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Requirements for the training of scientific divers —

Part 2: Advanced scientific divers

Exigences concernant la formation des plongeurs scientifiques —

Partie 2: Plongeurs scientifiques confirmés

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Foreword

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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

The ISO 8804 series is aimed primarily at scientists and academics training to become scientific divers (at three levels of competency) and sets minimum requirements for the training of scientific divers at the three levels reflected in the names of the three parts. It will be beneficial both to organizations involved in training scientific divers and the scientific diving community as a whole.

This document is considered the minimum competency standard for recognition as a scientific diver. It is intended to provide guidance regarding agreed-upon minimum training requirements, thereby easing barriers to cross-programme co-operation and reciprocity through common acknowledgment of the basic 'skill set' for scientific divers.

Many organisations will have additional requirements for qualification of scientific divers. These supplementary requirements can include, but are not limited to, a greater number of training dives, additional training, enhanced fitness qualifications and requirements for maintenance of active diver status.

Requirements for the training of scientific divers —

Part 2:
Advanced scientific divers

1 Scope

This document specifies minimum requirements for the training of advanced scientific divers to undertake advanced scientific diving.

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 8804-1, *Requirements for the training of Scientific Divers — Part 1: Scientific Diver*

ISO 8804-3, *Requirements for the training of Scientific Divers — Part 3: Scientific Diving Project Leader*

ISO 21416, *Recreational diving services — Requirements and guidance on environmentally sustainable practices in recreational diving*

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

ISO 24801-3:2014, *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*

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
scientific diving
diving performed as a part of a scientific, research or educational activity

3.2
scientific diver
diver competent in scientific methodology undertaking *scientific diving* (3.1)

4 Competencies

Advanced scientific divers shall be trained such that, when evaluated in accordance with Clause 11, they are deemed to have sufficient knowledge, skills and experience with regard to diving, as well as underwater scientific methodologies and protocols to participate in advanced scientific diving activities which involve:

— planning scientific dives;

— leading scientific dives under the oversight of a project leader in accordance with ISO 8804-3;

— coordinating the team with other teams;

— repetitive diving;

— challenging environmental conditions.

Advanced scientific divers trained in accordance with this document are competent to participate in scientific diving activities within the limits of their diving qualification.

5 Prerequisites for training

5.1 General

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

5.2 Minors and vulnerable persons

In the case of training provision to minors or vulnerable persons, training providers shall be aware of the additional responsibilities this entails. The training provider shall implement policies and procedures designed to provide reasonable protection and precautions against abuse occurring during the service provider's activities.

Documented parental or legal guardian consent shall be obtained when the applicant is a minor.

NOTE The age of a minor is defined by local legislation.

5.3 Health requirements

Documented evidence shall be obtained that the trainee has been medically screened as suitable for scientific diving.

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

NOTE See the Reference [1] for an example of a medical questionnaire and accompanying guidance to physicians.

5.4 Diving competencies

The training programme shall ensure that trainees possess diving competencies in accordance with ISO 24801-2. The training programme shall ensure that trainees possess competencies in diver rescue in accordance with ISO 24801-3:2014, 9.3, 9.4 and 9.5.

In cases where trainees already hold qualifications in accordance with ISO 24801-2 and ISO 24801-3:2014, 9.3, 9.4 and 9.5, these competencies shall be reviewed by assessing the trainees. Where gaps are identified, remedial training shall be carried out. Where trainees do not hold these qualifications, requirements

in accordance with ISO 24801-2 and ISO 24801-3:2014, 9.3, 9.4 and 9.5 shall be included in the training programme.

5.5 Scientific prerequisites

Trainees shall provide proof of meeting the competency requirements for a scientific diver in accordance with ISO 8804-1 and shall hold a relevant scientific credential or documented experience of working with scientific methodology.

6 Introductory information

Information in accordance with ISO 24803 shall be made available to the trainees prior to or during the first instructional session or meeting.

In particular, the trainees shall be informed of the limits of their training and qualification as specified in Clause 4.

7 Theoretical knowledge

7.1 Diving-related theoretical knowledge

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

— leading scientific dives in larger teams;

— the role of a team leader to coordinate the dive team within the plan;

— coordinating with other dive teams;

— calculating gas requirements;

— repetitive and decompression diving, decompression theory and planning;

— challenging environmental conditions (e.g. low visibility, water movement, cold water) and understanding of these relative to planning;

— different types of diving equipment configurations (e.g. full face masks, twin sets, stage gas cylinders) used in advanced scientific diving operations, recognizing the key features of each;

— approaching remote sites (e.g. small boat handling, backup equipment or gas supplies).

