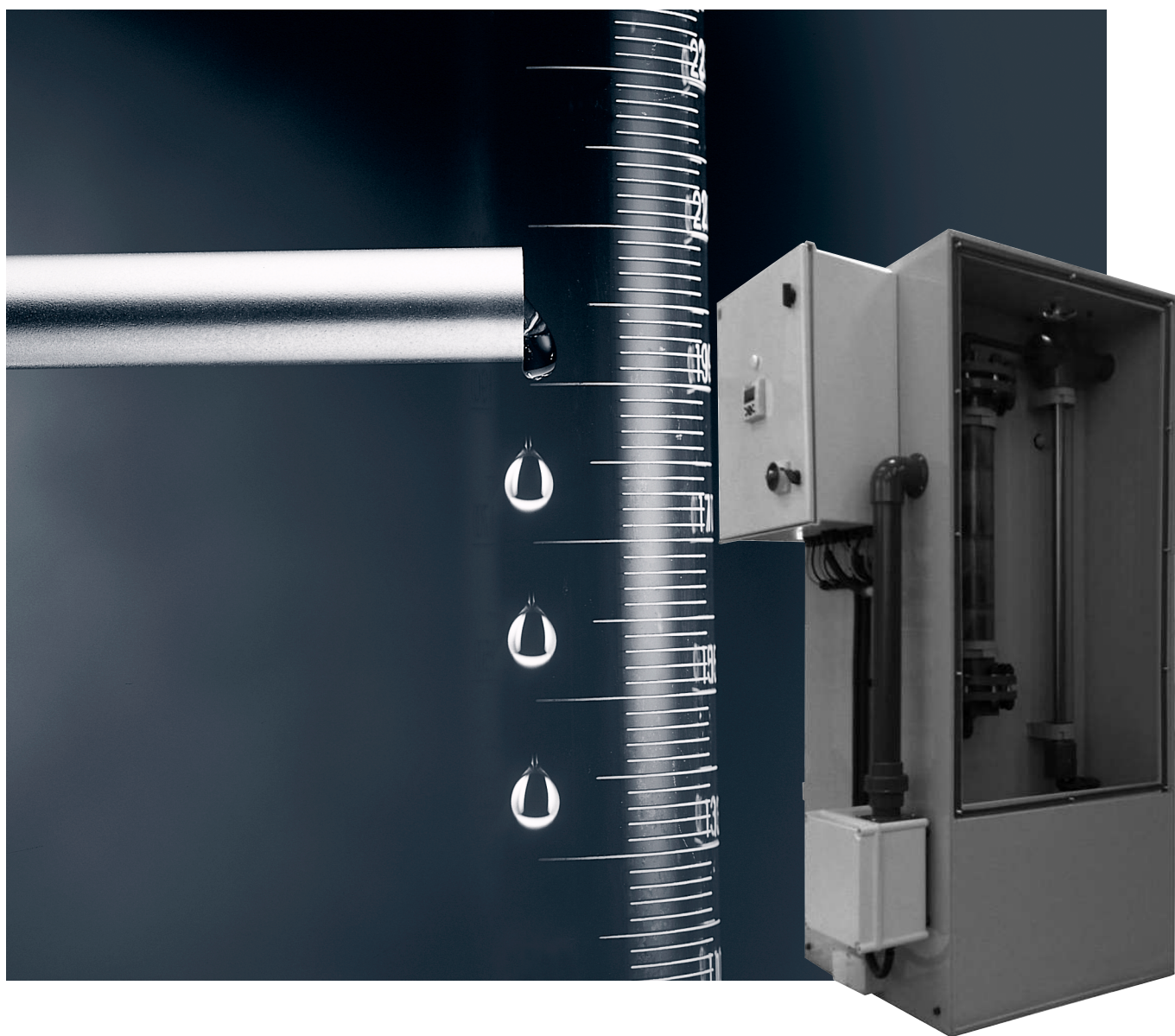


Selcoperm

Electrolytic chlorination systems



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- It is our mission - the basis of our existence - to successfully develop, produce and sell high-quality pumps and pumping systems world-wide, contributing to a better quality of life and a healthy environment



Bjerringbro, Denmark



Fresno, California



Olathe, Kansas



Monterrey, Mexico



Allentown, Pennsylvania



Oakville, Ontario

- One of the 3 largest pump companies in the world
- The second largest manufacturer of submersible motors in the world
- World's largest manufacturer of circulator pumps
- World headquarters in Denmark
- North American headquarters in Kansas City - Manufacturing in Fresno, California
- 80 companies in 45 countries
- More than 16 million motors and pumps produced annually worldwide
- North American companies operating in USA, Canada and Mexico
- Continuous reinvestment in growth and development enables the company to **BE** responsible, **THINK** ahead, and **INNOVATE**

Introduction

Many diseases are transmitted by drinking water. Among these diseases are typhus, paratyphoid, cholera and diarrhea 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 to disinfect it.

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. Historically, in bacteriological terms, chlorinating is a safe way of disinfecting drinking water. More than 75 years have passed since chlorine was first used to disinfect drinking water. Experience has proven that acute toxicity can be avoided, when chlorination is executed correctly.

The disinfecting properties of chlorine are based on the fact that hypochlorous acid (HClO) is produced when it is dissolved in water, according to the equation



and depend strongly on the pH value. The best effect is obtained with pH values less than 7.5.

Generally, three methods are used for chlorinating drinking and process water:

1. Chlorine gas dosing
2. Dosing of sodium or calcium hypochlorite solution
3. Electrolytic chlorine generation

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

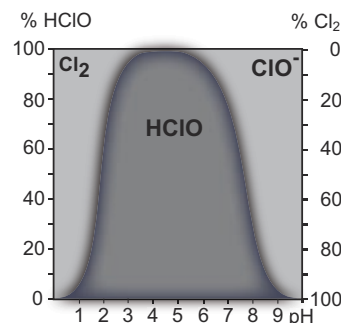


Fig. 1 Dissociation of hypochlorous acid in dependence of the pH value

The Selcoperm electrolysis principle

With electrolysis, chlorine is produced directly from a solution of common salt using electricity.

