

Diver's breathing air standard and the frequency of examination and tests

HSE information sheet

Diving Information Sheet No 9 (Revision 1)

Introduction

This diving information sheet (DVIS) is part of a series of information sheets providing guidance on diving at work.

It gives recommendations on the correct standard to be used for assessing the quality of divers' breathing air and includes revised guidance on acceptable levels of carbon monoxide (CO). It also provides guidance on the frequency of tests.

Unit symbols

There are two unit symbols used in this DVIS for 'per metre cubed'. Quotations from EH40/2005 *Workplace Exposure Limits*¹ are shown as .m⁻³, quotations from BS EN 12021: 1999 *Respiratory protective devices. Compressed air for breathing apparatus*² are shown as /m³.

Legislation

The Control of Substances Hazardous to Health Regulations 2002 (as amended) (COSHH)³ and the associated Approved Code of Practice (ACoP) and guidance⁴ apply.

Standard for diver's breathing air

For compressed air used by divers, BS EN 12021² should be used and not BS 4275 as stated in paragraph 178 of the COSHH ACoP and guidance.⁴

BS EN 12021² supersedes the previous standard, BS 4001.

BS EN 12021² applies to both SCUBA and surface supplied diving air supplies.

The National Foreword to BS EN 12021² requires that all contaminants should be kept to as low a level as possible and shall be not greater than 10% of the UK 8-hour time weighted average (TWA) workplace

exposure limits (WELs). These WELs are detailed in HSE publication EH40¹ (see Note 1). The maximum contaminant levels specified in BS EN 12021 are already 10% of the UK 8-hour TWA WELs with the exception of CO. Ten per cent of the 8-hour TWA WEL for CO is 3.5 mg.m⁻³ (3 ppm).

Taking into account the requirements of the National Foreword to BS EN 12021,² the standards for breathing air are detailed below. All measurements are at atmospheric pressure.

- The oxygen content shall be in the range of 21% (+_ 1) by volume (dry air).
- Lubricant content (droplets or mist) shall not exceed 0.5 mg.m⁻³.
- Carbon dioxide content shall not exceed 500 ml.m⁻³ (500 ppm).
- Carbon monoxide content shall be as low as possible but not exceed 3.5 mg.m⁻³ (3 ppm).
- The air shall be without significant odour or taste.
- There shall be no free liquid water.
- The maximum water content of the air measured at:
 - a compressor system outlet for filling cylinders, should not exceed 25 mg.m⁻³.
 - a cylinder outlet, cylinder pressure from 40 to 200 bar, should not exceed 50 mg.m⁻³.
 - a cylinder outlet, cylinder pressure >200 bar, should not exceed 35 mg.m⁻³.

Water content below 40 bar

There is no maximum water content specified for air supplied below 40 bar, ie low pressure air compressor supplies for surface supplied diving equipment and compression chambers. However, dew point limitations apply.

The dew point shall be sufficiently low to prevent condensation and freezing. Where the apparatus is used and stored at a known temperature, the pressure dew point shall be at least 5 °C below the likely lowest temperature. Where conditions of usage and storage of the compressed air supply is not known, the pressure dew point shall not exceed -11 °C. For further advice see Appendix 1.

Other contaminants

A risk assessment should be carried out to establish if any other contaminants should be tested for in addition to those specified in BS EN 12021.² There are two points to note:

- You should check the compressor lubricant safety data sheet and/or the compressor manufacturer's operation and maintenance manual to see if there are any specific substances that should be tested for.
- The location of the compressor inlet should be in a position that is unlikely to allow contaminated air to be drawn in. Local potential sources of contamination should be identified, such as ventilation exhausts, and the owners asked what is being exhausted into the atmosphere. If there is any doubt, additional tests for the likely contamination and increased frequency of tests may be necessary.

Frequency of tests

A competent person (see Note 2) should test the quality of the air supplied for breathing apparatus at least once every three months. More frequent tests should be conducted if contamination is foreseeable within this three-month period.

Additional methods of assuring air quality

Monitor filter life by measuring running hours or the volume of cylinders filled. Both of these methods rely on the contamination not exceeding the levels assumed by the manufacturer in setting the recommended hours or throughput.

A more reliable method of assurance is to monitor the air quality on-line.

One technique of monitoring on line is to measure the moisture content.

