RB15 Cell Validator

User Instruction Manual

Contents

Oxygen Cell Testing under hyperbaric conditions

Testing between 1.3 and 1.4 bar ppO_2 is done on every new and used lid before it is shipped from the factory.

It is a very simple test which allows you to check the oxygen control parameters including the speed of response and accuracy of the oxygen cells.

The test allows you to see instantly any gross errors in cell outputs, determine whether a cell needs calibrating or replacing and with practise gives you an indication of whether the solenoid flow rate is sufficient.

Although this test has been discussed with Inspiration owners over the years it hasn't been promoted by the factory due to the risk of the diver selecting calibration with the lid closed and sealed, with the inherent risk of the lid being damaged due to the excess pressure but by introducing a pressure relief valve, with a suitably high (but not too high) relief pressure, the procedure is now safer.

Furthermore, by introducing a calibrated relief pressure the requirement for a pressure gauge is removed which makes the product much more shock and water resistant than conventional cell testers allowing you to take it on the dive boat and store temporarily in a wet dive bag/box.

Principle of Operation

Providing the scrubber and lid has pure oxygen in it, the pressure seen on an external pressure gauge shows the pressure of oxygen, the ppO_2, and this should be the same as seen on the handset display. If the displays do not agree then, providing you have followed the correct procedure, you would know there is a problem.

In the side of the Cell validator moulding there is a part-ready moulded port for a 3/8"UNF connection, originally with a view to connecting a pressure gauge.

However, in practise the gauge added little benefit and by removing it, it makes the cell validator more useful in that it is more robust and more readily carried on every dive trip.

Adding a gauge adds complications. To be worthwhile it has to be accurate and to ensure it is accurate is not as easy as it might first seem.

In order for a pressure gauge to be accurate, it must be used in a controlled workshop environment and must be calibrated and of high quality. This usually means it must have a minimum diameter of 150mm, have a full scale deflection of 0.7 to 1.0 bar with a mirror dial. It should be mounted securely and upright. Extreme care needs to be taken regarding speed of pressurisation and de-pressurisation.

Once a pressure between 1.3 and 1.4 bar is acheived, you can introduce a small leak and the oxygen controller should continue to add oxygen with 3 secs between each injection (6 secs on Classics) as it attempts to maintain setpoint. Using this method it is very easy to spot wayward oxygen cells. You can introduce a small leak by either

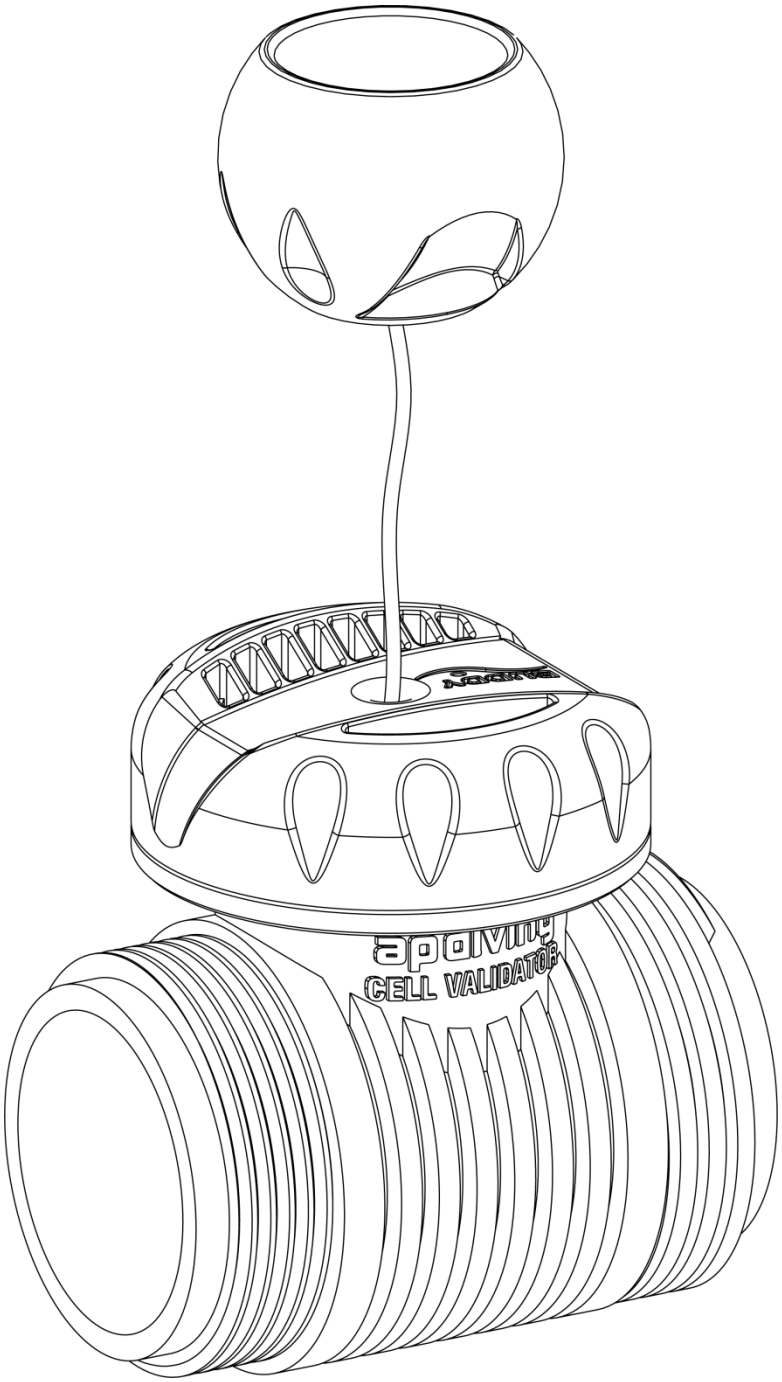
pulling gently on the pull-cord or you can automate it by selecting a setpoint slightly above the relief pressure which forces a slow leak through the pressure relief valve lowering the ppO_2 slightly which will then be followed by a small oxygen addition from the solenoid. In this way, long duration tests can be conducted to test the performance of the complete lid.

