



**SLOVENSKI STANDARD**  
**SIST DIN 19643-5:2003**

**01-maj-2003**

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**Priprava bazenske vode za plavalne in kopalne bazene - 5. del: Kombinacija postopkov: flokulacija, filtracija, adsorpcija z granuliranim aktivnim ogljem, kloriranje**

Treatment of water of swimming pools and baths - Part 5: Combination of process: Flocculation, filtration, adsorption at granular activated carbon; chlorination

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**Ta slovenski standard je istoveten z:**

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**ICS:**

13.060.25      Voda za industrijsko uporabo    Water for industrial use

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	<p style="text-align: center;">Treatment and disinfection of water used in bathing facilities</p> <p style="text-align: center;">Part 5: Combined coagulation, filtration, adsorption and chlorination method</p>	<p><b>DIN</b></p> <p><b>19643-5</b></p>
<p>ICS 13.060.25</p> <p>Aufbereitung von Schwimm- und Badebeckenwasser – Teil 5: Verfahrenskombination: Flockung – Filtration – Adsorption an Aktivkohle – Chlorung</p> <p style="text-align: right;">This standard, together with DIN 19643-1 to DIN 19643-3, April 1997 editions, and DIN 19643-4, February 1999 edition, supersedes parts of DIN 19643, April 1984 edition.</p> <p><i>In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.</i></p> <p><b>Foreword</b></p> <p>This standard has been prepared by Technical Committee IV 13 of the <i>Normenausschuss Wasserwesen</i> (Water Practice Standards Committee).</p> <p>The revision of DIN 19643, April 1984 edition, is in response to the future <i>Infektionsschutzgesetz</i> (German Infection Prevention Act) and the <i>Gesetz zur Neuordnung seuchenrechtlicher Vorschriften</i> (German Act to restructure German legislation on epidemics), in so far as these relate to water for swimming pools and public baths. The <i>Legionella pneumophila</i> and trihalomethane (haloform) levels specified in the regulations that implement the latter (the <i>Schwimm- und Badebeckenwasserverordnungen</i> of the <i>Länder</i> (German Länder regulations on water used in bathing facilities)) have been incorporated into the present standard.</p> <p>At the same time, the standard was divided into several parts, with DIN 19643-1 specifying general requirements, and subsequent parts dealing with different combinations of water treatment methods. Additional parts will be added to the series as the state of the art develops.</p> <p>To ensure proper application of this standard, water treatment systems should be designed, built and monitored only by experienced specialists. Attention is drawn to <i>DVGW-Arbeitsblätter</i> (DVGW Codes of practice) W 200 and W 201, which specify procedures for certifying water treatment experts.</p> <p style="text-align: center;"><a href="https://standards.iteh.ai/catalog/standards/sist/0af22edf-b7ad-4d24-b984-3cd38ed3700f/sist-din-19643-5-2003">https://standards.iteh.ai/catalog/standards/sist/0af22edf-b7ad-4d24-b984-3cd38ed3700f/sist-din-19643-5-2003</a></p> <p style="text-align: center;">SIST DIN 19643-5:2003</p> <p><b>Amendments</b></p> <p>This standard differs from DIN 19643, April 1984 edition, as follows.</p> <ol style="list-style-type: none"> <li>The standard now consists of several parts.</li> <li>The combined method in the present standard has been included.</li> <li>The standard has been brought into line with the state of the art.</li> </ol> <p><b>Previous edition</b></p> <p>DIN 19643: 1984-04.</p> <p><b>1 Scope</b></p> <p>In conjunction with DIN 19643-1, this standard specifies a method of treating water in bathing facilities (except therapeutic pools and hot whirlpool baths) that combines coagulation, filtration, adsorption on granulated activated carbon treatment and chlorination.</p> <p><b>2 Normative references</b></p> <p>This standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the titles of the publications are</p> <p style="text-align: right;">Continued on pages 2 to 7.</p> <p style="text-align: center;">Translation by DIN-Sprachendienst.</p> <p style="text-align: center;">In case of doubt, the German-language original should be consulted as the authoritative text.</p>		

