Guidance on
Surface Supplied Diving Operations using Nitrox

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Date	**Reason**	**Revision**
March 2012	Initial publication	
January 2017	Change to advice on the selection of gas mixes for emergency breathing cylinders carried in a wet bell or basket (section 4.2). Other minor updates made during review.	

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1 Background

Surface supplied diving is sometimes carried out using a breathing gas mix of nitrogen and oxygen with a higher percentage of oxygen in the mix than in natural compressed air. The common industry terminology for such a gas mix is nitrox.

Diving while breathing nitrox reduces the required decompression time for any particular dive in comparison to the same dive using natural compressed air.

The technique is normally used to ensure that particular dives can be carried out without the diver needing any decompression but in other cases is used to ensure that very lengthy decompression is not required.

The dive plan for the use of surface supplied diving using nitrox needs to consider all the relevant safety implications of using this technique instead of natural compressed air.

The main safety risk not normally present when breathing compressed air is the increased risk of oxygen toxicity problems, particularly those occurring while the diver is still under water.

1.1 Glossary of Abbreviations

DDC	deck decompression chamber
EAD	equivalent air depth
HP	high pressure
HSE	UK Health & Safety Executive
IMO	International Maritime Organization
IOGP	International Association of Oil & Gas Producers
LP	low pressure
RIB	rigid inflatable boat
USN	US Navy

2 Scope

This guidance identifies what is generally regarded in the diving industry as good practice to achieve safe working during surface supplied diving operations using nitrox. Principal areas covered are safety considerations, personnel and equipment requirements.

3 Application

This guidance is intended to apply internationally, but it is recognised that some countries will have legislation that requires different standards or practices to be followed. National regulations may exist in some parts of the world that restrict or exclude the use of this technique (for example by restricting depth or oxygen partial pressures). In such cases the national regulations must always take precedence over this guidance.

4 Safety Considerations

There are a number of safety issues associated with surface supplied diving operations using nitrox. However, as nitrox diving is at a depth shallower than 50m, then the majority of the safety considerations are likely to be similar to those for other surface supplied diving operations (apart from the complexities introduced by the gas mix and any extra equipment).

The application of the following will assist in providing a safe working environment:

- general requirements for safety, equipment and personnel as set out within IMCA D 014 – *IMCA International code of practice for offshore diving* – and the diving contractor's own diving procedures;
- an adequate safety management system;
- detailed risk assessment and hazard identification;
- provision of working procedures approved by relevant parties as defined within the safety management system;
- adequate briefings prior to commencement of diving operations;
- use of personnel competent in this type of diving;
- use of equipment suitable for this type of diving. Information on the equipment needed and the standards of this equipment are given in IMCA D 023 – *Diving equipment systems inspection guidance note (DESIGN) for surface orientated (air) diving systems*.

4.1 Operational Limits

Many countries limit surface supplied diving to a maximum depth of 50m, as do a number of clients.

Restrictions on the maximum partial pressure of oxygen (see section 4.5) mean that the use of nitrox has finite depth limits. In reality this technique is most efficient at shallower depths and is normally used at depths less than 30m although it can be used deeper.

IMCA recommends that diving using air should be organised in such a way that the planned bottom time does not exceed the limits outlined in Appendix 2 of IMCA D 014. This guidance recommends that any surface supplied dive using nitrox be limited to these maximum bottom times.

To calculate the depth that should be applied to establish the maximum bottom time allowed, the nitrox mix being breathed by the diver should be used to calculate the equivalent air depth (EAD).

Many countries and organisations also limit the maximum bottom time that a surface supplied diver is allowed to spend at any given depth (such as the UK Health & Safety Executive (HSE)). Any such regulatory limits take precedence.

4.2 Risk Assessment

The speedy recovery of an injured or unconscious diver from depth to a place of safety is a prerequisite of any assessment of risk during a diving operation. Surface diving using nitrox is no different in this respect to a similar dive using natural compressed air and in fact the use of nitrox may make emergency recovery easier as the requirements for decompression may be less.

There are, however, additional complexities introduced by the use of nitrox, mainly associated with the elevated partial pressure of oxygen or the possible problems if the nitrox supply fails and the diver (for whatever reason) resorts to breathing compressed air.

