



## Breathing gas management

### Diving Information Sheet No 3

#### Introduction

1 This diving information sheet is part of a series of information sheets providing guidance on diving at work. It replaces the following diving safety memoranda: DSM 4/1976, DSM 16/1976, DSM 17/1976, DSM 10/1983, DSM 2/1989, DSM 2/1994 and DSM 5/1994. The remaining DSMs have either been replaced by other diving information sheets, or were cancelled when the Diving at Work Regulations came into force on 1 April 1998.

2 There are six sections, containing guidance on the following aspects of breathing gas management:

- (a) oxygen safety in diving systems;
- (b) checking contents of breathing mixtures;
- (c) on-line oxygen analysis of the breathing medium when diving shallower than 50 metres;
- (d) divers' gas supply systems;
- (e) the marking of air and nitrox quads;
- (f) use of scuba in commercial diving.

#### Oxygen safety in diving systems

3 Fires have occurred when using high-pressure oxygen in diving operations. These have happened mainly when high-pressure oxygen has been opened up onto unpressurised lines. This has resulted in either explosions or localised fires. The majority of these incidents are caused by a combination of contaminated oxygen systems, or the use of materials in the oxygen system which are incompatible with oxygen and isentropic heating caused by too rapid pressurisation of the lines.

4 It is also important to note that if polytetrafluoroethylene (PTFE) reaches a high enough temperature it creates phosgene gas, which is lethal.

5 The following points should be considered when designing and using oxygen supplies in diving systems:

- (a) Reduce high-pressure oxygen to low-pressure (40 bars) at the main supply quad.
- (b) Avoid long runs of flexible hose.
- (c) All materials and fittings should be oxygen compatible.
- (d) Avoid ball valves in high-pressure systems and low-pressure systems.

(e) Avoid sharp bends in oxygen piping.

(f) All oxygen piping connections and oxygen supply connections on storage cylinders should be blanked when not in use.

6 Further guidance on this subject is contained in the AODC Guidance Note Number 029 *Oxygen cleaning*, published by IMCA (International Marine Contractors Association - previously the Association of Offshore Diving Contractors).

#### Checking contents of breathing mixtures

7 Although gas supply companies are rigorous in controlling diving breathing mixtures, experience shows that it is possible for a mixture to be supplied which does not correspond to the cylinder markings.

8 All diving breathing mixtures should be checked on receipt, and re-checked immediately prior to connecting them to a diving gas supply or breathing apparatus charging system.

9 Further guidance on this subject is contained in the AODC Guidance Note Number 016 Rev 1 *Marking and colour coding of gas cylinders, quads and tanks for diving applications*, published by IMCA.

#### On-line oxygen analysis of the breathing medium when diving at depths less than 50 metres

10 When using commercially supplied air quads, nitrox mixes and pure oxygen, it is recommended that oxygen analysers, fitted with audio and visual Hi-Lo alarms, are provided for surface supplied diving operations.

11 To ensure the accuracy of the analysis, the sample point should be taken downstream of the dive control panel and immediately before the diver's umbilical.

#### Divers' gas supply systems

12 This section outlines potential design faults regarding divers' gas supply and the consequences of a primary failure.

#### Surface oriented diving

13 The gas supply system to a diver should be designed in such a way that, in the event of the diver's umbilical being cut or severed, it should not deprive any other diver or standby diver of their gas supply. Take note that it is impractical to isolate the affected gas supply just by manually shutting a valve.

## Bell diving

14 The gas supply system in a diving bell should be designed in such a way that, if the main surface to bell umbilical pressure is lost, the emergency bell onboard gas is brought on-line to the diver or divers. This can be done either manually or automatically, with a safeguard against exhausting back into the main umbilical.

15 The gas supply system to the bell standby diver should give the option of using either unlimited surface gas supply or the independent limited onboard gas supply.

16 When designing new diving bells or modifying existing bells, you should consider the provision of an independent gas supply to each diver and the standby diver.

## Divers' reserve supply

17 The breathing gas supply to divers' masks must be designed in such a way that if the diver's umbilical supply fails, the gas from the reserve or bailout cylinder does not exhaust into the sea.

