# Product guide 2026

Dosing technology, measurement, control and sensor technology, water treatment and water disinfection as well as digital solutions

ProMinent®

# Right for your application:
# Innovations made by ProMinent

## Top products developed and manufactured in house

We develop and manufacture the high-quality ProMinent products in house. The high product quality stems from dec-
ades of engineering competence, our solid application knowledge and a continual willingness to innovate. We therefore
invest continuously in research and development. ProMinent also has a high degree of vertical integration at its twelve
production sites worldwide, including Heidelberg, guaranteeing quality and ensuring our independence from fluctuations
in supplier markets.

## Kind on the environment and your wallet

ProMinent offers environmentally friendly and economical solutions for your water treatment. With our technology, you
can save chemicals in numerous processes. This reduces operating costs and protects the environment. In more than
100 countries, more than 3,000 employees in our own sales, production and service companies work every day to provide
our customers with fast and reliable service for every product. Our leading position on the global market spurs us on to
constantly achieve new levels of excellence and at the same time obliges us to think and act responsibly.

## The right product for your application

The modular ProMinent range enables our customers in a wide range of industries to achieve high levels of safety and
efficiency in their production processes, at all times and in any location. For us, customer proximity means working with
you to achieve the right solution for your individual needs. Personal, practical advice and smooth project handling are as
much a part of our offering as our worldwide customer service.

## Location-independent system monitoring in real time

With DULCONNEX, you always have access to all the key data and measured values for your pump installations. Monitor the status of your system in real time and benefit from continuous documentation. Check your device data safely and reliably when you're out and about. Simply use the terminal device of your choice: smartphone, tablet or PC. Configurable alarms and notifications inform you of relevant events 24/7.

Be in a position to act promptly at all times with DULCONNEX. No matter whether you work with industrial and process water, cooling water, potable water or swimming pool water – DULCONNEX supports you in ensuring the reliable treatment of your fluids.

## Products supported as standard

### Pumps

- Solenoid-driven metering pump beta/ X
- Solenoid-driven metering pump gamma/ X
- Solenoid-driven metering pump gamma/ XL
- Motor-driven metering pump sigma/ X
- Motor-driven metering pump sigma Hygienic
- Peristaltic metering pump DULCOFLEX DFXa
- Peristaltic metering pump DULCOFLEX DFYa
- Peristaltic pump DULCOFLEX DF4a

### Controllers

- DULCOMETER diaLog DACb
- DULCOPOOL Pro
- diaLog X
- AEGIS II
- SlimFLEX 5a
- DULCOZERO FCL

### Radar sensor

- DULCOLEVEL

### Water treatment and disinfection systems

- UV systems DULCODES LP | LP certified | LP-PE (plastic) | LP F&B
- UV system DULCODES MP
- Chlorine dioxide systems Bello Zon CDLb | CDLb $H_2SO_4$
- Chlorine dioxide system Bello Zon CDVd
- Chlorine dioxide system Bello Zon CDKd
- Electrolysis system CHLORINSITU IIa 60–300 g/h

### Industrial standard signals via dedicated I/O modules

- Digital inputs (relays, with counters too)
- Analogue inputs (4…20 mA)

**DULCONNEX Platform can be accessed by going to**

https://www.dulconnex.com/welcome.html .

