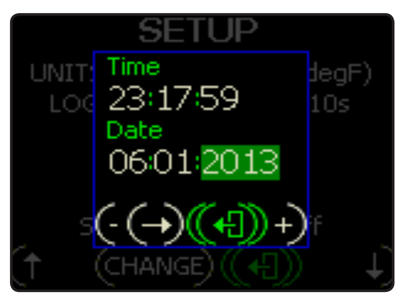


Fig. 3.13

DEFAULT GAS *(FIG. 3.14)*

Set this to your normal dive gas. During the Pre-dive if EXPLORER analyzes a different gas, it will alarm and ask you to recheck the analysis. For further detail on proper use of this function see the following section "Bail-out and Gas Configuration".

Fig. 3.14

HP PAIRING

To pair the HP transmitter, first press SEARCH, any transmitters in range will be displayed. Then press PAIR. The word PAIRED will appear once the transmitter is recognised *(Fig. 3.15)*. The transmitter ID is written on the transmitter attached to the first stage in your EXPLORER *(Fig. 3.16)*. Please confirm this is the correct transmitter.

Fig. 3.15

NOTE: The HP transmitter MUST have pressure applied to it to activate and be seen by the system. If the regulator is not pressurized the the transmitter will be off and not sending a signal.

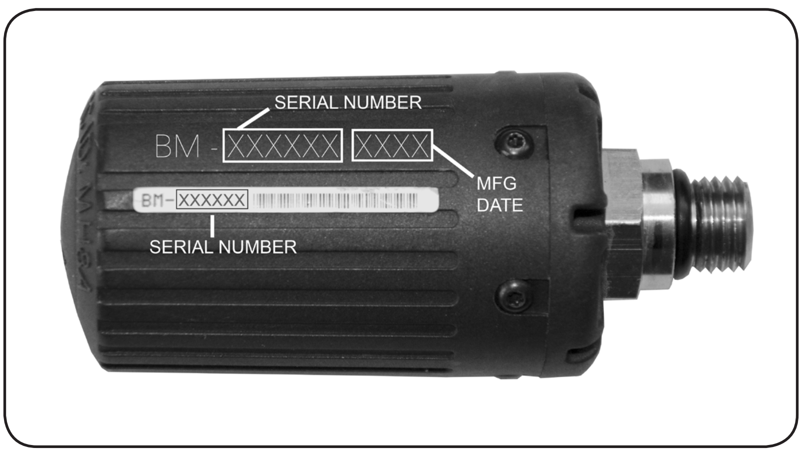


Fig. 3.16

SERVICE MODE

Service Mode allows access to more detailed information about the EXPLORER. It can be accessed by your Dealer. A separate Service Manual is available through www.HollisGear.com.

BAILOUT AND GAS CONFIGURATION

DEFAULT GAS SETTING

The EXPLORER has the capability to analyze the dive gas attached to the system. If this gas differs significantly from what the EXPLORER expects (the programmed Default Gas), then a warning will be given during the pre-dive sequence. This is to help protect against absent or faulty gas analysis by the gas supplier and user.

To change the Default Gas, when the unit turns on, go to the SETUP menu screen and highlight Default Gas by repeated short presses, then a short push of both left and right buttons to select *(Fig. 3.17)*. The gas can now be set.

Fig. 3.17

The Default Gas information is used to drive bailout gas calculation (using cylinder size) and hence gas time remaining and when the unit performs its gas analysis checks, if the gas analyzed is not the default gas then a warning will display to prompt you to re-analyze the gas or calibrate the oxygen sensors.

If the analyzed gas is not what you expected (the Default gas) but is still usable you can simply start the dive without having to change the Default gas but you must change the cylinder size if it is incorrect. If the analyzed gas is lower than expected (within 5%), then it will replace the gas used, else the default gas will be used.

On this screen you can also input the cylinder size.

DANGER: It is important that the correct cylinder size is entered for EXPLORER to correctly calculate the remaining resource times.

BAILOUT GAS

It is not necessary to set a bailout gas. Whether the bailout is undertaken on the onboard (attached) gas or on an external gas supply, the **EXPLORER assumes 21% oxygen and 79% nitrogen as the bailout gas**. This is to ensure as safe an ascent as possible in an emergency. All bailout decompression calculations are based on 21% oxygen and 79% nitrogen.

DCP (DIVE CONTROL PARAMETER)

DYNAMIC PO_2

The EXPLORER is a dynamic PO_2 controller. This means it can vary the PO_2 that it maintains based on the value of certain resources. A higher DCP (Dive Control Parameter) value means less decompression (higher PO_2) but more gas usage and a lower PO_2 is the opposite. For a set DCP the actual PO_2 will vary throughout the dive profile.

The DCP can be set to AUTO or MANUAL mode.

MANUAL MODE

In manual mode the diver can set the DCP using the screen shown *(Fig. 3.16)*. A long hold of either the + or - button will jump the DCP value by 10.

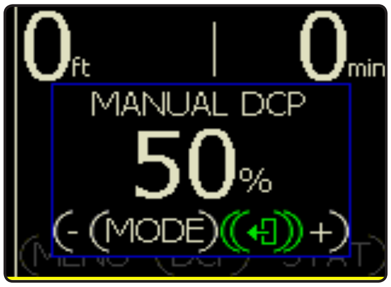


Fig. 3.18

AUTO MODE

AUTO mode automatically adjusts the DCP throughout the dive to give the best compromise between maximum NDL and minimum gas usage *(Fig. 3.19)*. While shallow (less than 10 m), the DCP will remain at its current value. This defaults to 50% each time the unit is switched on. The first time the dive exceeds 10 m depth, the DCP will automatically be set high to reduce the NDL but then as the diver ascends and the NDL naturally increases, then the DCP will start to automatically reduce to save gas while maintaining a long NDL (>1 hr). At the start of the dive the DCP will automatically set high to reduce the NDL but then as the diver ascends and the NDL naturally increases, then the DCP will start to automatically reduce to save gas while maintaining a long NDL (>1 hr)

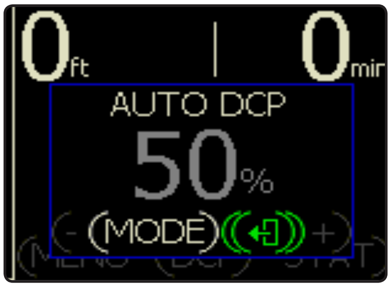


Fig. 3.19

NOTE: Auto Mode is the default. If on a dive where Manual Mode has been selected and you then surface and complete the dive, Auto Mode will be the default at the start of the next dive.

HOW AUTO MODE WORKS

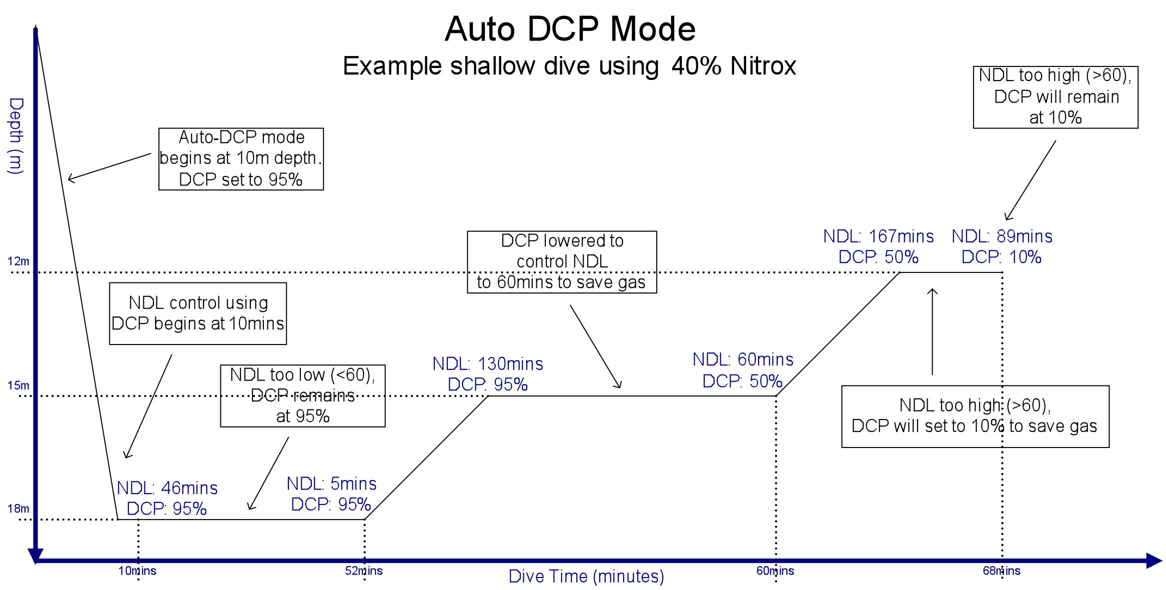
By setting 'Auto' DCP prior to diving the following events occur.

1. The DCP will automatically be set to 95% for the first 10 minutes of the dive but only after the diver exceeds 10 m of depth.

2. If the NDL is then less than 60 minutes the DCP will stay set to 95% to maximize the NDL.

3. If at any point on the ascent the NDL is in excess of 60 minutes then the DCP will reduce to save gas and maintain the NDL at 60 minutes.

4. The minimum DCP will only go to 105 so if a dive profile means that even with 10% the NDL is greater than 60 minutes then the DCP will stay at 10%.



RMS (RESOURCES MANAGEMENT SYSTEM)

The control of PPO_2 is the prime function for EXPLORER in addition it monitors a range of dive resources. The unit is able to make advanced decisions based on available resources in order to modify the PPO_2 and provide for a better dive outcome.

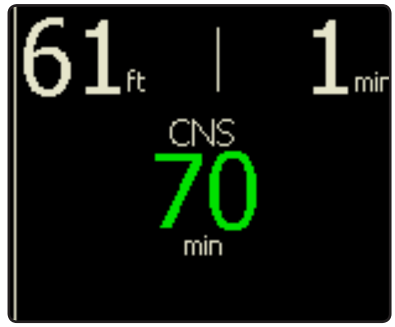


Fig. 3.20

The unit constantly monitors all resources such as available gas, filter duration, etc. and keeps the dive within parameters that allows for a safe bailout ascent. The unit uses a forward-looking algorithm to determine the best PPO_2 at any given time to avoid or reduce decompression, allow for a safe open circuit ascent and stay within safe battery and filter durations.

Resources monitored include;

- Depth
- NDL
- PPO_2
- PCO_2
- Battery
- HP gas
- CNS (Oxygen toxicity)
- Filter (CO_2 filter)

Resources are generally expressed in minutes and are noted in the center of the dive screen *(Fig. 3.20)*.

The controlling (most critical) resource is shown. This can change throughout the dive and another resource may take its place. Alarms will be activated when resources reach certain levels as defined in the Alarm Tables.

In addition, should a resource alarm be triggered for any reason occur the STATUS screen will appear. This will not only note the resource level but can also tell the user the direct action required, i.e. ASCEND NOW.

OXYGEN SENSOR CALIBRATION

The EXPLORER is able to perform accurate calibration of the Partial Pressure Oxygen (PPO_2) sensors in ambient air. This has particular importance on the ease and accuracy of achieving calibrated sensors.

The EXPLORER is able to measure atmospheric pressure during calibration and make the appropriate calibration adjustments for the sensors, even at altitude. When performing sensor calibrations, it is important that the calibration gas and ambient pressure are known. **By using ambient air as the calibration gas this is known accurately.**

Calibration Errors

When Oxygen sensors are new or completely dry and a calibration is undertaken, a small difference will be noted when another calibration is done after a dive. This is because the humidity inside a unit post-dive affects the sensor membranes permeability to a small (safe) degree.

In general, it is good practice to calibrate a unit in an as-dived state i.e. with humidity in the loop. This is performed naturally during the Pre-Dive Check sequence.

The EXPLORER uses advanced empirical techniques to ensure the accuracy of the ambient air calibration.

WARNING: When refitting an oxygen sensor or after calibration of the sensors, a full Pre-Dive sequence MUST be completed.

The user can cause the largest error in oxygen sensor calibration. If the calibration is not done in ambient air, the sensors will not give the correct readings after calibration. Therefore do not execute a manual calibration without ensuring the sensors are exposed to air at ambient pressure.

The units testing for good and bad oxygen sensor calibration is determined from the sensor mV level detected during calibration. At 1000mBar atmospheric pressure the range the unit can calibrate for is approximately 5mV to 15mV. However, if a sensor that would normally show 7.5mV in air has an enriched gas applied to it of 40%Oxygen during calibration, then the sensor will give 14.28mV, and the calibration will pass, but the sensor will be reading only about half of the actual ambient Oxygen.

Recommendations

- **Never store sensors for long periods of time before use; they have expiration dates.**
- **Never subject sensors to high temperatures i.e. (inside cars, garages etc.).**
- **Never freeze sensors (left in cars overnight).**
- **Never subject sensors to physical shocks.**
- **Never subject sensors to vacuum**
- **Never submerge sensors in liquids.**
- **Never attempt to open a sensor. They contain a caustic chemical.**
- **Sensors deteriorate very slowly and near the end of their useful life may show a drift soon after calibration.**
- **The oxygen sensors are not covered by the warranty, they must be replaced every 12months or at their 'do not use after' date or sooner depending on the pp02 they are stored in and the hours of use**
- **Oxygen sensor usage temperatures are:**

- Operating temperature range 0 – 40 °C / 32 - 104 °F
- Storage temperature -20 to +50 °C / -4 - 122 °F
- Recommended storage temperature +5 to +15 °C / 41 °C to 59 °C

DANGER: Always be careful when doing manual calibrations, AIR must be exposed to the sensors and NO OTHER GAS.

Calibrations should be conducted routinely. However prior to starting a dive sequence it is advisable to check the oxygen and CO_2 sensor calibration by opening the EXPLORER Module and removing it and the Sensor Module, place them together *(Fig. x.x)* and turn the unit on. Then go to the STATUS screen and view the PPO_2 and CO_2. If the PO_2 is not 0.21 and the CO_2 is not 0.3-0.4mb for the CO_2, then a calibration must be performed.

In general, Oxygen and CO_2 sensors do not drift excessively. Constant calibration (every dive) is not required. Periodically check sensors and keep them dry between dives if possible and especially during storage.

WARNING: Use calibration sparingly, not as a routine task that may mask other potential problems.

CONDUCTING AN O_2 SENSOR CALIBRATION

During the Pre-dive sequence you have the option to calibrate the oxygen and CO_2 sensors from the Calibration screen *(Fig. x.x)*. Selecting O_2, will display another series of screens that will guide you through the calibration. Please see descriptions later in the manual for calibrating the CO_2 sensor.

SUMMARY OF DO'S AND DON'TS OF OXYGEN SENSOR CALIBRATION

When calibrating sensors there are two factors that the EXPLORER takes into account:
1. Ambient pressure
2. Ambient AIR oxygen content

These two factors multiply to determine the partial pressure of the oxygen exposed to the Oxygen sensor.

Example:

20.9% oxygen at 1000mBar = 0.209mBar partial pressure of oxygen

20.9% oxygen at 750mBar = 15.675 mbar partial pressure of oxygen

The EXPLORER uses ambient air as the calibrating gas, because its composition is accurately known. This is in contrast to say a cylinder of compressed oxygen that can vary from supplier to supplier, as well as around the world, from at least 94% to 100%.

3.12

To achieve a good calibration some basic rules must be observed:

1. The Oxygen sensors must be exposed to the pure calibrating gas. So for an air calibration, the sensors must be flushed with air. Just taking the hoses off is NOT sufficient, as pockets of gas can be enveloping the sensors.

2. DO NOT routinely execute calibrations to remedy a rebreather that seems to be showing the wrong PPO_2. If the rebreather had previously been accurately displaying PPO_2, then some other problem is likely to be the cause. These include:

- **Oxygen sensors have become wet**
- **Current gas exposed to the Oxygen sensors is not what you think it is.**
- **The min-jack connection is corroded**

Check the readings on the STATUS screen (average) or Service Mode STATUS Screen (all 3 sensors).

If a sensor is reading incorrectly, first remove it and clean the mini-jack connector. This can be done with Hollis approved electrical contact cleaner or simply by wiping the connector with a lint free cloth. DO NOT scratch the connector with a metal instrument. Then look for droplets of moisture on the sensor membrane. Use a rolled tissue to gently wick any moisture droplets from the sensor WITHOUT making contact with the sensor membrane itself. Pushing on the sensor membrane face can destroy the sensor.

If neither of these corrects the reading, then the sensor should be replaced.

The Oxygen sensors vary only slightly over time. Temperature, atmospheric pressure and moisture have far greater short-term effects on the readings. Calibrations carried out once a week should be more than sufficient, unless the EXPLORER has been transported to different climates or significantly different ambient conditions.

So, calibration checks, not actual calibrations, should be carried out regularly to ensure the oxygen PPO_2 sensing system is performing correctly. Calibrations should be done more sparingly, as it takes time to ensure the correct conditions are exposed to the sensors. Often a bad calibration causes more confusing problems than small errors due to temperature change. User error caused by failure to use the appropriate ambient gas (air) is a big source of sensor errors.