7.2 Risk assessment

The training programme shall ensure that trainees have knowledge concerning assessment of the risks involved in the following scientific diving activities:

— team leading;

— increased depth;

— increased workload;

— longer time at depth;

— complex equipment set-ups (e.g. rebreathers).

7.3 Legal aspects

The training programme shall ensure that trainees have basic knowledge of:

— the relevance of local rules, regulations or laws (e.g. sampling licenses for wildlife or archaeological sites);

— health and safety regulations;

— duty of care, personal responsibility;

— safety measures, managing the safety of a diving site;

— personal protective equipment;

— standards that are relevant to diving, diving equipment and breathing gases;

— the relevance of approvals and certifications for equipment.

7.4 Scientific methodologies and protocols

7.4.1 General

The training programme shall ensure that trainees are able to apply their knowledge of the topics as required by ISO 8804-1 within the context of organising scientific dives and ensuring that a dive team can meet the objective of the scientific dive.

The training programme shall ensure that trainees are able to apply their knowledge of the topics as required by ISO 8804-1 within the context of advanced scientific diving activities which involve:

— repetitive and decompression diving;

— challenging environmental conditions (e.g. greater depth, currents and poor visibility).

The training programme shall ensure that trainees are able to demonstrate an understanding of the following subjects as they are applied in scientific diving operations:

— legal aspects and responsibilities relevant to scientific diving;

— ethics of science;

NOTE Some principles of ethics in science are presented in the Nagoya protocol (see Reference [2]).

— sustainable practices in scientific diving in accordance with ISO 21416;

— underwater work conducted by scientific divers;

— core responsibilities involved in the administration and safety of scientific diving.

7.4.2 Experimental design

The training programme shall ensure that trainees have basic knowledge of the following aspects of experimental design and how it can be applied in advanced scientific diving activities:

— scientific method: the question, hypothesis, sampling design, testing, data analysis, discussion and conclusions;

— sampling design (e.g. random sampling, systematic sampling, sampling by chance or by choice);

— estimating error and avoiding bias;

— required numbers of replicates for valid test results;

— factors influencing test results;

— power calculation and statistical analyses;

— reporting (e.g. technical reports, scientific publications).

7.4.3 Generic methods

The training programme shall ensure that trainees are able to explain how the following techniques are utilised in scientific diving and list the advantages, disadvantages and potential hazards associated with each one:

— search methods;

— survey methods, both surface and sub-surface;

— locating and marking objects and sites;

— the use of airbags and airlifts for controlled lifts, excavations and sampling;

— rigging and rope work;

— construction and deployment of transects and search grids;

— underwater navigation methods using suitable techniques;

— recording techniques;

— use of lines for diving communications (e.g. acting as a roped diver and as surface tender);

— sampling techniques

  — use of tools underwater (e.g. hammer, chisel, spanner, hand or power drilling machines, core machines, hydraulic devices).

7.4.4 Planning of scientific dives

The training programme shall ensure that trainees have knowledge of:

— initial scientific project-planning process (in order to achieve scientific goals);

— methods to address research goals;

— equipment selection and usage (troubleshooting, assembling, transporting);

— preparation and entry procedures;

— planning for scientific activities on each dive (with dry runs, if applicable);

— process for data recording;

— post-dive procedures;

— increased gas consumption on scientific dives and the importance of monitoring gas consumption;

— risk assessment related to scientific tasks performed during the dive.

7.5 Team management

The training programme shall ensure that trainees are able to apply their knowledge and skills as a level 1 scientific diver in accordance with ISO 8804-1 in the context of organising dives and ensuring that a dive team can meet the dive objective.

The training programme shall ensure that trainees have knowledge of the following in order to achieve the intended scientific objectives of the dive:

— how to organise a scientific dive team;

— how to assign scientific tasks to the individual team members;

— how to coordinate scientific underwater activities.

8 Practical scientific diving skills

The training programme shall ensure that trainees are able to conduct and plan each of the following:

— search methods;

— survey methods, both surface and sub-surface, capable of accurately locating and marking objects and sites;

— the use of airbags and airlifts for controlled lifts, excavations and sampling;

— rigging and rope work, including the construction and deployment of transects and search grids;

— underwater navigation methods using suitable techniques;

— use of lines for diving communications;

— recording techniques;

— sampling techniques appropriate to the scientific discipline being pursued.

The training programme shall ensure that trainees have skills that enable them to lead and coordinate a team to accomplish the following tasks:

— survey techniques (e.g. digital imaging, transects and quadrats, mapping);

— sampling techniques (e.g. coring, specimen collection, tagging);

— data collecting or data recording.