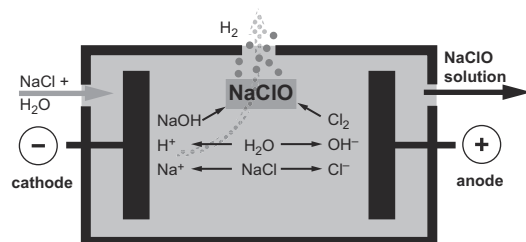
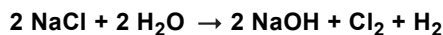


Fig. 2 Reactions in the electrolytic cell

The following reactions take place in the electrolytic cell:



The chlorine produced reacts immediately with the caustic soda solution also formed, resulting in a hypochlorite solution:



The solution generated has a pH value between 8.5 and 9.5, and a maximum equivalent chlorine concentration in the range of 6 - 8 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, for example, in membrane electrolysis. The sodium hypochlorite solution reacts in a balance reaction, resulting in hypochlorous acid, the efficient disinfectant:



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

Features and benefits

Selcoperm electrolytic chlorination systems provide these unique selling points:

- Robust turn-key system
- Safe and reliable method of producing chlorine on site
- Common salt, the base material, is nontoxic, easy to store and to handle.
- Only water, common salt and electricity are needed for the electrolysis, resulting in low operating costs, worldwide use
- Fresh hypochlorite is always on hand – the disinfectant solution does not dissociate like commercial hypochlorite solutions
- Lower formation of chlorate as a by-product
- Approved disinfection method complying with the DWI drinking water regulations – an alternative with less safety requirements to chlorine-gas-based systems
- Durable, elementary components for low maintenance and a long service life, compared with membrane cell electrolysis
- Lower pH of product compared with commercial sodium hypochlorite reduces scaling of injection points etc. in hard water areas.
- Quantitative airflow – air is blown continuously through the electrolyzer 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 plant room.
- No external risk zone – fully compliant with ATEX.
- Negative pressure on product 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 product tank is safely removed to atmosphere.
- Product solution with 6-8 g/l chlorine concentration can be stored for several weeks without any degradation.

System components

(For more details, see section *Construction* on page 10.)

Selcoperm units components are:

- electrolyzer
- degassing column
- brine dosing pump
- exhaust fan with quantitative air flow monitor for air dilution of electrolyzer chamber
- water softening system.

Additional required equipment:

- salt saturator
- product tank for storage of the generated solution
- 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 product 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 buffer storage required.
- The size of the brine tank also depends on the space available and on the salt filling option, manual or automatic.

Applications

Selcoperm systems typically fit disinfection applications such as:

- drinking water treatment
- swimming pool water treatment
- industrial treatment for cooling towers or process water.
- The systems are an excellent alternative to chlorine-gas or commercial hypochlorite applications.
- See the application examples on pages 6 and 7.

