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Chemicals used for treatment of swimming pool water — Hydrogen peroxide

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee CII/59, Chemicals for drinking water treatment.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Chemicals used for treatment of swimming pool water - Hydrogen peroxide

Produits chimiques utilisés pour le traitement de l'eau des piscines - Peroxyde d'hydrogène

Produkte zur Aufbereitung von Schwimm-und badebeckenwasser - Wasserstoffperoxid

This European Standard was approved by CEN on 26 October 2013.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 16400:2013) has been prepared by Technical Committee CEN/TC 164 “Water supply”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by June 2014, and conflicting national standards shall be withdrawn at the latest by June 2014.

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Introduction

In respect of potential adverse effects on the quality of water for swimming pools, caused by the product covered by this European Standard:

1) this European Standard provides no information as to whether the product may be used without restriction in any of the Member States of the EU or EFTA;

2) it should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

NOTE Conformity with this European Standard does not confer or imply acceptance or approval of the product in any of the Member States of the EU or EFTA. The use of the product covered by this European Standard is subject to regulation or control by National Authorities.

1 Scope

This European Standard is applicable only to hydrogen peroxide and not to mixtures with other chemicals used for treatment of swimming pool water. It describes the characteristics of hydrogen peroxide and specifies the requirements and the corresponding test methods for hydrogen peroxide. It gives information on its use in swimming water treatment. It also determines the rules relating to safe handling and use (see Annex B).

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 902, *Chemicals used for treatment of water intended for human consumption — Hydrogen peroxide*

3 Description

3.1 Identification

3.1.1 Chemical name

Hydrogen peroxide

3.1.2 Synonym or common name

None

3.1.3 Relative molecular mass

34,02

3.1.4 Empirical formula

H_2O_2

3.1.5 Chemical formula

H_2O_2

3.1.6 CAS Registry Number[1)]

7722-84-1

1) Chemical Abstracts Service Registry Number.

3.1.7 EINECS reference[2)]

231-765-0

3.2 Commercial form

The product is supplied as an aqueous solution.

3.3 Physical properties

3.3.1 Appearance and odour

The product is a colourless liquid, with a slightly pungent odour.

3.3.2 Density

The density of hydrogen peroxide is given in Table 1.

Table 1 — Density

Solution concentration Mass fraction in %	**Density** g/ml at 20 °C
20	1,075
30	1,114
35	1,132
50	1,195
60	1,241
70	1,289

3.3.3 Solubility in water

The product is miscible with water in all proportions.

3.3.4 Vapour pressure

The vapour pressure of hydrogen peroxide depending on concentration is given in Table 2.

2) European Inventory of Existing Commercial Chemical Substances.

Table 2 — Vapour pressure

Solution concentration Mass fraction in %	**Vapour pressure** kPa at 20 °C
20	2,0
30	1,8
35	1,7
50	1,3
60	1,1
70	0,8

3.3.5 Boiling point at 100 kPa[3)]

The boiling point of hydrogen peroxide depending on concentration is given in Table 3.

Table 3 — Boiling point

Solution concentration Mass fraction in %	**Boiling point** °C at 100 kPa
20	103
30	106
35	108
50	114
60	119
70	125

3) 100 kPa = 1 bar.

3.3.6 Crystallisation point

The crystallisation point of hydrogen peroxide depending on concentration is given in Table 4.

Table 4 — Crystallisation point

Solution concentration Mass fraction in %	**Crystallisation point** °C
20	- 14,6
30	- 25,7
35	- 32,5
50	- 51,0
60	- 55,0
70	- 37,0

3.3.7 Specific heat

The specific heat of hydrogen peroxide depending on concentration is given in Table 5.

Table 5 — Specific heat

Solution concentration Mass fraction in %	**Specific heat** kJ/(kg.K)
20	3,82 at 20 °C
50	3,32 at 20 °C
100	2,63 at 25 °C

3.3.8 Viscosity, dynamic

The viscosity of hydrogen peroxide depending on concentration is given in Table 6.

Table 6 — Viscosity

Solution concentration Mass fraction in %	**Viscosity** MPa.s at 20 °C
20	1,04
30	1,07
35	1,10
50	1,17
60	1,20
70	1,24
100	1,25

3.3.9 Critical temperature

The critical temperature of pure hydrogen peroxide is 457 °C.

3.3.10 Critical pressure

The critical pressure of pure hydrogen peroxide is 21,7 mPa.

3.3.11 Physical hardness

Not applicable.

3.4 Chemical properties

Hydrogen peroxide is a weak acid.

According to species in solution, it is an oxidising agent (E° = 1,776 V) or a reducing agent (E° = 0,682 V).

Oxidising agent:

$$H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$$

Reducing agent:

$$H_2O_2 \rightarrow O_2 + 2H^+ + 2e^-$$

NOTE 1 It can be activated by ultraviolet light, ozone or metals to generate free radicals.

NOTE 2 Singlet oxygen can be obtained by reaction of hydrogen peroxide with hypochlorite.

NOTE 3 In swimming pool water treatment, hydrogen peroxide is commonly used at 35 % mass fraction.

