PRISM™ 2

USER MANUAL

REV. 12

This is the operations manual for the
Hollis PRISM 2

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

The PRISM 2 is manufactured in the USA by Hollis Inc.,
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Testing conducted by ANSTI Test Systems. Hants.

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

WARNINGS, CAUTIONS, AND NOTES

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

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

CAUTIONS: indicate information that will help you avoid product damage, faulty assembly, or unsafe conditions.

NOTES: indicate tips and advice.

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Hollis PRISM 2

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Hollis PRISM 2 eCCR
User Manual

Document Control Number:
12-4072 Rev. 12
Publish Date: 9/16/2016

NOTE:
Information on the electronics can be found in the "PRISM 2 Displays And Electronics User Manual"
(ver. 1 electronics use doc. 12-4100)
(ver. 2 electronics use doc. 12-4106)

GENERAL SAFETY
STATEMENTS + WARNINGS

WARNING: USE OF THE PRISM 2 MANUAL

This manual is to be used in conjunction with the Displays and Electronics User Manual for the version of electronics your PRISM 2 is equipped with. The current copy can be found at www.HollisGear.com.

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 PRISM 2 CCR 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).

WARNING: GENERAL SAFETY

No person should breathe from, or attempt to operate in any way, a Hollis PRISM 2 rebreather, or any component part thereof, without first completing an appropriate Hollis Certified user-training course.

Further, no PRISM 2 diver should use a Hollis PRISM 2 without direct Hollis instructor supervision until they have mastered the proper set-up and operation of the Hollis PRISM 2 rebreather. This includes new PRISM 2 divers as well as PRISM 2 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 mastery of the Hollis PRISM 2. Failure to do so can lead to serious injury or death.

Your safety while diving the PRISM 2 depends on you knowing your PPO2 (oxygen levels) at all times. This is easily done by monitoring the LED HUD and wrist display.

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: HIGH PRESSURE OXYGEN

The PRISM 2 uses cylinders, gas feed lines, pressure gauges and other devices which will contain pure oxygen at high pressure when in operation. Oxygen by itself is non-flammable, however it supports combustion. It is highly oxidizing and will react vigorously with combustible materials. Oxygen at elevated pressure will enhance a fire or explosion and generate a large amount of energy in a short time.

The user must maintain all parts of the PRISM 2 that can come into contact with high-pressure oxygen as oxygen-clean components. This includes scheduled servicing by a Hollis service professional, and using approved oxygen-compatible lubricants on any part of the gas delivery systems that will come into contact with high-pressure oxygen.

If any part of the oxygen-clean system comes into contact with contaminants or is accidentally flooded with any substance (including fresh water), you **MUST** have the entire high-pressure oxygen system serviced by an authorized PRISM 2 service professional prior to use. Failure to do so can cause fire or explosion and lead to serious injury or death.

WARNING: DESIGN AND TESTING

The Hollis PRISM 2 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 PRISM 2. Additionally, **NEVER** substitute any part of the Hollis PRISM 2 with third-party items which have not been tested and approved by Hollis for use with the PRISM 2.

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 PRISM 2 with non-approved parts can adversely alter the breathing, gas delivery or CO_2 absorption characteristics of the Hollis PRISM 2 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 PRISM 2 will automatically void all factory warranties, and no repairs or service work will be performed by any Hollis service professional until the altered PRISM 2 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. Dives requiring staged decompression are substantially more risky than dives that stay well within no-stop limits.

Diving with rebreathers and/or diving mixed gases and/or performing staged decompression dives and/or diving in overhead environments greatly increases the risks associated with scuba diving.

WARNING: COMPUTER SOFTWARE

Never risk your life on only one source of information. Use a second computer or tables. If you choose to make riskier dives, obtain the proper training and work up to them slowly to gain experience. Always have a plan on how to handle failures. Automatic systems are no substitute for knowledge and training. No technology will keep you alive. Knowledge, skill, and practiced procedures are your best defense.

WARNING: WEIGHTING OF THE HOLLIS PRISM 2

Unlike open circuit scuba gear, it is possible for the Hollis PRISM 2 breathing loop to flood, causing the rebreather to quickly become 17 pounds negatively buoyant (not including any user-added weight or offsetting buoyancy inflation). It is the responsibility of the diver to insure that the Hollis PRISM 2 is never weighted in such a way that it is not possible for the installed buoyancy device to overcome the flooded weight of the unit plus any diver-added non-detachable weights, and still provide enough positive buoyancy at the surface to keep the divers head well above water.

Consult your instructor, dealer, or call the Hollis factory directly with any questions or concerns. Failure to maintain positive buoyancy at the surface with the Hollis PRISM 2 in a fully flooded state can lead to serious injury or death.

WARNING: BAILOUT GAS

The diver must always carry bailout gas, that provides an adequate volume and safe breathing mix, to deliver the diver safely to the surface from all points during the dive. Divers can and do die from underestimating their bailout needs. The diver shall receive details, training, and materials on selecting appropriate gases, volumes, and bailout equipment from their selected Hollis approved training agency and instructor.

WARNING: USER-PACKED RADIAL SCRUBBER

As of this writing, the Hollis PRISM 2 design does not include any technology or other device which can detect or warn of potentially dangerous levels of carbon dioxide (CO_2) within the breathing loop.

The Hollis PRISM 2 utilizes a user-packed, radial design CO_2 scrubber. Only Hollis tested and approved CO_2 absorbents should be used, and factory-stated maximum scrubber durations must **NEVER** be exceeded. Exceeding factory stated scrubber durations for a tested material will eventually lead to serious injury or death.

It is entirely possible that, for any number of reasons including but not limited to: channeling, ambient temperature, exhausted, damaged, inappropriately stored, or (for whatever reason), inert scrubber material, the chemical and thermodynamic reaction required to sequester gaseous CO_2 will not occur as expected, and a toxic, and possibly fatal level of gaseous CO_2 within the breathing loop can result.

You must carefully follow all instructor and manufacturer recommendations for use and handling of CO_2 absorbent, never use a CO_2 absorbent if you cannot verify that it is able to sustain CO_2 absorption and carefully pack the radial scrubber and complete a system pre-breathe prior to each immersion, as you were taught in your training course.

Further, you must carefully monitor yourself for any symptoms of possible CO_2 poisoning whenever you are breathing from the Hollis PRISM 2, and bail-out to open circuit should any physical or mental symptom lead you to suspect elevated CO_2 levels in your breathing loop. Failure to bailout at the first sign of trouble can lead to serious injury or death.

WARNING: NAUSEA AND THE BREATHING LOOP

The introduction of biological solids into the DSV/BOV can lead to obstruction of the critical mushroom valves. Additionally, nausea is a known symptom of improper gas mixture and/or contamination. Switch to an appropriate open circuit bailout as soon as you can perform the task safely. Consult your PRISM 2 instructor for further details/training.

WARNING: PROPER BATTERIES

ONLY name-brand batteries (such as "Duracell" or "Eveready") may be used to power the PRISM 2. Off-brand / Discount batteries have been found to vary greatly in quality of materials from batch to batch (and even piece to piece!) Therefore they may not perform as expected, or be capable of consistently delivering the power required to drive the components, despite battery voltage levels reported by a battery voltage meter.

While off-brand / discount batteries are perfectly acceptable for use in toys and flashlights, they have no place in life support gear and must never be used to power any component of your PRISM 2.

Because of the potential rapid drop-off of charge from rechargeable batteries, rechargeable batteries are not recommended for use with your PRISM 2 rebreather and must not be used.

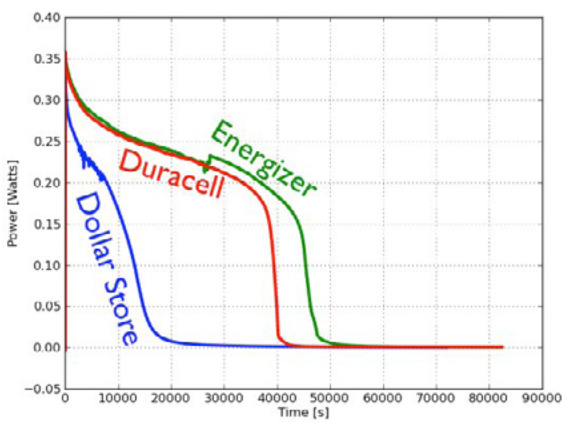

Diagram showing rapid discharge of non-branded batteries that in life support gear can result in unnecessary hazards.

The full article, "Are Expensive Batteries Worth The Extra Cost?" is available at Wired.com
Image courtesy of Rhett Allain, Wired

WARNING: OPERATIONAL RANGE

The PRISM 2 has been tested and qualified for use in water depths of up to 328 ft (100 m) and water temperatures between 39° - 93° F (4° - 34° C).

WARNING: COLD WATER

Diving rebreathers in frigid water requires special equipment, training, and preparation to prevent possible injury or death. Closed Circuit Rebreathers present unique variables to cold water diving that are not a factor in open circuit diving in the same temperatures. Cold water diving is beyond the scope of this manual. There are many variables not listed here. It is essential and the responsibility of the diver to be aware of all issues. The diver must know how to best prepare their equipment, and how to best prepare themselves for the cold water environment. The diver must obtain further training beyond standard CCR training or Open Circuit Ice Diver certification alone.

Cold Water Issues Include The Following:

- Alkaline battery performance degrades as the temperatures decrease. If diving consistantly in waters approaching freezing, it is recommended to use lithium batteries.

- If using a BOV with a PRISMS 2 in water colder than 50°F/10°C, you must use an approved Hollis PRISM 2 Environmentally Sealed Regulator First Stage for the diluent supply gas.

- Changes in temperature may lead to expansion and contraction of CO_2 absorbent material possibly leading to channeling.

- Decreases in temperature effect the efficiency of the scrubber.

- Sensors are sensitive to extreme temperatures. Storage of Oxygen Sensors below 32° F (0°) or above 100° F (37.8° C) can damage or greatly shorten the life of the sensor.

- Mushroom valves may freeze open or closed if condensation is allowed to cool. Always perform mushroom valve (stereo valve) checks and pre-breathe the unit before entering the water and before any subsequent dives. The diver should warm and visually inspect the mushroom valves between dives.

- Use of the manual addition valves should be limited to short bursts of less than 1 or 2 seconds at a time. Prolonged valve activation may cause freezing of the mechanism in frigid waters due to adiabatic cooling.

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SYSTEM OVERVIEW
DESIGN PHILOSOPHY

The PRISM family of rebreathers has a long and illustrious history, and it is considered one of the foundation platforms of the modern day electronically controlled "sport" rebreather.

The PRISM 2, like its forerunner the PRISM Topaz, is a digitally controlled electronic closed circuit rebreather with split front-mounted over the shoulder counterlungs (OTS-CL). It incorporates a radial design scrubber for the best possible duration and work-of-breathing. All gas delivery systems on the PRISM 2 have both automatic and manual function.

MANUAL CONTROL OR COMPUTER CONTROL?

One of the ongoing debates when discussing rebreather safety is whether manually controlled or electronically controlled rebreathers are safer. From the day in 1995 when PRISM Topaz class #1 was held in Hermosa Beach, CA, students were taught to "fly" their rebreathers manually by watching their secondary analog displays and manually injecting oxygen and diluent as needed.

From day one, PRISM students were taught that the primary control system was always the divers brain. It wasn't until the last dive of the last day of class that students were told, "OK, you can turn on your electronics and experience a computer controlled dive".

Diving with the computer monitoring the oxygen and the user keeping an eye on everything with (at that time) a Heads Up Display primary and a wrist-mounted analog secondary sure kept us busy, but we quickly realized that the computer was a LOT better at closely maintaining a setpoint! We also realized that our instructor had trained us to be manually controlled rebreather divers with the safety of "computer over-watch".

Why two independent monitoring systems in one rebreather? Simply put, electronics, batteries and wiring combined with salt water (or even fresh water) do not get along well together. While we can seal circuit boards and wiring interfaces against water intrusion, rebreathers should have a diver accessible compartment to change batteries, and because of this need for accessibility, flooding can occur.

This is the Achilles heel of rebreathers with on-board electronics. Any time an O-ring sealed Compartment is unsealed, the potential for debris to get on the O-ring and cause the compartment to flood during the next dive is increased.

So, with two separate systems onboard with separate battery compartments, if one battery compartment floods and destroys the battery, we simply switch to the other monitoring system to safely end the dive. When our dive is over, we dispose of the wiring harness and battery, clean the compartment and put in a fresh battery and new O-ring(s).

THE GAS PATH

The PRISM 2 incorporates an over-the-shoulder split counterlung design. The gas flows through the loop from left to right shoulder as has become a standard in the recreational rebreather market *(Fig. 1.1)*.

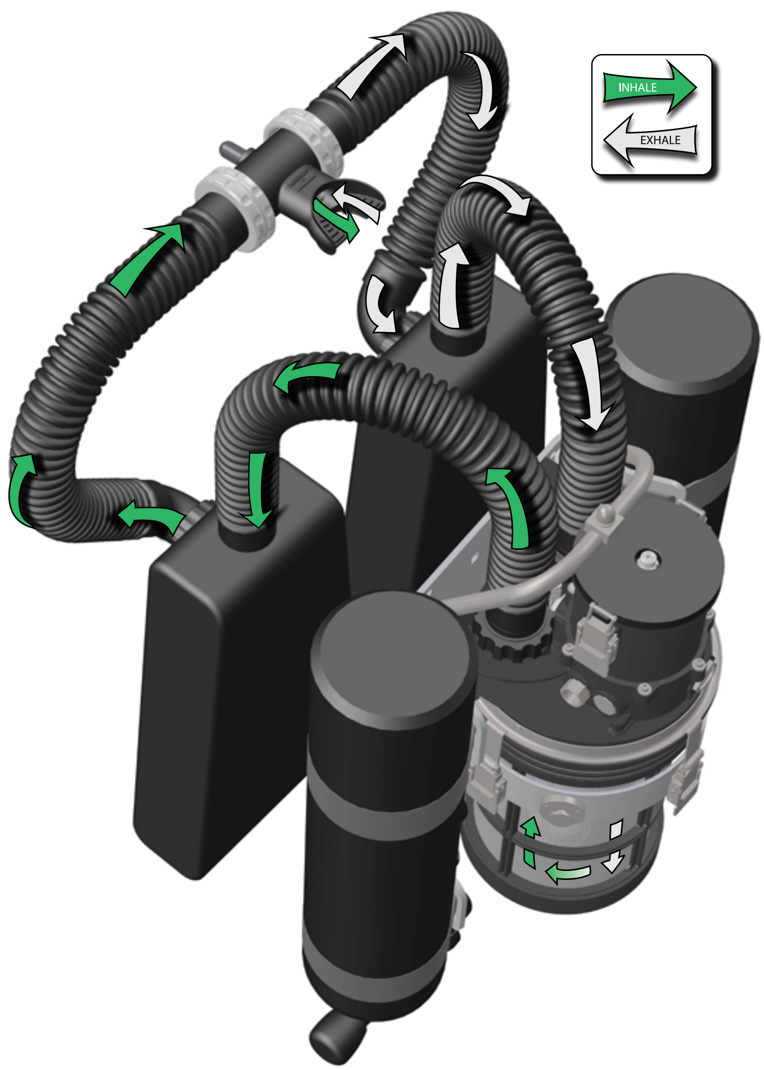


Fig. 1.1

OXYGEN & THE EXHALATION SIDE OF THE LOOP

Pure oxygen injection into the system, whether manually or electronically, via the solenoid, is injected into the exhalation side of the breathing loop. This design insures that a diver can never inadvertently get a high PO_2 dose of oxygen while diving, and that oxygen has plenty of time to properly mix with the loop gas and thereby avoid potentially dangerous O_2 spikes.

HEAD PLATE + RED CO_2 SEAL

Once the diver-exhaled gas enters the head, it travels into the head plate, which is also where O_2 injected by the solenoid enters the breathing loop. The red CO_2 seal *(Fig. 1.2)* which seals the scrubber basket to the head plate sits in a groove at the end of the head plate facing the scrubber basket. The Red CO_2 seal must be in place at all times during diving operations! *Failure to insure that the Red CO_2 seal is properly installed may lead to injury or death.*

Fig. 1.2

WARNING: Breathing from the PRISM 2 without the Red CO_2 Seal in place will result in 100% gas bypass of the scrubber.

THE SCRUBBER BASKET

The gas leaves the head plate and enters the radial scrubber basket through its center tube *(Fig. 1.3)*. As the gas radiates outwards through the CO_2 absorbent and towards the bucket walls, exhaled CO_2 is chemically sequestered (adsorbed) by the CO_2 absorbent, and any added oxygen is mixed with the loop gas as it travels through the scrubber granules. Upon exiting the scrubber, the heated gas enters the thermal air jacket area between the basket and bucket.

Fig. 1.3

The air jacket serves two purposes: First and most important, it insulates the scrubber material from colder external temperatures, which helps increase the efficiency of the absorption process. Secondly, the moisture in the heated gas exiting the scrubber has an opportunity to condense along the cooler bucket wall, dropping the overall humidity of the gas entering the oxygen sensor housing.

From the thermal jacket, the gas flows up through the scrubber basket flow vanes *(Fig. 1.4)*. This restriction creates higher gas velocities in the sensor area without increasing work of breathing, further dropping the dew point of the gas as it reaches the oxygen sensors. By using natural condensation along the surface of the bucket wall and manipulating gas velocities in the area around the O_2 sensors, we are able to keep the sensors as dry as possible without adding complexities such as sponges or other moisture blocking devices.

Fig. 1.4

THE INHALATION COUNTERLUNG

The inhalation counterlung is a 3.5 L or optional 2.5 L (currently available in the USA market only) front-mounted split counterlung design *(Fig. 1.5)* made of rugged nylon with a food-grade urethane interior. It houses the automatic diluent addition valve (ADV), counterlung drain, hose mounting hardware and BCD inflation hose wrap at its front.


Fig. 1.5

The hose attaching hardware for both the head and DSV/BOV assembly attaching points *(Fig. 1.6)* are welded into place, so they cannot become loose and cause an unintended loop flood. The DSV/BOV hose attaching hardware is “keyed” *(Fig. 1.7)* and will only accept the corresponding hose assembly elbow, thereby avoiding incorrect assembly of the loop which would result in potential reversal of gas flow within the loop.


Fig. 1.6


Fig. 1.7

Behind each counterlung, under the Fastex Buckle panel are weight pockets *(Fig. 1.8)* which will accept up to 5 lbs/2.3 kg of hard or soft weight. The weight pouch flap is held in place with Velcro. There are 2 D-rings on the counterlung, one on the side and one at the bottom. Each counterlung has a water drain at its bottom *(Fig. 1.9)* to drain fluids as they accumulate during a dive. The Fastex clip panel on the back of the counterlung contains 2 Fastex clips for clipping the counterlungs to the harness, backplate, and one chest strap with Fastex clips.


Fig. 1.8


Fig. 1.9

ADV (AUTOMATIC/MANUAL DILUENT ADDITION VALVE)

Having the ADV *(Fig. 1.10)* on the inhalation side of the loop makes sense for several reasons. Should the oxygen content ever become dangerously low, dangerously high, or the diver begins feeling “abnormal”, a known normoxic gas is immediately available while still breathing from the loop prior to switching to bailout*. Therefore, having the diluent as close to the mouthpiece as possible is the best way to insure that fresh breathing gas of known and safe oxygen content is only a breath away.
*(Not applicable if the diluent is a hypoxic mix)

Fig. 1.10

The ADV is held in place by a threaded fitting welded to the counterlung. To remove the valve for servicing, unscrew the outside retaining nut by turning it counter-clockwise until the valve comes loose. There is a rubber gasket under the valve which seals the valve body to the counterlung fitting. The removable plunger activates a Schrader valve which allows the gas to flow into the loop. The counterlung fitting is keyed so the valve will not rotate while in use. While the valve is shipped from the factory with the QD fitting facing up, the valve will work in any rotation.

THE EXHALATION SIDE COUNTERLUNG

The Exhalation side counterlung is of similar build and size to the Inhalation side counterlung in all respects excepting it houses the manual oxygen addition valve and the automatic, adjustable loop over-pressure valve (OPV). *(Fig. 1.11)*

Fig. 1.11

BREATHING HOSES + HARDWARE

The Breathing hoses *(Fig. 1.12)* are 15” X $1^{1/2}$” fixed-length rubber breathing hoses. They can not be cut to a different length. The Inhalation hose hardware which connects the hose to the DSV/BOV and counterlungs, also houses the inhalation mushroom valve on the DSV side of the hose. The BOV inhalation hose does not house the inhalation mushroom valve. All mounting hardware is held in place by two Oetiker clamps on each side of each hose.

Fig. 1.12

OPV (OVER PRESSURE VALVE)

The OPV *(Fig. 1.13)* is an automatic or manual adjustable pressure relief valve which is screwed into a fitting welded onto the front of the exhalation counterlung. To adjust the release pressure of the ADV, simply turn the body of the valve clockwise to increase the cracking pressure and counter-clockwise to decrease cracking pressure. To operate the valve manually, simply depress the body of the valve. The OPV is not a serviceable part so should it ever fail, it must be replaced.

Fig. 1.13

MANUAL OXYGEN ADDITION VALVE

The manual oxygen addition valve *(Fig. 1.14)* is located on the inside of the exhalation counterlung. It is a push button valve operated by a schrader valve. Under the quick disconnect fitting is a 0.0020 inch flow restrictor, to meter the injection of oxygen into the Loop. The manual oxygen valve is held in place by a threaded fitting welded to the counterlung. To remove the valve for servicing, unscrew the outside retaining nut by turning it counter-clockwise until the valve comes loose. There is a rubber gasket under the valve which seals the valve body to the counterlung fitting. The counterlung fitting is keyed so the valve will not rotate while in use. While the valve is shipped from the factory with the QD fitting facing up, the valve will work in any rotation.

Fig. 1.14

DSV (DIVE SURFACE VALVE)

The Dive Surface Valve *(Fig. 1.15)* is a neutrally buoyant one-way loop “shut down” valve with a water purge. The rotating barrel is made of stainless steel. The exhalation mushroom valve is seated on the right side of the valve housing.

Fig. 1.15

BOV (BAIL-OUT VALVE)

BOV (Bail Out Valve) *(Fig. 1.16)* is a unique 2-position neutrally buoyant loop shutdown valve with an in-line second stage for single action bail out to open circuit. When the lever is in the top position, the valve in closed circuit mode. The lower position is open circuit bail-out.

Fig. 1.16

BATTERY COMPARTMENT COVER

The battery compartment cover *(Fig. 1.17)* is made of aluminum. The cap utilizes two O-rings for redundant water tightness, a radial seal on the lip of the cap and a compression seal on the top of the battery compartment housing.

There is an automatic pressure relief valve built into the top of the cover to vent excess pressure should the battery compartment flood. If the pressure release valve were ever to actuate because of a battery compartment flood or solenoid gas containment loss, the valve will open to vent the excess pressure and close as soon as the pressure has been released.

Fig. 1.17

BATTERY COMPARTMENT

The battery compartment *(Fig. 1.18)* holds two sets of batteries: two 9V alkaline batteries wired in parallel which powers the solenoid, and one SAFT 3.6 volt LiON (Lithium Ion) battery which powers the Heads Up Display. The sealed bulkhead power connector at the bottom of the compartment is a female molex connector. A foam insert holds the batteries in place.

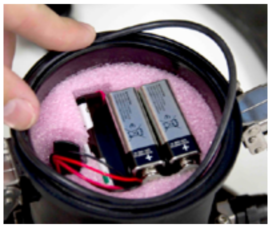


Fig. 1.18

O_2 SENSORS, SENSOR HOLDERS, CONNECTOR + PINS

The 3 O_2 sensors are located in a chamber above the scrubber basket. This insures a low condensation area and consequently drier O_2 sensors. The sensors are Hollis (PRISM 2 Ver.) which have an operating range of 8.5 mV-14 mV in air and 40.6 mV-67 mV at 100% O_2 at 1 atm pressure. The holders are removable to give users better access to the O_2 sensors, wiring harness and connector pins *(Fig. 1.19)*. The holders are manufactured from a soft silicone material to help protect the O_2 sensors from vibration and minor impact forces.

See "Taking Care of your Oxygen Sensors" on the next page for more information.

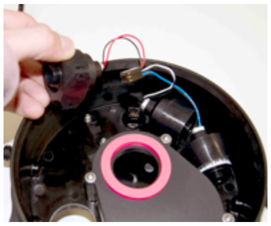


Fig. 1.19

SOLENOID

TAKING CARE OF YOUR OXYGEN SENSORS

The best way to care for an exotic animal is to first acquire some knowledge about it's likes and dislikes, and environments that will help the animal thrive. Likewise, having a working knowledge of what is and is not good for the health of your oxygen sensors will help you take the best care possible of them, and hopefully avoid unnecessary mid-season damage replacement. Here are some important questions, and their answers.

WHAT IS A GALVANIC O_2 SENSOR?

An oxygen sensor is a very small electrochemical generator. Some people equate them to a battery, but that comparison is largely incorrect since a battery does not produce electricity as the O_2 sensor does, and the O_2 sensor does not store electrical energy as a battery does. Understanding that the O_2 sensor is more like a delicate power-generating machine than a robust Duracell D battery is your first clue in understanding how they should be handled.

WHAT MATERIALS ARE USED TO MANUFACTURE THE HOLLIS PRISM 2 SENSORS?

The body of the sensor is made of High-Density Polyethylene (HDPE). The membrane on the front of the sensor is a thin Teflon gas permeable membrane. The internal components are comprised of a lead anode, a precious metals-plated cathode, a base pH electrolyte consisting of mostly water and a bit of Potassium Hydroxide. A printed circuit board (PCB) with resistor-thermistor temperature compensation circuitry is heat sealed to the outside back of the sensor.

WHAT ENVIRONMENTAL CONDITIONS ARE BEST AND WORST FOR THE O_2 SENSOR?

Your "PSR" series O_2 sensors are happiest between 32 °F/0 °C and 122 °F/50 °C. Operating or storing the O_2 sensor above 122 °F/50 °C will prematurely dry out the electrolytic fluid and destroy the sensor. Operating or storing the O_2 sensor below 32 °F/0 °C will freeze the electrolytic fluid causing expansion damage to the internal components, Teflon membrane, and possibly leakage of the electrolyte upon thawing, thereby destroying the sensor.

HOW DOES A CHANGE IN AMBIENT TEMPERATURE INFLUENCE THE O_2 SENSOR'S PERFORMANCE?

Temperature influences the signal output at a rate of 2.54% per °C. Gradual ambient changes in temperature can be maintained within ±2% accuracy by processing the signal output through the resistor - thermistor temperature compensation network. Rapid changes of 59 °F/15 °C require 45-60 minutes for the compensated signal output to equilibrate, e.g. the electronic thermistor reacts immediately to offset the change in the sensor, but the sensing membrane and electrolyte reacts at a much slower rate.

Because of the exothermic (heat generating) reaction of CO_2 scrubbing taking place next to the sensor housing during diving operations, it is important that you calibrate the sensors close to "room temperatures" (60 °F/16 °C – 80 °F/27 °C) so you are not temporarily outside of the 59 °F/15 °C "rapid compensation" range while diving.