1. Don't over calibrate
2. If something seems wrong, check everything. Do not just execute a calibration to fix the reading. You could be making matters worse.
3. Keep sensors dry.
4. When doing a calibration, do ensure the sensors are exposed to air - force air over the sensors, do not just assume "they must be exposed to air by now".
5. Just removing hoses is not enough to get air to the sensors. Either the breathing routine described in the Pre-Dive sequence must be used or the Sensor Module should be removed from the EXPLORER and sensors allowed to stabilize in ambient air.
6. If the EXPLORER has had a change in climate or significant ambient conditions, these are good reasons to check calibration.
7. The readings from the oxygen sensors change with temperature. If you are diving in warmer or colder water than normal, PPO_2 readings will vary. Ensure calibrations take place at a temperature as close to diving conditions as possible.

OXYGEN SENSOR VOTING

VOTING METHOD

The EXPLORER has a method of automatically removing Oxygen sensor sensors from the PPO_2 averaging and entering a fail-safe mode when it is not possible to resolve an accurate PPO_2 reading.

Rules:
1. If a single sensor is below 0.15 bar or above 3.00bar, then it will be removed from the averaging — a 'BAD CELL! DO NOT DIVE' alarm will be displayed if not diving, or 'ASCEND! BAD CELL' if diving.

Diver Action: Ascend on the rebreather

2. If a sensor is less than 7mv then it will be removed from the averaging — a 'BAD CELL! DO NOT DIVE' alarm will be displayed if not diving, or 'ASCEND! BAD CELL' if diving.

Diver Action: Ascend on the rebreather

3. If one sensor is +/- 0.2 bar away from the two remaining sensors then it will be removed from the averaging — a 'BAD CELL! DO NOT DIVE' alarm will be displayed if not diving, or 'ASCEND! BAD CELL' if diving.

Diver Action: Ascend on the rebreather

4. If all three cells are removed from the averaging for the same reason (i.e., all low or all high), then all cells will be used in the averaging (superseding rules 1, 2 and 3) — a 'BAD CELLS! DO NOT DIVE' alarm will be displayed if not diving, or 'ASCEND! BAD CELLS' if diving.

Diver Action: Ascend on the rebreather unless superseded by rule 7.

5. If the difference between the highest sensor and the lowest is greater than 0.5bar then the system will inject gas for 1 second out of every 3 as a fail-safe. This will cause an ASCEND NOW alarm.

Diver Action: Ascend on the rebreather. Rebreather switches to Fail-safe mode.

6. If the average of all sensors (not removed from the averaging by rules 1, 2, 3 or 4) is greater than 1.6bar when diving then an ASCEND NOW alarm

will be displayed.

Diver Action: Ascend on the rebreather

7. If the average of all sensors is less than 0.17 or greater than 2.0 when diving then a BAILOUT alarm will display.

NOTE: This alarm will supersede those in rules 1, 2, 3, 4, 5 and 6.

Diver Action: Open circuit Bailout to surface

8. If two or more sensors are removed from the averaging (because of rules 1, 2, 3 or 4) then the system will inject gas for 1 second out of every 3 as a fail-safe. This will cause an ASCEND NOW alarm.

Diver Action: Ascend on the rebreather. Rebreather switches to Fail-safe mode.

EXAMPLES

1. Sensor 1 = 0.65bar, sensor 2 = 0.60bar, sensor 3 = 0.70bar.

→ All sensors used

2. Sensor 1 = 0.3bar, sensor 2 = 0.60bar, sensor 3 = 0.70bar.

→ Sensors 2 and 3 still used

3. Sensor 1 = 0.3bar, sensor 2 = 0.60bar, sensor 3 = 0.9bar.

→ Failsafe – inject for 1 second out of every 3. {Sensors are greater than 0.5 apart across all 3 sensors (0.3 to 0.9)}.

CDM (CANISTER DURATION METER)

The EXPLORER Canister Duration Meter (CDM) is comprised of three main parts:
1. A patented, absorbent temperature profile duration meter.
2. An Oxygen Injection Meter (based on CE tested durations).
3. A gaseous CO_2 sensor

The readings from all of these devices together can be used to report a high confidence status regarding the state of the Absorbent Filter. However, user experience and training should also be used to determine the validity of the readings given. Absorbent Filters are a key item in the rebreather, and prone to miss-use. Great care should be taken when determining if a dive can be safely performed with the filter in its current state. Flooding, long time between uses, improper assembly, improper packing can all contribute to the canister duration meter reporting false readings. Use great care in assembling the device and in completing pre-breathe checks on the Absorbent Filter and breathing loop. The CDM is a useful feature as an aid to predicting absorbent duration.

WARNING: NEVER dive a partially used Absorbent Filter after 24 hours beyond its initial packing or opening irrespective of the CDM meter reading. This includes partially used filters that have been stored in a sealed loop or container.

TPM (TEMPERATURE PROFILE MONITOR)

This meter relies upon the heat producing reaction of the CO_2 absorbent. Temperature sensors are used to determine the status of the CO_2 absorbent has been performed in laboratory conditions for many years. The system detects a complex reaction heat wave front through the absorbent as it is being used.

The duration of the Absorbent Filter depends mainly on the amount of CO_2 being produced by the diver and the depth of the dive.

DANGER: The TPM will not detect breakthrough conditions of a poorly packed Absorbent Filter or failing seal. Therefore Pre-breathe checks must always be carried out to ensure CO_2 is being absorbed correctly by the filter.

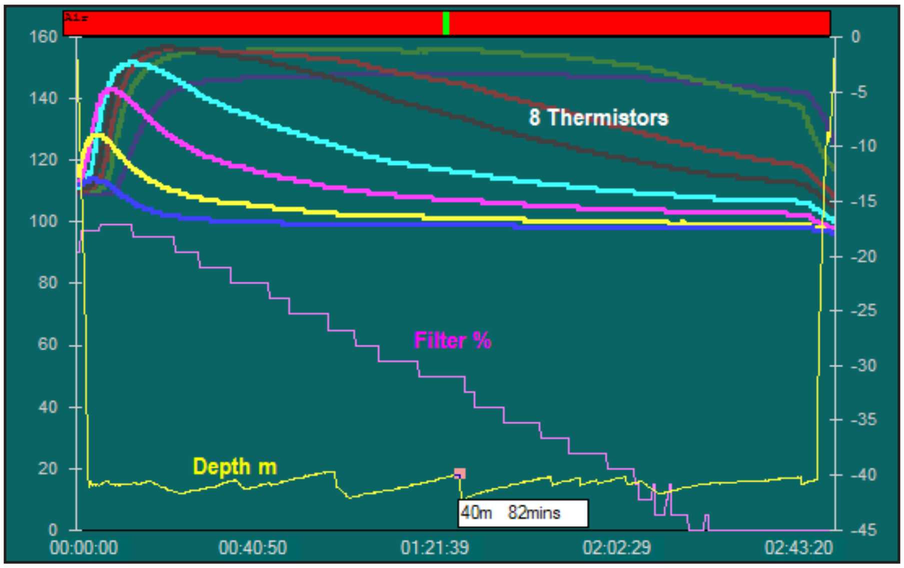
The TPM contains 5 Thermostats arranged longitudinally through the canister absorption path. The readings from these 5 thermistors are logged and analyzed by the system. In this manual, it is not appropriate to explain this data analysis in detail. However, it is appropriate to describe some of the limitations of the device.

The CO_2 absorbent produces heat when CO_2 is absorbed. However, there is also a temperature rise even when incomplete absorption of the CO_2 in the breathing gas is achieved. This is a potentially dangerous situation, as the system appears to be working correctly as there is still a measurable temperature rise and wavefront in the system. The human body is tolerant to only approximately 5 to 10mBar of CO_2 (ref CE standards for a life support system). A well-packed fresh Absorbent Filter absorbs all the exhaled CO_2 for a period of time until an amount of CO_2 starts to creep through. When this level reaches 5mb it is assumed there is no life left in the filter. However even at 5mb there is still considerable thermal activity within the filter.

DANGER: So be aware that a well packed and well maintained Absorbent Filter is key in achieving a life-support system. The CDM is not a substitute for good system maintenance and Pre-Dive checks. Always use your training and discipline to ensure the sub-systems in the EXPLORER are operating correctly.

Critical components and potential failures are:
- The filter seal around the Absorbent filter
- A poorly packed (user pack only) filter
- Used or out of date absorbent material

Below is a graph of the data log from a chamber breathing system test dive. 1.6litres of CO_2 are being fed into the system every minute. The external water temperature is approximately 4 degrees Celsius. It shows the thermistor readings on an arbitrary scale, canister remaining percent prediction and depth in meters. The endpoint of the graph is when the CO_2 levels reach 5 mBar break through.



The thermistor curves at the beginning of the dive, as the canister heats up, have a different shape to the middle to latter part of the dive. It is not sufficient to simply look for the position of the hottest part of the canister. This will give poor predictions of canister duration. The algorithm first normalizes temperature difference data. Then uses a technique to determine which part of the curve the system is on – beginning, middle or end. It then correlates a look-up of the measured data into the suitable reference data to determine the canister duration.

The filter should always be kept sealed until required for use. Once installed, the filter should be changed within 24 hours even if it has not been fully used through breathing. When installed and being unused, the EXPLORER should have its breathing loop closed so that external air does not accelerate the degradation of the filter. However, once open and used, even if only a little, the filter will continue to degrade and change its characteristics post-dive. Therefore, as previously stated, the filter should always be changed within 24 hours of opening and/or use.

Partially used filters should be stored in the EXPLORER with a closed breathing loop.

Although the algorithm that analyzes the thermistor curve is adequately accurate during diving, if the filter is not being breathed on, the thermistors curve will be abnormal. It also takes time for the absorbent to rise to normal operating temperatures. Therefore for routine use, the addition of the Oxygen injection meter (described in the next section) is used to report the filter percentage remaining to the user.

OXYGEN INJECTION METER

The CO_2 created by the diver is in direct proportion to the oxygen breathed. The oxygen metabolized by the body is replaced by the injection of oxygen into the breathing loop. By knowing the volume of gas injected, the amount of metabolized oxygen and therefore the amount of CO_2 created can be estimated. From tests, the duration of the filter types has been determined and the corresponding volume of CO_2 absorbed before the absorbent begins to reduce its effectiveness.

Using these principles, the system measures the amount of gas injected by the solenoid valve and converts it to a percentage of minutes remaining at CE CO_2 rates. Although the displayed minutes are at CE CO_2 generation standards, the minutes will tick down more slowly if the diver is breathing at a reduced rate. This will be the most common scenario. However, in the unusual condition of CO_2 generation at an elevated rate compared to 1.6ltr/min then the minutes will tick off more quickly. If the diver knows a particularly strenuous dive is ahead, they should allow extra conservatism in the minutes remaining counter, for that dive.

The Oxygen Injection Meter should be used in conjunction with the Temperature profiler and the Gaseous CO_2 sensor to determine the appropriate state of the filter. The remaining Oxygen injection meter percent is displayed on the STATUS screen as a ‘Filter minutes’. The Oxygen Injection Meter minutes are reset when the absorbent is replaced and confirmed in the Pre-Dive Sequence.

WARNING: The CO_2 Absorbent Filter Alarm will activate when there is sufficient duration to allow an ascent to the surface with an additional (approximate) 10 minutes reserve remaining. At such time, the diver should ascend to the surface on closed circuit.

DANGER: If in doubt of the condition of the CO_2 filter, replace the absorbent and perform full pre-dive checks. Filter time remaining must exceed the planned dive time.

OPERATION AND INTERACTION OF TEMPERATURE PROFILER AND OXYGEN INJECTION METER

The thermistor bar chart of the temperature profile through the filter is shown to give the diver information on the activity of absorbent inside the filter. This should have a peak when the filter is being breathed on. From cold it will take about 5 minutes for the CO_2 reaction to cause a visible peak. This peak should then continue and grow higher. The temperature bars fill from the left to the right as the filter is being used. This screen is in the Pre-dive sequence.

If there is no peak, then there is a problem with the filter. This could be caused by:

1. Flooded filter
2. Filter not fitted
3. Filter empty – all used up

During pre-breathe, the unit needs to be breathed on to see a change in the thermal profile. This does not guarantee correct operation, but has a high likelihood of correct operation. Any sense of dizziness, nausea or other CO_2 symptoms should also be used to alert the diver that the filter is not operating correctly. A small bypass due to a badly fitted filter or CO_2 seals could give this scenario of a good peak, but an amount of CO_2 could still bypass the filter. If this occurs, stop breathing on the EXPLORER. This will be indicated (and alarmed for) by the Gaseous CO_2 sensor. Replace the absorbent and/or check filter packing and seating.

CAUTION **CAUTION: Pre-breathing any rebreather should be done in a safe seated position where the diver can monitor displays and any potential symptoms of CO_2 poisoning. Pre-breathing should never be conducted while walking or standing in a place where the diver could fall into the water or injure him or herself.**

The actual minutes remaining number displayed to the diver comes from the Oxygen Injection Monitor. This gives a consistent and reliable reading of current absorbent duration based on Oxygen injection.

Always remember to reset the absorbent duration when a new filter is fitted. You will be prompted to do this during the Pre-dive sequence *(Fig 3.21)*.

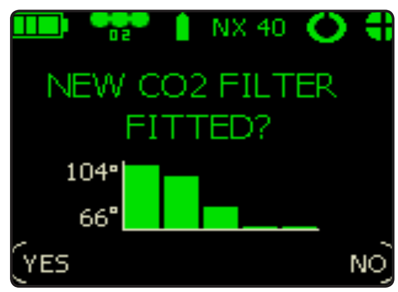


Fig. 3.21

DANGER: DO NOT reset the absorbent duration unless a new filter with fresh absorbent has been fitted.

Always change the absorbent when the low filter alarm appears, or before if you suspect the absorbent is not operating correctly or close to the end of its life - be conservative - be safe.

DANGER: If an absorbent filter is not fitted, the green central indicator will not be visible on the Right Hand End Cap and it will not be possible to breathe off of the loop.

No matter how many safety monitoring systems are in place, use your own common sense and discipline to ensure you do not push the life support systems beyond their designed limitations. It is your life being supported - respect the equipment and its limitations.

CARBON DIOXIDE SENSING MODULE

Premise:
The EXPLORER comes with an option to fit a CO_2 sensor. The user can elect to buy this from new or upgrade to the sensor later. The CO_2 sensor gives many advantages as detailed below.

EXPLORERS not fitted with CO_2 sensors or that have had their CO_2 sensor temporarily removed by the user, can still be dived but with no CO_2 sensor fitted a 5 minute pretreated of the absorbent filter will be forced in stead of the normal 1 minute.

DANGER: With no CO_2 sensor fitted careful monitoring of filter duration is vital.

There is little confirmed data on actual absorbent durations typical for sport diving rebreather use. Sports divers often push the absorbent duration beyond the published CE durations, because they assume that they will not be creating as much CO_2 as the CE trials or operate at the same temperature or depths.

The problem can arise that if a diver has gone deep and works hard, perhaps to rescue another diver; when the absorbent duration is near its limit, the extra depth and work rate push the CO_2 to dangerously high levels very quickly.

The CO_2 sensor will help by giving feedback in this scenario, and advise the diver of the high CO_2 levels. The diver should then reduce their work rate and reduce their depth and finish the dive as safely as possible or bail-out to open circuit as indicated. The relatively fast rise in CO_2 readings is also an indication that the absorbent cannot be pushed any harder without causing even higher CO_2 levels.

A question asked already by many divers who have seen the system in operation, is “Can the CO_2 reading be used to determine the duration remaining in the filter?”

The answer in principle is ‘yes’. However with the current knowledge and data available, there is no practical system to achieve this. The duration of the absorbent changes with CO_2 generation, temperature, depth, and rebreather design. People have achieved over 8 hours duration with relatively small absorbent loads, but this has been in warm water, with low breathing rates and shallow depths. It is currently not known what the effects are when an absorbent filter working at a CO_2 level of say 2mBar that has been used in a shallow scenario is taken deeper and the work rate is increased. We know that the CO_2 would increase, but do not know how fast. In field tests, we have seen the CO_2 jump quickly from 3mBar to 6mBar just by the diver going deeper near the end of absorbent duration. This same rise will not occur if the filter is at the start of its life. Forecasting potential duration with the CO_2 sensor will be possible in the future after more development but this is not currently the main function of the CO_2 sensor. Its' current functionality is as an active warning device for CO_2 absorbent system issues. **It can detect for bad absorbent, no absorbent, high work rates and general CO_2 seal issues.**

WARNING: Currently the CO_2 sensor reading should not be used as a duration meter for the rebreather. It is vital that it is used to report and alarm for a high CO_2 reading that could occur with a faulty seal or exhausted absorbent.

