Selcoperm SES

Electrolysis system for 110-1800 g/h Cl_2 (equivalent)

Safe and simple production of sodium hypochlorite solution

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Table of contents

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.

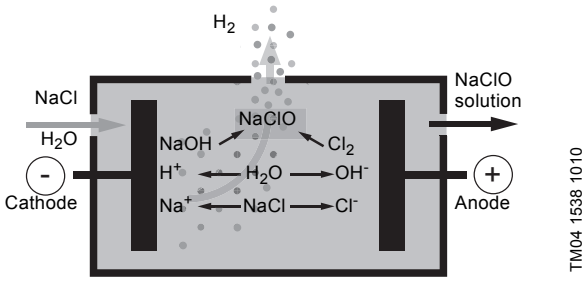

Fig. 1 Selcoperm electrolysis principle

The following reactions take place in the electrolysis cell:

$$2NaCl + 2H_2O \rightarrow 2NaOH + Cl_2 + H_2$$

The chlorine (Cl_2) produced reacts immediately with the caustic soda solution (NaOH) also formed, resulting in a sodium hypochlorite solution (NaClO):

$$Cl_2 + 2NaOH \leftrightarrow NaCl + NaClO + H_2O$$

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:

$$NaClO + H_2O \leftrightarrow NaOH + HClO$$

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:

$$HClO + H_2O \leftrightarrow H_3O^+ + ClO^-$$

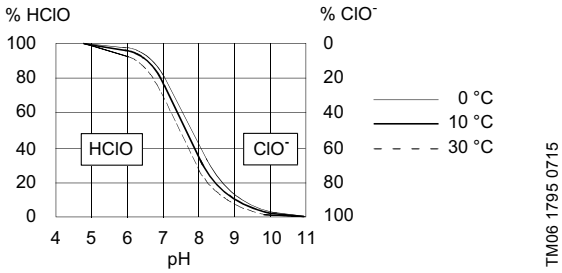

Fig. 2 Dissociation of hypochlorous acid in dependence of the water pH value

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

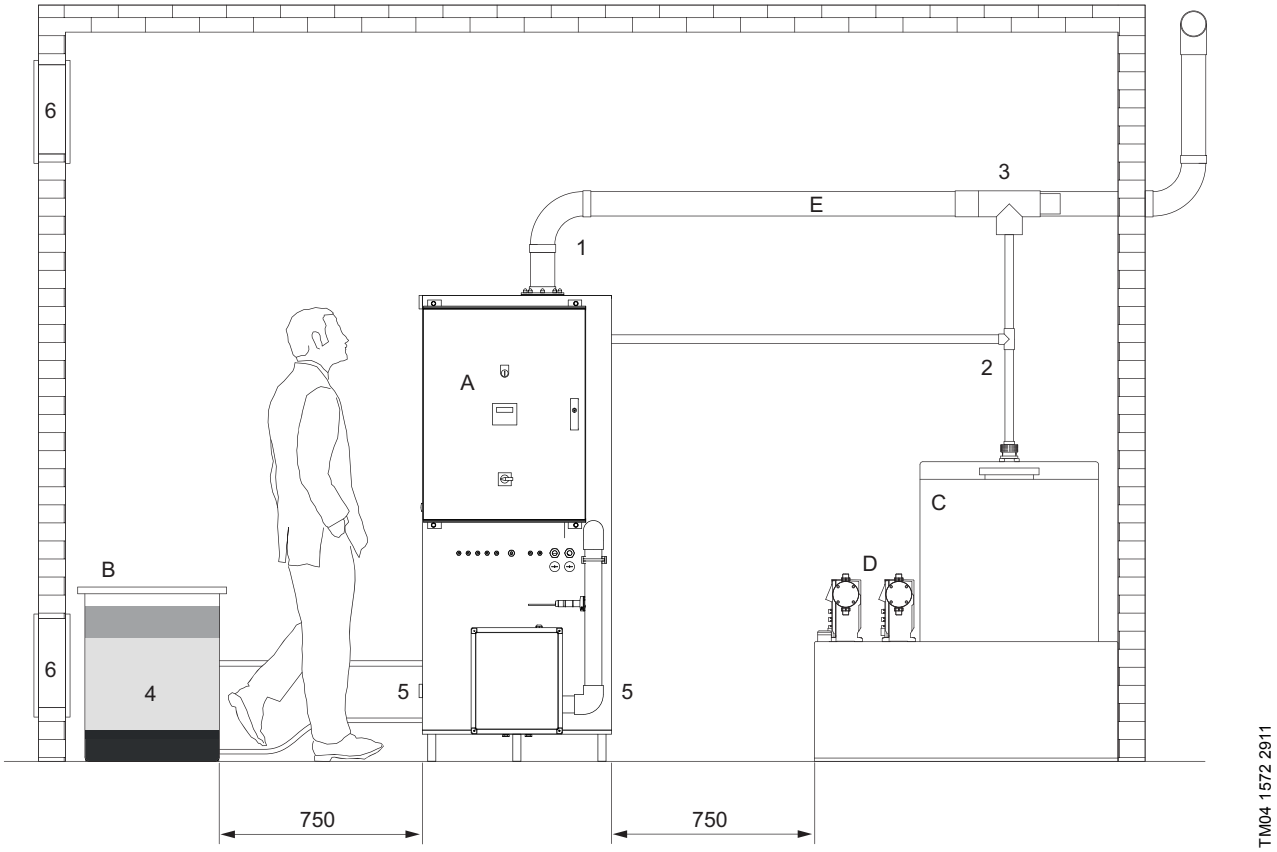

Fig. 3 Room installation with a Selcoperm system

Pos.	Description
1	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.
2	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.
3	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.
4	The top edge of the brine has to be at least 100 mm above the brine outlet.
5	Around the electrolysis system, enough space should be left free for operation and maintenance work.
6	It is recommended that the room has high and low level natural ventilation.

