Selcoperm SES
Electrolysis system for 110-1800 g/h Cl₂ (equivalent)
Safe and simple production of sodium hypochlorite solution
1. General information
   Fundamentals of disinfection ............................................................... 3
   Disinfection with chlorine ...................................................................... 3
   The Selcoperm electrolysis principle ..................................................... 3
   Benefits of the electrolysis with Selcoperm .......................................... 4
   Applications ......................................................................................... 4
   Unique selling points ............................................................................ 4
   Structure of a Selcoperm system .......................................................... 5

2. Applications
   Drinking water treatment ...................................................................... 6
   Swimming pool water treatment ............................................................. 7

3. Construction
   Electrolysis cell and hydrogen degassing column .................................. 8
   Hydraulic chamber ............................................................................... 8
   Control system ..................................................................................... 8
   Ventilation ........................................................................................... 8
   Constructional scheme Selcoperm components ...................................... 9

4. Dimensions ....................................................................................... 11

5. Identification
   Type key .............................................................................................. 12

6. Technical data
   General data ....................................................................................... 13
   Temperatures and humidity .................................................................. 13
   Weight ................................................................................................. 13
   Water quality specification ................................................................... 13
   Salt specification .................................................................................. 13
   Connections ........................................................................................ 13

7. Product selection
   Product selection diagram .................................................................... 14
   Product selection table ......................................................................... 15

8. Accessories
   Brine tank ............................................................................................ 16
   NaClO solution storage tank with collecting tray ................................ 16
   Large NaClO solution storage tank without collecting tray .............. 16
   Test kit .................................................................................................. 17
   Acid rinsing set .................................................................................... 17
   Compact photometer DIT-L ................................................................. 17
   Maintenance kit ................................................................................... 17

9. Grundfos Product Center ...................................................................... 18
1. General information

Fundamentals of disinfection
Many diseases are transmitted by drinking water. Among these diseases are typhus, paratyphoid, cholera and diarrhoea with vomiting, as well as viral infections such as hepatitis and poliomyelitis. Legionella in shower or bathing water can provoke pulmonary diseases.

Compared to the chemical contamination of water, where toxicity values are attained only slowly in general, in a drinking water epidemic infections spread dramatically in the whole supply area. The best prevention of epidemics is to use microbiologically clean non polluted water, preferably deep ground water as drinking water. Unfortunately, in some regions this is not possible for hydrogeological or quantitative reasons. In these regions, surface water is used, which often has to be purified. Pathogens that are possibly encountered, can be removed from the water or killed by adding certain substances to the water, i.e. by disinfecting the water.

Disinfection with chlorine
The most widespread disinfectant used in the treatment of drinking water is chlorine, which can be applied in a variety of ways. History has taught us that, in bacteriological terms, chlorinating water is a quite safe way of disinfecting drinking water. After all, more than 75 years have passed since chlorine was used to disinfect drinking water for the first time. Many years of experience have shown that acute toxicity can be excluded, when chlorination is executed correctly. Generally, three methods are used for chlorinating drinking and process water:

- Chlorine gas dosing
- Dosing of commercial sodium hypochlorite solution or calcium hypochlorite solution
- Electrolytic sodium hypochlorite generation on site

The third method in particular offers a number of advantages, which are incorporated in the Selcoperm chlorine electrolysis systems.

The Selcoperm electrolysis principle
With electrolysis, sodium hypochlorite is produced directly from a solution of common salt using electricity.

The following reactions take place in the electrolysis cell:

\[ 2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{Cl}_2 + \text{H}_2 \]

The chlorine (Cl\(_2\)) produced reacts immediately with the caustic soda solution (NaOH) also formed, resulting in a sodium hypochlorite solution (NaClO):

\[ \text{Cl}_2 + 2\text{NaOH} \leftrightarrow \text{NaCl} + \text{NaClO} + \text{H}_2\text{O} \]

The sodium hypochlorite solution, which is the disinfectant, has a pH value between 8.5 and 9.5, and a chlorine concentration of 5 - 6.5 g/l. It has a half-life of several months, which makes it ideal for storage in a buffer tank.

