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Breathing performance of ‘Octopus’ demand diving regulator systems [Abstract and executive summary]

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Abstract

Self Contained Underwater Breathing Apparatus (SCUBA) often use an ‘Octopus’ system as an alternative air supply. QinetiQ at Alverstoke were contracted by the Health and Safety Executive (HSE) (Contract D5008) to conduct a review and breathing performance test of ‘Octopus’ systems. It was shown that SCUBA single demand valve systems capable of meeting the breathing performance requirements of BS EN 250, cannot be relied upon to meet the same requirements when used as part of an ‘Octopus’ system. Reduced breathing performance of ‘Octopus’ systems (when compared to single valve systems) was found to be a result of the use of low performance first stage regulators, second stage demand valves of different and poor performance and breathing in phase as opposed to out of phase. Recommendations on the use of ‘Octopus’ systems are presented. Appropriate test procedures and acceptance criteria should be identified for ‘Octopus’ systems, and proposed for the next revision of BS EN 250.

Executive summary

When using Self Contained Underwater Breathing Apparatus (SCUBA) it is recommended to use an appropriate alternative breathing gas source/secondary life support system. ‘Octopus’ systems are often used to fulfil or support this requirement.

BS EN 250:2000 specifies the performance requirement of a single demand valve, first stage regulator combination. This, however, gives no indication as to how an ‘Octopus’ two demand valve, first stage regulator combination might perform.

The Centre for Human Sciences at QinetiQ Alverstoke was contracted by the Health and Safety Executive (HSE), Contract D5008, to conduct a review and breathing performance test of ‘Octopus’ systems.

A literature review was conducted. Based on data available from the review and in consultation with the HSE, six configurations of ‘Octopus’ systems were selected and purchased anonymously for test. The selections sought to emulate purchases likely to be made by UK divers.

The systems were evaluated for compliance with elements of BS EN 250 and the Norwegian Petroleum Directorate/UK Department of Energy guidelines for breathing apparatus, when used both as single demand valves and in tandem as ‘Octopus’ systems. The pass/fail criteria adopted encompassed both BS EN 250 and the NPD/DEn guidelines.

Test data obtained showed that SCUBA single demand valve systems capable of meeting the breathing performance requirements of BS EN 250 cannot be relied upon to meet the same requirements when used as part of an ‘Octopus’ system.

Reduced breathing performance of ‘Octopus’ systems (when compared to single valve systems) was found to be a result of the use of low performance first stage regulators, second stage demand valves of different and poor performance and breathing in phase as opposed to out of phase.

The observed breathing performance of ‘Octopus’ systems may go some way to explaining the number of divers who inexplicably break contact with their buddies during alternative air supply (AAS) ascents using SCUBA ‘Octopus’ systems.

The results support the view that the preferred system for an alternative air supply is a completely independent gas supply and demand regulator.

If ‘Octopus’ systems are to be used it is recommended that:

• Divers are made aware that although CE marked valves to BS EN 250 may be considered as ‘fit for purpose’ when used alone, their performance cannot be assured when configured as part of an ‘Octopus’ system.

• Octopus systems should be based on a high performance first stage regulator.
Octopus systems should be configured with demand valves of similar performance. Older valves, or valves whose performance may have degraded should not be used. The diving community should be made aware of the effects of breathing in and out of phase.

Appropriate test procedures and acceptance criteria should be identified for ‘Octopus’ systems and proposed for inclusion in future diving apparatus standards, including the next revision of BS EN 250.

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Key words
Reprinted from, scuba, equipment, performance, emergency ascent, diving safety memos

The evidence-basis of diving and hyperbaric medicine. A synthesis of the high-level clinical evidence with meta-analysis [Abstract]

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Abstract

Introduction: Hyperbaric oxygen therapy (HBOT) is the administration of 100% oxygen at pressures greater than 1 atmosphere. One recurrent criticism that has been made of this field is that treatment is based on little or no good clinical evidence.

Aims: The primary objective of this thesis is to make a useful response to that criticism. I planned to collate all the available randomised evidence in the fields of diving and hyperbaric medicine, supply a critical appraisal of each paper, and synthesise that evidence in a series of systematic reviews with meta-analysis. I also intended to use a cost analysis of hyperbaric practice in our own facility to inform formal cost-effectiveness analysis using the estimates of effect generated by the individual meta-analyses.

Methods: A comprehensive search strategy was used to identify all clinical RCTs involving the administration of hyperbaric breathing mixtures. Each trial was appraised using the software developed by the Oxford Centre for Evidence Based Medicine. Each critical appraisal was loaded onto a searchable website at <www.hboevidence.com>. Each diagnostic category identified was considered for inclusion in a Cochrane systematic review and meta-analysis.

Results: The database includes 130 critical appraisals covering 173 separate reports. The site has received more than 17,000 hits. There are 12 formal meta-analytical reviews and all have been accepted for publication in the Cochrane Database of Systematic Reviews at the time of writing. These form the basis of this thesis and include late radiation tissue injury, chronic wounds, acute hearing loss and tinnitus, multiple sclerosis and decompression illness. The meta-analyses in this thesis suggest there are several areas where HBOT is associated with improved clinical outcomes and that routine use is probably justified in some areas (e.g., radiation proctitis healing with HBOT: NNT 3, 95% CI 2 to 11). On the other hand, these analyses suggest there is most unlikely to be significant clinical benefit from the application of HBOT to patients currently referred for HBOT (e.g., multiple sclerosis).

Conclusions: The randomised evidence for the use of HBOT is now significantly easier to access. Recommendations for therapy and future research directions can be made on the basis of these analyses.

Key words
Reprinted from, underwater medicine, hyperbaric oxygen therapy, medical conditions and problems, research, evidence, Cochrane library

The database of randomised controlled trials in hyperbaric medicine maintained by Dr Michael Bennett and colleagues at the Prince of Wales Diving and Hyperbaric Medicine Unit is at:

<www.hboevidence.com>