The risk assessment should therefore consider:

- nature of work to be performed;
- working practices where the risk may increase such as underwater burning when the diver's exhaled gas will contain a high percentage of oxygen;
- the depth at which the dive will take place;

- the diving platform being used (fixed installation, anchored barge, DP vessel, etc.) – see IMCA D 010 – *Diving operations from vessels operating in dynamically positioned mode*;
- predictability of weather conditions, where a vessel may be subject to sudden squalls or unpredictable sea conditions endangering the diver in the water;
- tidal conditions, e.g. where dives are limited to periods of slack water;
- visibility (both on surface and under water);
- water temperature;
- where the standby diver is located and the length of time it would take him to reach an incapacitated diver;
- diver recovery in the event of a vessel or platform emergency;
- evacuation of a diver undergoing decompression in the surface chamber if an emergency arose such as a vessel/installation fire;
- working on, or in the vicinity of, offshore installations; in particular any obstructions or items that could snag an umbilical, causing equipment damage or over run of bottom time;
- the gas to be used in the diver's emergency supply (bail-out);
- the duration of the diver's bail-out bottle at maximum anticipated depth. This should be estimated to allow the diver at least one minute's duration for each 10m of horizontal distance he is away from a safe refuge (such as a wet bell or basket) or one minute for each 10m of umbilical he has paid out if tended from the surface (Note: The assumed breathing rate to be used to calculate the required bail-out volume may be prescribed in some regions of the world or by some clients);
- the provision of emergency breathing gas carried in a wet bell or basket (if one is to be used). Any such emergency breathing cylinders should be filled with the breathing gas mix specified in the diving contractor's operating procedures;
- the requirement for the gas system to meet the standards of cleanliness for oxygen use;
- the possible contamination of the gas system if at any time air is used instead of nitrox;
- the method by which the nitrox mix is provided, i.e. premix prepared off site and stored in cylinders or gas mixed at site using a blender or membrane compressor;
- the accuracy of control of the oxygen percentage if the gas is mixed at site;
- the requirement to limit the maximum partial pressure of oxygen breathed by the diver;
- the maximum safe depth for the nitrox mixture being used;
- measures to ensure that the diver does not descend deeper than is safe for the nitrox mixture he is breathing based on the maximum partial pressure limit. This should include consideration of umbilical management techniques if the diver is on a long horizontal excursion;
- the ability (or inability) to continue to supply the diver with the correct nitrox mix if his primary supply fails;
- the effect on decompression requirements if the diver is forced to switch to compressed air instead of nitrox;
- the ability to deal with a situation where a diver suffers oxygen toxicity problems while under water.

4.3 Equipment Failure

If the nitrox is supplied to the diver using premixed gas prepared off site and supplied in storage cylinders then the possible equipment failures should be no different from the situation encountered during surface supplied diving using compressed air.

However, if the nitrox is supplied to the diver using a blender or membrane compressor system mixing the gas at site, the dive plan will need to address the situation where this specialised equipment fails during the dive.

The main point to be considered is whether there are adequate supplies of the correct nitrox breathing mixture used during the dive available in storage cylinders to allow the diver to return to the surface without the need to switch him to another mix or to compressed air.

4.4 Fire and Explosion Risk

The main international guidance documents (IMO, USN, IMCA, IOGP) and a number of national regulations state that any gas mix containing a percentage of oxygen greater than 25% should be handled as if it is pure oxygen.

This means that any nitrox mix which is over 25% oxygen content will require the use of oxygen compatible greases and equipment components throughout the system, the use of slow opening valves, special cleaning procedures, etc. – see IMCA D 031 – *Cleaning for oxygen service: Setting up facilities and procedures* – and IMCA D 012 – *Stainless steel in oxygen systems*.

Normal practice is that quarter turn valves should not be used if such gas is at a pressure higher than 15bar. There are, however, safety benefits in having quarter turn valves on the diver's gas control panel as this allows the diving supervisor to easily identify if a particular valve is open or closed. The gas will normally have been regulated down at this point although the supply pressure may still be above 15bar. The risk assessment should therefore consider the desirability of having quarter turn valves on the control panel set against any increased risk of fire and explosion.

Such nitrox mixes stored in cylinders or quads should be located in open or well ventilated areas and will require suitable firefighting arrangements.

If at any time compressed air is used in the nitrox breathing gas system, then there may be a need to re-clean the system. Re-cleaning may not be required if the air used can be confirmed to have the required low contaminant levels compatible with use with oxygen. Typically, such air will have been supplied in cylinders from a recognised commercial source and accompanied by detailed analysis certificates. Air generated by low pressure (LP) or high pressure (HP) compressors at the worksite will not normally meet the low contaminant levels required and may raise re-cleaning issues.