HOW DOES PRESSURE INFLUENCE THE OXYGEN SENSOR'S PERFORMANCE?

Pressure influences the signal output on a proportional basis. The sensor is accurate at any constant pressure up to 30 ATM provided the sensor (front and rear membranes) is pressurized and decompressed gradually (similar to human lungs). The membranes, especially the front sensing membrane, do not tolerate rapid changes in back pressure or vacuum. Normal diving operations will not generate pressures beyond which the sensor is designed to operate.

If you use a pressure vessel to check current limiting, it is important that you slowly bleed off the pressure in the vessel after the checks are completed. The optimal analysis pressure range is 5-30 psig, up to 100 PSIG, with a flow rate of 1-2 scfh. The longer you keep the cells pressurized, the slower you need to bleed off pressure. This procedure should sound familiar to divers.

WHAT IS THE MAXIMUM ALTITUDE THE OXYGEN SENSOR CAN BE EXPOSED AND STILL FUNCTION?

The oxygen sensors have been tested up to 20,000 ft/6096 m with no error.

DOES MOISTURE OR WATER AFFECT THE OXYGEN MEASUREMENT?

If moisture or water is present in the gas stream it will not damage the oxygen sensor or analyzer, but it can collect on the sensor's sensing membrane, thus blocking the flow of gas.

WHAT HAPPENS WHEN THE O_2 SENSOR HAS BEEN EXPOSED TO WATER?

The collection of condensation on the sensing surface of the sensor (standing water) reduces the signal output. Once either drying or gravity removes the standing water, the signal output will return to normal within 30 seconds. For example, a thin layer of water over the sensing surface will reduce the signal output of a sensor from 11.8 mV to 10.1 mV within 20 minutes; remove the standing water and the signal output returns to 11.8 mV in 30 seconds.

WARNING: Salt water can corrode or bridge electrical connections resulting in erratic oxygen readings.

CAN A SENSOR BE CONTAMINATED BY CARBON DIOXIDE (CO_2) GAS, REDUCING THE SENSOR LIFE?

Exposure of the sensor with its base electrolyte to carbon dioxide (CO_2) gas or any other acid gas will produce crystal-like deposits on the cathode, which reduces the surface area of the cathode and the corresponding signal output. This effect is cumulative, cannot be reversed and can dramatically reduce the expected sensor life. This means that attempting to "Push the Scrubber" beyond its factory-stated duration, or breathing into a loop without active scrubber material installed could shorten the life of your O_2 sensor.

CAN THE OXYGEN SENSOR BE DAMAGED IF DROPPED OR IF THE REBREATHER IS DROPPED?

Absolutely! Sensors are fragile and can be damaged in a number of ways. Dropping a sensor by itself or while mounted in the rebreather can result in: broken wires, broken electrical connections, dislodging the anode. Dislodged anodes cause a broken connection or an internal short as the loose anode comes in contact with the cathode connection. If the motion stop-force is applied onto the sensor face, the liquid electrolyte can be forced onto the Teflon membrane, stretching the material and destroying the sensor. Testing has shown that dropping a sensor one time from 3 ft/1 m onto a carpeted concrete slab can result in an immediate 25-100% reduction in signal output.

Types of forces known to cause sensor damage while housed in a rebreather include but are not limited to transportation shock (baggage handler throwing distance competitions, driving over rough terrain, jolts during heavy seas and extreme motor vibrations). It is always recommended that you temporarily remove the sensors from the rebreather if it may be subject to any of the above conditions.

CAN I TOUCH THE TEFLON MEMBRANE WITH MY FINGER? HOW DO I CLEAN THE SENSOR CONTACTS?

No, you must not touch the sensor face with anything, especially your fingers. Fingers have oils on them even when freshly washed, and the oil permanently clogs the membrane, destroying the sensor. If salt has dried on the sensor face, you can gently pour a bit of distilled water on the membrane and allow it to air dry. Never use any cleaning solutions on the sensor face. You may use an electronics contact cleaner such as DeoxIT**®** GOLD GN5 on the contact pins, but use it sparingly and wipe off all residual cleaner before use.

WHAT IS THE EXPECTED OXYGEN SENSOR LIFE?

The operational life of the Hollis (PRISM 2) sensors are calculated as one year from the date they are put in service. There is a “DO NOT USE AFTER” (date) also. Whichever date comes first is the proper time to discontinue sensor use. DO NOT attempt to extend the life of the sensors. Doing so can result in incorrect, erratic, or no signal output which can lead to serious injury or death.

WHAT IS THE RECOMMENDED STORAGE TEMPERATURE?

During a “diving season” (if one exists for you) the oxygen sensors, when stored, should be kept in a cool, ambient, unsealed environment to insure they are immediately operational. If you will be storing the sensors for a month or more, you can place them in an airtight container in a refrigerated environment that is kept above 34 °F/0.1 °C to insure that the electrolyte does not freeze (see “Environmental Conditions”). While this will not extend the operational life of the sensor, it may reduce response time degradation during the latter part of its 12-month service life.

After storage, you will need to acclimate the sensors by placing them in air at room temperature for 24 hours prior to putting the sensors back in service. Failure to acclimate the sensors after storage can cause the sensors to read incorrectly and possibly lead to injury or death.

ARE THE O_2 SENSORS DATE CODED?

Oxygen sensors have a finite life. Understanding the date code is vital to getting the benefit of the warranty period. As an example, the serial number 10734789 breaks down as follow: Digit #1 a (1) denotes the year of manufacture as 2011; digits #2, #3 (07) indicate July as the month of manufacture; the remaining digits are sequential for uniqueness. As the result of a number of issues related to the use of aged sensors, Analytical Industries has added a "DO NOT USE AFTER: (date)" to the sensor's labeling. For a sensor with less than 12 months in service, this date supersedes. If the sensor is past the "DO NOT USE AFTER: (date)", discontinue use of the sensor. DO NOT use it regardless of how it seems to perform.

WARNING: You must NEVER use oxygen cells beyond their expiration date or twelve months of service, whichever comes first.

WARNING: ALWAYS acclimate sensors to ambient air for a minimum of 24 hours before calibration or use.

The PRISM 2 solenoid *(Fig. 1.20)* is a low power (0.65 watt) normally closed electromagnetic valve mounted in an isolated compartment in the head. The normally closed solenoid will only allow gas to flow when an electrical current is applied and the valve is momentarily opened.
Operational failure or loss of adequate voltage to open the solenoid valve will keep oxygen from flowing into the system. While the solenoid is “normally closed” debris finding its way into the valve, rust from flooding, or poor maintenance could cause the valve to fail in an open position. If this were to occur, the loop would quickly flood with a potentially dangerous level of oxygen. It is very important that the micron filter at the hose fitting is in place at all times and properly maintained. Oxygen flows from the solenoid body directly into a channel that leads from the solenoid into the head plate in the head.

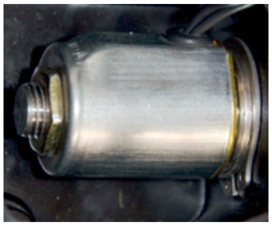


Fig. 1.20

All electrical components of the solenoid are external to, and isolated from the breathing loop.

The solenoid chamber *(Fig. 1.21)* is designed that, should the solenoid ever lose gas containment, gas vents to the outside environment through the battery cap over-pressure valve. There are no user serviceable parts in the solenoid compartment, and only factory authorized repair technicians should replace the solenoid.

Fig. 1.21

SOLENOID ELECTRICAL CONNECTIONS

The Molex electrical connector for the solenoid is found in the electronics module and connects through a bulkhead into the sealed solenoid compartment *(Fig. 1.22)*. There are no user serviceable parts inside either compartment, and these compartments should only be opened by a factory authorized service technician.

Fig. 1.22

SOLENOID O-RINGS

The solenoid is sealed by two O-rings *(Fig. 1.23)*. The outer O-ring seals out water, and the inner O-ring keeps the oxygen contained within the solenoid. The O-rings are replaced during routine annual service by an authorized PRISM 2 service technician and are therefore not considered user-serviceable parts.

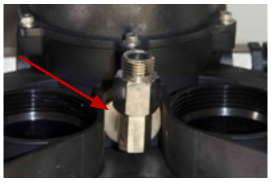


Fig. 1.23

BUCKET SEALING O-RINGS

NOTE:

The oxygen solenoid is a safety-critical part. Should it malfunction, replacement by a factory authorized service technician is highly advised vs. repair.

THE SOLENOID +THE PID CONTROLLER

The PRISM 2 Solenoid is controlled by state-of-the-art PID Control loop feedback circuitry (The Controller). The PID Controller makes calculations based on an error value which is calculated as the difference between a measured process variable (how much oxygen is in your loop) and a desired setpoint (the O_2 setpoint). It also considers the history of what has occurred previously, and makes predictions about what may occur in the future, constantly making adjustments to it's algorithms accordingly. Sometimes called a "Three Term Controller", the P, I and D stands for Proportional - Integral - Derivative.

A familiar example of a control loop is the action taken when adjusting hot and cold faucets (valves) to maintain the water at a desired temperature. This typically involves the mixing of two process streams, the hot and cold water. The person touches the water to sense or measure its temperature. Based on this feedback they perform a control action to adjust the hot and cold water valves until the process temperature stabilizes at the desired value.

The sensed water temperature is the process variable or process value. The desired temperature is the setpoint. The input to the process (the water valve position) is the variable. The difference between the temperature measurement and the setpoint is the error and quantifies whether the water is too hot or too cold and by how much.

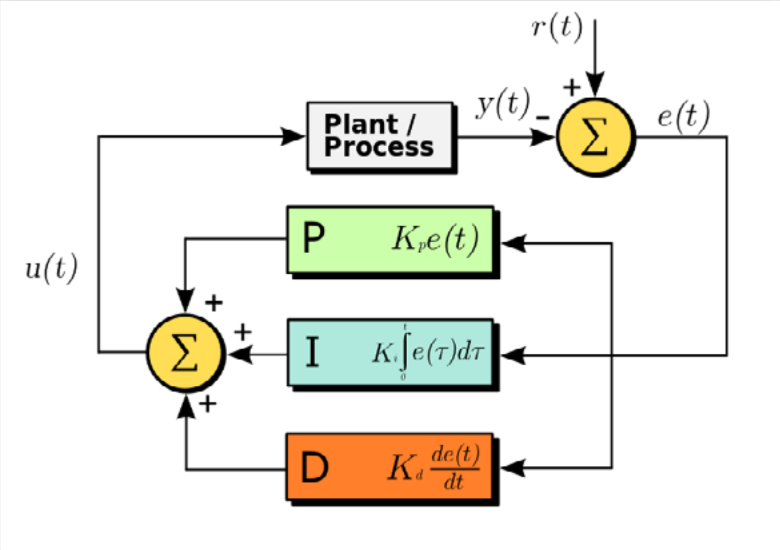
After measuring the temperature, and then calculating the error, the controller decides when to change the tap position and by how much. When the controller first turns the valve on, it may turn the hot valve only slightly if warm water is desired, or it may open the valve all the way if very hot water is desired. This is an example of a simple proportional control. In the event that hot water does not arrive quickly, the controller may try to speed-up the process by opening up the hot water valve more-and-more as time goes by. This is an example of an integral control.

Making a change that is too large when the error is small is equivalent to a high gain controller and will lead to overshoot. If the controller were to repeatedly make changes that were too large and repeatedly overshoot the target, the output would oscillate around the setpoint in either a constant, growing, or decaying sinusoid. If the oscillations increase with time then the system is unstable, whereas if they decrease the system is stable. If the oscillations remain at a constant magnitude the system is marginally stable.

In the interest of achieving a gradual convergence at the desired temperature, the controller may wish to damp the anticipated future oscillations. So in order to compensate for this effect, the controller may elect to temper its adjustments. This can be thought of as a derivative control method.

If a controller starts from a stable state at zero error, then further changes by the controller will be in response to changes in other measured or unmeasured inputs to the process that impact on the process, and hence on the process variable. Variables that impact on the process other than the manipulated variable are known as disturbances. Generally controllers are used to reject disturbances and/or implement setpoint changes. Changes in feed water temperature constitute a disturbance to the faucet temperature control process.

In theory, a PID controller can be used to control any process which has a measurable output, a known ideal value for that output and an input to the process that will affect the relevant process value. PID controllers are used in industry to regulate temperature, pressure, flow rate, chemical composition, speed and practically every other variable for which a measurement exists.



*Source: Wikipedia

There are two bucket sealing O-rings *(Fig. 1.24)* for redundant sealing of the breathing loop. Standard user maintenance during system set-up and tear-down are required.

Fig. 1.24

BUCKET LATCHES

There are 3 Nielson Sessions 300 series Stainless Steel locking latches mounted on a stainless steel band *(Fig. 1.25)* that hold the bucket securely onto the head assembly. While two latches will hold the bucket securely, it was felt that redundancy here was critical.

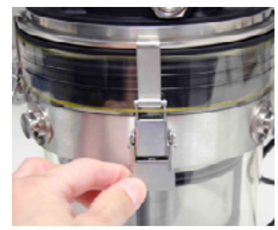


Fig. 1.25

BASKET SPRING ON BUCKET

The absorbent basket is pressure-sealed onto the Red CO_2 Seal under the head by the bucket spring assembly *(Fig. 1.26)* at the bottom of the bucket. The spring creates the seal between the basket and Red CO_2 Seal and also reduces vibration on the basket during transit.

Fig. 1.26

WARNING: Proper spring tension is critical for safety and an effective seal. One thread should be exposed above the locknut as shown. Further instructions are available in the User Service Guide doc. 12-4091.

Fig. 1.27

ABSORBENT BASKET ASSEMBLY

The absorbent basket is comprised of six pieces *(Fig. 1.27)*. The basket outer cage that supports the nylon absorbent-retaining mesh, a screw-in center tube and O-ring. It also supports the nylon mesh and a screw-on cover. Two foam pads must be installed top and bottom prior to filling the absorbent basket. The bottom pad has a larger center diameter hole than the top pad. The foam pads impede the flow of gas against the smooth surfaces of the basket top and bottom, hindering any potential gas channeling in these areas.

The gas flow vanes built into the top of the scrubber basket create an area of increased gas velocity within the O_2 sensor area of the head, reducing the dew point of the gas around the O_2 sensors. The reduction in condensing humidity in this critical area helps reduce the potential for water to condense on the surface of the hydrophobic membrane of the O_2 sensor.

BACKPLATE

The Hollis PRISM 2 can be outfitted with any industry standard technical style backplate. The unit is currently shipped from the factory with a Hollis Aluminum Backplate and Solo Harness *(Fig. 1.28)*. The style of threading, for the webbing on the backplate, is left to user preference.

Fig. 1.28

O_2 + DILUENT FIRST STAGES

All PRISM 2 first stages (*Fig. 1.29)* have been oxygen cleaned and assembled in a clean room environment with specially designed materials, halocarbon-based lubricants and color-coded for easy identification on and off the PRISM 2 chassis (green=O_2, Black=Dil).

Fig. 1.29

PRISM 2 O_2 first stages are equipped with a M26 fitting when shipped to the European market. This is in compliance with EN 144-3 requirements that regulators with oxygen mixtures greater than 21% use a M26 fitting. Non-CE countries are outfitted with 300 BAR/4500 PSI DIN connections.

First stages are custom designed with a port block consisting of 4 low pressure and 1 high pressure ports. The custom design does away with the need to add in failure points such as hose swivels. The working Intermediate pressure of both first stages is 140 to 145 psi / 9.7 to 10 bar.

All First stages are equipped with pressure relief valves *(Fig. 1.30)*. The valves reduce the likelihood of an uncontrolled increase in intermediate pressure causing a free-flow of gas into the breathing loop. The first stage pressure relief valve is not a user serviceable part.

Fig. 1.30

The oxygen feed lines to the solenoid and manual O_2 addition valve incorporate in-line flow restrictors to meter the flow of oxygen into the breathing loop. The restrictors must not be removed.

GAS CYLINDERS

The Hollis PRISM 2 will accommodate most sizes of cylinders commonly used on rebreathers.

FITTING YOUR PRISM 2

Your PRISM 2 rebreather should be fitted to you with the same attention as you would any other fine (and very expensive) custom-made piece of clothing. A properly fitted rebreather will perform more consistently with better all around breathing characteristics, have less hydrostatic imbalances in all diving positions, less strain and fatigue on spinal musculature and better diver trim while diving.

The fitting process begins before you even set-up the PRISM 2. First you must assess your body type, as that will give you a starting place for making close approximations to what will be the final, best fit.

The standard counterlung yoke fits a wide range of body types, and generally anyone between 5ft to 6ft tall with a standard torso will find a best fit using the standard counterlung yoke. At the upper ranges of that measurement, a person with a long torso, or anyone taller than 6' will probably find that the Long yoke works best for them. If you have any questions, or need help finding which set-up works best for you, ask a PRISM 2 Instructor, or go into your local Hollis dealer. They will be more than happy to help you get your rebreather properly fitted.

Once you have decided which yoke should work best, you will begin testing out the different variables such as backplate position (2 available), Wing position (3 available) and three positions on the yoke, which will dictate where the counterlungs sit on your chest.

First look at the backplate. The harness webbing should be adjusted so the top of the backplate plate sits about 4 to 6 inches / 10.2 to 15.2 cm or so below your shoulders. Next, put the counterlungs on the yoke. Take the assembly and put it on so the yoke hangs over the backplate while holding the counterlungs on your chest. The center of the DSV/BOV assembly breathing hose holes should be level with your collar bones.

Proper fit is the first element in a rather complex dance with physics. These few pointers should give you a good starting place in custom fitting the Hollis PRISM 2 for best fit. Don't be afraid to experiment with placement as the ultimate goal is diver comfort. Once you have a fit that you feel will work for you in the water, we need to examine how and where to distribute any weight you will require to get you the best in-water "stability" possible.

STABILITY
ARTICLE BY GERARD NEWMAN

What is stability? Briefly, it's the ability to choose and maintain your position in the water column. When we have a stable platform for diving we are more comfortable, in better control and better able to observe our underwater surroundings. Diving with a CCR adds some additional considerations for stability. Ideally, we should be stable when swimming (dynamic stability) and when hovering (static stability). We have better control over our stability when we assume prone (horizontal) trim in the water with our fins flat. This increases our vertical drag (helping to maintain our vertical position in the water column) and decreases our horizontal drag (as when swimming) (*Fig. 1.31)*.

Fig. 1.31

Stability is affected by weighting and buoyancy. Our weighting components include the cylinders we choose to dive with, lights, fins, backplates and lead ballast that we carry with us. These components may be distributed from side to side and head to toe. Improper distribution will result in non-horizontal trim. Too much lead at our waist will tend to drag our hips down resulting in a head-up position in the water *(Fig. 1.32)*. Fins that are too light will result in a feet-up position. Divers often instinctively compensate for weight placement problems by arching their backs to maintain trim. The objective is to allow proper trim with a relaxed posture in the harness. Of course proper weighting is key – we should be able to maintain a 10 foot stop with no gas in the wing and a comfortable amount of gas in our exposure suit (when diving a drysuit). With the CCR we have to account for the gas volume in our breathing loop. I typically recommend starting with an extra 4 lbs over what the diver would normally wear with a single tank open circuit rig as a starting point. Divers with larger or smaller tidal volumes will need to adjust accordingly.

Fig. 1.32

Our buoyancy components include our exposure suit, our wing, and our counterlungs. Minimizing the gas volumes in each will go a long way towards minimizing the effects of Boyle's Law. The larger the gas bubble, the harder it is to control. The shallower you are, the more pronounced the effects of Boyle's Law – careful attention to controlling the gas volumes in our counterlungs, wing and our exposure suit on ascent is critical. Adding or removing small amounts of gas and allowing time for the change to take effect is the key to controlling our buoyancy *(Fig. 1.32 & 1.33)*.

Fig. 1.33

Counterlung position should be such that they are as close to your lungs as possible, both in the vertical and horizontal planes *(Fig. 1.34)*. This will minimize static lung loading and decrease the work of breathing. The bottoms of the counterlungs should be secured to the waist strap to hold them in place when they are inflated and become buoyant. For most divers the elbows on the counterlungs should be positioned at the collarbones, with the chest strap tightened to control their horizontal position. Gas volume in the counterlungs will affect both your buoyancy and trim. Too much gas in the counterlungs will result in head-up trim; too little will result in head-down trim (and difficulty taking a full breath). With practice one can become proficient at adding and removing gas from the breathing loop to maintain horizontal trim and neutral buoyancy.

Fig. 1.34

The wing may be positioned to increase buoyancy towards our head or our feet if needed to adjust our trim. Weights can be placed near the shoulders to provide a counterbalance to the counterlungs and help keep us prone in the water with minimal effort.

The backplate should be positioned such that the top of the plate is easily reachable with the tips of your fingers if you swing your arms back with your elbows next to your ears. On most people this will position the backplate at the top of the scapulas. Straps should be loose enough to allow full range of movement of your arms across the chest and allow you to “chicken wing” into and out of the harness. The crotch strap should be adjusted to keep the rig stable – tight, but not too tight. If the crotch strap is pulling the waist strap down then it is too tight and needs to be lengthened *(Fig. 1.35)*.

Fig. 1.35

A very helpful technique is to have someone shoot some video of you while hovering and while swimming. Reviewing this video can help identify where your buoyancy or trim needs adjusting. A good Intro to Tech instructor can also be very helpful.

SETUP
AN O-RING CLEANING PRIMER

O-Rings are an integral component of almost every part of a functioning rebreather and as such, you must be adept at properly inspecting and caring for them. For the sake of brevity we will give you a generic description of how to prepare the O-rings in the Hollis PRISM 2 for use, below. In the checklist "step-by-step" to follow, unless there are unusual design, access, or handling considerations for a particular O-ring, we will simply state,

"Remove, clean and prepare the O-ring(s), O-ring groove and mating surface for use, or replace if worn or damaged."

Remove the O-ring from the O-ring channel using a non-metal O-ring removal tool *(Fig. 2.1)* being careful not to over-stretch the O-ring. Never use a sharp metal O-ring pick or any metal object as that can damage the O-ring, the O-ring groove or O-ring mating surface.

Fig. 2.1

NOTE: O-RING REMOVAL TIP
While squeezing opposite sides of an O-ring, slide both sides in the same direction. This will create a protrusion of the O-ring on that side that you can grab with your fingers, to roll it out of the groove. If necessary, the tapered end of a plastic Zip Tie can be used to help pull an O-ring up and out from its groove.

Clean the O-ring with a soft, dry lint-free cloth, *(Fig. 2.2)* being careful to remove any debris and old lubricant. Run your fingers around the O-ring feeling for uneven surfaces, abrasions, sand or other debris that could cut the O-ring. If you see or feel any damage, replace the O-ring. Never dive with a damaged O-ring, as a flood may result.

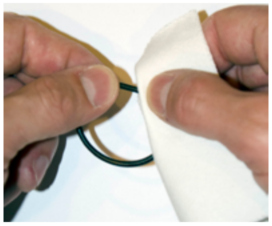


Fig. 2.2

Clean the O-ring channel and area surrounding the channel of debris and old lubricant *(Fig. 2.3)*. Place a small amount of lubricant on your finger and coat the O-ring lightly. Inspect the O-ring to make sure there is no debris, lint or hairs on it. Carefully replace the O-ring in its cleaned O-ring channel.

Fig. 2.3

Make sure to clean the O-ring's mating surface (the surface the O-ring seals against) of all lubricant, dirt and lint.

PACKING THE PRISM 2 CO_2 SCRUBBER

To pack your PRISM 2 scrubber, you will need the following items:

(Fig. 2.4)

- 1 towel
- Paper towels or newspaper sheets
- 1 ea. top and bottom absorbent basket foam pads
- Approximately 6 lbs (2.7 kg) fresh unused 8-12 CO_2 absorbent*
- 1 pair surgical gloves
- 1 painter's or surgical mask
- 1 eye protection

** See PART 5 section 2 for list of approved absorbent material.*

Fig. 2.4

The PRISM 2 scrubber is easy to pack, and with experience should only take 5 to 10 minutes from set-up to clean up.

Find a dry area away from and downwind of other people. If necessary, take a moment to let people around you know that you will be working with caustic materials, and request they stay upwind from where you will be working.

Before handling the caustic CO_2 absorbent, put on your personal protective gear including gloves, breathing mask and eye protection.
A dive mask may look silly, but works quite well as eye protection.

WARNING: If you ever ingest CO_2 absorbent due to handling mishaps or a loop flood, known as a "Caustic Cocktail", immediately seek emergency medical treatment and drink copious amounts of water. DO NOT INDUCE VOMITING unless instructed to do so by medical professionals. (For more information download the latest Material Safety Data Sheet from the product manufacturer, or contact your local Poison Control Center.)

Spread out a towel or other soft covering on the ground in a flat area, and lay a few sheets of paper towel or newspaper on top of that. Place the bottom foam pad (larger center hole) in the basket making sure it lays flat against the bottom and sides of the basket *(Fig. 2.5)*. Take a piece of paper, golf ball or absorbent container cap and cover the top of the center tube. This will keep absorbent from going down the center tube as you pour it into the scrubber basket. *(Fig. 2.6)*


Fig. 2.5


Fig. 2.6

Pour the absorbent slowly from about 12" above the basket, allowing the wind to carry off any dust. The absorbent should be granular and not produce much dust while pouring *(Fig. 2.7)*. If the material looks crushed or is exceptionally dusty, don't use it, as that can be an indication that the absorbent has been mishandled and may not scrub CO_2 properly during a dive.

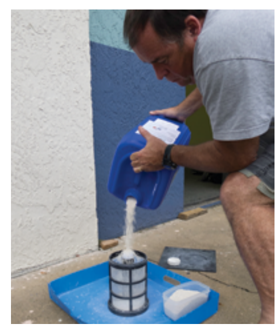


Fig. 2.7

Continue pouring until the absorbent reaches the first horizontal brace on the basket *(Fig. 2.8)*. Unless you were exceedingly careful, some material will have fallen onto the paper around the basket. Lift the basket off the paper and pour the granules from the paper into the basket. If the material on the paper is mostly dust, dispose of it carefully rather than pouring it into the basket.


Fig. 2.8

Fig. 2.9

With the basket on the towel-covered ground, gently begin tapping the basket where the vertical and horizontal braces meet *(Fig. 2.9)*. This will begin to settle the granules in the basket. The trick is to tap hard enough on the cross braces that the vibrations cause the material to settle, but not so hard that the granules jump around. Make sure you do not tap the mesh as that will only displace the material from the sides.
While tapping the cross braces, rotate the basket so you tap all sides of the basket. Spend at least a minute tapping the basket sides. You may notice that the absorbent level drops as the granules settle.

Fig. 2.10

Repeat the filling process up to the second horizontal brace, then tap to settle the granules as before. Repeat the filling process to the top of the bucket, leaving a small hill of absorbent on the top *(Fig. 2.10)*. Tap and settle the material as before. You will probably be ably to settle this material until it is almost level with the basket top.

