BS EN 936:2013

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Chemicals used for treatment of water intended for human consumption — Carbon dioxide

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National foreword

This British Standard is the UK implementation of EN 936:2013. It supersedes BS EN 936:2006 which is withdrawn.

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.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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EN 936

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English Version

Chemicals used for treatment of water intended for human consumption - Carbon dioxide

Produits chimiques utilisés pour le traitement de l'eau destinée à la consommation humaine - Dioxyde de carbone

Produkte zur Aufbereitung von Wasser für den menschlichen Gebrauch - Kohlenstoffdioxid

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

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Contents

Page

Foreword

This document (EN 936:2013) 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of an identical text or by endorsement, at the latest by June 2014, and conflicting national standards shall be withdrawn at the latest by June 2014.

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 936:2006.

Significant technical differences between this edition and EN 936:2006 are as follows:

a) the transportation regulations and labelling have been updated;

b) the requirement for carbon dioxide content is now 99,9 % instead of 99,0 % in the latest edition;

c) possible impurities are taken into account;

d) reference to sampling is changed;

e) revision of clause for raw materials;

f) revision of rules for safe handling and use of the product.

According to the CEN-CENELEC Internal Regulations, the national standards organizations 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.

Introduction

In respect to the potential adverse effects on the quality of water intended for human consumption caused by the product covered by this European Standard:

a) 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;

b) 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 to carbon dioxide used for treatment of water intended for human consumption. It describes the characteristics of carbon dioxide and specifies the requirements and corresponding analytical methods for carbon dioxide. It also gives information on its use in water treatment.

2 Description

2.1 Identification

2.1.1 Chemical name

Carbon dioxide.

2.1.2 Synonym or common name

Carbonic acid gas (carbonic anhydride).

2.1.3 Relative molecular mass

44,011.

2.1.4 Empirical formula

CO_2.

2.1.5 Chemical formula

CO_2.

2.1.6 CAS Registry Number[1)]

124-38-9.

2.1.7 EINECS reference[2)]

204-696-9.

2.2 Commercial form

The carbon dioxide is supplied as a pressurised liquefied or refrigerated pressurised gas.

NOTE The solid form is not usually used for the treatment of water intended for human consumption.

1) Chemical Abstracts Service Registry Number.

2) European Inventory of Existing Commercial Chemical Substances.

2.3 Physical properties

2.3.1 Appearance

The carbon dioxide is a colourless gas or liquid.

2.3.2 Density

The density of the gas at 0 °C and 101,3 kPa [3)] is 1,976 8 kg/m^3, while the density of the liquid at 0 °C and 4 000 kPa is 933,318 kg/m^3.

2.3.3 Solubility in water

The solubility of the gas in water is 1,72 g/l at 20 °C and 101,3 kPa.

2.3.4 Vapour pressure

The vapour pressure of the liquid is 5 733,0 kPa at 20 °C.

2.3.5 Boiling point at 100 kPa

See 2.3.6.

2.3.6 Melting point

The sublimation point of solid CO_2 is −78,9 °C and 101,3 kPa.

2.3.7 Specific heat

The specific heat of carbon dioxide is 0,827 kJ/kg x K at 0 °C and 100 kPa.

2.3.8 Viscosity (dynamic)

The viscosity of the liquid is 147 × 10^{-7} Pa x s at 20 °C.

2.3.9 Critical temperature

The critical temperature of the liquid is 31 °C.

2.3.10 Critical pressure

The critical pressure of the carbon dioxide is 7 383 kPa.

2.3.11 Physical hardness

Not applicable.

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3) 100 kPa = 1 bar.

2.4 Chemical properties

The carbon dioxide CO_2 forms a weak acid when dissolved in water. It reacts in aqueous solution with alkali hydroxides to form carbonates and bicarbonates.

3 Purity criteria

3.1 General

This European Standard specifies the minimum purity requirements for carbon dioxide used for the treatment of water intended for human consumption. 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, the user and when necessary to relevant authorities, shall be notified.

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

Limits have been given for impurities and chemical 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 further impurities or by-products being present, this shall be notified to the user.

3.2 Composition of commercial product

The products shall conform to the requirements specified in Table 1.

Table 1 — Composition of commercial product

Carbon dioxide, CO_2	volume fraction ≥ 99,9 %

NOTE The minimum requirements of the commercial product are defined in the EU Directive 2008/84/EC of August 27, 2008 (see [2]) and additional Changes RL 2010/67/EG from October 20th, 2010.