4.5 Maximum Partial Pressure of Oxygen

It was suggested in the past that divers under water can breathe gas containing a partial pressure of oxygen up to 1.6bar with minimal risk of oxygen toxicity problems.

A number of national regulations and international guidance documents (IMCA, IOGP) have reduced this figure to give an extra safety factor. Indeed, one of the most commonly used decompression tables for such diving is based on a maximum partial pressure of 1.4bar for the working gas.

This guidance recommends that the figure of 1.4bar is used as the upper limit for partial pressure of oxygen in the nitrox mix breathed by the diver when at depth if using surface supplied diving techniques.

It is recognised that some decompression schedules may require the use of higher partial pressures of oxygen during the decompression phase.

4.6 Bail-out Bottle

There is considerable debate within the industry as to whether the contents of the diver's emergency gas supply carried by the diver (his bail-out) should be the same nitrox mix as his main breathing supply or compressed air.

One view is that the contents of the bail-out may be breathed by the diver during the dive (deliberately or inadvertently) and his decompression will not be altered if the bail-out mix is the same as the main surface supply. Were the contents of the bail-out to be air or a different nitrox mix then this could result in an incorrect decompression schedule being used.

The alternative view is that if the bail-out contents are compressed air then this provides the ability to switch almost instantly from nitrox to air if an oxygen toxicity problem is suspected.

This is therefore a matter which needs to be considered during the risk assessment and will depend on the diving contractor's operating policy.

It is noted that in at least one country there is a mandated requirement that the bail-out contains compressed air. In such a case this mandatory requirement takes precedence over this guidance.

If the bail-out contents are air or a different nitrox mix to the primary supply then the diving supervisor should ensure that regular checks are carried out and recorded throughout the dive of the bail-out contents pressure. This will ensure that any inadvertent use or leakage will be identified.

4.7 Secondary Surface Gas Supplies

There are two distinct operating practices to be considered.

The first is where nitrox mix of the same composition as the primary supply is used as the secondary supply. The second is where compressed air is used as the secondary supply.

In the first case, if the diving supervisor requires to switch the diver on to the secondary gas supply, there is little effect overall as the diver can be recovered to the surface using the decompression schedule originally intended and the diving system is unlikely to require re-cleaning or any other attention.

The second case, where compressed air is used as the secondary supply, is more problematical as the diving supervisor is then required to manage the diver's recovery to the surface as if compressed air had been breathed throughout the dive which may result in decompression requirements that were not envisaged for the original dive. There is also the possibility that the use of this compressed air will result in a need to re-clean the diving system to oxygen cleanliness standards.

There are possible potential benefits in using compressed air as the secondary gas supply in that a diver suffering from the onset of oxygen toxicity problems can be quickly switched to this air supply with the diver (or another diver if nearby) using the helmet free flow to rapidly remove all nitrox and revert to breathing the lower partial pressure of oxygen provided by the air.

It is of course possible to have both primary and secondary supplies as nitrox but with a third supply of compressed air available in the event of oxygen toxicity problems.

4.8 Surface Standby Diver

The primary gas supply for the surface standby diver can be either nitrox or compressed air. This supply should be independent of the supply to the working diver(s).

As the standby diver will only be deployed in an emergency it is unlikely that his breathing air will result in extended decompression requirements.

The choice of gas to be supplied to the standby diver should be a matter for consideration during the risk assessment process and may depend on the diving contractor's own internal procedures.

The use of air for the standby diver supply may raise issues regarding the cleanliness of the gas system for subsequent use with nitrox and this should be considered as part of the risk assessment process.

4.9 Oxygen Toxicity

The use of an elevated oxygen percentage in the breathing gas introduces an increased risk of oxygen toxicity that would not exist with compressed air. For this reason consideration should be given to all aspects of the diving programme including both routine and emergency situations.

A diver who is breathing a nitrox mixture will be exposed to elevated oxygen levels and this can result in toxicity problems both during the dive and afterwards depending on what the diver is expected to do.

As identified earlier in this guidance, the risk assessment should consider all aspects surrounding possible oxygen toxicity problems during the dive, however consideration should also be given to other aspects:

- if surface decompression using oxygen is planned as part of the dive then careful consideration will need to be given to the overall oxygen exposure of the diver including both the elevated partial pressure breathed in the water and the partial pressure experienced in the chamber. Surface decompression using oxygen will always be a suitable technique in an emergency if a diver has to be rapidly recovered to the surface due to outside factors;
- asking the diver to do a second dive in the same shift (repeat diving) should be carefully considered and will normally only be possible where the first dive was relatively shallow and/or short;
- in the event of decompression illness, the treatment will involve elevated partial pressures of oxygen over an extended period.