Once the basket appears to be full, pour a few extra mound of absorbent onto a cup or other small container and put it aside.(A mask box works well!) Remove the material you used to block the center tube.

Fig. 2.11

Lay the top foam pad (smaller center hole) on top of the mound of absorbent, and place the basket cover on top of the foam pad *(Fig. 2.11)*. Slightly tighten the basket top onto the first threads. Do not force the top on. If you cannot easily start the top onto the basket threads, remove a bit of absorbent and try again.

Fig. 2.12

Once you have started the top onto the basket threads, clean the towel of loose absorbent, then pick up the basket by the top horizontal brace and using your thumbs to hold the basket and top together securely, lift the basket a few inches above the ground and tap the basket slowly and firmly 3 times on the towel covered ground *(Fig. 2.12)*. Never tap the basket on uncovered ground, as that can damage the basket to exhale plenum sealing surface *(Fig. 2.13)*. The sealing area on the basket must be kept clean of caked-on absorbent, so don't tap the basket down on loose absorbent. Doing so will just make extra work and make any
post-packing scrubber basket cleanup take longer.

Fig. 2.13

WARNING: Resist the urge to blow on the packed basket to get rid of dust, as the dust will get in your eyes, nose and throat.

3 TAPS THEN TURN

Once you have tapped the basket 3 times on the ground, turn the basket top until in makes contact with the absorbent. Do not force the top! Tap 3 times again and turn the top. Repeat this process until the top is sealed completely on the threads.

Using the 3 tap and turn method will insure that you do not overpack the bottom of the basket while leaving the top material loose. Also, making a repeatable process your habit will insure that all you are packing your scrubber consistently. **Arbitrary methods lead to arbitrary results!**

Remove the top and foam pad, and using more of the absorbent you set aside on the paper, refill the basket until you again have a small mound of absorbent on the top. Replace the foam pad, seat the top onto the basket threads, and repeat the process.

Once you have fully seated the top onto the basket a second time, check the firmness of the material. The top and bottom of the basket should be equally firm and you should not be able to displace absorbent grains by applying moderately firm pressure against the mesh. If the top is not as firm as the bottom, turn the basket upside down and tap three times on the basket top. If the material is still loose or unevenly packed, open the basket, add some more absorbent and repeat the process then check firmness again.

Once the basket is packed to your satisfaction, use a clean paper towel to carefully remove any dust collected on the outside of the basket. Collect any left over absorbent that you had set aside for packing and if it is not dusty, you may pour it back in the absorbent container. Seal the absorbent container and store it in a cool, dry place.

NOTE:
There is no set number of times you will need to remove the basket top to add material, but spending more time settling the material as you fill the basket will help reduce it.

PRE-PACKING THE PRISM 2 SCRUBBER

While pre-packing the scrubber well in advance of a dive, or transporting packed scrubbers is not advised due to potential absorbent settling issues, we recognize there are instances where packing a scrubber on-site is either impractical or impossible.

If you will not be using the packed scrubber immediately, put the basket in an airtight container and seal the container. Put tape across the seal on the outside of the airtight container and write your name, the date you packed the basket, and the absorbent material used *(Fig. 2.14)*. Since this is a fresh fill write “0 hours used” on the tape. Store the container in a cool, dry place. After short-term storage or transportation, you must check the scrubber for settling or loose scrubber material prior to installing it in the rebreather.

Fig. 2.14

NOTE:
To avoid damage, use only factory tested cleaning solutions. See list of approved cleaning solutions in the PART 5 Section 2 for further information.

CLEANING YOUR EMPTY SCRUBBER

After use, it is always a good idea to wash and dry the scrubber basket, basket pads and bucket to remove residual dust and used absorbent. Use fresh water and make sure to wash out any loose granules.

If you notice that the threads of the basket or top are becoming clogged by crushed, caked absorbent dust or the absorbent is beginning to cake-up *(Fig. 2.15)*, you will need to soak the top and basket threads in white vinegar for 15 to 30 minutes, which will dissolve the caked on absorbent and return the basket to like-new condition. Heating the vinegar to 120 °F/49 °C will make it work faster, but will make you unpopular with anyone close by. Wash the cleaned parts thoroughly with fresh water until the smell of vinegar is completely gone.

Fig. 2.15

DISPOSING OF USED CO_2 ABSORBENT

You have probably heard that used absorbent is simple calcium carbonate, the same stuff seashells and reefs are made from. Eventually that will be true, but even spent absorbent is still highly caustic and will be for some time. Never dump freshly spent absorbent in the ocean! It is best to find a covered pail or a garbage bag in which to store the spent material, and mark the container as containing a caustic substance.

WARNING: If you do need to store the scrubber or transport it to your dive site, YOU MUST check the scrubber basket for absorbent material settling prior to inserting it in the rebreather. If the absorbent seems loose at all, top-off the basket with additional absorbent prior to use. Failure to insure a properly packed scrubber may lead to injury or death.

USING CHECKLISTS

THE IMPORTANCE OF USING YOUR CHECKLISTS

Imagine you are sitting on a commercial airliner watching the pilot ready the plane for takeoff. The copilot turns to the captain and asks if he is ready to go through the pre-flight checklists. The pilot does a cursory scan of the cockpit, turns to the copilot and says, "Everything looks good to me, we can skip them". How comfortable would you feel flying at 32,000 feet with that captain at the controls?

CASE STUDY OF A CLOSE CALL

A rebreather diver, self-described as being "very experienced" with his rebreather, has completed two 1½ - hour dives. He changes out the scrubber with fresh absorbent to complete a third 2-hour dive later in the day. He reports that he was feeling "rushed" because he was delaying his buddies from lunch. After quickly re-packing the scrubber, relying on memory instead of his checklist, he reassembles the rebreather and then joins his buddies.

An hour after lunch, he dons the rebreather and enters the water. After completing his 15 ft checks, he descends to 35 feet whereupon he begins to feel short of breath. Still clear-headed enough to realize this could possibly be a sign of CO_2 toxicity, and deciding to err on the side of caution, he bails out to open circuit and aborts the dive.

Once safely back, the diver disassembles the unit and finds that an O-ring sealing the breathing loop is missing, allowing his exhaled gas to bypass the scrubber completely and enter the inhalation side of the rebreather.

Fortunately, due to his quick actions, this incident resolved without tragedy.

NOTE:
Don't allow yourself to become rushed or distracted when setting up or working on your rebreather. An inattentive rebreather diver is an accident waiting to happen. Take your time while setting up your rebreather and when diving.

LESSONS LEARNED

WARNING: The importance of working with checklists when setting up your PRISM 2 cannot be overstated! If you have not set-up your PRISM 2 using the checklists, DO NOT dive the rebreather.

In his on-line report, the diver stated he had learned a hard lesson from this life threatening incident. The first and most obvious was he had not followed his training, relying on his memory instead of using the checklist. He also reported that "to be honest", this was not the first time he had skipped using a checklist. He vowed never to make that mistake again.

WHY A MULTIPLE LIST FORMAT

One thing that became clear to us as we talked to rebreather divers about their use of checklists was that a simple, one-size-fits-all checklist often does not follow the stages in which they normally set-up their rebreathers. The checklist becomes an encumbrance to safety if divers have to skip around the checklist, checking off only those items needed to get to the next phase.

For instance, some divers set-up and test their rebreather days in advance of the dive, and leave the rebreather assembled during transport to a dive site. A start to finish checklist may not take into account the checks required once the unit arrives at the site.

We have broken the PRISM 2 checklists into 4 distinct sub-lists which should follow the steps encountered in the majority of real world diving situations.

NOTE:
It is always recommended that you do a full set-up and "pre-dive" check before any trip, as that is the only sure way to verify all systems are fully functional.

To follow is the group of 4 "expanded" checklists, which includes the incremental steps you need to complete each step on the checklist. The lists are broken out as follows:

"PRISM 2 Component Inspection", **"PRISM 2 Assembly Order"** and **"PRISM 2 Operational Checklist"**. The fourth sub-section of the operational checklist, **"Immediate Pre-Dive Checks & System Settings"** are for final "systems go" verifications prior to entering the water.
You can use the 3 main sections individually as follows:

PRISM 2 Component Inspection:

This section of the checklist is used to help you verify that all parts of a complete PRISM 2 are present and visually undamaged prior to packing it for transport. There is nothing worse than boarding a local dive boat or landing in a foreign country just to find out that you left your DSV/BOV in your dive locker back home.

PRISM 2 Assembly Order:

This is the list you will normally use to "build your rebreather" from its component parts.

PRISM 2 Operational Checklist:

This is the checklist you will use to test all assembled components of the rebreather to make sure they are functioning properly as a whole prior to entering the water. You will complete these steps after assembly, or if a piece of the functioning rebreather has been disassembled at any time. This is the most critical part of the entire set up process, since a non-functional rebreather will always become evident at some point as you go through the operational checks. Do not dive the rebreather if it has not passed every step of this checklist.

Immediate Pre-Dive Checks & System Settings:

These are the final few checks done with the unit secured to your body before jumping in the water. While most checks are verifications of previously checked items, it is absolutely imperative that you check these again before entering the water.

COMPONENT INSPECTION CHECKLIST

KEY:
W = WEAR / **O** = OPERATION / **I** = INSTALL

☐ **1. Check H-Plate / Harness / BC for Wear, Damage or Missing Parts**
- ☐ A. H-Plate
- ☐ B. Harness (W)
- ☐ C. Fabric (W)
- ☐ D. Inflator / Alt. Air Source (O)
- ☐ E. Dump Valve(s) (O, W)
- ☐ F. Removable Weight Pockets (W, I)
- ☐ G. Fastening Clips (W)

☐ **2. Inspect Counterlungs**
- ☐ A. Fabric (W)
- ☐ B. Drains (O)
- ☐ C. Threaded DSV/BOV Assembly Rings (W)
- ☐ D. Breathing Hoses, Oetiker Clamps, + O-Rings (W)
- ☐ E. O_2 Addition Valve (I, O)
- ☐ F. Automatic Diluent Valve (ADV) (O)
- ☐ G. Over-Pressure Valve (OPV) (O)

☐ **3. Inspect DSV/BOV Breathing Hoses**
- ☐ A. Hoses,
- ☐ B. Oetiker Clamps (W)
- ☐ C. O-Rings (W)
- ☐ D. Inhalation Hose Mushroom Valve (only on inhale hose for DSV supplied systems) (O, W)

☐ **4. Inspect DSV/BOV**
- ☐ A. Shut-Down/OC Assembly (O)
- ☐ B. Water Drain (O)
- ☐ C. Mouthpiece, Zip-Tie
- ☐ D. DSV/BOV Exhalation Mushroom Valve (O,W)
- ☐ E. Inhalation Hose Mushroom Valve (only on inhale side of BOV) (O, W)

☐ **5. Inspect Regulators + Hoses**
- ☐ A. 1st Stages (W)
- ☐ B. Pressure Relief Valves
- ☐ C. LP Hoses + Connectors (W)
- ☐ D. HP Hoses + Connectors (W
- ☐ E. Diver Installed Gas Supply Hoses (if installed)
- ☐ F. Pressure Gauges

☐ **6. Inspect Wiring**
- ☐ A. Heads Up Display (W)
- ☐ B. Wrist Display (W)

☐ **7. Battery Compartment, Batteries + O-Rings**
- ☐ A. Solenoid Batteries (I)
- ☐ B. Heads Up Display Battery (I)
- ☐ C. O-Rings (2) (W)
- ☐ D. Cover, Cover Latches + Keepers (O,W)

☐ **8. Solenoid Operation (O)(If proceeding immediately to assembly and operational checks, you can skip this step.)**

☐ **9. Inspect Head Assembly**
- ☐ A. Red CO_2 Seal (I, W)
- ☐ B. Head To Bucket O-Rings (2) (W)
- ☐ C. O-Ring Seats (W)
- ☐ D. Latch Keeper (W)
- ☐ E. Nut Bars, Head Bolts, Head Cover Bar + Head Cover (W, I)

☐ **10. Oxygen Sensors**
- ☐ A. 3 Oxygen Sensors + Sensor Holders Installed (I)
- ☐ B. Oxygen Sensor Wiring Harness (I)
- ☐ C. mV Readings Within Range(O) (8.5 mV to 14 mV in air)

☐ **11. Bucket Assembly**
- ☐ A. Basket Compression Spring + Pad(I)
- ☐ B. Latches (3) (W, O)
- ☐ C. 1 Moisture Pad (I)

☐ **12. Basket Assembly**
- ☐ A. Check Mesh (W)
- ☐ B. Center Tube O-Ring (I)
- ☐ C. Top + Basket Threads Clean (O)
- ☐ D. Top + Bottom Foam Pads (I)

COMPONENT INSPECTION CHECKLIST: DETAILS

KEY:
W = WEAR / **O** = OPERATION / **I** = INSTALL

1: CHECK H-PLATE / HARNESS / BC FOR WEAR, DAMAGE, OR MISSING PARTS: 7 STEPS

A: H-Plate

Look for any bent or broken parts on the H-plate. Verify that the rubber cylinder pads are in place on the cylinder rests. Check the cylinder bands for wear.

B: Harness (W)

Check the webbing for excessive wear. Check D-rings, buckle, crotch strap and any diver installed hardware such as knives or equipment pouches are present and in working order.

C: Fabric (W)

Lay the BC down flat and inspect the fabric for any tears or signs of excessive wear. Pay special attention to areas around inflators and areas that experience chaffing during use. Never dive the rebreather with a buoyancy compensator that is not in good condition.

D: Inflator (O/W)

Depress the inflator and deflator buttons feeling for smooth actuation. If there is any binding or sticking of either button this usually indicates that salt has dried inside the mechanisms. Dried salt can abrade O-rings and cause slow leaks. If you do find that the inflator buttons stick on first actuation, clean with fresh water or repair as needed.

You will complete a pressurized test of the inflator later on in the operational checks. However, it is always a good idea to test each component, but especially important if you find that the buttons have been sticking. Finally, partially inflate the buoyancy compensator by manually blowing air into the valve *(Fig. 2.16)* while depressing the deflator button. Check that the buoyancy compensator is holding air and not leaking. Do not deflate the buoyancy compensator – See step E: Dump Valves.

Fig. 2.16

E: Dump valve(s) (O, W)

Inspect the buoyancy compensator dump valves. Momentarily open each valve and let a bit of air from the buoyancy compensator out to make sure they open and close freely. Also inspect the air dump pull cords *(Fig. 2.17)* to make sure they are in good condition and not entangled.

Fig. 2.17

F: Removable weight pockets (W, I) (If Installed)

Verify that you have 2 weight pockets *(Fig. 2.18)*. Check that their Velcro flaps, quick-lock and the pull handles in good working condition. Secure them in place.

Fig. 2.18

NOTE:

Integrated weight pockets are one of the most frequently lost or left behind pieces of dive gear! Do you know where your weight pockets are?

G: Fastening clips (W)

Check for broken or cracked parts in the following areas:

1.) Waist strap (Buckle)
2.) Large counterlung retainer clips attached to waistband (male Fastex) *(Fig. 2.19)*
3.) Small lateral counterlung adjusting straps (male Fastex) *(Fig. 2.20)*

Fig. 2.19

Fig. 2.20

PART 2 . SECTION 4

2: INSPECT COUNTERLUNGS: 7 STEPS

A: Fabric (W)

Lay the counterlungs out and inspect the fabric for tears or obvious signs of abnormal wear. While the counterlungs are quite robust, you must never dive with counterlungs that show signs of excessive wear or damage, as counterlung integrity failure during a dive would cause immediate and catastrophic flooding of the breathing loop. Shake the counterlungs to make sure no foreign objects have entered the counterlung during storage or transportation. Smell the inside of each counterlung. They should not have any distinct odor.

B: Drains (O)

Unscrew the locking collar and actuate the valve by depressing the nipple inward toward the body of the valve *(Fig. 2.21)*. Blow into the valve to make sure it is not clogged or broken. The valve should pop back out when you let go of the valve. If it does not, it must be replaced. Re-tighten the locking collar.

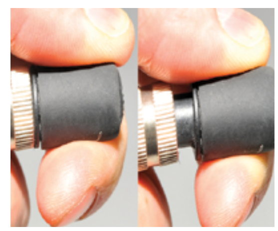


Fig. 2.21

NOTE: THE SNIFF TEST

Sniff the air inside of the counterlung. It should smell clean and possibly have a hint of sanitizer smell to it. This is normal when using Hollis approved breathing loop cleaners, however a distinct smell of sanitizer is not normal and is probably due to inadequate rinsing after cleaning.

C: Threaded DSV/BOV assembly rings (W)

Check for cracks and thread stripping. The hose mounting rings *(Fig. 2.22)* are welded to the counterlungs. Make sure the rings are firmly attached to the counterlung fabric.

D: Breathing hoses, Oetiker clamps & O-rings (W)

Check the counterlung-to-head hoses for holes, wear or age cracking *(Fig. 2.23)*. Stretch the hose slightly and inspect the rubber material. If you can see separation or light spiderweb cracking in the rubber, it is beyond it's serviceable life and must be replaced. Never dive with breathing hoses that show signs of rubber aging, as immediate and catastrophic loop flooding will occur if the hoses fail during diving.

Wipe the interior surface of each breathing hose with a clean, dry towel then look at the spot on the towel where you wiped the hose interior. If the towel has foreign particles or dirt on it, re-clean the counterlung and hose using a bottle brush *(Fig. 2.24)* to remove any foreign material in the hose corrugations. See PART 4 Section 2 for further cleaning instructions.

The counterlung-to-head attachment hardware has an O-ring seal *(Fig. 2.25)*. Remove, clean and prepare the O-ring(s), O-ring groove and mating surface for use, or replace if worn or damaged. Also at this stage you will want to make sure there is no debris in the hose connection at the head *(Fig. 2.26)*. Locate the two hose connections in the head and run your finger inside them. If you feel any debris, clean the inside with a lint-free cloth. If there was any debris on the exhalation side head connector, especially old absorbent particles, some absorbent may have fallen into the head plate area *(Fig. 2.27)*, which is located on the underside of the head. Clean out any debris that may have collected in the head plate area prior to unit assembly. If you hear grinding when turning the hose nut, sand or grit has collected between the nut and hose connector. Dip the hose nut and connector in a bucket of water and gently tap the hose nut against the bucket wall to remove the sand.

E: O_2 Addition valve (O)

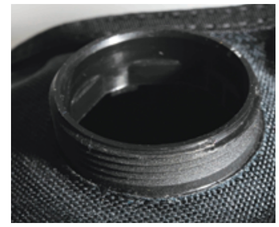


Fig. 2.22

Fig. 2.23

Fig. 2.24

Fig. 2.25

Fig. 2.26

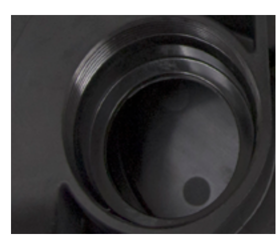


Fig. 2.27

Check the oxygen addition valve on the exhale counterlung for tightness by holding the base of the valve from the back of the counterlung through the counterlung fabric and attempt to tighten (twist clockwise) the threaded nut *(Fig. 2.28)*. There should be no movement. If the valve has come slightly loose, hand tighten the nut as needed until it will not turn further. Activate the valve button to make sure it operates smoothly. It should not feel stiff or difficult to depress. You will check the valve again for proper operation during your operational checks. See the User Service Guide doc. 12-4091 if the button does not move freely.

Fig. 2.28

F: Automatic diluent addition valve (ADV) (O)

While holding the counterlung, depress the valve body until you feel the plunger move *(Fig. 2.29)*. It should move freely. (You will check the valves automatic and manual addition of diluent into the breathing loop during your operational checks.) For a closer inspection, or if you think the valve may be damaged, you can unscrew the valve body from the counterlung by turning the nut counter-clockwise until the valve comes loose from the lung.

Fig. 2.29

G: Over-pressure valve (OPV) (O)

The over-pressure valve is located on the exhale counterlung slightly below the threaded DSV/BOV hose opening *(Fig. 2.30)*. Rotate the body open and closed. You should feel a slight ratcheting as you twist the body. Rotate the OPV body clockwise until it is fully closed in preparation for the oxygen flush during your operational check.

Fig. 2.30

3: INSPECT DSV/BOV BREATHING HOSES: 4 STEPS

Fig. 2.31

A: Inhalation & exhalation hoses (W)

While holding the hose by the threaded hose nuts, gently stretch them to insure the ends are secure. If there is any movement, check the hose clamps and hose material next to the clamps *(Fig. 2.31)* for wear or tears.

While continuing to stretch the hose, look along the hose length at the rubber for signs of wear or age cracking. If you see signs of abrasions or spider web cracking, the hose must be replaced. Never dive with breathing hoses that show signs of rubber aging, as immediate and catastrophic loop flooding will occur if a breathing hose tears during diving.

Fig. 2.32

B: Oetiker clamps

Check to make sure the clamps are securely locked down onto the hoses *(Fig. 2.32)* and then cover them with the silicone clamp covers so they do not snag fabrics such as wetsuit material while putting on and taking off the rebreather.

C: O-Rings (W)

There are two O-rings on each breathing hose assembly. You will find the first O-ring under the counterlung elbow-retaining nut of each hose assembly. Pull the elbow retaining nut back with your thumb and forefinger and using an O-ring pick, gently remove the O-ring from its groove. Remove, clean and prepare the O-ring(s), O-ring Groove and mating surface for use, or replace if worn or damaged.

The O-ring under the DSV/BOV threaded nut counterweight is a bit trickier as you may not be able to fully retract the weighted nut to expose the O-ring. However, you can remove the O-ring with an O-ring pick.

Pull the counterweight nut as far as back from the hose opening as possible. You should be able to see the O-ring. Carefully extract the O-ring from its groove, making sure not to scratch the seating surface. Remove, clean and prepare the O-ring(s), O-ring groove and mating surface for use, or replace if worn or damaged.

To clean the O-ring groove, you can use a Q-tip *(Fig. 2.34)*, but be careful not to allow cotton fibers to remain behind. If there are dirt particles on the O-ring when you remove it from the groove, disassemble the threaded counterweight side of the DSV/BOV hose assembly by removing the Oe-tiker clamp and thoroughly clean the O-ring groove.

Fig. 2.34

D: Inhalation hose mushroom valve (O, W)

(only on inhalation hose for DSV supplied systems)
If your PRISM 2 is supplied with a DSV, the inhalation side breathing hose will house a one-way mushroom valve *(Fig 2.35)*. (The inhalation mush-room valve on BOV supplied systems is housed in the BOV on the inhala-tion side of the BOV body).

Fig. 2.35

To test the sealing integrity of the valve, place the hose elbow on your mouth and put the DSV counterweight in your other hand. While looking at the mushroom valve gently inhale. You should see the mushroom valve seal around the outside surface of the 6-spoke mushroom valve seat *(Fig. 2.36)*. You should not feel or hear any air movement from the valve. If you can inhale air, clean the mushroom valve and seat with water. If it contin-ues to leak after cleaning, you must replace the valve (and possibly the valve seat), then repeat the test.

Fig. 2.36

If you remove the valve seat for inspection or repair, you must clean and prepare the O-ring(s), O-ring groove and mating surface for use, or replace if worn or damaged.

4: INSPECT DSV/BOV: 5 STEPS

A: Shut-Down/OC assembly (O)

Open and close the DSV/BOV to make sure the inner barrel operates smoothly and does not bind. If it is hard to open or close, or if you hear a scraping sound during barrel movement, the DSV/BOV barrel and housing will need to be cleaned and lubricated.

Fig. 2.37

DSV: There are three sealing O-rings on the DSV rotating barrel *(Fig. 2.37)*. You will be checking the sealing of these during your positive and negative pressure tests. If any of these O-rings should fail, you will need to service the DSV. Check the User Service Guide doc. 12-4091 for further information.

BOV: The BOV barrel is a 2-position barrel with sealing O-rings much like a DSV. You will be checking the sealing of these during your positive and negative pressure tests. If any of these O-rings should fail, you will need to service the BOV barrel. Check the User Service Guide doc. 12-4091 for further information.

Fig. 2.38

B: Water drain (O)

On the underside of the DSV/BOV you will see a small hole just under the mouthpiece *(Fig. 2.38)*. This is the water drain hole. Check to make sure it is not clogged.

Place the DSV/BOV in your mouth with the valve closed and blow into the mouthpiece. You should be able to blow air through the drain hole, but you will feel some back-pressure. If you cannot blow air through the drain hole, debris may have clogged the hole or become lodged in the drain channel in the rotating stainless steel sleeve. You will need to service the DSV.

C: Mouthpiece, zip-tie

Check for holes or torn bite tabs in the mouthpiece. Replace as needed. Check that the zip-tie retainer is present and holding the mouthpiece securely onto the DSV/BOV.

D: DSV/BOV exhalation mushroom valve (O, W)

Open the DSV/BOV to the CC position. Place your palm over the left side opening of the DSV/BOV, fully blocking it, and attempt to gently draw air in. There should be no air movement. If you are able to draw air in, clean the exhalation mushroom valve and seat with water. If it continues to leak after cleaning, you must replace the exhalation side mushroom valve and seat, then repeat the test.

E: Inhalation hose mushroom valve (O, W) (only on inhale side of BOV)

(BOV ONLY): Open the BOV to the CC position. Place your palm over the right side opening of the BOV, fully blocking it, and attempt to gently exhale. There should be no air movement. If you are able to exhale air, clean the exhalation mushroom valve and seat with water. If it continues to leak after cleaning, you must replace the exhalation side mushroom valve and seat, then repeat the test.

5: INSPECT REGULATORS + HOSES: 6 STEPS

A: 1st stages (W)

Remove the cap on the first stage DIN valve and inspect the DIN fitting for signs of previous water ingress such as discoloration or salt buildup *(Fig. 2.39)* on the filter surface. If there are signs of water ingress, do not dive the unit until the first stage, hoses and pressure gauges attached to it have been serviced by a Hollis authorized repair facility. Failure to properly maintain the first stages could result in a free-flow of gas into the breathing loop and lead to serious injury or death. Verify that the DIN valve's tank O-ring is in place and clean. Replace it if there are any signs of wear.

Fig. 2.39

B: Pressure relief valves

Check that the pressure relief valve *(Fig. 2.40)* is in place and the body of the valve has not sustained any impact damage. You will verify that the valve is sealed when you pressurize the first stage. Should the valve activate and discharge gas, suspect a malfunctioning first stage. You can verify if the intermediate pressure is outside of operating parameters with an in-line pressure gauge outfitted with a low pressure QD fitting.

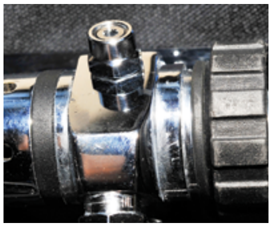


Fig. 2.40

C: LP (Low Pressure) hoses & connectors (W)

Check each hose leading from the first stages for signs of wear or age. Replace as necessary only with Hollis approved parts. Check all LP quick disconnect hardware for corrosion and verify that the Schrader valve is clean of debris, salt or corrosion. If the QD fittings are becoming stiff or are built-up with corrosion, a ½ hour soak in white vinegar may remove the build-up.