Example of Selcoperm in drinking water treatment application

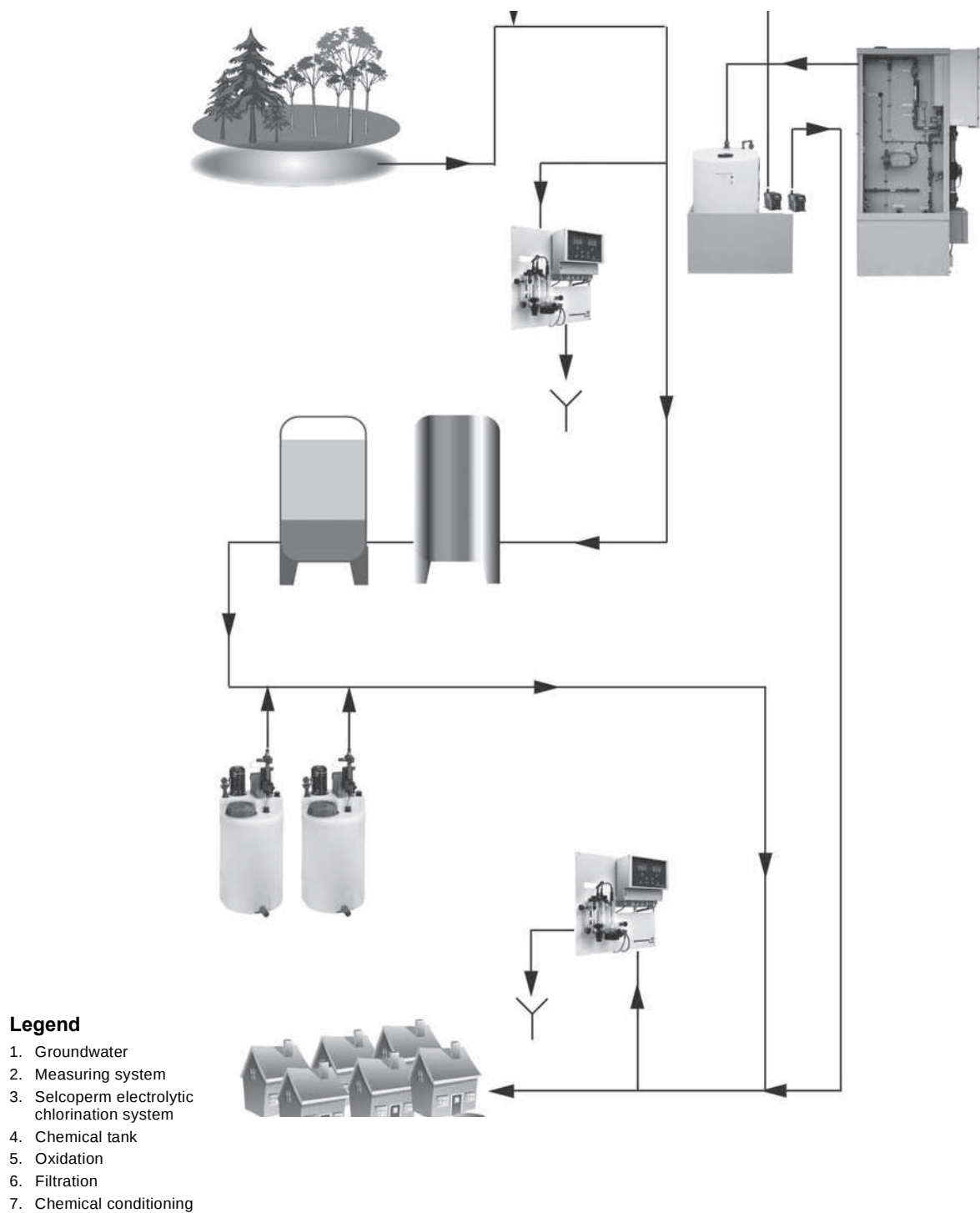
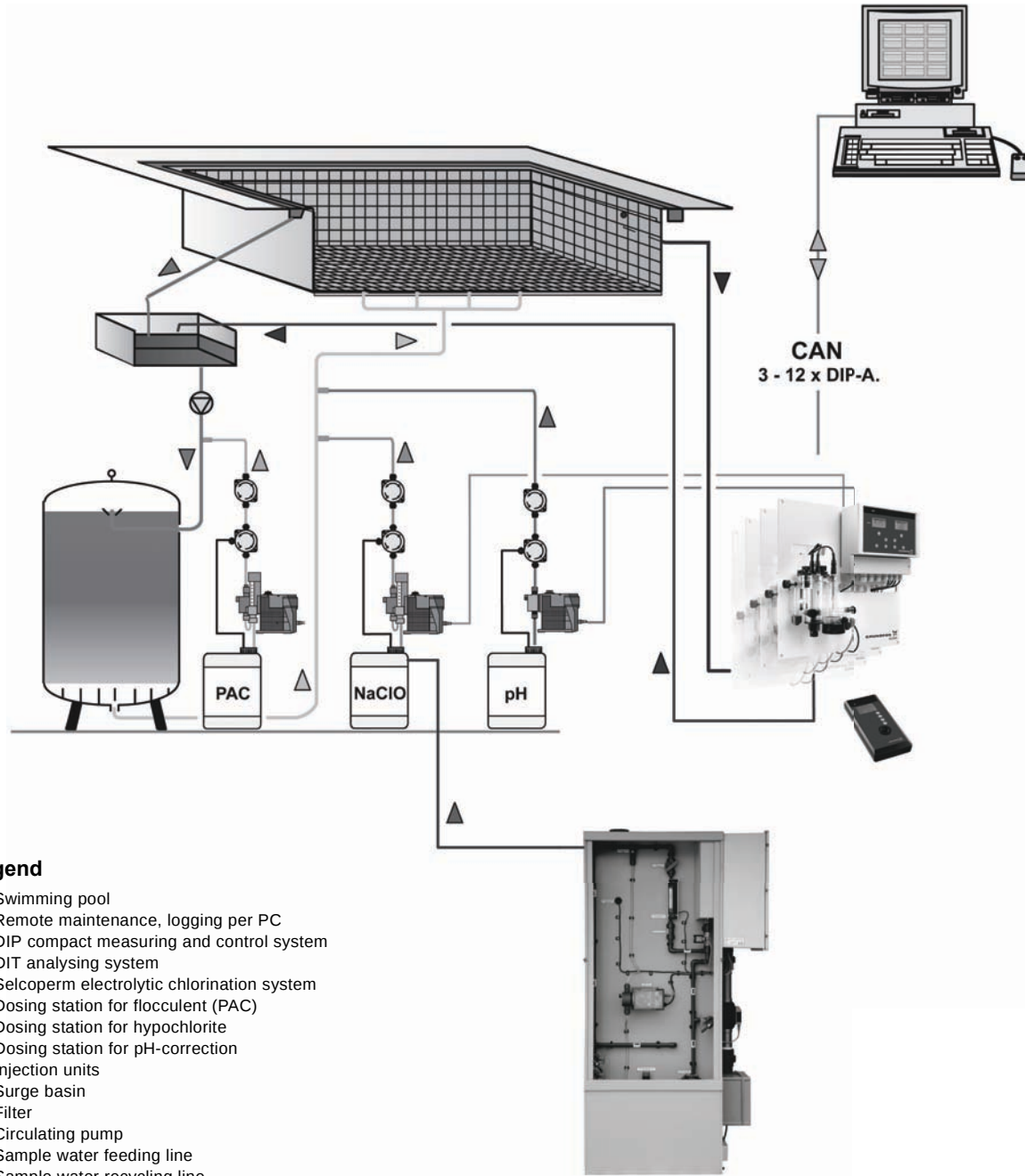


Fig. 3 Selcoperm application in drinking water treatment

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Example of Selcoperm in swimming pool water treatment application



Legend

1. Swimming pool
2. Remote maintenance, logging per PC
3. DIP compact measuring and control system
4. DIT analysing system
5. Selcoperm electrolytic chlorination 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. Circulating pump
13. Sample water feeding line
14. Sample water recycling line