Our bodies produce the same CO_2 quantities independently of depth. So just staying shallow does not reduce CO_2. It can however; help the CO_2 absorbent perform more efficiently. Therefore a low CO_2 reading on a filter that has been used in shallow water for some time may rapidly increase if (towards the end of its' life) it is taken deeper or the work rate increases. Be aware that the CO_2 reading can rise dramatically for higher work rates and deeper depths, especially when an absorbent has been used for over 50% of its recommended duration.

Therefore, in order of priority, the EXPLORER is fitted with a gaseous CO_2 sensor, a metabolism 'click' counter (providing an estimate of oxygen consumed, hence CO_2 generated) and a TPM giving an indication of thermal activity within the filter. These three features give a more accurate indication of absorbent life remaining.

The use of the CO_2 readings is four fold:
1. To ensure active absorbent has been fitted
2. To ensure the absorbent sealing systems are operative
3. To warn of reducing absorbent efficiency in order to give the diver time to respond by reducing depth, temperature or work rate to avoid an incident occurring.

4. To warn of rare situations when excessively high CO_2 levels may require immediate bailout to safe open circuit gas.

DANGER: The CO_2 sensor should NOT be used to determine absorbent duration.

NOTE: As more actual dive data becomes available it may be possible to model the CO_2 curves and generate some level of prediction of remaining absorbent life. This is currently a work in progress.

CO_2 – CARBON DIOXIDE SENSOR FOR EXPLORER

This section describes the operation of the CO_2 sensor as fitted to the EXPLORER rebreather.

The EXPLORER CO_2 sensor is the world's first commercially available carbon dioxide sensor proofed and designed by VR Technology for operation in a high humidity, high oxygen rebreather breathing loops.

The CO_2 sensor actively measures carbon dioxide while the user is breathing on the loop. It can thus warn of high CO_2 levels before unconsciousness or other symptoms occur, in time for the user to perform remedial tasks such as finishing a dive, reducing activity or even bailing out to other gas sources.

BACKGROUND

It should be noted that this is the first use of a CO_2 sensor in an active-user breathing loop. As such, new data on CO_2 levels will be obtained that will identify areas of adjustment of common practice and improved use of the CO_2 readings as time goes on.

Much of the research in CO_2 poisoning has been conducted with military levels of exertion and requirements. From this research the 5 to 10 mBar limits for CO_2 were formalized as the upper working range for CO_2 by a diver undergoing considerable exertion. Thus the alarm levels within the EXPLORER have been initially set as 5mB and 10mB. As the user moves into the 5 mB+ range, although no symptoms may occur, it is highly advisable that the dive be terminated as soon as possible.

It is assumed that CO_2 levels in the region of 15 – 20mB are potentially very dangerous and potentially fatal, and the user could easily lose consciousness with little or no warning and as such it is potentially extremely dangerous to work at any CO_2 level above the 10mb range.

MAIN FEATURES

The CO_2 sensor consists of a proprietary combination of filters and sensors that together provide a robust CO_2 monitoring system for breathing loops in rebreathers. The CO_2 sensor is able to compensate for pressure and humidity environments as normally achieved in a diving rebreather system.

The EXPLORER version is powered from the LSS Module rechargeable battery.

The CO_2 sensor requires occasional calibration. EXPLORER has a sophisticated logging system that minimizes the number of calibrations. It also removes the need to use CO_2 calibration gasses.

WHAT SHOULD I EXPECT TO SEE ON THE CO_2 SENSOR READINGS?

As a unique CO_2 sensor in an active breathing loop, some user education is required to understand the benefits, features and limitations of the device. From this standpoint, it is worth the user taking a short time to understand more of how CO_2 is dealt with in the breathing loop.

CO_2 filter endurance is reduced by increased depth, low water temperature and high work rate (CO_2 generation) variables. As the user pushes the CO_2 absorbent filter towards (or past) the end of its CE tested limits, the levels of CO_2 in the loop may be surprisingly high or could be low if the variables are less extreme but could accelerate rapidly dependant on the rebreather design.

Some divers feel they are getting more duration because they are not producing as much CO_2 as that used in CE trials or that other variables are less extreme within their diving environment.

Information from field use with the CO_2 sensor indicates the filter durations are actually quite close to the CE durations and the 5 mB CO_2 point. However, 5 mBar of CO_2 is not fundamentally damaging. Metabolism and respiration can occur to some degree even up to 20mB CO_2. However, the amount of exertion and other pressure related effects mean that this is unadvisable, and CO_2 poisoning and death may occur at levels in the 10-20 mB range in some cases. So some of the extended durations currently experienced are due to the user taking the CO_2 level into the 5-10 mB range, without any obvious symptoms of CO_2 poisoning.

The user must be aware that strenuous exertion when CO_2 is at these elevated levels can quickly cause the CO_2 levels to rise rapidly. As the symptoms of CO_2 poisoning are almost impossible for the user to recognize – they will just pass out and may drown. However, the readings from the CO_2 sensor showing that CO_2 levels are rising (while still not exhibiting symptoms) should be used as much as anything to limit the strenuous activity and further use of the filter after the dive has finished.

DANGER: New dives must not be performed on the filter once CO_2 levels in the 5-10 mB region have occurred, regardless of how short a duration. Some rebreather fatalities are possibly due to users pushing the CO_2 filter with strenuous activity near the end of the filter life.

Increased depth or reductions in temperature when the CO_2 filter is near the end of its life are also not advised, as the filter is less able to cope with high CO_2 levels. So increased depth, coupled with muscular activity and cold are a very bad combination when near the end of filter life where CO_2 levels are already raised.

NOTE: Conversely, reducing your depth and work rate and returning to warmer water, are all good ways to manage CO_2 levels until you can return to the surface and change the filter. In any event if a CO_2 alarm is seen the EXPLORER will force an immediate action to return you to the surface.

GASEOUS CO_2 SENSOR SYSTEM CONSTRUCTION

The CO_2 sensor system comprises of a Sensor and a removable/changeable filter. The basic principle of the system is to use Infra Red technology to detect carbon dioxide (CO_2) in the retreaters' breathing loop. However certain contaminants and in particular moisture, will affect the sensors ability to read accurately. To help with this issue, the assembly comes complete with a user-changeable filter system that can be simply disconnected from the Sensor Module and serviced by the diver *(Fig. 3.22)*.

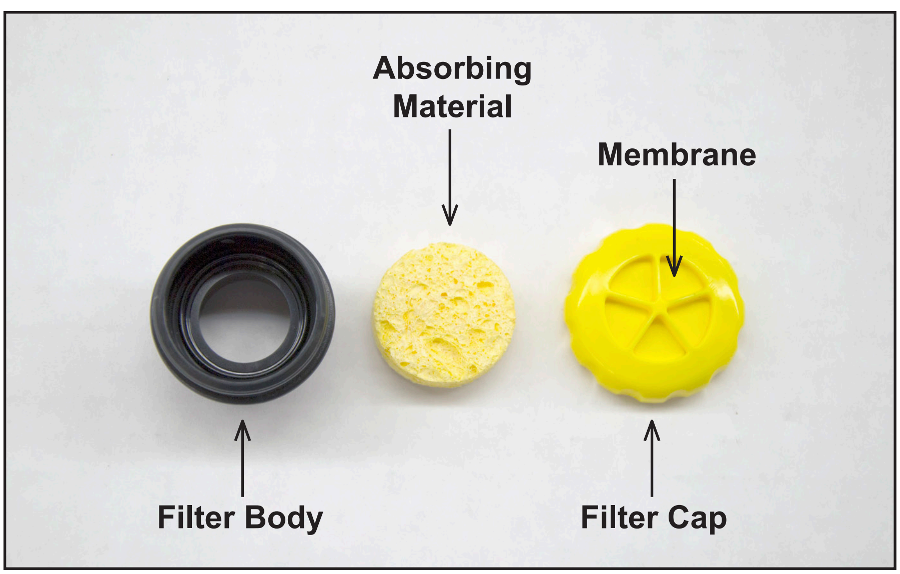
Fig. 3.22

DANGER: It is vital that to maintain accurate CO_2 readings the performance of the filtration system is maintained and a dry piece of absorbing material fitted before every dive. Calibration of the sensor must be confirmed periodically by exposing it to air. CO_2 readings in air should be 0.4 ± 0.1 mb. If in doubt then recalibrate the sensor.

NOTE: Readings in air should be between 0.4 ± 0.1mb.

CO_2 FILTER CARE

DANGER: For accurate CO_2 readings, a clean and dry piece of absorbent material must be fitted prior to every dive. Different environments will produce different amounts of moisture and hence the filter change-out routine may vary.



The filter cap attaches to the filter body and is a push fit. The basic construction of the filter starts with a specialist filter membrane in the cap (the yellow material) backed up by a water absorbing material (the central sponge like material in the picture).

NOTE: The filter cap retains the membrane (yellow material) that must NEVER be removed. The Sensor itself is not a user serviceable part and damage may result if it is tampered with. If the filter cap membrane becomes damaged it must be replaced.

The yellow water absorbing material (center of picture) is removable. The EXPLORER is supplied with spare absorbing material. Simply remove one and refit a new one *(Fig 3.23)*.

Fig. 3.23

The absorbing material will become wet during a dive. The used absorbing material can be dried out, preferably in an air-conditioned environment, as it will become moist during a dive.

WARNING: Each absorbing material piece should only be used for a maximum of 10 dive hours or if damage is noted, replaced immediately or sooner if the readings from the CO_2 sensor are not within the expected range (i.e. almost 0mb at the end of the Pre-dive sequence with a new filter fitted).

DANGER: Failure to replace the absorbing material may result in faulty CO_2 readings.

If debris is noted on the front face of the membrane (yellow material) or if it is suspected that contamination is restricting the flow through the membrane, it should be replaced.

CALIBRATION

During the Pre-dive sequence you are prompted if you want to calibrate the CO_2 sensor *(Fig. 3.24)*.

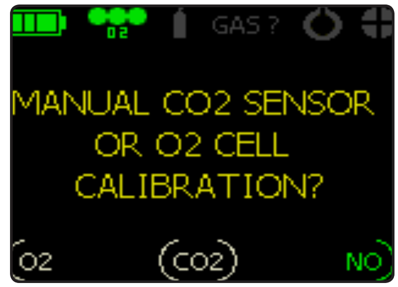


Fig. 3.24

The **ONLY** source of calibration gas is fresh air. **With the filter removed and the sensor in fresh air the CO_2 reading should read 0.4mb +/- 0.1mb.** Leave the sensor exposed for at least 5 minutes. The on-screen prompts will guide you through the calibration. This involves removing the exhale hose from the mouthpiece and breathing the unit for one minute to circulate fresh air into the system.

WARNING: At the end of a Pre-dive sequence with a new filter fitted the CO_2 readings should be almost 0mb. If this is not the case then the sensor must be recalibrated (as above) or re-placed.

NOTE: Post dive, if you want to do another calibration, you must remove the filter cap to calibrate.

The same system should be used to just check the calibration. There is no need to constantly calibrate but it is good practice to check the calibration at the start of a dive sequence using the above method.
Once it is calibrated, to confirm the operation, gently breathe across the sensor face until the reading changes. Now re-install the filter prior to diving.

After calibration and with the sensor inserted into the loop if a full pre-breathe with fresh absorbent is undertaken the CO_2 reading should fall to 0mb. This is normal.

Post dive and with no gas flow (breathing) you may see a small rise in CO_2 levels due to gas density and pocketing. After a pre-breathe this should stabilize. Blowing into the sensor face may also create the same affect until it is used again normally in the breathing loop.

WARNING: If at anytime you see a reading that is abnormal you should check the calibration.

Abnormal readings could include:
1. A reading fixed at zero or any other number when you are breathing directly onto the sensor face with the rebreather disassembled.
2. An abnormally high reading during a dive.

NOTE: Under CE conditions after approximately 50 minutes at 40 m at 1.6 l of CO_2 (very high workload) in 4 °C/39.2 °F it should read 5 mb.

3. Readings that change up and down (not in one direction). This could be a faulty sensor or a faulty connection into the Sensor Module.

The CO_2 sensor will benefit from calibration at the start of a dive sequence and if the sequence is longer than 1 week, at the start of each new dive week. When having not been used for over a month or if you suspect a bad reading (see additional notes on filter care) a calibration must be done prior to diving. **It is good practice for the user to check the approximate validity of the CO_2 readings regularly, ideally prior to any dive.** Simple testing by breathing directly onto the sensor should see the reading rise within approximately 1 minute. **Also exposure to clean fresh outside air should give a reading in the order of 0.4 mB.** The unit will respond faster with the filter removed. So the user must familiarize themselves with the operation and assembly of the system to be confident the device is working correctly. Consult your Hollis dealer if in doubt.

WARNING: If you wish to calibrate the unit you must ensure you are in fresh ventilated (outside) air. DO NOT calibrate in a closed room. The calibration method is discussed above and is detailed step by step in the pre-dive sequence.

ELECTRICAL CONNECTION

The connector for the CO_2 sensor is imbedded into the Sensor Module next to the 3 x O_2 sensors.

NOTE: If moisture is present when this connection is mated, then contact corrosion may occur. This may give false readings on the CO_2 sensor.

It is vital this connection is kept clean. hollis approved contact cleaner or white vinegar and a soft brush can be used to achieve this. **Inspect this connection regularly.**

MECHANICAL FITTING

The sensor should be fitted into the EXPLORER Sensor Module.

Check the O-rings around the filter carrier are not damaged. Ensure the O-rings are lightly greased.

Ensure the absorbing material is clean, dry and not damaged. The filter assembly should be periodically checked for water or mechanical damaged. It is advised to keep spare replacement filters. The filter is the main protection for the sensor from the breathing loops general environment. If damage occurs to the filter or it becomes exhausted, then damage will result to the CO_2 sensor itself. So always keep in it good condition.

NOTE: After a days diving, you can remove the Sensor Module from the rebreather and keep the Sensor Module (and the sensors) in a dry environment (air conditioning if possible) until the next dive. Removing the CO_2 filter assembly to ventilate the CO_2 sensor is also advised.

CALIBRATION SCREEN

To access the CO_2 feature for calibration go to the "CO_2 option" in the Predive screens.

WARNING: The CO_2 sensor MUST always be calibrated in fresh clean air, outside, preferably at sea level.

Select the CO_2 option *(Fig. 3.25)* and EXPLORER will prompt you through the setup procedure and calibration will occur automatically.

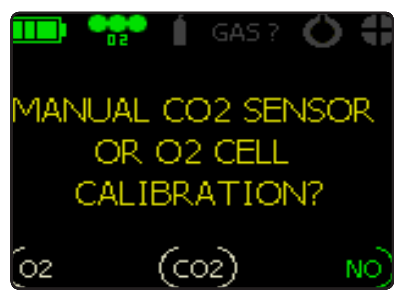


Fig. 3.25

Always check that the sensor reading after calibration reads approximately 0.4± 0.1 mBar.

DIVE SCREENS

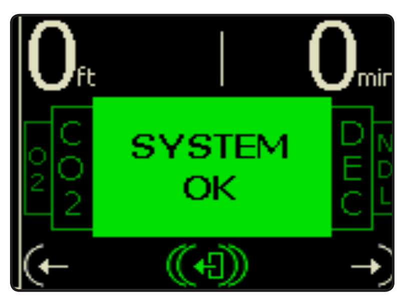


Fig. 3.26

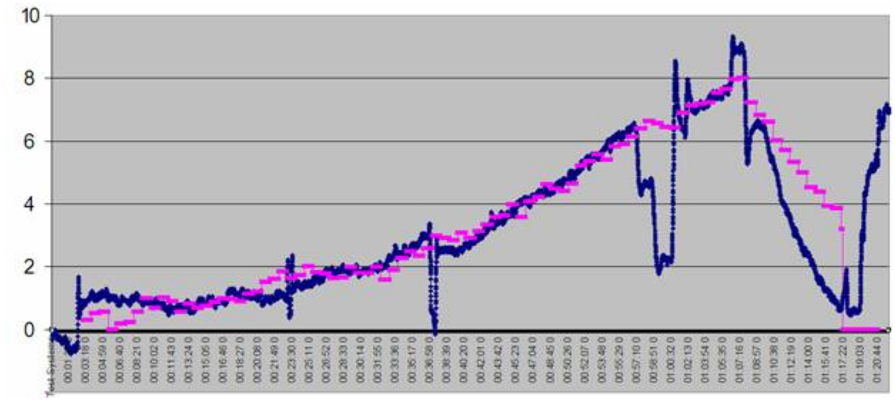
In the Main Dive screen *(Fig. 3.26)* the CO_2 reading is found by accessing the STATUS screen by a double press of the right button. Then scroll through the screens to see CO_2.

Scrolling through the screens to the CO_2 display will now display the CO_2 reading in Millibars in the central window *(Fig. 3.27)*.

Fig. 3.27

CE TESTING OF CO_2 SENSOR

Gaseous CO_2 sensor module:
Tests conducted at ANSTI test systems.
As can be seen from the graph below, the CO_2 sensor readings keep in close correlation with the ANSTI Teledyne Lab CO_2 analyzer. The Blue trace is the ANSTI detector. The CO_2 sensor is represented in pink. The quick occasional changes to the Blue ANSTI trace are calibration tests to ensure accuracy of the measured readings.



