BRITISH STANDARD

BS EN
1207:2005

Chemicals used for treatment of water intended for human consumption — Tetrapotassium pyrophosphate

The European Standard EN 1207:2005 has the status of a British Standard

ICS 71.100.80

National foreword

This British Standard is the official English language version of EN 1207:2005. It supersedes BS EN 1207:1998 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee CII/59, Chemicals for drinking water treatment, which has the responsibility to:

— aid enquirers to understand the text;

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Chemicals used for treatment of water intended for human consumption - Tetrapotassium pyrophosphate

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

Produkte zur Aufbereitung von Wasser für den menschlichen Gebrauch - Tetrakaliumdiphosphat

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Foreword

This document (EN 1207:2005) 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of an identical text or by endorsement, at the latest by September 2005, and conflicting national standards shall be withdrawn at the latest by September 2005.

This document supersedes EN 1207:1997.

Significant technical differences between this edition and EN 1207:1997 are as follows:

a) deletion of reference to EU Directive 80/778/EEC of July 15, 1980 in order to take into account of the last Directive in force (see [1]);

b) replacement of ISO 5666-1 by EN 1483 and of EN 26595 by EN ISO 11969.

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Introduction

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

a) this document 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 document 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 document is subject to regulation or control by National Authorities.

1 Scope

This document is applicable to tetrapotassium pyrophosphate used for treatment of water intended for human consumption. It describes the characteristics and specifies the requirements and the corresponding test methods for tetrapotassium pyrophosphate. It gives information on its use in water treatment.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 1483, *Water quality — Determination of mercury.*

EN ISO 3696, *Water for analytical laboratory use — Specification and test methods (ISO 3696:1987).*

EN ISO 5961, *Water quality - Determination of cadmium by atomic absorption spectrometry (ISO 5961:1994) .*

EN ISO 11885, *Water quality - Determination of 33 elements by inductively coupled plasma atomic emission spectroscopy (ISO 11885:1996).*

EN ISO 11969, *Water quality - Determination of arsenic- Atomic absorption spectrometric method (hydride technique (ISO 11969:1996)).*

ISO 2997, *Phosphoric acid for industrial use - Determination of sulfate content - Method by reduction and titrimetry.*

ISO 3165, *Sampling of chemical products for industrial use - Safety in sampling.*

ISO 3357, *Sodium tripolyphosphate and sodium pyrophosphate for industrial use – Determination of total phosphorus (V) oxide content - Quinoline phosphomolybdate gravimetric method.*

ISO 3360, *Phosphoric acid and sodium phosphates for industrial use (including foodstuffs) - Determination of fluorine content - Alizarin complexone and lanthanum nitrate photometric method.*

ISO 6206, *Chemical products for industrial use - Sampling - Vocabulary.*

ISO 6703-1, *Water quality - Determination of cyanide – Part 1: determination of total cyanide.*

ISO 8213, *Chemical products for industrial use - Sampling techniques - Solid chemical products in the form of particles varying from powders to coarse lumps.*

ISO 8288, *Water quality - Determination of cobalt, nickel, copper, zinc, cadmium and lead – Flame atomic absorption spectrometric methods.*

ISO 9174, *Water quality - Determination of chromium - Atomic absorption spectrometric methods.*

ISO 9965, *Water quality - Determination of selenium - Atomic absorption spectrometric method (hydride technique).*

3 Description

3.1 Identification

3.1.1 Chemical name

Tetrapotassium pyrophosphate.

3.1.2 Synonym or common names

Diphosphoric acid tetrapotassium salt: TKPP.

3.1.3 Relative molecular mass

330,0.

3.1.4 Empirical formula

$K_4P_2O_7$.

3.1.5 Chemical formula

$K_4P_2O_7$.

3.1.6 CAS Registry Number[1)]

7320-34-5.

3.1.7 EINECS reference[2)]

230-785-7.

3.2 Commercial form

The tetrapotassium pyrophosphate is available in a number of different forms (see 3.3.1).

Different commercial forms, solids or dissolved in water are possible. All concentrations mentioned refer to the active matter and shall be calculated accordingly.

NOTE Tetrapotassium pyrophosphate can be a component of mixtures sold for water treatment purposes.

3.3 Physical properties

3.3.1 Appearance

Solid : the product is a white powder.

Liquid : the product is a clear solution.

1) Chemical Abstracts Service Registry Number.

2) European Inventory of Existing Commercial Chemical Substances.

3.3.2 Density

Solid : the bulk density of product is equal to 400 g/dm^3.

Liquid : the density of solution is 1,046 g/ml for a product concentration of 50 g/l at 20°C.

3.3.3 Solubility in water

The solubility in water is approximately 1 300 g/l at 25 °C.

3.3.4 Vapour pressure

Not applicable.

3.3.5 Boiling point at 100 kPa[3)]

Not applicable.