4.10 Breathing Apparatus

Incidents have occurred in the past where a diver has suffered an oxygen toxicity problem causing him to lose consciousness. On regaining consciousness, the diver has been disorientated and has tried to remove his breathing apparatus.

For this reason it is recommended that divers who are breathing nitrox should wear full helmets (which are more difficult to remove under water) rather than bandmasks or similar easily removed breathing apparatus.

5 Personnel

The use of surface supplied diving using nitrox has very similar requirements to surface diving operations using compressed air, however the following criteria should be applied to personnel selected for such operations.

5.1 Divers

Divers should hold one of the surface supplied diver certificates for offshore diving recognised by IMCA. IMCA produces an up-to-date list of diving certificates that are IMCA recognised (IMCA D 16/16). There is no requirement for divers to hold saturation or bell diving certificates.

Divers should have received adequate familiarisation training in the complexities introduced to normal surface diving by the use of nitrox as the breathing mix including such things as:

- symptoms and effects of oxygen toxicity;
- recognising the onset of oxygen toxicity symptoms in self and others;
- actions required in various types of emergency;
- need for cleanliness of equipment etc.;
- importance of not exceeding maximum safe depth for the nitrox mix in use.

This will normally be in-house training with content, date and performance recorded. This training should only be carried out by those familiar with, and experienced in, the running of such operations. Participation in external and/or e-learning courses are also options that may be considered.[1]

Fuller guidance is available in IMCA C 003 – *Guidance on competence assurance and assessment: Diving Division*. This document specifies a competence assurance framework for divers participating in nitrox diving projects (Job Category D05).

The exact competences required for a diver who will not be either the working diver or the standby diver will depend on their role in the operation. This may include recently trained divers being used for general deck duties while gaining experience.

When reviewing competences, consideration needs to be given to the role that the individual may be asked to play throughout the whole operation. For example, the diver acting as a tender during one dive may be the standby diver in a subsequent dive and would then require to be competent for both roles.

5.2 Supervisors

A diving supervisor who is qualified to supervise surface supplied diving operations offshore should also be able to supervise such operations if the divers are breathing nitrox.

It should not however be assumed that all supervisors holding an IMCA surface supplied (or bell) diving supervisor certificate will be familiar with surface supplied diving using nitrox or that they will have the knowledge or experience required for running such an operation. Ideally they will have previous experience of surface supplied diving operations using nitrox either as a diver or as a supervisor.

If the supervisor is not able to demonstrate suitable previous experience of supervising diving operations using nitrox then they will require adequate familiarisation training in the complexities introduced to normal surface diving by the use of nitrox as the breathing mix including such things as:

- symptoms and effects of oxygen toxicity;
- recognising the onset of oxygen toxicity symptoms;
- actions required in various types of emergency;
- need for compatibility of and cleanliness of equipment etc.;

1 In some parts of the world adequate familiarisation training in the complexities introduced to normal surface diving by the use of nitrox as the breathing mix may have taken place as part of initial diver training. Where necessary, diving contractors should check with the relevant commercial diving certification authority.

- maximum safe depths for the various nitrox mixes available;
- the effects on decompression requirements if a change is made from nitrox to compressed air either during the dive or the decompression phase;
- the calculation of EAD.

This will normally be in-house training with content, date and performance recorded. This training should only be carried out by those familiar with, and experienced in, the running of such operations. Participation in external and/or e-Learning courses are also options that may be considered.

Fuller guidance is available in IMCA C 003 – *Guidance on competence assurance and assessment: Diving Division*. This document specifies a competence assurance framework for supervisors of nitrox diving projects (Job Category D03).

If the diving is to be carried out using gas mixed at site using a blender or membrane compressor then it is likely that the supervisor will also require training in the use of this equipment. This may be in-house training or an external (e.g. manufacturer) course.

5.3 Equipment Technicians

An experienced and competent dive system technician used to working with offshore surface supplied systems should already have a general awareness of the requirements for using oxygen (or high oxygen content gases) as such systems already use similar gases for treatment purposes.

However, a technician working with a surface supplied diving system using nitrox should have received extra (probably in-house) training on the specific aspects of oxygen cleanliness; use of certain types of valves; use of suitable lubricants, etc.

If the nitrox is to be mixed offshore by use of any form of blender or mixer then the technician would need to have had suitable training (such as a manufacturer's course) in the maintenance and repair of such equipment.