listed below. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

DIN 19605	Design of fixed granular bed filters for water treatment
DIN 19643-1	Treatment and disinfection of water used in bathing facilities – General requirements
DIN 38409-7	German standard methods for the examination of water, wastewater and sludge – Parameters characterizing effects and substances (Group H) – Determination of acid capacity and alkalinity (H 7)
DIN 66131	Principles of determining the total surface area of solid particles by the Brunauer, Emmett and Teller (BET) gas adsorption method
DIN EN 878	Chemicals used for treatment of water intended for human consumption – Aluminium sulfate
DIN EN 881	Chemicals used for treatment of water intended for human consumption – Aluminium chloride, aluminium chloride hydroxide and aluminium chloride hydroxide sulfate (monomeric)
DIN EN 882	Chemicals used for treatment of water intended for human consumption – Sodium aluminate
DIN EN 888	Chemicals used for treatment of water intended for human consumption – Iron(III) chloride
DIN EN 890	Chemicals used for treatment of water intended for human consumption – Iron(III) sulfate
DIN EN 891	Chemicals used for treatment of water intended for human consumption – Iron(III) chloride sulfate
DIN EN 896	Chemicals used for treatment of water intended for human consumption – Sodium hydroxide
DIN EN 897	Chemicals used for treatment of water intended for human consumption – Sodium carbonate
DIN EN 898	Chemicals used for treatment of water intended for human consumption – Sodium hydrogencarbonate
DIN EN 899	Chemicals used for treatment of water intended for human consumption – Sulfuric acid
DIN EN 936	Chemicals used for treatment of water intended for human consumption – Carbon dioxide
DIN EN 939	Chemicals used for treatment of water intended for human consumption – Hydrochloric acid
DIN EN 1485	Water quality – Determination of adsorbable organically bound halogens (AOXs)
DIN EN 12904	Products used for treatment of water intended for human consumption – Sand and gravel
DIN EN 12915	Products used for treatment of water intended for human consumption – Granular activated carbon
DIN EN ISO 7027	Water quality – Determination of turbidity (ISO 7027 : 1999)

DVGW-Arbeitsblätter (DVGW Codes of practice)\*):

- W 200 *Qualifikationsanforderungen an Unternehmen für Wasseraufbereitungsanlagen* (Certification of water treatment plant manufacturers – Requirements and testing)
- W 201 *Qualifikationsanforderungen an DVGW-Sachverständige für Wasseraufbereitung* (Certification of DVGW experts for water treatment – Requirements and testing)

*Gesetz zur Neuordnung seuchenrechtlicher Vorschriften* (German Act to restructure German legislation on epidemics), as of 1 January 2001, *BGBl.* (German Federal Law Gazette) I, No. 33, pp. 1045–1077

*Infektionsschutzgesetz*

*Schwimm- und Badebeckenwasserverordnungen* of the German Länder

### 3 Principle

First, dispersed colloidal impurities are destabilized by coagulation with iron(III) or aluminium salts and orthophosphates are precipitated, the pH value of the raw water being kept within a range consistent with the type of coagulant used. The mixture of iron(III) phosphate or aluminium phosphate and colloids is then removed by filtration, the redox potential being kept at not less than +650 mV.

At the subsequent stage, fully dissolved organic compounds are adsorbed on granular activated carbon and the concentration of chlorine reaction by-products is reduced. The filtrate is then chlorinated and fed to the bath or pool.

The load capacity factor,  $k$ , is  $0,5 \text{ m}^{-3}$ , equivalent to a treated water volume of  $2 \text{ m}^3$  per person.

\*) Obtainable from *Wirtschafts- und Verlagsgesellschaft Gas und Wasser mbH*, Postfach 14 01 51, 53056 Bonn, Germany.

## 4 Procedure

### 4.1 Acidity adjustment

#### 4.1.1 General

To achieve satisfactory coagulation, adjust the acidity,  $K_{S_{4,3}}$  (cf. DIN 38409-7), of the raw water to a given minimum value, unless the acidity of the filling water is high enough to prevent that of the raw water from dropping below the minimum value. Acidity adjustments are to be made by adding an aqueous solution of sodium carbonate or sodium hydrogencarbonate to the raw water via a feeder.

#### 4.1.2 Reagents

The reagents to be used for the acidity adjustment are sodium carbonate (as in DIN EN 897) or sodium hydrogencarbonate (as in DIN EN 898).