**Don't hesitate to contact us for free trial access.**

Digital Fluid Management

IIoT Data

3rd party products

ProMinent products

DULCONNEX Gateway

DULCONNEX Platform

Data Exchange & Export

Web Apps

Mobile Apps

DULCONNEX API

3rd party products

Mobile Product Assistance

DULCONNEX Blue
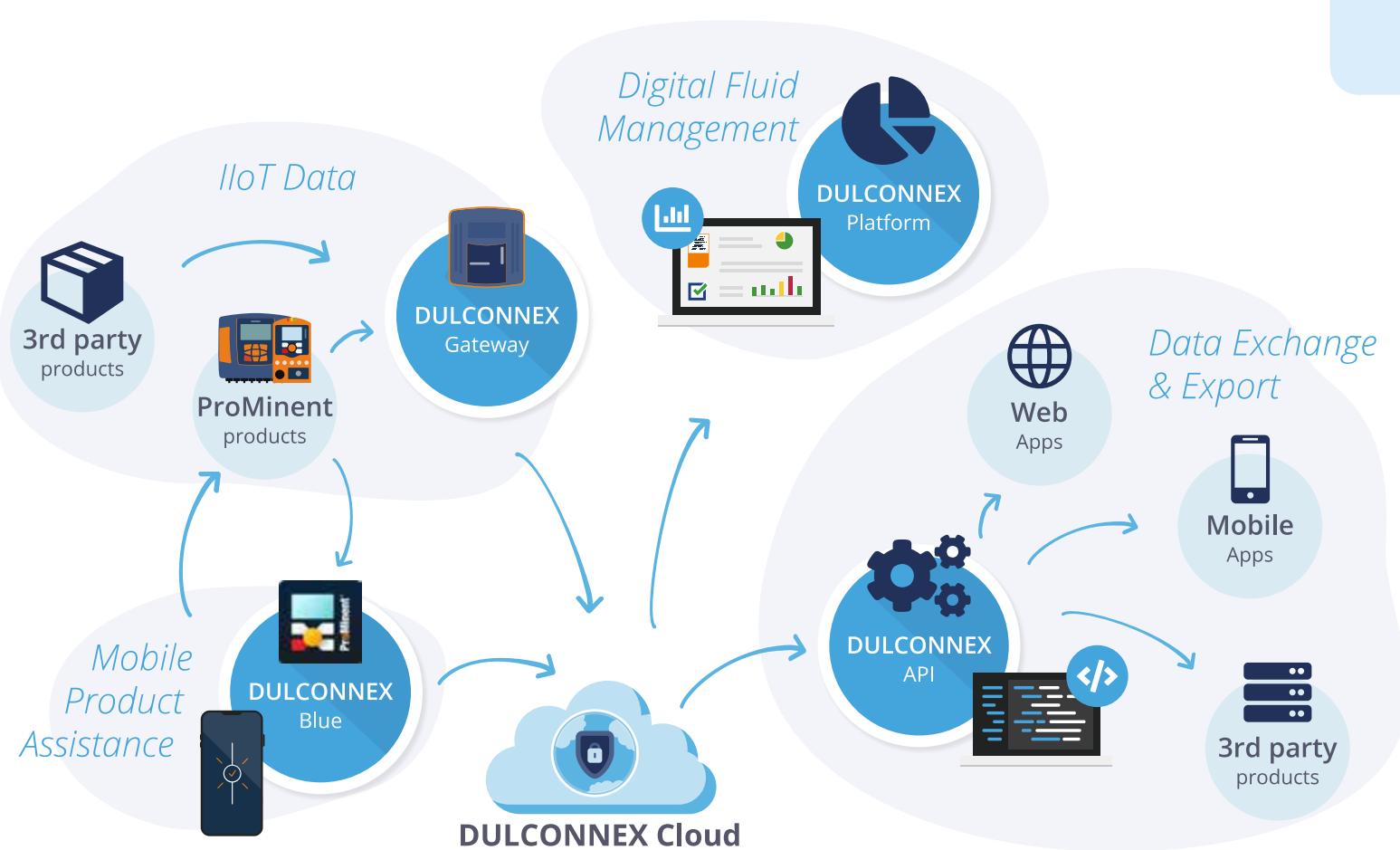
DULCONNEX Cloud

# DULCONNEX – IIoT solution for digital fluid management

ProMinent's DULCONNEX is a cloud-based IIoT solution for digitally networking your system components. DULCONNEX is based on robust, networked products that can be individually adapted to operating conditions. As all the components of a system are linked, metering pumps, disinfection systems, controllers and sensors can interact in an optimised manner – increasing process reliability and system efficiency.



### DULCONNEX Inventory Management

The DULCONNEX Inventory Management add-on is an extension to the DULCONNEX Platform. It can be used to monitor tank levels and inventory levels of chemicals at various sites regardless of your location. Tank level monitoring is based on the data of the DULCOLEVEL radar level sensor.



### DULCONNEX Gateway

The DULCONNEX Gateway safely and reliably transfers the data of all products supported as standard to the DULCONNEX Cloud



### DULCONNEX IPC Gateway

The DULCONNEX IPC Gateway safely and reliably transfers the data of all products supported as standard to the DULCONNEX Cloud



### DULCONNEX Blue

The next generation of mobile product assistance from ProMinent – DULCONNEX Blue. The smart app enables intelligent pumps to be conveniently controlled by Bluetooth.

■ Mobile app for Android and iOS

### DULCONNEX Platform

DULCONNEX Platform is a web-based IIoT platform for digital fluid management. The web application offers simple and location-independent access to all relevant system and process data and thus increases system availability. By continuously monitoring important parameters, the process quality can be optimized and the safety of employees increased. Comprehensive logging and automated generation of reports facilitate the fulfilment of documentation obligations.