Note: this is not an automated test rig – it is simply a modification which allows you to conduct multiple tests; the validity of which depends on your methodology and protocols.

Benefits

- Allows you to prove the cells will display accurately above 1.3 bar – prior to a dive.
- Allows hyperbaric testing of oxygen cells without using a pressure chamber or external pressure gauge and without removing them from the lid.
- Allows testing of all oxygen controller functionality including connections, calibration, solenoid operation and oxygen supply on your rebreather.
- Allows accurate, repeatable, pre-dive testing, even on a wet boat.
- Allows long term testing
- Shock proof and water proof – keep it in your dive bag
- Lightweight (only 125g or 158g with thread protector/ mesh caps) – take it on every dive trip
- When in place it seals the scrubber, so ideal for scrubber storage between dives.
- T-piece caps included, which have stainless steel mesh inserts to prevent insects entering the counterlungs during storage.

Product Images



The cell validator has two different threads on the same moulding for complete compatibility with all AP rebreathers produced since January 2003.

An adaptor hose is available for units produced between November 1997 and December 2002.

Thread Protector / Mesh caps

The Cell validator is supplied with “thread protection caps”, which when removed from the cell validator can be attached to the rear side of each T-piece. The caps have stainless steel mesh panels to allow the inner bags to “breathe” but also prevent insects from entering.

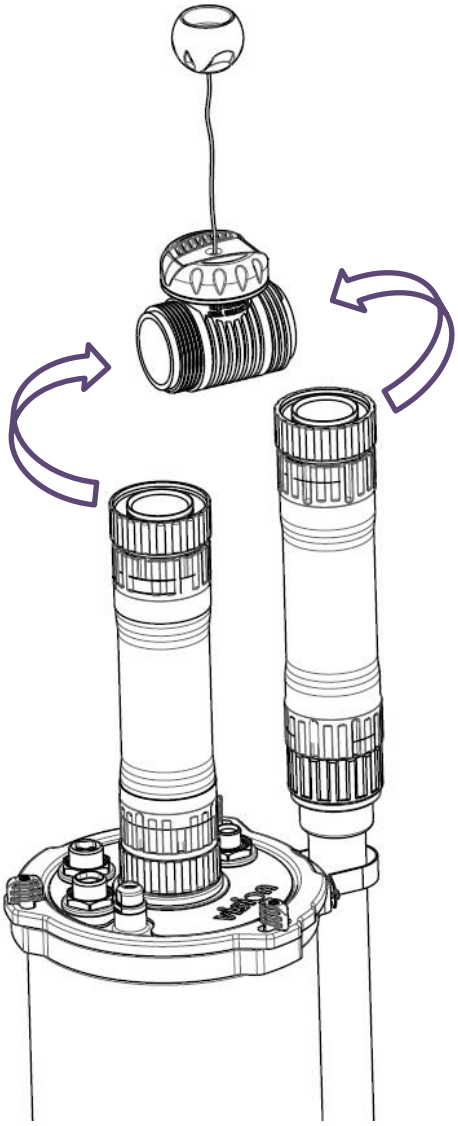
Additional mesh caps are available separately:

The Exhale T-piece Mesh Cap has a fine thread (2mm pitch), suitable for right shoulder T-piece, scrubber top and pre-2003 Inspiration’s left shoulder T-pieces & ADVs. Product Code: RB15A

The Inhale T-piece Mesh Cap has a coarse thread (4mm pitch), suitable for left shoulder T-pieces & ADVs. Product code: RB15B:

Test Assembly

Although the scrubber is shown here as though it has been removed from the rebreather, it is easier to leave it velcroed in place, simply unscrew the hoses from the rear side of the Counterlungs' T–pieces and then insert the cell validator moulding between the two.