WARNING: It is important to understand that all of the LP oxygen supply hoses contain in-line flow restrictors, and must never get exposed to salt water. Never replace an O_2 side low or high-pressure hose with anything other than the correct Hollis part.

D: HP (High Pressure) hoses & connectors (W)

Check each HP hose leading from the first stages for signs of wear. Replace as necessary only with Hollis approved parts.

E: Diver installed gas supply hoses (if present) (W)

If any other gas supply hoses are attached to the diluent first stage such as a dry suit hose or second stage, check them for signs of wear. Replace as needed.

F: Pressure gauges (O, W)

Look at both pressure gauges and verify that the needle is resting at 0 psi / 0 bar. If it is not, have the pressure gauge repaired or replaced. Unless there are obvious signs of impact damage to the faulty gauge, suspect water ingress through the first stage and have the rebreather gas supply system serviced by an authorized Hollis repair facility. It is especially important for the Oxygen side of the system to remain free from contamination, as all parts must remain oxygen clean. (Refer to the User Service Guide doc. 12-4091 for further information).

6: INSPECT WIRING : 2 STEPS

A: HUD (Heads Up Display) (W)

Check the Heads Up Display and wiring for damage. Turn the unit power on and verify that all three of the LED's *(Fig. 2.41)* illuminate red then green, once. If all three lights illuminate continuously orange for 30 seconds, the Heads Up Display battery must be changed. Once checked, turn off the HUD. (See the HUD light states section of the PRISM 2 Displays and Electronics User Manual for display explanations.)

Fig. 2.41

B: Wrist Display (W)

Inspect Wrist Display and wiring for wear or damage. Turn on the Wrist Display by depressing both the menu and select buttons *(Fig. 2.42)*. After the splash screen, the system will switch to the main information screen.

Fig. 2.42

7: BATTERY COMPARTMENT, BATTERIES + O-RINGS: 4 STEPS (W)

NOTE: Solenoid Battery

For the computer to measure the dynamic load of the solenoid battery, the PRISM 2 must have a valid calibration stored in memory to allow the solenoid to fire. If, when you turn on the Wrist Display, all three sensors display "fail", the solenoid will not fire and the voltage display for the solenoid battery will show "?". You will not be able to verify the dynamic voltage of the solenoid batteries until the system has been calibrated, which will then allow the solenoid to fire.

A: Solenoid batteries

The solenoid runs on two 9V alkaline (Duracell® or equivalent quality only) batteries wired in parallel and located in the battery compartment of the electronics housing *(Fig. 2.43)*. To check the solenoid voltage, you will first need to make the wrist unit fire the solenoid at least once. The easiest way to do this is switch the setpoint to one that has a higher PO_2 than ambient air.

If all readings on the wrist unit read "FAIL" you will need to calibrate the wrist unit before it will fire the solenoid, see note below. With the wrist display turned on from the previous step, depress the select button six times until you see the bottom of the screen display the voltages for the external battery (solenoid) and the internal battery (wrist display) *(Fig. 2.44)*. A voltage above 7V, as reported by the Wrist Display, is considered by the electronics as acceptable. Therefore no dive should be conducted unless the voltage reported by the Wrist Display is greater than 7V. If the voltage is reported at or below 7V then both batteries must be changed prior to conducting a dive.

EXT V	INT V
8.8	3.4

Fig. 2.44

The computer measures the dynamic voltage of the solenoid batteries, which means the voltage is being measured while the solenoid is firing and the batteries are under load. This is the most accurate way to verify the actual working capacity of the batteries. Using a voltmeter that does not put a load on the battery can give you a higher voltage reading, but the measurement will not be nearly as accurate a gauge of actual battery capacity. This is why we do not recommend relying on a voltmeter to test the solenoid batteries.

Fig. 2.43

B: HUD (Heads Up Display) battery

The HUD battery is located in the battery compartment. It is a SAFT 3.6V AA battery.

Fig. 2.45

C: O-Rings (2) (W)

There are two O-rings sealing the battery compartment. A “compression seal” O-ring sits inside the O-ring groove at the top of the battery compartment *(Fig. 2.45)*, and its mating face is the underside edge of the battery cap. Remove, clean and prepare the O-ring(s), O-ring groove and mating surface for use, or replace if worn or damaged.

Fig. 2.46

The second “Radial seal” O-ring resides in a groove on the inside edge of the battery cap *(Fig. 2.46)*, and its mating edge is the inside surface of the electronics stack. Remove, clean and prepare the O-ring(s), O-ring groove and mating surface for use, or replace if worn or damaged.

D: Cover, cover latches & keepers (O, W)

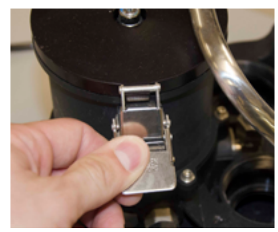


Fig. 2.47

The aluminum battery cap is held in place by two Nielsen Sessions stainless steel locking latches *(Fig. 2.47)*. Operate the latches and check that they are free of debris, and the locking mechanism locks firmly into place. Damaged latches must be replaced before immersing the PRISM 2 in water.

Failure to keep the battery compartment latches in working order can result in flooding of the battery compartment.

The latch keepers are molded into the battery compartment cap. Make sure there is no impact damage which could have cracked the aluminum keepers.

WARNING: The Battery Cap is equipped with a pressure relief valve. If the battery compartment were to flood, battery acid and poisonous gases will form inside the compartment. You must never expose yourself to either the acid or gases from the venting battery compartment.

Should the compartment flood during diving operations, the pressure relief valve will vent the pressurized gases and acid into the surrounding water.

Because the Solenoid and Heads Up Display batteries are in this compartment, if the compartment floods, the batteries will quickly lose their charge and the Heads Up Display and the Solenoid will stop working.

After a battery compartment flood, you must take precautions while cleaning and disposing of all materials within the compartment, and must not dive again until you have replaced the battery cap pressure relief valve. (See the User Service Guide doc. 12-4091 for further information on recovering from a flooded battery compartment.)

8: SOLENOID OPERATION (O,W)

(If you are proceeding immediately to assembly and operational checks, you can skip this step.)

While you will be verifying the operation of the solenoid with the operational checks, it is always a good idea to verify its operation at this stage if you will be traveling away from immediate repair support.

To check the solenoid operation now, you will need to hook up the oxygen side 1st stage, solenoid supply hose and a pressurized oxygen cylinder to the solenoid and power up the PRISM 2 to check that the solenoid is firing and adding O_2 to the breathing loop.

Install the oxygen supply hose onto the solenoid. Install an oxygen cylinder onto the oxygen side first stage. This is temporary and you will be removing the O_2 tank after this test, so you can leave the tank on loosely *(Fig. 2.48)*. Slowly open the O_2 tank valve to charge the lines, then close the valve.

Fig. 2.48

Turn on the Wrist Display and change the setpoint to either low or high setpoint. Listen for the solenoid firing and watch the oxygen pressure gauge. You should see the pressure in the lines drop as oxygen is injected into the head. Allow the solenoid to continue firing until the pressures in the lines are drained. Remove the O_2 first stage from the tank valve and the supply hose from the solenoid.

If you can hear the solenoid click, but the pressure in the lines does not decrease as shown on the pressure gauge, most likely you have a clogged flow restrictor. If the solenoid does not fire, make sure you have selected an active setpoint above ambient air. Remember, if all 3 cell outputs read “fail”, there is no valid calibration stored in memory and the solenoid will not fire regardless of the active setpoint. If all the O_2 sensor readings on the wrist unit show “fail”, you will need to calibrate the unit prior to verifying solenoid operation. If the Wrist Display does show readings for the O_2 cells and the battery display shows charged batteries, it may be that water has gotten into the oxygen first stage and hoses, or the solenoid has simply failed. Have the unit serviced by an authorized Hollis service center. Never dive your PRISM 2 with a failed solenoid.

9: INSPECT HEAD ASSEMBLY: 5 STEPS

A: Red CO_2 Seal (I, W)

The Red CO_2 Seal is a thick, spongy-feeling red gasket that resides on the underside of the head in a channel on the face of the head plate adjacent to the three O_2 sensors *(Fig. 2.49)*.

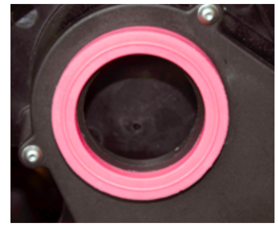


Fig. 2.49

WARNING: DO NOT lubricate the Red CO_2 Seal.

The Red CO_2 Seal MUST be checked now and prior to sealing the bucket to the head. The Red CO_2 Seal is a critical component of a properly functioning breathing loop. If the seal were left out during operation *(Fig. 2.50)*, you would have 100% CO_2 breakthrough, possibly leading to injury or death.

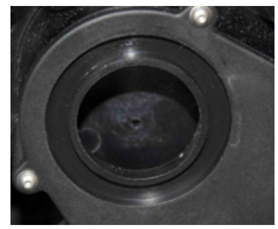


Fig. 2.50

WARNING: You must verify that the Red CO_2 Seal is in place, seated properly in its groove and is clean and undamaged anytime you load the CO_2 scrubber basket into the unit. Failure to check the Red CO_2 Seal may lead to serious injury or death.

B: Head to bucket O-rings (2) (W, I)

The head to bucket sealing flange *(Fig. 2.51)* incorporates two bucket sealing O-rings. You must check clean, and lubricate both O-rings and their seating surfaces whenever the bucket has been removed from the seating flange. To begin the cleaning process, remove the two O-rings from their grooves starting with the O-ring closest to the head (#1) *(Fig. 2.52)* and lay it on a clean towel. Next, remove the O-ring closest to the edge of the bucket flange (#2) *(Fig. 2.53)*.

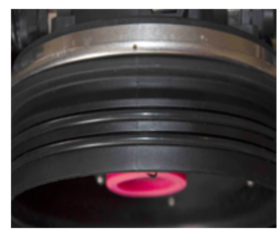


Fig. 2.51

Never use any sharp or metal objects to remove the O-rings, as that would damage the O-ring and/or the seating surface. Never over-stretch the O-rings while removing them.

Fig. 2.52

NOTE:
Remove the O-rings
in the order stated in the text to keep you from having to drag an O-ring across an empty O-ring groove, which can result in nicked, stretched or broken O-rings.

Fig. 2.53

Clean any debris (usually small particles of soda lime) and lubricant on the O-rings with a lint-free towel. Once clean, run the O-rings through your fingers feeling for any nicks or left over debris while visually inspecting them at the same time. There must be no lint, hair, or particles of any kind on the cleaned O-ring, since debris on the O-ring would cause a seal failure. If you find any damage to the O-ring, it must be replaced with a new O-ring from your spares kit.
Lay the two cleaned, but not yet lubricated O-rings aside on a clean surface. Clean the seating surface on the head flange, making sure to remove any debris that may have collected in the O-ring grooves.

NOTE:
Never lay a lubricated O-ring down, even on a seemingly clean surface. The lubricant will pick up an amazing amount of surrounding debris that your eyes didn't see.

C: O-ring seats

Use a clean lint-free cloth or Q-tip and clean old lubricant and absorbent from the two O-ring channels. It may be difficult to clean the portion of the channel facing the H-plate when the Head is mounted into the H-plate.

Put a small dab of lubricant on your forefinger and lightly coat each O-ring with a sheen of lubricant by running the O-ring between your forefinger and thumb. While you are doing this, feel for any leftover debris and if found, re-clean the O-ring and reapply fresh lubricant.

Immediately replace all cleaned and lubricant-treated O-rings onto the head after you lube them, in the opposite order in which you took them off.

To re-install the O-rings, start by putting the first O-ring in the bottom groove (#2) on the head. This will make putting the subsequent O-ring in place easier by not having to work the O-ring past an empty groove.

Once the head to bucket sealing surface has been cleaned and the treated O-rings are in place on the flange, it is recommended that you temporarily replace the bucket on the head. This will keep debris off the cleaned surfaces until you are ready to mount the absorbent-filled basket assembly on the head in preparation for diving.

D: Bucket latch keeper (W, O)

The bucket latch keeper is a stainless steel channel that runs around the face of the head and is screwed into place. Verify that the 4 screws are in place and the seat is not loose *(Fig. 2.54)*. If the seat were to fail during a dive, the Velcro bucket strap would most likely keep the bucket firmly seated on the head, however with a failed latch keeper, a catastrophic flood could result.

Fig. 2.54

WARNING: All screws that secure the bucket latch keeper onto the head must be in place and in good condition. Never dive the unit if any retaining screws are missing or damaged. Never replace the screws with non-approved hardware. Doing so could cause the latch seat to fail and the unit to experience an immediate and catastrophic flood, possibly leading to injury or death.

E: Nut Bars, Head Bolts, Head Cover Bar, and Head Cover

Verify that the Nut Bars and Head Bolts are in place. Check that the Head Cover Bar is not bent. Verify that the Head Cover latch is working and there are no impact cracks on the cover.

10: OXYGEN SENSORS : 3 STEPS

A: 3 Oxygen sensors & sensor holders installed (I)

The three oxygen sensors are mounted on the underside of the head in removable, vibration resistant cell holders *(Fig. 2.55)*. Each cell holder is held in place by two pins. Make sure all three-cell holders are firmly seated on the pins and are in good condition. You should never allow any lubricant to get on the sensor housings or the sensor holders, as that could allow the sensor to slide out of the holder during a minor transit impact, thereby damaging the sensor. If there is grease on the sensor housing or holder, gently clean both with a mild surfactant cleaner such as Crystal Simple Green™. Do not attempt to clean this area with the O_2 sensors in place. Remove the sensors prior to cleaning.

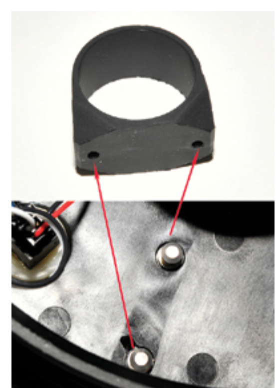


Fig. 2.55

(See the list of approved cleaning agents in PART 5 Section 2).

B: Oxygen sensor wiring harness (W)

The O_2 sensor-wiring harness has one locking 6 pin Molex connector *(Fig. 2.56)*, which connects into the head and three locking 3 pin (2 wire) Molex connectors that go to each sensor. The connectors are the high pressure 4 sided pin capture style. The wiring is silver-coated copper stranded wire. It really does not matter which 3 pin connector goes to which O_2 sensor as they are mounted in the head, but for diagnostic purposes, the connectors are numbered and the wiring color designation is as follows:

Fig. 2.56

COLOR		O_2 READOUT ON WRIST DISPLAY AND HUD
RED & BLK	=	# 1
WHT & BLK	=	# 2
BLU & BLK	=	# 3

C: mV readings within range (O) (8.5 mV to 14 mV in air)

The Analytical Industries Hollis (PRISM 2) O_2 sensor voltage output should be between 8.5 and 14 mV in air, and 40 to 67 mV at sea level in 100% oxygen (the valid mV reading (as far as the computer is concerned) for 98% O_2 calibration is 30-70 mV). On the wrist unit, switch the display to the sensor's mV readings and verify that the sensors are in range for the gas to which they are exposed.

From the main screen, depress the select button until the cell readouts display their millivolt readings *(Fig. 2.57)*.

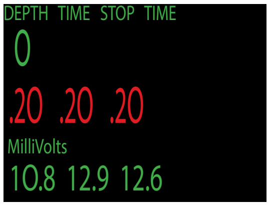


Fig. 2.57

11: BUCKET ASSEMBLY : 3 STEPS

The scrubber bucket is made from high density, high-pressure injection-molded clear urethane *(Fig. 2.58)*. It is an extremely rugged, durable and strong material that also helps thermally protect the scrubber material by creating an insulating gas space around the scrubber. Because high pressure Urethane is a very poor thermal conductor compared to other commonly used materials, such as aluminum or stainless steel, it also acts to preserve the heat needed for efficient CO_2 sequestration.

Fig. 2.58

A: Basket compression spring & pad (I)

The scrubber basket compression spring *(Fig. 2.60)* sits on a retaining post that is molded into the bottom of the scrubber bucket. The spring is designed to keep the inhalation tube area of the scrubber basket firmly sealed on the red Red CO_2 Seal, which is mounted on the head plate in the head.

Fig. 2.60

Confirm that the spring pad and locking nut are in place and that the spring compresses by pushing down on it. Ensure as well that the nyloc nut holding the spring pad onto the post and spring has one thread exposed.

B: Latches (W, O)

There are three Nielson Sessions stainless steel hinged latches *(Fig. 2.61)* mounted on the stainless steel band toward the top of the bucket. Operate the latches and check that they are free of debris, rust, or excessive wear. Verify that the locking mechanisms lock firmly into place.

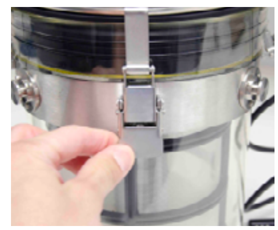


Fig. 2.61

WARNING: Damaged or worn latches must be replaced before immersing the PRISM 2 in water or commencing diving operations. Failure to verify that the scrubber bucket latches are in good working order, or diving with broken or worn latches can result in a catastrophic flooding of the loop, possibly leading to serious injury or death.

C: 1 Moisture pad (I)

Check that you have a bucket moisture pad installed at the bottom of the bucket. The moisture pad should be capable of absorbing the majority of condensation moisture that collects along the bucket wall, which drips to the bottom of the bucket during use.

WARNING: You must use only Hollis approved bucket moisture pads. Never use a moisture pad that can interfere with the compression spring and clearances of the scrubber basket. Using moisture pads that were not designed for the Hollis PRISM 2 could damage the basket, bucket spring, bucket latches, Red CO_2 Seal or latch seat. A failure in any of these areas during diving operations could lead to serious injury or death.

12: BASKET ASSEMBLY (W): 4 STEPS

Fig. 2.62

The basket assembly comes in four basic parts *(Fig. 2.62)*: the basket, the basket lid, the center tube and the center tube O-ring. The basket assembly utilizes a strong nylon mesh to avoid rips and is also somewhat elastic so it will not create dust by abrading the absorbent along its walls during packing, transit or handling. The nylon mesh is also thermally non-conductive which helps keep the absorbent material as thermally efficient as possible.

A: Check mesh (W)

Look at the mesh of both the basket and the center tube. There must not be obvious tears or abrasions of the mesh. Do not attempt to repair a basket with torn or abraded mesh, as any material or repair failure during diving operations would cause the absorbent to spill out of the basket, resulting in an instant and catastrophic CO_2 bypass.

B: Center tube O-ring (I)

The center tube screws into the basket base and is sealed with an O-ring. You do not normally have to remove the center tube for cleaning, but if you do, remove, clean the O-ring, its groove and mating surface for use, or replace if worn or damaged. It is neither necessary or advisable to lubricate the center tube O-ring. It would only serve to collect dust, and there is no pressure differential on either side of the O-ring.

continued

C: Top + basket threads clean (O)

Keeping the scrubber clean is very simple, but one of the problems between cleaning is crushed absorbent dust caking up in the scrubber basket threads *(Fig. 2.63)*. The more humid the environment in which you are packing your absorbent basket, the more you will find the material is building up in the threads. While not a safety concern in and of itself, caked-on absorbent can make it more difficult to screw down the top of the basket, which can be a safety concern if the basket top is not fully engaged onto the threads. Prevent crushing absorbent into the threads by keeping the absorbent material away from the edges when placing material at the top of the basket.

Fig. 2.63

WARNING: Never attempt to repair or dive a scrubber basket that has torn mesh. Doing so could lead to injury or death.

The easiest way to remove absorbent that has built up in the threads is to soak the top and basket threads in white vinegar for 10 to 15 minutes. If time is an issue, heat the vinegar to 100 °F/38 °C, and soak the parts. Rinse thoroughly and dry the basket before re-packing it.

D: Top + bottom foam pads (I)

The foam pad with the larger diameter center hole is placed on the bottom of the basket prior to filling *(Fig. 2.64)*. The pad, with the smaller hole, goes on top of the absorbent filled basket, under the basket cap. Both the bottom and top pads are used to impede any laminar flow of gas which might occur along the smooth surfaces of the basket top and bottom.

Fig. 2.64

WARNING: The Foam Pads MUST be used to impede laminar gas flow and CO_2 breakthrough.

After many uses and cleanings, the foam pads will become thin and start to deteriorate. At that point you should replace the pads with new ones.

WARNING: You must ensure that you replace the center tube O-ring during assembly. Failure to do so could allow some gas to channel through the top of the scrubber.

If you use a dull scraping tool to remove caked-on absorbent from the basket top threads, be very careful! It is very easy for the tool to accidentally slip on the threads and tear the mesh, your skin, or both.

ASSEMBLY ORDER CHECKLIST

☐ 1. **Fill scrubber basket with CO_2 absorbent + store in airtight container. Label Container: Date Packed, Grade, Time Used, Time Left, User**

Date Packed: _______ Grade: _______ Time Used: _______ Time Left: _______ User: _______

Maximum Scrubber Duration:

EN 14143 conforming testing: *84 min* (0.5%, SEV CO_2) using 8-12 @ 40 °F/4.4 °C, 1.61 L/min CO_2, 131 fsw/40 msw; *61 min* (0.5%, SEV CO_2) using 8-12 @ 40 °F/4.4 °C, 1.61 L/min CO_2, 328 fsw/100 msw

Non-CE testing from ANSTI: 240 minutes (0.5% SEV CO2) using 8-12 @ 40 °F/4.4 °C, 1.35 L/min CO2, 40 lpm RMV, 60 fsw/28 msw

☐ **2. Fill O_2 & Diluent cylinders, analyze contents, label cylinders with name, date, contents.**

O_2%: ______ Pressure: _______ psi/bar Dil Contents: _______ ressure: ______ psi/bar MOD: _______

☐ **3. Install Regulators + Hoses on H-Plate**

- ☐ A. O_2 system on right (head facing up) - run all lines under bottom tank strap.

☐ **4. Install Head Assembly Onto H-plate**

- ☐ A. Nut bar, mounting tube, and head to H-plate
- ☐ B. Run O_2 solenoid line between right side head mount, flange & H-plate. Tighten hose to solenoid.

☐ **5. Install BCD, Yoke + Backplate Onto H-plate**

- ☐ A. Long screw on top, short screw on bottom - secure with nylon keepers.
- ☐ B. Install BCD on plate - inflator facing H-Plate.
- ☐ C. Install yoke harness - Fastex clips facing BCD.
- ☐ D. Install the counterlung pull down straps
- ☐ E. Install the counterlung side straps to the back-plate
- ☐ F. Install backplate and harness – place on washers and tighten butterfly nuts.

☐ **6. Attach Counterlungs To Yoke**

- ☐ A. Insure inhale counterlung is on right side (with bladder & yoke face-up).
- ☐ B. Clip Fastex buckles in place
- ☐ C. Line-up Velcro parts and compress

☐ **7. Install Counterlung Breathing Hoses To Head**

- ☐ A. Clean and lubricate O-rings, O-ring grooves and mating surfaces.
- ☐ B. Install hose nuts finger tight. Do not over-tighten.

☐ **8. Attach Gas Supply Lines To Diluent + Oxygen Addition Valves On Counterlungs + BCD Inflator**

- ☐ A. Attach all 3 QD fittings. Pull on hoses to make sure they are secure.

☐ **9. Assemble DSV/BOV + Hoses, Check + Install**

- ☐ A. Open/close, purge, mouthpiece
- ☐ B. Check mushroom valve seals and flow direction.
- ☐ C. Install hoses onto DSV/BOV
- ☐ D. Perform a mushroom valve sealing test (stereo check)
- ☐ E. Install DSV/BOV onto counterlungs paying attention to flow direction arrow.
- ☐ F. Install LED Heads Up Display holder fix/attach cable to breathing hose.

☐ **10. Clean Head To Bucket Sealing Rings, O-Ring Grooves + Lube O-Rings**

- ☐ A. Remove O-rings per manual instructions, clean + replace if needed.

☐ **11. Clean Red CO_2 Seal + Secure In Place**

- ☐ A. Make sure there is no debris, dust or lubricant. Clean seal groove.
- ☐ B. Make sure the red CO_2 seal is firmly seated in its groove (triple check!)

☐ **12. Check Filled CO_2 Scrubber Basket**

- ☐ A. Basket top secure
- ☐ B. Check for settling and firmness of absorbent bed

☐ **13. Check Scrubber Bucket**

- ☐ A. Ensure bucket sealing surface is clean
- ☐ B. Basket compression spring installed + functional
- ☐ C. Install bucket moisture pads
- ☐ D. Make sure the pad is not resting on or interfering with the basket compression spring

☐ **14. Place CO_2 Basket In Bucket, Confirm Center Tube Opening Up, Mount + Seal Bucket To Head (record usage time on operational checklist)**

1: FILL SCRUBBER BASKET WITH CO_2 ABSORBENT & STORE IN AN AIRTIGHT CONTAINER. LABEL CONTAINER: DATE FILLED, GRADE, TIME USED TIME LEFT.

Date Packed: ______ Grade: ______ Time Used: ______ Time Left: ______

Maximum Scrubber Duration:

EN 14143 conforming testing:

- 84 min (0.5%, SEV CO_2) using 8-12 @ 40 °F/4.4 °C, 1.61 L/min CO_2, 131 fsw/40 msw
- 61 min (0.5%, SEV CO_2) using 8-12 @ 40 °F/4.4 °C, 1.61 L/min CO_2, 328 fsw/100 msw

Non-CE testing from ANSTI:

- 240 minutes (0.5% SEV CO2) using 8-12 @ 40 °F/4.4 °C, 1.35 L/min CO2, 40 lpm RMV, 60 fsw/28 msw

Fill the scrubber basket in accordance with the directions in PART 2 Section 2. Record the date you packed the scrubber, confirm the absorbent used is Sofnolime® 8-12, any usage time you have put on the scrubber since it was packed and the time left before the CO_2 absorbent must be disposed.

It is important to remember that using the scrubber beyond the factory tested maximum allowable time per fill of CO_2 absorbent is extremely dangerous and can lead to injury or death.

WARNING: Only use Hollis tested and approved absorbent grades and brands. Other absorbents may not perform as expected or be safe for use in the PRISM 2.

2: FILL O_2 & DILUENT CYLINDERS, ANALYZE CONTENTS, LABEL CYLINDERS WITH NAME, DATE, AND CONTENTS.

Have the Oxygen cylinder filled with pure, compliant with EN 12021:2014 (in European countries) or E grade USP (in USA) or higher O_2* (See PART 5 Section 1). Fill the diluent cylinder with an appropriate diluting gas for the planned dive(s). The Diluent must have a minumum oxygen content of 5% O_2. Never use a hypoxic mix of diluent with a BOV or alternate air source plumbed into the diluent cylinder. Crack the diluent cylinder and sniff the gas. It should have no odor. If it does, suspect contaminants in the fill, have the cylinder inspected by a qualified inspector, then have it re-filled from a new source. Verify the oxygen content of BOTH bottles using a calibrated oxygen analyzer. The oxygen should read 100%* and the diluent (if air) 20.9% (see your oxygen analyzers' directions for calibration and environmental variance information).