After dosing the solution into the water flow, no pH value correction is necessary, as it is often required e.g. in electrolysis according to the membrane principle. The sodium hypochlorite solution reacts in a balance reaction, resulting in hypochlorous acid (HClO), the effective disinfectant:

\[ \text{NaClO} + \text{H}_2\text{O} \leftrightarrow \text{NaOH} + \text{HClO} \]

The resulting hypochlorous acid is the actually effective compound for disinfection of the water. The dissociation of acid to anions is primarily according to an equilibrium dependent on the pH value according to the equation:

\[ \text{HClO} + \text{H}_2\text{O} \leftrightarrow \text{H}_3\text{O}^+ + \text{ClO}^- \]

The dosing quantity depends on the application as well as the local regulations. In general, the concentration after the injection unit is 0.3 to 2 ppm chlorine equivalent.
Benefits of the electrolysis with Selcoperm

- Safe and reliable method of producing sodium hypochlorite on-site
- Common salt is the base material - it is non-toxic, easy to store and easy to handle
- Only water, common salt and electricity are needed for the electrolysis - low operating costs, world-wide use
- Fresh sodium hypochlorite is always on hand and does not dissociate like commercial sodium hypochlorite solutions
- Low formation of chlorate as a by-product
- Less safety requirements than chlorine-gas-based systems
- Lower pH value than commercial sodium hypochlorite reduces scaling of injection units etc. in hard water areas
- Robust design for easy installation and maintenance
- Long service life, compared with membrane cell electrolysis

Applications

Typical disinfection applications for Selcoperm systems are especially in
- Drinking water treatment
- Swimming pool water treatment
- Water treatment for industrial processes and cooling towers.

The systems are an excellent alternative to chlorine gas or commercial sodium hypochlorite applications.

Remark: Legislation on the use of disinfectants in water treatment applications is country-specific.

Please contact your local Grundfos sales office for further details on the use of our products in your application and area.

Unique selling points

- Quantitative airflow - air is blown continuously through the electrolysis chamber, and is monitored by a quantitative airflow sensor to ensure that the correct volume of air is flowing through the system at all times.
- The electrodes as well as the hydrogen degassing column are dual contained, in order to avoid hydrogen leaking from the system into the installation room.
- No external risk zone - fully compliant with ATEX.
- Negative pressure on NaClO solution storage tank - a venturi tee is fitted in the hydrogen ventilation pipework; this serves as a siphon break and tank ventilation to ensure that all hydrogen in the NaClO solution tank is safely removed to the atmosphere.
- NaClO solution with 5 - 6.5 g/l chlorine concentration can be stored for several weeks without any degradation.
Structure of a Selcoperm system

Selcoperm systems consist of the electrolysis cell, degassing column, brine dosing pump, exhaust air fan with quantitative air flow monitor for air dilution of electrolysis chamber and a water softening system. In addition the following equipment is required: a salt saturator, a tank for storage of the generated sodium hypochlorite (NaClO) solution and dosing pumps. The installation can be rounded off with a measuring and control unit for chlorine dosing, if required.

The Selcoperm system is supplied as a turn-key solution, only the tubing for the water connection, the connections for the salt and NaClO solution storage tanks and the exhaust air tubing have to be installed. The size of the storage tank depends on the space available and the amount of NaClO solution buffer storage required. The sizing of the brine tank also depends on the space available and on the salt filling option, manual or automatic.

Installation scheme and requirements

![Diagram of room installation with a Selcoperm system](image)

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The internal vent tube has to be piped to the exterior of the building. Minimum tube diameter 90 mm. Maximum length of the tubing 10 m. Must be installed without dips and adequately supported to a safe discharge point.</td>
</tr>
<tr>
<td>2</td>
<td>Minimum diameter 32 mm for tubing between the unit and the NaClO solution tank. Tubing from the Tee above the NaClO solution tank in an upward direction until the Venturi Tee.</td>
</tr>
<tr>
<td>3</td>
<td>A Venturi Tee is supplied together with the system to assure the adequate dilution of the exhaust air. It should be mounted as close as possible to the vent discharge point.</td>
</tr>
<tr>
<td>4</td>
<td>The top edge of the brine has to be at least 100 mm above the brine outlet.</td>
</tr>
<tr>
<td>5</td>
<td>Around the electrolysis system, enough space should be left free for operation and maintenance work.</td>
</tr>
<tr>
<td>6</td>
<td>It is recommended that the room has high and low level natural ventilation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Components of the installation</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Selcoperm system</td>
</tr>
<tr>
<td>B</td>
<td>Brine tank</td>
</tr>
<tr>
<td>C</td>
<td>NaClO solution tank</td>
</tr>
<tr>
<td>D</td>
<td>Dosing pumps</td>
</tr>
<tr>
<td>E</td>
<td>Vent tubing</td>
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2. Applications