#### 4.1.3 Minimum acidity

When the method specified in this standard is used for bathing facilities,  $K_{S_{4,3}}$  shall be equal to 0,7 mol/m<sup>3</sup>.

#### 4.1.4 Check

After the reagents have been added and thoroughly dispersed, determine the acidity to check for compliance with the value specified in subclause 4.1.3.

### 4.2 pH value adjustment

#### 4.2.1 General

To ensure satisfactory coagulation and adequate disinfection with the lowest possible consumption of disinfectant, adjust the pH value of the water to a specified value using a feeder which automatically controls the pH value. The reagents added shall be thoroughly mixed with the water before they reach the pH sensor and the sampling point.

#### 4.2.2 Reagents

The following reagents shall be used to adjust the pH value:

- 1) If the pH value of the raw water is too low:
  - a) sodium carbonate (as in DIN EN 897) or
  - b) sodium hydroxide (as in DIN EN 896),
- 2) If the pH value of the raw water is too high:
  - c) carbon dioxide (as in DIN EN 936),
  - d) hydrochloric acid (as in DIN EN 939),
  - e) sulfuric acid (as in DIN EN 899) or
  - f) sodium hydrogensulfate.

#### 4.2.3 pH range

The pH value shall be between 6,5 and 7,2 if aluminium salts are used for coagulation, and between 6,5 and 7,5 (or up to 7,8 in the case of seawater) if iron salts are used.

#### 4.2.4 Check

After the reagents have been added, check whether the pH value is within  $\pm 0,1$  of the specified value using a pH meter.

### 4.3 Stabilization of redox potential of filtrate after coagulation

#### 4.3.1 General

To minimize the concentration of microbes taken up by the granular activated carbon filter, maintain the redox potential at not less than + 650 mV. If it drops below this value, automatically add at least 1 g/m<sup>3</sup> of chlorine to the raw water prior to adjusting the pH value to achieve the required period of action, and report the fault.

#### 4.3.2 Check

Throughout the entire filtering operation, use a stationary measuring instrument to measure the redox potential of the coagulation filtrate against an Ag/AgCl 3,5 mol/l KCl electrode to ensure compliance with the value in subclause 4.3.1.

#### 4.3.3 Recording

Continuously measure and record the redox potential, and at the beginning and end of each bathing session, enter the values for raw water against item 12 in the log book shown in table 5 of DIN 19643-1, April 1997 edition.

## 4.4 Coagulation

### 4.4.1 General

After the acidity and the pH value of the water have been adjusted, a feeder shall be used to feed coagulant continually and uniformly.

The coagulant shall be rapidly and completely mixed with the water directly at the feed point. This can be achieved, for example, by an abrupt change in pipe diameter (e.g. by reducing the pipe diameter by 30 %) immediately downstream of the feed point. The reaction time prior to the water entering the liquid head of the filter shall not be less than ten seconds and the flow velocity shall not exceed 1,5 m/s. To ensure that flocs formed in the reaction section are not destroyed by internal pipe fittings, throttle valves shall only be fitted upstream of the reaction section or downstream of the filter section.

It will not be necessary to feed coagulant between bathing sessions, provided the requirements specified in table 2 of DIN 19643-1 are complied with.

### 4.4.2 Coagulants

The following may be used as coagulants:

- aluminium sulfate (as in DIN EN 878);
- aluminium chloride hexahydrate (as in DIN EN 881);
- sodium aluminate (as in DIN EN 882);
- aluminium chloride hydroxide or aluminium chloride hydroxide sulfate (as in DIN EN 881);
- iron(III) chloride hexahydrate (as in DIN EN 888);
- iron(III) chloride sulfate solution (as in DIN EN 891);
- iron(III) sulfate (as in DIN EN 890).

### 4.4.3 Minimum quantity of coagulant

The minimum quantity of coagulant fed to the water shall be 0,05 g/m<sup>3</sup> for aluminium salts (expressed as Al) and 0,1 g/m<sup>3</sup> for iron salts (expressed as Fe).

### 4.4.4 Check

A check shall be made at the filter outlet to ensure that the coagulation process is performing satisfactorily by testing for compliance with the requirements set out in table 2 (see subclause 4.5.3).

