SLOVENSKI STANDARD
SIST EN 14143:2013

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Oprema za dihala - Samoreševalni dihalni potapljaški aparati

Respiratory equipment - Self-contained re-breathing diving apparatus

Atemgeräte - Autonome Regenerationstauchgeräte

Appareils respiratoires - Appareils de plongee autonomes à circuit ferme

Ta slovenski standard je istoveten z: EN 14143:2013

ICS:

13.340.30	Varovalne dihalne naprave	Respiratory protective devices

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EUROPEAN STANDARD

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English Version

Respiratory equipment - Self-contained re-breathing diving apparatus

Appareils respiratoire - Appareils de plongée autonome à recyclage de gaz

Atemgeräte - Autonome Regenerationstauchgeräte

This European Standard was approved by CEN on 1 May 2013.

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Foreword

This document (EN 14143:2013) has been prepared by Technical Committee CEN/TC 79 “Respiratory protective devices”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2014, and conflicting national standards shall be withdrawn at the latest by January 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 14143:2003.

Annex D provides details of significant technical changes between this European Standard and the previous edition.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies minimum requirements for self-contained re-breathing diving apparatus to ensure a minimum level of safe operation of the apparatus. It applies to the following:

— a maximum depth of 6 m for apparatus using pure oxygen;

— a maximum depth of 40 m for apparatus using oxygen in nitrogen gas mixtures;

— a maximum depth of 100 m for apparatus using oxygen and helium or oxygen, nitrogen and helium gas mixtures;

— water temperatures from 4 °C to 34 °C or outside these temperatures as specified by the manufacturer.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 132:1998, *Respiratory protective devices — Definitions of terms and pictograms*

EN 134:1998, *Respiratory protective devices — Nomenclature of components*

EN 144-1, *Respiratory protective devices — Gas cylinder valves — Part 1: Thread connections for insert connector*

EN 144-3, *Respiratory protective devices — Gas cylinder valves — Part 3: Outlet connections for diving gases Nitrox and oxygen*

EN 148-1, *Respiratory protective devices — Threads for facepieces — Part 1: Standard thread connection*

EN 148-2, *Respiratory protective devices — Threads for facepieces — Part 2: Centre thread connection*

EN 148-3, *Respiratory protective devices — Threads for facepieces — Part 3: Thread connection M 45 x 3*

EN 12021, *Respiratory protective devices — Compressed air for breathing apparatus*

EN 15333-1:2008, *Respiratory equipment — Open-circuit umbilical supplied compressed gas diving apparatus — Part 1: Demand apparatus*

EN 61000-6-1, *Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments (IEC 61000-6-1)*

EN ISO 10297, *Transportable gas cylinders — Cylinder valves — Specification and type testing (ISO 10297)*

EN ISO 12209-1, *Gas cylinders — Outlet connections for gas cylinder valves for compressed breathable air — Part 1: Yoke type connections (ISO 12209-1)*

EN ISO 12209-2, *Gas cylinders — Outlet connections for gas cylinder valves for compressed breathable air — Part 2: Threaded connections (ISO 12209-2)*

EN ISO 12209-3, *Gas cylinders — Outlet connections for gas cylinder valves for compressed breathable air — Part 3: Adapter for 230 bar valves (ISO12209-3)*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in EN 132:1998 and the nomenclature given in EN 134:1998 together with the following apply.

3.1
self-contained re-breathing diving apparatus
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 re-circulated within the apparatus

Note 1 to entry: A self-contained re-breathing diving apparatus may also be called a diving re-breather.

3.2
high pressure
pressure inside the gas cylinder(s) and between the gas cylinder(s) and any pressure reducer

3.3
medium pressure
pressure between the pressure reducer and a gas control system

Note 1 to entry: This is sometimes referred to as intermediate pressure.

3.4
low pressure
pressure within the facepiece, breathing hoses, counterlung and absorbent canister, i.e. approximately ambient pressure

3.5
respiratory pressure
differential pressure at the mouth relative to the no flow pressures at the end of inhalation and exhalation

Note 1 to entry: See Figure 2.

3.6
rated working pressure
maximum working pressure of the respective components

3.7
hydrostatic imbalance
difference at end exhalation “no flow” between the pressure at the mouth and that at the reference point which could either be the suprasternal notch or the lung centroid of the diver

Note 1 to entry: See Figure 1 for the suprasternal notch or the lung centroid of the diver and Figure 2 for the difference at end exhalation.