Fig. 4 Selcoperm application in swimming pool water treatment

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Identification

Type key

SES electrolytic chlorination system

**Example: Type key SES-250-M/1 = capacity 250 g/h,
metric connections, supply voltage 220-260 V / 60 Hz**

Example:	SES	-250	-M	/5
Type range				
Max. capacity				
125	125 g/h (6.6 lb. per day)			
250	250 g/h (13.2 lb. per day)			
500	500 g/h (26.4 lb. per day)			
1000	1000 g/h (52.8 lb. per day)			
2000	2000 g/h (105.6 lb. per day)			
Connection				
I	Imperial			
M	Metric			
Supply voltage				
H	95-120 V / 50-60 Hz			
6	240-260 V / 60 Hz			
S	380-440 V / 60 Hz; 3 + N*			

* Neutral

Choosing a system

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

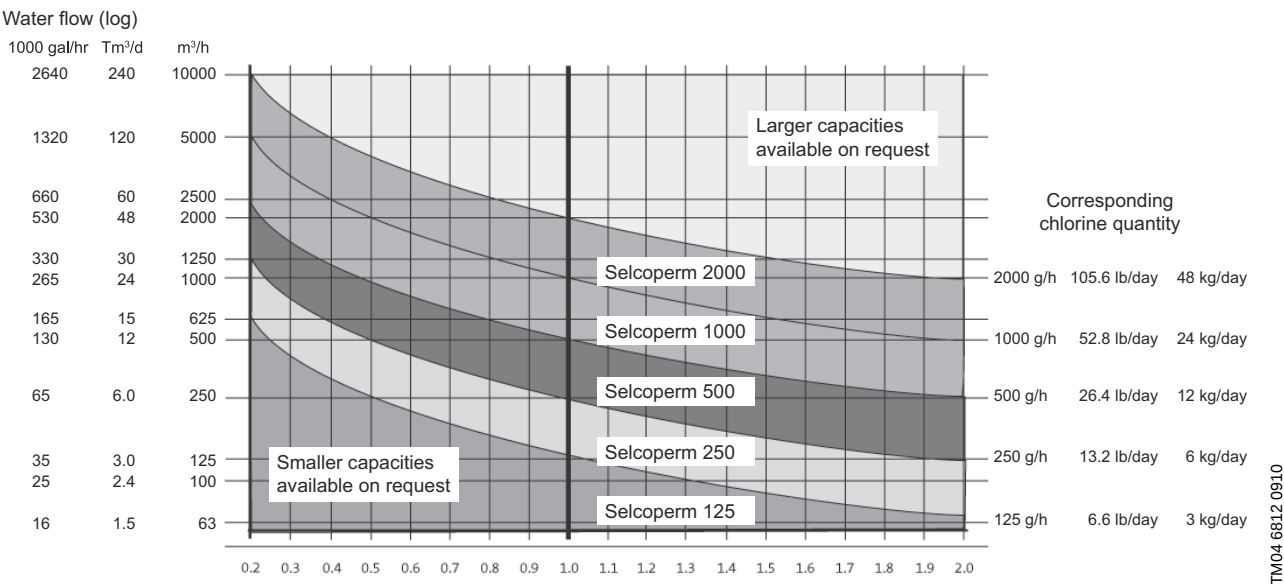


Fig. 5 Selcoperm capacity selection chart

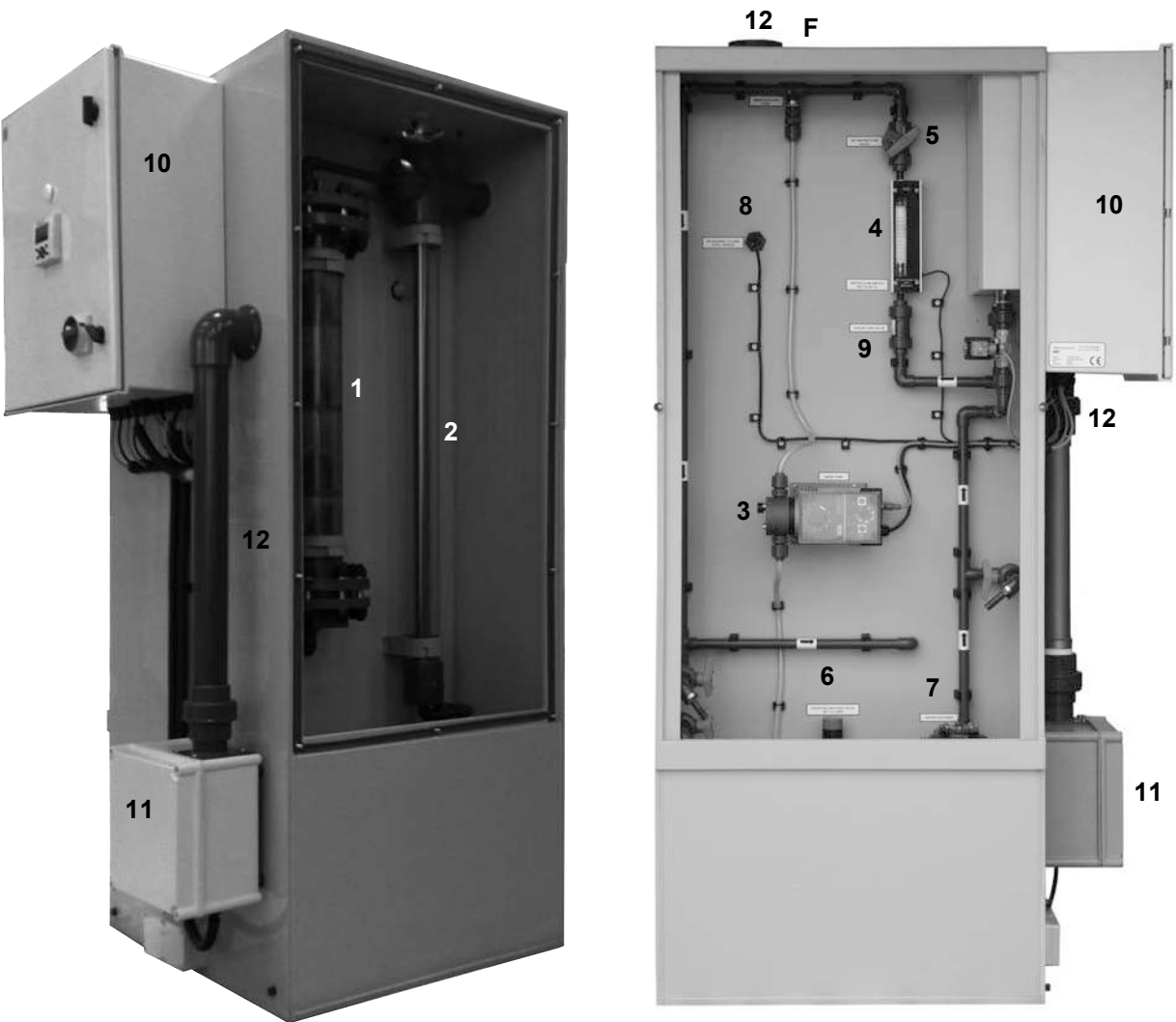


Fig. 6 Selcoperm components

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Components

Refer to fig. 6 to see photo image of the following components.

Electrolyzer cell and hydrogen degassing column

- Installed in a separate chamber with a quantitatively monitored air flow.
- Electrolyzer 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 40 °F (5 °C) and higher.
- The hydrogen degassing column **(2)** removes the formed hydrogen via the vent hole and prevents it from penetrating the product storage tank. The hydrogen is piped through the outlet **(F)** via a dual contained pipework into the ambient air. In the event of a blockage, an integrated sensor switches off the system.

Hydraulic chamber

- Grundfos dosing pump **(3)** with a wide adjustment range for precise dosing of the salt solution.
- Flow meter **(4)** with switch for safe process interruption, if the value falls below its critical minimum.
- Water flow 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 20 mg/l (CaCO₃) (1.2 grains per gal).