Pos.	Components of the installation
A	Selcoperm system
B	Brine tank
C	NaClO solution tank
D	Dosing pumps
E	Vent tubing

2. Applications

Drinking water treatment

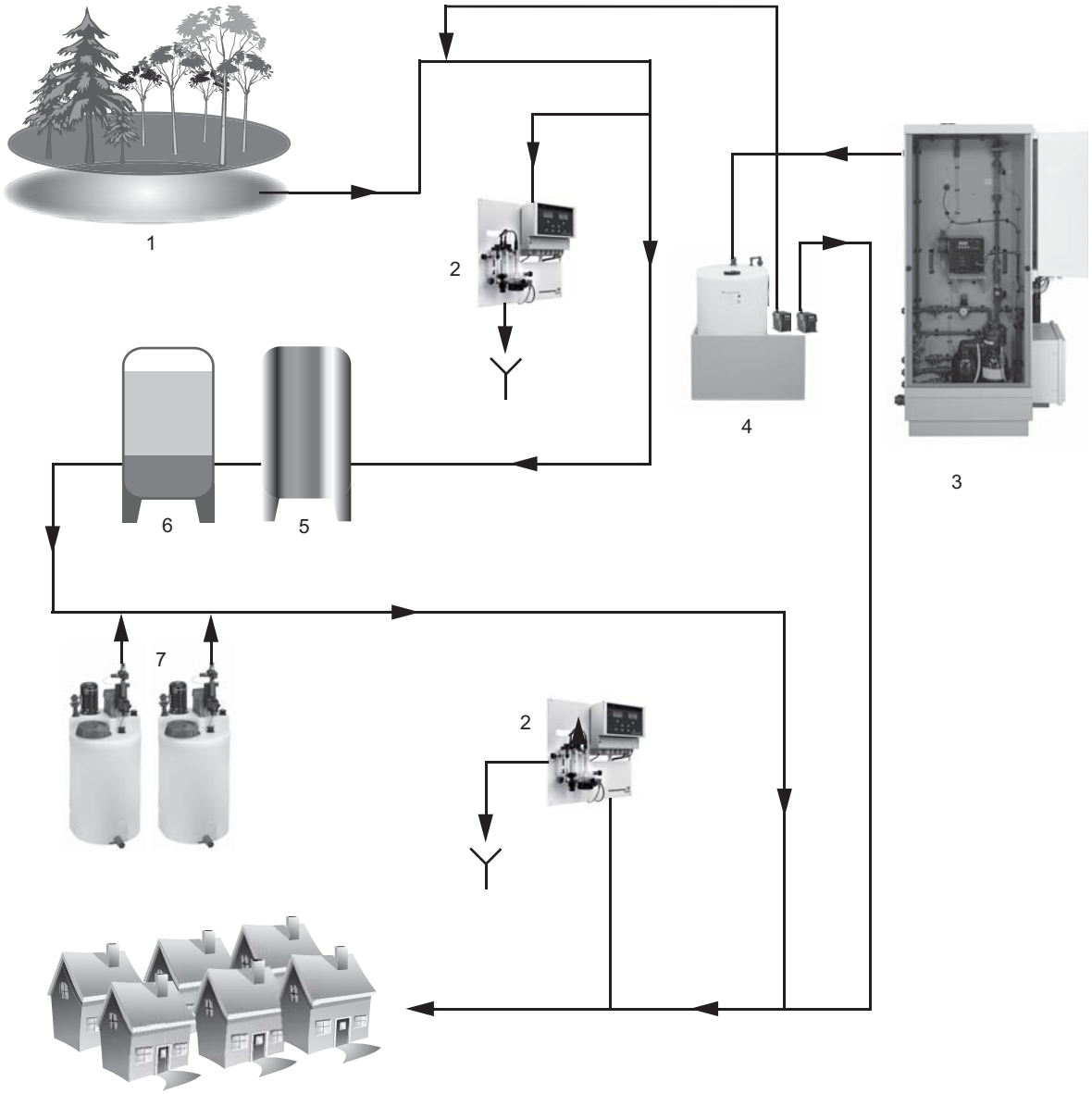

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Fig. 4 Scheme: Drinking water treatment with Selcoperm

Legend	
1	Groundwater
2	Measuring system
3	Selcoperm electrolysis system
4	Chemical tank
5	Oxidation
6	Filtration
7	Chemical conditioning