Drinking water treatment

Fig. 4 Scheme: Drinking water treatment with Selcoperm

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<thead>
<tr>
<th>Legend</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Groundwater</td>
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<tr>
<td>2</td>
<td>Measuring system</td>
</tr>
<tr>
<td>3</td>
<td>Selcoperm electrolysis system</td>
</tr>
<tr>
<td>4</td>
<td>Chemical tank</td>
</tr>
<tr>
<td>5</td>
<td>Oxidation</td>
</tr>
<tr>
<td>6</td>
<td>Filtration</td>
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<tr>
<td>7</td>
<td>Chemical conditioning</td>
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</table>
Swimming pool water treatment

Fig. 5  Scheme: Swimming pool water treatment with Selcoperm

Legend

1  Swimming pool
2  Remote maintenance, logging per PC
3  DIT compact measuring and control system
4  DIT analysing system
5  Selcoperm electrolysis system
6  Dosing station for flocculent (PAC)
7  Dosing station for hypochlorite
8  Dosing station for pH-correction
9  Injection units
10 Surge basin
11 Filter
12 Circulation pump
13 Sample water feeding line
14 Sample water recycling line
3. Construction

Electrolysis cell and hydrogen degassing column
- Installed in a separate chamber with a quantitatively monitored air flow.
- Electrolysis cell (1) in a vertical transparent PVC pipe for easy process monitoring and visual electrode check.
- Electrodes are made of titanium carrier material with a very durable catalytic metallic oxide coating, also suitable for cold water applications of 5 °C and higher.
- The hydrogen degassing column (2) removes the formed hydrogen via the vent hole and prevents it from penetrating the NaClO solution storage tank. The hydrogen is piped through the outlet (I) via a dual contained pipework into the ambient air. In the event of a blockage, an integrated sensor switches off the system.

Hydraulic chamber
- Brine dosing pump (3) with a wide adjustment range for precise dosing of the brine.
- Flowmeter (4) with switch for safe process interruption, if the value falls below its critical minimum.
- Water flow adjustment valve (5) for the reproducible adjustment of the dilution ratio.
- Adjustable pressure reducing valve (6) with pressure reading for the water supply.
- Continuously operating water softener system (7) for the reduction of the water hardness to below 17.8 mg/l (CaCO₃).
- Sample valves for softened water (F), brine (G) and NaClO solution (H).

Control system
- Lockable control panel (10) IP54 with integrated cooling for the high-performance electronics.
- Display (11) with presentation of system status, amperage, voltage, service hours and air flow rate.
- Functions: automatic tank refilling, manual system shutdown or remote Off.
- Display of error messages: low voltage, high voltage, overtemperature electrolysis cell, leakage, overtemperature electronics, ventilation error, water flow error.
- Potential-free alarm contact.

Ventilation
- Air dilution fan (12) with airflow sensor (13).
- Forced ventilation in the electrolysis chamber. At the vent discharge point outside the building dilution of the hydrogen produced.
The turn-key Selcoperm systems are piped, wired, labelled and tested before delivery.
Constructional scheme Selcoperm components

Fig. 6  Constructional scheme Selcoperm - back side and right side

Legend
1  Electrolysis cell
2  Hydrogen degassing column
3  Brine dosing pump
4  Flowmeter
5  Water flow adjustment valve
6  Pressure reducing valve
7  Water softener
8  Level sensor (hydrogen degassing column)
9  Non-return valve
10  Control panel
11  Display
12  Air dilution fan
13  Airflow sensor
A  Inlet water supply
B  Outlet soft water
C1  Inlet brine backflush for water softener
C2  Inlet brine for dosing pump
D  Outlet regeneration water
E  Outlet NaClO solution
F  Soft water sample valve
G  Brine sample valve
H  NaClO solution sample valve
I  Outlet hydrogen gas
**Legend**

1. Electrolysis cell
2. Hydrogen degassing column
3. Brine dosing pump
4. Flowmeter
5. Water flow adjustment valve
6. Pressure reducing valve
7. Water softener
8. Level sensor (hydrogen degassing column)
9. Non-return valve
10. Control panel
11. Display
12. Air dilution fan
13. Airflow sensor

A. Inlet water supply
B. Outlet soft water
C1. Inlet brine backflush for water softener
C2. Inlet brine for dosing pump
D. Outlet regeneration water
E. Outlet NaClO solution
F. Soft water sample valve
G. Brine sample valve
H. NaClO solution sample valve
I. Outlet hydrogen gas