Test Procedure

The cell validator can be used for various tests:

- You can use it for an instant comparison of cell readings against an elevated pressure as well as ambient pressure.
- The output of the cells can be seen by bringing up the mVolt readings on the handset, so you can see whether the problem lays in the cell or in the calibration.
- You can then do a calibration and see if the accuracy improves or not.
- You can leave the assembly running for 10 mins or all day if you require to ensure the cells are likely to lose their linearity during the dive. Unfortunately, there is no accurate way to forecast the drop off in linearity which can often be quite sudden but this test does at least give you more confidence in the cell's performance prior to the dive.
- You can test whether the oxygen controller is working properly by lowering the oxygen pressure (gently) using the manual pull-cord.
- You can see how the cells react compared with each other when oxygen is injected

WARNING: Be sure the lid is securely fastened before starting the test and ensure the pressure is released before attempting to open the lid – **Failure to do so can result in irreparable damage to the lid.**

Basic 1.35 bar test

Assuming the rebreather electronics are switched on and in dive mode:

1) Remove the convoluted hoses from the rear side of each T-piece.
2) Insert the Cell validator between the two convoluted hoses, making the scrubber and hoses a sealed system.
3) Ensure all three lid catches are securely holding the lid closed.
4) Select the high setpoint, by pressing and holding the centre button on the handset
5) As oxygen is added by the solenoid the pressure will rise quickly until the pressure relief valve releases gas.
6) Monitor the ppO_2 displays on the handset, the ppO_2 is likely to be lower than 1.3 bar as there is probably still Nitrogen in the scrubber.
7) As the pressure relief valve operates, a mixture of Nitrogen and oxygen is released and is then replaced with pure oxygen (assuming you are feeding pure oxygen into the solenoid), allowing the displayed ppO_2 to rise.
8) Increase the high setpoint in 0.2 bar increments to 1.36 to 1.38 bar

9) The system should stabilise nicely with approx. 1.35 bar showing on all three cells on the handset display adding oxygen as the ppO_2 drops below the setpoint and the pressure relief valve operating as the oxygen is added.

Note: it will take time to reach 100% oxygen. .

10) If the ppO_2 display is significantly different to 1.35 bar, release the pressure slowly, remove the cell validator, switch off the electronics, switch on again and select “Calibrate”. After calibration the electronics should be in dive mode unless problems are detected. Once into dive mode re-insert the cell validator and repeat the 1.35 bar test.

11) Every care is taken in quality control to ensure consistency but the reality is spring pressures vary slightly from batch to batch. In practise a relief pressure between 1.3 and 1.4 is sufficient for testing.

Note: the actual displayed valued depends on:

a. the individual spring’s relief pressure, which will vary slightly from product to product,

b. the purity of the oxygen (is there 100% O_2 in the lid?)

c. the degree of flushing that has been done(is there 100% O_2 in the lid?)

d. the calibration accuracy

e. the performance of the cells

12) When up to pressure, you can either adjust the setpoint so that the pressure in the system is just below the relief pressure which prevents the solenoid opening and saves oxygen or the setpoint can be adjusted so the pressure in the system is just above the relief pressure, which exercise the oxygen control system. How long you leave it at pressure for is up to you and depends on what you are trying to achieve with the test. If you are looking, for example, to see if a cell’s output is about to fall when the cell is near the end of its life, then it would seem appropriate to leave it at pressure for 10 to 20 mins.

Note: storing oxygen cells at a ppO_2 higher than 0.21 significantly reduces it’s life.

13) Once the test is finished change to the low setpoint (by pressing and holding the centre button) and reduce the pressure slowly to atmospheric pressure by pulling gently on the pull-cord. Once all the pressure is released , remove the cell validator from the loop.

Note: DO NOT unfasten the lid until you have released the pressure in the loop using the pull-cord vent.

14) Ensure you re-connect the hoses to the T-pieces before you dive.

Maintenance

Simply rinse in fresh water when exposed to salt water or dirt and allow to air dry.

Caution:

- Ensure the lid is fastened securely BEFORE pressurising
- Ensure the loop is de-pressurised BEFORE opening.
- Internal components in the cell validator have been specially developed for the cell validator and components must not be cross-transferred with other AP pressure relief valves which have similar components. The obvious example is the spring which must not be used in a BCD or rebreather pressure relief valve. Additionally the “spring-hat” is made in a stronger material and is moulded in a green colour to differentiate it from those used in the BCD and Counterlung pressure relief valves. Only use the green “spring hat” in the cell validator.

Manufacturer

Designed and Manufactured in the UK by:

Ambient Pressure Diving Ltd
Water-ma-Trout Industrial Estate,
Helston, Cornwall. TR13 0LW.
Telephone: +44 (0)1326 563834
FAX: +44 (0)1326 573605
www.apdiving.com

For spares and accessories visit:
www.apdivingdirect.com