TECHNICAL DIVING: A BEGINNER'S GUIDE

Mike Busuttili

Technical diving has arrived and is fast becoming established in the diving world. But what exactly is technical diving, and what's in it for you? Mike Busuttili explains it all here.

Sport diving, or recreational diving, can be defined as diving that is enjoyable, attainable, perhaps exciting and demanding and certainly safe.

It has been the aim of training organisations such as the BS-AC to bring people to a level of competence that should not expose them to unnecessary risk.

It is when the type of diving being undertaken begins to present new problems that new solutions and new techniques have to be evolved and in recent times diving exploration has been taking us beyond the norm, requiring a broader range of techniques and equipment in order to maintain the required level of safety.

The depth limit for air diving recommended by the BS-AC is 50 m (less by some other training organisations) and this is deeper than the vast majority of divers may ever feel able to go. But there are some who have reached this limit, and still find the need to dive deeper in safety, and it is these who have caused the so-called technical diving wave.

For many, the wish arose in the pursuit of underwater projects that took them outside the envelope of normal sport diving and into a new area of risk that needed a new set of solutions. This is an area also called extended range diving since it recognises the wish to go further, for longer, sometimes in more extreme conditions, the necessary precautions having to be taken.

It is this professional/amateur attitude, professional in approach, amateur in motivation, that is at the heart of the technical diving movement.

So what does it all involve?

Well, technical diving uses a range of special techniques and equipment to extend the safe operational range of the diver. A principle feature is the use of gas mixtures other than compressed air to reduce the problems associated with nitrogen (narcosis and decompression sickness).

For many divers the passage into technical country starts with nitrox (although nitrox will probably come to be considered a standard diving gas within a few years).

Nitrox is a mixture of nitrogen and oxygen that contains more oxygen than ordinary compressed air does. It is available in a variety of mixes and each is named after the percentage of oxygen it contains e.g. Enriched Air Nitrox 36 (EAN36), containing 36% oxygen, compared with 21% in compressed air.

The advantage of using nitrox is longer no-stop times, or shorter decompression stops or improved safety. By reducing the proportion of nitrogen in our breathing mixture, we absorb less nitrogen during the dive and thus have less nitrogen to eliminate during the ascent.

For a given mixture we can calculate, or read from a table, the Equivalent Air Depth (EAD). This is the depth at which we would have the same partial pressure if nitrogen (PPN_2) as if we were diving on air.

For example, our no-stop limit at 30 m using air on the BS-AC's '88 Table A is 20 minutes, but if we use EAN36, we will have an EAD of 24 m, so we can extend our time to 30 minutes.

As another example, if we want to spend 40 minutes at 30 m on air, we would need to make decompression stops of 1 minute at 9 m, and 9 minutes at 6 m. But by using EAN36 we would need only 1 minute at 6 m. (NB: this will only work for the first dive using current BSAC '88 Tables, as the surface interval is carried out in air, a different gas to that used during the dive).

A further possibility is to carry out a dive on compressed air, say to 40-45 m, but to use a nitrox mix (probably between 50% and 80% oxygen, or even pure oxygen) for decompression stops. This will give faster elimination of nitrogen and therefore shorter decompression times.

Yet another approach is to improve your safety margin by diving on nitrox but treating it as compressed air for decompression purposes. In other words, you breathe nitrox during the dive or the decompression stops, or both, but use your usual decompression table or air dive computer to control your decompression procedure.

The latest generation of nitrox computers enables divers to gain the benefits of reduced nitrogen intake on dives where a multi-level profile is involved. The oxygen percentage of your gas mix is simply entered into the computer, which then deduces the balance of nitrogen and calculates the decompression requirement accordingly.

It has been suggested that nitrox reduces the narcosis effect, but there is no scientific evidence to support this. Another observation is that nitrox results in a lower gas consumption rate, but this has not yet been demonstrated.

There are some problems with using nitrox. Although reducing the nitrogen content brings some advantages, increasing the oxygen content introduces some new disadvantages. We have all learned that oxygen becomes toxic when breathed at high partial pressures, and that, at 66 m, normal compressed air has reached the maximum safety limit for the partial pressure of oxygen (PPO_2) of 1.6 bar.

If we take it that the limit for sport divers is the 1.45 bar recommended by the BS-AC, then EAN32 has a maximum depth safety limit of 35 m and EAN36 is limited to 30 m, with air at 59 m.

Clearly, then, nitrox is not a gas for deep diving, and the limits should never be exceeded.

An additional oxygen problem is that it can have a toxic effect upon our lungs if we are exposed to high concentrations over a longer period. Thus, if we are diving to 30 m on EAN36 (PPO_2 = 1.44) then our maximum exposure should not exceed 120 minutes at that depth, which can be built up over a series of dives. In fact, over the course of 24 hours time spent at this PPO_2 should not exceed 180 minutes.

Nitrox computers are able to track your oxygen exposure to ensure that you do not exceed the recommended oxygen toxicity limits.

Oxygen in high concentrations also presents problems in its handling and use. Although not in itself flammable, it supports combustion and when it comes into contact with certain substances, such as hydrocarbons at high pressure, there is a risk of explosion.

Any part of our diving equipment that stands a chance of coming into direct contact with high concentrations of oxygen must therefore be scrupulously clean and free from any such contamination.