- Sample valves for softened water **(B)**, brine solution **(C)** and product solution **(D)**.

Control system

- Lockable control panel **(10)** IP 55 with integrated water cooling for the high-performance electronics.
- Display 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 electrolyzer cell, leakage, overtemperature electronics, ventilation error, water flow error.
- Potential-free alarm contact.

Ventilation

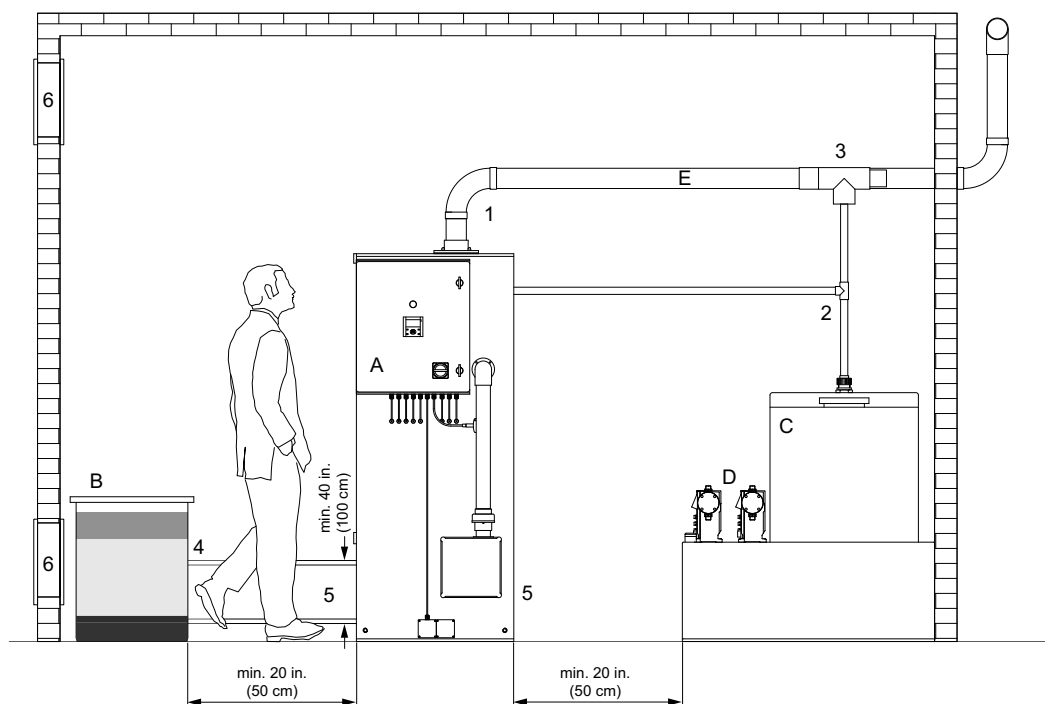
- Air dilution fan **(11)** with air flow sensor **(12)**.
- Forced ventilation in the electrolyzer chamber. At the vent discharge point outside the building dilution of the hydrogen produced.

The turn-key Selcoperm systems are piped, wired, labelled and tested before delivery.

Requirements

Water	Water quality	Good water quality with low iron (< 200 mg/m ³ or 0.2 ppm) and manganese (< 50 mg/m ³ or 0.01 ppm) content, preferably drinking water
	Supply pressure range	35 to 145 psi (2.5 to 10 bars). For lower water pressures, booster pumps are available.
	Water inflow temperature	40° F to 70 °F (5 °C to 20 °C).
Water demand	15 gal per lb (125-150 liters per kg) of prepared chlorine.	
Salt	- Food-grade common salt (DIN 19604 or EN 973) - For drinking water disinfection, salt with a low bromide concentration must be used (max. 0.01%).	
Salt consumption	3 to 3.5 lb of salt per lb of prepared chlorine.	
Electrical connection	95 to 125 V, 185 to 256 V, or 380 to 440 V; 50/60 Hz.	
Power consumption	Approx. 2.0 kWh per lb of prepared chlorine.	
Drain	An on-site drain for the regeneration water of the water softener is necessary.	
Exhaust air	- The outlet of the exhaust air has to be as close as possible to the electrolytic chlorination system. - Natural air supply via a ventilation hole in the room is required.	
Installation	Must be installed indoors. Max. temperature 100 °F (40 °C).	