*You can dive the PRISM 2 using oxygen of less than 100% purity. See the "Cal. PPO_2 Function" in the PRISM 2 Displays and Electronics User Manual for instructions to do so.

O_2 %: ___ **Pressure:** _____ **psi/bar Dil Contents:** ___ **Pressure:** ___ **psi/bar MOD:** ___Record Record

Record contents and pressures for both gas supplies and the maximum operating depth (MOD) for the diluent.

$$MOD(fsw) = 33\left[\left(\frac{ppO_2}{fO_2}\right) - 1\right]$$

$$MOD(msw) = 10\left[\left(\frac{ppO_2}{fO_2}\right) - 1\right]$$

3: INSTALL REGULATORS + HOSES ON H-PLATE

Install the oxygen regulator and hoses on the right side of the H-plate by running all the hoses under the bottom tank band strap on the inside of the tank bracket with the DIN valve facing outward toward where the tank will be installed. Leave the Solenoid feed hose (shortest hose) loose. Then run the other two hoses (HP & LP) under the top tank band as well *(Fig. 2.65)*. Install the diluent regulator and hoses on the left side (head facing up) by running all the hoses under the bottom and top tank band strap on the inside of the tank bracket with the DIN valve facing outward *(Fig. 2.66)*.

Fig. 2.65

Fig. 2.66

4: INSTALL HEAD ASSEMBLY ONTO H-PLATE: 2 STEPS

A: Nut bar, mounting tube, and head to H-plate

i. Place the nut bars on both sides of the head assembly, oriented as shown *(Fig. 2.67)*.
ii. Insert the mounting tube into the holes of the nut bars. Ensure that the curved section of the tube runs over the battery housing.
iii. Using a philip's crewdriver and 3/8" wrench, secure the mounting tube to the nut bar. The screw head needs to be oriented as shown for further assembly *(Fig. 2.68)*.
iv. Using a 5/16" Allen driver, bolt the head onto the H-Plate using the 4 nylon Allen key bolts *(Fig. 2.69)*. DO NOT over-tighten.

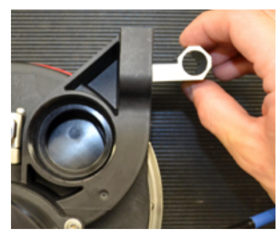


Fig. 2.67

B: Run O_2 solenoid hose between right side head mount flange & H-plate.

Run the solenoid supply hose in the channel created between the right side head mount flange and the bucket mount. Screw the hose fitting onto the solenoid and hand tighten.

Fig. 2.68

5: INSTALL BLADDER, YOKE + BACKPLATE ONTO H-PLATE: 4

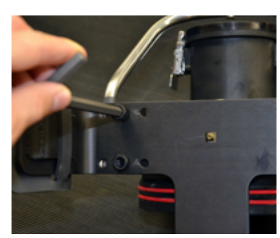


Fig. 2.69

STEPS

A: Long carriage bolt on top, short carriage bolt on bottom. Secure with nylon keepers.

Install the longer of the two carriage bolts (1 ½”) on the top square bolt hole and secure it in place with a nylon bolt keeper. Install the shorter 1” carriage bolt on the bottom square bolt hole and secure it in place with a nylon bolt keeper.

B: Install BCD on H-plate (inflator facing H-plate)

Carefully install the bladder onto the 2 harness mounting bolts of the H-plate, making sure that the inflator mechanism is facing the H-Plate. Take care to not accidentally push the mounting bolts out of the nylon keepers as you run the bolts through the bladder mounting grommets.

The BCD has three mounting grommet positions. Depending on your trim in the water, you may want to raise or lower the BCD position on the H-plate. It is recommended that you begin using the middle position. Then adjust position, if needed, to aid in proper trim as experience is gained on the unit.

C: Install yoke harness - Fastex clips facing bladder

Place the counterlung yoke on top of the bladder with the plastic Fastex clips facing the bladder. Take care to not accidentally push the mounting bolts out of the nylon keepers as you run the bolts through the yoke mounting holes. Like the BCD, the yoke has three mounting grommets. Both your height and girth will dictate which adjustment point you should use.

D: Install the counterlung side straps to the backplate

Using bookend screws attach both counterlung side straps to the circular hole above the waist strap on both sides of the waist strap.

E: Install the counterlung pull down straps to the waist strap

Thread the waist strap webbing on one side through the tri-glide of one of the counterlung pull down straps *(Fig. 2.70 & 3.71)*. Repeat on the other side with the other pull down strap. It will be necesarry to make an initial adjustment; so they hold the counterlungs straight down from the shoulder.

Fig. 2.70

F: Install backplate & harness - Place washers and tighten butterfly nuts

Place the backplate carefully on the two mounting bolts and secure the assembly in place using the two stainless steel washers and butterfly nuts. Tighten the butterfly nuts by hand.

Fig. 2.71

6: ATTACH COUNTERLUNGS TO YOKE: 3 STEPS

A: Insure inhale counterlung is on right side (bladder & yoke facing up)

Verify that the inhale counterlung is on the right side by checking that the lung you are installing on the right has the ADV on the front. The exhalation lung will go on the left side and has the OPV on it.

B: Line up velcro parts and compress

Press the Velcro pieces together to assure a firm adhesion of the parts.

Fig. 2.72

C: Clip fastex buckles in place

Attach the plastic Fastex clips of the yoke to the counterlungs making sure they lock into place *(Fig. 2.72)*. Attach the lower large fastex buckle on the waist belt webbing to the Fastex buckle at the bottom of the counterlung *(Fig. 2.73)* and the side strap webbing attached to the backplate to the small Fastex clip at the lower side of the counterlung.

Fig. 2.73

7: INSTALL COUNTERLUNG BREATHING HOSES TO HEAD : 2 STEPS

A: Clean/Lubricate O-rings, O-ring Grooves And Mating Surfaces

Remove, clean and prepare the O-ring(s), O-ring groove and mating surface for use, or replace if worn or damaged.

B: Install hose nuts finger tight. Do not over-tighten.

To properly attach the counterlung hoses to the head, put the hose mount into the head connector *(Fig. 2.74)* and push down until firmly seated against the stainless steel ring on the fitting. Hand-tighten the nut, but do not over-tighten it, as over-tightening will only make removal more difficult. Gently pull on the hose to insure that the assembly is firmly in place.

Fig. 2.74

8: ATTACH GAS SUPPLY HOSES TO DILUENT AND OXYGEN ADDITION VALVES ON COUNTERLUNGS + BCD INFLATOR: 2 STEPS

A: Attach all 3 QD fittings. Pull on hoses to make sure they are secure

Each counterlung will have one supply hose which needs to be firmly attached to its corresponding gas addition valve. Verify you are attaching the correct supply hose to its valve on the counterlung, then pull up on the locking sleeve, insert the female quick disconnect attachment onto the male nib and release the sleeve. Pull on the hose to verify that the hose is securely connected. Connect one of the diluent hoses to the BCD inflator.

9: ASSEMBLE DSV/BOV AND HOSES, CHECK AND INSTALL: 6 STEPS

In steps 3 & 4 of the pre-assembly checks you verified the operation of the three main sub-assemblies that make up the DSV/BOV assembly. Now you will put together the assembly, check its operation and install the assembly on the counterlungs.

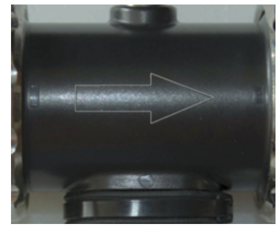


Fig. 2.75

Fig. 2.76

Fig. 2.77

A: Open/close, purge, mouthpiece

Open and close the DSV/BOV shut down lever to make sure it is not binding or was damaged during transit. With the DSV in the closed position, blow into the closed mouthpiece to make sure the water purge hole is not obstructed.

B: Inspect mushroom valves

Look at the top of the DSV/BOV. The arrow denotes the gas flow direction *(Fig. 2.75)* and points at the exhalation mushroom valve *(Fig. 2.76)*. Make sure the mushroom valve is intact and in good condition and the seat is firmly seated in the DSV/BOV assembly.

C: Install hoses onto DSV/BOV

Take the inhalation hose (mushroom valve installed in the counterweight side of the hose on DSV hose) *(Fig. 2.77)* and screw the nickel-plated brass counterweight onto the inhalation side of the DSV/BOV (the flow direction arrow on the DSV/BOV points away from the inhalation side). Leave the counterweighted nut slightly loose until you adjust the mouthpiece angle after you have mounted the assembly onto the counterlungs.

Take the exhalation hose and screw the nickel-plated brass counterweight onto the DSV/BOV exhalation side. Leave this nut slightly loose as well.

D: Perform a mushroom valve sealing test ("stereo check")

To test that the assembly will flow gas in one direction only and the valves are sealing properly, open the DSV/BOV and place the mouthpiece in your mouth. To check the inhalation mushroom valve, seal the exhale hose elbow on your right cheek and put the inhale hose elbow by your left ear and blow gently into the DSV/BOV. You should not be able to exhale, or hear any air escaping from the inhale side. To check the exhale mushroom valve, reverse the elbows (left on cheek, right at ear) and attempt to inhale from the DSV/BOV. If either mushroom valve fails to seal, disassemble the DSV/BOV assembly, clean or replace the failing mushroom valves and retest.

E: Install DSV/BOV onto counterlungs paying attention to flow direction arrow

Take the inhalation side elbow and insert it into the counterlung at ap-

WARNING: When mounting and adjusting the DSV/BOV on the hoses, be very careful not to adjust the angle of the mouthpiece by twisting one of the hoses as this could cause the hoses to kink during diving. A kinked hose will increase the work of breathing and as a result possibly cause the diver to retain an unhealthy level of CO_2, which over time could lead to unconsciousness and possibly drowning.

Fig. 2.78

proximately an outward facing 45^{O} angle (away from the unit's center) *(Fig. 2.78)*. Both elbows are keyed *(Fig. 2.79)* so the DSV/BOV assembly cannot be accidentally reversed. If they are accidentally reversed and screwed down, they will not lock in place and you will be able to spin them even when they are fully secured. Screw the inhalation hose onto the inhalation counterlung (left) and tighten it down. Do the same with the exhalation hose elbow, installing it on the exhalation (right) counterlung.

Fig. 2.79

With the DSV/BOV mouthpiece pointing upwards, turn it approximately 45° towards the rebreather *(Fig. 2.80)*. This should be a good starting point for the mouthpiece angle, but the angle should be set for the diver's prefer-ence. You can continue to rotate the mouthpiece angle to find out what works best for you.

NOTE:

If there is any doubt about hose twisting, unscrew the counterweight from the DSV/BOV. Watch how the hose comes to rest against the counterlung. Lift the hose up to its diving position. (You can look at the hose clamp to visually mark where the top of the hose should be.) Re-install the DSV/BOV.

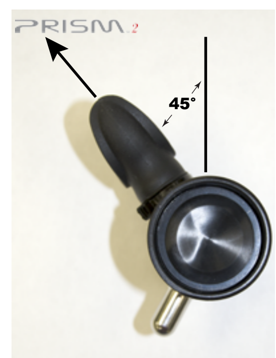


Fig. 2.80

F: Install HUD (Heads Up Display) holder.
Fix / attach cable to breathing hose

The HUD is held on to either the right or left DSV/BOV counterweight by a plastic c-clamp *(Fig. 2.81)*. The c-clamp is designed to come off from the counterweighted nut fairly easily in the event of an impact or entanglement. This design protects the wiring from damage.

How the wiring is run is user choice, but take caution not to run the wiring in such a way as to make it an entanglement hazard. The HUD wiring from the head can route down the inside of the breathing hoses.

Fig. 2.81

10: CLEAN HEAD TO BUCKET SEALING O-RINGS, O-RING GROOVES AND LUBRICATE O-RINGS

In the Component Inspection (Step 9 B) you checked and if needed cleaned the bucket sealing O-rings. If you are assembling the PRISM 2 right after your inspection, you do not need to re-clean the O-rings. You can simply use this step to verify that nothing had fallen onto the O-rings that could cause a leak during dive operations.

If the PRISM 2 has been transported or disassembled in such a way that debris could have gotten on the O-rings, we recommend repeating this step. We have duplicated these steps here, instead of making you go back in the manual. (If you don't need to clean the O-rings, skip ahead to Step 11):

The head to bucket sealing flange incorporates two bucket sealing O-rings. It is important that you clean and check both O-rings and their seating surfaces whenever the bucket has been removed from the seating flange.

To begin the cleaning process, using an O-ring removal tool, remove the two O-rings from their grooves starting with the O-ring closest to the head (#1) and lay it on a clean towel. Next, remove the O-ring closest to the edge of the bucket flange (#2). Never use any sharp or metal objects to remove the O-rings, as that would damage the O-ring and/or the seating surface. Never over-stretch the O-rings while removing them.

Clean any debris (usually small particles of soda lime) and lubricant on the O-rings with a lint-free towel. Once clean, run the O-rings through your fingers feeling for any nicks or left over debris while visually inspecting them at the same time. There must be no lint, hair, or particles of any kind on the cleaned O-ring, since debris on the O-ring would cause a seal failure. If you find any damage to the O-ring, it must be replaced with a new O-ring from your spares kit.

Lay the 2 cleaned (but not yet lubricated) O-rings aside on a clean surface. Clean the seating surface on the head flange, making sure to remove any debris that may have collected in the O-ring grooves.

Put a small dab of lubricant on your forefinger and lightly coat each O-ring with a sheen of lubricant by running the O-ring between your forefinger and thumb. While you are doing this, feel for any leftover debris and if found, re-clean the O-ring and reapply fresh lubricant. Immediately replace all cleaned and lubricant-treated O-ring back on the head after you lube them, in the opposite order in which you took them off.

11: CLEAN RED CO_2 SEAL AND SECURE IN PLACE: 2 STEPS

The Red CO_2 Seal is a large soft red silicone gasket that resides on the underside of the head in a channel on the face of the head plate, next to the three O_2 sensors *(Fig. 2.82).*

Fig. 2.82

A: Make sure there is no debris, dust or lubricant

Check the face of the red CO_2 seal to insure there is no old absorbent or other debris that could compromise a proper seal of the basket. Remove the seal and check that there is no lubricant in the seal channel that could cause the seal to come loose during assembly. Do not lubricate the red CO_2 seal. Clean the seal channel of any debris or lubricant.

B: Make sure the Red CO_2 Seal is firmly seated in its groove (triple check)

Check that the gasket is in place and securely seated in its channel in the head plate by pushing down on it all the way around the gasket. Recheck that the gasket is properly seated just before you install the scrubber basket and bucket assembly on the head.

The Red CO_2 Seal is a critical component of a properly functioning breathing loop. If the gasket is left out during operation, the unit will not scrub any CO_2. Resulting in 100% breakthrough. For this reason, you must verify that the gasket is in place, seated properly in its groove, clean and undamaged. Failure to check the Red CO_2 Seal will lead to serious injury or death.

12: CHECK FILLED CO_2 SCRUBBER BASKET: 2 STEPS

Regardless of whether you packed your scrubber basket ten minutes ago or yesterday, you must recheck the basket one final time before loading it into the rebreather. This is especially true if the absorbent might have had an opportunity to settle during transportation, or if the basket top came loose in handling. Remember, a properly packed absorbent basket is essential for a safe dive.

A: Basket top secure

Make sure the basket top is tight and fully seated on the basket. The bottom of the basket top should line up with the bottom of the threaded section of the basket cage. *(Fig. 2.83)*

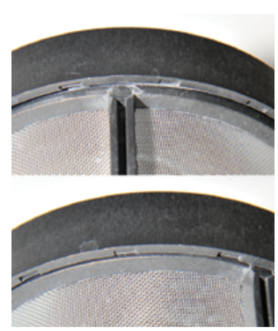


Fig. 2.83

B: Check for settling and firmness of absorbent bed

Just as you do when packing the basket, feel the absorbent from bottom to top. It should feel evenly dense throughout. Put slight pressure on the mesh by squeezing it. The applied pressure should not displace grains of absorbent. If the absorbent is not tight and even throughout, you must re-pack the scrubber.

13: CHECK SCRUBBER BUCKET: 4 STEPS

A: Clean bucket sealing surface

Before mounting the bucket to the head, give the bucket flange O-rings one last look for hair, lint, dirt or anything that might have fallen onto the lubricant. Clean the sealing surface of the bucket with a clean, lint-free cloth. Check that there is no debris or hairs left on the sealing surface that could cause a slow leak into the bucket.

B: Basket compression spring installed and functional

Press down on the basket compression spring, making sure that the spring is functioning correctly and is firmly held in place by the retaining nut.

C: Install bucket moisture pads

Place the supplied moisture pad at the bottom of the bucket

D: Make sure the pad is not resting on or interfering with the basket compression spring

Make sure the absorbing pad is laying flat and it is not hung up on the spring or spring pad. *(Fig. 2.84)*

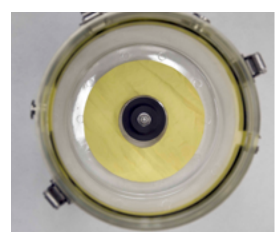


Fig. 2.84

14: PLACE CO_2 BASKET IN BUCKET, CONFIRM CENTER TUBE OPENING UP, MOUNT AND SEAL BUCKET TO HEAD

Gently place the basket in the bucket making sure the center breathing tube is facing up. *(Fig. 2.85)*

Push down on the basket top and make sure it springs back. If it does not move, you have either placed the basket in the bucket up side down, or the spring assembly is not working correctly. Open up the nylon bucket strap and slide the bucket underneath making sure the top bucket latche is centered and facing away from the backplate. Open all 3 bucket latches and fold back the hooks, so they do not get caught between the bucket and head.

Put your hand at the bottom of the bucket and push it up towards the head, making sure not to twist or push at an angle.

WARNING: If you can't inhale from the loop once you seal the bucket on the head it's most likely because you installed the scrubber basket upside down in the bucket. The bucket spring forces the flat basket top onto the Red CO_2 Seal as a safety precaution, stopping gas flow around the loop.

When the bucket is close enough to the head that the latches can catch onto the Latch Keeper, flip the two side latches onto the keeper and lock them in place. Verify that the latches are locked by attempting to pull up on them. Then flip the middle latch into place and lock it down. Then verify it is locked too. Look at the two O-rings through the clear bucket to verify that they are in their grooves and are not twisted or pinched.

Fig. 2.85

Intra -Dive: ☐ No ☐ Yes
Scrubber: ☐ New ☐ Used
Total Time Used On Scrubber: ____

EN 14143 testingl:

- 84 min (0.5%, SEV CO2) using 8-12 @ 40 °F/4.4 °C, 1.61 L/min CO2, 131 fsw/40 msw
- 61 min (0.5%, SEV CO2) using 8-12 @ 40 °F/4.4 °C, 1.61 L/min CO2, 328 fsw/100 msw

Non-CE testing from ANSTI:

- 240 minutes (0.5% SEV CO2) using 8-12 @ 40 °F/4.4 °C, 1.35 L/min CO2, 40 lpm RMV, 60 fsw/28 msw

OPERATIONAL CHECKLIST LEVEL 1

Name: ________________________ *Date:* ___ /___ /___

- ☐ **1. Assembly Checklist Completed**
- ☐ **2. Install Analyzed + Labeled Gas Cylinders**
- ☐ **3. Turn On Wrist Display**
- ☐ **4. Turn On HUD – Check Battery Status**
- ☐ **5. Oxygen System Leak Test**
  (hold for 30 seconds minimum)
- ☐ **6. Negative Pressure Test**
  (hold for 1 minute minimum)
- ☐ **7. Positive Pressure Test**
  (hold for 1 minute minimum)
- ☐ **8. Flush Loop (2 times)**
- ☐ **9. Calibrate Wrist & HUD**
  (hold for 30 seconds minimum)
- ☐ **10. Check Solenoid & Wrist Display Battery**
- ☐ **11. Install Cover**
- ☐ **12. Diluent System Leak Test**
- ☐ **13. Check ADV, BOV if equipped, and BCD**
- ☐ **14. Pre-Breathe (5 minutes)**

If Diving Immediately:
Continue with *"Pre-Dive Checks"*.

If *NOT* Diving Immediately:
Close O_2 + diluent cylinder valves, drain hoses, turn off electronics and secure unit.

Pre-Dive Checks:

- ☐ **15. Weights**
- ☐ **16. HUD And Wrist Displays On**
- ☐ **17. Tank Valves Open**
- ☐ **18. Verify Setpoint And Loop Contents**
- ☐ **19. Don The Prism 2**
- ☐ **20. Pre-Jump**
  (See hang tag on rebreather.)

Intra -Dive: ☐ No ☐ Yes
Scrubber: ☐ New ☐ Used
Total Time Used On Scrubber: _____

Maximum Scrubber Duration:

EN 14143 testingl:

- 84 min (0.5%, SEV CO2) using 8-12 @ 40 °F/4.4 °C, 1.61 L/min CO2, 131 fsw/40 msw
- 61 min (0.5%, SEV CO2) using 8-12 @ 40 °F/4.4 °C, 1.61 L/min CO2, 328 fsw/100 msw

Non-CE testing from ANSTI:

- 240 minutes (0.5% SEV CO2) using 8-12 @ 40 °F/4.4 °C, 1.35 L/min CO2, 40 lpm RMV, 60 fsw/28 msw

OPERATIONAL CHECKLIST LEVEL 2

Name: ____ *Date:* ___ /___ /___

☐ **1. Assembly Checklist Completed**

☐ **2. Install Analyzed + Labeled Gas Cylinders**

☐ **3. Turn On Wrist Display.**

A. Check O_2 cell mV readings in air (acceptable: 8.5 mV to 14 mV - replace if needed)
B. Change to Setpoint .19 (8 X MENU - Left Button)

☐ **4. Turn On HUD – Check Battery Status**

☐ **5. Oxygen System Leak Test**

(hold for 30 seconds minimum)

A. Slowly open oxygen valve, pressurize hoses, close valve
B. Watch oxygen pressure gauge for pressure loss
C. Slowly open oxygen valve

☐ **6. Negative Pressure Test**

(hold for 1 minute minimum)

A. Open DSV/BOV
B. Inhale from DSV/BOV in CC mode, exhaling through nose until counterlungs are fully collapsed
C. Close DSV/BOV
D. Allow to sit for one minute; watch for signs of leaks.

☐ **7. Positive Pressure Test**

(hold for 1 minute minimum)

A. Close OPV
B. Fill loop fully with oxygen using manual oxygen addition valve until OPV vents
C. Allow to sit for one minute, watch for signs of leaks
D. Open DSV/BOV, evacuate loop contents

☐ **8. Flush Loop (2 times)**

A. Close DSV/BOV
B. Fill loop with oxygen until OPV vents
C. Evacuate loop fully
D. Repeat steps A. & B.
E. Open DSV/BOV to equalize pressure to ambient pressure. Close DSV/BOV.

☐ **9. Calibrate Wrist & HUD Wrist Display:**

Wrist Display:

A. Menu to calibrate (2 X MENU – left button)
B. Press Select (right button) twice to calibrate
C. Check mV readings in O_2 (acceptable: 40.6 mV - 66.9 mV)

HUD:

D. 3 rapid presses (within 1 second) on Heads Up Display piezo power switch

☐ **10. Check Solenoid & Wrist Display Battery**

A. Setpoint to high (>1.1)
B. Solenoid fires, O_2 injection verified
C. Change setpoint to .19
D. Solenoid and wrist display battery check [acceptable: Ext V ≥ 7 / Int V ≥ 3.18] (6 X SELECT – Right button)

☐ **11. Install Cover**

☐ **12. Diluent System Leak Test**

(hold for 30 seconds minimum)

A. Open diluent cylinder
B. Watch diluent pressure gauge for pressure loss
C. Open diluent cylinder

☐ **13. Check ADV, BOV if equipped, and BCD**

A. Inhale from onboard alternate air source if supplied
B. Open DSV/BOV, inhale from loop until ADV engages, dropping loop PO_2
C. BCD Inflation + deflation mechanisms / air holding

☐ **14. Pre-Breathe (5 minutes)**

A. Change wrist display to low setpoint
B. Block nose and begin breathing from the PRISM 2 (in a safe location)
C. Observe setpoint maintenance

If Diving Immediately:
Continue with “Pre-Dive Checks”.

If NOT Diving Immediately:
Close O_2 + diluent cylinder valves, drain hoses, turn off electronics, and secure unit.

Pre-Dive Checks:

☐ **15. Weights**

☐ **16. HUD And Wrist Displays On**

☐ **17. Tank valves open**

☐ **18. Verify Setpoint And Loop Contents**

☐ **19. Don The Prism 2**

☐ **20. Pre-Jump** (See hang tag on rebreather)

A. Begin Breathing Unit
B. Check: ADV/BOV, O_2 Add, Dil Add; BCD
C. Check SPG: O_2, Dil; OC
D. Observe Setpoint Maintained
E. Always Know PPO_2 & Have Fun

1: ASSEMBLY CHECKLIST COMPLETED

2: INSTALL ANALYZED + LABELED GAS CYLINDERS

Place the diluent tank under the two tank straps on the divers left. Place the O_2 tank on the divers right. It is very important that you put the correct tank in the appropriate position. Screw the DIN first stage into the valve and then do the same with the oxygen side of the system. Tighten the tank bands.

NOTE: EUROPEAN OXYGEN REGULATOR

European models of the PRISM 2 Oxygen Regulator utilize a M26 fitting for attachment. The threads are different than standard DIN fittings to avoid confusion. Though Installation is the same.

3: TURN ON WRIST DISPLAY.

A: Check O_2 Cell mV Readings In Air, Replace If Out Of Range (acceptable: 8.5 mV to 14 mV)

Record O_2 Cell mV readings in air: #1_____ #2_____ #3_____

Turn on the Wrist Display. Press the select (right) button twice, and view the millivolt screen. Record the mV outputs for each cell. You will use these readings to check linearity. Do so by multiplying these readings by 4.76 and comparing them to the readings after flushing the loop with pure O_2.

B. Setpoint to 0.19 (8X menu - left button)

If not already set, you will need to set the active setpoint to 0.19 so the computer is not automatically injecting O_2 into the loop. Depress the menu button 8 times until you see the "Setpoint .19" menu item, then press the select button once to select it. This will, in effect, shut off the solenoid while the O_2 sensors are exposed to air.

NOTE:

Get in the habit of checking off each item on the checklist as you go and DO NOT skip around on the list. Good check-list habits are the best way to insure that you have assembled your PRISM 2 correctly, and have not left out a critical step.

4. TURN ON HUD – BATTERY CHECK

☐ **OK** ☐ **Replaced & OK**

Turn the HUD power on with a single press of the piezo switch on the back of the electronics stack on the head and verify that all three of the LEDs illuminate, first green then red. If all three lights continuously show orange for 30 seconds upon start-up, the Heads Up Display battery is low and must be changed, before diving.