**Fig. 7** Constructional scheme Selcoperm - front side and left side
4. Dimensions

Fig. 8  Dimensions
5. Identification

Type key
Example: SES-250-M/G-GB

<table>
<thead>
<tr>
<th>Example</th>
<th>SES-250-M/G-GB</th>
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Capacity

<table>
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<th>Max.</th>
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<tr>
<td>125</td>
<td>110 g/h</td>
</tr>
<tr>
<td>250</td>
<td>220 g/h</td>
</tr>
<tr>
<td>500</td>
<td>450 g/h</td>
</tr>
<tr>
<td>1000</td>
<td>900 g/h</td>
</tr>
<tr>
<td>2000</td>
<td>1800 g/h</td>
</tr>
</tbody>
</table>

Connection

<table>
<thead>
<tr>
<th>I</th>
<th>imperial</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>metric</td>
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</tbody>
</table>

Supply voltage

<table>
<thead>
<tr>
<th>H</th>
<th>110-120 V, 50/60 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>220-240 V, 50/60 Hz</td>
</tr>
<tr>
<td>K</td>
<td>380-415 V, 50/60 Hz</td>
</tr>
</tbody>
</table>

Display language

<table>
<thead>
<tr>
<th>GB</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>DE</td>
<td>German</td>
</tr>
<tr>
<td>FR</td>
<td>French</td>
</tr>
<tr>
<td>ES</td>
<td>Spanish</td>
</tr>
<tr>
<td>RU</td>
<td>Russian</td>
</tr>
<tr>
<td>PL</td>
<td>Polish</td>
</tr>
</tbody>
</table>
6. Technical data

General data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>Sodium hypochlorite concentration</td>
<td>5 - 6.5 g/l</td>
</tr>
<tr>
<td>Water demand</td>
<td>140-170 litres per kg of prepared chlorine</td>
</tr>
<tr>
<td>Water pressure</td>
<td>3-10 bar</td>
</tr>
<tr>
<td>Salt consumption</td>
<td>4 - 4.5 kg of salt per kg of prepared chlorine</td>
</tr>
<tr>
<td>Soft water quality for operation</td>
<td>Drinking water quality, softened to: 1 °dH / 17.8 ppm CaCO₃ and less</td>
</tr>
<tr>
<td>Connections</td>
<td></td>
</tr>
<tr>
<td>SES-125 mm</td>
<td>DN 15 (Ø 20)</td>
</tr>
<tr>
<td>SES-125 inch</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>SES-250 mm</td>
<td>DN 15 (Ø 20)</td>
</tr>
<tr>
<td>SES-250 inch</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>SES-500 mm</td>
<td>DN 15 (Ø 20)</td>
</tr>
<tr>
<td>SES-500 inch</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>SES-1000 mm</td>
<td>DN 15 (Ø 20)</td>
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<tr>
<td>SES-1000 inch</td>
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<td>SES-2000 mm</td>
<td>DN 15 (Ø 20)</td>
</tr>
<tr>
<td>SES-2000 inch</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>SES Type</td>
<td>Outlet soft water</td>
</tr>
<tr>
<td>SES-125 mm</td>
<td>DN 15 (Ø 20)</td>
</tr>
<tr>
<td>SES-125 inch</td>
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<td>SES-250 mm</td>
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<td>SES-1000 inch</td>
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<td>SES-2000 inch</td>
<td>1/2&quot;</td>
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</table>

Weight

<table>
<thead>
<tr>
<th>SES Type</th>
<th>Gross weight [kg]</th>
<th>Net weight [kg]</th>
</tr>
</thead>
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<tr>
<td>125</td>
<td>299</td>
<td>160</td>
</tr>
<tr>
<td>250</td>
<td>309</td>
<td>170</td>
</tr>
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<td>500</td>
<td>319</td>
<td>180</td>
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<tr>
<td>1000</td>
<td>334</td>
<td>195</td>
</tr>
<tr>
<td>2000</td>
<td>349</td>
<td>210</td>
</tr>
</tbody>
</table>

Water quality specification

The water supply must be in accordance with the required standard of drinking water given in the specification below. Ask your local water supplier for the specific values.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value (maximum unless stated otherwise)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>[mg/l Pt/Co] 20</td>
</tr>
<tr>
<td>pH value</td>
<td>6.5 - 10.0</td>
</tr>
<tr>
<td>Iron Fe</td>
<td>[µg/l] 200</td>
</tr>
<tr>
<td>Manganese Mn</td>
<td>[µg/l] 20</td>
</tr>
<tr>
<td>Fluoride F</td>
<td>[mg/l] 2</td>
</tr>
<tr>
<td>Turbidity</td>
<td>[NTU] 4</td>
</tr>
<tr>
<td>Max. particle size</td>
<td>[µm] 100</td>
</tr>
</tbody>
</table>