3.3.6 Melting point

For the solid product.

1 100 °C.

3.3.7 Specific heat

Not known.

3.3.8 Viscosity (dynamic)

For the solid product it is not applicable.

For the liquid the viscosity is equal to 5 mPa.s for a product concentration of 50 g/l.

3.3.9 Critical temperature

Not applicable.

3.3.10 Critical pressure

Not applicable.

3.3.11 Physical hardness

Not applicable.

3.4 Chemical properties

The solutions of tetrapotassium pyrophosphate have alkaline reactions.

The pH value of a solution of a mass fraction of 1 % is approximately 10.

3) 100 kPa = 1 bar.

4 Purity criteria

4.1 General

This document specifies the minimum purity requirements for tetrapotassium pyrophosphate 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, this shall be notified to the user and when necessary to relevant authorities.

NOTE 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 products not stated in this document.

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 impurities, by-products or additives being present, this shall be notified to the user.

4.2 Composition of commercial product

The product shall conform to the following requirements on a dry mass basis:

— phosphate content expressed as P_2O_5 : mass fraction of (43 ± 1,0) %;

— potassium content expressed as K_2O : mass fraction of (57 ± 1,0) %.

4.3 Impurities and main by-products

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

Table 1 — Impurities

Impurity		Limit mg/kg of dry product
Sulfate ($SO_4 2^-$)	max.	500
Fluoride (F^-)	max.	10

4.4 Chemical parameters

Content of various chemical parameters depends on the origin of the raw materials, most of these elements are present only as traces.

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

Table 2 — Chemical parameters

Parameter		Limit mg/kg of dry product
Antimony (Sb)	max.	3
Arsenic (As)	max.	3
Cadmium (Cd)	max.	3
Chromium (Cr)	max.	10
Cyanide (CN)	max.	5
Lead (Pb)	max.	10
Mercury (Hg)	max.	1
Nickel (Ni)	max.	10
Selenium (Se)	max.	3
NOTE Pesticides and polycyclic aromatic hydrocarbons are not relevant in tetrapotassium pyrophosphate. For parametric values of tetrapotassium pyrophosphate on trace metal content in drinking water, see [1].		

5 Test methods

5.1 Sampling

5.1.1 General

Observe the recommendations of ISO 3165 and take account of ISO 6206.

5.1.2 Solid

Prepare the laboratory sample(s) required by the relevant procedure described in ISO 8213.

5.1.3 Liquid

5.1.3.1 Sampling from drums and bottles

5.1.3.1.1 General

5.1.3.1.1.1 Mix the contents of each container to be sampled by shaking the container, by rolling it or by rocking it from side to side, taking care not to damage the container or spill any of the liquid.

5.1.3.1.1.2 If the design of the container is such (for example, a narrow-necked bottle) that it is impracticable to use a sampling implement, take a sample by pouring after the contents have been thoroughly mixed. Otherwise, proceed as described in 5.1.3.1.1.3.

5.1.3.1.1.3 Examine the surface of the liquid. If there are signs of surface contamination, take samples from the surface as described in 5.1.3.1.2. Otherwise, take samples as described in 5.1.3.1.3.

5.1.3.1.2 Surface sampling

Take a sample using a suitable ladle. Lower the ladle into the liquid until the rim is just below the surface, so that the surface layer runs into it. Withdraw the ladle before it fills completely and allow any liquid adhering to the ladle

to drain off. If necessary, repeat this operation so that, when the other selected containers have been sampled in a similar manner, the total volume of sample required for subsequent analysis is obtained.

5.1.3.1.3 Bottom sampling

Take a sample using an open sampling tube, or a bottom-valve sampling tube, suited to the size of container and the viscosity of the liquid.

When using an open sampling tube, close it at the top and then lower the bottom end to the bottom of the container. Open the tube and move it rapidly so that the bottom of the tube traverses the bottom of the container before the tube is filled. Close the tube, withdraw it from the container and allow any liquid adhering at the outside of the tube to drain off.

When using a bottom-valve sampling tube, close the valve before lowering the tube into the container and then proceed in a similar manner to that when using an open sampling tube.

5.1.3.1.4 Sampling from tanks and tankers

From each access point, take samples as follows:

a) from the surface of the liquid, using a ladle as described in 5.1.3.1.2;

b) from the bottom of the tank or tanker, using a sampling tube as described in 5.1.3.1.3 or using a specially designed bottom-sampling apparatus;

c) from one or more positions, depending on the overall depth, between the bottom and the surface using a weighted sampling can.

5.2 Analyses

5.2.1 Main product

5.2.1.1 Phosphate (main product)

The determination of the concentration of phosphate (P_2O_5) is carried out according to ISO 3357.

