The Diving Medical Advisory Committee

DMAC, Eighth Floor, 52 Grosvenor Gardens, London SW1W 0AU, UK
Tel: +44 (0) 20 7824 5520
www.dmac-diving.org
info@dmac-diving.org

In-Water Diver Monitoring

Report prepared by Monitoring Sub-Committee of Diving Medical Advisory Committee
DMAC 02 – February 1979

1 Introduction

The Diving Medical Advisory Committee has considered the subject of in-water monitoring of divers and considers the following recommendation represent a basis for both industry and government to bear in mind should legislation on this aspect of diver safety be contemplated.

2 General

In general, in-water monitoring of divers can be divided in *physiological* and *equipment* monitoring.

Whilst it is clear that the majority of past accidents occurring to divers would not have been influenced had in-water monitoring been available (i.e. monitoring other than communications), it is undeniable that certain cases exist to prove that the prospect of averting a serious outcome would have been enhanced had some aspects of monitoring been available and in use.

3 Communications

It can only be re-emphasised that the most important single component of any in-water monitoring system is an adequate communications system with suitable redundancy.

Communications should not present any technical difficulties with surface supplied divers and, in the view of DMAC, should be considered obligatory for all such divers.

For divers operating below 50m, a speech processing system should also be obligatory for oxy-helium breathing mixtures.

For free-swimming divers using Scuba gear in relatively shallow water, it is considered that through-water communication devices are now commercially available which allow 'diver to diver' and 'diver to surface' communication. Although the range of such devices is variable depending on underwater conditions, the range is considered to be sufficiently adequate for most commercial applications.

It is for consideration whether recording of speech transmissions should be extended from its present requirement to include all forms of commercial diving where a communications system is used.

4 Physiological Monitoring

Whilst the range of physiological monitoring that is potentially available is already quite extensive, DMAC has considered the problem in terms of the immediate practical use of such information rather than a collection of information which can be used for retrospective analysis. With this in mind, the question of 'real-time' interpretation of physiological information is equally important and quite clearly, information that cannot be of immediate use to the supervisor in determining the well-being of divers is of little use in practical diving operations. Therefore, DMAC considers the only currently desirable form of physiological monitoring is that of respiration. Monitoring of heart

rate, possible in several ways, is not considered to provide useful information bearing in mind the wide variation consequent upon various forms of stress.

It is accepted that current monitoring of respiration is possible through communications systems. This system is only satisfactory if each individual diver is linked to the supervisor on a separate channel and becomes unwieldy if more than two divers are being monitored. Methods of monitoring respiratory rate and giving a numerical display are available. The simplest forms use thermistors mounted in the diver's gas supply adjacent to the demand valve or helmet gas inlet. It is for further consideration whether such a numerical display is preferable to audible evidence of respiration and its character as opposed to rate. DMAC has an open mind on this question and will monitor further developments. However, DMAC does consider that a simple, robust method of assessing respiratory rate could and should be developed which would be independent of the communications system and yet allow the communications system to provide evidence on character of respiration.

DMAC considers that measuring of core-temperature is not yet sufficiently developed to meet the criteria of robustness and simplicity. Future developments of radio-pills show promise in terms of cost and their ability to measure core-temperature by non-invasive methods. DMAC is ideally placed to assess such developments and will advise government and industry when such an application is considered ready for general use. However, when core-temperature is monitored, it should be possible to lay down acceptable lower and upper limits which would greatly add to the simplicity of displaying transmitted information.

5 Equipment Monitoring

As with the physiological monitoring, several aspects of equipment function may be monitored but DMAC considers that only the partial pressure of oxygen in the counterlung of closed or semi-closed circuit UBAs is practical. Such a system should be able to meet the criteria of robustness, compactness and ease of maintenance. Present technology allows such monitoring and where practical a *high/normal/low* display should be mounted within a diver's helmet.

DMAC assumes that in the case of divers supplied with breathing gas via an umbilical, the partial pressure of oxygen will only need to be monitored before supply to the diver. However, experience shows that this may not be adequate and the only way of ensuring an adequate O_2 partial pressure is to monitor at the point of delivery.

Other monitoring of the diver's equipment can be categorised as either non-essential (breathing gas temperature, heating water temperature), in that the diver's subjective comment is perfectly adequate; or non-available (carbon dioxide levels in helmets and counter-lungs), in that suitable transducers are currently not available and probably will not be available in a suitable form in the foreseeable future.

6 Physiological and Medical Monitoring Within Chambers

DMAC considers that this should be the subject of a separate report which is under consideration.

The whole topic will be kept under review by DMAC.