Firstly, the diving cylinder, along with its valve, must be cleaned for oxygen use, known as "in oxygen service", because the procedure for filling it with nitrox could start by introducing a quantity of pure oxygen into the cylinder. The standard air regulator is normally suitable for use with nitrox mixes containing up to 40% oxygen, but for higher concentrations it, too, must be cleaned and never then used with normal air.

That is nitrox diving, with its various limitations.

In order to achieve greater depths than normal, we need to reduce the oxygen content in the mix to avoid oxygen toxicity and reduce the nitrogen content to avoid narcosis problems. This is where we enter the true realm of technical diving.

To reduce the amount of nitrogen it is obviously necessary to add another inert gas to make up the difference.

Helium is the gas usually used and such a mixture is called Trimix.

Trimix diving allows divers to achieve great depths, well beyond 65 m, but needs exceptionally careful planning (usually involving using desktop computers) and complex stage decompression.

This means that divers must carry various different supplies of gas, each in its own cylinder, and also be sure which mouthpiece is which, switching at the required time and depth.

The well organised "tekkie" will carry a travel mix suitable for breathing from the surface down to a certain depth, will then switch to a bottom mix (lower in oxygen content), and during the return to the surface will switch back to the travel mix, with the additional possibility of a decompression mix which will have a high oxygen content to give optimal nitrogen elimination.

Trimix divers are seen entering the water with four or more cylinders, and this is true technical diving, suitable for only the minority.

For even deeper diving still, it is possible further to reduce the oxygen content in the mix and to replace all of the nitrogen with helium. Called Heliox, the use of this is beyond the scope of almost all divers.

Clearly, techniques have had to be developed to ensure safe diving in extreme underwater situations, such as the penetration of wrecks like the *Lusitania*, deep underground cave systems, and diving under ice, all grouped under the description overhead environments.

Diving in a situation where you cannot make a direct ascent to the surface presents a host of additional problems and puts great emphasis on managing your gas supply. There is, too, the question of navigating your way in and out!

Other techniques have been evolved to allow extended in-water decompression procedures to be carried out in greater safety and with greater efficiency.

Helium, incidentally, has two major disadvantages: It is horribly expensive and it cools the diver down faster than when breathing air.

What about rebreathers?

The problem of carrying large amounts of gas on a dive can be a real one. An obvious solution is to use the gas more efficiently, rebreathing it so that the oxygen content is used more fully. A rebreather using a nitrox mix containing, say, 32 or 36 percent oxygen will typically be equipped with a much smaller reservoir cylinder than an open-circuit aqualung set.

Among other benefits, such as compactness and low bubble production (in the case of semi-closed-circuit versions) or no bubble production (in the case of fully-closed units), rebreathers achieve major reductions in gas consumption. Against this must be weighed their currently high initial cost, and their need for considerably more care and attention than open-circuit equipment.

One significant handicap to progress is the fact that dive centres equipped to fill your dedicated nitrox cylinder with the appropriate gas mixture are still few and far between. This is only likely to change as a result of increased demand, because a fully-equipped mixed gas blending system requires a major investment on the part of the filling station.

What training is available for nitrox and technical diving?

If you are a BS-AC member, you will soon be offered skill development courses leading to BS-AC Nitrox Diver and BS-AC Advanced Nitrox Diver qualifications. An extended range diver course is also in hand.

An alternative is to go to one of the specialist agencies: IANTD (International Association of Nitrox and Technical Divers): TDI: (Technical Diving International); or ANDI (American Nitrox Divers International). They all offer a path to nitrox and trimix diving, eventually with rebreathers.

A good starting point for those interested is *An Introduction to Technical Diving*, by Rob Palmer, available from dive shops and the *DIVER* Bookshop at £17.95.

CMAS (the World Underwater Federation) should soon have international equivalents available which will allow member organisations to apply for equivalents to their certificates for issuing to their members.

Glossary

ANDI	American Nitrox Divers International.
EAD	Equivalent Air Depth.
EAN	Enriched Air Nitrox.
Heliox	A breathing gas mixture containing oxygen and helium.
IANTD	International Association of Nitrox and Technical Divers.
Nitrox	Any gas mixture (including air) containing nitrogen and oxygen, but commonly used to describe one where the oxygen content exceeds that of normal air. Known as Oxygen Enriched Air, Safe Air (registered to ANDI), and EAN.
PPO_2	Partial pressure of oxygen in the mixture breathed. The BS-AC recommended limit for this is 1.45 bar for in-water use.
PPN_2	Partial pressure of nitrogen in mixture breathed.
TDI	Technical Diving International.
Trimix	A breathing gas mixture containing oxygen, nitrogen and helium.

Key Words

Equipment, mixed gas, nitrox, physiology, reprint, safety, technical diving.

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KILLER FACTORS IN TECHNICAL DIVING

Killer factors in technical diving are complacency, attitude, oxygen toxicity, exceeding personal limits, ignorance and complexity.

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COULD DO BETTER!
BRITISH SUB-AQUA CLUB INCIDENTS IN 1995

Tim Parish

Nineteen-ninety-five was a good year for diving. Great weather, a 2,000 increase in BSAC membership and, probably as a result of both these factors, a rise in the number of "man-dives" carried out, estimated at over 3,000,000, half a million more than in 1994.

Even better was the drop in the number of incidents, from 389 in 1994, to 351 in 1995, despite the large increase in the number of dives carried out. This reduction has also