4 Purity criteria

4.1 General

This European Standard specifies the minimum purity requirements for hydrogen peroxide used for the treatment of water for swimming pools. Limits are given for impurities commonly present in the product. Depending on the raw material and the manufacturing process other impurities may be present and, if so, this shall be notified to the user and when necessary to relevant authorities.

Users of this product should check the national regulations in order to clarify whether it is of appropriate purity for treatment of water for swimming pools, taking into account raw water quality, required dosage, contents of other impurities and additives used in the product not stated in this product standard.

Limits have been given for impurities and chemicals parameters where these are likely to be present in significant quantities from the current production process and raw materials. If the production process or raw materials lead to significant quantities of impurities, by-products or additives being present, this shall be notified to the user.

4.2 Composition of commercial product

The hydrogen peroxide is usually available in concentrated solution with a concentration of 35 %.

4.3 Chemical parameters

The product shall conform to the requirements specified in Table 7.

Table 7 — Chemical parameters

Parameter		**Limit in mg/kg of hydrogen peroxide** (mass fraction 100 %)	
		Type 1	**Type 2**
Arsenic (As)	max.	0,5	1
Cadmium (Cd)	max.	0,5	1
Chromium (Cr)	max.	0,5	1
Mercury (Hg)	max.	0,5	1
Nickel (Ni)	max.	1	5
Lead (Pb)	max.	0,5	1
Antimony (Sb)	max.	0,5	1
Selenium (Se)	max.	0,5	1
NOTE Cyanide which does not exist in a strong oxidising medium such as hydrogen peroxide is not a relevant chemical parameter. Pesticides and polycyclic aromatic hydrocarbons are not by-products of the manufacturing process.			

5 Test methods

The sampling and the analytical methods are those described in EN 902.

6 Labelling - Transportation - Storage

6.1 Means of delivery

Hydrogen peroxide shall be delivered in:

a) Polyethylene drums up to 225 l for hydrogen peroxide concentration not greater than a mass fraction of 50 %.

b) Intermediate bulk containers if hydrogen peroxide concentration is not greater than a mass fraction of 50 %.

c) Aluminium or stainless steel tanks of up to 25 t capacity for all concentrations.

In order that the purity of the product is not affected, the means of delivery shall not have been used previously for any different product or it shall have been specially cleaned and prepared before use.

6.2 Labelling according to the EU legislation[4)]

The labelling requirements applying to hydrogen peroxide at the date of the publication of this standard are given in Table 8:

Table 8 — labelling requirements of hydrogen peroxide

35 % ≤ C < 50 %	8 % ≤ C < 35 %	5 % ≤ C < 8 %
— Hazard pictogram(s)  GHS05 GHS07	Hazard pictogram(s)  GHS05 GHS07	Hazard pictogram(s)  GHS07
— Signal word: **Danger** — hazard statements: H315: Causes skin irritation. H318: Causes serious eye damage. H302: Harmful if swallowed. H332: Harmful if inhaled. H335: May cause respiratory irritation.	— Signal word: **Danger** — hazard statements: H318: Causes serious eye damage. H302: Harmful if swallowed. H332: Harmful if inhaled.	— Signal word: **Warning** — hazard statements: H319: Causes serious eye irritation. H302: Harmful if swallowed. H332: Harmful if inhaled.
Precautionary statements ('P statements') should be provided by the company being responsible for the marketing of the substance. They should be indicated on the packaging label and in the extended safety data sheet (eSDS) of the substance.		

The regulation [4], and its amendments for the purposes of its adaptation to technical and scientific progress contains a list of substances classified by the EU. Substances not listed in this regulation should be classified on the basis of their intrinsic properties according to the criteria in the regulation by the person responsible for the marketing of the substance.

6.3 Transportation regulations and labelling

The following transportation regulations and labelling (see Table 9) apply to hydrogen peroxide at the date of publication of this European Standard.

4) See [2].

Table 9 — Transportation regulations and labelling

H_2O_2 mass fraction %	**8 to 20**	**20 to 60**	**> 60**
UN-Number [a]	2984	2014	2015
RID [b] /ADR [c]	Class 5.1 Classification code O1 Packing group III.	Class 5.1 Classification code OC1 Packing group II	Class 5.1 Classification code OC1 Packing group I
IMDG [d]	Class 5.1	Class 5.1	Class 5.1
IATA [e]	Class 5.1	> 40 Class 5.1	Prohibited: > 40

[a] United Nations Number.

[b] Regulations concerning International carriage of Dangerous goods by rail.

[c] European Agreement concerning the international carriage of Dangerous goods by Road.

[d] International Maritime transport of Dangerous Goods.

[e] International Air Transport Association.

6.4 Marking

The marking shall include the following:

— the name “hydrogen peroxide” and trade name,

— the net mass;

— the name and address of the supplier and/or manufacturer;

— the statement “This product conforms to EN 16400”, type.

6.5 Storage

6.5.1 Containers

The product shall be stored in suitable containers, vented to avoid any pressure build-up, away from any heat sources.