### DULCONNEX API

With DULCONNEX API, you can access your data on request from the DULCONNEX Cloud. Use this for integration into existing process control systems, SCADA, mobile or online apps as well as MES or share data with other digital solutions.

# The all-rounders:
# metering pumps and metering systems

Around 1.6 million ProMinent pumps are in use worldwide, delivering reliable, accurate performance under tough conditions. Our metering technology allows fewer chemicals to be used in numerous processes. For our customers, this means reduced costs, economical metering and environmental sustainability.

Our proven design principles guarantee a high standard of quality and precision. Sophisticated monitoring functions ensure reliability in operation. And minimal chemical consumption with optimum disinfection. Microprocessor technology allows the pumps to be controlled with accuracy. Interfaces integrate the pumps into a fully automated process.

Alongside individual components for metering liquids, we also supply complete metering systems. If requested, the entire system is supplied wired for use. Alternatively, the system can be installed and taken into operation on site by ProMinent technicians.

## How do metering pumps work?

Most metering pumps are oscillating displacement pumps (diaphragm and plunger pumps) or peristaltic pumps. With oscillating displacement pumps, an exactly defined volume of liquid is drawn into the displacement body on the reciprocal stroke and forced into the dosing line on the compression stroke.

The pump settings can be changed to achieve consistently accurate metering. With a peristaltic pump, an exactly defined volume is pumped by clamping and squeezing a hose. Liquid is drawn in again by raising the hose into a neutral position.

# Selection guide for low-pressure metering pumps

**Find the right pump type in four steps**

- Specify pump capacity in litres per hour [l/h]
- Specify back pressure in bar
- Find the intersection of these two values and select the pump type that lies nearest to it

**Pump Guide**

The choice of pumps is huge: 80 industries, 100,000 products and infinite applications. To make it easy to find your ideal metering pump, ProMinent designed the Pump Guide. In just a few clicks you will find a selection of suitable models.

www.pump-guide.com
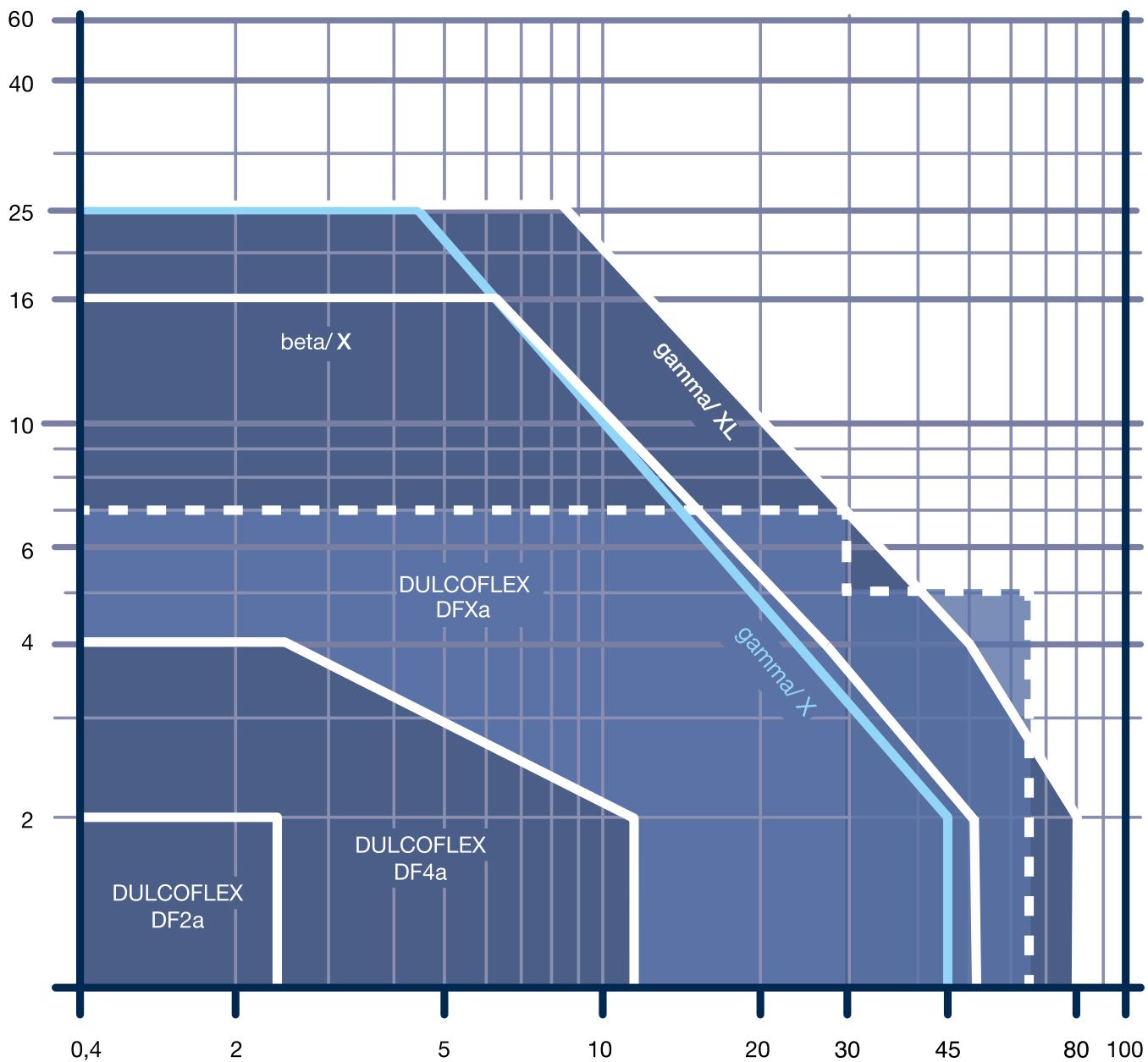
# Diaphragm Metering Pumps