Swimming pool water treatment

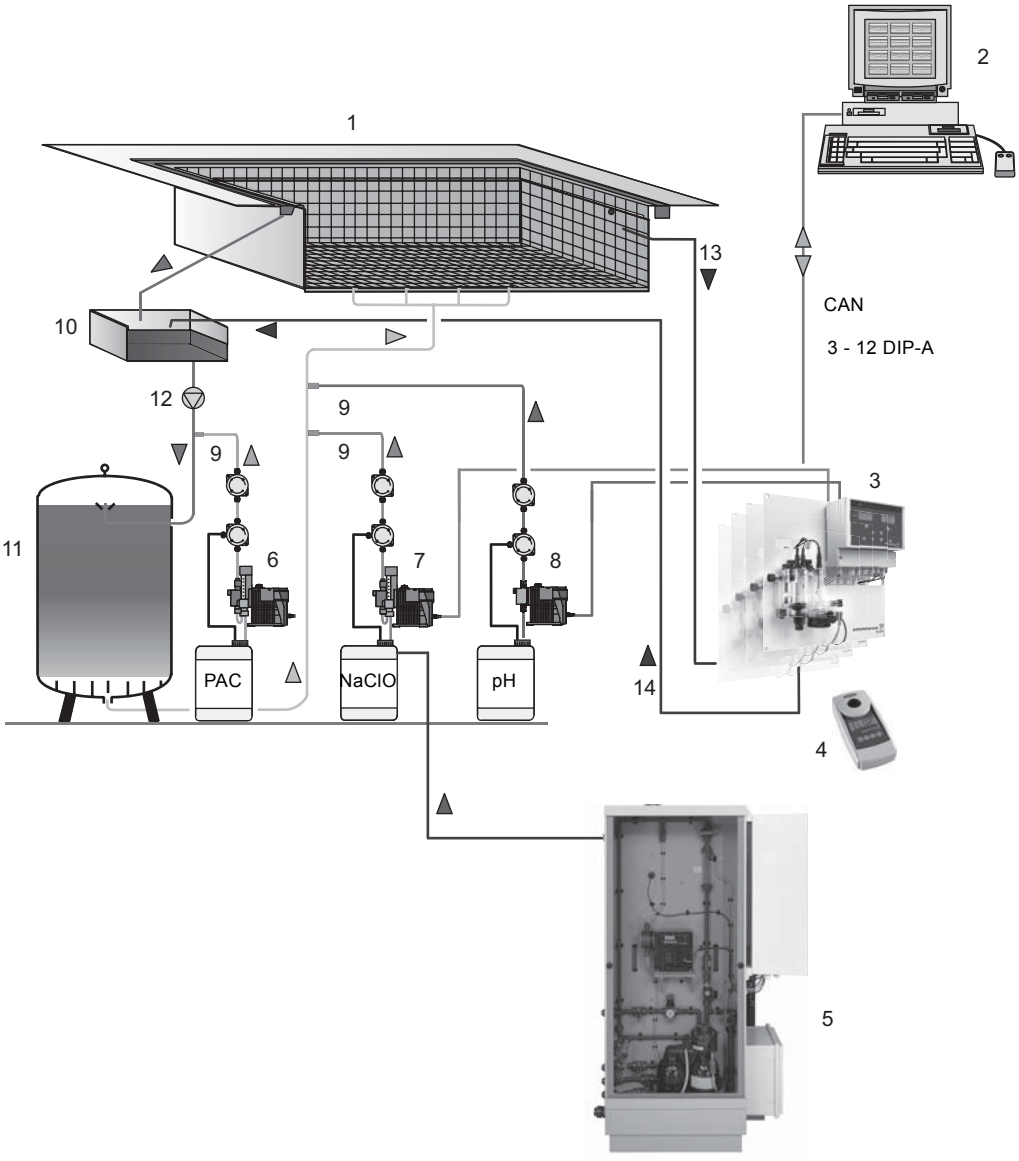


Fig. 5 Scheme: Swimming pool water treatment with Selcoperm

Legend	
1	Swimming pool
2	Remote maintenance, logging per PC
3	DIP 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 ($CaCO_3$).
- 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