KEY:
BLUE = ANSTI
PINK = CO2 sensor
(inside breathing loop)
Y scale = CO2 mbar

It can be seen from the graph that after 60 minutes there is less correlation between the in loop and ANSTI readings. This is due to the rapid ascent rate pressure change causing a temporary temperature drop. The CO_2 sensor will quickly recover from the temperature drop.

To a lesser extent, there is also the reverse condition at the beginning of the dive, where the chamber is being pressurized and the temperature is rising. Within a few minutes the readings are correlated.

DISPLAY & ALARM SYSTEMS

HUD, BUD, & COLOR SCREENS

The EXPLORER can be routinely dived by using the HUD (Heads Up Display) as the main underwater human interface. This frees up the diver to concentrate on the dive at hand.

The HUD is in the divers vision and attached to the BOV. It utilizes color LED's and a vibration feature to get your attention when necessary. Additionally, the EXPLORER has a BUD (Buddy Universal Display) on the side of the LSS Module for the Buddy/Instructor to see your status at a glance. Both the HUD and BUD indicate the same color codes.

If the HUD/BUD system changes from Green for ‘go mode’ to a flashing green/blue then the diver can refer to the main wrist display and investigate the additional information on the STATUS display.

The wrist display utilizes color as an alert for general status changes and couples this alert with unprecedented clarity of information that can be reviewed in further detail.

The HUD, BUD, color screens on the wrist display, and uncluttered screen layouts are key to providing the diver and dive team with essential information in high stress scenarios.

DEFINITIONS

Alarm (state): These are mostly alarm(ing) conditions, but not always. They could represent a state of the system that is displayed in some way other than via the HUD or STATUS screens.

Alarm Display: The method by which an alarm state is passed to the user. On the LSS module, the HUD, BUD, and tactile alarm are used. On the handset, this is done via the GUI (Graphical User Interface) displays and the STATUS screen, which also has an ACTION Panel reflecting the HUD and a message containing a single user action. Some alarm displays vary depending on other system states, such as other alarms or the dive status (e.g., diving, not diving).

ALARM CODES

With the EXPLORER, a key task has been to process the fault levels and error conditions to indicate the status of the rebreather. Further, the LED states are configured for color blind as well as highly stressed divers. The position of the LED's coupled with the flashing or solid states, provide conditions that cannot be confused with one another. During stressful dive scenarios, the position and status is quickly understood to speed up the desired response/correction by the diver. The status sceens on the wrist display add one more level of security by adding extra information on an alarm states.

WARNING: This information is in English, and all users should be adequately trained in interpreting this information appropriately.

There are 3 main warning levels associated with the HUD, BUD, and on-screen displays.

Alarm Code	Meaning	Correct Action
Solid Green	This code means there are no detected problems.	OK - Procede with dive as planned.
Flashing Green & Blue (HUD/BUD) & Yellow (wrist display)	Warning - It is activated when a manageable error situation is in place.	The correct response will be displayed on the STATUS screen and will often tell the diver to ascend slowly on closed circuit monitoring the wrist display.
Magenta (wrist display only)	Loss of communication between sensors or modules. It is usually associated with DO NOT dive or OC bailout but could just be a warning.	Check the status and for any message on the wrist display an react accordingly.
Flashing Red & Vibrating	It is activated when there is an urgent issue.	- DO NOT start the dive. - If already diving, the diver should switch to the bailout gas and ascend.

NOTE: Red alarms take priority in the HUD over Green/Blue alarms.

NOTE: Yellow on the display is equivalent to the alternating blue/green state of the HUD.

NOTE: The HUD vibration alarm will vibrate every second for 5 seconds, then repeat the 5 second alarm every 30 seconds, or if the source of the alarm changes.

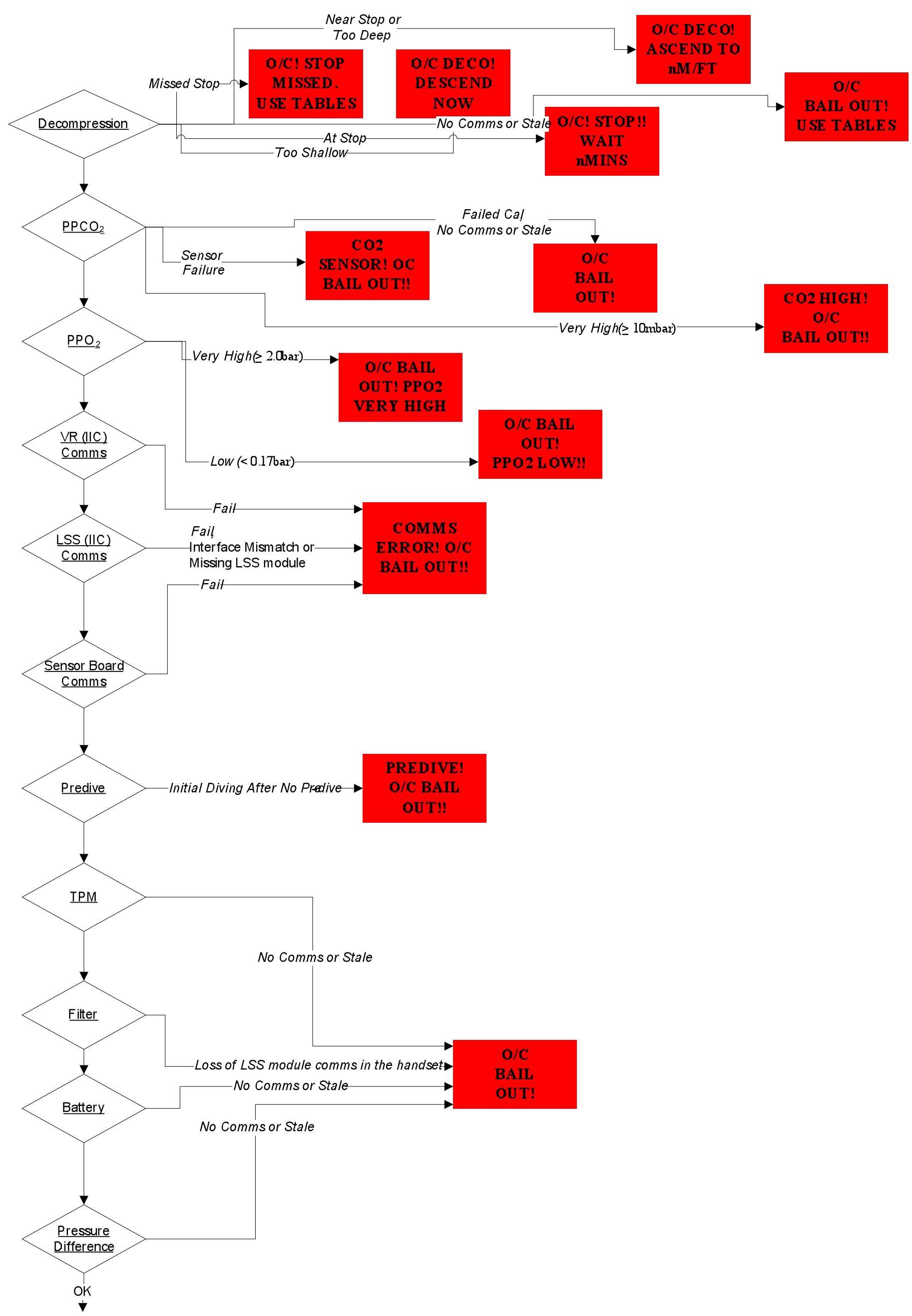
ALARM FLOW DIAGRAMS

The following sections contain flow diagrams to indicate which actions / HUD indication will be used separated into diving and surface cases.

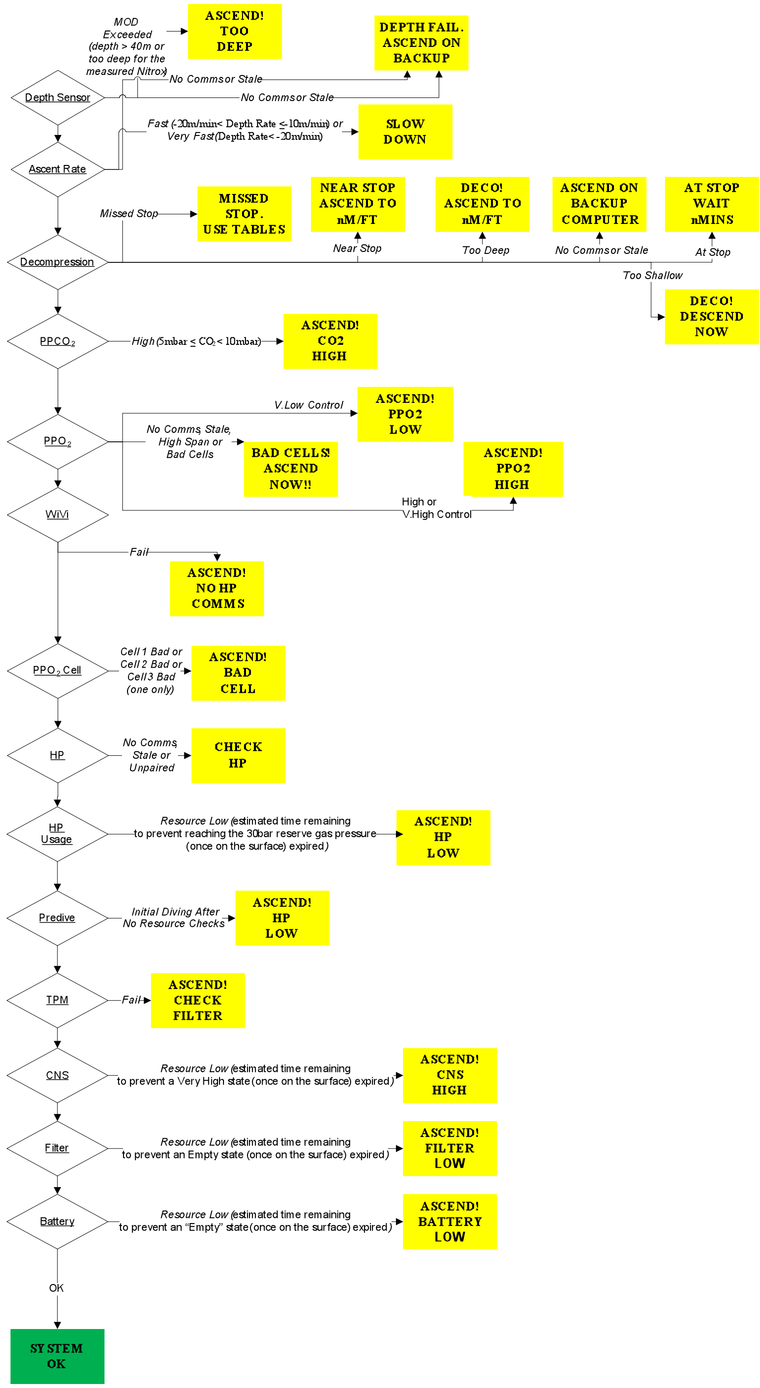
The following flow charts should be used in sequence, where an OK from the red HUD cases leads to blue/green HUD cases. Note the following decompression/tissue model 'O/C Bail-Out' alarm states (used in the diagram):

No Comms — Pressure Sensor alarm is "No Comms"
Stale — Pressure Sensor alarm is "Stale"
Missed Stop — Deco Ceiling violated for more than 1min. This alarm state latches for 24 hours.
Too Shallow — Deco Ceiling violated for < 1min
At Stop — Within 0.1 bar (deep) of the next stop
Near Stop — Within 0.3 bar (deep) of the next stop
Too Deep — Greater than 0.3 bar (deep) of the next stop

Red (OC Bailout) Alarms



Blue/Green Alarms



PPO_2 "Bad Cell" States Are As Follows:

- Cell input timed-out
- Cell input stale
- Calibrated sensor input > 3.00 bar
- Calibrated sensor input < 0.15 bar
- Raw sensor input < 7 mV
- Cell input excluded having failed calibration
- Calibrated cell input > 0.2 bar from the other two cells (only a single cell can be in this state)

PPO_2 "Ascend" Alarm States Are:

High Span
PPO_2 cell span > 0.5 bar (if 2 or 3 cells in state "OK")

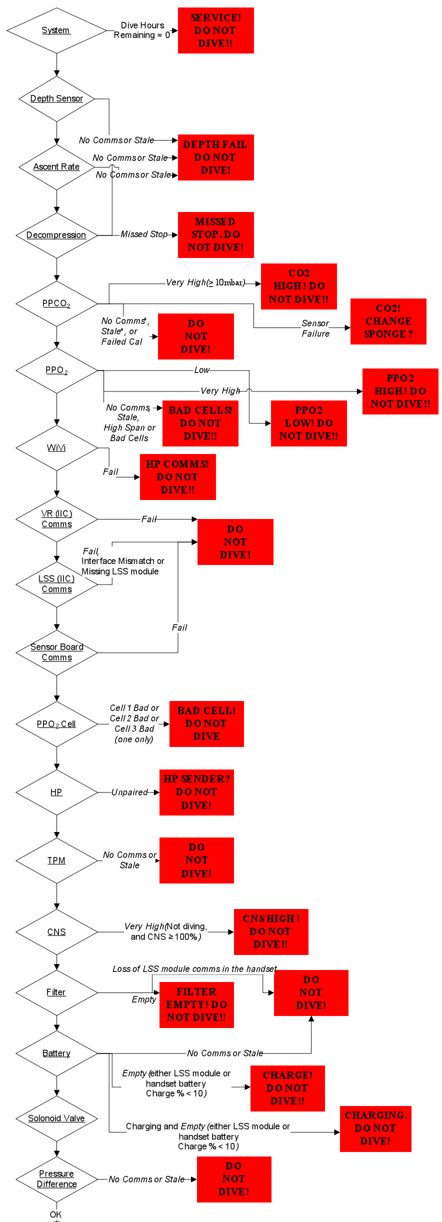
Bad Cells
1 cell in state "OK" or; no cells in state "OK" but with different high/low alarm states or the same alarm states and no O/C bailout case

V. Low Control
If 2 or 3 cells in state "OK", and PPO_2 < -0.20 bar

V. High Control
If 2 or 3 cells in state "OK", and $PPO_2 \geq 0.70$bar where; $PPO_2 = PPO_2 -$ setpoint, i.e., the difference between the average PPO2 and the setpoint. The average PPO_2 is based on the calibrated value from all cells in alarm state "OK".

SURFACE HUD/BUD ALARMS

Red (Do Not Dive) Alarms



PPO_2 "Bad Cell" States:

- Cell input timed-out
- Cell input stale
- Calibrated sensor input > 3.00 bar
- Calibrated sensor input < 0.15 bar
- Raw sensor input < 7 mV
- Cell input excluded having failed calibration
- Calibrated cell input > 0.2 bar from the other two cells (only a single cell can be in this state)

PPO_2 "Do Not Dive" alarm states are:

<u>No Comms</u>
All PPO_2 cell alarms are “No Comms”

<u>Stale</u>
Any PPO_2 cell alarm is “Stale”

<u>High Span</u>
PPO_2 cell span > 0.5 bar (if 0*, 2 or 3 cells in state “OK”)

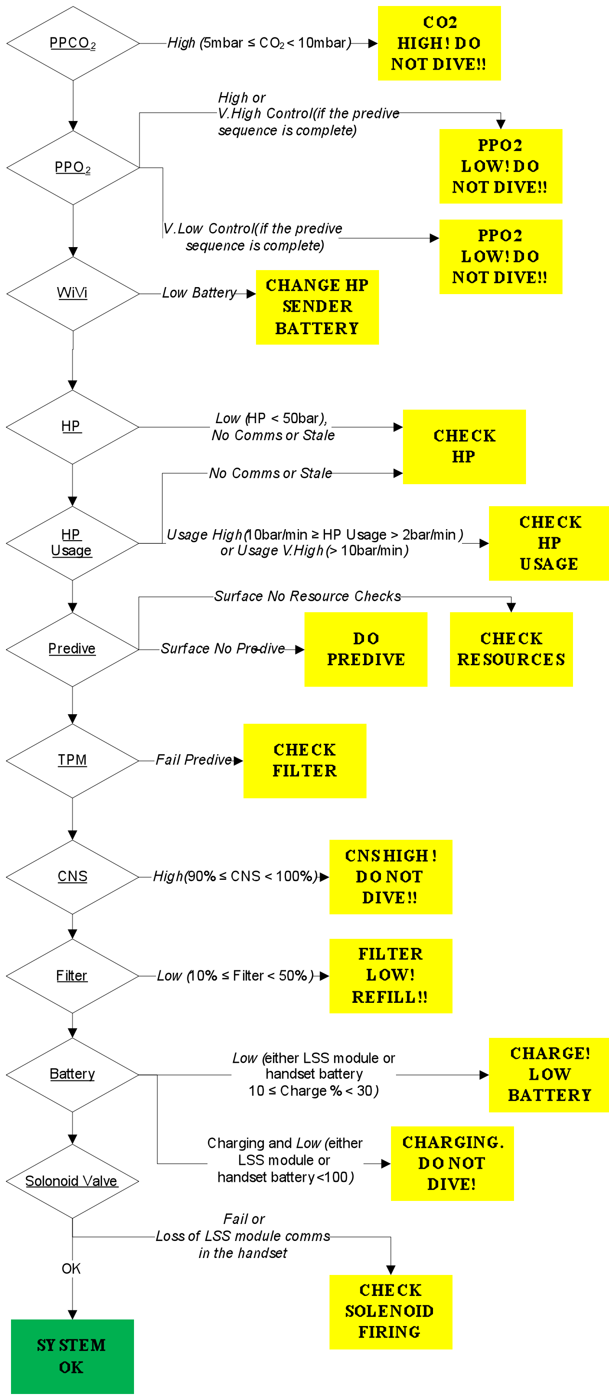
<u>Bad Cells</u>
None or 1 cell in state “OK”

<u>Very High</u>
If 0*, 2 or 3 cells in state “OK” and average $PPO_2 \geq 2.0$ bar

<u>Low</u>
If 0*, 2 or 3 cells in state “OK” and average $PPO_2 < 0.17$ bar
where; $PPO_2 = PPO_2$ – setpoint, i.e., the difference between the average PPO_2 and the setpoint. The average PPO_2 is based on the calibrated value from all cells in alarm state “OK”.