Diaphragm metering pumps are available in capacities ranging from 1 ml/h - 1.040 l/h at a back pressure of 25 to 2 bar. To be able to meter almost any liquid chemicals, ProMinent uses a very extensive range of materials.



### Diaphragm metering pump beta/ X

The beta/ X diaphragm metering pump provides simple handling, precise metering and digital networking. With its intuitive operation, robust design and environmentally-friendly PFAS-free variant, it is setting new standards in metering technology.

■ Capacity range 10 ml/h – 50 l/h, 16 – 2 bar



### Solenoid-Driven Metering Pump gamma/ X

The solenoid-driven diaphragm metering pump gamma incorporates a wealth of eX cellent ingenuity! With integrated pressure measurement, it ensures the smooth running of your metering process. The gamma/ X is ideal for all metering work involving liquid media.

■ Feed rate of product range 1 ml/h – 45 l/h; 25 – 2 bar



### Solenoid-Driven Metering Pump gamma/ XL

The gamma/ XL is a smart, connectible solenoid-driven metering pump that is setting new standards in terms of productivity, reliability and cost-effectiveness.

■ Feed rate of product range 4 ml/h – 80 l/h; 25 – 2 bar



### Motor-Driven Metering Pump Sigma/ 1 (Basic type)

The Sigma/ 1 Basic is an extremely robust motor-driven metering pump with patented multi-layer safety diaphragm for excellent process reliability. It offers a wide range of power end designs, such as three-phase or 1-phase AC motors, also for use in areas at risk from explosion.

■ Capacity range 17 – 144 l/h, 12 – 4 bar

### Motor-Driven Metering Pump Sigma/ 2 (Basic Type)

Robust motor-driven metering pumps like the Sigma/ 2 Basic guarantee excellent process reliability with their patented multi-layer safety diaphragm. The diaphragm metering pump offers a number of power end versions, also suitable for use in areas at risk from explosion.

■ Capacity range 50 – 420 l/h, 16 – 4 bar

### Motor-Driven Metering Pump Sigma/ 3 (Basic Type)

The patented multi-layer safety diaphragm for excellent process reliability is just one feature of the extremely robust motor-driven metering pump Sigma/3 Basic. It also offers a wide range of power end versions, such as three-phase or 1-phase AC motors, also for use in ATEX areas.

■ Capacity range 146 – 1,030 l/h, 12 – 4 bar

### Motor-Driven Metering Pump alpha

The motor-driven metering pump alpha is the metering pump for liquid media and the optimum solution for simple applications. Robust, low-noise, chemical-resistant, with precise metering and good suction capacity.

■ Capacity range 1.0 – 30.6 l/h, 10 – 2 bar

### Motor-Driven Metering Pump Sigma X Control Type – Sigma/ 1 - S1Cb

The Sigma control type is a smart motor-driven metering pump that is setting new standards in terms of productivity, reliability and safety.