- Filter cartridges are usually designed so that the drying element becomes saturated before there is any deterioration of the other elements. Therefore monitoring the moisture content of the air at the filter outlet can indicate when the filter has reached the end of its life.
- On-line moisture content measurement equipment can be:
 - built into the filter element;
 - a separate measuring device;
 - a simple visual indicator.

- The provision of on-line moisture content measurement equipment will be of particular benefit where the air is for sale, as it will provide visible assurance to the user of the gas.

CO can be produced within a compressor as a result of breakdown of the lubricating oil caused by pyrolysis (chemical decomposition by heat). Pyrolysis can occur when the system is hot, but not necessarily overheating and the resulting short-term high levels of CO would not necessarily be identified during periodic sampling. To minimise this hazard provision of a CO catalyst in the filter system and/or online monitoring for CO content should be considered.

Before fitting any such additional devices, you should seek the views of the compressor and/or filter manufacturer.

Appendix 1 - Advice on establishing the pressure dew point limit

HSE commissioned a research project to provide advice on how to establish that the pressure dew point limit does not exceed the limits specified in BS EN 12021.² Two proposals for guidance have been established.

Simple operational guidance

Using the requirement that the water content should have a pressure dew point that does not exceed (ie reach a higher temperature than) -11 °C, an extension of the levels specified in the original table in BS EN 12021² has been derived. The new calculated values, together with the existing limits from BS EN 12021² (ie water content at 40, 200 and 300 bar), are presented in Table 1.

Table 1 Simple operational guidance

| Nominal maximum supply pressure bar | Maximum water content of air at atmospheric pressure and 20 °C mg.m ⁻³ |
|--|--|
| 5 | 290 |
| 10 | 160 |
| 15 | 110 |
| 20 | 80 |
| 25 | 65 |
| 30 | 55 |
| 40 | 50 |
| 200 | 50 |
| >200 | 35 |

This is likely to be the simplest way of interpreting the requirements of BS EN 12021² for low supply pressures and is recommended as the preferred system. However, it does not take into account ambient temperature or provide any flexibility in permitted levels based on local climatic conditions.

Flexible operational guidance

A more flexible method of establishing the maximum permitted water content has been developed but this requires a more complex presentation. The details are outside the scope of this DVIS, but can be obtained from HSE Research Report 427 *Moisture levels in compressed breathing air* at: www.hse.gov.uk/research/rpdf/rr427.pdf.

Notes

1 Workplace Exposure Limits (WELs) are Occupational Exposure Limits (OELs) set under COSHH,³ in order to help protect the health of workers.

2 A 'competent person' is a person having a combination of training, knowledge and experience that will mean they can do the job required in a safe and efficient manner, using the test apparatus provided for the task. The dutyholder will have to decide who the 'competent person' will be. An appropriately qualified employee could fulfil the requirement.

References

1 EH40/2005 *Workplace Exposure Limits: Containing the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulations 2002* (as amended) Environmental Hygiene Guidance Note EH40 HSE Books 2005 ISBN 978 0 7176 2977 0

2 BS EN 12021:1999. *Respiratory protective devices. Compressed air for breathing apparatus* British Standards Institution ISBN 0 580 32082 0

3 *The Control of Substances Hazardous to Health Regulations 2002* SI 2002/2677 (as amended) The Stationery Office ISBN 0 11 042919 2

4 *Control of substances hazardous to health (Fifth edition). The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved Code of Practice and guidance L5* (Fifth edition) HSE Books 2005 ISBN 978 0 7176 2981 7

Further reading

Commercial diving projects offshore. Diving at Work Regulations 1997. Approved Code of Practice L103 HSE Books 1998 ISBN 978 0 7176 1494 3

Commercial diving projects inland/inshore. Diving at Work Regulations 1997. Approved Code of Practice L104 HSE Books 1998 ISBN 978 0 7176 1495 0

Recreational diving projects. Diving at Work Regulations 1997. Approved Code of Practice L105 HSE Books 1998 ISBN 978 0 7176 1496 7

Media diving projects. Diving at Work Regulations 1997. Approved Code of Practice L106 HSE Books 1998 ISBN 978 0 7176 1497 4

Scientific and archaeological diving projects. Diving at Work Regulations 1997. Approved Code of Practice L107 HSE Books 1998 ISBN 978 0 7176 1498 1

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

For British Standards see: www.bsi-global.com

For Stationery Office publications see: www.tso.co.uk

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This document contains notes on good practice which are not compulsory but which you may find helpful in considering what you need to do.

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