** Zero cells “OK” with the same high/low alarm state, in which case all three are used in the average.*

Blue/Green Alarms



PPO_2 Blue/Green 'Do Not Dive' alarm states are:

High
If 2 or 3 cells in state "OK" and average $PPO_2 \geq 1.6$ bar

V. High Control
If 2 or 3 cells in state "OK", and provide complete, and $PPO_2 \geq 0.70$ bar

V. Low Control
If 2 or 3 cells in state "OK", and predive complete, and $PPO_2 < -0.20$ bar where; $PPO_2 = PPO_2 -$ setpoint, i.e., the difference between the average PPO_2 and the setpoint. The average PPO_2 is based on the calibrated value from all cells in alarm state "OK".

PRIMARY ELECTRONIC BAILOUT SCENARIO CHART*

Failure mode	Loop	HUD status	Solenoid fire	Primary display	Action	Deco will follow
None	Usable loop	Green	Y	System OK	None. Stay on EXPLORER	On-board, 3 sensor driven PO_2
Bad sensor	Usable loop	Blue/ Green	Y – Fail-safe mode	STATUS screen action panel will show AS-CEND NOW.	Stay on EX-PLORER and ascend	Air
Bad sensor readings (error greater than 0.5 PPO_2).	Usable loop	Blue/ Green	Y – Fail-safe mode	STATUS screen action panel will show AS-CEND NOW. PO_2 panel will be in Magenta (No Comms)	Stay on EX-PLORER and ascend	Air
PPO_2 ex-ceeds safe limits or mul-tiple sensor errors	Usable loop	Red	Y depen-dant on DCP/PO_2	BAILOUT	Ascend on open circuit	Air
Wireless HP data loss	Usable loop	Blue/ Green	Y	STATUS screen action panel will show AS-CEND NOW. HP panel will be in Magenta (No Comms)	Stay on EX-PLORER and ascend	On-board, 3 sensor driven PO_2
High CO_2 (>5 mb)	Usable loop	Blue/ Green	Y	STATUS screen action panel will show AS-CEND NOW.	Stay on EX-PLORER and ascend	On-board, 3 sensor driven PO_2
Very High CO_2 (>10 mb)	Unus-able loop	Red	Y depen-dant on DCP/PO_2	BAILOUT	Ascend on open circuit	Air

** (see Alarm Tables for lower priority alarms)*

GAS RESERVES

DYNAMIC RESERVE

The EXPLORER monitors the high pressure (HP) contents of the on-board gas supplies.

The EXPLORER includes two warning system for the HP contents.

1. Pressure below reserve level

2. Rate of use of gas is too high or too low indicating either a leak or that the HP cylinder valve is turned off and gas injection is being unsuccessfully attempted.

The gas supply reserve level is dynamically adjusted based on depth (because ascent times vary with depth) and assumes a stressed breathing rate of 20 l/min on open circuit bailout using the on-board cylinder. If the system sees this reserve limit approaching, it will warn the diver to ascend.

BAILOUT TO OPEN CIRCUIT

Should the operation of the EXPLORER generate an emergency alarm (red HUD LED and vibrating HUD) then the diver must bailout to open circuit on either the in-board supply (above 18 m/60 ft) or the off-board supply (below 18 m/60 ft).

NOTE: Decompression calculations for the ascent profile will assume air as a breathing gas to provide additional safety during a bailout ascent.

MOD (MAXIMUM OPERATING DEPTH)

The EXPLORER will warn on the main display if the maximum operating depth of the unit is exceeded. This MOD is based on three things:

1. A maximum depth of 40 m/130 ft

2. A maximum depth such that the gas attached to the unit (as measured) cannot result in a PPO_2 exceeding 1.6bar.

3. When a maximum PPO_2 of 1.6 bar is reached

The EXPLORER will not freeze the user out of operation if these depths are exceeded. However, the system and diver are operating beyond the normal recommended conditions and therefore these limits should never be routinely exceeded.

WARNING: Exceeding these limits is not condoned by the manufacturer and is not a safe diving practice and must be avoided. If an MOD alarm is seen then you should ascend immediately to a depth where the alarm is not displayed. This depth reduction should be at least 6 m/20 ft but could be more if the MOD has been exceeded by a large amount.

DECOMPRESSION CONTINGENCY

The EXPLORER is designed for recreational diving without decompression. All dives however require safety decompression stops to be conducted (consult your training agency for information).

If you accidentally stray into decompression the system will generate a green/blue HUD alarm, the decompression stop, and stop time will be displayed on the STATUS screen. This feature is designed for contingency purposes only.

DANGER: The EXPLORER is not designed for use with gases other than Nitrox.

WARNING: Decompression diving significantly increases the risk of decompression illness.

Various alarms will be generated if elements of decompression are violated. Please see the Deco States Table below and the EXPLORER flow charts for further detail.

DECO STATES

State	Reason	HUD Color Code	Status Screen Display
Missed Stop	Missed deco stop	Blue/Green	MISSED STOP! USE TABLES
Too Shallow	Deco Ceiling violated for < 1 min	Blue/Green	DECO! DESCEND NOW
At Stop	Within 1 m/3.3 ft below the next stop	Blue/Green	AT STOP WAIT x MINS
Near Stop	Within 3 m/10 ft of the next stop	Blue/Green	NEAR STOP ASCEND TO x M (FT)
Too Deep	>3 m/10 ft below ceiling	Blue/Green	DECO! ASCEND TO x M (FT)

NOTE: When you have decompression stops to complete (or if any alarm is showing) the STATUS display will remain on (and not automatically time out).

INTERNET REPROGRAMMING

The EXPLORER can be automatically reprogrammed and upgraded with new software downloads from the Internet. The PC Link option enables use of this feature. Contact the manufacturer web site or your dealer for more information.

Some updates will be available for a fee. Other updates will be free.

To check if you're EXPLORER has any available updates and to obtain the reprogramming software then please go to http://hollis.com/support.asp.

DANGER: After new software is installed you MUST recalibrate the oxygen and CO_2 sensors.

WEIGHTING

As the counterlungs inflate, the diver may experience movement in the EXPLORER. This is minimized by tightening the harness or adding trim weights to the pocket available on the top of the case. A weight of up to 2-3 kg/4.4-6.6lbs can be used.

If the EXPLORER is allowed to move on the divers back, a change in breathing resistance may be noted. With the Explorer's back mounted counterlungs it is important that the Explorer is as close to the diver's back as possible.

Your instructor will teach you how to weight yourself correctly.

WARNING: Over-weighting is dangerous. With an empty BCD, no additional bailout cylinder and 50 bar/735 PSI in the main cylinder you should be able to begin slowly to submerge in a controlled fashion by exhaling slightly (too much and the ADV will add gas).

WARNING: It is important to perform weight checks in confined shallow water with at least 50 bar/735 psi bailout gas prior to any open water diving.

HARNESS/BCD POSITIONING

When adjusting the harness try and imagine that the center of the counter-lungs should be within ± 100 mm/4 inches of the tip of your sternum to give an optimum breathing performance. While the BCD/harness must be comfortable it should not be loose. The harness will sit differently on land compared to when you are in the water.

OCTOPUS, BAILOUT, & CYLINDER CONFIGURATIONS

While the exact gas requirements for any type of diving are a matter of personal choice and predicted by specific level of EXPLORER certification and training agency, it is vital that a breathable open circuit bailout is carried at all times for all depths of the dive, of sufficient volume to allow a safe ascent to the surface with a stressed breathing rate.

NOTE: Certain training agencies may required additional gas supplies for diving in 'mixed teams' (open circuit/closed circuit). Please check with your agency for details.

DANGER: It is vital that a breathable open circuit bailout is carried at all times for all depths of the dive, of sufficient volume to allow for a safe ascent to the surface at a stressed breathing rate.

DANGER: For deep/long duration dives the on-board gas supply should only be treated as a short-term gas supply, used for a limited period until the off-board bailout gas can be accessed.

WARNING: In depths shallower than 18 m/60 ft you must be able to provide gas to another diver (buddy). This will require the use of an additional second stage octo attached to your EXPLORER first stage if you are not carrying an external bailout cylinder.

NOTE: The BOV is connected to the on-board gas supply. Dives shallower than 18 m/60 ft dives can be conducted using only this available gas as a bailout providing that the gas endurance alarms are not exceeded on the unit.

NOTE: Certain training agencies may required additional gas supplies for diving in 'mixed teams' (open circuit/closed circuit). Please check with your agency for details.

The following is offered as a guide when configuring the EXPLORER for a range of diving conditions. This must be used in conjunction with the recommendations from your Hollis approved training agency.

Depth	On-board Gas	Off-board Gas
Less than 18m/60ft	5l @ 200 bar/2940 psi (1000 l/40 cuft). Nitrox 32 to 40%	Not required
>19m/63ft to 40m/130ft	5l @ 200 bar/2940 psi (1000 l/40 cuft). Nitrox 32 to 40%	Air to 40% nitrox of sufficient volume for an ascent from depth with a 150 l/5.3 cuft reserve at the surface after an open circuit ascent.

Bailout gas volumes should be calculated based on the depth of the dive and the ascent gas requirements. Cylinders can be positioned on D-ring attachment points on the harness or optional EXPLORER BCD.

Your Instructor and Training Agency will detail how to calculate for sufficient bailout gas volumes.

COUNTERLUNG VOLUME

The volume of gas in the counterlungs will affect the ‘breathing feel’ of the unit. Too little gas will make inhaling difficult and too much will make exhaling difficult. All retreaters have optimal positions in the water where they have a better or worse breathing feel due the hydrostatic effects of the counterlung position and the breathable volume within the counter-lungs.

It is important to balance the volume in the breathing loop so that excessive inhale or exhale pressure is not experienced.

Under certain situations the EXPLORER will vent during the exhaled breath. This will result in a drop in oxygen levels and more gas addition by the system.

It is possible to balance the loop to an extent by venting a small amount through your nose, particularly on ascents if the need arises.

ADJUSTING THE BREATHING ‘FEEL’

Fig. 4.1

The breathing ‘feel’ of EXPLORER is partially controlled by the LCV. Having removed the case cover this can be seen underneath the Canister. This is an adjustable valve (over a small range). Oriented as shown, Moving the valve to the left vents more easily and to the right it vents at a slightly elevated pressure *(Fig. 4.1)*.

The LCV is a hydrostatically balanced valve, this means that in any swim position it releases gas from counterlungs at approximately the same pressure and rate. In addition it is a water drain device and it is connected to the exhale counterlung via a water drain tube such that as water enters the counterlung (condensed exhaled breath) then it moves through the tube and out of the LCV regularly throughout the dive.

THE AUTOMATIC DILUENT VALVE

The EXPLORER also has an automatic diluent addition valve (ADV), which compensates for loss of gas volume. To activate the ADV either descend or exhale through your nose and breathe in. The ADV is designed to help maintain a breathable lung volume in conjunction with the LCV.

The ADV on the Explorer is a simple tilt lever system that in the relaxed position (no gas applied) will remain open. It seals when gas is applied.

If moisture is present in the system and extreme freezing temperatures are experienced that are able to form ice within the rebreather this valve could freeze in the open position. Freezing of ADV’s is a common failure mode in most rebreathers. The EXPLORER design assumes this and provides an additional link to the Pre-dive alarm sequence to warn of such a failure.

If the valve is frozen open then gas will freely flow into the circuit. This will give a ‘HIGH HP’ usage alarm and the unit will fail its Pre-dive sequence. This is the correct failure mode for this device.

If the system had been pressurized and then it froze and hence the valve failed closed, again pre-dive will fail momentarily until counterlung collapse removes the icing as the lever activates, then pre-dive will pass unless there is a leak due to icing then the pre-dive will again fail (high gas flow alarm).

This system was developed because in use no units are completely free from moisture, and ADV free flows, due to icing, regularly occur though there has not been an alarm for it.

PRE-DIVE SETUP

Having assembled and tested the unit upon receipt, it is still critical that all pre-dive tests are conducted prior to diving.

The EXPLORER is equipped with a set of pre-dive checks that are built into the electronics prompting the diver to test certain aspects of the unit prior to diving. Additionally, there are several manual tasks that should be completed prior to this final system check. These checks automatically start once you turn the unit on. A complete flow chart of all the screen layouts can be found on the enclosed CD and in the rear of this manual.

TURN ON SYSTEMS

The EXPLORER can be fully activated in three separate ways:

1. By button push
2. By breathing (breath detection as a low PPO_2 of 0.17 is reached)
3. At depth (>1.15 bar absolute pressure or about 5 ft/1.5 m)

DANGER: The batteries must be charged for the automatic systems to work. If the batteries are not charged the unit will not turn on and not support life.

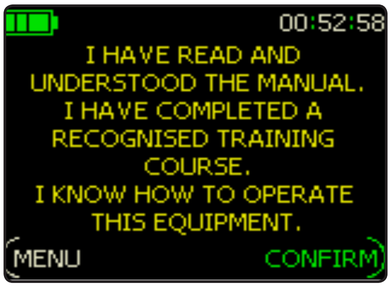


Fig. 4.2

To turn on EXPLORER simply press both buttons on the handset and hold for 3 seconds. After which, the Hollis splash screen and then the training acknowledgement screen *(Fig. 4.2)* will appear.

DANGER: It important that you have read this manual and are properly trained in order to complete the Pre-dive sequence and dive EXPLORER safely. If you have not undertaken these steps yet, do not proceed any farther.

Fig. 4.3

By selecting CONFIRM the Pre-dive sequence starts and you will be prompted through the sequence.

At the end of a successful Pre-dive sequence you will see the check resources screen *(Fig. 4.3)*.

At this point you should cycle through the screens by pressing the left or right button to check that all resourcesare adequate to complete the dive. After a few seconds the display will time-out to the Dive screen *(Fig. 4.4)*.

Fig. 4.4

EMERGENCY START-UP SYSTEM (ESS)

Should you have no option other than to enter the water immediately, EXPLORER will activate the display and show all pertinent alarms in the STATUS screen. It is vital that you correct anything in error immediately before continuing to dive.

If you enter the water without completing the relevant Pre-dive checks and ESS mode is activated, you will be given an O/C bailout alarm (red HUD) warning you to return to the surface immediately to complete the Pre-dive checks. After 1 minute underwater (if nothing else is alarming) the bailout alarm will stop.

DANGER: The ESS should never be used as a routine diving start-up system. A full Pre-dive check MUST always be conducted to ensure safe operation. The ESS is designed ONLY as a safe guard. If you have not completed pre-dive checks, abort the dive and perform a proper pre-dive on the surface.

LESS THAN 2 HOUR PRE-DIVE SEQUENCE

If you have completed a Pre-dive Sequence within the last 2 hours, then upon reactivating the unit (assuming there is nothing wrong with the system) it will display the Hollis splash screen followed by two screens *(Fig. 4.5, 4.6).* It will then allow you to dive immediately.

TURNING OFF

The EXPLORER cannot inadvertently turn off while submerged. Although while at the surface, if no button pushes are detected within 15 minutes it will automatically turn off to save power *(Fig. 4.7)*.

To manually turn off EXPLORER then select the Menu option and do a long press of the left button - OFF *(Fig. 4.8)*.