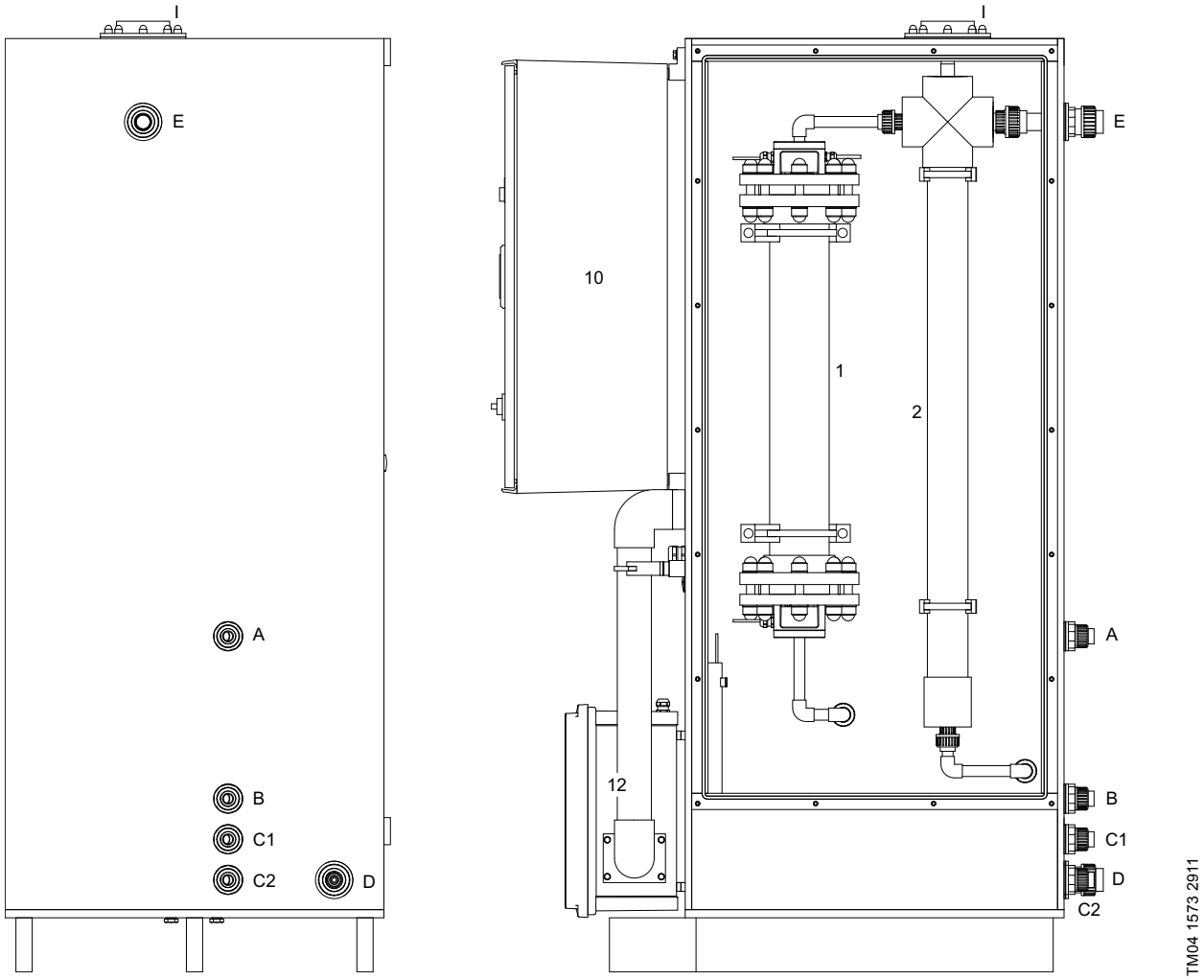


Fig. 6 Constructional scheme Selcoperm - back side and right side

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

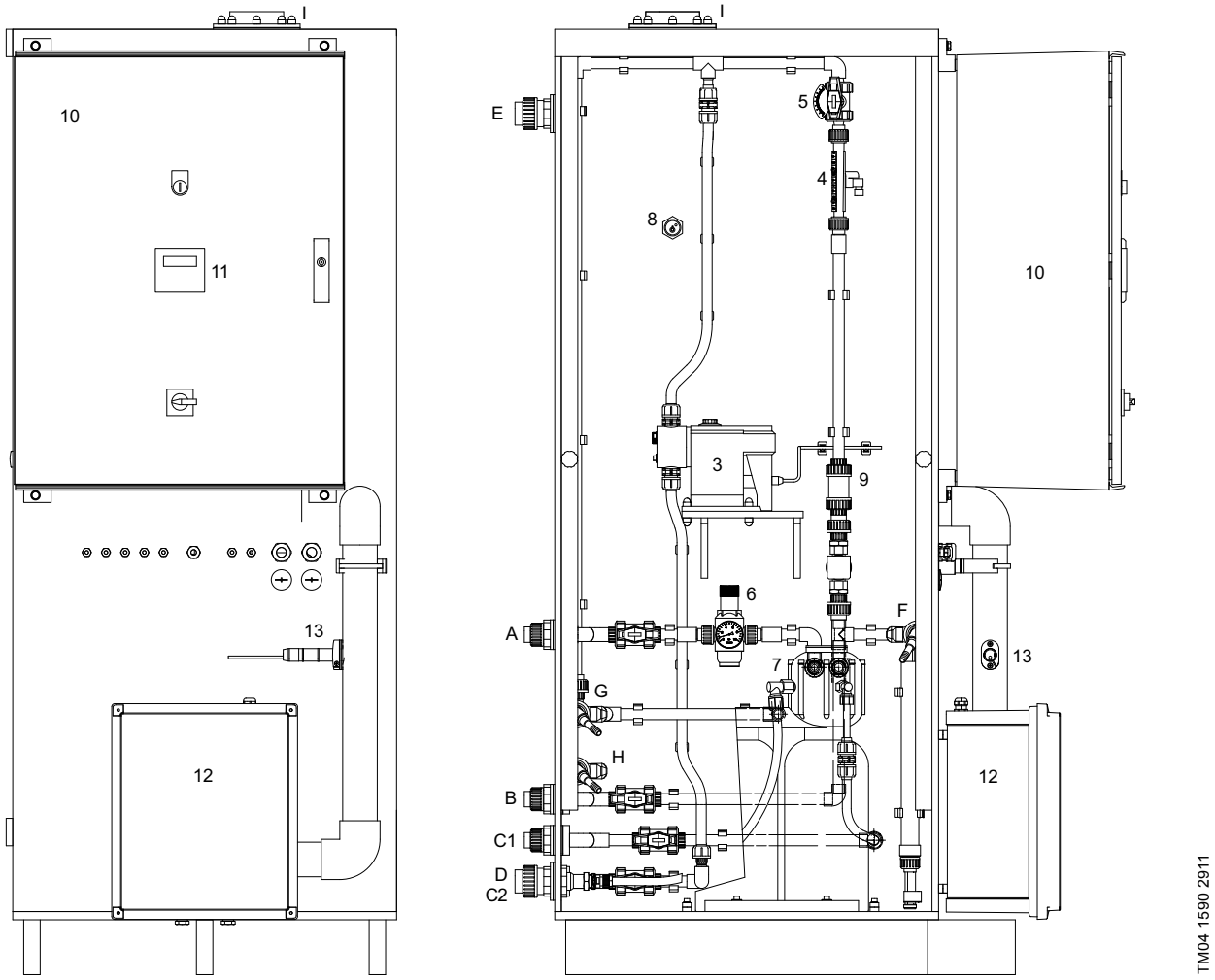


Fig. 7 Constructional scheme Selcoperm - front side and left side

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

4. Dimensions

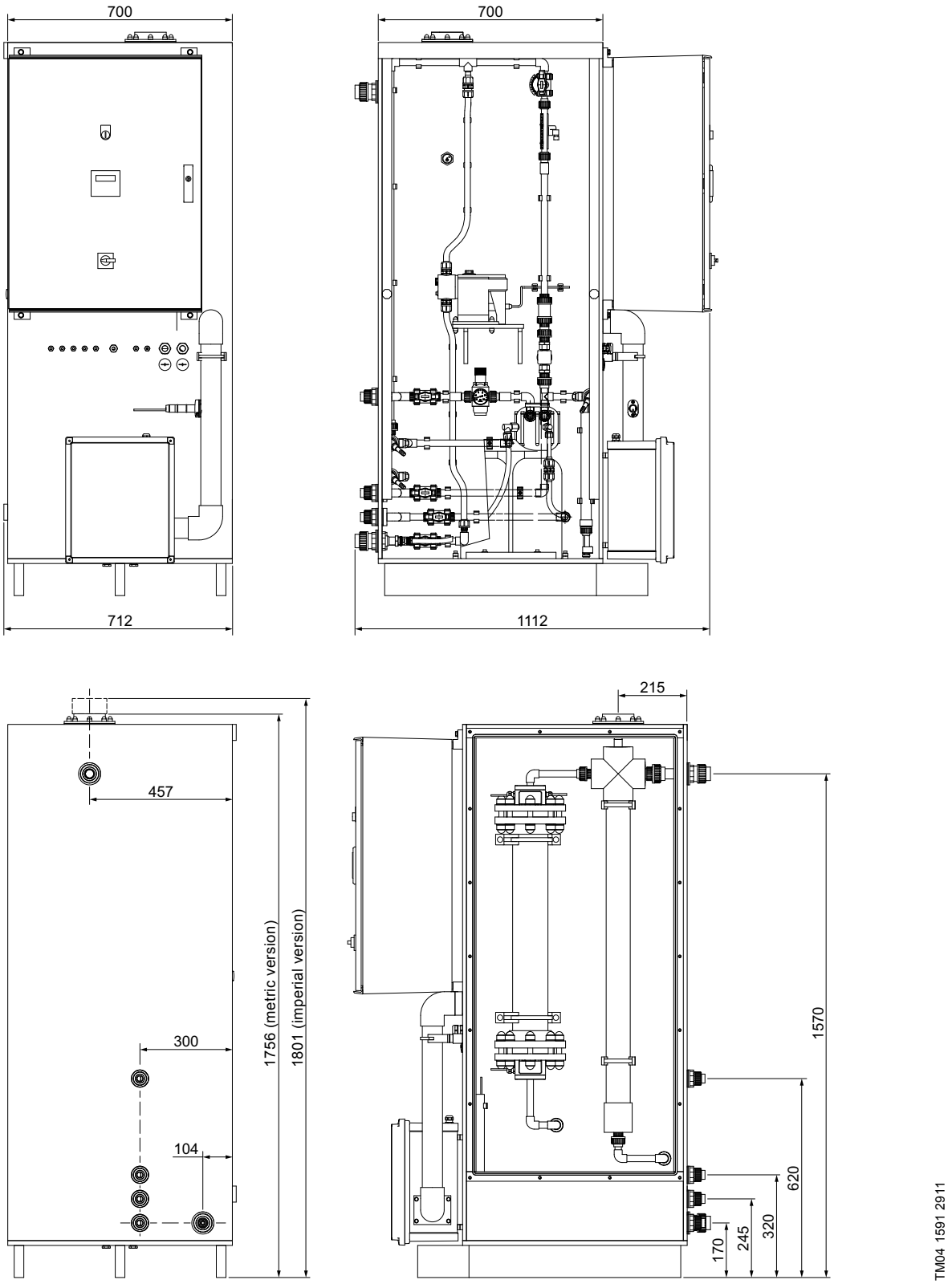


Fig. 8 Dimensions

5. Identification

Type key

Example: SES-250-M/G-GB

Example		SES	-250	-M	/G	-GB
Capacity						
Max.	**Nominal**					
125	110 g/h					
250	220 g/h					
500	450 g/h					
1000	900 g/h					
2000	1800 g/h					
Connection						
I	imperial					
M	metric					
Supply voltage						
H	110-120 V, 50/60 Hz					
G	220-240 V, 50/60 Hz					
K	380-415 V, 50/60 Hz					
Display language						
GB	English					
DE	German					
FR	French					
ES	Spanish					
RU	Russian					
PL	Polish					

6. Technical data

General data

Sodium hypochlorite concentration	5 - 6.5 g/l
Water demand	140-170 litres per kg of prepared chlorine
Water pressure	3-10 bar For lower water pressures, booster pumps are available
Salt consumption	4 - 4.5 kg of salt per kg of prepared chlorine
Soft water quality for operation	Drinking water quality, softened to: 1 °dH / 17.8 ppm $CaCO_3$ and less
Electrical connection	SES-125: 110-120 V or 220-240 V SES-250: 220-240 V SES-500, -1000, -2000: 380-415 V
Power consumption (AC)	Approx. 5.5 - 6.5 kWh per kg of prepared chlorine
Drain	An on-site drain for the regeneration water of the water softener is required.
Exhaust air	• The outlet of the exhaust air has to be as close as possible to the Selcoperm system. • In addition, natural air supply via a ventilation hole in the room is required.

Temperatures and humidity

Max. relative humidity, non-condensing	[%]	80
Permissible ambient temperature	[°C]	+5 to +40
Permissible mains water operating temperature	[°C]	+10 to +20
Transport and storage temperature, drained and not connected*	[°C]	-5 to +50
Max. altitude above sea level	[m]	2000

* For storage temperatures below +5 °C, the whole system including water softener, lines and external components must not contain any water.