■ Capacity range S1Cb: 21 – 117 l/h, 12 – 4 bar

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### Motor-Driven Metering Pump Sigma X Control Type – Sigma/ 2 - S2Cb

The Sigma control type is a smart motor-driven metering pump that is setting new standards in terms of productivity, reliability and safety.

- Capacity range S2Cb: 61 – 353 l/h, 16 – 4 bar

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### Motor-Driven Metering Pump Sigma X Control Type – Sigma/ 3 - S3Cb

The Sigma control type is a smart motor-driven metering pump that is setting new standards in terms of productivity, reliability and safety.

- Capacity range S3Cb: 182 – 1,040 l/h, 12 – 4 bar

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### Motor-driven metering pump sigma Hygienic

The hygienic design version of the sigma diaphragm metering pumps is optimised in terms of dead space, features as few gaps as possible and has smooth, wetted surfaces for flexible and easy use in hygienically sensitive applications.

- Capacity range of the Sigma: 25 – 1,000 l/h, 10 – 4 bar

# Peristaltic metering pumps

Peristaltic metering pumps DULCOFLEX Control are used in a capacity range of between 10 ml/h and 660 l/h. They pump against a pressure of up to 8 bar. The incredible durability and broad chemical compatibility of the high-performance hoses used by ProMinent are particularly impressive.



### Peristaltic metering pump DULCOFLEX DFXa

DULCOFLEX DFXa meters outgassing, viscous, abrasive or shear-sensitive media and is setting new standards in metering. Linear and reproducible metering (± 1 %) is guaranteed with this peristaltic pump under all process conditions. Hose replacement is a very simple process.

- Feed rate of 10 ml/h to 65 l/h at up to 7 bar back pressure



### Peristaltic metering pump DULCOFLEX DFYa

The valveless peristaltic metering pump DULCOFLEX DFYa delivers precise, linear and reproducible metering in all process conditions. It is highly suited to outgassing, viscose, shear-sensitive media, possibly containing particles – ProMinent is therefore setting new standards in metering with peristaltic pumps.

- 3 variants with maximum flow rates of 200, 410 and 660 l/h at up to 8 bar back pressure

# Accessories for metering technology

In addition to a correctly selected metering pump, individually combined accessories, installed in accordance with all pertinent regulations, are needed for the perfect operation of metering systems.

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### Radar liquid level sensor DULCOLEVEL

With the new radar level sensor DULCOLEVEL, your chemical inventory management is child's play.

### Flow meter DULCOFLOW

The flow meter DULCOFLOW reliably measures pulsating flows in the range above 0.03 ml/stroke based on the ultrasound measuring principle. The flow meter achieves maximum chemical resistance as all wetted parts are made of PVDF and PTFE.

■ For the measurement of pulsating volumetric flows within the range of 0.03 ml/stroke to 10 ml/stroke

# Process metering pumps for all capacity ranges

There is no room for compromise in high-end applications in the petrochemical, oil and gas industries. Risks associated with the metering of toxic, corrosive and flammable liquids must be fully eliminated. Reliable metering pumps need to be able to withstand very high pressure levels and extreme temperatures. What could be a more obvious solution for very challenging applications than ProMinent cutting-edge technology?

### Diaphragm metering pump EXTRONIC

The diaphragm metering pump EXTRONIC is perfectly suited to the sensitive application of liquid media in facilities at risk of gas explosions as it is approved in compliance with the EU EX Regulation 2014/34/EU (ATEX).

■ Capacity range of single head pump: 1 – 60 l/h; 25 – 1 bar

### Diaphragm Metering Pump Makro TZ

The modular construction of the diaphragm metering pump MAKRO TZMb with adjustable eccentric drive mechanism and mechanically deflected multi-layer safety diaphragm enables it to be outstandingly adapted to the performance requirements of the respective application.

■ Capacity range of single head pump: 260 – 2,100 l/h, 12 – 4 bar

### Hydraulic Diaphragm Metering Pump ORLITA Evolution E1Sa/E2Sa

As an extremely robust hydraulic diaphragm metering pump, the ORLITA Evolution E1Sa/E2Sa meets the most exacting safety requirements. It is characterised by its PTFE multi-layer diaphragm with integral diaphragm rupture warning / signalling system and unique diaphragm position control.

