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BSI Standards Publication

Domestic swimming pools — Water systems

Part 3: Water treatment — Requirements

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National foreword

This British Standard is the UK implementation of EN 16713-3:2016.

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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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Schwimmbäder für private Nutzung - Wassersysteme - Teil 3: Aufbereitung - Anforderungen

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European foreword

This document (EN 16713-3:2016) has been prepared by Technical Committee CEN/TC 402 "Domestic Pools and Spas", 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of an identical text or by endorsement, at the latest by August 2016, and conflicting national standards shall be withdrawn at the latest by August 2016.

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.

EN 16713, *Domestic swimming pools — Water systems*, currently comprises:

— *Part 1: Filtration systems— Requirements and test methods*;

— *Part 2: Circulation systems— Requirements and test methods*;

— *Part 3: Water treatment— Requirements*.

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1 Scope

This European Standard specifies requirements and test methods for equipment and means of pool water treatment utilized in domestic swimming pools.

This standard applies for swimming pools as defined in EN 16582-1 and will be read in conjunction with it.

This standard does not apply to:

— pools for public use covered by EN 15288-1;

— spas for domestic or public use;

— paddling pools according to EN 71-8;

— natural and nature like pools.

NOTE For filtration systems see EN 16713–1 and for circulation systems see EN 16713–2.

The purpose of this standard is furthermore to ensure a consistently high quality of pool water in terms of hygiene in order to prevent damage to human health, particularly as a result of pathogens. At the same time, account is also to be taken of the well-being of the bathers (e.g. by minimizing the side effects caused by disinfectants). To this end, requirements are specified for water quality and water treatment.

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 15031, *Chemicals used for treatment of swimming pool water — Aluminium based coagulants*

EN 15074, *Chemicals used for treatment of swimming pool water — Ozone*

EN 15797, *Chemicals used for the treatment of swimming pool water — Iron based coagulants*

EN 16380, *Chemicals used for treatment of swimming pool water — Potassium peroxomonosulfate*

EN 16400, *Chemicals used for treatment of swimming pool water — Hydrogen peroxide*

EN 16582-1:2015, *Domestic swimming pools — Part 1: General requirements including safety and test methods*

EN 16582-2:2015, *Domestic swimming pools — Part 2: Specific requirements including safety and test methods for inground pools*

EN 16582-3:2015, *Domestic swimming pools — Part 3: Specific requirements including safety and test methods for aboveground pools*

EN 16713–1, *Domestic swimming pools — Water systems — Part 1: Filtration systems — Requirements and test methods*

EN 16713–2, *Domestic swimming pools — Water systems — Part 2: Circulation systems — Requirements and test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 16582-1:2015, EN 16582-2:2015 and in EN 16582-3:2015, and the following apply.

3.1
water treatment
way to ensure water quality through physical and chemical actions

3.2
pool water
water in the swimming or bathing pool

3.3
disinfection
killing or inactivating certain microorganisms

3.4
filtrate
water after the filtration process

3.5
fill water
water used for the initial filling and for topping up

3.6
flow
Q
volume of water flowing through a certain cross section per unit time

3.7
pollutants
undesirable inorganic and organic substances and microorganisms which enter, or are already present, in the pool water

3.8
free chlorine
dominating forms of chlorine (dissolved gas Cl_2, hypochlorous acid HOCl, hypochlorite ion OCl^-) depending upon the pH-value

Note 1 to entry: In the pH-range relevant in the pool application, these forms are HOCl/OCl^-.

3.9
active chlorine
proportion of free chlorine available as the biologically active hypochlorous acid (HOCl) at a given pH

4 Requirements

4.1 General

Depending on the equipment being installed and type of chemicals used, the necessary instructions and safety requirements (e.g. hazards of using chemicals inappropriately) shall be provided to the pool owner.

Pool water treatment is essential for the safety of the users but incorrect treatment can also be the cause of various disorders (e.g. stains, discolorations, corrosion). The different problems related to improper pool water treatment or materials are listed in EN 16582-1:2015, Annex D (as an example for polyester shells but can be in a similar way for other pool materials e.g. liner, paint, tiles, mineral coating and pool equipment).

4.2 Fill water specifications

Water that is obtained from a mains water supply is deemed to be suitable as fill water without testing.