3.8
displaced (tidal) volume
volume of respirable gas displaced by the breathing simulator during one half cycle (inhalation or exhalation) measured in litre

3.9
breathing frequency
setting of the breathing simulator measured in cycles per minute

3.10
respiratory minute volume
RMV
product of the tidal volume and breathing frequency measured in litre per minute

3.11
pressure volume diagram
diagram generated during one breathing cycle by plotting the respiratory pressure against the displaced volume

Note 1 to entry: See Figure 2

3.12
work of breathing
WOB
work expended during one breathing cycle measured in Joule per litre which is proportional to the area bounded by the pressure volume diagram divided by the tidal volume

Note 1 to entry: See Figure 2

3.13
breathing hose
flexible low pressure hose(s) connecting the facepiece to either the counterlung(s) or absorbent canister

3.14
counterlung
variable volume container for the diver to inhale from and exhale to

3.15
absorbent canister
container filled with absorbent materials which will remove as a minimum at least carbon dioxide from the gas passing through them

3.16
dead space
the volume of the cavity formed between the mouth and the inhalation and exhalation parts

3.17
body harness
component of the re-breather to attach the apparatus to the body of the diver

3.18
facepiece
device for connecting the apparatus to the wearer's respiratory tract and isolating the respiratory tract from the environment

Note 1 to entry: It may be a mouthpiece assembly, a half mask, a full face mask or a helmet.

3.19
oxygen and nitrogen gas mixture
gas comprising a specified mixture of oxygen 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 and pure nitrogen, with or without compressed air.

Note 2 to entry: This definition differs from that of Nitrox in EN 13949:2003 in that it covers all oxygen and nitrogen gas mixtures irrespective of oxygen content.

3.20
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.

3.21
heliox
gas comprising a specified mixture of oxygen and helium, capable of supporting human life under appropriate diving or hyperbaric conditions

3.22
active warning device
device that informs the diver of an adverse event without the diver having to take any action to receive the warning

Note 1 to entry: This information may be audible, visual or tactile.

3.23
emergency breathing system
system that allows the diver to breathe in the event of an apparatus failure

4 Minimum equipment

The apparatus shall comprise at least the following components:

a) breathing circuit;

NOTE The breathing circuit can comprise a facepiece, breathing hose(s), counterlung(s), exhaust valve or absorbent canister.

b) gas control or supply system;

c) gas supply cylinder(s);

d) safety device(s);

e) body harness.

It shall also be delivered with information supplied by the manufacturer.

The apparatus may also include an emergency breathing system.

5 Requirements[1)]

5.1 Design

The apparatus design shall be supported by the manufacturer through the provision of a failure mode effect and criticality analysis (FMECA) and following the methodology of EN 60812. The safety of the apparatus design shall be such that it has an acceptable risk as defined in Table 3.

In order to quantify the acceptable risk of the use of a re-breather a risk analysis shall be conducted using the risk criteria defined in Table 1 to Table 3.

1) For a comparison between clauses of this European Standard concerning requirements and clauses concerning the respective tests, see Annex A.

Table 1 — Qualitative likelihood categories

Likelihood category	Qualitative Definition
Frequent	Likely to occur repeatedly during one year of use of one re-breather
Probable	Likely to occur from time to time during one year of use of one re-breather
Occasional	Likely to occur once or more during one year of use of one re-breather
Remote	Unlikely, but can exceptionally occur during one year of use of one re-breather
Improbable	Very unlikely to occur during one year of use of one re-breather
Incredible	Extremely unlikely that the event will occur at all, given the assumptions recorded about the domain and the re-breather

Table 2 — Consequence categories

Severity category	Definition
Catastrophic	Multiple deaths
Critical	Up to a single death; and/or multiple severe injuries or severe occupational illnesses
Major	A single severe injury or occupational illness (requiring more than 3 days off work); and/or multiple minor/marginal injuries or minor/marginal occupational illnesses
Marginal	A single injury (requiring more than 3 days off diving)
Negligible	At most a single minor injury or minor occupational illness not requiring time off work or diving

Table 3 — Risk criteria

Severity	Likelihood (per year)					
	Frequent[a]	Probable	Occasional	Remote	Improbable	Incredible
	>0,1[b]	>0,01 and ≤0,1	>0,001 and ≤0,01	>0,000 1 and ≤0,001	>0,000 01 and ≤0,000 1	≤0,000 001
Catastrophic	Unacceptable risk	Unacceptable risk	Unacceptable risk	Unacceptable risk	Unacceptable risk	Acceptable risk
Critical	Unacceptable risk	Unacceptable risk	Unacceptable risk	Unacceptable risk	Acceptable risk	Acceptable risk
Major	Unacceptable risk	Unacceptable risk	Unacceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
Marginal	Unacceptable risk	Unacceptable risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk
Negligible	Unacceptable risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk	Acceptable risk

[a] Quantitative likelihood category.

[b] Likelihood of dangerous failure of any safety critical function (in a single re-breather per year) .

Check by assessment of FMECA report(s) (see 6.2).