18 Further guidance on this subject is contained in the AODC Guidance Note Number 028, *Divers' gas supply*, published by IMCA.

## The marking of air and nitrox quads

19 There have been instances where air and nitrox quads have been wrongly identified. As a result the incorrect gas has been used for breathing purposes.

20 The Health and Safety Executive, in consultation with the IMCA Safety and Medical Committee and several major gas supply companies, has assessed several quad colour coding designs to eliminate identification problems.

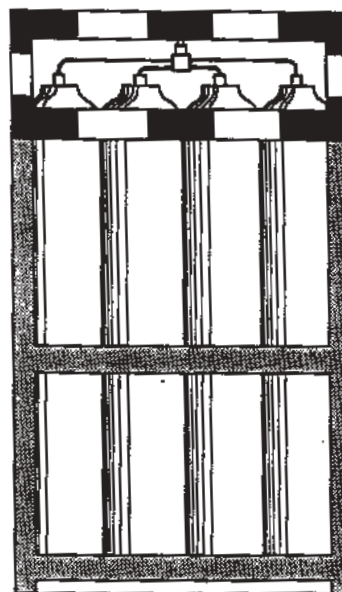
21 The recommended design is based on BS EN 1089-3: 1997 *Transportable gas cylinders . Gas cylinder identification (excluding LPG). Colour coding*. This is black and white banding on the quad frame. This will be extended to include oxygen/nitrogen mixtures (nitrox). This means all air and nitrox quads and cylinders should be marked as indicated:

- (a) Quad frames should be marked in short, alternating bands of black and white, with a maximum length of 20 cm (8 in). (See Figure 1)
- (b) Cylinders within quads should be marked vertically on the body as follows.

AIR:	AIR DIVING QUALITY
NITROX:	% OXYGEN and % NITROGEN, DIVING QUALITY

22 The BS EN 1089-3: 1997 colour coding for nitrogen quads of solid black cylinder necks and solid black quad frame upper crossbars will remain unchanged.

Figure 1 The marking of air and nitrox quads



Short alternating colour bands, 20 cm (8 in) in length

23 Quads will be changed to the new design as they are returned to base for refilling and/or refurbishment.

24 Further information on colour coding and marking of cylinders quads and banks is contained within AODC Guidance Note 016 Rev 1, published by IMCA.

## Use of scuba in commercial diving

25 Scuba (self-contained underwater breathing apparatus) has limitations. It should not be used for:

- (a) offshore diving operations in support of oil/gas projects;
- (b) offshore, inshore and inland diving operations in support of construction, maintenance and salvage projects.

26 In other cases where scuba may be considered appropriate (eg work in an open tank or when clearing a fouled propeller), the risk assessment should take into account all hazards and environmental factors which may affect the safety of the diver, such as entrapment, tidal conditions, visibility and other operational constraints. The results of this risk assessment should be reflected in the dive plan.

## Further reading

1 *Commercial diving projects offshore. Diving at Work Regulations 1997. Approved Code of Practice L103 HSE Books 1998 ISBN 0 7176 1494 8*

2 *Commercial diving projects inland/inshore. Diving at Work Regulations 1997. Approved Code of Practice L104 HSE Books 1998 ISBN 0 7176 1495 6*

3 *Recreational diving projects. Diving at Work Regulations 1997. Approved Code of Practice L105 HSE Books 1998 ISBN 0 7176 1496 4*

4 *Media diving projects. Diving at Work Regulations 1997. Approved Code of Practice* L106 HSE Books 1998 ISBN 0 7176 1497 2

5 *Scientific and archaeological diving projects. Diving at Work Regulations 1997. Approved Code of Practice* L107 HSE Books 1998 ISBN 0 7176 1498 0

6 *The Diving at Work Regulations 1997* SI 1997/2776 The Stationery Office 1997 ISBN 0 11 065170 7

IMCA and AODC guidance notes are available from IMCA, Carlyle House, 235 Vauxhall Bridge Road, London SW1V 1EJ.

More information about diving can be found at [www.hse.gov.uk/diving](http://www.hse.gov.uk/diving).

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<p>This leaflet contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.</p>
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