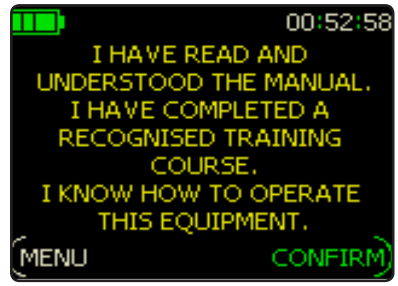


Fig. 4.5

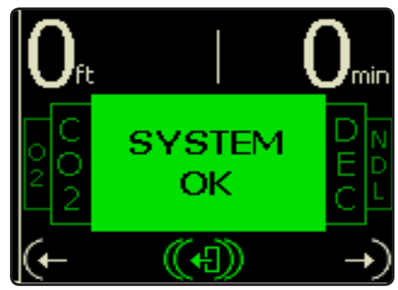


Fig. 4.6

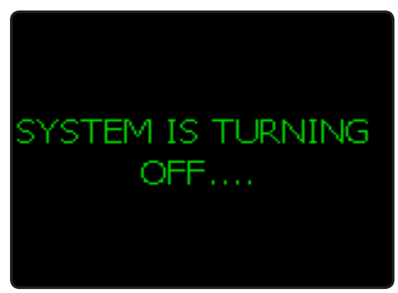


Fig. 4.7

Fig. 4.8

FILLING THE GAS SUPPLY CYLINDERS

The nitrox cylinder has a maximum fill pressure. This is stamped on the cylinder and must be checked before filling. Refer to regional limitations for maximum fill pressures. Install the nitrox cylinder into the case and tighten the cam band. Now install the regulator DIN connection.

DANGER: Although the EXPLORER will analyze its own gas supply it is still important that you always analyze your gas prior to use.

WARNING: If you suspect that the cylinders have become contaminated with salt, water or other contaminants then you must get the cylinder inspected and cleaned as appropriate.

GAS ENDURANCE

Gas endurance is defined by the Dive Control Parameter (DCP) setting.

With the cylinder pressurized to 200 bar/2940psi and assuming a usable gas pressure of the working pressure (minus the regulator interstate pressure of 11 bar/161psi) this equates to 189 bar/2779psi available.

Assuming a DCP setting of 50% and a worst case FO_2 of 32%. The EXPLORER gas supply will last a maximum of 189 minutes based on normal swimming work rates.

The EXPLORER will continuously update gas minutes remaining throughout the dive for any DCP setting and work rate.

DANGER: High pressure gas cylinders (especially nitrox cylinders) must have their cylinder valves opened slowly to avoid risk of injury.

This duration is also dependent on how much loop venting, mask clearing, BCD/drysuit inflation occurs.

NOTE: Cylinder valves for use with the EXPLORER must be certified in accordance with EN12021 for use in Europe.

THE ABSORBENT FILTER

The unit has been tested under CE requirements for CO_2 absorbent filter duration. The weight of absorbent in the filter is approximately 1.5kg/3.3lbs. Tests were conducted with Molecular Products 797 Grade CO_2 Absorbent.

WARNING: Using any other absorbent will change and possibly reduce the Canister duration and could lead to injury or even death.

CANISTER DURATION

At 40m/130ft of depth, with Nitrox 32% as a diluent at 4 °C/39 °F water temperature with a CO_2 injection rate of 1.6 l/min and a ventilation (breathing rate) of 40 l/min and a 1.5 kg/3.3 lbs absorbent load of a Hollis Approved absorbent (See Unit Specification), the unit will last 40 minutes at 40 m/130 ft as an extreme test (Ref EN14143: 2003).

This duration changes significantly with higher temperatures and lower work rates

continued

Below is a table of endurance versus depth and changing workloads with temperature.

MINUTES TO 5MB CO_2 REFERENCE

Depth	Total dive time	Ventilation rate	Work rate	Water temp
40 m/130 ft	37 mins	40 l/min	Hard swimming	4° C/39° F
40 m/130 ft	120 minutes +reserve capacity	22.5 l/min	Normal swimming	15° C/59° F
40 m/130 ft	88 mins	40 l/min	Hard swimming	15° C/59° F

DANGER: Ventilation rates up to 40 l/min are referenced as "Normal swimming" and rates of 40 l/min and above are referenced as 'Hard swimming'. Under strenuous conditions however consumption rates may be significantly higher. Regardless of conditions or readings on the computer, the scrubber should NEVER be used for more than 2 hours.

WARNING: These tests were conducted using Hollis approved absorbent grade and durations can only be duplicated using this grade. DO NOT use any other type of absorbent with the EXPLORER. Safety data on absorbent products can be found at: http://www.molecularproducts.co.uk

Tests conclude that depth (gas density), temperature, and CO_2 generation all massively affect absorbent duration. The EXPLORER employs a highly efficient axial canister design which not only offers greatly extended durations when compared to other designs employing a similar absorbent load, but it is less affected by the commonly experienced high loss of efficiency associated with increased depth.

FILLING STEPS – PROPACK VERSION ONLY

DANGER: DO NOT perform this action unless you are certified to do so.

1. Remove the Filter from the Canister. Inspect the quad ring for cleanliness/damage and clean/replace with a small amount of grease *(Fig. 4.9)*.
2. Unscrew the yellow top nut and canister lid and inspect the meshes for damage.
3. Remove any excess absorbent stains from the canister components with warm, soapy water and then rinse in fresh water. Then allow it to dry.
4. Fill the canister in a well-ventilated environment. Raise the absorbent barrel at least 200mm (8 inches) above the canister to allow dust to blow away as you fill. Fill to the top of the canister, making sure absorbent is at an even depth across the canister.
5. Pack the absorbent by tapping the sides for at least 1 minute.
6. Fill to the top again.
7. Pack the absorbent by tapping the sides for at least 1 minute
8. Refill with Absorbent to the top. Tap down as required until you can fit the lid. Refit the lid and the spring (under the yellow nut).
9. Screw down the top nut.
10. Wipe any dust from inside the canister.
11. Look into the Canister head and run your finger around the sealing face for the quad-ring removing any debris.
12. Insert the filled Filter into the Canister.
13. Refit the Right Hand end cap.
14. Dispose of old absorbent as normal household waste. Do not leave it lying around for animals to ingest.

Filling instructions are also found on the side of the canister tube.

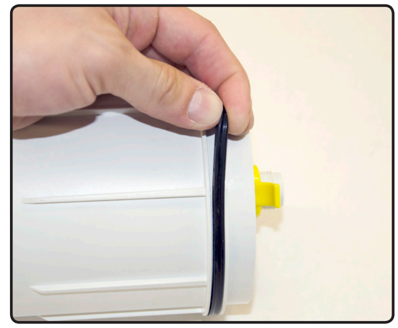


Fig. 4.9

FILLING STEPS – PRE-PACKED VERSION ONLY

1. Remove the Filter from it sealed packaging.
2. Inspect the quad ring for cleanliness/damage
3. Apply a small amount of grease to the quad ring.
4. Wipe any dust from inside the canister.
5. Install the filter.
6. Refit the Right Hand end cap.
7. Dispose of old absorbent filter as normal household waste. Do not leave it lying around for animals to ingest.

POST DIVE

During a diving sequence, it is important that a small amount of daily maintenance is undertaken. These fall into 5 categories:

1. Care of oxygen and CO_2 sensors
2. Loop cleaning
3. Recharging
4. Cylinder filling
5. Absorbent changing
6. BCD

CARE OF OXYGEN AND CO_2 SENSORS

The Sensor Module (SM) is easily removed from the unit by removing the Life Support System Module (LSS) and pulling the SM out. The SM carries the three oxygen sensors and the CO_2 sensor.

Post dive the CO_2 filter (yellow cap) sponge should be replaced as detailed.

At the end of a days' diving the complete SM should be removed (and the LSS cap refitted) and kept in a dry (low humidity) and ambient temperature environment. The CO_2 filter cap should be removed for the non-diving period.

LOOP CLEANING

After a dive the hoses should be removed and fresh water should be flushed through the complete assembly and be allowed to drain out. To remove excess water, push the hose corrugations together (like using a concertina) to squeeze the water out.

Disinfect the unit as per the 'Explorer Rebreather Maintenance Chart', PART 7 Section 4.

RECHARGING

Please see "Batteries" PART 1 section 2.

CYLINDER FILLING

All dives must start with a full cylinder. All gas must be analyzed prior to use.

ABSORBENT CHANGING

Absorbent must be changed in accordance with the section in the manual titled ‘The Absorbent Filter’.

BCD

Drain any water from the BCD. Re-inflate and the operate dump valves and the inflator to confirm everything is OK.

COMPLETING PRE-DIVE CHECKS

4.3

PURPOSE

These tests are designed to:
1. Check that all functions of the EXPLORER have a high likelihood of operating correctly
2. Detect assembly errors
3. Detect breathing loop errors
4.Advise the user of system measurements that are outside correct operating parameters including:

a. High Pressure readings too low
b. High Pressure readings dropping too quickly – possible leaks
c. Battery Levels
d. PPO_2 partial pressure of oxygen in the breathing loop
e. Calibration of PPO_2/CO_2 sensors performed correctly
f. Ensure the CO_2 absorbent is functioning correctly, and the filter is inserted correctly and is sealed

THE COMPLETE (PASS MODE) PRE-DIVE SEQUENCE

The complete sequence is detailed on the following page. This sequence assumes all tests pass OK and no Pre-dive has been conducted within one hour. The full screen chart is available on the CD enclosed with the product. An APP for any Android device is available at http://hollis.com/support.asp and on the enclosed CD with your EXPLORER.


00:52:58
I HAVE READ AND UNDERSTOOD THE MANUAL. I HAVE COMPLETED A RECOGNISED TRAINING COURSE. I KNOW HOW TO OPERATE THIS EQUIPMENT.
MENU
CONFIRM
PLEASE WAIT PERFORMING SYSTEM CHECKS
GAS ?
MANUAL CO2 SENSOR OR O2 CELL CALIBRATION?
O2
CO2
NO
GAS ?
CHECK RUBBER MOUTHPIECE AND MUSHROOM VALVES
NOT OK!
OK
GAS ?
CONNECT HOSES, CLOSE HP CYLINDER VALVE AND OPEN MOUTHPIECE
ABORT
CONFIRM
GAS ?
FILL LOOP, THEN EVACUATE LOOP AND CLOSE MOUTHPIECE
ABORT
CONFIRM
GAS ?
PLEASE WAIT 28s
NEGATIVE TESTING LOOP
ABORT
GAS ?
ENSURE MOUTHPIECE CLOSED. OPEN HP CYLINDER VALVE.
ABORT
CONFIRM
GAS ?
PLEASE WAIT 34s
PRESSURISING LOOP
ABORT
NX 36
OPEN MOUTHPIECE
ABORT
CONFIRM
NX 40
EVACUATE LOOP TO TEST ADV
ABORT
OK
NX 40
BLOCK NOSE AND BREATHE ME FOR 49 SECONDS
ABORT
NX 36
BREATHING LOOP CHECKED OK
ABORT
CONFIRM
NX 40
NEW CO2 FILTER FITTED?
104°
66°
YES
NO
NX 36
CHECK BAILOUT AND BCD
OK

From the dive screen, each resource must then be checked *(Fig. 4.10)*. Once you have checked each resource the STATUS display will show SYSTEM OK.

DIVING WITHIN 2 HOURS OF A SUCCESSFUL PRE-DIVE SEQUENCE

If you start a dive within two hours of a successful Pre-dive being conducted then EXPLORER will display the following Startup screen *(Fig. 4.11)*. Now you can simply select DIVE or go through the Pre-dive sequence again by selecting PREDIVE.

Fig. 4.10

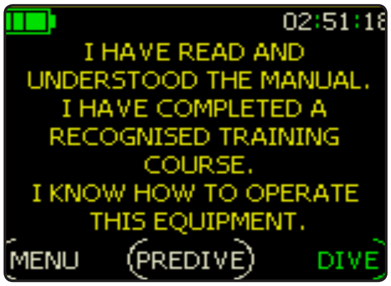
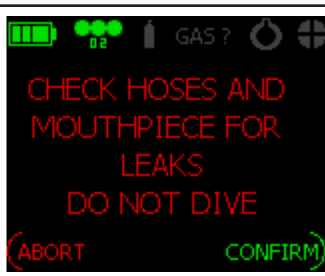
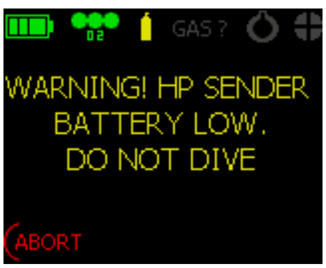
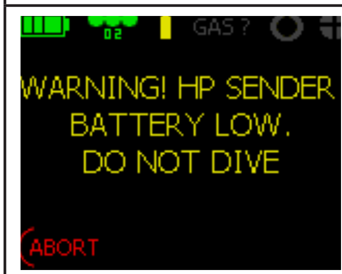
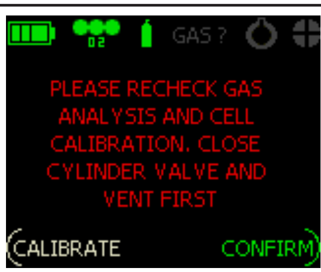


Fig. 4.11

USER FAULT FINDING & TESTING

PRE-DIVE PRIMARY ERROR MESSAGES & THEIR MEANINGS

Message	Meaning
	The batteries in the EXPLORER must be charged prior to diving.
	CO_2 sensor is unable to calibrate and must be replaced or removed (the 5 minute pre-breather system will be activated).
	O_2 sensor(s) unable to calibrate and must be replaced and/or their connectors cleaned.
	O_2 sensor(s) unable to calibrate or failed LSS/Sensor Module. Recharge unit and try again. Return to dealer if problem persists.
	Negative test failed. Ensure Cylinder is attached. Ensure Mouthpiece is fully in OC mode. Fill loop until vent valves exhausts then attempt negative test again.

Message	Meaning
	Low HP gas in dive cylinder.
	If HP reduces by >50bar/735 psi or does not reduce by at least 5bar/73.5 psi.
	Make sure cylinder valve is fully open. Check cylinder size is correct in DEFAULT GAS Menu. Do not use unlisted cylinders. Submerge unit and look for LP/HP leaks, BC inflator failures etc.
	Wireless HP sender battery is low.
	Analyzed gas is not what is expected by the DEFAULT GAS setting. Analyze gas and check setting.

Message	Meaning
	The LCV and OPV are not venting at the correct pressure. Flush valves with fresh water and repeat test. If the problem persists return the unit to your dealer.
	You have stopped breathing while conducting a pre-breathe sequence. Repeat the test. If the error persists return the unit to your dealer.
CHECK HP USAGE	If the Predive sequence is completed, the STATUS window is active, and you see the above alarm, then HP usage is greater than 1bar/min – 14.7 psi/min. This could indicate a leak in the HP or LP circuit (internal pipework), BC or BOV. Submerge to locate the leak.

MANDATORY DIVING SKILLS
EXPLORER BASICS

The primary diving skills required to use the EXPLORER will be covered in your chosen agency's training program and will not be reviewed here. However, there are certain unit-specific skills, which must be covered during your training course. These are detailed below.

5.1

LEAK TESTING

See PART 4 Section 4.

CALIBRATION

See PART 3 Section 12.

HARNESS ADJUSTMENT

See PART 4 Section 1.

BUOYANCY CONTROL AND TRIM

Initially, in shallow confined water you will be required to maintain a hovering simulated decompression stop. You will then practice short ascents/ descents initially Ascents will be made from progressively deeper depths and will involve the use of a Surface Marker Buoy.

OPEN CIRCUIT BAILOUT

On every dive you will practice switching to the BOV and/or bailout stage bottle. On some dives you may be required to conduct additional bailouts possibly back to the surface as defined by your instructor.

Preparing the unit for diving and maintenance/cleaning
You will be shown how to assemble the unit and complete the pre-dive check sequence. In addition you will be shown how to care for your unit post-dive.

FLOOD RECOVERY

Condensate will naturally collect in the exhale hose on the diver’s right. This will be accompanied by a ‘gurgling’ noise.

Water is allowed to then move into the top of the exhale counterlung. This is acceptable for the following reasons:

1. Water entering the counterlung is forced out again by the LCV system.
2. A small amount of water will not affect the CO_2 absorbent performance

Moving water into the water removal system allows you to purge the water through the LCV.

To move water into the LCV system: Close the mouthpiece, put the hoses above your head and shake the hose, squeezing the exhale hose like squeezing an accordion will move water down the hose quickly.

Now return to the loop and keep breathing normally.

If water continues to enter the loop, attempt to locate the leak and fix it. A common leak point might be a mouthpiece that is not fully open or closed or a rubber mouthpiece, which has not been properly secured to the BOV.

If water is in the inhale hose, again close the mouthpiece and move the water across to the exhale hose and evacuate as above.

BAILOUT AND ASCENTS

Open circuit bailouts become necessary if a loop is unbreathable (high CO_2 or low/high PO_2) or flooded. In the unbreathable scenario the loop will need to vent during the ascent. This is done automatically by the OPV and the LCV combined.

WARNING: Ascents must be practiced on the training course while on open circuit and with a loop full of gas. Venting will occur naturally if the diver is weighted correctly.

With a flooded loop the diver must carry sufficient additional buoyancy to overcome approximately 5 kg/42 Newtons (11 lbs) of buoyancy loss.