3.3 By-products

The product tested in liquid phase shall conform to the requirements specified in Table 2.

Table 2

By-products	Content
Moisture	volume fraction ≤ 50×10^{-6} (mass fraction ≤ 20×10^{-6} max.)
Ammonia	volume fraction ≤ $2,5 \times 10^{-6}$
Oxygen	volume fraction ≤ 30×10^{-6}
Oxides of Nitrogen (NO/NO_2)	volume fraction ≤ $2,5 \times 10^{-6}$ each
Non-volatile residue(particulates)	mass fraction ≤ 10×10^{-6}
Non-volatile organic components (oil and fat)	mass fraction ≤ 5×10^{-6}
Phosphine [a]	volume fraction ≤ $0,3 \times 10^{-6}$
Total volatile hydrocarbons (calculated as methane)	volume fraction ≤ 50×10^{-6} of which volume fraction ≤ 20×10^{-6} non-methane hydrocarbons
Acetaldehyde	volume fraction ≤ $0,2 \times 10^{-6}$
Benzene	volume fraction ≤ $0,02 \times 10^{-6}$
Carbon Monoxide	volume fraction ≤ 10×10^{-6}
Methanol	volume fraction ≤ 10×10^{-6}
Hydrogen Cyanide [b]	volume fraction ≤ $0,5 \times 10^{-6}$
Total sulfur (as S) [c]	volume fraction ≤ $0,1 \times 10^{-6}$
Taste and odour in water	Acceptable to consumers and no abnormal change

[a] Analysis necessary only for carbon dioxide from phosphate rock sources.

[b] Analysis necessary only for carbon dioxide from coal gasification sources.

[c] If the total sulfur content exceeds volume fraction $0,1 \times 10^{-6}$ as sulfur then the species shall be determined separately and the following limits apply:

— Carbonyl Sulfide ≤ volume fraction $0,1 \times 10^{-6}$;

— Hydrogen Sulfide ≤ volume fraction $0,1 \times 10^{-6}$;

— Sulfur Dioxide ≤ volume fraction $1,0 \times 10^{-6}$.

3.4 Chemicals parameters

Further chemical parameters and indicator parameters according to EU Directive 98/83/EC (see [1]) are not found in the gaseous phase. Pesticides and polycyclic aromatic hydrocarbons are not by-products of the manufacturing process.

4 Test methods

4.1 Sampling

The recommendations of ISBT “Carbon Dioxide Quality Guidelines and Analytical Procedure Bibliography, November 2010” (see [4]) should be observed.

4.2 Analysis

4.2.1 Carbon dioxide

Measure of a fixed volume of product (V_1). Absorption in potassium hydroxide solution (KOH) 30 % by a proper CO_2 appliance with an accuracy of volume fraction from 0 % to 0,05 % (calibrated in 0,01 % steps).The residue volume (V_2) which is measured after absorption of CO_2 is to subtract from (V_1). The difference (V_1 - V_2) = V_3 is equivalent to the volume part of CO_2 (Equipment: Orsat, Zahm, Hasselberg).

The recommendations of International Society of Beverage Technologists (ISBT) “Carbon Dioxide Guidelines and Analytical Procedure Bibliography November 2010” should be observed (see [4]).

Alternatively, the carbon dioxide may be determined by gas chromatography.

4.2.2 Impurities

Determine the volume of gas impurity (see 4.2.1).

Alternatively, the impurities content may be determined by gas chromatography.

5 Labelling - Transportation - Storage

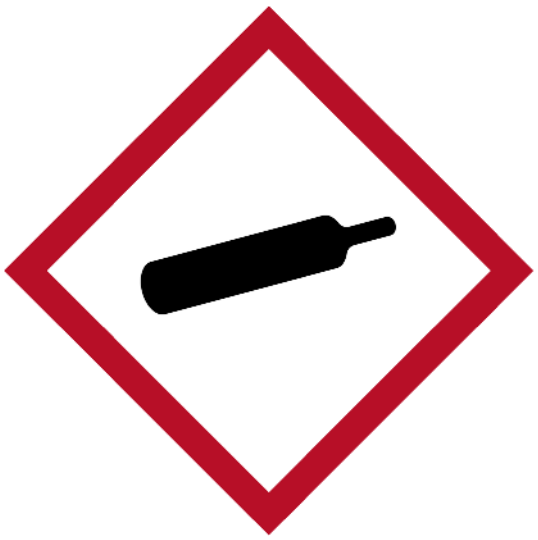
5.1 Means of delivery

Carbon dioxide shall be delivered liquefied, in pressurised containers (vessels) or as cryogenic liquefied gas in tanks.

