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Recreational diving services — Requirements for rebreather diver training — Decompression diving to 100 m

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 228, *Tourism and related services.*

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Rebreathers (i.e. breathing devices that recirculate some or all of the diver's exhaled breath and replenish any consumed oxygen to maintain a breathable mixture) are becoming much more widely available and popular among divers. The market for rebreather diving has been constantly growing in recent years and is now considered to be large enough that the need for standards for training organizations on minimum training requirements is evident. Rebreathers allow divers to dive longer and to greater depths. Such depths can go beyond 30 m and may therefore require mandatory decompression stops. If rebreathers are used improperly they can be hazardous; divers have had fatal accidents due to incorrect use of these devices. It is therefore important to specify training for diving with such devices.

Training organizations offering training that conforms with this document may exceed any of the requirements in terms of the volume or complexity of training but should at least ensure the students master all the skills and knowledge defined in this document.

Recreational diving services — Requirements for rebreather diver training — Decompression diving to 100 m

1 Scope

This document specifies requirements for rebreather diver training programmes which provide the competencies required to perform dives to 100 m with a rebreather using a breathing mixture containing helium requiring mandatory decompression stops.

This document specifies evaluation criteria for these competencies.

This document specifies the requirements under which training is provided, in addition to the general requirements for recreational diving service provision in accordance with ISO 24803.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 24801-3, *Recreational diving services — Requirements for the training of recreational scuba divers — Part 3: Level 3 — Dive leader*

ISO 24802-2, *Recreational diving services — Requirements for the training of scuba instructors — Part 2: Level 2*

ISO 24803, *Recreational diving services — Requirements for recreational diving providers*

ISO/DIS 24806, *Recreational diving services — Requirements for rebreather diver training — Decompression diving to 60 m*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
rebreather
apparatus that has a supply of gas carried by the diver, allowing the diver to breathe under water which enables the diver to inspire gas from a facepiece connected to a counterlung and to pass exhaled gas through a carbon dioxide absorption material before it is re-breathed from the counterlung and inspired partial pressure of the gases within the apparatus remain within acceptable physiological limits so that gas is thus recirculated within the apparatus

Note 1 to entry: A rebreather can also be called a self-contained rebreathing apparatus.

Note 2 to entry: A facepiece can be a mouthpiece assembly, a half mask, a full-face mask or a helmet.

[SOURCE: EN 14143:2013, 3.1, modified — Note 1 to entry modified and Note 2 to entry added. This content has been reproduced with the permission of CEN. Copyright remains with CEN.]

3.2
rebreather type
primary rebreather design

EXAMPLE Closed-circuit rebreather (CCR), manually controlled closed-circuit rebreather (mCCR), electronically controlled closed-circuit rebreather (eCCR), semiclosed-circuit rebreather (SCR), manually controlled SCR (mSCR), electronically controlled SCR (eSCR), hybrid closed-circuit rebreather (hCCR).

3.3
rebreather unit
type of *rebreather* (3.1) having consistent controls, displays and configuration over several *rebreather models* (3.4) where the operation is essentially the same from rebreather model to rebreather model

3.4
rebreather model
specific individual design of *rebreather* (3.1) made by a manufacturer

3.5
breathing gas
gas present in the *breathing loop* (3.14) inspired by the diver

3.6
supply gas
gas present in a cylinder which may be added to the *breathing loop* (3.14)

3.7
bailout gas
gas present in a cylinder that may be breathed directly by the diver

3.8
nitrox
breathable mixture of nitrogen and oxygen with more than 21 % oxygen content, which may contain trace gases at levels no higher than those found in normal air

[SOURCE: ISO 11107:2009, 3.5]

3.9
trimix
gas comprising a specified mixture of oxygen, helium and nitrogen, capable of supporting human life under appropriate diving or hyperbaric conditions

Note 1 to entry: This includes manufactured gas mixtures made up from combinations of pure oxygen, pure helium and pure nitrogen, with or without compressed air.

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3.10
heliox
gas comprising a specified mixture of oxygen and helium, capable of supporting human life under appropriate diving or hyperbaric conditions

3.11
PO_2
partial pressure of oxygen in a gas mixture

Note 1 to entry: This usually refers specifically to the breathing-gas mixture inhaled by a diver.

3.12
set-point
PO_2 setpoint
PO_2 value that is used by a control system to determine when a solenoid valve injects oxygen into the *breathing loop* (3.14)

3.13
respiratory minute volume
RMV
product of the tidal volume and breathing frequency measured in litres per minute

[SOURCE: EN 14143:2013, 3.10]

3.14
breathing loop
portion of a *rebreather* (3.1) through which gas circulates, usually consisting of a mouthpiece, breathing hose(s), counterlung(s), non-return valves and a CO_2 absorbent canister

3.15
scrubber
canister in the *breathing loop* (3.14) containing CO_2 absorbent

3.16
confined water
swimming pool with a depth appropriate to the activity or body of water, offering similar conditions with regard to visibility, depth, water movement and access

[SOURCE: ISO 24801-2:2014, 3.5]

3.17
open water
body of water significantly larger than a swimming pool, offering conditions typical of a natural body of water

[SOURCE: ISO 24801-2:2014, 3.6]

3.18
limited open water
open water (3.17) no deeper than 20 metres with no appreciable water movement, and visibility that is sufficient to allow effective student supervision and skill development

3.19
service provider
entity (individual or organization), including any individual acting on behalf such an entity, which offers one or more of the following services:

— introductory diving activities;

— snorkelling excursions;

— provision of training and education;

— organized and guided diving for qualified divers;

— rental of diving equipment.