IN-WATER SKILLS

In-water skills are a vital element of dive training. It is important, especially when teaching complex skills or equipment, that training is progressive. Non-progressive training only serves to scare and confuse students and at best reduce the learning experience to a series of ‘hoops’ that should be jumped through. This is not the goal at all; the desire to learn should be nurtured by making the experience as informative, fun, and as exciting as possible. Only then will the subject matter and key survival skills be remembered.

As in all training, while certain skills must be mastered first before the student can progress safely to the next level, there are always issues that affect the training sequence. These can include:

1. Environment
2. Support logistics
3. The students ability to learn

Your instructor will sequence skills according to standards of the agency you will be certified through. Though all agencies will complete the same list found in the "In-Water Skills Chart" section of this chapter, additional skills may vary by agency.

DIVING SAFETY GUIDELINES

After **ALL** drills involving a cylinder or valve isolation, the instructor should confirm the valves are again open before completing the dive.

All divers must enter the water with enough gas in their BC to allow the diver to safely float on the surface.

The Pre-Dive sequence must not be done sitting on the edge of a boat or pontoon. It **MUST** be done, when prompted, with the nose blocked, seated in a safe location*, and in a way they can easily read their displays.

Divers should carry a minimum 3 liter of bailout gas for dives deeper than 18 m/60 ft.

Safety decompression stops should be conducted on all dives.

** Safe location: where a student is unlikely to injure themselves or drown if they lose consciousness.*

IN-WATER SKILLS CHART

Skill Number	Skill	Learning Requirement	Purpose	Details
1	Pre-dive checks	Accurately complete all checks without bypassing any items.	To confirm the EX-PLORER has been prepared correctly, the function of the absorbent, and the monitoring system function.	Follow on screen sequence using the primary display.
2	Calibration of Explorer	Complete calibration of O_2 & CO_2 sensors.	To confirm calibration of all sensors on primary electronics with air CAL sequence.	Explain sensor calibration rules in manual, importance of sensor position, date stamp, logging system, O_2 sensor voting logic system, and CO_2 filter replacement.
3	In-water leak, buoyancy, and trim checks	Diver checks themselves and buddy for leaks. Diver maintains buoyancy and trim checks.	To ensure no LP, HP, or breathing loop leaks are present that either were missed by Pre-dive checks or occurred after checks. Make buoyancy and trim adjustments.	Check LP, HP, and breathing loop fittings/hoses while submerged, between the surface and 6 m/ 20 ft. Look for incorectly configured or stowed equipment. Ensure proper weighting (should be neutral with full counterlungs. Emphasis should be placed on good trim.

Skill Number	Skill	Learning Requirement	Purpose	Details
4	Carry and use of additional bailout gas	Carry external bailout gas cylinder on dives deeper than 18 m/60 ft. Practice use of the BOV and external bailout. Perform static and dynamic open circuit bailout drill. Include at least 2 OC ascents from bottom the bottom to approximately 6 m/20 ft	To verify bailout systems function. To ensure the diver is correctly weighted to maintain depth control under all urgent/emergency conditions. To reinforce how to deal with a hypercapnia situation and reinforce involved muscle memory.	The unit should be weighted to offset the buoyant volume of the EXPLORE. Additional weight is needed to compensate for their exposure suits and additional bailout cylinder. Switch to off-board open circuit via the BOV. Ascend slowly. The biggest buoyancy change is in the last 10 m/33 ft, and ideally the student should remain horizontal within this depth range. Weighting should be such that automatic venting should control the ascent. (This skill should be conducted twice, 1st along a contoured bottom or shot line; the 2nd time with an SMB.)

Skill Number	Skill	Learning Requirement	Purpose	Details
5	Dive Control Parameter Adjustment	Use the Manual and Auto DCP settings on the primary controller.	To fully understand the function, adjustment of the DCP, and how different settings effect no-stop times and endurance.	Using the primary display, adjust the DCP with both the manual and automatic settings.
6	Remove and replace unit on surface	User demonstrates comfort removing and replacing equipment.	To ensure a diver is comfortable in the equipment, can remove it in an emergency, and improve abillity to dive equipment from a small vessel.	This skill is to be completed at the surface, with weights removed, and BCD inflated.
7	Electronics operation	User demonstrates competency and understanding of the use of the electronics.	To ensure the diver understands all functions with a focus on the STATUS system.	On the surface the diver should be able to demonstrate navigation of the STATUS screens and an abillity to describe each screens meaning. In the water the diver should be able to comfortably interpret all displayed information.
8	SMB deployment	User demonstrates deployment of an SMB followed by a safe ascent, stopping at 6 m/ 20 ft, while using the EXPLORER.	To ensure the diver can maintain buoyancy and monitor displays, while tasked with SMB deployment.	This skill teaches students the relationship between PO_2 changes due to ascent and buoyancy changes.

Skill Number	Skill	Learning Requirement	Purpose	Details
9	Remove water from the breathing loop with the LCV	User demonstrates how to clear water from the breathing loop.	To learn how to survive a partial flood due to mouthpiece loss; etc.	Towards the end of a dive, move to an upright position, switch to open circuit and shake loop above head to any drain water from mouthpiece and hose, then return to CCR. Continue breathing, as normal, and the LCV system will vent water from the loop. If on an ascent, simply continue ascending until the counter lung over pressurizes. Water will drain through the LCV.
10	HUD/BUD use + STATUS monitoring	Understand Handset/computer operation, STATUS monitoring, Menu System, & HUD/BUD	To understand the STATUSdisplay and the HUD light and vibration motor alarms. To understand the set-up menus of EXPLORER	Using the Simulator APP and during dives, review the STATUS information. Using the Simulator APP and the display, understand the surface menu's
11	Gas share with a buddy	User demonstrates gas sharing with a buddy	To practice deploying and receiving a second stage bailout	Stay on the EXPLORER. Allow a Buddy to use the Buddy regulator. Initially conduct in a horizontal swim then during an ascent to 6m/20ft.

5.2

EXPLORER SKILLS – COMPLETED

DRY SKILLS

1. Management of O-rings	Student ______	Instructor ______
2. Assemble the unit	Student ______	Instructor ______
3. Proper dive planning	Student ______	Instructor ______
4. Post dive care	Student ______	Instructor ______
5. Complete Explorer Exam (with a minimum score of 80%, missed questions reviewed with instructor)	Student ______	Instructor ______

IN-WATER SKILLS

1. Pre-dive checks	Student ______	Instructor ______
2. Callibration of EXPLORER	Student ______	Instructor ______
3. In-water leak, buoyancy, and trim checks	Student ______	Instructor ______
4. Carry and use of additional bailout gas	Student ______	Instructor ______
5. Dive Control Parameter Adjustment	Student ______	Instructor ______
6. Remove and replace unit on surface	Student ______	Instructor ______
7. Electronics operation	Student ______	Instructor ______
8. SMB deployment	Student ______	Instructor ______
9. Remove water from the breathing loop with the LCV	Student ______	Instructor ______
10. HUD use/STATUS monitoring	Student ______	Instructor ______
11. Gas share with a buddy	Student ______	Instructor ______

IN-WATER SKILLS

12. Equalizing ears	Student ______	Instructor ______
13. Mask clearing skills	Student ______	Instructor ______
14. Drysuit use (where applicable)	Student ______	Instructor ______
15. Reducing compliant lung volume	Student ______	Instructor ______
16. Follow dive plan, not exceeding depth or dive time	Student ______	Instructor ______
17. Maintain depth while making Safety Stop	Student ______	Instructor ______
18. Omitted decompression procedures	Student ______	Instructor ______

COMPLETE DISASSEMBLY & REASSEMBLY OF COMPONENTS
THE FULL DEAL

INTRODUCTION

The information below will enable complete disassembly, cleaning, rebuilding, and testing of the EXPLORER Rebreather. Further disassembly must be performed by a qualified Hollis EXPLORER Technician.

GENERAL NOTES ON ASSEMBLY

1. All O-rings should be lightly lubricated.
2. Inspect all O-rings for cracks and other damage during each assembly.
3. Sanitize all breathing loop parts.

DANGER: Only Hollis Explorer Oxygen sensors must be used with this unit. No other sensors are tested or approved. These are available from your Hollis Dealer.

DANGER: ONLY the Hollis CO_2 sensor must be used with this unit. No other sensors are tested or approved.

WARNING: All non-user servicing must be performed by an approved Hollis service facility Explorer service technician.

BOV DISASSEMBLY

There are very few parts that should be removed by the customer within the BOV assembly since many parts (especially the second stage components) require additional set-up by a trained Explorer technician.

• Unscrew the breathing hose ends.
• Remove and inspect the hose ends O-rings for damage
• Using the rubberized end of a pencil or other blunt/soft instrument, insert the pencil through one of the mushroom valve carriers (moving the mushroom valve aside first) and gently push out the opposite carrier assembly.

NOTE: DO NOT push on the center of the carrier. ONLY push on the outer edge.

• Remove the mushroom valve carrier O-rings
• Gently pull out the mushroom valve
• Remove the mouthpiece cable tie and the rubber bite mouthpiece

BOV REASSEMBLY

• Clean the mushroom valve carrier O-ring and the groove around the mushroom valve carriers. Lightly grease and refit new O-rings.
• Inspect the mushroom valve and mushroom valve carrier for damage. Wash/disinfect and remove any debris from the carrier.
• Clean the mushroom valve carrier O-ring and the groove around the mushroom valve carriers. Lightly grease and refit the O-rings.
• Refit the mushroom valves to the carriers.

DANGER: DO NOT put grease on the mushroom valve.

• Having cleaned and disinfected the BOV outer; hold the BOV in your hand with the mouthpiece towards you and the second stage port facing forwards. Position the right hand side mushroom valve carrier with the valve facing out and the left hand side valve carrier with the valve facing in, into the mouthpiece. Install the valve/carrier assembly in by pressing on the edges of the carrier, do not press on the center of the mushroom valve Ensure the O-rings around the mushroom valve carriers have not extruded out of their grooves.

DANGER: Check the flow in the BOVis from diver's left to diver right (with the mouthpiece in the diver's mouth).

• Inspect and clean the rubber mouthpiece. Refit with a tight cable tie. Remove sharp edges from the cable tie.

BOV PRIMARY TEST

In closed circuit mode, block the right hand (exhale) side and blow (do not apply excessive force) into the mouthpiece. The inhale (diver's left side) mushroom valve should seal and no gas should exit out of the second stage exhaust port or the front diaphragm plate.

Faults:
• Mushroom valve (inhale side) leak. Remove the carrier and inspect again.
• BOV barrel O-ring or activation handle O-ring leak. Replace O-ring.

In closed circuit mode, block the inhale (diver's left) side and suck into the mouthpiece.

Faults:
• Mushroom valve (right hand side) leak. Remove the carrier and inspect again.
• BOV barrel O-ring or activation handle O-ring leak. Refer to a Hollis service center.
• Remove both hoses from the Canister (leave connected at the BOV/DSV). Put the BOV/DSV in open circuit mode. Block the exhale hose end and blow into the inhale hose end. Submerge the BOV and look for leaks from the mouthpiece or hose ends/hoses.
• If bubbles are seen from the mouthpiece outlet then the barrel O-rings need replacing. Refer to your Hollis dealer.
• If bubbles are seen at the hose ends then replace the hose end O-rings
• If bubbles are seen along the hoses then refer to your Hollis dealer.

BOV SECONDARY TEST

In open circuit mode, with the second stage BOV (HP) gas turned OFF. Remove the breathing hoses. Block both inhale, exhale, and mouthpiece ports and the LP inlet to the second stage. Then suck from the mouthpiece.

Faults:
• If a leak is heard, the Exhaust valve or the diaphragm may need replacing. If a fault is found, Refer to a Hollis service center.

BREATHING HOSE ASSEMBLY

Clean, inspect the hose end O-rings and assemble

BREATHING HOSE ASSEMBLY TESTING

Block one end of the hose and blow into the other. Look for leaks along the hose while submerging it. Repeat for the other hose.

MOUTHPIECE/HOSE ASSEMBLY

• Connect the LP feed, which should be over the diver's right shoulder, to the BOV. Replace the LP hose end O-ring if required.
• Fit the breathing hose with the white ID O-rings to the left hand side (inhale) side of the mouthpiece.

• Repeat for the right hand side (black) hose.

MOUTHPIECE/HOSE ASSEMBLY TESTING

In open-circuit mode, immerse the mouthpiece. Block the exhale hose end (green) and blow into the inhale hose end (red).

Faults:

• If bubbles come out of the mouthpiece there may be a leak in the barrel/activation handle seals. Return to your Hollis dealer for repair.

EXPLORER LSS MODULE - DISASSEMBLY/ASSEMBLY

• Remove the LSS Module by twisting the lock ring anti-clock wise ½ turn.

• Inspect & clean O-ring and sealing surfaces, re-grease and refit the LSS Module sealing O-rings.

• Refit the head by lining up the solenoid post, pushing it into the Canister, and turning the lock ring clockwise by 180 degrees to 3 O'clock *(Fig. 6.1)*.

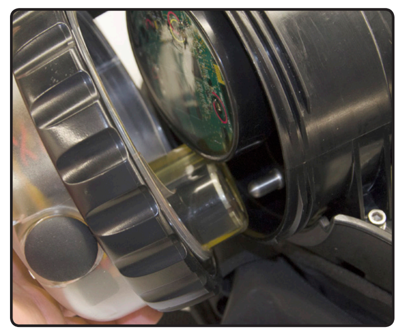


Fig. 6.1

NOTE: Ensure the lock ring is in the 9 O'clock position for the O-rings to engage then twist it by 180 degrees to 3 O'clock to lock. The Case Back Cover will not fit correctly if the lock ring is in the wrong position.

SENSOR MODULE - DISASSEMBLY/ASSEMBLY – OXYGEN SENSOR MAINTENANCE/TESTING

• Remove the Sensor Module *(Fig. 6.2)* from the Canister
• Remove all 3 oxygen sensors *(Fig. 6.3)*
• Inspect the Thermal Profile Monitor (TPM) body and O-ring for damage ,and clean the TPM with warm soapy water. **NEVER** expose the sensors to water.
• Clean the sensor jack connectors with a soft cloth (look for damage and corrosion).

DANGER: After sensor replacement you must ensure the unit is calibrated by completing a full pre-dive sequence.

DANGER: It is important that oxygen sensors are maintained and cared for. Avoid excessive moisture. Some moisture will always form during a dive but if the rebreather has been flood-ed the sensors MUST be replaced.

Fig. 6.2

Fig. 6.3

Fig. 6.4

CO_2 SENSOR TESTING/ DISASSEMBLY/ASSEMBLY

Having removed the Sensor Module, carefully remove the CO_2 sensor protection cap and the CO_2 sensor *(Fig. 6.4)*. Handle the CO_2 sensor with care.

• Inspect the mini-jack connector and carefully wipe clean with a soft cloth

• Remove the yellow sponge inside the cap and allow it to dry.

DANGER: A dry sponge must be fitted prior to every dive to ensure accurate CO_2 readings.

• Replace the sponge every 10 dives.
• Refit the Sensor Module into the Canister

DANGER: After replacement you must ensure the unit is cali brated by completing a full pre-dive sequence.

CANISTER END CAP - DISASSEMBLY/ASSEMBLY

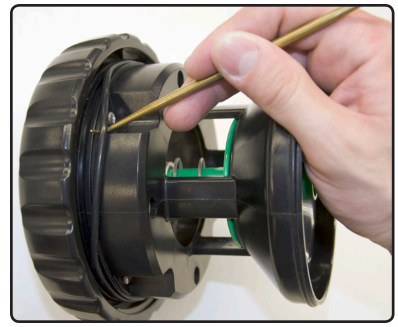


Fig. 6.5

• Remove the Right Hand end cap by twisting the lock ring counter-clock wise ½ turn.
• Inspect, clean, O-ring and sealing surfaces re-grease and refit the end cap sealing O-rings *(Fig. 6.5)*.
• Refit the head by pushing it into the canister and turning the lock ring clockwise by 180 degrees to 3 O'clock.

NOTE: The Diver's Right Side End Cap contains the Go/No Go Device. This is the green piece in the picture above surrounded by a spring.

DANGER: If you do not insert an absorbent filter, the device seals off the breathing loop to prevent you from taking a CC breath. You must not dive without a CO_2 filter fitted.

CANISTER – DISASSEMBLY/ASSEMBLY

Fig. 6.6

• Remove the counterlungs and hoses by unscrewing the hose lock rings. Clean and inspect the sealing face for each end cap seal and the hose ends/counterlung ports.
• Then unscrew the LP feed to the ADV *(Fig. 6.6)*.
• Disconnect the LCV balance cap and tube from the exhale counterlung to the Canister at the counterlung. This is a 1/2 turn (counterclockwise) unlock.
• Inspect the LCV counterlung mushroom valve and cap sealing ring for damage. Replace/re-grease as required.
• The Canister can be removed for washing/service if needed by unscrewing the 4 Canister securing screws from the case.
• In normal diving operations the canister should be flushed with fresh water and rinsed with sanitizing liquid and wiped clean without removing it from the case.