5.2.1.2 Potassium oxide (main product)

5.2.1.2.1 General

The determination of the concentration of potassium oxide (K_2O) is carried out is accordance with the method of determination of potassium oxide (K_2O) and phosphate (P_2O_5), calculation of molar ratio.

5.2.1.2.2 Principle

Alkalimetric titration. Measurement of consumption of alkali to increase pH value from 4,45 to 9,22.

5.2.1.2.3 Reagents

All the reagents shall be of a recognized analytical grade and the water used shall conform to grade 3 specified in EN ISO 3696 and shall be boiled and cooled immediately before use.

5.2.1.2.3.1 Sodium hydroxide solution, c(NaOH) = 0,5 mol/l;

5.2.1.2.3.2 Sulfuric acid solution, c(1/2 H_2SO_4) = 0,5 mol/l;

5.2.1.2.3.3 Indicator for titrating alkali oxide.

Dissolve 150 mg bromocresol green, 9 mg, methyl red, 470 mg p-nitrophenol, 600 mg phenolphthalein in 100 ml ethanol.

5.2.1.2.3.4 Solution for comparison, pH : 4,45.

Dissolve (30 ± 0,001) g of potassium dihydrogen phosphate (KH_2PO_4) in 1 000 ml of water.

5.2.1.2.3.5 Solution for comparison, pH : 9,22.

Dissolve (76 ± 0,001) g of disodium hydrogen phosphate dodecahydrate (Na_2HPO_4 . 12 H_2O) in 1 000 ml of water.

5.2.1.2.4 Apparatus

Ordinary laboratory apparatus and optionally potentiometer with pH electrode.

5.2.1.2.5 Procedure

5.2.1.2.5.1 Preparation of comparison solution

Dilute 50 ml of solution (5.2.1.2.3.4) with 50 ml of water in a conical flask. Add four drops of indicator (5.2.1.2.3.3). The colour corresponds to pH 4,45.

Dilute 50 ml of solution (5.2.1.2.3.5) with 50 ml of water in a conical flask. Add four drops of indicator (5.2.1.2.3.3). The colour corresponds to pH 9,22.

NOTE The preparation of comparison solution is not necessary in the case of potentiometric titration.

5.2.1.2.5.2 Test solution

Weigh, to the nearest 0,1 mg, about 2,5 g of the laboratory sample of solid product (m_0) or a mass, from the product in solution evaporating to dryness at (105 ± 5)°C, corresponding to about 2,5 g of dry product (m_0). Transfer quantitatively to a conical flask. Add 100 ml of water and then (50 ± 0,01) ml of the sulfuric acid solution (5.2.1.2.3.2). Boil under reflux over a period of 150 min.

5.2.1.2.5.3 Determination

Add four drops of indicator (5.2.1.2.3.3) to the test solution. Titrate with the sodium hydroxide solution (5.2.1.2.3.1) to the first change in coloration, pH = 4,45 (volume V_2), then titrate to the second change in coloration, pH = 9,22 (new volume V_3).

NOTE Alternatively, the test solution can be titrated using the potentiometer (5.2.1.2.4) without indicator.

5.2.1.2.6 Expression of results

The content of phosphate (P_2O_5), C_1, expressed as a mass fraction in % of the product is given by the equation:

$$C_1 = \frac{V_3 \times 3{,}549}{m_0} \qquad (1)$$

The content of potassium oxide (K_2O), C_2, expressed as a mass fraction in % of the product is given by the equation:

$$C_2 = \frac{V_3 + (V_1 - V_2) \times 2{,}355}{m_0} \quad (2)$$

where

m_0 is the mass, in grams, of the test portion (5.2.1.2.5.2);

V_1 is the volume, in millilitres, of H_2SO_4 (5.2.1.2.3.2) added to sample;

V_2 is the volume, in millilitres, of NaOH (5.2.1.2.3.1) used until pH : 4,45;

V_3 is the volume, in millilitres, of NaOH (5.2.1.2.3.1) used from pH : 4,45 until pH : 9,22.

5.2.2 Impurities

5.2.2.1 Sulfate

The sulfate (SO_42^-) content shall be determined in accordance with ISO 2997.

5.2.2.2 Fluoride

The fluoride (F^-) content shall be determined in accordance with ISO 3360.

5.2.3 Chemical parameters

NOTE When preparing the tetrapotassium pyrophosphate for analysis, it is important to ensure that the chemical parameters are effectively dissolved. The concentration of the solution should be sufficient to permit adequate sensitivity in analysis of the chemical parameters and appropriate steps should be taken to compensate for any matrix interference caused by the concentration of tetrapotassium pyrophosphate.

5.2.3.1 Determination of antimony (Sb), arsenic (As), cadmium (Cd), chromium (Cr), cyanide (CN^-) lead (Pb), mercury (Hg), nickel (Ni) and selenium (Se)

5.2.3.1.1 Principle

The elements antimony, arsenic, cadmium, chromium, lead, mercury, nickel and selenium are determined by atomic absorption spectrometry. Cyanide is determined by molecular absorption spectrometry.