WARNING: The Heads Up Display will only give a battery warning on start-up and will not alert the user to a critically low battery while diving. Therefore, you MUST change the Heads Up Display battery whenever the electronics illuminate the 3 LEDs orange for 30 seconds upon start-up.

5: OXYGEN SYSTEM LEAK TEST (HOLD FOR 30 SECONDS MIN.)

You will check to make sure there are no small leaks in the oxygen delivery system (1st stages, hoses QD fittings, valves).

A: Slowly open oxygen valve, pressurize hoses, close valve

Slowly open the oxygen cylinder valve. Allow the hoses to fully stretch and pressurize. With new hoses, allow them to stretch for a minute or two while the tank is on. Shut off the oxygen cylinder valve.

B: Watch oxygen pressure gauge for pressure drop

Listen for leaks and check that the pressure on the gauge has not dropped after a minute or two.

C: Slowly open oxygen valve

Slowly open the oxygen valve.

NOTE:

At any time, but especially for extended range diving, it is advisable to allow the loop to sit for at least 5 minutes before checking to see if vacuum or pressure is being lost. Small leaks may not allow enough pressure or vacuum to escape in the first minute or two of the tests to be noticeable by palpatation of the counterlungs, but may allow enough water into the loop during diving to become problematic. Small leaks will also usually show up in the bubble check but it is usually less time-consuming to identify and correct leaks at this stage of set-up.

6: NEGATIVE PRESSURE TEST (HOLD FOR 1 MINUTE MINIMUM)

The negative pressure test will check for the types of leaks that may not show during a positive pressure test. These types of leaks are fairly rare but are just as potentially dangerous, so it is extremely important to perform the test. Make a mental note of either the mV readings or the PO_2 readings on the Wrist Display prior to starting the test. If the negative pressure in the loop during this test is strong enough, you will notice that the mV or PO_2 readings drop a point or two and will remain at those values as long as there are no leaks in the loop. If the readings do not drop at all, it is possible that you cannot create enough of a vacuum to drop the values, or you have a leak in the system that will not allow a vacuum to form at all.

We do the negative pressure test at this stage of the checklist because we are also preparing the loop for an oxygen flush, which we will begin doing during the positive pressure test. Performing the negative pressure test now removes as much air from the loop as possible.

Fig. 2.86

A: Open DSV/BOV

Open the DSV/BOV and press on both counterlungs *(Fig. 2.86)* to remove as much air as possible from the counterlungs.

B: Inhale from DSV/BOV in CC mode, exhaling through nose until counterlungs are fully collapsed

Now place the open DSV/BOV in your mouth, and while inhaling from your mouth and exhaling through your nose, get as much air as possible out of the loop. Continue until the counterlungs have fully collapsed and you cannot pull any more air out of the loop, leaving a slight vacuum, “negative pressure”, in the loop.

C: Close DSV/BOV, evacuate loop contents

With the loop drained of as much gas as possible and the DSV/BOV still in your mouth, shut down the DSV/BOV. Do not allow air back into the loop while shutting down the DSV/BOV.

D: Allow to sit for one minute, watch for signs of leaks on Wrist Display PO_2 /mV readings

After you pull a vacuum on the loop, the counterlungs will be fully collapsed and hard to the touch *(Fig. 2.87)*. Allow the loop to sit for at least one minute while you watch the Wrist Display mV or PO_2 readings for a change and/or watch the counterlungs and loop hoses to see if the material appears to relax, even slightly *(Fig. 2.88)*. If the loop does appear to be losing vacuum, you must track down and fix the leak, or leaks, prior to diving.

Fig. 2.87

Leaks that only show up in negative pressure tests but not positive pressure tests are rare. However, they are the hardest to find because you cannot do a simple bubble check to find them. Usually they are the result of a counterlung drain locking collar not being tightened which could cause the negative pressure in the loop to open the valve and allow air in. (This problem would not occur during diving). Make sure both counterlung drain locking collars are shut tight *(Fig. 2.89)*. Another possibility is debris in the OPV mushroom valve or seat. A flush with fresh water might remove the material creating the leak. Worn O-rings in the DSV/BOV may also show up in the negative leak test. Never dive a PRISM 2 that shows signs of a leaking loop, as that could compromise the integrity of the loop, possibly leading to injury or death.

Fig. 2.88

7. POSITIVE PRESSURE TEST (HOLD FOR 1 MINUTE MINIMUM)

The positive pressure test will identify most leaks in the breathing loop. It also begins the process of flushing the loop with oxygen in preparation for calibration of the O_2 sensors.

Fig. 2.89

A: Close OPV

Make sure the DSV/BOV is closed and turn the OPV (over-pressure valve) fully counter-clockwise to restrict its flow. *(Fig. 2.90)*

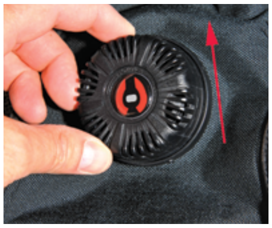


Fig. 2.90

B: Fill loop fully with oxygen using manual oxygen

addition valve until OPV vents.

Depress the manual oxygen addition valve on the exhalation counterlung to add oxygen. Continue adding oxygen into the loop until the over-pressure valve on the front of the exhalation counterlung begins to release pressure. The counterlungs should feel firm to the touch and remain that way. If the counterlungs lose pressure, you must track down and fix the leak or leaks prior to diving. If the leak is small such that you can not hear gas escaping while the loop is under pressure, you can submerge the rebreather in water and look for a trail of bubbles. (Tanks must be mounted on the first stages prior to submerging the unit to avoid flooding the first stages.) Do not submerge a fully built and absorbent packed unit that rapidly loses air because you could fully flood the unit, ruin your absorbent and destroy the O_2 sensors. Never dive a PRISM 2 that shows signs of a leaking loop, as that could lead to injury, and possibly death.

C: Allow to sit for one minute, watch for signs of leaks

Fully fill the loop with oxygen, with the OPV closed, until it vents gas. Allow the loop to sit for at least a minute. Be careful not to jostle the counterlungs as any added external pressure could cause the OPV to activate, releasing internal pressure. You should gently palpate (feel) the counterlungs after filling them and after a few minutes see if they feel the same as they did when you first filled the loop.

D: Open DSV/BOV, evacuate loop contents

Open the DSV/BOV in CC mode and push on the counterlungs to remove as much gas as possible from the loop.

8. FLUSH LOOP (2 TIMES)

Since the DSV/BOV is open at this stage, pull another negative.

A: Close DSV/BOV

Once you have pulled the negative, close the DSV/BOV

B: Fill loop with oxygen until OPV vents

Press the Manual Oxygen Addition valve as you did during the Positive Pressure Test, and fill the loop until the OPV vents.

C: Evacuate loop fully

Pull another negative.

D: Repeat steps A & B.

E: Open DSV/BOV to equalize pressure to ambient pressure. Close DSV/BOV

After the two oxygen flushes, crack open the DSV/BOV momentarily to let any positive pressure escape from the loop, returning the loop to ambient pressure.

9. CALIBRATE WRIST & HUD (HEADS UP DISPLAY)

Wrist Display: This step will calibrate the Wrist Display.

A: Menu to calibrate (2X menu - left button) *(Fig. 2.91)*

Depress the menu button (left) twice to get to the calibrate screen.

B: Press select button twice to calibrate

Depress the "select" button twice to calibrate. Once the Wrist Display accepts calibration, all 3 PO_2 display values will match with the "Cal. PPO_2" value programmed into the computer during system setup (see "Cal PPO_2" programming in the PRISM 2 Displays and Electronics User Manual). The system default is 0.98 PO_2.

C: Check mV readings in O_2:

#1_____ #2_____ #3_____ (acceptable range 40.6 mV to 66.9 mV)

You want to record the millivolt readings so you can monitor the health of the O_2 sensors over time. As the cells age, the current output in both air and pure O_2 will decrease to a point where they can become unstable and unpredictable. Usually, the cells will exceed their "Use by" date and need to be retired before they become a problem, but occasionally you may get a cell which "goes bad" during its service life (which is printed right on the cells' label for your safety). Recording these mV readings will allow you to better track cell behavior and aging.

NOTE:
If the wrist unit electronics do not have a valid O_2 calibration stored in memory, the solenoid will not fire when the system is turned on. If the Wrist Display reads "FAIL" on the O_2 sensor readouts *(Fig. 2.91)* you will need to use the mV readings to verify a proper loop flush.

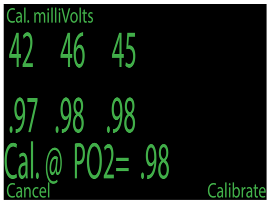


Fig. 2.91

NOTE:
The electronics might catch an inadequate oxygen flush, as the Millivolt readings from the O_2 sensors in a loop which has not been fully flushed might be too low and the software would reject calibration. Recording the pre and post O_2 pressures is one tool in your kit of diagnostic clues when your electronics are rejecting calibration.

Also, recording the mV values in oxygen and comparing those values with previous values can give us a good indicator if we have done a thorough flush of the loop. For instance, if the last time you calibrated the system, the mV values were 55, but a week later they are outputting 45 mV post-flush, you may want to consider flushing more oxygen through the loop to see if those mV values increase as you add more O_2, which would indicate an incomplete loop flush.

Finally, after you have satisfied yourself that your loop is thoroughly flushed with oxygen, you can do a 2 point field linearity check by multiplying the readings in air (from Step 3) by 4.76. You should get a number that is within a few percentage points of the mV readings recorded here in pure O_2. While this field test is not a true linearity test as it only compares 2 points, both of which are at ambient pressure and cannot take the place of a true full range (ambient + hyperbaric) linearity test, it is easy to do and doesn't hurt the cell, so why not do the math. (Poor loop flushes or O_2 less than 100% purity will affect these comparisons adversely). Cells which are not linear or are current limited must not be2 dived.

HUD:

A: 3 rapid presses (within 1 second) on HUD piezo power switch

This will lock in the calibration. All three LEDs will turn red for 5 seconds then begin reporting 1.0 PO_2 with 1 orange blink every 5 seconds. If any of the LEDs blink in any other fashion after indicating a successful calibration, attempt to re-calibrate the HUD. If that does not solve the problem, you must bring the unit in for service. It may take some practice with tapping the switch quickly enough to get the HUD to calibrate.

10. CHECK SOLENOID & WRIST DISPLAY BATTERIES

A: Setpoint to high (>1.1)

The active setpoint is presently .19 which was set in step 3. Depress the menu button 3 times until "Switch .19 > xx" is displayed on the screen. Depress the select button once to select the programmed low setpoint. Repeat to choose the programmed high setpoint.

But my setpoint high is not (>1.1)

It may be necessary to edit the high setpoint so it is higher than 1.1. The Wrist Display has user programmable low and high setpoints. The default low setpoint is 0.7 ata O_2. The default range for low or high setpoints are 0.5 – 1.5. The PRISM 2 Displays and Electronics User Manual contains full details on how to program setpoints.

Adjusting high setpoint (2 steps)

- Step 1: Menu to dive setup+
Depress the menu (left) button until you come to the "dive setup+" screen *(Fig. 2.92)*.

- Step 2: Menu to edit high setpoint high setpoint: ________
Press the select button (right) to enter the "edit high SP" screen *(Fig. 2.93)*. Press the select button again to edit the low setpoint value. Pressing the menu button will change the value incrementally and continue to roll over until a value is saved using the select button.

B: Solenoid fires & oxygen injection is verified

This step will check that the solenoid is adding oxygen to the breathing loop when it fires. As long as the high setpoint is greater than 1.0 PO_2, the solenoid will begin firing to add oxygen to the loop. If the high setpoint is less than 1.0 PO_2, you will either need to drop the loop PO_2 by injecting diluent via the ADV or increase the high setpoint in the System Setup menu. Once the solenoid begins injecting O_2, you should be able to hear the oxygen entering the loop at the head plate, but if you are in a noisy environment, such as on a boat, you can simply turn off the O_2 cylinder valve momentarily and watch for the pressure gauge needle to drop as the solenoid fires or release some pressure from the loop by manually pressing the OPV, then watch as the counterlungs expand as the O_2 enters the loop. Make sure to turn the oxygen valve back on if you momentarily shut the valve during the test. If the solenoid fires but no oxygen is injected, check to see if the 0.0020ths in-line restrictor located in the hose fitting at the first stage *(Fig. 2.94)* could be clogged. Do not dive without this restrictor in place.

C: Change setpoint to .19

Fig. 2.92

Fig. 2.93

Fig. 2.94

NOTE:
The voltage screen is timed and will automatically go back to the main screen after 20 seconds. To make your life easier, it would be a good idea to record both battery voltages at the same time.

Once the solenoid has fired and you have verified that oxygen is getting into the loop, change the active setpoint back to .19 by depressing the menu button 8 times until "Setpoint .19" shows on screen *(Fig. 2.95)*. Depress the select button once. The solenoid should stop firing.

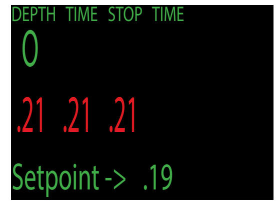


Fig. 2.95

D: Solenoid and wrist display battery check

Solenoid Battery V: ______ ☐ OK or ☐ Replaced

From the main screen depress the select (right) button six times until the EXT V (external [solenoid] voltage) and INT V (internal [wrist display] voltage) readings are displayed on the bottom of the screen *(Fig. 2.96)*. Record the EXT V in the space provided. A voltage greater than 7 V is considered Ok and below 7 V indicates the alkaline batteries must be replaced before diving. Do not use a voltage meter to check battery state as most meters do not put a load on the battery and will give artificially high readings as a result.

Fig. 2.96

Wrist Display Battery V: ______ ☐ OK or ☐ Replaced

On the same display screen as the solenoid battery (EXT V) is the battery voltage for the Wrist Display battery shown under "INT V" *(Fig. 2.97)*. Check and record the "INT V" value in the space provided. If the voltage value is flashing yellow or red, you must replace the battery before diving.

Fig. 2.97

11. INSTALL COVER

Attach the PRISM 2 cover to the back of the unit to protect the scrubber head.

12. DILUENT SYSTEM LEAK TEST

This test will determine if there are any leaks in the diluent system.

A: Open diluent cylinder

Slowly open the diluent cylinder valve. Allow the hoses to fully stretch and pressurize. With new hoses, allow them to stretch for a minute or two while the tank is on. Shut off the diluent cylinder valve.

B: Watch diluent pressure gauge for pressure loss

Watch the diluent pressure gauge for at least a minute, looking for any pressure drop. If the diluent first stage and hoses are slowly losing pressure you can use a spray bottle filled with soapy water to track down the leak. Never dive the PRISM 2 with leaks in the diluent system as catastrophic loss of pressure could occur during a dive.

C: Open diluent cylinder

Open the diluent cylinder valve.

13. CHECK ADV, BOV IF EQUIPPED, AND BCD

A: Inhale from onboard alternate air source if supplied

If your PRISM 2 is equipped with a BOV, switch to open circuit mode and breathe from it to verify that it is operational. If your diluent system has multiple alternate air sources attached, switch from one to the other.

B: Open DSV/BOV (CC mode), inhale from the loop until ADV engages, dropping loop PO_2.

Open DSV/BOV, inhale through your mouth, and exhale through your nose, until the inhalation lung collapses fully. When collapsed the ADV should actuate to add gas into the loop.

C: BCD inflation + deflation mechanisms air holding

Auto-inflate the buoyancy compensator partially and verify that it is holding pressure. Deflate the buoyancy compensator by letting a little air out of each deflation mechanisms.

14. PRE-BREATHE (5 MINUTES)

A. Change wrist display to low setpoint

The active setpoint is presently .19 which was set in step 3. Depress the menu button 3 times until “Switch .19 > xx” is displayed on the screen. Depress the select button once to select the programmed low setpoint.

B. Block nose and begin breathing from the PRISM 2 (in a safe location)

Pre-breathing gives you time to verify that all systems are go prior to entering the water. It is unlikely that even a 5 minute pre-breathe can identify a

WARNING: Despite doing a pre-breathe, it is entirely possible that unhealthy levels of CO_2 can build up in the breathing loop for any number of seen and unforeseen reasons. You must remain vigilant for the symptoms of CO_2 poisoning at all times while diving a rebreather.

problem with the absorbent, or even verify that you have installed the absorbent basket in the loop! So don't allow a pre-breathe regimen to lull you into a false sense of security. Remain vigilant, especially during the first few minutes of a dive, for any signs or symptoms of CO_2 buildup, and bailout to OC at the first hint of trouble.

C. Observe setpoint maintenance

Once you have metabolized enough loop O_2 that the electronics register the drop in O_2 and fire the solenoid, watch how the O_2 sensors react. They should not register a large jump in PO_2 but an incremental increase over 3 or 4 breaths back to the active setpoint. If you see a wild swing in PO_2, DO NOT DIVE THE REBREATHER as that would indicate a serious problem with the electronics or sensors that could lead to possible injury or death.

If diving immediately, continue with Immediate Pre-Dive Checks now.

If NOT diving immediately: Close O_2 and diluent cylinder valves & drain lines, turn off electronics and secure unit.

PRE-DIVE CHECKS:

15. WEIGHTS

After some trial and error you will figure out how much weight you will need to safely dive the PRISM 2. How you choose to distribute that weight is mostly a comfort issue, based on your physical build. The PRISM 2 has weight pockets sewn into the back of each counterlung. The only hard and fast rule regarding weight distribution is that the majority of the weight must be easily ditch-able in the event of a catastrophic loop flood on the surface or any event requiring an emergency buoyant ascent from depth.

A: Counterlung

Each counterlung can hold up to 5 lbs/2.2 kg of either hard or soft lead. How much lead you use is up to you, but most people report that 3 - 4 lbs/1.3 - 1.8 kg is sufficient to offset counterlung buoyancy.

Some PRISM 2 divers prefer not to add weight to the counterlungs. Again, weight distribution is mostly a comfort and in-water trim issue.

What works for one person may not work for another.

B: Trim weights

Depending on your system configuration, you may have various trim weights on the system. Since trim weights are not easily ditch-able in an emergency, use them sparingly, and make sure that the total non-detachable weights, plus the weight of a fully flooded loop (17 lbs/7.7 kg) is not greater than the buoyancy compensator can lift and maintain positive buoyancy on the surface.

16. HUD AND WRIST DISPLAYS ON

HUD Turn on the HUD while watching the HUD LEDs. All LEDs on the HUD should begin to blink, reporting the O_2 content of the loop. (As a reminder, If the HUD displays orange for 30 seconds at start-up, you must change the battery before diving.

Wrist Display Turn on the wrist display by depressing both switches. Look at the Wrist Display and verify the content of the loop, that all three O_2 sensors readings agree, the battery is charged and the setpoint is set correctly for the dive.

17. TANK VALVES OPEN

Ensure O_2, diluent, bailout, and any offboard drysuit inflation cylinders are open.

18. VERIFY SETPOINT AND LOOP CONTENTS

A: Verify active setpoint on “low setpoint” (≥ 0.4)

Make sure your PO_2 is on a breathable setpoint, **NOT** 0.19.

B: Verify loop contents are within user set limits on wrist display

You should not attempt to breathe from the loop if the Wrist Display indicates the O_2 content in the loop is less than your pre-set low setpoint.

WARNING: Always verify that your gas supply cylinders are turned on prior to entering the water! Have you ever jumped in the water while diving an open circuit system only to find out you forgot to turn your air on? It’s a pretty obvious oversight the moment you try to inhale gas. If you do that on a closed circuit rig wtih your O_2 tank, the consequences may be delayed (you can still breathe on the loop) but may be fatal.

At this point in the set-up, the computer should be monitoring the O_2 content of the loop and adding O_2 to keep the loop at your user selected low setpoint. If the loop PO_2 is low, check that you have not accidentally switched from low setpoint to the 0.19 PO_2 setting in the computer.

Do not dive your PRISM 2 until you verify the computer is maintaining your programmed loop PO_2.

19. DON THE PRISM 2

Attach counterlung straps, crotch strap(s), cummerbund and waist strap, and tighten as needed.

20. PRE-JUMP (see hang tag on rebreather) *(Fig. 2.98)*

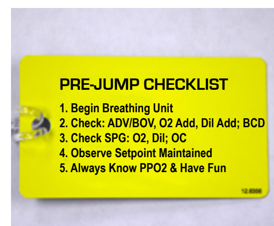


Fig. 2.98

A: Begin Breathing Unit

Pre-breathing gives you time to verify that all systems are go prior to entering the water. It is unlikely that even a 5 minute pre-breathe can identify a problem with the absorbent, or even verify that you have installed the absorbent basket in the loop! So don't allow a pre-breathe regimen to lull you into a false sense of security. Remain vigilant, especially during the first few minutes of a dive, for any signs or symptoms of CO_2 buildup, and bailout to OC at the first hint of trouble.

To do a proper pre-breathe, block your nose by pinching it and remain securely seated throughout the pre-breathe while constantly monitoring and maintaining a safe loop PO_2.

WARNING: Despite doing a pre-breathe, it is entirely possible that unhealthy levels of CO_2 can build up in the breathing loop for any number of seen and unforeseen reasons. You must remain vigilant for the symptoms of CO_2 poisoning at all times while diving a rebreather.

B: Check: ADV/BOV, O_2 Add, Dil Add; BCD

Breathe the loop down (breathe in from mouth, exhale from nose) while watching the diluent SPG, until the diluent addition valve fires. The SPG needle should not move. If the needle moves it is likely that the Diluent tank valve is closed. Ensure that the valve is opened (counterclockwise) and retest.

Now depress the ADV body until the valve fires. This will lower the loop PO_2. If the PO_2 lowers enough below the setpoint, it will cause the electronics to fire the solenoid. Continue breathing from the loop. If the unit is supplied with a BOV, momentarily switch to open circuit and breathe from the BOV. Return to Closed Circuit Mode.

Partially inflate the BCD and then check that all the deflation mechanisms of the BCD are operational and easily accessible.

NOTE:
Save gas, manually inflate the BCD during setup when feasible!

C: Check SPG: O_2, Dil (diluent); OC (open circuit bailout supplies)

Momentarily depress the manual oxygen addition valve while watching the O_2 SPG. You should hear (or feel) oxygen enter the loop and the SPG needle should not move. If the needle moves it is likely that the O_2 tank valve is closed. Ensure that the valve is opened (counterclockwise) and retest.

Check the pressure in each cylinder and verify that you have the planned amount of gas available in each cylinder. Breathe from all off-board bailout supplies to verify they work as well.

D. Observe setpoint maintained (within selected setpoint on HUD and Wrist Displays)

Once you have metabolized enough loop O_2 that the electronics register the drop below setpoint and fire the solenoid, watch how the O_2 sensors react. They should not register a large jump in PO_2 but an incremental increase over 3 or 4 breaths back to the active setpoint. If you see a wild swing in PO_2, **DO NOT DIVE THE REBREATHER** this could indicate a serious problem with the electronics or sensors that could lead to possible injury or death.

Instead, recalibrate the sensors and perform another Pre-Breathe. If your unit still performs erratically with wild swings in PO_2, **DO NOT DIVE THE REBREATHER**. It must then be evaluated and serviced by a qualified PRISM 2 Service Technician before any further use.

E. Always know PPO_2 & have fun

Constantly monitor the breathing loop PPO_2 to ensure a safe breathing gas and proper function of your PRISM 2. Monitoring the PPO_2 is your best protection and early warning of unit failure.

Don't forget to do your in-water bubble checks, and have a safe dive!

POST-DIVE CHECKLIST

Name: ______________________ Date: ___ /___ /___

☐ **1. Verify and record batteries (Solenoid/Wrist Display).**

Solenoid battery: V:_______ Good ☐ Replaced ☐

Wrist Display battery: V:_______ Good ☐ Replaced ☐

☐ **2. Turn off, Secure Wrist Display**

☐ **3. Verify Heads Up Display Battery** Good ☐ Replaced ☐

☐ **4. Drain counterlungs of fluid**

☐ **5. Remove CL weights**

☐ **6. Remove weight pockets, weights, rinse and hang to dry**

☐ **7. Soak complete, sealed unit in fresh water for 20 minutes if possible or hose off with fresh water**

☐ **8. Turn off O_2 and drain lines, remove tank**

☐ **9. Turn off diluent and drain lines, remove tank**

☐ **10. Detach Bucket from head, record absorbent usage, or discard absorbent material**

Stored for re-use ☐ Discarded ☐

Date packed: ___/___/____ Size: _____ Total hours used:_______

☐ **11. Sanitize bucket**

☐ **12. Inspect O_2 sensors, record readings in air**

Sensor 1: ________ Sensor 2: __________ Sensor 3: _________

☐ **13. Disassemble mouthpiece to counterlung hose assembly, sanitize; hang to dry**

☐ **14. Remove counterlungs, sanitize, hang to dry**

☐ **15. Drain and hang BCD/backplate/head assembly in a shaded area to dry.**

☐ **16. Review maintenance/repair log and address any repairs if required.**

POST-DIVE CHECKLIST: DETAILS

During the post-dive tear-down, pay attention to each part looking for any damage or wear that would require maintenance or repair. Record the damage in your maintenance/repair log and address the needed repairs immediately after finishing your post-dive checklist.

1: VERIFY AND RECORD BATTERIES (SOLENOID/WRIST DISPLAY)

This is a good time to verify that the batteries in your PRISM 2 have enough power for continued use. Should you need to replace a battery, it is better to find out now than to be scrambling for new batteries during set-up.

Solenoid battery: V:________ ☐ Good ☐ Replaced

Wrist Display battery: V:________ ☐ Good ☐ Replaced

From the main menu, depress the select button (right) six times until the lower display shows the solenoid (ext) and Wrist Display (int) batteries. A voltage reading of less than 3.28 volts for the Wrist Display and a voltage of 4 volts for the solenoid indicate a battery that must be changed. If you change a battery, make sure to notate it on your maintenance log so you remember to replace the battery in your spares kit.

2: TURN OFF, SECURE WRIST DISPLAY

Turn off the Wrist Display. Secure the Wrist Display so it is not damaged during cleaning or tear-down. Pay particular attention to make sure the wiring is secured so you cannot snag it while moving the unit during cleaning and tear down.

3: VERIFY HEADS UP DISPLAY BATTERY

Turn off the Heads Up Display then turn it back on. If the display shows orange continuously for 30 seconds upon turn-on, the battery must be replaced. Otherwise, consider the battery to be good, but have a spare in your kit just for safety. Remember, both the HUD and Wrist Displays use SAFT 3.6V AA lithium batteries.

☐ Good ☐ Replaced

4: DRAIN COUNTERLUNGS OF FLUID

Your exhale counterlung will have fluid in it which contains both water from your dive environment (fresh or salt) and saliva and other bio-fluids. Open the counterlung drain by loosening (unscrewing) the stainless steel locking collar and push the tip in toward the body of the drain. A viscous fluid, either clear or slightly milky white will drain from the exhale lung.

The Inhale lung should have very little, if any fluid in it. If it does contain excessive fluid, that would indicate a leak somewhere on the inhale side of the loop. Do not dive the unit until you have found and repaired the leak.