6.5.2 Long term stability

The product is stable for long periods without any significant loss of active oxygen (less than 2 % relative per year).

6.5.3 Storage incompatibilities

The product shall not be allowed to come into contact with combustible materials, organic materials, catalysts (such as iron, chromium, nickel, zinc, copper), reducing compounds, acids, alkalis or mild steel.

Annex A
(informative)

General information on hydrogen peroxide

A.1 Origin

A.1.1 Raw materials

Hydrogen peroxide is manufactured from hydrogen and atmospheric oxygen.

A.1.2 Manufacturing process

It is produced from hydrogen and oxygen (air) by the use of anthraquinonoid compounds as an auto oxidation catalyst.

A.2 Use

A.2.1 Function

Its functions in swimming pool water treatment are as an oxidant to remove oxidisable impurities and as a disinfectant.

NOTE Hydrogen peroxide can either be used alone for these purposes or in accordance with existing national regulations in conjunction with other disinfectants and/or systems (e.g. ozone, ultraviolet light, or any activating systems) as hydroperoxide radical generators.

A.2.2 Form in which it is used

It is used as delivered.

A.2.3 Treatment dose

The treatment dose can be up to 200 mg/l of H_2O_2, (expressed as mass fraction of 100 % hydrogen peroxide), as shock treatment, depending on the quality of the swimming pool water.

However, the treatment dose should be up to 60 mg/l of H_2O_2, (expressed as mass fraction of 100 % hydrogen peroxide), as weekly treatment, depending on the quality of the swimming pool water.

A.2.4 Means of application

It is applied using a metering pump or directly into the swimming pool.

A.2.5 Secondary effects

The secondary effects include the following:

— increase in dissolved oxygen;

— decrease in colour or turbidity of water;

— corrosion inhibition by passivating effect.

A.2.6 Removal of excess product

The most practical method is:

— the addition of reducing agent;

— the addition of activated carbon;

— the use of ultraviolet light.

A.3 Routine analyses

A.3.1 Determination of chemical parameters

A.3.1.1 Preparation of the test solution

A.3.1.1.1 Reagents

All reagents should be of a recognised analytical grade and the water used should conform to grade 3 in accordance with EN ISO 3696.

A.3.1.1.1.1 Sodium hydroxide solution, 100 g/l.

A.3.1.1.1.2 Methyl orange indicator solution, 0,2 g/l.

A.3.1.1.1.3 Hydrochloric acid ρ = 1,18 g/ml.

A.3.1.1.1.4 Potassium iodide.

A.3.1.1.2 Procedure

A.3.1.1.2.1 Test portion

Weigh, to the nearest 0,01 g, about 25 g *(m)* of the laboratory sample into a 100 ml conical flask.

A.3.1.1.2.2 Test solution

Add 2 ml of sodium hydroxide solution (A.3.1.1.1.1), cover the flask with a watch glass and decompose the sample by gentle warming. When decomposition has ceased, boil the solution for 15 min taking care to maintain a volume of about 25 ml by the addition of water. Cool and add five drops of methyl orange indicator solution (A.3.1.1.1.2). Add by means of a dropping pipette, sufficient hydrochloric acid (A.3.1.1.1.3) to neutralise the solution. Add 2 g of potassium iodide (A.3.1.1.1.4) and swirl to dissolve.

Prepare a blank test solution as described above omitting the sample.

A.3.1.2 Determination

Determine the content of chemical parameter in the test solution (A.3.1.1.2.2) in accordance with the following methods:

As: in accordance with EN ISO 11969; Se: in accordance with ISO 9965 (AAS).

Annex B
(normative)

General rules relating to safety

B.1 Rules for safe handling and use

The supplier shall provide current safety instructions.

B.2 Emergency procedures

B.2.1 First aid

Seek medical advice if signs or symptoms develop.

In case of contact with skin, remove any contaminated clothing. Wash skin with plenty of water, use emergency shower if large area of body contaminated. Wash any contaminated clothing well.

In case of contact with eyes, rinse out with plenty of water for at least 15 min and seek medical advice quickly.

In case of ingestion, do not induce vomiting. Rinse out mouth quickly and then give plenty of milk or water if the victim is conscious.

In case of inhalation, remove from contaminated area to fresh air. Seek medical advice.

B.2.2 Spillage

Dilute with plenty of water.

B.2.3 Fire

Pressure bursts can occur due to gas evolution. Oxygen released on decomposition assist fire. Use a fine water spray to extinguish. Self-contained breathing apparatus can be necessary. Keep product containers cool with plenty of water, working at safe distance.

Bibliography

[1] EN ISO 3696, *Water for analytical laboratory use — Specification and test methods (ISO 3696)*

[2] EN ISO 11969, *Water quality — Determination of arsenic — Atomic absorption spectrometric method (hydride technique) (ISO 11969)*

[3] ISO 9965, *Water quality — Determination of selenium — Atomic absorption spectrometric method (hydride technique)*

[4] Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 (REACH)

[5] H_2O_2 Bulk storage guideline – CEFIC – September 2001

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