Weight

SES Type	125	250	500	1000	2000
Gross weight [kg]	299	309	319	334	349
Net weight [kg]	160	170	180	195	210

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.

Parameters	Value (maximum unless stated otherwise)	
Colour	[mg/l Pt/Co]	20
pH value		6.5 - 10.0
Iron Fe	[µg/l]	200
Manganese Mn	[µg/l]	20
Fluoride F	[mg/l]	2
Turbidity	[NTU]	4
Max. particle size	[µm]	100

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.

Parameter	Symbol	Max. mass fraction [mg/kg]
Iron	Fe	10.0
Manganese	Mn	10.0
Bromide	Br	100.0
Calcium	Ca	100.0
Magnesium	Mg	100.0

Connections

SES Type	Inlet water	Outlet soft water	Inlet brine - water softener	Inlet brine - dosing pump	Outlet regeneration water	Outlet NaClO solution	Hydrogen gas outlet
SES-125 [mm]	DN 15 (∅20)	DN 15 (∅20)	DN 15 (∅20)	DN 15 (∅20)	DN 25 (∅32)	DN 25 (∅32)	∅90
SES-125 [inch]	1/2"	1/2"	1/2"	1/2"	1"	1"	3"
SES-250 [mm]	DN 15 (∅20)	DN 15 (∅20)	DN 15 (∅20)	DN 15 (∅20)	DN 25 (∅32)	DN 25 (∅32)	∅90
SES-250 [inch]	1/2"	1/2"	1/2"	1/2"	1"	1"	3"
SES-500 [mm]	DN 15 (∅ 0)	DN 15 (∅20)	DN 15 (∅20)	DN 15 (∅20)	DN 25 (∅32)	DN 25 (∅32)	∅90
SES-500 [inch]	1/2"	1/2"	1/2"	1/2"	1"	1"	3"
SES-1000 [mm]	DN 15 (∅20)	DN 15 (∅20)	DN 15 (∅20)	DN 15 (∅20)	DN 25 (∅32)	DN 25 (∅32)	∅90
SES-1000 [inch]	1/2"	1/2"	1/2"	1/2"	1"	1"	3"
SES-2000 [mm]	DN 15 (∅ 0)	DN 15 (∅20)	DN 15 (∅20)	DN 15 (∅20)	DN 25 (∅32)	DN 25 (∅32)	∅90
SES-2000 [inch]	1/2"	1/2"	1/2"	1/2"	1"	1"	3"