5: REMOVE CL WEIGHTS

Remove any weights you had in the counterlung weight pockets. Not having the additional weight in the counterlungs will make them easier to handle.

6: REMOVE WEIGHT POCKETS, WEIGHTS, RINSE AND HANG TO DRY

Remove weight pockets if supplied, or any other removable weights from the unit. Soak the pockets in fresh water then hang to dry.

7: SOAK COMPLETE, SEALED UNIT IN FRESH WATER FOR 20 MINUTES IF POSSIBLE OR HOSE OFF WITH FRESH WATER

Submerge the rebreather in a fresh water rinse tank if one is available. Put the unit in the water and drain all the air from the counterlungs by holding the mouthpiece above water and opening it to let the gas escape from the loop. Also, drain all gas from the buoyancy system. Allow the unit to soak for 20 minutes.

If a rinse tank is not available, rinse the unit as best as you can with a hose. Pay special attention to the core of the system (head, bucket, bladder, first stages, and hoses). Any items that will be removed for sanitizing in the following steps can be soaked separately in a bucket or other small container.

8: TURN OFF O_2 AND DRAIN LINES, REMOVE TANK

Turn off the O_2 tank valve. Depress the manual O_2 addition valve until the first stage and hoses are fully drained. Unscrew the O_2 first stage, loosen the tank straps, remove the tank. Put the dust cover on the first stages.

9: TURN OFF DILUENT AND DRAIN LINES, REMOVE TANK

Turn off the diluent tank valve. Depress the ADV until the diluent first stage and hoses are fully drained. The diluent first stage, loosen the tank straps, remove the tank. Make sure to put the cover on the first stage DIN fitting.

10: DETACH BUCKET FROM HEAD, RECORD ABSORBENT USAGE OR DISCARD ABORBENT MATERIAL

Stored for re-use ☐ Discarded ☐

Date packed: ___/___/____ Size: _____ Total hours used:_________

It is extremely important that any absorbent that is not immediately thrown out is stored shortly after removal in an airtight container. This will insure that the moisture in the absorbent pellets necessary to maintain the chemical reactions that scrub CO_2 does not evaporate.

It is also extremely important that you track the usage of the absorbent pack so you do not accidentally over-use the absorbent pack beyond its serviceable life. Never use absorbent beyond its serviceable life. Using absorbent beyond its serviceable life can lead to injury or death. If you are ever in doubt, throw out the absorbent and re-pack with fresh material. Your life is worth far more than the cost of 6 lbs/2.7 kg of absorbent.

11: SANITIZE BUCKET

If you are using Steramine™ or other dissolving sanitizers, the scrubber bucket is a great vessel to mix up 1 gallon / 3.78 L of sanitizer and soak the breathing hoses, DSV/BOV and moisture pad, then pour the remaining sanitizer into the counterlungs to sanitize them.

For 1 gallon / 3.78 L, fill the bucket to ¾ inch/19 mm below the bottom of the stainless steel latch strap.

After using the sanitizer, either dry the bucket with a clean, dry towel or turn the bucket over and allow it to drip-dry.

12: INSPECT O_2 SENSORS, RECORD READINGS IN AIR

Sensor 1: _________ Sensor 2: ___________ Sensor 3: __________

After settling in air for a few moments, each O_2 sensor should read 0.21 ata O_2. Record the readings in either mV or PO_2, whichever you feel is more relevant to your record keeping.

Acceptable millivolt range for a sensor in air is 8.5-14.5 mV.

13: DISASSEMBLE MOUTHPIECE TO COUNTERLUNG HOSE ASSEMBLY, SANITIZE, HANG TO DRY

Disassemble the sub-assembly, open the DSV/BOV shut-down valve and let soak in the sanitizer. Stretch each hose and allow excess fluid to drain out, then place the hoses in the sanitizer, making sure there are no air pockets trapped in the hose. Remove the hoses and mouthpiece from the sanitizer and hang to dry.

14: REMOVE COUNTERLUNGS, SANITIZE, HANG TO DRY

Remove both counterlungs from the harness and drain any left over fluids by turning the lungs upside down and allowing the fluids to drip out of the hoses. Pour ½ of the sanitizer from the bucket into each counterlung, then slosh the liquid around inside the counterlung and hose. Drain the sanitizer and hang the lungs to dry.

15: DRAIN AND HANG BCD/BACKPLATE/HEAD ASSEMBLY IN SHADED AREA TO DRY

Drain any water that might have collected in the buoyancy device then hang the unit core to dry somewhere away from direct sunlight and allow the fabric to dry.

16: FILL OUT MAINTENANCE/REPAIR LOG AND ADDRESS ANY REPAIRS IF REQUIRED

Any items which you notated in your maintenance/repair log during the post-dive breakdown should be reviewed, and the parts in question re-examined closely and repaired or replaced as required. If parts are used from your spares kit, make note so that you can re-order replacements from your local Hollis PRISM 2 dealer.

NOTE:

Why Sanitize Your Loop Daily?

A rebreather "loop" collects all sorts of biological material during a dive. There is your saliva, which fortunately is composed of 98% water. However the other 2% consists of compounds such as electrolytes, mucous, blood and various enzymes that normally begin the process of breaking down food, and probably food particulates food particulates from a recently eaten meal or snack. Then you add in seawater (if you are diving in the ocean) or freshwater, both of which contain living and dead microscopic creatures. Now, imagine allowing this solution to sit and putrify for a few days in a dank, dark hole, all the while collecting more and more dead and dying biomass while you continue diving. Would you knowingly want to breathe from this? I didn't think so. Make it your habit to sanitize your breathing loop after each dive day and you will never have to think about this again.

MAINTENANCE + REPAIR LOG

Owner: ______________________________ Date of report: __________

Reason for maintenance (check one)

☐ Pre-Dive Failure

☐ Post-Dive Maintenance

☐ Preventative/Scheduled Maintenance

☐ Part(s) Replaced ____

☐ Reason ____

☐ Parts needing service ____

☐ Action ____

☐ Operational observations ______________________________________

☐ Replacement part(s) need to be ordered to complete this maintenance

Date Part(s) ordered:____________ Expected delivery: ________________

Signed: ____

SKILL # 1
CONTROLLED DESCENT

Prior to your initial descent you must verify that the oxygen content in your breathing loop is at your low setpoint with minimum fluctuation of O_2. Look at your HUD and Wrist Display O_2 sensor readings. Verify your breathing gas is within those limits, the three sensor readings agree, are steady, and the HUD agrees with the Wrist Display.

If you had taken the DSV/BOV out of your mouth while on the surface, exhale the air in your lungs while you put the DSV/BOV in your mouth. Continue exhaling through the DSV/BOV purge hole to clear any water in the mouthpiece. Open the DSV/BOV valve and breathe normally. Signal your buddy to begin your descent. Purge your buoyancy device of air and begin slowly descending, using a down line, if available, to control your descent. Don't forget to equalize. Descend slowly to give yourself time to equalize, add volume to the loop, and control your PO_2. The faster the drop, the harder it is for a new rebreather diver to keep control of the loop volume and PO_2. You will stop at 15 ft/4.6 m to perform a bubble check (Skill # 2). If no bubbles are detected, you will continue your controlled descent to your target depth. Your instructor may have you stop at 25 ft/7.62 m to complete a "current limit check".

NOTE:
EXHALE FIRST

The reason you should exhale all the air in your lungs prior to opening the loop is two-fold. First, you will expel any water that may have been in the mouthpiece, and second, you do not want to introduce any outside gases into the breathing loop, unintentionally changing the gas mix.

NOTE: BUOYANT ENTRY

Whenever you first enter the water with a rebreather, your buoyancy device should always be almost fully inflated because should the rebreather experience a "catastrophic flood" on entry (the entire breathing loop fills with water), you could quickly become up to 17 lbs negatively buoyant. Without the buoyancy device inflated to offset that buoyancy loss, you could immediately begin to sink below the surface.

Surf entries on rebreather might be a situation where you would want to enter the water breathing on the loop with the buoyancy device deflated so you can dive under incoming waves. Once you are past the surf zone fully inflate the buoyancy system and begin your buddy checks.
You and your instructor will discuss entry options.

WARNING: If the HUD and Wrist Display PO_2 readings do not agree, immediately bail out and abort the dive. Recalibrate both displays on the surface. If this does not remedy the problem, you must have your PRISM 2 evaluated by an authorized PRISM 2 Service Technician.

SKILL # 2
THE IN-WATER BUBBLE CHECK

The primary bubble check is critical to insure no part of the breathing loop has been compromised, damaged or dislodged during storage, donning or getting in the water. It is also a second pair of eyes, which will help insure nothing was overlooked during your pre-dive routine.

To do a proper buddy-assisted bubble check enter the water with your buoyancy device fully inflated, the DSV/BOV in your mouth, breathing from the loop. Make sure you hold the DSV/BOV securely in your mouth when getting in the water.

Once you are in the water and ready to dive, while holding onto a down-line, slowly deflate your buoyancy device until you submerge the unit about 15 ft/4.6 m below the surface. Your buddy will check for the telltale sign of water leaking into the breathing loop... a stream of small bubbles. Also, your buddy will check inside the clear scrubber bucket for any signs of water intrusion. While your buddy is doing a full check, you should check the mouthpiece, hoses and counterlungs.

Initially there may be a small amount of air trapped in the buoyancy device material but they should dissipate quickly. If there are a lot of bubbles coming from everywhere, give the fabric a few moments to shed the trapped air. Sometimes, tapping the rebreather on one of its hard bits, or shaking the unit lightly will help shed superficial bubbles quickly.

WARNING: If you are doing a giant stride entry, the force of the gas in the loop being displaced by the water against the counterlungs will want to push the DSV/BOV out of your mouth. Keep your palm firmly against the DSV/BOV in your mouth until you settle comfortably in the water.

WARNING: The one place where a leak could occur and you would not notice initially is the battery compartment. If you have a leak in the battery compartment, the Heads Up Display will stop functioning as will the solenoid. It is therefore important that you keep an eye on the Heads Up Display before you begin your descent, and for the first few minutes of the dive. If the display is not lit, bail-out to open circuit and discontinue the dive immediately.

NOTE:
DEFINING PROPER WEIGHTING

With all weights installed in your rebreather, you should float at eye level with minimum volume (see “Minimum, Maximum, Optimal Loop Volumes, and Work of Breathing” found after skill #8 in this section) in your counterlungs, holding a normal volume of air in your lungs. Upon exhaling out of your nose, you should begin sinking. For further information on weighting the PRISM 2, refer to the article “Stability” in PART 1 Section 3.

SKILL # 3
DSV & BOV OPERATION

Whenever the DSV/BOV is out of your mouth, the breathing loop must be sealed off “shut down”, so loop gas does not escape and water does not enter the loop. This is probably one of the most difficult skills to get used to, other than buoyancy if you are used to working with open circuit equipment. Practice the DSV/BOV shut down drill until it becomes second nature.
An accidentally flooded loop because you left the DSV/BOV open ruins a perfectly good dive.

NOTE:
OPEN UP,
SHUT DOWN:

When operating the DSV/BOV lever, try to remember “open up” to open the loop and “shut down” to close the loop.

DSV Operation

To accomplish the DSV shut-down drill, put one hand on the DSV body to hold it in place and operate the barrel knob with the other hand, pulling it down toward your chin. Verify that it is sealed by blowing into the DSV; you should see bubbles coming out of the purge orifice.

Eventually you may find you can shut-down the valve with one hand, but for now use two hands to make sure you do not accidentally pull the DSV out of your mouth while it is still open. Once you have verified the valve is sealed, re-open the DSV and resume normal breathing.

BOV Operation

The bail-out valve (BOV) operates in much the same way as the DSV, but when you rotate the mouthpiece lever in a downward position, you are closing the loop and switching it to open circuit mode. The BOV works the same as the “open up” and “shut down” DSV. To complete the shut-down skill with the BOV, simply “shut-down” the BOV to open circuit mode, take a breath or two in OC mode, exhale the OC gas then “open up” the valve and breathe from the loop.

Mouthpiece skills are “habit drills” and your old habits of spitting out your OC second stage may prove hard to break initially. Your instructor will have you repeat DSV/BOV shut down many times throughout your course. DSV/BOV shutdown, whether underwater or on the surface is an integral step in all emergency bailout drills, so it MUST come as second nature muscle memory.

SKILL # 4
MASK CLEARING

Mask clearing on rebreathers is substantially like you have been taught using open circuit gear, with one significant difference. Unlike Open Circuit mask clearing where you might exhale a full breath to clear a mask, in rebreather diving your objective is to clear the mask of water, but not exhale more gas that is absolutely necessary. Therefore, when you clear your mask, try to do so without a great stream of bubbles coming out of the mask after you have displaced the water. You will find that a bit of patience and more attention to the skill will help you accomplish this easily, and minimum gas mask clearing will become second nature quickly.

NOTE:

Unlike Open Circuit systems, there is no "purge button" on the DSV to purge water from the mouthpiece if you do not have enough breath in your lungs. If you ever find that you have removed the DSV from your mouth but do not have enough gas to manually purge it, you can open the DSV and allow the small amount of water into the Loop. If you have to do this, remember to clear the Loop and Exhale Counterlung (see Skill # 14).

SKILL # 5
REMOVE, CLEAR & REPLACE DSV/BOV

In skill # 3, you practiced shutting down your DSV/BOV while it remained in your mouth. In the DSV/BOV removal drill, you will shut down the DSV/BOV as before, then remove it from your mouth. In so doing, the mouthpiece portion will fill with a small amount of water. We practice this remove and replace skill in preparation for a full bailout to an offboard bailout system.

WARNING: Remember to blow tiny bubbles whenever the mouthpiece is out of your mouth.

DSV:

To purge the water, simply replace the DSV in your mouth and blow a small amount of air into it with it in the surface (shut) position. This will force the water through the purge hole in the bottom. As soon as you see or hear bubbles coming from the purge hole/drain, switch the DSV to closed circuit mode and resume breathing normally.

BOV:

To purge the water from the BOV, simply exhale into it while in the open circuit mode, or push the purge button on the front of the BOV. Remember, unless you have taken a breath from the BOV while in open circuit mode, you will be exhaling loop gas. For this reason, be conservative with how much gas you use to clear the BOV.

SKILL # 6
MANUAL ADDITION OF DILUENT

The PRISM 2 comes equipped with a combination Automatic/Manual diluent addition valve (ADV) located on the front of your left (inhale) counterlung, slightly below the breathing loop elbow. During descent, as the volume of gas in your loop decreases, the automatic diluent addition valve will add gas volume to the loop when the actuator in the valve hits the strike plate inside the counterlung.

However, there may be times you want to add additional diluent to the loop manually, such as when you want to “fly” the rebreather at a setpoint other than is programmed into the on-board computer, if you find that the PO_2 is too high and wish to quickly bring it down or if you simply wish to add gas volume to the loop to match your breathing volume.

To manually activate the valve, simply depress the body of the valve inward toward the strike plate until you hear gas entering the loop. You can control how much gas enters the loop by using short bursts of gas, until the desired effect is achieved. If you are attempting to reduce the PO_2 of your loop, add a small amount of diluent, breath normally for approximately 5 breaths while watching the readouts of the 3 oxygen sensors on your Wrist Display. Continue to add diluent and repeat the breathing cycle until the desired PO_2 has been reached or the desired gas volume is achieved.

NOTE:
GAS PHYSICS AND THE DILUENT ADDITION VALVE

Remember, as you descend in the water column, the partial pressure of oxygen in your loop will increase as overall volume decreases, so the addition of diluent is critical at this stage. Your instructor will teach you, and you must understand completely, the gas physics of ascent and descent before you enter the water.

SKILL # 7
MANUAL ADDITION OF OXYGEN

The oxygen manual addition valve is located on the inside bottom of the exhale counterlung facing the inhale counterlung. It is a “manual only” addition valve. To increase the PO_2 in your loop, add one short burst of gas by depressing the button on the valve. Cycle your breathing approximately 5 times while watching the readout of the 3 oxygen sensors on your Wrist Display. Continue to add oxygen and repeat the breathing cycle until the desired PO_2 has been reached.

Be extremely conservative when manually adding oxygen to your loop, as it is essential that you do not add too much oxygen. Remember, a PO_2 above 1.4 should not be used under normal circumstances. Also, manually adding oxygen during descent should be done quite conservatively, if at all, as your PO_2 will increase simply by going deeper.

SKILL # 8
MINIMUM (OPTIMAL) LOOP VOLUME & THE OVER-PRESSURE VALVE (OPV)

The loop over-pressure valve (OPV) is located on the front right (exhale) counterlung. It is designed to purge excess gas pressure from the loop automatically, such as during ascent from depth when the volume of gas in the breathing loop is increasing. The OPV should be continually adjusted as needed throughout a dive to maintain minimum loop volume.

To decrease the sensitivity of the OPV, thereby increasing the pressure and volume of gas inside the breathing loop, turn the OPV valve clockwise several clicks. To increase sensitivity and purge excess pressure and volume, rotate the OPV counter-clockwise several clicks.

Your body position in the water will have an effect on the OPV. If you are in a horizontal diving position, the static loading on the OPV will be less than if you are in an upright position. You may find that when you change from a horizontal to vertical position while diving, the OPV will automatically vent gas. This is normal and is caused by the change in static loading. Adjust the valve as needed to maintain a comfortable volume of gas in the loop. See the article "Minimum, Maximum, Optimal Loop Volumes, and Work of Breathing", appearing later in this section.

During ascent to the surface, you may want to fully open the OPV to allow the expanding gas in the loop to bleed off easily. However, because the oxygen manual addition valve is on the same counterlung as the OPV, when manually adding oxygen during ascent you will want to add oxygen after the valve has purged excess pressure. Otherwise, your added oxygen will simply bleed out of the OPV, not enter the breathing loop, and not increase the PO_2. You can also exhale excess gas volume from your nose during ascent to keep the OPV from actuating while manually injecting oxygen . Oxygen injected by the solenoid will not be affected as it is injected in the head plate, after the OPV.

MINIMUM, MAXIMUM, OPTIMAL LOOP VOLUMES, & WORK OF BREATHING

ARTICLE BY DR. RICHARD PYLE

The volume of gas contained in a rebreather loop (the hoses, canister, and counterlung(s) of the rebreather plus the diver's lungs) is seldom fixed. I define "minimum" loop volume as that volume of gas occupying the rebreather loop when the counterlung(s) are completely "bottomed-out", and the diver has completely exhaled the gas from his or her lungs. Conversely, "maximum" loop volume is the volume of gas in the breathing loop when the counterlung(s) are maximally inflated, and the diver has maximally inhaled gas into his or her lungs. Although the magnitude of the difference between these two volumes, ([***Vmax***]-[***Vmin***]), will vary from one rebreather design to another, it will always be non-zero.

Rebreather divers must learn to maintain the loop volume close to its optimal level for their particular model of rebreather. If the volume is maintained too close to [***Vmin***] the counterlungs will tend to "bottom-out" on a diver's full inhalation. If the loop volume is maintained too close to [***Vmax***] the overpressure relief valve will tend to vent excess gas at the peak of a diver's full exhalation. Furthermore, total loop volume will influence work of breathing due to hydrostatic effects.

On rebreather models with a relatively large value of ([***Vmax***]-[***Vmin***]), the optimal volume should ideally be closer to [***Vmin***] for models with a relatively small value of ([***Vmax***]-[***Vmin***]), the optimal loop volume should be ideally close to the mid-point. In either case, the diver should maintain the loop volume at whatever level results in the minimum total work of breathing and gas loss.

SKILL # 9
MANUALLY MAINTAIN SETPOINT WHILE STATIONARY

Manually maintaining setpoint is simply a function of replacing the oxygen in the loop as it is metabolized. As easy as it sounds though, in practice, it takes concentration since we use O_2 at different rates throughout a dive. When you hear people discussing "flying manually" this is the skill set they are discussing. "Flying manually" means you must continually monitor your PO_2, adding oxygen via the manual O_2 addition valve to replenish the metabolized oxygen in your loop. In effect, you become the computer.

Your Instructor will have you set your computer to a "safety" setpoint with the electronics on for safety, however your instructor will give you a new higher "manual" setpoint, which you will learn to maintain while learning new skills and mastering skills you have already practiced.

Remember to allow for several breath cycles after manually adding O_2, as the gas has to move from the exhale counterlung, through the scrubber and up to the O_2 sensors to register on your electronics. Your breathing is the engine that moves the gas through the loop. Repeat the process to manually maintain the required setpoint.

SKILL # 10
MANUALLY MAINTAIN SETPOINT DURING DESCENT

As you read in your training manual, while descending to depth on a rebreather, several things are happening. The volume of gas in your loop is decreasing and the PO_2 is increasing. Because the gas molecules are compressing, you will need to add diluent to the loop to keep the volume of gas adequate for comfortable breathing. The automatic/manual diluent addition valve on the inhale counterlung will automatically add diluent as you breathe to compensate for the increased pressure/decreased volume in your loop. But what about the increasing PO_2?

Fortunately, this is where the diluting capacity of the diluent comes into play. By adding diluent, you automatically drop the PO_2 in your loop. However, when descending on a rebreather, you must do so slowly, watching your PO_2 on your HUD and wrist display to make sure it does not go above your setpoint. Should you find that the PO_2 is too high at any point during descent, you can stop your descent, exhale from your nose, and add a compensating amount of diluent to the loop, thereby slightly dropping the PO_2.

It is recommended you use a descent line to easily arrest your descent should you need time to adjust your PO_2 to keep it from spiking. If you find that your PO_2 has dropped below your setpoint, descend until the PO_2 reaches your setpoint. You will rarely need to add oxygen during descent.

WARNING: Never allow the PO_2 in your loop to go above 1.4 ata oxygen. If you do accidentally spike your PO_2 exhale through your nose and inject diluent, then breathe normally and monitor the drop in your PO_2. Repeat if necessary to bring your PO_2 back to your target. Continue to monitor your PO_2 on your HUD and Wrist Display and add gas as needed to maintain your new setpoint.

SKILL # 11
DILUENT FLUSH

The Diluent Flush is conducted on a rebreather to verify that the unit and O_2 sensors are functioning properly. The most common reasons to flush the loop with diluent are to verify that all 3 O_2 sensors are reading the loop PO_2 correctly, or conversely, verify that a cell which the computer has “voted out” is indeed faulty, and the 2 remaining active cells are reading loop PO_2 correctly.

The on-board diluent gas is our one source of “known gas”. In other words, we know the exact oxygen percentage in the gas and can use that gas to verify O_2 cell readings by multiplying the fraction of O_2 in the diluent by our absolute pressure at depth.

WARNING: While we also know the PO_2 of our Oxygen supply, we cannot use it at diving depths to verify cells, as pure oxygen into the loop at diving depths would be highly toxic!

While this may sound complicated because we measure our depth in feet or meters and you have to convert those numbers to atmospheres, the Wrist Display has a handy feature on the dive screen titled “DilPPO$_2$” (**SELECT** button X 1) which does all the math for you.

It is important that the loop is fully flushed to insure a correct reading. To begin, open the OPV fully so the excess gas will be able to easily vent. Cross your right arm over the exhale counterlung to keep the incoming diluent gas from inflating the lung and affecting your buoyancy. Take your right hand, and using your thumb and index finger close off the inhale breathing hose by squeezing the hose between your thumb and index finger. Concurrently, crush the inhalation counterlung with your left forearm so it too will not fill with gas - affecting your buoyancy. Press down on the ADV which will start to inject diluent. By closing off the inhalation hose while adding diluent via the ADV, you will reverse the normal flow of gas through the loop and quickly flush the core with diluent. Take your left forearm and crush the inhalation counterlung so it too will not fill with gas and affect your buoyancy. Be careful not to cause unnecessary stress on the hose segment which might cause damage.

Allow the gas to flow backward through the system for a few seconds. Once you think you have fully flushed the system, look at your wrist display PO_2 readings and compare those with the $DilPPO_2$ value you checked earlier. Then release the inhalation hose and allow diluent gas to flow through the front of the loop while breathing normally for another few seconds

Because the minimum PO_2 value that can be set in the system is 0.4, diluent flushes above 30 ft / 9.14 m are ineffective. We never recommend temporarily shutting off the oxygen supply to complete a diluent flush as the result of forgetting to turn the gas back after completing the flush could be injury or death.

Additionally, a diluent flush allows the introduction of a "safe" gas into the loop as a sanity breath if you feel the gas mix may be wrong or quickly reduce the PO_2 if it has somehow increased to unsafe levels. In this instance you would not have to worry about the solenoid injecting oxygen. Simply cross your arms over the counterlungs as before and inject diluent. If you feel you have the time to do so, open the OPV so the excess gas can escape from the loop. In a true emergency, In addition to the OPV venting, you can also let any excess gas escape from around your lips as you breathe in the fresh diluent. If there is any doubt as to the contents of the breathing loop, it is recommend that you switch to your off-board bailout as a preferred method for breathing a safe gas and terminate your dive. Remember, when in doubt, bail out.

NOTE:
It is important that you DO NOT use your counterlungs as a means of buoyancy control. If you find that you need additional buoyancy above 60 ft / 20 m of depth, consider reducing the amount of lead you are carrying.

SKILL # 12
NEUTRAL BUOYANCY PRACTICE

Neutral buoyancy is not something which can be mastered in a classroom. We can teach the physics of neutral buoyancy and how to attain and maintain neutral buoyancy, but until you are in the water practicing the skill you will not begin feeling it. Neutral buoyancy is all about “feel”.

As you learned in your open water class, you know that inhaling a lung full of gas will increase your displacement of water, making you lighter so you can ascend, and exhaling will decrease your displacement of water, making you heavier so you can descend.

In closed circuit diving, none of this applies. Remember, you are simply moving your breathing gas from one flexible membrane (your lungs) to another flexible membrane (your counter-lungs). Therefore we must rely on our buoyancy device to maintain neutral buoyancy. Every open circuit trained diver who takes a rebreather class always comments in frustration that they have to re-learn their buoyancy skills. This is normal and you will quickly learn to adjust.

This means the fin pivot as a way of attaining neutral buoyancy is out. It won’t matter how much you breathe in or out. Your buoyancy won’t change.

To maintain depth with a rebreather, you will add just enough air to your buoyancy device to get you neutrally buoyant and when swimming, use your body as a rudder and your fins as propeller. If you want to go up slightly, bend your body so your head and chest are higher than your lower body and kick with your fins. If you want to descend slightly, put your head and shoulders down while kicking.

As you change depths, inflate or deflate your buoyancy device as needed but never use your buoyancy device as an elevator button, allowing the equipment to control your ascent or descent. Remember, ascents and descents on a rebreather must be slow and deliberate to control and maintain your PO_2.

SKILL # 13
MANUALLY MAINTAIN SETPOINT ON ASCENT

On ascent, our PO_2 will be dropping and our loop volume will be expanding which is exactly the opposite of what happens on descent.
To begin your ascent, watch your Wrist Display, verify that your OPV is opened sufficiently to easily vent the expanding gas and place one hand on the manual oxygen addition valve.