Installation example



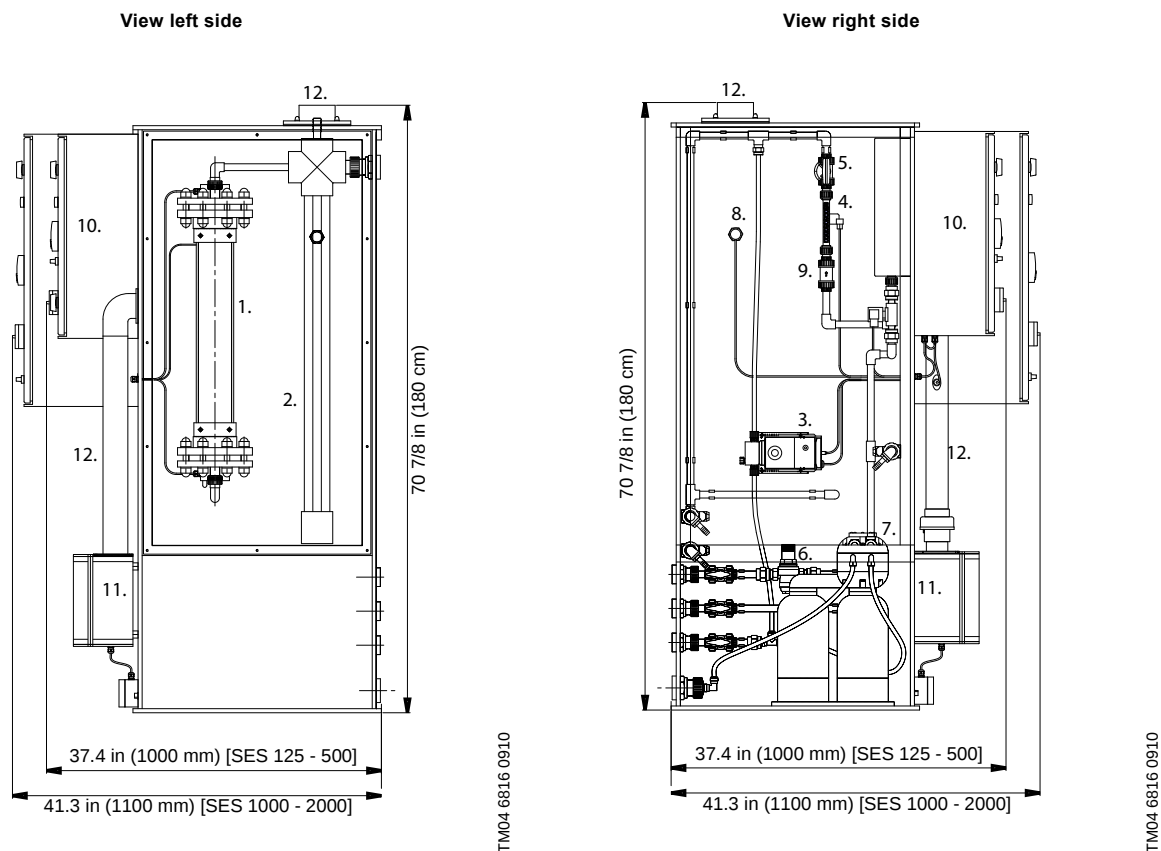
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Legend

- A. Selcoperm system
 - B. Brine tank
 - C. Product tank
 - D. Dosing pumps
 - E. Vent tubing
1. The internal vent tube has to be piped to the exterior of the building. Minimum tube diameter 3 1/2" (90 mm). Maximum length of the tubing 32 ft (10 m). Must be installed without dips and adequately supported to a safe discharge point.
 2. Minimum diameter 1 1/2" (32 mm) for tubing between the unit and the product tank. Tubing from the Tee above the product tank in an upwards 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 40 in (100 cm) above the brine outlet.
 5. Around the electrolyzing 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.

Fig. 7 Selcoperm room installation example

Dimensions



Legend

- | | |
|------------------------------|---|
| 1. Electrolyzer cell | 9. Non-return valve |
| 2. Hydrogen degassing column | 10. Control panel |
| 3. Dosing pump | 11. Air dilution fan |
| 4. Water flow meter | 12. Exhaust system with air flow sensor |
| 5. Water flow valve | 13. Drain plug |
| 6. Pressure reducing valve | |
| 7. Water softener | D. Outlet: product to storage tank |
| 8. Level sensor | F. Vent discharge outlet |

