

# Oxygen Sensor Life in Rebreathers

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Oxygen sensor cells used in **rebreathers** are exposed to pressures of oxygen much greater than normally encountered in analyzing gas. As they age they become 'non-linear', meaning they are perfectly accurate for some conditions and very inaccurate for certain other conditions and this can have serious consequences for rebreather divers. Rebreather manufacturers recommend replacing the cells annually, long before they can become non-linear. The

widely accepted absolute maximum useful lifespan of cells in rebreather applications is 18 months, with 12 months being the recommended replacement interval.

No manufacturer recommends doing things to cells like vacuum packing, freezing, refrigerating, storing in inert gas because they have not tested what happens to cells when these things are done. They can tell you that based on their expert knowledge of the cells, these life-extending steps can and probably will cause minor improvements in the life of some components in the cell while damaging or having no effect on other components in the cell. They are almost certain to cause the cell to go non-linear faster than normal, to become unstable, affect the cell response time curves, and on and on.

So real world for a rebreather diver....

1. Case one: take three cells, install them in the rebreather, and leave them there. At the end of 12 months, throw the perfectly good sensors away and install new ones. In my opinion, and those of the manufacturers, this is the best course of action to follow.
2. Case two: another rebreather diver installs and removes the cells after each dive trip... carefully doing their favorite ritual to store the sensors to extend their life. At the end of twelve months the rebreather diver discards the sensors that have been handled in a manner that literally frightens the rebreather manufacturers. Hopefully the diver survives case two, there have been a few accidents where handling of the cells have been implicated or even declared the proximate cause of the accident.
3. Case Three: See case one or two, except the rebreather manufacturers extremely strong warnings regarding cell replacement times are further ignored and the cells are continued to be used until failure. Hopefully the diver survives case three; there continue to be fatalities directly linked to old cells, even in the face of the information available today. I was personally involved in investigating a high profile fatality in 2010 where the oxygen sensors were 22 months old and tested non-linear.

The experiences of the rebreather community demonstrate the life of the '36 month in air 10mv oxygen sensor' in rebreather applications is 12 to 18 months and with heavy use it's probably less. I do 150 hours a year and replace my perfectly good sensors every 8 to 10 months. It would seem most reasonable rebreather divers at this point would just follow manufacturer's recommendations, but there are always those who feel the manufacturers have a 'hidden agenda' in the frequent replacement of oxygen sensors and choose their own path.

Heat has a major impact on the life of oxygen sensors because sensor life can be significantly shortened by excessive exposure to heat. Keep rebreathers out of the sun both pre-dive and post-dive; an easy solution is just to cover the area where the sensors are mounted with a light colored towel. Treat your rebreather or contents analyzer with respect, keep it at temperatures you are comfortable in (if you are too hot or too cold, so are the sensors).

Another factor that can significantly affect sensor life is the length of time the sensor is exposed to elevated levels of oxygen. The most common circumstance is setting up the rebreather a day or two before diving and leaving 100% oxygen in the loop following calibration of the sensors until the unit is actually used. This means the sensors were exposed to very high levels of oxygen for the long period prior to use, and this can shorten the life of the sensors quite a bit. Best practice is if your rebreather loop has an elevated PO<sub>2</sub> and will not be used for a while, then flush the loop with diluent to keep the loop PO<sub>2</sub> to a minimum.

So what is the shelf life of a new, unopened sensor? The manufacturers specify the shelf life for most types of sensors at 12 or 24 months from date of manufacture, and that's reasonable for sensors intended for use in analyzers. However, I suggest you may want to use a fresher sensor in rebreather applications. For this reason I do NOT recommend rebreather divers keep a 'backup' sensor in their spares kit. Rotating a sensor from the spares kit into the rebreather might seem cost effective, but it's not best practice. There are a variety of reasons, but ultimately rattling around in the spares kit is hard on sensors and they often come out of the bag not working well anyway. If you suddenly need a replacement sensor, they are generally available via overnight delivery. If you feel you must keep a spare sensor for immediate availability, such as during dive travel, then it should be discarded no later than 18 months after date of manufacture, regardless whether it was used or not.

**One final thought, pushing the useful life of an oxygen sensor is a 'risk vs. reward' decision. If you choose to use a sensor for an additional six months beyond recommendations, you saved only a few dollars and incurred an unknown but very significant risk.**

*For more information about the care and handling of oxygen sensors together with information about the Dive Rite O<sub>2</sub>ptima rebreather, you can visit my website at <http://www.DiveGearExpress.com/rebreathers/>*