5.4 Manning Levels

The dive team size and composition should always be sufficient to enable the diving operation to be conducted safely and efficiently.

The absolute minimum number of personnel required to carry out an offshore surface dive using premixed nitrox stored in cylinders is five. This is made up of one supervisor (who does not dive), a working diver, a standby diver and two tenders (who are normally also qualified divers).

Depending on the exact operational method in use, the experience and competence requirements of the dive team may vary. Consideration may also be given to having extra personnel available to assist in an emergency.

This team will allow one dive with one working diver in the water. After that dive is complete, once the diver has been fully decompressed and is able to take his place as a member of the diving team on the surface, it may be possible to carry out another dive using one of the other divers as the working diver.

The use of a mechanical deployment device such as diving basket or wet bell, the use of on-site equipment to mix the nitrox, a requirement for two divers in the water at the same time or the need for a number of dives during the day will all increase the team size required for safe operations from the minimum requirement given above.

The provision of adequate and suitable personnel in the dive team will need to be carefully considered during the planning of this type of diving operation, for example whether a dedicated system technician and/or dedicated winch operator is required.

6 Equipment

6.1 Diving Equipment

The level of equipment required to conduct a surface supplied diving operation using nitrox will normally be the same as for a surface supplied diving operation using air (assuming it is compatible with and suitably cleaned for gas mixtures with elevated oxygen percentages), however the use of nitrox as the breathing gas may introduce additional complexities particularly if the nitrox is mixed at site using a blender or membrane compressor. It may also vary according to the work programme.

6.2 Decompression Facility

The requirements for on-site decompression facilities for surface supplied diving using nitrox are exactly the same as for surface supplied diving using air. This comprises a deck decompression chamber (DDC) complying with the requirements of IMCA D 023. Such a chamber is also needed for any possible emergency or therapeutic treatments required.

6.3 Marking of Gas Storage Cylinders/Quads

As many international colour coding systems for gas cylinders specify the same or very similar colours and markings for both compressed air and nitrogen/oxygen mixes, there exists a serious potential for confusion – see IMCA D 043 – *Marking and colour coding of gas cylinders, quads and banks for diving applications*.

It is recommended that cylinders are clearly marked and labelled. In particular, if they contain nitrogen and oxygen mixtures with a different percentage make-up to air, the percentages of both nitrogen and oxygen should be clearly visible.

Nitrox mixes for offshore use should be analysed and checked following similar protocols to those used for helium and oxygen mixes. This requires as a minimum:

- analysis certificates being supplied along with the cylinders;
- clear marking on the cylinder/quad showing the contents and percentages;
- analysis on-site when the cylinder is received to confirm the contents. Cylinders in a multi-cylinder quad may require individual analysis as experience has shown that they may not all contain the same mixture (see IMCA safety flash 13/09);
- analysis immediately prior to connection to the gas panel;
- an on-line oxygen analyser with high/low alarm fitted to the downstream gas supply to the diver(s).

6.4 On-site Gas Mixing

While nitrox mixes will be supplied to many worksites premixed in cylinders or quads, other sites will mix or generate their own gas on site.

There are two distinct ways in which this can be done. The first is using equipment such as a gas blender or membrane compressor and the second is to mix at site by adding pure oxygen to compressed air (often called decanting). This second technique can also be used to change the percentage of oxygen in a nitrox mix.

In either case there should be a system in place to ensure that the final nitrox mix does not contain excess oil or other impurities which could pose a risk in a system designated as oxygen clean. This requirement could be met by suitable filtration but this would need to be considered as part of the risk assessment process.

Both of these methods require a detailed risk assessment plus a requirement to follow a number of basic procedural steps. These include:

6.4.1 Use of Gas Blender or Membrane Compressor

In this technique the normal practice is to mix the gas and store it in one or more large reservoirs for subsequent use. It is not normal to mix the gas and then supply it directly to the diver.

For these techniques the equipment used should be:

- designed and specified by the manufacturer/supplier as fit for its intended purpose;
- correctly maintained;
- operated by competent personnel;
- operated in line with manufacturer's instructions;
- cleaned for oxygen service to an appropriate standard;
- fitted with suitable oxygen high/low alarms.

The risk assessment should ensure that all the separate components are designed and used in accordance with good industry practice. It should also consider the effect temperature changes may have on the mixed gas.

6.4.2 Decanting

For this technique the risk assessment should include the following factors:

- ability to thoroughly mix gases;
- safety considerations when using pure oxygen to mix;
- hazards of using compressors to increase the pressure of such mixes.