Water that is not obtained from a mains water supply should be tested for suitability and treated, if necessary. The following maximum values are recommended for the fill water:

— iron: 0,1 mg/l;

— copper: 0,2 mg/l;

— manganese: 0,05 mg/l;

— polyphosphate as phosphorus: 0,01 mg/l;

— nitrates: 50 mg/l.

If these values are exceeded it is recommended to treat the water to achieve the recommended values.

Phosphates introduced into the swimming pool water both with the fill water, and by the swimmers, promote algal growth. By optimization of flow, treatment (e.g. filtration and flocculation) and operation, the growth of microorganisms can be reduced together with the reduction of the phosphates.

4.3 Physical and chemical pool water requirements

The following parameters ensure good quality bathing water. To ensure that these parameters can be achieved and maintained, the following shall be considered:

a) pool design according to EN 16582 (all parts) and EN 16713-1 and EN 16713-2;

b) pool installation according to EN 16582 (all parts) and EN 16713-1 and EN 16713-2;

c) pool operation and maintenance;

d) physical and chemical parameters should be checked regularly with suitable measuring equipment.

Basic parameters for good quality bathing water are the pH value, free chlorine (or alternate disinfectants) and combined chlorine (if applicable).

If chlorine is not used or actively measured, the redox potential is one method of measurement.

Table 1 — Indicative physical and chemical parameters when using chlorine disinfectant

Parameter	Value
Water clarity	clear view of the pool bottom
Colour of the water	no colour should be observed[e, f]
Turbidity in FNU/NTU	max 1,5 (preferably less than 0,5)
Nitrate concentration above that of fill water in mg/l	max 20
Total organic carbon (TOC) in mg/l[a]	max 4,0
Redox potential against Ag/AgCI 3,5 m KCl in mV	min 650
pH value[c, d]	6,8 to 7,6
Free active chlorine (without cyanuric acid) in mg/l	0,3 to 1,5
Free chlorine used in combination with cyanuric acid in mg/l	1,0 to 3,0
Cyanuric acid in mg/l	max 100[b]
Combined chlorine in mg/l	max 0,5 (preferably close to 0,0 mg/l)
When using alternative/additional disinfectants other appropriate parameters may be considered.	

a When using organic compounds this value may be higher.

b If national regulations allow > 100 mg/l then a suitable treatment should be applied (e.g. dilution).

c Subject to the flocculant(s) used (if any).

d When pH is greater than 7,5 the free active chlorine is less than 50 %.

e Natural water sources may introduce water colouration.

f Intentional water colouration is excluded.

4.4 Flocculation/coagulation

The finest of dirt particles, hardly visible or invisible, may be present in the water. Due to their very small size these can pass through the filter under certain circumstances. In order to prevent this, the smallest of dirt particles could be converted into larger particles with the help of a flocculation agent.

The use of flocculants/coagulants has long been used to assist in the enhancement of water quality. It is particularly relevant in the removal of microorganism, e.g. Cryptosporidium cyst, which occurs in human faeces and is virtually impervious to disinfection. Consequently it shall be removed by filtration.

The following substances are commonly used as flocculants/coagulants:

a) aluminium based coagulant, as in EN 15031;

b) iron based coagulant, as in EN 15797;

Special caution is needed with the use of iron based coagulants, to avoid the development of corrosion and stains.

These substances all form a gelatinous precipitate by hydrolysis and shall be removed by cleaning.

Flocculants are commonly used with granular media filters when necessary, however they are not mandatory.

Alternative flocculants can be used, but shall comply with the general requirements regarding effectiveness, reaction and residual effect.

The level of contamination of pool water in domestic pools is very small in comparison with commercial pools. It may be used in certain cases but generally flocculation/coagulation is not required on a permanent basis.

4.5 Disinfection

4.5.1 General

In order for a disinfectant to work safely and reliably, it shall be equally effective against viruses, bacteria, fungi and parasites. Indications for the microbiological parameters providing effective disinfection of the pool water is in Annex B. When choosing a disinfectant, differing advantages and disadvantages as regards handling, storage, transport, influence on pH value, etc. shall be taken into account. The safe, simple and economic operation should be at the forefront of that choice.

In addition, the disinfectant should react very quickly, have a long-lasting effect (residual effect), as well as be easily and quickly measurable. Taking all of these requirements into consideration, the recommended reliable and suitable disinfectant is chlorine or bromine. The chlorine may be supplied in a gaseous, liquid (made onsite or delivered ready-made) or solid form.