7. Product selection

Product selection diagram

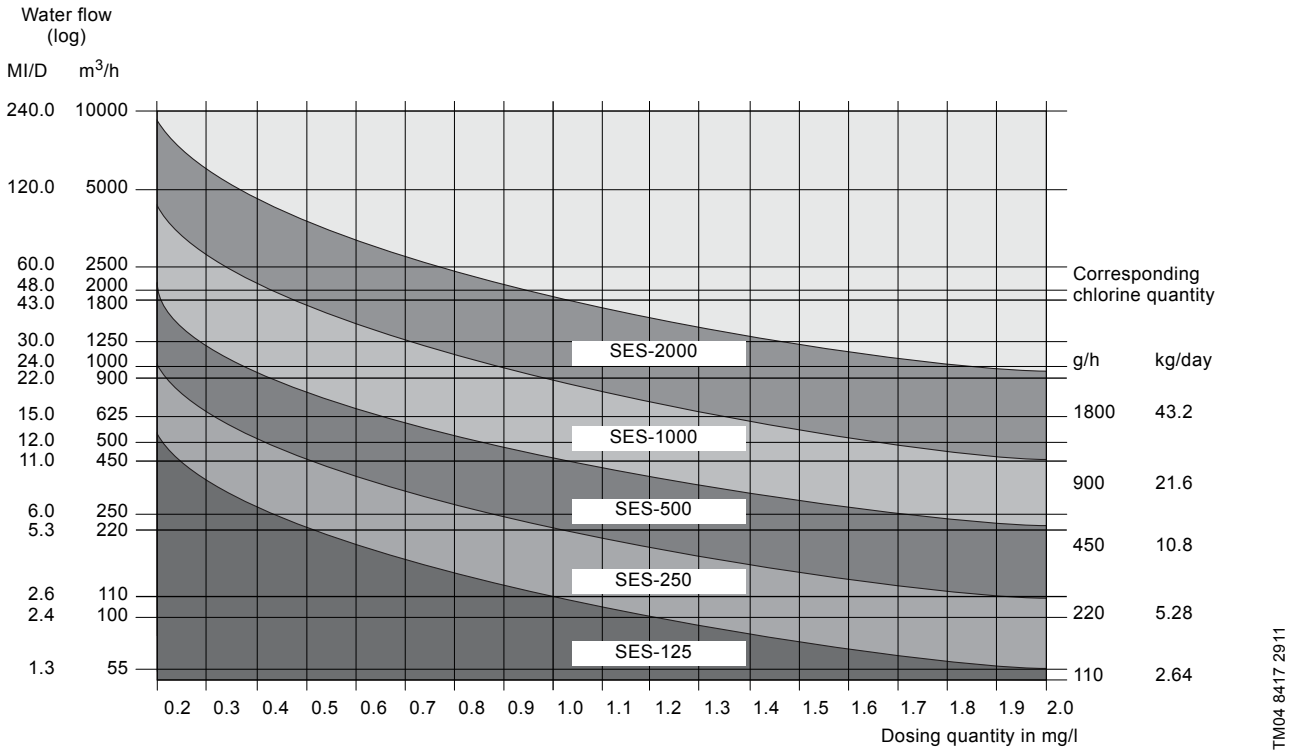


Fig. 9 Selcoperm selection diagram

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

Generation capacity [g/h]	Voltage [V]	Frequency [Hz]	Phases	Power consumption [VA]	Connections	Language	Type key	Product number
110	220-240	50/60	1	1500	mm	DE	SES-125-M/G-DE	95732227
						GB	SES-125-M/G-GB	95732228
						FR	SES-125-M/G-FR	95732229
						RU	SES-125-M/G-RU	95732230
						ES	SES-125-M/G-ES	95732231
						PL	SES-125-M/G-PL	95733367
	110-120	50/60	1	1500	mm	GB	SES-125-M/H-GB	95732232
						FR	SES-125-M/H-FR	95732233
						ES	SES-125-M/H-ES	95732234
	220-240	50/60	1	1500	inch	DE	SES-125-I/G-DE	95732235
						GB	SES-125-I/G-GB	95732236
						FR	SES-125-I/G-FR	95732237
						RU	SES-125-I/G-RU	95732238
						ES	SES-125-I/G-ES	95732239
	110-120	50/60	1	1500	inch	GB	SES-125-I/H-GB	95732240
						FR	SES-125-I/H-FR	95732241
						ES	SES-125-I/H-ES	95732242
220	220-240	50/60	1	2500	mm	DE	SES-250-M/G-DE	95732243
						GB	SES-250-M/G-GB	95732244
						FR	SES-250-M/G-FR	95732245
						RU	SES-250-M/G-RU	95732246
						ES	SES-250-M/G-ES	95732247
						PL	SES-250-M/G-PL	95733368
					inch	DE	SES-250-I/G-DE	95732251
						GB	SES-250-I/G-GB	95732252
						FR	SES-250-I/G-FR	95732253
						RU	SES-250-I/G-RU	95732254
						ES	SES-250-I/G-ES	95732255
450	380-415	50/60	3	4500	mm	DE	SES-500-M/K-DE	95732264
						GB	SES-500-M/K-GB	95732265
						FR	SES-500-M/K-FR	95732266
						RU	SES-500-M/K-RU	95732267
						ES	SES-500-M/K-ES	95732268
						PL	SES-500-M/K-PL	95733375
					inch	DE	SES-500-I/K-DE	95732274
						GB	SES-500-I/K-GB	95732275
						FR	SES-500-I/K-FR	95732276
						RU	SES-500-I/K-RU	95732277
						ES	SES-500-I/K-ES	95732278
900	380-415	50/60	3	8800	mm	DE	SES-1000-M/K-DE	95732279
						GB	SES-1000-M/K-GB	95732280
						FR	SES-1000-M/K-FR	95732281
						RU	SES-1000-M/K-RU	95732282
						ES	SES-1000-M/K-ES	95732283
						PL	SES-1000-M/K-PL	95733370
					inch	DE	SES-1000-I/K-DE	95732284
						GB	SES-1000-I/K-GB	95732285
						FR	SES-1000-I/K-FR	95732286
						RU	SES-1000-I/K-RU	95732287
						ES	SES-1000-I/K-ES	95732288
1800	380-415	50/60	3	14700	mm	DE	SES-2000-M/K-DE	95732289
						GB	SES-2000-M/K-GB	95732290
						FR	SES-2000-M/K-FR	95732291
						RU	SES-2000-M/K-RU	95732292
						ES	SES-2000-M/K-ES	95732293
						PL	SES-2000-M/K-PL	95733371
					inch	DE	SES-2000-I/K-DE	95732294
						GB	SES-2000-I/K-GB	95732295
						FR	SES-2000-I/K-FR	95732296
						RU	SES-2000-I/K-RU	95732297
						ES	SES-2000-I/K-ES	95732298

8. Accessories

Brine tank

For the production of a saturated salt solution.

- Material: Polyethylene
- With water inlet valve
- With gravel bed

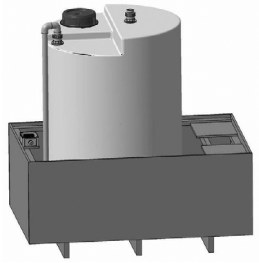
TM04 1569 2911

Salt capacity [kg]	Diameter [mm]	Height [mm]	Weight (tank + gravel) [kg]	Connections		Product number
				Inlet [mm]	Outlets [mm]	
150	500	740	36	20	2 x 20	95714317
300	550	1020	73	20	2 x 20	95714318
500	770	1030	112	20	2 x 20	95714319
1000	1050	1040	231	20	2 x 20	95714320

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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Tank	Connections		Collecting tray			Total height [mm]	Total weight [kg]	Product number
Volume [l]	Inlet [mm]	Outlets [mm]	Height [mm]	Width [mm]	Depth [mm]			
300	32	2 x 25	500	1180	790	1218	60	98028290
500	32	2 x 25	590	1300	910	1368	81	95732608
1000	32	2 x 25	680	1600	1200	1389	134	98028286
2 x 500	32	2 x 25	670	2150	915	1503	143	98028287

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.

TM04 1570 2911

Volume [l]	Diameter [mm]	Height [mm]	Length [mm]	Weight [kg]	Connections		Product number
					Inlet [mm]	Outlet [mm]	
2000	1300	1400	1700	66	32	40	98028288
3000	1500	1600	1900	92	32	40	98028289
5000	2250	1700	-	137	32	40	95732696

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

Description	Product No.
Test kit	98842487

Acid rinsing set

- For cleaning the electrolysis cell in case of deposits.