Salt specification

Use food-grade granular/pellet salt (98.5 % NaCl) according to EN 14805 type 2 with following minimum requirements:

Max. limits of dry salt.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Max. mass fraction [mg/kg]</th>
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</thead>
<tbody>
<tr>
<td>Iron</td>
<td>Fe</td>
<td>10.0</td>
</tr>
<tr>
<td>Manganese</td>
<td>Mn</td>
<td>10.0</td>
</tr>
<tr>
<td>Bromide</td>
<td>Br</td>
<td>100.0</td>
</tr>
<tr>
<td>Calcium</td>
<td>Ca</td>
<td>100.0</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Mg</td>
<td>100.0</td>
</tr>
</tbody>
</table>
7. Product selection

Product selection diagram

Fig. 9 Selcoperm selection diagram

Dimensioning

Standard Selcoperm systems are available in five capacity levels. The choice of the system depends on the maximum daily chlorine demand (dosing quantity multiplied by daily maximum water flow rate).
## Product selection table

<table>
<thead>
<tr>
<th>Generation capacity [g/h]</th>
<th>Voltage [V]</th>
<th>Frequency [Hz]</th>
<th>Phases</th>
<th>Power consumption [VA]</th>
<th>Connections</th>
<th>Language</th>
<th>Type key</th>
<th>Product number</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>220-240</td>
<td>50/60</td>
<td>1</td>
<td>1500</td>
<td>mm</td>
<td>GB</td>
<td>SES-125-M/GB</td>
<td>95732227</td>
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<tr>
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8. Accessories

Brine tank
For the production of a saturated salt solution.
- Material: Polyethylene
- With water inlet valve
- With gravel bed

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<th>Salt capacity [kg]</th>
<th>Diameter [mm]</th>
<th>Height [mm]</th>
<th>Weight (tank + gravel) [kg]</th>
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<td>231</td>
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NaClO solution storage tank with collecting tray
For storage of the hypochlorite solution.
- Tank material: Polyethylene
- Collecting tray material: Polypropylene
- Integrated float switch
- Connection box for easy connection with Selcoperm.

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Large NaClO solution storage tank without collecting tray
For storage of the hypochlorite solution.
- Material: Polyethylene
- With float switch
- Connection box for easy connection with Selcoperm.

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<th>Volume [l]</th>
<th>Diameter [mm]</th>
<th>Height [mm]</th>
<th>Length [mm]</th>
<th>Weight [kg]</th>
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Test kit
Test kit for SES, comprising:
• Measuring cylinder
• Total hardness test for titrimetric determination of the water hardness
• Thermometer
• Spindle for density measurement
• Titration set for measurement of the chlorine concentration in the sodium hypochlorite solution
• Laminated instruction sheet

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<td>Test kit</td>
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Acid rinsing set
• For cleaning the electrolysis cell in case of deposits.

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Compact photometer DIT-L
• For quick determination of the concentration of chlorine, chlorine dioxide or ozone as well as the pH in water.
• For details, please see the DIT-L data booklet.

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<td>Chlorine dioxide</td>
<td>0.02 - 11 mg/l</td>
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<td>pH value</td>
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Maintenance kit
• The maintenance kit includes parts for maintenance after two years (maintenance kit for brine pump and for Selcoperm).

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9. Grundfos Product Center

Online search and sizing tool to help you make the right choice.

http://product-selection.grundfos.com

SIZING enables you to size a pump based on entered data and selection choices.

REPLACEMENT enables you to find a replacement product. Search results will include information on
- the lowest purchase price
- the lowest energy consumption
- the lowest total life cycle cost.

CATALOGUE gives you access to the Grundfos product catalogue.

LIQUIDS enables you to find pumps designed for aggressive, flammable or other special liquids.

All the information you need in one place
Performance curves, technical specifications, pictures, dimensional drawings, motor curves, wiring diagrams, spare parts, service kits, 3D drawings, documents, system parts. The Product Center displays any recent and saved items - including complete projects - right on the main page.

Downloads
On the product pages, you can download installation and operating instructions, data booklets, service instructions, etc. in PDF format.

Subject to alterations.