In order to minimize and reduce disinfectant by-products, special attention should be paid to an effective filtration (see EN 16713-2).

The disinfection of the pool water may require the installation of disinfection equipment. The disinfectant shall be added to the filtrate either using dosing pumps, erosion/soaker feeders, *in situ* electrochlorination systems, control valves, or other suitable methods. An automatically controlled feeder unit and equipment for determining and recording parameters such as free chlorine, the Redox potential and pH value may also be installed.

NOTE The automatic system may need periodic checks according to the manufacturer's instructions.

Chlorine tablets and chlorine floating dispensers shall be used according to manufacturer's instructions.

4.5.2 Primary disinfectants

Chlorination is the most widely used pool water disinfection method, usually in the form of chlorine gas, sodium or calcium hypochlorite, but also with chlorinated isocyanurates. These are all loosely referred to as ‘chlorine’ or 'bromine'. The following disinfectants are recommended for the water in pools:

a) chlorine gas/hypochlorous acid/hypochlorite solution, produced at the point of use (*in situ*) by electrolyzing sodium chloride solution (common salt solution, sea water or brine, as in EN 16401), hydrochloric acid or salt added filtrate;

b) sodium hypochlorite solution, as specified in EN 15077, containing 150 kg/t chlorine and about 12 g/l sodium hydroxide and having a pH value of about 11. During storage, the chlorine concentration decreases, resulting in a daily chlorine loss of about 1 g/l at 20 °C;

c) calcium hypochlorite, as specified in EN 15796, in granular, tablet or pellet form, containing no less than 65 % (m/m) $Ca(OCl)_2$ and less than a mass fraction of 16 % water;

d) chlorinated isocyanurates: trichloroisocyanurate compounds, as specified in EN 15032; or dichloroisocyanurate compounds, as specified in EN 15072 and EN 15073;

e) 1-Bromo-3-chloro-5,5-dimethylhydantoin (BCDMH), in pellet form, particularly recommended for spas or high temperature water;

f) hypobromous acid: At waters which contain bromine in a reaction with chlorine or ozone hypobromous acid is developed as efficient disinfectant.

4.5.3 Alternative disinfection methods

There are also a variety of alternative disinfectants, which can be applied to pool disinfection some alone and others in combination with a primary disinfectant (in accordance with manufacturers' instructions). It shall be mentioned that when using these disinfectants, the range of action is limited for the general requirements (effectiveness, quick reaction, residual effect, easy and quick analysis) and cannot be fulfilled all in parallel.

The most common alternative disinfection methods are:

a) ozone (very low residual effect), as specified in EN 15074;

b) UV (no residual effect);

c) hydrogen peroxide (slow reaction), as specified in EN 16400;

d) potassium monopersulfate as specified in EN 16380 (slow reaction);

e) PHMB (poly hexa methylene biguanide) only used in association with hydrogen peroxide and an algicide (incompatible with some equipment).

Both a) and b) require a disinfectant residual to be used in combination.

NOTE At the time of writing this standard, the use of copper/silver (incompatible with some equipment) is banned in some European countries. In some other European countries its effectiveness is being reviewed.

4.6 pH-adjustment

For pool water treatment, the pH value is of utmost importance. The pH is a measurement value that provides information about the acidic, neutral or alkaline nature of a solution. The pH value has a large influence on the activity of the dosed chlorine, the chemical corrosion behaviour, skin and/or eye tolerance, as well as, if applicable, the flocculation process. Therefore, an important pool water treatment step consists of a corresponding correction of the pH value. If, and how much, acid (pH-decreasing) or alkali (pH-increasing) should be added to adjust the pH value depends on the water's alkalinity, the disinfection method used, as well as on the level of pollution in the pool, and may be regulated and adjusted according to the manufacturers' recommendations.

The reagents added should be thoroughly mixed with the water.

The following reagents may be used for pH value adjustment and/or stabilization:

a) sodium carbonate (as in EN 15362), sodium bicarbonate (as in EN 15075) or sodium hydroxide (as in EN 15076) if the pH value is too low;

b) carbon dioxide (as in EN 15513), hydrochloric acid (as in EN 15514), sulphuric acid (as in EN 15078) or sodium hydrogen sulfate (as in EN 16038) if the pH value is too high.

