

BRISTOL CHANNEL DIVING SERVICES

Engineering Diving Excellence

FOCUS ON

BY NEIL BROCK **GAS ANALYSIS**

Okay, What's it all about?

The air we breath needs to be of a certain standard, otherwise, the deeper we go in terms of pressure, the greater the effect of any contaminants in our cylinders. In addition, if our cylinders should come into contact with oxygen, say with the use of nitrox or trimix, then some types of contaminates, specifically oil can cause explosions !

The contaminates can come from many sources, and, although where they come from is important, how we stop it getting into the cylinders is more important. Modern breathing air compressors have good filtration systems designed and manufactured to cope with the contaminates and pressures, but they require good housekeeping standards by the compressor operators to ensure that the filters are changed out when they have reached the end of the use, measured in hours of running time, or volume of gas filtered.

Under normal conditions, a well maintained compressor with the back up of say, a HSM inline moisture indicator that measures the percentage of humidity in the gas, will ensure good quality air. However as compressors wear and pass more oil into the compression process, the filters work harder, also, temperature and humidity in the atmosphere play a part in the life of the filters.



To combat these variables, it's prudent to test the air from the compressor on a regular basis. The test requires that the filtered air contains below the maximum allowable level of certain contaminates. The contaminates we are concerned with are:

Carbon Monoxide (CO): Carbon Monoxide is the most toxic contaminant in compressed air. It enters the breathing air system through the air intake or is produced by the overheating of piston type compressors. The air intake must be placed away from engine exhausts or other sources of carbon monoxide.

Carbon Dioxide (CO2): Normal CO2 levels in outdoor air (i.e. 200 - 400 ppm) or indoor air (i.e. 500 - 2,500 ppm) are not considered hazardous. However, compressed air with CO2 levels that are within the 'indoor air range' can create problems in compressed breathing air. Some compressors are equipped with filters to reduce CO2 levels. High CO2 in SCBA can produce many of the same symptoms as CO poisoning. In addition, high CO2 levels will increase a persons breathing rate hence shortening the usage time of the SCBA. One of the most common causes of SCBA air quality failures is excessive CO2 content.

Water/Water Vapour: Air contains moisture which is drawn into the compressor and enters the air stream as a vapour. As compressed air flows through the system, it cools, causing the vapour to condense in the filter towers. Moisture combines with oil mist and solid contaminants to form a sludge and is then manually or automatically drained off from the compressor system. If this is not done it can clog up or the reduce the lifespan and filtering ability of the filters and system components. Water also causes rust in storage cylinders and diving cylinders, and can freeze in first stage regulators in cold weather, this is a leading cause of accidents as it can block air flow or cause free flows.

Oil/Oil Mist: Oil is a major contaminant in systems using lubricated compressors. In reciprocating compressors, lubricating oil

applied to cylinders causes small droplets by the shearing action of the piston to enter the air system as a mist. Oil mist can cause breathing discomfort, nausea and pneumonia and can create unpleasant tastes and odours.

Not a contaminant, but worth checking at the same time is Oxygen percentage and gas odour.

Oxygen Level (O2): The O2 level in compressed air derived from natural or synthetic air should fall within a narrow % range, typically, 20 - 22% range for compressed air. Most compressed natural air samples will have test values of 21% ± 0.5. Synthetic air samples tend to have a slightly wider, but acceptable, O2 range.

Odour Evaluation: Clean air is odourless. Many air compressors have filters to remove odours. The standards require that "no pronounced odour" be present in compressed air. Since the sensory response of the human nose is highly variable and extremely sensitive to certain odours, evaluation of odour is highly subjective. If there is a slight odour, this may be abnormal. We would suggest further investigation.

The standard, **BS EN 12021:1999** requires that air quality testing take place at 3 month intervals, or, more if contamination is suspected. Obviously, the standards are legally enforceable for compressor operators in "at work" situations, private compressor operators such as clubs and individual operators have no legal obligation but, should remember that contamination is not selective in as much as it can happen to any poorly maintained compressor, "at work" or not. For clubs who operate a compressor, testing the air will show that the club takes its duty of care seriously.

The testing of compressed air can be done many ways. For most commercial compressor operators it usually pays to purchase an air test kit of one type or another, and use it as well as any air testing done when the compressor is maintained by a professional. In the event of accidents, organisations like the HSE would use laboratories who would use either a gas chromatograph or a mass spectrum analyser.

This is one of the units we sell as breathing air purity test kit, it's compact and easily transportable. It will test CO2, CO, Oil Mist and Water Vapour levels using the Kitigawa tube system, and is complete with yoke and DIN sampling connectors. Supplied with 10 tubes for each of the four tested gases.



Other kits may look like these:



Colorimetric gas detection tubes such as those sold by Drager (or Draeger), Kitagawa, (two that we use predominantly) and by Gastec, and pumps from Drager, Gastec, Komyo Rikagaku Kitagawa all work on a similar principle. A measured volume of gas (or air) is drawn through a tube which contains chemicals which change in colour in response to the presence of a specific target gas (or range of gases) present in the sample.

By knowing the volume of gas or air sampled, the amount of color change read on a linear scale on the colorimetric gas detection tube can be translated into a very accurate measurement of level of gas present, described in the percentage of the total air or, in say parts per million (PPM).

BS 8478 – Breathing Gases for Diving and Hyperbaric Applications

This a new European standard that is also a legal requirement for the constituent gases in use with typically, nitrox, trimix, heliox, etc.

This BS EN Standard 8478 specifies requirements for the composition and purity of breathing gases, other than compressed air, for diving and hyperbaric applications. It specifies reduced levels of contaminants compared with those required to meet the compressed air standard, BS EN 12021.

Be aware of this new standard !

Gas Analysis

One of the services we offer as an alternative to purchasing an air testing kit, and are finding is more and more popular, is an air testing service.

We send you a small (0.2L) cylinder that you fill from your compressor, full instructions and packaging is included. You then return the cylinder to us and within 24 hours we will email you the results with a hard copy certificate of analysis following in the post.

Our reports are simple and complete; we email them in 24 hours and, then mail them. If there is a problem with the sample you have taken we will call you, tell you what caused it, and send you a repeat test kit for just the cost of postage (approx. £6.00 or less). Our sampling kits are the simplest and one of the most effective in it's class; it leaves you with no glass to break or needles to bend, and it is robust. After you pull the sample you will send the entire kit back to us, there is nothing for you to keep track of or worry about misplacing, we send a freshly cleaned cylinder to use each time you pull a sample. The kit is designed for testing SCUBA and SCBA air systems. We use Kitigawa tubes to determine the quality of your air, you just take the sample!

We organize everything and send you instructions, a shipping container and a return label. Our sampler connects to your charging whip to sample SCUBA/SCBA systems.