Description	Product No.
Acid rinsing set comprising a manual acid rinsing pump with hose	95702377

TM04 1549 1010

Fig. 10 Acid rinsing pump

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.

TM04 8418 2711

Fig. 11 DIT photometer

Parameter	Measuring range
Chlorine	0.01 - 6 mg/l
Chlorine dioxide	0.02 - 11 mg/l
Ozone	0.02 - 2 mg/l
pH value	6.5 - 8.4 pH

Maintenance kit

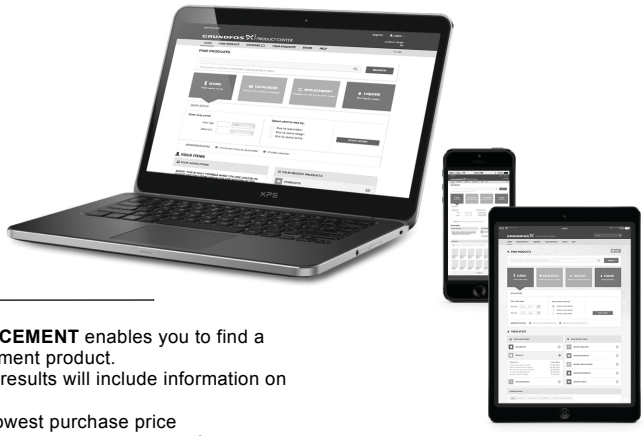
- The maintenance kit includes parts for maintenance after two years (maintenance kit for brine pump and for Selcoperm).

Description	Product No.
Maintenance kits for Selcoperm systems before 2010	
Maintenance kit for Selcoperm 125 to 500	95702281
Maintenance kit for Selcoperm 1000 to 2000	95702282
Maintenance kits for Selcoperm systems from 2011	
Maintenance kit for Selcoperm 125 to 500	98045877
Maintenance kit for Selcoperm 1000 to 2000	98045899
Maintenance kits for Selcoperm systems from 2012	
Maintenance kit for Selcoperm 125 to 500	98047506
Maintenance kit for Selcoperm 1000 to 2000	98047507

9. Grundfos Product Center

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

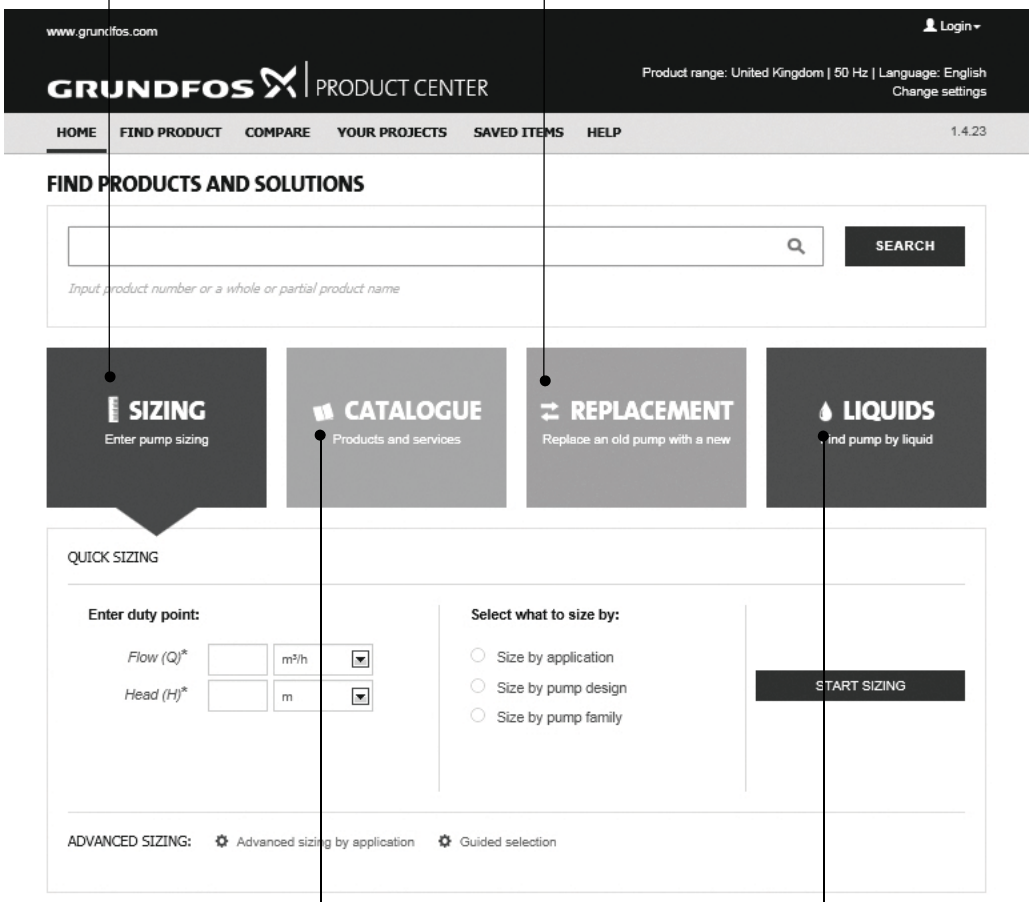
http://product-selection.grundfos.com



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.

be think innovate

95725540 1115
ECM: 1170105

GRUNDFOS A/S
DK-8850 Bjerringbro . Denmark
Telephone: +45 87 50 14 00
www.grundfos.com

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