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Recreational diving services — Requirements for rebreather diver training — Decompression diving to 45 m

Services relatifs à la plongée de loisirs — Exigences concernant la formation des plongeurs à l'utilisation des recycleurs — Plongée avec décompression jusqu'à 45 m

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 329, *Tourism services*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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 on minimum training requirements for training organizations is evident. Rebreathers allow divers to dive for longer and to greater depths. Such depths can go beyond 30 m and 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 45 m

1 Scope

This document specifies requirements for rebreather diver training programmes which provide the competencies required to perform dives with a rebreather to 40 m using a nitrox breathing mixture or to 45 m using a trimix breathing mixture, 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 11107, *Recreational diving services — Requirements for training programmes on enriched air nitrox (EAN) diving*

ISO 24801-2, *Recreational diving services — Requirements for the training of recreational scuba divers — Part 2: Level 2 — Autonomous diver*

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 24804, *Recreational diving services — Requirements for rebreather diver training — No-decompression diving*

3 Terms and definitions

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

ISO and IEC maintain terminology 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 underwater, 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 rebreathed 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 diving 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 model to 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* (3.13) inspired by the diver

3.6
supply gas
gas present in a cylinder which may be added to the *breathing loop* (3.13)

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
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.

3.11
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* (3.13)

3.12
respiratory minute volume
RMV
product of the tidal volume and breathing frequency measured in litres per minute

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3.13
breathing loop
portion of a rebreather through which gas circulates, usually consisting of a mouthpiece, breathing hose(s), counterlungs, non-return valves and a CO_2 absorbent canister

3.14
scrubber
canister in the *breathing loop* (3.13) containing CO_2 absorbent

3.15
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]

3.16
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]

3.17
service provider

entity (individual or organization), including any individual acting on behalf of 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, 3.1]

3.18
safety stop
non-mandatory decompression stop near the surface prior to surfacing

3.19
decompression stop
mandatory stop during ascent from depth prior to surfacing

3.20
decompression diving
diving with mandatory *decompression stops* (3.19)

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 40 m using a rebreather that supplies a nitrox breathing mixture; or

— to 45 m using a rebreather that supplies a trimix breathing mixture using a trimix supply gas with a minimum of 20 % oxygen and a maximum of 35 % helium.

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

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

In order to participate in a training programme in accordance with this document, students shall either:

— have met all competency requirements in accordance with ISO 24804 and have logged 20 open-water dives with at least 20 hours underwater using a rebreather;

or

— be qualified in accordance with ISO 24801-2;

— be qualified in accordance with ISO 11107;

— be trained in procedures of decompression diving and have conducted at least five dives with actual or simulated staged decompression; and

— have logged 30 open-water dives with at least 25 h underwater using open-circuit scuba and have logged at least five dives to a minimum depth of 30 m.

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 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 that they will be trained to dive:

— to 40 m using a rebreather that supplies a nitrox breathing mixture; or

— to 45 m using a rebreather that supplies a trimix breathing mixture using a trimix supply gas with a minimum of 20 % oxygen and a maximum of 35 % helium.

7 Theoretical knowledge

7.1 Rebreather basics

The training programme shall ensure that students have knowledge concerning the following:

— the definition of a rebreather;

— the difference between a rebreather and open-circuit scuba;

— advantages and limitations of different rebreather types;

— the concept of rebreather unit-specific requirements;

— maintaining PO_2 within physiological limits.

7.2 Function of rebreather components

The training programme shall ensure that students have knowledge concerning the function of the following components of a rebreather, with emphasis on the specific features of the rebreather unit they will use during their training:

— breathing loop, definition of “minimum/optimum breathing loop” and breathing loop volume;

— counterlungs;

— inhalation and exhalation hoses;

— non-return (mushroom) valves;

— scrubber (CO_2 absorbent);

— oxygen sensor(s);

— gas supplies (this shall include, where applicable, oxygen, diluent or other supply gases);

— gas addition valves [this shall include, where applicable, manual, automatic diluent valve (ADV) or other automatic gas addition];

— regulator(s), including the first stage pressure relief valve (if applicable);

— overpressure valve (OPV);