## 4.5 Filtration

### 4.5.1 General

Filter the water to remove most of the destabilized colloids, precipitated aluminium phosphate or iron phosphate, and aggregated and encapsulated microorganisms that have escaped the action of the disinfectant in the pool. Matter retained by the filters shall be removed by backwashing.

DIN 19605 filters shall be used for filtration.

### 4.5.2 DIN 19605 filters

#### 4.5.2.1 Size fractions, bed heights and filtration rates

The size fractions, bed heights and filtration rates for single-medium filters using sand (as in DIN EN 12904) shall be as specified in table 1.

**Table 1: Size fraction, bed heights and filtration rates for single-medium sand filters**

Parameter	Unit	Open filters	Closed filters
Size fraction	mm	0,71 to 1,25	
Bed height <sup>1)</sup>	m	≥ 0,9	≥ 1,2
Minimum freeboard	m	≥ 25 % of filter material bed height + 0,2 m	
Filtration rates <sup>1)</sup>	m/h		
– for fresh water		≤ 12	≤ 30
– for seawater and water having a salt concentration above 2 000 mg/l	m/h	≤ 12	≤ 20
1) Bed height and filtration rate for mineral water shall be determined experimentally.			

#### 4.5.2.2 Single-medium filter backwashing

To backwash filters, the filter beds shall be fluidized and expanded by at least 20 % in order to remove substances retained in the filter, particularly any significant microorganisms found in the bath or pool water. When the backwashing process is complete, deaerate the filter bed.

The backwashing operation shall be automatic and shall not be interrupted. In addition, steps shall be taken to ensure that the wastewater can flow off without hindrance, if necessary, by providing a collecting tank for the wastewater.

When closed filters are being backwashed, pipes shall be provided to vent the space above the filter bed. Guide values for backwashing single-medium sand filters with a size fraction of 0,71 mm to 1,25 mm are given below. If filter sands having different size fractions are used, the water flow rate and backwashing times shall be varied to take account of the type of filter material used and of the backwashing water temperature.

The backwashing programme shall comprise the following stages:

Stage 1: Venting the filter container and lowering the water level to the top of the outlet funnel.

Stage 2: Flushing with water at a flow rate of about 60 m/h to 65 m/h at 25 °C for about three minutes.

Stage 3: Flushing with air at a flow rate of about 60 m/h for about five minutes.

Stage 4: Flushing with water at a flow rate of about 60 m/h to 65 m/h at 25 °C for about three to five minutes.

Stage 5: Discharging the first filtrate as waste.

Stage 6: Re-establishing water treatment operations.

After flushing filters with air, allow the filter material to deaerate for about two minutes before backwashing with water. Backwashing with air and water shall not be combined unless specified by the manufacturer.

#### 4.5.3 Check

Compliance with the values given in table 2 shall be checked throughout the filtration process.

**Table 2: Filtration requirements**

Subclause as in table 2 of DIN 19643-1	Parameter	Unit	Requirement
5.3.1.1	<i>Pseudomonas aeruginosa</i> at (36 ± 1) °C	1/(100 ml)	n.d. <sup>1)</sup>
5.3.1.2	<i>Escherichia coli</i> at (36 ± 1) °C	1/(100 ml)	n.d. <sup>1)</sup>
5.3.1.3	<i>Legionella pneumophila</i> at (36 ± 1) °C	1/(100 ml)	n.d. <sup>1)</sup>
5.3.1.5	Colony forming units (CFU) at (36 ± 1) °C	1/ml	≤ 100
5.3.2.2	Turbidity	FNU <sup>2)</sup>	≤ 0,20
5.3.2.6	Oxidizability of Mn VII → II above that of filling water <sup>3)</sup> , expressed as O <sub>2</sub> content	mg/l	0
	Consumption of KMnO <sub>4</sub> above that of filling water <sup>3)</sup> , expressed as KMnO <sub>4</sub> content	mg/l	0
5.3.2.7	Redox potential against Ag/AgCl 3,5 mol/l KCl	mV	≥ 650
–	Orthophosphates, expressed as phosphorus	mg/l	≤ 0,005
–	Iron <sup>4)</sup>	mg/l	≤ 0,020
–	Aluminium <sup>4)</sup>	mg/l	≤ 0,050

1) n.d. = not detectable.  
 2) FNU (formazine nephelometric unit) is the unit of turbidity specified in EN ISO 7027.  
 3) If the oxidizability of the filtrate is lower than that of the filling water for an unoccupied pool, this lower value shall be used as the reference value; if, however, the oxidizability of the filling water is lower than 0,5 mg/l O<sub>2</sub> or lower than 2 mg/l KMnO<sub>4</sub>, these values shall be used as reference values.  
 4) Permitted only where the appropriate additives are present.