The apparatus shall be designed and its components and parts located to provide protection against mechanical damage caused by external influence and to ensure that it is possible to perform the required pre-dive functional checks. It shall not be possible to assemble or combine the components or parts in such a way that it can affect the safe operation and safe use of the apparatus, e.g. by incorrect connection of the hoses to the breathing circuit. The apparatus shall not have any sharp edges or protrusions that can injure the diver.

Check compliance by visual inspection (see 6.2) and test in accordance with 6.18.

All parts, which have to be actuated by the diver during use, shall be accessible and controllable even when wearing protective gloves (three fingers, with 6 mm to 7 mm padding on either side). They shall be designed such that their setting cannot be altered inadvertently during use.

Test in accordance with 6.18.

The apparatus shall function satisfactorily out of the water and in all orientations in the water. The apparatus shall be designed to prevent any chemicals used within the apparatus, saliva, condensation or ingress of water from adversely affecting the operation of the apparatus or causing harmful effects to the diver when used according to the information supplied by the manufacturer.

Check compliance by visual inspection (see 6.2) and test in accordance with 6.18.

Any part of the equipment intended for high pressure gas with an oxygen content greater than air as specified in EN 12021 shall be designed and selected for use with high pressure oxygen.

Check compliance by visual inspection (see 6.2) and test in accordance with 6.15.

If the apparatus is intended for use in water temperatures less than 4 °C or above 34 °C, the manufacturer shall state the minimum and maximum temperatures and its performance shall be tested at those temperatures.

Check compliance by visual inspection (see 6.2) and test in accordance with 6.3, 6.7 and 6.8.

Any gas supply within the apparatus shall have a minimum oxygen content of 5 %.

Check compliance by visual inspection (see 6.2).

5.2 Materials

The parts used, individually and when assembled, shall have adequate mechanical strength, durability and resistance to wear and feature sufficient resistance to changes caused by the effect of temperature.

Check compliance by visual inspection (see 6.2) and test in accordance with 6.8, 6.9, 6.13 and 6.18.

Materials that come into direct contact with the wearer's skin and the respirable gas shall not be known to be likely to cause irritation or any other adverse effect to health.

Check compliance by visual inspection (see 6.2) and test in accordance with 6.18.

5.3 Gas cylinder(s)

The gas cylinder(s) shall comply with regulations appropriate to the country of use and shall be approved and tested with respect to the rated working pressure and gas content if appropriate.

The gas cylinder(s) shall be marked with the appropriate neck thread designation in accordance with EN 144-1 where the preferred threads are M 18 x 1,5 or M 25 x 2.

Cylinder(s) shall be designed for use at the maximum diving depth.

Check compliance by visual inspection (see 6.2).

5.4 Cylinder valve(s)

Cylinder valve(s) shall comply with EN ISO 10297 and shall be tested and approved for use at the rated working pressure and gas.

Check compliance by visual inspection (see 6.2) and test in accordance with 6.15, if applicable.

The threads for connecting the gas cylinder(s) and the cylinder valve(s) shall comply with EN 144-1 where the preferred threads are M 18 x 1,5 or M 25 x 2.

The connections between the cylinder valve(s) and the gas control or supply system shall be:

a) EN ISO 12209-1, EN ISO 12209-2 or EN ISO 12209-3 for gas cylinders intended for compressed air; or

b) EN 144-3 for gas cylinders intended for use with gases with an oxygen content greater than air as specified in EN 12021.

Check compliance by visual inspection (see 6.2).

The opening of the valve orifice shall be progressive. Complete opening shall require more than one rotation of the operating mechanism. For valves in which it is technically difficult to limit opening in this way (e.g. diaphragm valves), other means shall be provided to delay full gas flow.

The valve(s) shall be designed and located so that it (they) cannot be closed inadvertently, e.g. by requiring at least two full turns from fully open to fully closed position.

The function of a cylinder valve shall not be impaired by the ingress of water.

Check compliance by visual inspection (see 6.2) and test in accordance with 6.18.

The cylinder valve(s) shall be protected against the entrainment of dirt, solid particles and water from inside the gas cylinder.

EXAMPLE By means of a protective tube with a length of at least 30 mm and an inside diameter of at least 2,5 mm.

Check compliance by visual inspection (see 6.2).

5.5 High and medium pressure parts and connections

5.5.1 General

It shall not be possible to directly connect a low or medium pressure subassembly to a high pressure outlet or connection.

It shall not be possible to directly connect a low pressure subassembly to a medium pressure outlet or connection.

Check compliance by visual inspection (see 6.2) and test in accordance with 6.18.

All metallic high pressure tubes, valves and couplings shall be capable to withstand a pressure 50 % above the working pressure of the gas cylinder.

All metallic medium pressure parts, valves and couplings shall be capable to withstand a pressure of 50 % above their rated working pressure.