6.5 Gas Purity

Any nitrox mixes, whether premixed onshore or mixed/generated at site, should meet the same standards of gas purity and be tested to the same standards as the breathing air which would otherwise be used, or relevant national or international breathing gas standards.

6.6 Charging of Storage Cylinders

Surface supplied diving using nitrox is carried out in some locations using small vessels as the dive platform, with a larger vessel in the close vicinity on which the DDC and other support equipment is based. This is often referred to as a mothercraft/daughtercraft operation. In other situations the diving is carried out from a rigid inflatable boat (RIB) or similar using a 'scuba replacement' package – see IMCA D 015 – *Mobile/portable/daughtercraft surface supplied systems*. Information on the equipment needed and the requirements for this equipment are given in IMCA D 040 – *DESIGN for mobile/portable surface supplied systems*.

In both cases, the gas supply carried in the RIB/daughtercraft is limited and the cylinders require refilling at regular intervals.

Conventional guidance is that pure oxygen (or mixes containing more than 25% oxygen) should be regulated down to a maximum of 40bar at the supply point and hard piping should be used as much as possible with flexible pipes being limited to a maximum of 5m in length.

This guidance was intended for use in relation to conventional dive systems and if it were to be applied to the recharging of the nitrox cylinders in a RIB/daughtercraft from a mother vessel then it would impose limitations and potentially additional risks that were not intended, including the likely requirement that the RIB/daughtercraft had to be recovered from the water each time the cylinders required to be recharged.

This guidance therefore clarifies that for the purpose of recharging the nitrox storage cylinders in a RIB/daughtercraft from a mother vessel (and for that purpose only) it is acceptable to use unregulated gas mixes containing over 25% oxygen and with a flexible charging hose of length greater than 5m, subject to the following limitations:

- the decision to employ flexible hoses longer than 5m should be based on a risk assessment;
- the area should be barriered off to minimise the number of personnel in the vicinity during charging activities;
- the charging hose needs to be one continuous length with no intermediate joints;
- the hose needs to be supplied as suitable for use with oxygen and needs to be cleaned to a standard suitable for oxygen use;
- each hose should be tagged and marked clearly to show that it is cleaned, suitable for oxygen service and available for use with nitrox mixes;
- the hose needs to be rated for the pressure intended;
- the hose run while in use should be as straight as possible with no kinks or sharp bends;
- the hose should be protected from impact or other physical damage while in use;
- the hose should be correctly restrained/anchored (see IMCA D 03/11);
- the distance from the nitrox supply point to the charging connection at the cylinders should be established and the length of the charging hose used should be such that excess hose is minimised, although allowance will need to be made for the possible relative movement of the vessels;
- the hose should be monitored at all times from both the RIB/daughtercraft and the mother vessel.

7 Decompression Tables

The diving project plan should clearly identify the working depth, number of working divers, maximum umbilical lengths to reach the worksite, maximum bottom time, required decompression time, etc.

Almost all surface supplied diving using nitrox is carried out using the EAD method to establish decompression requirements. This involves a calculation being done to work out what the equivalent depth would be if the dive had been carried out using compressed air. Thereafter normal commercial decompression tables are used for the specific bottom time at the calculated depth.

Clear instructions should be available to the supervisor on how to calculate EAD and how to then carry out the required decompression.

Clear instructions should also be available to the diving supervisor as to what action needs to be taken if at any time during the dive or the decompression a change of gas to compressed air has to be made.

Whatever tables are used, the diving doctor on call as part of a project's emergency procedures should be familiar with and have immediate access to these tables.

8 References

IMCA D 010 Diving operations from vessels operating in dynamically positioned mode

IMCA D 012 Stainless steel in oxygen systems

IMCA D 014 IMCA international code of practice for offshore diving

IMCA D 015 Mobile/portable/daughtercraft surface supplied systems

IMCA D 023 DESIGN for surface orientated (air) diving systems

IMCA D 031 Cleaning for oxygen service: Setting up facilities and procedures

IMCA D 040 DESIGN for mobile/portable surface supplied systems

IMCA D 043 Marking and colour coding of gas cylinders, quads and banks for diving applications

IMCA C 003 Guidance on competence assurance and assessment: Diving Division

OGP Report No. 411 – Diving Recommended Practice

IMO *Code of Safety for Diving Systems*, 1995 Resolution A.831(19)

HSE Approved Code of Practice L 103 – *Commercial Diving Projects Offshore*, Diving at Work Regulations 1997