Fig. 8 Left and right side dimensional sketch

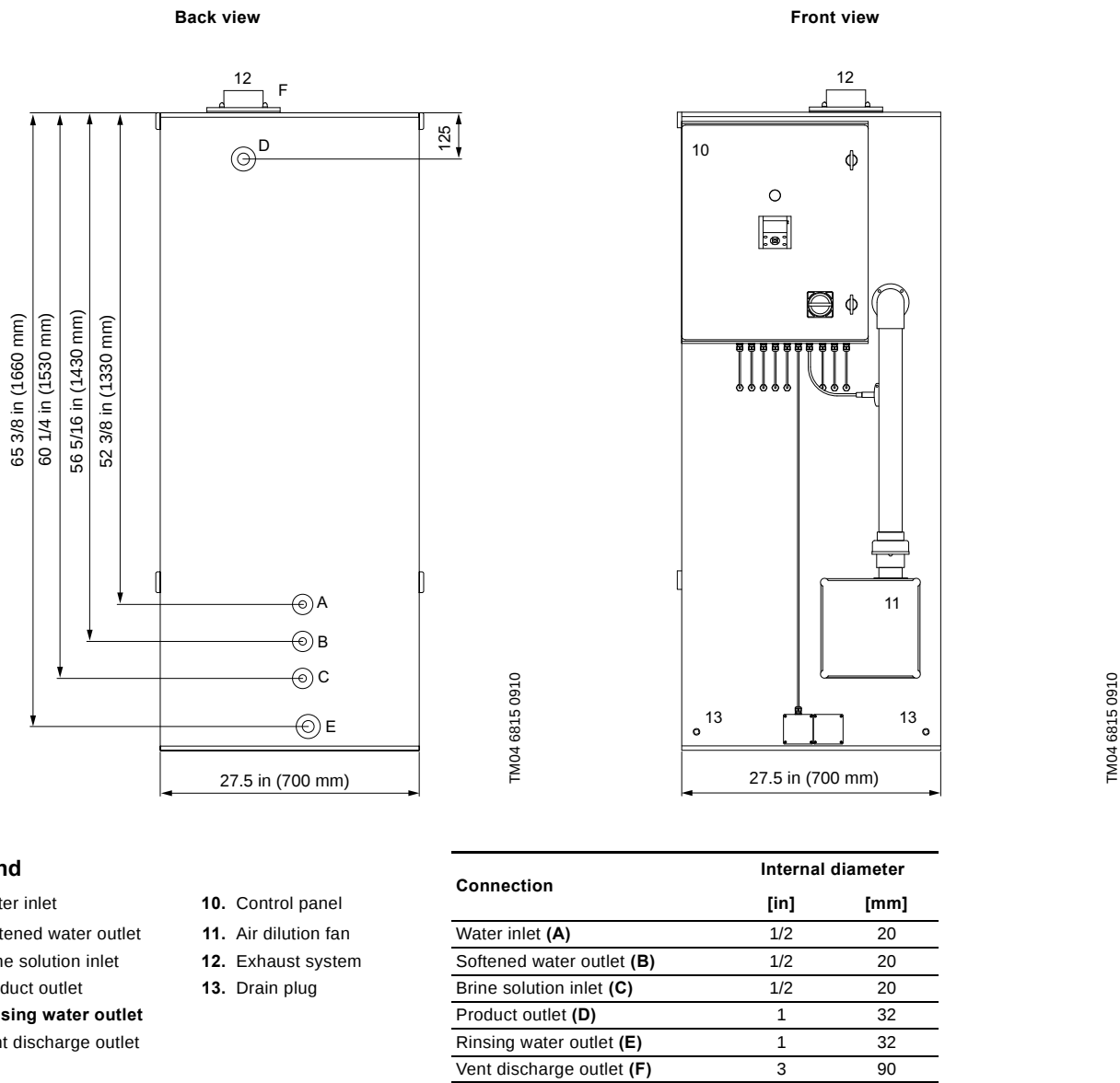


Fig. 9 Back and front dimensional sketch

Technical / order data

Selcoperm type	Capacity [g Cl ₂ /h] [lb Cl ₂ /h (kg Cl ₂ /h)]	Voltage [V]	Phases	Frequency [Hz]	Connections	Product number
SES-125-I/6	125	240-260	1	60	imperial	95702181 (195-125-10004)
SES-125-I/H						95702182 (195-125-10005)
SES-125-M/6						95702178 (195-125-10001)
SES-125-M/H						95702179 (195-125-10002)
SES-250-I/6	250	240-260	1	60	imperial	95702193 (195-250-10004)
SES-250-I/H						95702194 (195-250-10005)
SES-250-M/6						95702190 (195-250-10001)
SES-250-M/H						95702191 (195-250-10002)
SES-500-I/6	500	240-260	1	60	imperial	95702201 (195-500-10005)
SES-500-I/H						95702203 (195-500-10007)
SES-500-M/6						95702197 (195-500-10001)
SES-500-M/5						95702199 (195-500-10003)
SES-1000-I/6	1000	240-260	1	60	imperial	95702172 (195-1000-10005)
SES-1000-I/5						95702174 (195-1000-10007)
SES-1000-M/6						95702168 (195-1000-10001)
SES-1000-M/5						95702170 (195-1000-10003)
SES-2000-I/6	2000	380-440	3 + N*	60	imperial	95702186 (195-2000-10003)
SES-2000-I/5						95702184 (195-2000-10001)

Brine tanks

For use in the production of a saturated salt solution. Material: Polyethylene. With water inlet valve and gravel bed.

Type	Capacity		Diameter		Height		Inlet connection		Outlet connection		Weight approx.		Product number
	[lb]	[kg]	[in]	[mm]	[in]	[mm]	[in]	[mm]	[in]	[mm]	[lb]	[kg]	
SET 250-S	250	114	18	457	29	737	1/2"	13	1/2"	13	80	36	—
SET 600-S	600	273	22	559	36	914	1/2"	13	1/2"	13	190	86	—
SET 725-S	725	330	24	610	48	1219	1/2"	13	1/2"	13	340	155	—
SET 1825-S	1825	830	36	914	48	1219	1/2"	13	1/2"	13	480	218	—
SET 2500-S	2515	1143	42	1067	48	1219	1/2"	13	1/2"	13	550	250	—

Product storage tanks

Tanks are made of polyethylene, have a level sensor, and are ready for connection with Selcoperm.

Tanks up to 310 gal. have an integrated polypropylene containment with leakage sensor.