4.7 Water-balance

Due to differences in tap water, pool types, temperatures and water treatment facilities, the water balance or water equilibrium can vary. Balance means, that neither the water has an aggressive reaction

due to carbon dioxide, nor precipitation occurs. Precipitation should be avoided, since salts could cause scale and block the filters. Because of dosing disinfectants, flocculants and pH-chemicals, and because of the relative concentration of alkalinity and desired pH value (see above) in the pool, the pool water is always aggressive.

4.8 Dilution

Dilution can be considered as a treatment process in the pool water cycle. There are many chemical compounds which cannot be removed by flocculation and filtration, for example salts like chlorides, sulphates and nitrates. The levels of these salts indicate the pool loading and also the age of pool water. By adding a certain amount of filling water regularly, the salt level can be continuously kept low.

NOTE The filling water, added due to loss of water when filter washing is part of the above dilution.

4.9 Cleaning

4.9.1 General

Pool owners shall be advised that there is a certain amount of manual cleaning necessary to be regularly carried out by the user and or the owner in order to keep the pool water in a hygienically proper condition, even where there are automated water treatment systems installed. Cleaning can consist of the combination of brushing the bottom and the walls (to separate persistent dirt) vacuum cleaning, using a detergent, disinfectants and/or rinsing with filling water.

4.9.2 Pool

Many pollutants in the water settle to the pool floor. These pollutants can cause bacterial, algal or fungal growth. The cleaning process is based on brushing and vacuum cleaning. Only the usage of brushes allows a separation of dirt or bio-films from the pool floor. Pools should be cleaned as regularly as necessary. After a time, tenacious stains or bio-films on pool walls or high concentrations of salts or unwanted reaction by-products can occur. Depending on hygienic condition, cleanliness, visibility, odour, debris and stains, it could be recommended to change the water completely and clean/disinfect the pool. When emptying the pool, the regulations and the manufacturers'/builders' instructions for draining the water shall be observed.

4.9.3 Overflow channel

Overflow channels shall be brushed and flushed to avoid staining or the growth of algae and/or fungi. The covers shall be cleaned as well (especially on the underside where the growth of algae/fungi is also possible). When cleaning and flushing the channel, it is recommended that the water cannot flow into the balance tank (e.g. a separate pipe and valve may be installed to drain the cleaning water).

4.9.4 Balance tank

Balance tanks (when present) are part of the water circulation system to contain the balancing water, therefore they will get dirty the same way as the pool does and so regular cleaning is required. It shall be possible to drain the water reservoir completely (e.g. drain valve).

Access to balance tanks and cleaning shall be carried out in accordance with health and safety regulations.

4.9.5 Pool surround

Barefoot areas and relaxing areas shall be considered in the cleaning process as well. No cleaning water may flow into the pool or pool water cycle. The dirt and cleaning agents shall be rinsed carefully to a drain in the pool surround.

4.9.6 Swimming pool features and equipment

Swimming pool features and equipment (e.g. skimmer, swimming pool attractions) shall be cleaned regularly when necessary according to the manufacturers' instructions.

Annex A
(informative)

Environmental aspects

Every product has an impact on the environment during all stages of its life-cycle, e.g. extraction of resources, acquisition of raw materials, production, testing, distribution, use (application), reuse, end-of-life treatment, including final disposal. These impacts range from slight to significant; they can be short-term or long-term; and they occur at global, regional or local level. Provisions in product standards have an influence on environmental impacts of products.

The need to reduce the potential adverse impacts on the environment of a product that can occur during all stages of its life is recognized around the world. The potential environmental impacts of products can be reduced by taking into account environmental issues in product standards.

During the life-cycle of a given product, different environmental aspects can be determined. The aim is to promote a reduction of potential adverse environmental impacts caused by products.

NOTE For information an environmental checklist is given in Table A.1. The purpose of the environmental checklist is to explain whether the standard covers relevant product environmental aspects and, if so, how they are dealt with in the standard.

By no means shall these environmental aspects interfere with the basic health and safety requirements in this standard. In any case the requirement of this standard prevails any environmental aspect that might be related to this product.