5.2.3.1.2 Reagents

All reagents shall be of a recognized analytical grade and the water used shall conform to grade 3 specified in EN ISO 3696.

5.2.3.1.2.1 Hydrochloric acid, concentrated density ρ =1,18 g/ml

5.2.3.1.3 Procedure

5.2.3.1.3.1 Test portion

Weigh, to the nearest 0,1 mg, about 2,5 g of the laboratory sample of solid product (m) or a mass , from the product in solution evaporating to dryness at (105 ± 5)°C, corresponding to about 2,5 g of dry product (m). into a 100 ml one-mark volumetric flask.

5.2.3.1.3.2 Test solution

Add 20 ml of water and 2 ml the hydrochloric acid (5.2.3.1.2.1), dissolve and make up to the mark with water and mix.

5.2.3.1.3.3 Determination

Determine the content of chemical parameters in the test solution (5.2.3.1.3.2) in accordance with the following methods :

Ni and Pb : In accordance with ISO 8288, Method A ;

Cd : In accordance with EN ISO 5961,

Cr : In accordance with ISO 9174 ;

CN^- : In accordance with ISO 6703-1;

As : In accordance with EN ISO 11969 ;

Se : In accordance with ISO 9965 ;

Sb : In accordance with EN ISO 11885 ;

Hg : In accordance with EN 1483.

These methods are providing an interim result (y) expressed in milligrams per litre which needs to be converted to give the final concentration according to the equation in 5.2.3.1.3.4.

5.2.3.1.3.4 Expression of results

From the interim results (y) determined (see 5.2.3.1.3.3), the content, c_3, of each chemical parameters in the laboratory sample, expressed in milligrams per kilogram of dry tetrapotassium pyrophosphate is given by the following equation:

$$c_3 = y \times \frac{V}{m} \times 100 \qquad (3)$$

where

y is the interim result (5.2.3.1.3.3);

V is the volume, expressed in millilitres, of the test solution (5.2.3.1.3.2) (= 100 ml);

m is the mass, expressed in grams, of the test portion;

6 Labelling - Transportation - Storage

6.1 Means of delivery

In order that the purity of the products 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 Risk and safety labelling according to the EU Directives[4)]

Tetrapotassium pyrophosphate is not subject to labelling regulations at the date of publication of this document.

NOTE Annex I of the Directive 67/548/EEC on Classification, packaging and labelling of dangerous substances and its amendments and adaptations in the European Union contains a list of substances classified by the EU. Substances not in this Annex I should be classified on the basis of their intrinsic properties according to the criteria in the Directive by the person responsible for the marketing of the substance.

6.3 Transportation regulations and labelling

Tetrapotassium pyrophosphate is not listed under a UN number [5)].

Tetrapotassium pyrophosphate is not classified as a dangerous product for road, rail, sea and air transportation.

6.4 Marking

The marking shall include the following information:

— name "tetrapotassium pyrophosphate", trade name and grade;

— net mass;

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

— statement "this product conforms to EN 1207".

6.5 Storage

6.5.1 Material

Use plastics, avoid contact with metals.

6.5.2 Long term stability

Product is stable for at least one year if stored in closed containers.

6.5.3 Storage incompatibilities

No special requirement.

4) See [2].

5) United Nations Number.

Annex A
(informative)

General information on tetrapotassium pyrophosphate

A.1 Origin

A.1.1 Raw materials

Tetrapotassium pyrophosphate is manufactured from phosphoric acid and potassium hydroxide.

A.1.2 Manufacturing process

Potassium hydroxide is added to phosphoric acid in a molar ratio of 2:1. Then the resulting product is spray dried.

A.2 Use

A.2.1 Function

Tetrapotassium pyrophosphate is used for scale inhibition. To improve corrosion inhibition depending on the water quality combinations with othophosphates are also used.

A.2.2 Form in which it is used

Tetrapotassium pyrophosphate is mainly used as a solution and within the range of a mass fraction of 0,5 % to 20 %.

A.2.3 Treatment dose

The treatment dose is such that the phosphate content in the treated water should not exceed 5 mg/l expressed as P_2O_5.

A.2.4 Means of application

The product is applied using metering pump.

A.2.5 Secondary effects

The product has no secondary effects.

A.2.6 Removal of excess product

Not applicable.

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

In case of contact with eyes or skin, it is recommended to rinse immediately with plenty of water.

A.3.2.2 Spillage

It is recommended to remove mechanically as much as possible of the solid product, then to rinse the area with plenty of water.

A.3.2.3 Fire

Not applicable

Bibliography

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

[2] 67/548/EEC, *Council Directive of 27th June 1967 on the approximation of the laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances and its amendments and adaptations.*

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