The training programme shall ensure that trainees have skills that enable them to lead and coordinate a team to accomplish scientific objectives while demonstrating that they are capable of dealing with multiple mental or physical tasks while maintaining safe diving practices, including the following:

— always putting safety first before the scientific objectives;

— maintaining good buoyancy control;

— maintaining the buddy system;

— monitoring depth, time and gas supplies.

The training programme shall ensure that trainees are able to demonstrate how to do the following in order to achieve the intended scientific objectives of the dive:

— plan a scientific dive, including organising the dive team;

— assign scientific tasks to the individual team members;

— coordinate scientific underwater activities.

9 First aid and emergency oxygen administration

Trainees shall complete a course or courses in first-aid and cardiopulmonary resuscitation (CPR) approved by the training organization and have a valid qualification or certificate.

Trainees shall have completed training in emergency administration of oxygen and have a valid qualification or certificate. This training shall include theoretical instruction of the medical principles involved and practical tuition on the use of an emergency oxygen unit.

10 Requirements for training provision

10.1 Overall supervision

The training programme shall be conducted under the auspices of an organisation implementing a scientific diving operation.

Each training course shall be conducted under the overall supervision of an individual approved by a scientific body with at least the following:

— a scientific diver qualification in accordance with ISO 8804-3;

— the competencies of a diving instructor in accordance with ISO 24802-2.

10.2 Instructors and lecturers

Instruction of scientific diving knowledge and skills shall be provided by competent specialists in scientific diving. Such specialists in scientific diving shall either be:

— instructors competent in accordance with ISO 24802-2 who have been assessed as an advanced scientific diver in accordance with this document with additional documented experience in scientific diving; or

— professionally qualified scientists who have documented experience of scientific diving methodologies.

Instruction for competencies not requiring dives (e.g. management, communications or medical topics) may be delivered by specialist lecturers with demonstrated competence in their specialist fields. While such lecturers need not hold a formal qualification as a diver, they shall be familiar with scientific diving operations.

10.3 Risk assessment

The training provider shall ensure that a site- and task-specific risk assessment is conducted before each in-water activity and shall adopt procedures to ensure that all risks are controlled as far as is reasonably practicable. The following factors shall be considered as part of this assessment, taking into account the capability of participants and available equipment:

— water movement (e.g. high water-flow rates, wave action, tides and currents);

— depth;

— underwater visibility;

— temperature;

— pollution;

— entry and exit methods;

— surface traffic and restricted zones (e.g. ports, harbours, marinas, differential pressure hazards);

— suitability of the site for the planned activities, including hazardous fauna and flora;

— emergency action plan;

— special hazards associated with the specific scientific diving project;

— depth, time, decompression, type of gas, reserve gas, gas strategies;

— dive equipment failure contingencies and risks directly relating to use of specific types of equipment.

10.4 Surface support procedures and related safety provisions

The training provider shall ensure that each person is recorded on entering the water and accounted for on exit.

For each group entering open water, a maximum time for the activity shall be agreed upon. Provisions shall be made to trigger search and rescue operations should this time be exceeded.

10.5 Emergency equipment and procedures

10.5.1 Emergency equipment

For all locations where diving activities take place, the service provider shall ensure the availability of the following:

— a first aid kit suitable for the planned activities;

— a communication system suitable for alerting emergency services;

— an emergency oxygen unit with a capacity of delivering at least 15 l/min of pure oxygen with sufficient capacity to continue delivering oxygen until alternative emergency medical care is available.

NOTE It is considered good practice that, wherever possible, the service provider provides an emergency oxygen system delivering an inspired oxygen concentration of up to 100 % and to a non-breathing patient receiving respiratory resuscitation at an inspired oxygen concentration of at least 50 %.

10.5.2 Emergency procedures

At each site where in-water activities take place, a documented emergency plan comprising at least the following information shall be available:

— diver recall procedures;

— procedures for casualty recovery, resuscitation and evacuation;

— use of the emergency oxygen supply;

— information (including contact details) on emergency medical advice (e.g. a suitable diving emergency "hotline") and the nearest medical resources (including data about accessing treatment in a hyperbaric chamber).

10.6 Practical training parameters

If trainees do not already have the competencies of a diver of at least ISO 24801-2, then the underwater elements of this training programme shall be directly supervised by an instructor who has at least the competencies described in ISO 24802-2.

If trainees do have the competencies of a diver of at least ISO 24801-2, they may conduct training dives under the indirect, surface supervision of an instructor who shall be present at the dive site.

An open water dive shall comprise at least the following activities:

— briefing;

— preparation to dive;

— pre-dive checks;

— entry into water;

— descent procedures;