The following environmental aspects should be considered:

a) Materials should be selected to optimize product durability and lifetime and consideration should be made to avoiding the selection of rare or hazardous materials.

b) Consideration should be made to using recycled or reused materials, and to the selection of materials which can then be subsequently recycled.

c) The possibility of marking components to aid to their sorting for disposal/recycling at end of life should also be reviewed.

d) Packaging design should consider using recycled materials, and materials that need little energy for their manufacture, and should minimize waste.

e) Packaging design should consider subsequent reuse and recycling.

f) The size and weight of packaging should be minimized while protecting the products to minimize waste through damage. Packaging should be designed to optimize capacity of transportation vehicles while facilitating safe loading and unloading.

g) Test materials should be used and disposed properly, according to the manufacturer's instructions and to the enforced law in respect of environmental protection.

h) Test facility, test equipment and tool shall be designed to minimize the risk of leaks into the environment.

i) Maximum use should be made of high efficiency motors, lighting and displays.

j) The design should facilitate the manufacturing of the product and packaging using tools which minimize the generation of noise and vibration;

k) In case of treatment with chlorine or bromine, the use of sodium thiosulfate pentahydrate, as specified in EN 16038, can be used to remove the excess chlorine to reduce the environmental impacts (where applicable).

Table A.1 — Environmental Checklist

Environmental Issue	Stages of the life cycle										All stages
	Acquisition		Production		Use			End-of-Life			
	Raw materials and energy	Pre-manufactured materials and components	Production	Packaging	Use	Maintenance and repair	Use of additional products	Reuse/ Material and Energy Recovery	Incineration without energy recovery	Final disposal	Transportation
Inputs											
Materials											
Water											
Energy											
Land											
Outputs											
Emissions to air											
Discharges to water											
Discharges to soil											
Waste											
Noise, vibration, radiation, heat											
Other relevant aspects											
Risk to the environment from accidents or unintended use											
Customer information											
Comments:											
NOTE 1 The stage of packaging refers to the primary packaging of the manufactured product. Secondary or tertiary packaging for transportation, occurring at some or all stages of the life cycle, is included in the stage of transportation. NOTE 2 Transportation can be dealt with as being a part of all stages (see checklist) or as separate sub-stage. To accommodate specific issues relating to product transportation and packaging, new columns can be included and/or comments can be added.											

Annex B
(informative)

Microbiological parameters

For sampling and determination of the parameters in Table B.1, EN ISO 19458 applies.

Table B.1 — Microbiological parameters

Bacterium	**Detection**
Pseudomonas aeruginosa at (36 ± 1) °C in 100 ml	None detected
Escherichia coli at (36 ± 1) °C in 100 ml	None detected
Legionella species at (36 ± 1) °C in 100 ml	None detected
Colony-forming units at (36 ± 1) °C in 1 ml	max. 100

Bibliography

[1] EN 15288 (all parts), *Swimming pools*

[2] EN 71-8, *Safety of toys — Part 8: Activity toys for domestic use*

[3] AC P90-323, *Private swimming pools for family use — Copings and pool decks*

[4] EN 15032, *Chemicals used for treatment of swimming pool water — Trichloroisocyanuric acid*

[5] EN 15072, *Chemicals used for treatment of swimming pool water — Sodium dichloroisocyanurate, anhydrous*

[6] EN 15073, *Chemicals used for treatment of swimming pool water — Sodium dichloroisocyanurate, dihydrate*

[7] EN 15075, *Chemicals used for treatment of swimming pool water — Sodium hydrogen carbonate*

[8] EN 15076, *Chemicals used for treatment of swimming pool water — Sodium hydroxide*

[9] EN 15077, *Chemicals used for treatment of swimming pool water — Sodium hypochlorite*

[10] EN 15078, *Chemicals used for treatment of swimming pool water — Sulfuric acid*

[11] EN 15362, *Chemicals used for treatment of swimming pool water — Sodium carbonate*

[12] EN 15513, *Chemicals used for treatment of swimming pool water — Carbon dioxide*

[13] EN 15514, *Chemicals used for treatment of swimming pool water — Hydrochloric acid*

[14] EN 15796, *Chemicals used for treatment of swimming pool water — Calcium hypochlorite*

[15] EN 16038, *Chemicals used for treatment of water for swimming pools — Sodium hydrogen sulfate*

[16] EN 16401, *Chemicals used for treatment of swimming pool water — Sodium chloride used for electrochlorinator systems*

[17] EN ISO 19458, *Water quality — Sampling for microbiological analysis (ISO 19458)*

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