Type	Capacity		Diameter		Width		Length		Height		Inlet connection		Outlet connection		Weight Approx.		Product number
	[gal]	[l]	[in]	[mm]	[in]	[mm]	[in]	[mm]	[in]	[mm]	[in]	[mm]	[in]	[mm]	[lb]	[kg]	
SET-100-P ¹⁾	100	378	—	—	41	1041	41	1041	54	1372	1	25	3/4	19	165	75	—
SET-155-P ¹⁾	155	586	—	—	38	965	58	1473	64	1626	1	25	3/4	19	210	95	—
SET-200-P ¹⁾	200 (2x100)	756 (2x378)	—	—	38	965	58	1473	54	1372	1	25	3/4	19	300	136	—
SET-280-P ²⁾	281	1062	—	—	41	1041	66	1676	90	2286	1	25	3/4	19	310	141	—
SET 310-P ²⁾	310 (2x155)	1172 (2x586)	—	—	41	1041	66	1676	64	1626	1	25	3/4	19	350	159	—
SET-540-P	540	2041	38	965	—	—	—	—	90	2286	1	25	3/4	19	175	80	—
SET-805-P	805	3043	38	965	—	—	—	—	125	3175	1	25	3/4	19	230	105	—
SET-1400-P	1400	5292	64	1626	—	—	—	—	126	3200	1 1/2	38	3/4	19	400	182	—
SET-2650-P	2650	10017	96	2438	—	—	—	—	111	2819	1 1/2	38	3/4	19	900	409	—

¹⁾ For SET 100, 155, and 200: bund (containment) height is 26 inches (66 cm).

²⁾ For SET 200 and 310: bund (containment) height is 32 inches (81 cm).



Fig. 10 Brine tank



Fig. 11 Product tank

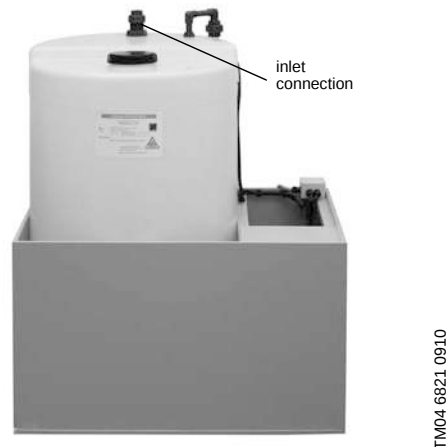


Fig. 12 Product tank with bund (containment)

Test kit

- For testing the generated product by titration method.

Description	Product number
Test Kit PWS T1000, comprising: • Sample vials (2) • Hardness test kit (1) • Thermometer (1) • Hydrometer (1) • Chlorine concentration test kit (bleach strength) for product solution (1) • Laminated instruction sheet (1) • PP carry case (1)	—



Fig. 13 Test kit

TM04 6826 0910

Acid rinsing set

- For cleaning the electrolyzer cell in case of deposits.

Description	Product number
Acid rinsing set comprising a manual acid rinsing pump with hose	95702377



Fig. 14 Acid rinsing pump

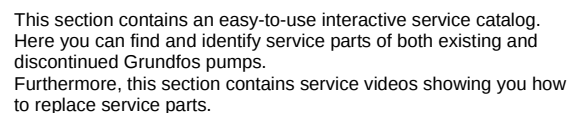
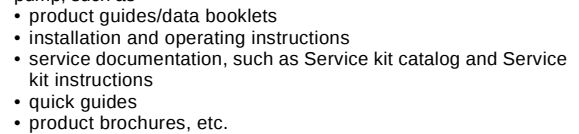
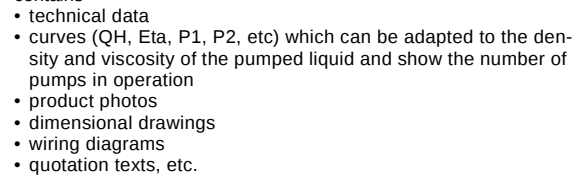
TM04 6813 0910

Maintenance kit

- Included parts for maintenance after two years (maintenance kit for brine pump, set of sealings for Selcoperm).

Description	Product number
Maintenance kit gaskets for Selcoperm 125 to 500	95702281
Maintenance kit gaskets for Selcoperm 1000 to 2000	95702282

- Catalog
- Literature
- Service
- Sizing
- Replacement
- CAD drawings.





Sizing

This section is based on different fields of application and installation examples, and gives easy step-by-step instructions in how to

- select the most suitable and efficient pump for your installation
- carry out advanced calculations based on energy consumption, payback periods, load profiles, life cycle costs, etc.
- analyze your selected pump via the built-in life cycle cost tool
- determine the flow velocity in wastewater applications, etc.



Replacement

In this section you find a guide to selecting and comparing replacement data of an installed pump in order to replace the pump with a more efficient Grundfos pump. The section contains replacement data of a wide range of pumps produced by other manufacturers than Grundfos.

Based on an easy step-by-step guide, you can compare Grundfos pumps with the one you have installed on your site. When you have specified the installed pump, the guide will suggest a number of Grundfos pumps which can improve both comfort and efficiency.



CAD drawings

In this section it is possible to download 2-dimensional (2D) and 3-dimensional (3D) CAD drawings of most Grundfos pumps.

These formats are available in WebCAPS:

2-dimensional drawings:

- .dxf, wireframe drawings
- .dwg, wireframe drawings.

3-dimensional drawings:

- .dwg, wireframe drawings (without surfaces)
- .stp, solid drawings (with surfaces)
- .eprt, E-drawings.

WinCAPS



Fig. 1 WinCAPS CD-ROM

WinCAPS is a **Windows-based Computer Aided Product Selection** program containing detailed information on more than 185,000 Grundfos products in more than 20 languages.

The program contains the same features and functions as WebCAPS, but is an ideal solution if no Internet connection is available.

WinCAPS is available on CD-ROM and updated once a year.

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