## 4.6 Adsorption on granular activated carbon

### 4.6.1 General

Filtration with granular activated carbon filters removes nearly all the chlorine-nitrogen compounds, organohalogen compounds (THMs, AOXs) and organic compounds.

DIN 19605 closed filters are to be used for filtration.

### 4.6.2 Filtration and backwashing

#### 4.6.2.1 Granular activated carbon, size fractions, bed heights and filtration rates

Normally, activated carbon obtained from hard coal shall be used, although carbon obtained from other raw materials may be used if it has been experimentally shown to be suitable for this combined method. The material shall comply with the minimum requirements given in table 3.

**Table 3: Granular activated carbon filter fraction size, bed height, filtration rate and material properties**

Parameter	Unit	Requirement
Activated carbon size fraction	mm	0,6 to 2,4
Sand size fraction	mm	1 to 2
Activated carbon bed height	m	0,9
Height of sand separating bed	m	0,15
Free board	m	30 % of bed height of filter material + 0,3 m
Filtration rate	m/h	≤ 30
Density of activated carbon after vibration (as in DIN EN 12915)	g/l	≥ 450
Chlorine half-value length	mm	≤ 70
Total effective surface area of particles (determined by the BET method as in DIN 66131)	m <sup>2</sup> /g	≥ 950

Since the activated carbon layer is subject to constant losses due to backwashing, the bed height shall be checked regularly and the carbon shall be topped up if the height has decreased by 10 %, but at least once a year.

The activated carbon shall be replaced if the chloroform and chlorine contents exceed those given in table 4.

**Table 4: Activated carbon filtrate values**

Trihalomethanes, expressed as chloroform content	0,02 mg/l
Adsorbable organohalogen compounds, expressed as chloride (see DIN EN 1485)	0,10 mg/l

These values do not apply for the one- to two-day start-up period. They shall be determined at least once a year, the samples being collected prior to backwashing. If the values only approach those in table 4, they shall be checked once a month.

#### 4.6.2.2 Backwashing granular activated carbon filters

The filters shall be backwashed twice a week.

After the bed has been loosened up with air, backwash the activated carbon filters with water only, not in a combined process with air. At least once a month, backwash the filters using chlorinated filtrate (with a chlorine concentration about 1 mg/l Cl) from the coagulation filter. A backwashing water balancing tank shall be provided.

Guide values for backwashing filters with a 0,6 mm to 2,4 mm size fraction are given below. The programme shall comprise the following stages.

Stage 1: Venting the filter container and lowering the water level to about 5 cm above the surface of the filter material.

Stage 2: Loosening up of the bed for about one minute to two minutes with an air flow rate of about 60 m/h, followed by a pause of about three to five minutes to deaerate the filter bed.

Stage 3: Backwashing for about four to six minutes with a water flow rate of about 60 m/h to 65 m/h at 25 °C.

Stage 4: Discharging the initial filtrate as waste for about two to three minutes.

Stage 5: Re-establishing water treatment operations.

#### 4.6.3 Check

Compliance with the values given in table 5 shall be checked throughout the filtration process.

**Table 5: Activated carbon filtration requirements**

Subclause in table 2 of DIN 19643-1	Parameter	Unit	Requirement
5.3.1.1	<i>Pseudomonas aeruginosa</i> at (36 ± 1) °C	1/(100 ml)	n.d. <sup>1)</sup>
5.3.1.2	<i>Escherichia coli</i> at (36 ± 1) °C	1/(100 ml)	n.d. <sup>1)</sup>
5.3.1.3	<i>Legionella pneumophila</i> at (36 ± 1) °C	1/(100 ml)	n.d. <sup>1)</sup>
5.3.1.5	Colony forming units (CFU) at (36 ± 1) °C	1/ml	≤ 100

(continued)