[SOURCE: ISO 24803:2017-03, 3.1]

3.20
safety stop
a non-mandatory *decompression stop* (3.21) near the surface prior to surfacing

3.21
decompression stop
mandatory stop during ascent from depth prior to surfacing

3.22
no-decompression diving
diving without requiring mandatory *decompression stops* (3.21)

3.23
decompression diving
diving with mandatory *decompression stops* (3.21)

3.24
delayed surface marker buoy
DSMB
surface marker buoy that can be deployed by a diver from underwater

4 Competencies

The training programme shall ensure that students are qualified to independently plan and conduct dives requiring mandatory decompression stops using the specific rebreather unit for which the diver has received training.

Divers qualified in accordance with this document are competent to dive with a suitably qualified buddy to 100 m using a rebreather with a supply gas containing:

— a minimum of 5 % oxygen; and

— sufficient helium to control narcosis and to ensure a breathing gas density of less than 6,3 g/l.

In order to be deemed qualified to dive with a specific rebreather unit other than the one that the diver has received training for, a diver will need further unit specific training.

The training program shall ensure that the student has a full understanding of any theoretical concepts or skills applicable to the rebreather type, rebreather unit and rebreather model they will use. Students shall be provided with an overview of any information that is not specific to their rebreather, but this only needs to be informative in nature so that they are aware of the general possible configurations that other divers may use.

5 Prerequisites for training

5.1 General

The service provider shall ensure that the student fulfils the following prerequisites to take part in the training course envisaged.

In order to participate in a training programme in accordance with this document students shall be qualified in accordance with ISO/DIS 24806.

5.2 Minimum age

The minimum age to participate in a training programme in accordance with this document shall be 18 years.

5.3 Diving experience

Students shall have logged at least 100 dives with a minimum of 100 h using a rebreather. At least 50 dives and 50 h shall have been made with the same specific rebreather unit to be used in the course, including dives in the last six months.

Concerning these dives,

— a minimum of 30 rebreather dives shall have been made to a depth deeper than 30 m;

— at least ten of these 30 dives shall have been made to a depth deeper than 50 m using a gas mix containing helium and requiring staged decompression; these dives shall have been completed after qualification as a 60 m rebreather diver in accordance with ISO/DIS 24806.

5.4 Health requirements

Documented evidence shall be obtained that the student has been medically screened as suitable for recreational diving by means of an appropriate questionnaire or medical examination.

NOTE See the Reference [2] for an example of a medical questionnaire and accompanying guidance to physicians.

In case of doubt, the training service provider shall refer students to proper medical resources. If the student is not examined by a physician, the student shall be obliged to confirm by signature that he or she has understood written information given by the instructor on diseases and physical conditions which can pose diving-related risks.

Students shall be advised of the importance of appropriate regular medical examinations.

6 Introductory information

Information in accordance with ISO 24803 shall be made available to the students prior to, or during the first class or meeting.

In particular the students shall be informed of the limits of their training and qualification as specified in accordance with Clause 4.

7 Theoretical knowledge

7.1 Knowledge review

The training programme shall ensure that knowledge in accordance with ISO/DIS 24806 is reviewed by assessing the students (e.g. by means of an exam or quiz) before teaching new knowledge. Where knowledge gaps are identified remedial training shall be carried out.

7.2 Risk management

The training program shall ensure that students have knowledge concerning the identification, potential consequences, and management of the following risks, specifically related to decompression dives to 100 m:

— risks associated with each phase of the dive from dive planning to exiting the water;

— risks associated with hypoxic gas mixtures;

— use of bailout valve when using hypoxic gas mixtures at shallow depths or at the surface;

— risks associated with carrying multiple gases in multiple cylinders;

— failure to follow decompression model ascent rates;

— no direct or immediate access to the surface in an emergency due to decompression requirements and/or distance;

— inadequate bailout options;

— hypoxia, hyperoxia and hypercapnia leading to unresponsiveness and drowning due to switching to the wrong gas, improper gas choice, failing to properly analyse the gas or rebreather system problems;

— inert gas narcosis;

— omitted procedures and errors caused by extensive equipment task overloading, high physical exertion and/or psychological loading;

— taking untried equipment on a deep dive without prior testing in shallow water;

— overweighting or loss of buoyancy;

— dive team members not adequately prepared or not proficient;

— dive plan incomplete and without sufficient contingencies;

— inadequate surface support for the planned dive;

— loss of critical gases (breathing loop and supply gases);

— separation from dive team;

— separation of the dive team from surface support;

— remote dive site.

The training program shall ensure that students have knowledge concerning the following means and measures to mitigate risks:

— dive team assessment and readiness;

— dive team proficiency;

— dive plan and roles;

— equipment preparation and testing;

— surface support readiness;

— emergency evacuation plan.

7.3 Team diving

The training programme shall ensure that students have knowledge concerning the following potential risks of diving:

— in mixed teams using different rebreathers;

— in mixed teams using different equipment configurations;

— in mixed teams of open circuit and rebreather divers;

— when team members use different dive and emergency procedures.