PROFESSIONALLY PACKED ABSORBENT FILTER - DISASSEMBLY/ASSEMBLY

• Disassemble and Discard the absorbent material as per local regulations. Wash the Absorbent Filter in warm soapy water to remove absorbent

debris. Disinfect as required.
• Inspect the Filter for damage especially around the Quad ring sealing face.
• Inspect and replace the quad ring seal as recommended in the maintenance chart.
• Inspect the upper and lower steel mesh for damage. Your Hollis dealer can replace damaged meshes.
• Fill with CO_2 absorbent (as per the manual and label) and refit the top nut and spring.

ABSORBENT FILTER – QUAD RING

DANGER: This is the most important seal in the system and should be regularly cleaned and inspected. It is vital in preventing CO_2 bypass.

• If you are using the single use CO_2 filter then each filter comes with a new quad-ring seal.

DANGER: This is not a normal O-ring and must not be replaced with anything else.

• If you are using the ProPack Filter, then this seal MUST BE REPLACED EVERY 30 HOURS OF USE.

DANGER: The ProPack CO_2 filter Quad-ring seal must be replaced every 30 hours of use.

COUNTERLUNG - DISASSEMBLY/ASSEMBLY

• Remove the counterlungs by unscrewing the connectors

• Remove the exhale counterlung LCV mushroom valve cap (1/2 turn lock).
• Sanitize and inspect the counterlungs.

COUNTERLUNG TESTING

• Attach the BOV exhale side (right) of the mouthpiece to the exhale counterlung canister port.
• Unclip the exhale counterlung LCV port cap from it’s hose and block the

end of the exit tube.
• With the BOV in CC mode, Fully inflate the counterlung
• Immerse and look for leaks.
• Repeat for inhale counterlung (there is no LCV cap to cap off).

REGULATOR WIRELESS HP TRANSMITTER TESTING

• Connect a diving cylinder
• Turn on the wrist display and complete the pre-dive sequence
• During the Pre-dive HP gas test sequence, if the first stage transmitter battery is low, a warning will appear *(Fig. 6.7)* or if low at the start or end of a yellow warning *(Fig. 6.8)* will appear.

DANGER: If you are in doubt as to the HP readings on EXPLORER, you must check it by attaching a normal gauge and hose to the HP post.

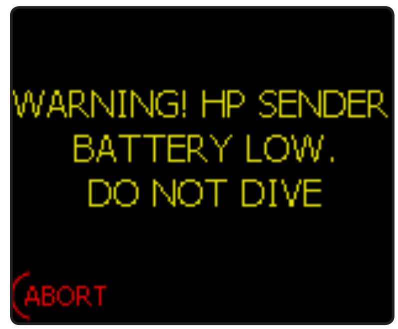


Fig. 6.7

PUTTING ASSEMBLIES TOGETHER

• Ensure the Canister is in place and secured with it's 4 screws
• Fit the Sensor Module, EXPLORER Module and Right Hand end cap along with a new Absorbent Filter.
• Fit the LP hose to the ADV
• Fit the counterlungs and the LCV port cap to the exhale counterlung
• Fit the LP hose to the BOV
• Fit the hoses to the BOV
• Fit the cylinder and the DIN wheel
• Connect the LP hose to the BCD inflator

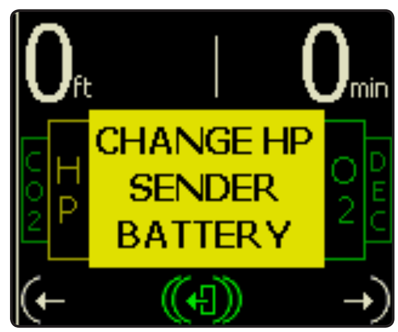


Fig. 6.8

COMPLETE EXPLORER TEST

Follow the on-screen pre-dive sequence
If the unit fails the negative or HP leak test and the fault is not easily recognizable.
Follow these steps:

- Remove the LCV hose from the Canister or restrict the hose to stop the counterlung venting through the LCV
- Turn on the gas.
- Put the BOV into closed circuit mode.
- Inflate the counterlungs by blowing into the loop until it is full then put the BOV in open circuit mode.
- Fully submerge the unit and look for leaks.

NOTE: The OPV situated under the Canister will vent some bubbles. THIS IS NORMAL. Look for other leaks.

Finally, complete all on-screen pre-dive checks before diving.

APPROVED OXYGEN SENSORS

The EXPLORER is only approved to use Hollis EXPLORER Oxygen Sensors. Hollis EXPLORER Oxygen Sensors have temperature ranges as detailed below.

Operating temperature range: 0 – 40 °C
Storage temperature: -20 to +50 °C
Recommended storage temperature: +5 to +15 °C

OXYGEN SENSOR CARE

WARNING: For the sensor life prediction alarms to operate correctly the oxygen sensors, if removed, MUST be replaced in the same position.

WARNING: In the event of a faulty sensor, all three sensors should be replaced together as it cannot be guaranteed that the scenario that made the first sensor fail has not affected all the sensors.

WARNING: Number each individual sensor before removal so they can be replaced in the same position.

Basic care includes:
- **NEVER** store sensors in any gas other than air.
- **NEVER** subject sensors to high temperatures i.e. (Car trunks).
- **NEVER** freeze sensors (left in cars overnight).
- **NEVER** subject sensors to physical shocks.
- **NEVER** subject sensors to vacuum.
- **NEVER** submerge sensors in liquids.
- **Never** attempt to open a sensor housing.
- Sensors deteriorate very slowly and near the end of their useful life may show a reading drift soon after calibration.
- always change all 3 sensors together and after a maximum of 12 months from first usage.
- Water and corrosion on the sensor jack plug may give false Oxygen readings. Seawater may dry leaving a deposit on the jack connectors and the sensor membrane. Always leave the sensor jack locking ring finger tight on the sensor socket. If you suspect corrosion, remove the sensor from the sensor module and clean the jack plug with a cloth and contact cleaner.

• Check the sensor membrane. A certain amount of moisture will always appear on and around the sensors. If you suspect excessive water has made contact with the sensor faces. Remove excess water carefully with a paper tissue and leave to dry in a warm area. If the jack socket on the sensor is wet, the sensor may be damaged, as the electronics inside the sensor will also be wet.

WARNING: Flooded sensors must be replaced.

SANITIZING

The recommended sanitizing product for the EXPLORER is Steramine™.
This sanitizer is available through your Hollis dealer.

Please see www.Steramine.com for Safety Handling Instructions.

Basic sanitizing can be conducted by making up a solution in the correct quantities and soaking or wiping the part with the solution.

WARNING: The use of any other sanitizing may damage the component parts of the rebreather, in particular the mushroom valves.

Items to be sanitized are:

- The mouthpiece and hoses
- The counterlungs
- The canister tube and all its' internal components

WARNING: You MUST make sure you read the Material Safety Data information before using.

CO_2 ABSORBENT

CO_2 ABSORBENT STORAGE

DANGER: Once a CO_2 filter has been packed it should remain so. Do not attempt to remove absorbent from a part used filter and dry it, refurbish or re-pack the absorbent in any way.

After a dive and providing the absorbent filter remains in a sealed state (i.e. within a closed EXPLORER loop) it may be used again until the limit of the absorbent timer is reached. Storage for more than 24 hours is not recommended and a used absorbent filter removed from the canister should be discarded.

HANDLING ABSORBENT

WARNING: CO_2 absorbent may cause burns to eyes and skin.

First aid treatment is as follows:

• Inhalation. Remove from exposure. Seek medical attention.
• Skin Contact. Drench with clean water and seek medical attention if skin becomes inflamed.
• Eyes. Irrigate thoroughly with clean water. Seek medical attention.
• Ingestion. Wash out mouth thoroughly with clean water. Seek medical attention.

Safety data on absorbent products can be found at: http://www.molecular-products.co.uk

For User packed filters, always fill filters in a well-ventilated environment. Avoid contact with eyes and skin.

SERVICE

Your instructor will educate you on what you the end user can service yourself. For all other service needs your Hollis Explorer Technician has been trained in the proper skills to service your your Hollis equipment.

Always follow the Maintenance Schedule at the end of this chapter to keep your EXPLORER in peak condition. The EXPLORER also keeps a log of usage hours, and it will display a service reminder when it is close to the service interval *(Fig. 7.1)*.

Fig. 7.1

7.5

MAINTENANCE SCHEDULE

KEY:
E = before every dive A = annually
C = at canister change 30 = every 30 hours of diving

Item	User (U) or Dealer (D)	Inspect/clean	Replace hours/ service	Notes
Mushroom valves	U	E	100/annually or if damaged prior	
Quad Seal	U	C	30/annually or if damaged prior	
CO_2 sensor filter sponge	U	E (swap)	10 hours/ or if damaged	Change the sponge for a dry one every dive. Replace after 10 hours.
Hose end O-rings	U	E	200/annually or if damaged prior	
Mouthpiece barrel O-rings	D	If pre-dive failed (leaks)	200/annually or if damaged prior	
End cap O-rings	U	C	200/annually or if damaged prior	
Adv diaphragm	D	A	200/annually or if damaged prior	
Oxygen/CO_2 sensor connections	D	30	Clean at annual service	Inspect for damage. Clean with contact cleaner (Deoxit Gold GN5)
Oxygen sensors	U	30	Whichever comes first, 12 months or the DO NO USE AFTER DATE	Inspect for damage.
Absorbent Filter mesh	D	A	If damaged	User-pack version only
Counterlungs and LCV port mushroom valve/O-ring	U	30	200/annually or if damaged prior	Water flush every 2 days. Disinfect counterlungs at end of each trip or sooner if required (Steramine).

Item	User (U) or Dealer (D)	Inspect/clean	Replace hours/ service	Notes
Hoses + mouth-piece assembly	D	E	See separate items on this list	Fresh water flush daily. Disinfect end of each trip or soon-er if required.
LCV assembly	D	Wash at end of dive trip	200/annual or if damaged prior	Fresh water flush after dive trip
OPV	D	Wash at end of dive trip	200/annual or if damaged prior	Flush with fresh water. Replace if not holding a negative.
Regulator first stage	D	Wash at end of dive trip	200/annual or if needs adjustment prior	Flush with fresh water.
Regulator second stage - BOV	D	Wash at end of trip	A or if damaged prior	Flush with fresh water and disinfect as required

APPROVED PRODUCTS AND GLOSSARY
APPROVED PRODUCTS

CO_2 SCRUBBER MATERIAL

Intersorb 812 (8-12 mesh) or Sofnolime (8-12 mesh)

OXYGEN SENSORS

Hollis EXPLORER Sensors

CLEANING PRODUCTS

Steramine 1-G Tablet
White Vinegar
Crystal Simple Green® or Dawn (or similar mild) dish detergent

MAINTENANCE PRODUCTS

Dow Corning® 7 Silicone (non-O_2 clean parts only)
CRISTO-LUBE® MCG 111
Tribolube 71®
DeoxIT® Gold GN5 Electrical Contact Cleaner

Other products not listed may be appropriate for use with the Explorer. If there is a particular product which you wish to use, please call the factory to make sure the product does not contain chemical components which may be harmful to components within the rebreather or the diver.

CAUTION

CAUTIONS: Consult manufacturer Material Safety Data Sheets for further safety recommendations for these materials.

Never use the following products or families of products on ANY part or surface of the Explorer rebreather:

- Products which contain alcohol, high concentrations of chlorine, ammonia, gasoline, Benzene or any petrochemical-based solvent (Basically, any product with the suffix "ene" in it.)

- Polishes, wax, automotive cleaning products.

- Glues, binding agents, plastic fillers other than those specifically listed in the "maintenance and troubleshooting" or "approved products" sections of the manual.

DANGER: Never attempt to clean your rebreather, or any part of your rebreather in a dishwasher or any other type of machine that employs high pressure jets of cold, warm or scalding hot water.

GLOSSARY

Absorbent: chemical media used to remove CO_2 from exhaled gas

Absorbent Filter: Mechanical assembly where the CO_2 absorbent is housed

ADV: automatic diluent valve - a valve that automatically adds fresh gas supply to the counter-lungs as it collapses from increased pressure of depth or if it is needed after venting too much gas as in a mask clearing exercise.

Bailout: redundant gas supply system

Balance Tube: The tube between the exhale counterlung and the LCV. This tube removes water from the counterlung and controls (breathing) loop pressure with the LCV.

BUD (Buddy Universal Display): Universal display on side of LSS module, codes identical to HUD

BCD (Buoyancy Control Device): the harness/buoyancy compensator assembly

BOV: bail out valve

Breakthrough: where absorbent scrubber fails, no longer removing CO_2 at an adequate rate

Breathing Hose: The large hoses that connect the Canister assembly to the BOV

Breathing Loop: parts of the rebreather that breathing gas circulates within

Canister: Mechanical assembly where the Absorbent Filter is housed

Caustic Cocktail: very alkaline liquid (water mixed with CO_2 absorbent material)

CCR (CC): closed circuit rebreather

CO_2: carbon dioxide

Diluent: a gas used for breathing volume and to reduce the fraction of oxygen in the Breathing Loop

Dive Control Parameter (DCP): The control to define how high the oxygen level is set for the dive profile.

Exhale Counterlung: The counterlung positioned behind the diver’s right shoulder

FO_2: fraction of oxygen

Graphical User Interface (GUI): The display system for communicating information to the diver

Heads Up Display (HUD): the LED display positioned in front of the mask

HP: high pressure

Inhale counterlung: the counterlung positioned behind the diver’s left shoulder

IP: intermediate pressure

LCV Port: the port on the exhale counterlung that houses the exhale counterlung mushroom valve. This port links to the LCV via a balance tube.

Life Support System (LSS) Module: the diver's left hand electro/mechanical assembly

Loop Control Valve (LCV): the valve in the canister that controls the amount of exhaust gas exiting the rebreather and controls the breathing loop pressure

LP: low pressure

Maximum operating depth (MOD): the maximum depth a given gas can be used safely

Mushroom valve: a flexible one-way flapper valve that permits the gas to flow in a

circular path through a rebreather

Negative Pressure Check: a test placing the Breathing Loop under a vacuum condition to check for leaks

O_2: oxygen

OC: open circuit

Optocon: The wireless transmission system used in Explorer to send data between the

Oxygen Sensor: Galvanic oxygen sensors

LSS and Sensor Module.

OPV: over-pressure valve

PCO_2: Partial pressure of carbon dioxide

PO_2: Partial pressure of oxygen

Positive Pressure Check: a test that looks for leaks in the Breathing Loop when pressurized

PPO_2 (PO_2): partial pressure of oxygen

QD: quick disconnect

Quad Ring: a specially designed sealing ring that creates a positive seal on

the CO_2 canister. It is replaced every 30 hours of use.

Sensor Module: Electro/mechanical assembly where the oxygen sensors, CO_2 sensor

and Thermal Profile Monitor are housed

Setpoint: The PO_2 that Explorer supplies based on the DCP setting

TPM (Thermal profile Monitor): The device that monitors the usage of the CO_2 absor-

bent

The Right Hand End Cap: End cap that when removed gives access to the CO_2 filter

WOB: work of breathing

OUR HISTORY //

Bob Hollis had his first rebreather experiences in the mid 60's. He used Draeger units to allow him to get close to Sea Otters and other marine life in Monterey Bay. In 1970, Hollis made some of the first dives on the Electrolung rebreather using Heliox down to 300 feet in Honduras and Bonaire, filming shipwrecks and deep reefs. In 1990, Bob & Oceanic developed the "Phibian" rebreather, which at the time was the only commercially available unit.

In 2000, Hollis' parent company American Underwater Products under two separate contracts with the United States Naval Surface Warfare Command, developed and delivered a unit called the "ATUBA" (Advanced Tactical Underwater Breathing Apparatus). That led to the development and success of the Prism 2 eCCR technical rebreather. All of that experience has been leveraged to bring you something new the Hollis Explorer eSCR, the world's first electronically controlled semi-closed rebreather for recreational divers.

HOLLIS REBREATHER DEALER SUPPORT COMMITMENT //

As a consumer, you will receive a greater level of support from a Hollis Rebreather Dealer. Not because a non-Rebreather dealer doesn't care about support. Instead, the Hollis Rebreather Dealer has a greater level of commitment to the complete product line. A Hollis Rebreather Dealer has perfected their diving skills and is at their peak of instruction. They will provide access to rebreather training, service, consumables, upgrades and travel. The view from a Hollis rebreather into the underwater realm is like a view from no other place on earth. Hollis Gear promises to deliver an experience like no other.

AMERICAN UNDERWATER PRODUCTS ENVIRONMENTAL QUALITY POLICY //

American Underwater Products is committed to the preservation of our oceans and supports outreach and awareness programs that develop an understanding of the oceans' importance to life on earth, the fragility of marine ecosystems, the damage done by pollution, and the threat of overfishing. We produce innovative products of the highest quality, manufactured in an environmentally sustainable manner that meets or exceeds our customer's expectations and regulatory requirements

HOLLIS®

NO LIMIT