Begin to slowly ascend (no faster than 10 m/30fpm) watching your PO_2 on your Wrist Display. Add oxygen to maintain your setpoint, but remember that you should not add oxygen while your OPV is venting gas as the added oxygen will vent out of the OPV with the expanded gas. One trick is to exhale some of the expanded loop volume from your nose while adding oxygen to offset the added pressure of that added oxygen without actuating the OPV.

WARNING: During your ascent from depth, the PRISM 2 will be automatically adding O_2 to maintain loop PO_2 and that can have significant effect on the buoyancy of the rebreather. Carefully monitor air spaces such as your dry suit, BCD, and counterlungs to avoid an uncontrolled ascent. It is very important that you ascend no faster than 10 m/30 fpm per minute to avoid a runaway ascent on your CCR. Until you have sufficient experience with your PRISM 2, you should consider using an up line during ascent.

You will want to be continually dumping air from your buoyancy device, dry suit and counterlungs (exhale through your nose) to maintain minimum loop volume on ascent.

SKILL # 14
CLEAR WATER FROM HOSE

Since learning skill # 3, DSV/BOV shutdown, you have become quite proficient at closing your DSV/BOV before removing it from your mouth underwater and on the surface. In a perfect world that would be the end of it. Water would never enter your breathing loop. But this world isn't perfect and neither are the divers around you. Someone, some day, may accidently kick that DSV/BOV out of your mouth. You, however, will NEVER remove an open DSV/BOV from your mouth, right? Because, through all that practice you are now perfect!

Accidental flooding is not the only way to get fluids into your counterlungs. If your dive is long enough, you may find that water has entered the loop around your lips and enough has drained into your exhalation counterlung that you hear bubbling in the exhale counterlung whenever you manually add oxygen. Water leaking around your lips is normal and does not mean that you should chastise yourself for allowing a small amount of water into the loop. Even through normal breathing, the moisture in your exhaled breath will condense in the exhale hose and collect in the bottom of the exhalation counterlung as a viscous fluid mix of saliva, salt water and fresh water.

There are two methods to clear the exhale hose of water. Lean slightly to your right and allow the water to drain into your exhalation counterlung. The directional mushroom valves inside the DSV/BOV will block the water from entering the inhalation side of the loop, so it can only go to the exhalation side. You can also close the mouthpiece, lift the hose assembly above your head and allow the water to drain into the exhalation counterlung.

WARNING: Remember to blow tiny bubbles whenever the mouthpiece is out of your mouth.

Each of your counterlungs has a drain valve located on the bottom of the counterlung. On the end of the drain valve you have a silver twist lock, which should be closed for diving. Fully loosen the lock mechanism. During your exhale cycle, push the drain nib back towards the valve body. This will open the drain and allow the liquid inside the counterlung to vent out. You only open the valve during exhale so the back pressure inside the counterlung helps force the fluid out.
If you have your body position in such a way that the exhale lung is higher

than the inhale lung, that will also increase the gas pressure in the exhale lung without adding volume to the loop. Let go of the nib during your inhale cycle. Repeat the process until you see a stream of bubbles exit through the drain valve.

Draining the counterlung can be a very slow process. It may take a few minutes to fully drain the counterlung, depending on how much water has entered. If you are in salt water, you may see that the fluid exiting the drain creates a halocline (salt water mixing with fresh water) as it vents. If you are absolutely positive that no draining is occurring, you may increase the pressure in the loop slightly by adding a small amount of diluent to increase loop pressure and help force fluid out of the drain. Watch your buoyancy though, as adding diluent will increase your positive buoyancy.

WARNING: If you find a lot of water collecting in your inhalation counterlung during a dive, this IS NOT normal and indicates a potentially dangerous leak in the loop. If you find water building up in your inhalation lung, immediately switch to your bailout and abort the dive. Once safely on land, track down and repair the leak prior to diving again.

There are four areas where water could be entering the inhalation side of the loop and draining into the inhalation counterlung. The first and most critical area would be the absorbent bucket. A leak here would soak the CO_2 absorbent and create a caustic fluid, which will then travel into the inhalation counterlung and, if left unchecked, eventually into the diver's mouth, causing skin burns and great discomfort if not serious injury.

Usually these types of floods occur slowly enough that you will notice the work of breathing getting harder and you may hear gurgling water when you attempt to breathe in. If you suspect an inhalation side leak, bail out immediately and signal your buddy to have a look in your clear bucket. A hole or tear in either inhalation side breathing hose will also cause water to leak into the counterlung, but if the leak is in the DSV inhalation hose, the water will also drain directly into the mouthpiece.

Lastly, the counterlung or the attaching hardware itself could be leaking. Check that the silver locking collar on the counterlung drain is tight. Check that the ADV and hose elbow are screwed down completely.

SKILL # 15
DIVING WITH OFF-BOARD OPEN CIRCUIT SYSTEM (BAILOUT TANK)

The PRISM 2 has D-rings incorporated into the design specifically for use with a bailout tank. The tank must have the necessary attachment hardware installed for you to clip the bottle to the D-rings. Always clip the tank with the valve facing forward. This will make it easy to verify that the gas is on, and remove any entanglements that may occur during a dive.
Adding an off-board bailout system to your rebreather will add weight and bulk to the system on the surface, but you will find that once underwater, the added weight and bulk of the system will mostly disappear. It is important that you spend a moment adjusting your buoyancy to accommodate the added weight of the off-board cylinder. If you find that you are having difficulty carrying the added weight on the surface, carry the bailout tank to your ingress point before donning the rebreather, and then clip the bailout tank on once you are in the water. Your instructor can help you do this until you become familiar with finding the D-rings by feel. It is far better to stage your equipment close to the water and get assistance, than jump in the water already exhausted from unnecessary exertion.

Before entering the water, turn on the bailout tank valve and fully charge the regulator. Verify that the bottle is full by checking the pressure gauge, then shut off the valve leaving the regulator fully charged. We turn off the air so there is no chance that a leak or free-flow can drain the air from the system while we are entering the water. We leave the regulator charged so if you do need to suddenly switch to your bailout during entry, there is at least 1 breath available to draw from while you are turning on the tank. Once underwater, turn the bailout tank on and do not turn it off until you are out of the water.

Your Instructor will demonstrate the skill then will give you the out-of-air signal. Pull the regulator second stage hose free from the elastic hose stowage cords. Make sure the second stage is correctly oriented and get ready to place it in your mouth while verifying that the tank valve is turned fully on. Close the DSV/BOV and remove it from your mouth. Place the bailout second stage in your mouth, purge it and breathe normally. Signal your buddy and prepare for your ascent.

Before going back on the loop, always check your Wrist Display to verify that the gas in the loop is breathable. Close the bailout tank valve, leaving the regulator charged.

SKILL # 16
OFF-BOARD BAILOUT ASSIST OF ANOTHER DIVER

Should you be called on to supply air to another diver, you should deploy your off-board bailout system. It may be preferable, under certain circumstances, to unclip the bailout system and hand it off to the out of air diver once they are breathing from the second stage. Once you have handed off your bailout system, you must begin your ascent as you no longer have a bailout system.

Your instructor will give you the out of air signal and have you deploy your bailout regulator. Once your buddy or instructor is breathing comfortably on your bailout regulator and has given the OK signal, unclip the tank and hand it off. Once you have completed the skill successfully, your instructor will hand back your bailout system for you to secure back onto your kit. You may also be doing this skill as an ascent drill.

SKILL # 17
VALVE SHUT-OFF DRILLS

In the unlikely event that one of the two regulator/hose systems (oxygen/diluent) on the PRISM 2 loses containment, you would want to first bail out to off-board gas. Then isolate which system is leaking, so you can make a judgment on how to safely return to the surface.

WARNING: If your rebreather were to ever lose gas containment, such a malfunction requires that you bailout to open circuit and abort the dive immediately.

WARNING: Do not dive or breathe from a closed loop if any part of the O_2 first stage and hoses system normal operation is comprised. The correct course of action for an O_2 feed malfunction is for the diver to bailout to open circuit and abort the dive.

Oxygen First Stage and Hoses

Let's start by looking at a possible oxygen leak. The first rule of a closed loop is, anytime you turn off oxygen, you **MUST FIRST** switch to open circuit bailout. Never breathe from a closed loop that does not have a working supply of oxygen.

If the oxygen side of the loop has lost containment, immediately switch to open-circuit bailout. While you are ascending to the surface, turn the O_2 cylinder valve almost fully off but leave the valve cracked slightly so only a trickle of gas is escaping. This will allow some pressure into the first stage and hoses to keep the oxygen first stage and hoses from flooding.

Diluent First Stage and Hoses

If the diluent system is found to be leaking, but the oxygen side appears fine, you must abort the dive, but you can stay on the loop during your ascent to the surface. Since you won't need diluent until you reach the surface, turn the diluent valve until only a trickle of gas is escaping from the leak. Maintaining positive pressure in the first stage and hoses will keep the diluent side of the loop from flooding. Once at the surface, you would need to turn on the tank to inflate your buoyancy device (or manually inflate the buoyancy compensator), and then turn the tank back to almost fully off to conserve diluent until you were "feet dry".

SKILL # 18
LEAK DETECTION: DISCONNECTING QUICK DISCONNECTS UNDERWATER

Diluent First Stage and Hoses

There are two quick disconnects on the diluent side of the rebreather. One is on the ADV and the other on the BCD inflator. Should either system begin leaking, you can disconnect the gas feed hose.

If the leak is in the ADV and disconnecting and reconnecting the hose does not correct the problem, you must end the dive rather than continue diving with the ADV hose disconnected as that could allow water to enter the loop during the breathing cycle which could lead to a loop flood. If you must stay on the loop, you may “feather” the diluent cylinder valve (open valve only when gas injection is required)

O_2 First Stage and Hoses

The one quick disconnect on the O_2 side feeds the manual oxygen addition valve. By disconnecting the manual O_2 addition valve hose, you can diagnose whether the O_2 leak into the loop is coming from the solenoid or the manual O_2 addition valve, as these are the only two oxygen paths into the breathing loop.

Disconnect and reconnect the hose. If you have a leak on the oxygen side of the system, you must bail out to open circuit while you deal with the problem. If you cannot correct the problem, stay on bailout; leave the O_2 manual addition valve disconnected and abort the dive.

SKILL # 19
DEPLOYING A SURFACE MARKER BUOY (SMB)

An important part of your rebreather kit will be an SMB (surface marker buoy) and finger spool. The SMB will be used any time you are ascending to the surface or safety stop in open water and need to mark your location for a safe ascent.

There are several styles of SMB's but the "open bottom" and "LP inflator" styles are the most commonly used today. To deploy an "open bottom" SMB, uncoil the SMB and clip or tie the reel line to it. Keeping the SMB and line in front of you at all times, place your second stage alternate gas source below the bottom opening of the SMB and add enough gas to partially inflate the SMB. It is not necessary and you should not attempt to fully inflate the SMB underwater, as the gas in the SMB will expand as it ascends toward the surface.

Holding the line reel at arms length, check to ensure that the line is clear of all your equipment. Let go of the SMB and allow the reel to unspool, keeping slight tension on the reel so the line does not become a tangled mess (also known as a "birds nest"). Watch your depth and do not allow the SMB to pull you towards the surface as it ascends. It is very important to keep the reel and line in front of you at all times so you do not become entangled in it and get pulled to the surface.

Deploy the "LP inflator" SMB in much the same way except gas is fed into the SMB using the LP inflator hose from the bailout tank.

You can use the SMB line to maintain your depth once it is on the surface and doing so will keep the SMB standing up in the water so it is easier to see from a boat or shore. Reel the line in as you ascend and once on the surface you can re-stow the SMB and reel as you make your way back to the shore or boat.

NOTE: USING A DRYSUIT WITH A REBREATHER

Except in the coldest environments where argon gas is used for dry suit inflation or when using a helium mix in the diluent, most people simply plumb their dry suits into their on-board diluent gas. This is acceptable if you are doing short and shallow dives (1 hr. or less, 60 ft or less) without a lot of depth changes. However, if you will be doing longer and/or deeper dives, or dives with a lot of depth changes, to properly manage and conserve bailout gas you should consider using a small dedicated dry suit inflation system.

SKILLS + DRILLS COMPLETION LIST

PRE-DIVE EQUIPMENT CHECK

1. Calibrate oxygen sensors STUDENT________ INSTRUCTOR_______
2. Assembly, disassembly, cleaning, examining STUDENT________ INSTRUCTOR________
3. Proper scrubber packing STUDENT________ INSTRUCTOR________
4. Evaluating systems operations STUDENT________ INSTRUCTOR________
5. In-water bubble check STUDENT________ INSTRUCTOR________
6. Controlled descent STUDENT________ INSTRUCTOR________
7. DSV/BOV shut-down STUDENT________ INSTRUCTOR________
8. Mask clearing STUDENT________ INSTRUCTOR________
9. Remove & replace DSV/BOV STUDENT________ INSTRUCTOR________
10. Emergency bailout: On-board gas STUDENT________ INSTRUCTOR________
11. Manual addition of diluent STUDENT________ INSTRUCTOR________
12. Manual addition of oxygen STUDENT________ INSTRUCTOR________
13. Minimum loop volume / OPV operation STUDENT________ INSTRUCTOR________
14. Manually maintain setpoint: Stationary STUDENT________ INSTRUCTOR________
15. Manually maintain setpoint: Descent STUDENT________ INSTRUCTOR________
16. Neutral buoyancy STUDENT________ INSTRUCTOR________
17. Manually maintain setpoint: Swimming STUDENT________ INSTRUCTOR________
18. Manually maintain setpoint: Ascent STUDENT________ INSTRUCTOR________
19. Clear water from hose STUDENT________ INSTRUCTOR________
20. Diving with off-board bailout STUDENT________ INSTRUCTOR________
21. Off-board bailout assist of another diver STUDENT________ INSTRUCTOR________
22. Valve shutoff drills STUDENT________ INSTRUCTOR________
23. Disconnecting quick disconnects STUDENT________ INSTRUCTOR________
24. Changing computer setpoints underwater STUDENT________ INSTRUCTOR________
25. Bailing-out the computer to OC underwater STUDENT________ INSTRUCTOR________
26. Working with PRISM 2 Checklists STUDENT________ INSTRUCTOR________

Optional skills

27. Using a drysuit with your rebreather STUDENT________ INSTRUCTOR________
28. Deploying an SMB STUDENT________ INSTRUCTOR________

By initialing each skill above, the student and instructor certify that the listed skill can be completed with mastery and no further remediation is required to move onto the the next skill. The student also certifies by initialing the skill theat he/she will continue practicing the skills after formal training has been completed.

____ ____

Student *Instructor*

MAINTENANCE + CLEANING
SERVICE FACILITY & YOU

It is necessary to have a Hollis PRISM 2 Service Facility complete a “Full Service” annually to maintain safe operation of your PRISM 2. You may find some items that need attention before your scheduled anual service. Hollis has developed a “PRISM 2 User Service Guide” (doc. # 12-4091) to aid you the user in completing many minor Maintenance tasks yourself. It is available for download at www.HollisGear.com. **DO NOT** attempt to make any repairs without the guide.

Below is a list of items that require specialized training, tools, and techniques. If they need service before the scheduled anual service date, they must be repaired by a Hollis PRISM 2 Service Facility or the Hollis factory.

SERVICE FACILITY ONLY PARTS

- Solenoid
- Solenoid Chamber Pressure Relief Valve
- Heads Up Display
- Wrist Display
- Heads Up Display Piezoelectric switch
- Electronics Compartment including printed circuit boards
- Oxygen first stage
- Oxygen Pressure gauge
- Bail Out Valve (BOV), 2nd stage regulator
- Diluent first stage
- Diluent pressure gauge

CAUTION: DO NOT attempt to unscrew the Heads Up Display wiring from the head or the Wrist Display wiring from either end of the wire. This is not a threaded part! Attempting to unscrew or remove either wiring will destroy the wiring and quite possibly the hardware sealing surface in the Head or Wrist Display.

CAUTION: Opening the electronics housing compartment or attempt to service Service Facility Only Parts by unauthorized persons will void the warranty.

RED CO_2 SEAL

Tools Needed: None
If the gasket gets dirt or absorbent dust on it, remove the gasket from its groove and clean the surface of the gasket with warm, soapy water, rinse and allow to air dry. The gasket should feel "gummy" but not sticky to the touch. If the gasket has hardened or has cuts or abrasions on its surfaces it needs to be replaced. **DO NOT** use lubricant of any kind on the Red CO_2 Seal.

O_2 SENSOR HOLDERS

Tools Needed: None
Each of the three O_2 sensor holders are held in place by 2 pins molded into the head assembly. They are made of a soft silicone. Remove the holders from their pins and clean with warm soapy water then rinse off and allow to air dry.

During annual service these will be checked to see if they are beginning to harden and will be replaced as necessary. **DO NOT** attempt to repair a torn cell holder.

O_2 SENSOR HARNESS

Tools Needed: None
Use one drop of DeoxIT® Gold GN5 electrical contact cleaner on the contacts and wipe off any excess contact cleaner before re-installing the harness in the head. If the wiring, conectors are showing excessive oxidations, or the insulation is cracking, replace the harness.

BREATHING HOSES

Tools needed: Oetiker clamp pliers, Large Bottle Brush, O-ring Lubricant
Every ten hours of use you should scrub the inside of the counterlung hoses with a bottle brush and Steramine™ solution. First, remove the hose from the counterlung by removing the 2 Oetiker clamps holding it in place. This will insure that any debris scrubbed from the hose will not simply settle in the counterlung. Place the bottle brush inside the hose and place the hose in the bucket of Steramine™. Move the brush in and out of the hose to scrub the interior. Clean the hose attaching hardware as well. Finally, clean the attaching hardware O-ring, O-ring groove and treat itwith approved lubricant.

COUNTERLUNGS + DRAINS

Tools Needed: Oetiker clamp pliers, large bottle brush, lubricant, Steramine™, clean dry cloth.
You may choose to remove the breathing hose, or you can clean it as an assembly with the counterlung. Fill the counterlung with Steramine™ and thoroughly clean the inside with the bottle brush, being sure to scrub all sides, bottom and top. Loosen the Counterlung drain locking collar and allow some Steramine™ to run through the drain hole. Pour the Steramine™ out of the counterlung and re-drain the counterlung drain.

If you removed the hose for cleaning, reattach the hose using the Oetiker clamps and hang the counterlung to dry. It is always recommended that if you hang the counterlungs to dry in an area where bugs can enter, you stuff all the holes in the counterlungs using paper towels. This will allow the interior of the lungs to dry while blocking bugs from getting in and making a home.

For further disassembly see the “PRISM 2 User Service Guide” (doc. # 12-4091).

DSV/BOV INHALATION HOSE + FITTINGS

Tools Needed: Oetiker clamp pliers, large bottle brush, toothbrush, sponge, lubricant, Steramine™
The inhalation side of the DSV/BOV hose assembly contains the inhalation side mushroom valve and valve seat. Before cleaning the hose, it is important to remove the mushroom valve and seat. Removing the part will allow you to run a bottle brush through the hose, but the valve and valve seat require special, separate treatment as described in the next section. To remove the valve seat, remove the 2 Oetiker clamps holding the valve seat and DSV/BOV counterweight, pull the part from the hose, and set it and the counterweight aside. Place the hose and elbow in a bucket of Steramine™ and run the bottle brush back and forth through the hose several times. Remove the hose and set it aside to dry.

The mushroom valve and valve seat are delicate parts and should be cleaned with care. Remove the O-ring on the outside edge of the valve body and set it aside. Using a soft sponge soaked with Steramine™, gently wipe down the topside of the mushroom valve and then gently lift the valve off the valve seat and wipe down the underside of the valve as well as the valve seat.

Clean the O-ring groove and set aside the valve body to dry. Clean the O-ring you had set aside, treat it with lubricant and reinstall it in its groove. There is no need to sterilize the counterweight, but if you like keeping your gear shiny and looking new, you can soak it in water then wipe it down with a clean dry cloth to restore its shine.

Once the parts are dry, you can re-assemble the hose and fittings. Make sure that you put 2 clamps back in each hose fitting with the clamp openings 180 degrees opposed from each other.

Test the valve operation by attempting to gently inhale. You should see the mushroom valve firmly seat itself against the valve body but not be able to pull any air through. If the valve does not seal, the assembly must be replaced.

DSV/BOV EXHALATION HOSE + FITTINGS

Tools Needed: Oetiker clamp pliers, Large Bottle brush, toothbrush, lubricant, Steramine™

Since there is no valve on the end of the hose assembly, you do not need to take the hose assembly apart for a simple cleaning. You can simply put the hose in a bucket filled with Steramine™ and clean the interior of the hose with a bottle brush. DO NOT attempt to force the bottle brush through the elbow fitting. Use the toothbrush to clean the fitting.

If you need to treat the O-ring under the counterweight, you will need to remove the 2 Oetiker clamps and pull the fitting from the hose. Put thecounterweight aside. Remove the O-ring, clean and treat it and its mating groove, then replace the O-ring and reassemble the hose.

DSV/BOV (DIVE SURFACE VALVE/BAIL OUT VALVE)

After a day of diving, the DSV/BOV can simply be soaked in Steramine™ solution and allowed to dry. Because the DSV barrel is opened and closed frequently and over time can become hard to actuate as the lubricant migrates away from the sealing O-rings, it is always a good idea to service the valve during more thorough cleanings. For further disassembly instructions see the “PRISM 2 User Service Guide” (doc. # 12-4091).

SCRUBBER BUCKET + BASKET SPRING

The scrubber bucket does not need cleaning beyond rinsing with Steramine™ solution unless absorbent material builds up on the clear urethane. To clean built up absorbent material, wipe with white vinegar and rinse with fresh water.

The Stainless Steel band and 3 Nielson Sessions latches should remain free of rust as long as it is soaked in fresh water after use. There is no need to use any lubricants on the latches.

The scrubber basket-retaining piece and pressure spring are held ontothe spring assembly-retaining stem with a stainless steel nylon locking nut and washer. The spring assembly-retaining stem is molded into the Urethane bucket. Neither part requires maintenance beyond normal cleaning with fresh water and checking that the locking nut is firmly in place.

SCRUBBER BASKET

Tools Needed: White Vinegar, stiff toothbrush
The scrubber basket requires cleaning after each use. Depending on the CO_2 absorbent used, the basket threads can become clogged with crushed absorbent, making screwing down the top difficult.

If absorbent dust does become caked in the threads, soaking the threads in white vinegar for 15 to 20 minutes will usually dissolve all the material. You may need to remove any residual material with a stiff toothbrush. After cleaning the basket, rinse it thoroughly with fresh water.

The center tube is removable in the event that it requires service or replacement. There is usually no need to remove the center tube. It is recommended that it is left in place whenever possible, except during annual service. Should you need to remove the center tube see the “PRISM 2 User Service Guide” (doc. # 12-4091).

BUOYANCY DEVICE

To keep your BCD, Wing, and/or Harness in top condition, follow these procedures, in sequence, after each day of diving:

- Fill the BCD one third full of fresh water through the inflator mouthpiece.
- Inflate fully, then rotate and shake, ensuring a complete internal rinse.
- Hold upside down and completely drain the water through the mouthpiece.
- Thoroughly rinse the outside of the BC with fresh water.
- Store partially inflated out of direct sunlight in a cool, dry place.
- Periodically flush the BCD with sanitizer solution (available in dive stores) or Steramine™ solution to kill any bacterial growth.
- Transport your BCD in a padded carrying case or equipment bag, separated from sharp items (e.g., dive knife, spear gun, etc.) that might puncture the bladder.
- You should also protect the inflation system from damage from heavy objects (e.g., dive light, weights, first stage, etc.).

ALL OTHER EXTERNAL SURFACES

Though Hollis uses the best materials available, UV rays, salt water, and chlorine environments can be harsh on equipment. For that reason, it is essential to rinse all components with fresh water after use and avoid unnecessary UV exposures (DO NOT leave to dry or store equipment in sunlight). Following these recommendations will help keep your PRISM 2 looking like new.

WARNING: 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.

APPROVED PRODUCTS, CAPACITIES, & SPECS

LIST OF APPROVED PRODUCTS FOR USE IN YOUR PRISM 2

CO_2 SCRUBBER MATERIAL

The recommended material is Sofnolime® (8-12 mesh). Other brands have not been independently tested to evaluate performance or duration times. Use of other brands is at the sole discretion and responsibility of the user.

BATTERIES

Solenoid - (2) 9 V alkaline or 9 V lithium
Wrist Display Ver. 1 - (1) AA SAFT LS 14500 lithium
Wrist Display Ver. 2 - (1) AA size (alkaline, lithium, or SAFT LS 14500)
Heads Up Display - (1) AA SAFT LS 14500 lithium

CLEANING PRODUCTS

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

MAINTENANCE PRODUCTS

CRISTO-LUBE® MCG 111
Tribolube 71®
DeoxIT® Gold GN5 Electrical Contact Cleaner

Other products not listed may be appropriate for use with the PRISM 2. 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.

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 PRISM 2 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.**

WARNING: 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.

COMPONENT CAPACITIES + SPECS

SCRUBBER DURATION

EN 14144 conforming testing:
84 min (0.5%, SEV CO_2) using 8-12 @ 40 °F/4.4 °C, 1.61 L/min CO_2, 131 fsw/40 msw
61 min (0.5%, SEV CO2) using 8-12 @ 40 °F/4.4 °C, 1.61 L/min CO2, 328 fsw/100 msw

Non-CE Testing from ANSTI:
240 min @(60 fsw, 40 °F, 1.3 L/min CO_2, 0.5% CO_2 SEV)

TESTED OPERATIONAL RANGE OF THE PRISM 2

328 ft (100 m) of depth

water temperatures between 39° - 93° F (4° - 34° C)

BUCKET CAPACITY

Total Capacity: 1.75 gallon / 6.6 Liter

To measure 1 Gal / 3.8 Liters for mixing sterilizing agents in the field, fill bucket with fresh water to 3/4” (19 mm) full, under the bottom of the SS bucket latch strap.

COUNTERLUNGS

3.5 L or optional 2.5 L (currently available in the USA market only) volume per counterlung

On-Board gas cylinder carrying capacity (Standard configuration)
Up to 50 cu. ft / L

BREATHING HOSES

1 1/2” X 15”

OXYGEN SENSORS

Hollis (PRISM 2)
Storage Temperature Range: 32 °F/0 °C - 122 °F/50 °C
Operational Voltages: Air: 8.5-14 mV, 100%O_2: 40.6-67 mV

GLOSSARY

Absorbent: chemical media used to remove CO_2 from exhaled gas

ADV: automatic diluent valve

Bailout: redundant gas supply system

BOV: bail out valve

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

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

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

CCR (CC): closed circuit rebreather

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

DSV: dive surface valve

FO_2: fraction of oxygen

HP: high pressure

IP: intermediate pressure

LP: low pressure

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

OC: open circuit

OPV: over-pressure valve

PPO_2 (PO_2): partial pressure of oxygen

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

QD: quick disconnect

WOB: work of breathing

NOTES

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). This solid background of rebreather technology has led to the development of the Prism 2.

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