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

5.2 Labelling according to the EU legislation[4)]

The following labelling requirements in Figure 1 shall apply to carbon dioxide at the date of publication of this European Standard:

<table>
<tr><td>Hazard pictogram
 
GHS04</td><td>For carbon dioxide (cryogenic liquefied gas)
Signal word: Danger
Hazard statement
H281: Contains refrigerated gas; may cause cryogenic burns or injury

For carbon dioxide (as gas)
Signal word: Danger
Hazard statement
H280: Contains gas under pressure; may explode if heated</td></tr>
<tr><td colspan="2">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.</td></tr>
</table>

Figure 1

The regulation [2], along with 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.

4) See [2].

5.3 Transportation regulations and labelling

The labelling of tanks and transportable cylinders is as follows:

a) liquid carbon dioxide is listed as UN Number [5] 1013 and cryogenic liquefied carbon dioxide is listed as UN Number 2187;

b) for liquid carbon dioxide:

RID [6], ADR [7]: class 2, classification code 2A;

IMDG [8]: class 2;

for refrigerated carbon dioxide:

RID [6] ADR [7], class 2, classification code 3A;

IMDG [8]: class 2.

5.4 Marking

The marking shall include the following information:

— name “carbon dioxide” and the trade name;

— net mass;

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

— statement “This product conforms to EN 936”.

5.5 Storage

The product is stable during long term storage.

Transportable cylinders containing carbon dioxide shall be protected from direct heat and against falling down, the storage rooms shall be well-ventilated.

5) United Nations Number.

6) Regulation concerning the International Carriage of Dangerous Goods by Rail (RID).

7) European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR).

8) International Maritime Transport of Dangerous Goods (IMDG).

Annex A
(informative)

General information on carbon dioxide

A.1 Origin

A.1.1 Raw materials

Carbon dioxide, which does not make any difference if it is natural or a product from chemical processes.

A.1.2 Manufacturing process

Carbon dioxide is condensed gradually in one or more steps up to the corresponding liquefying pressure, then cleaned, dried up, if needed filtered and subsequently liquefied in large scaled refrigerators; then it is stored in pressurised containers (tanks).

A.2 Use

A.2.1 Function

The product is used for increasing water hardness, for adjustment of pH value and as a regenerate for ion exchange resins.

A.2.2 Form in which it is used

The product is used in gaseous form.

A.2.3 Treatment dose

The treatment dose is variable depending on the quality of the raw water.

Lime and carbon dioxide is used for adjustment of pH and alkalinity of soft water.

A.2.4 Means of application

Carbon dioxide is dissolved under pressure inside the pipe or by using a porous system (disk or tube) at the bottom of the water storage vessel.

A.2.5 Secondary effects

The product has no secondary effects.

A.2.6 Removal of excess of product

Excess carbon dioxide is removed by aeration, binding with alkaline reacting chemicals or by stripping with other inert gases.

A.3 General rules relating to safety

A.3.1 Rules for safe handling and use

The supplier will provide current safety instructions.

A.3.2 Emergency procedures

A.3.2.1 First aid

Inhalation	In high concentrations can cause asphyxiation. Symptoms can include loss of mobility/consciousness. The victim might not be aware of asphyxiation.
	Low concentrations of CO_2 cause increased respiration and headache.
	Remove victim to uncontaminated area wearing self-contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing has stopped.
Skin/eye contact	Immediately flush eyes thoroughly with water for at least 15 min. In case of frostbite, spray with water for at least 15 min. Apply a sterile dressing. Obtain medical assistance.
Ingestion	Ingestion is not considered a potential route of exposure.

A.3.2.2 Spillage

Affected and lower-lying areas should be left immediately. Ventilation and the escape of carbon dioxide should be ensured.

A.3.2.3 Fire

The product is not combustible.

Bibliography

[1] Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption

[2] Commission Directive 2009/10/EC of 13 February 2009 amending Directive 2008/84/EC laying down specific purity criteria on food additives other than colours and sweeteners

[3] Carbon Dioxide Source Certification, Quality Standards and Verification, European Industrial Gas Association (EIGA) IGC Doc 70/08 (www.eiga.eu)

[4] International Society of Beverage Technologists (ISBT) “Carbon Dioxide Quality Guidelines and Analytical Procedure Bibliography”, November 2010

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