■ Capacity range of single-head pump: 0.9 – 134 l/h, 260 – 30 bar

### Hydraulic diaphragm metering pump ORLITA Evolution Mikro

The ORLITA Evolution mikro is an innovative micro-metering pump for high pressures. The hydraulic diaphragm metering pump is the first of its kind with an electronically regulated linear direct power end. The power end has few mechanical functional elements and thus operates with virtually minimal maintenance.

■ Capacity range 0.01 – 18 l/h, 250 – 10 bar

## Hydraulic Diaphragm Metering Pump HYDRO API

The HYDRO API 675 is an extremely robust hydraulic diaphragm metering pump, which meets the most exacting safety requirements and is designed in accordance with API 675. This is ensured by the PTFE multi-layer diaphragm with diaphragm monitoring, the full-motion drive and automatic bleeding, for example. Its modular construction makes it extremely versatile.

■ Capacity range of single-head pump: 7 – 1,506 l/h, 100 – 7 bar



## Hydraulic Diaphragm Metering Pump HYDRO Classic

As an extremely robust hydraulic diaphragm metering pump, the HYDRO range meets the most exacting safety requirements. Its modular construction, with either one or two dosing heads, 4 gear ratios, 2 dosing head sizes and 3 dosing head materials, offers a very high degree of flexibility in terms of areas of application.

■ Capacity range of single-head pump: 3 – 1450 l/h, 100 – 7 bar



## Hydraulic Diaphragm Metering Pump Makro/ 5

The robust hydraulic diaphragm metering pump Makro/ 5 guarantees outstanding process reliability. Its modular construction offers extremely good flexibility and a large range of drive versions are available.

■ Capacity range of single pump: 450 – 6,108 l/h, 25 – 6 bar



## Hydraulic Diaphragm Metering Pump ORLITA Evolution

The ORLITA Evolution meets the most exacting safety requirements as an extremely robust hydraulic diaphragm metering pump. It is characterised by its PTFE multi-layer diaphragm with integral diaphragm rupture warning/signalling and unique diaphragm position control.

■ Capacity range of single-head pump: 3 – 7400 l/h, 400 – 10 bar

**Hydraulic Diaphragm Metering Pump ORLITA MF**

The hydraulic diaphragm metering pump ORLITA MF offers reliable dosing rates even under high pressure and has a modular construction, making it highly versatile. Thanks to its modular design, this pump is tailored to meet your requirements even at very high pump capacities.

- Capacity range of single-head pump: 0 – 9200 l/h, 400 – 30 bar



**Hydraulic Diaphragm Metering Pumps with Metal Diaphragm ORLITA MH**

The diaphragm metering pump ORLITA MH has a robust metal diaphragm. This permits precise pump capacities even at very high pressure. The ORLITA MH has a modular construction and is therefore very versatile. For example, a range of drive versions is available and drives and dosing heads can be freely combined.

- Capacity range of single pump: up to 320 l/h, up to 900 bar
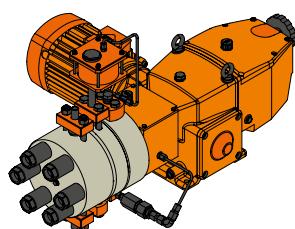


**Hydraulic metal diaphragm metering pump high-pressure ORLITA MHRH**

The metal diaphragm metering pumps ORLITA MHHP are special pumps, which provide precise pump capacities even at maximum pressures of up to 3000 bar.

- Capacity range of a single pump: 3 – 4 l/h; 3000 bar

### Plunger metering pump sigma SBKa

The plunger metering pump Sigma SBKa is an extremely robust plunger metering pump with high-performance plunger and the option to adjust the pump capacity in 0.2% increments. It offers a wide range of power end versions, such as three-phase or 1-phase AC motors, even for Exe and Exde areas with ATEX certification.

- Capacity range 2 – 76 l/h, 320 – 12 bar

### Plunger metering pump ORLITA PS

The high-performance plunger metering pump ORLITA PS enables precise pump capacities even at maximum pressure and temperatures of up to +400 °C. The ORLITA PS pump has a modular construction and is therefore very flexible.

- Capacity range of single-head pump: 0 – 2800 l/h, 800 – 11 bar

### ORLITA DR metering pump

The plunger metering pump ORLITA DR does not need valves and can therefore be operated within a broad stroke rate range. It is therefore suitable for use with high-viscosity and extremely high-viscosity media of up to $10^6$ mPas within a wide temperature range of -30 °C to +200 °C.

- Capacity range of single-head pump: 0 – 273 l/h, 400 – 76 bar

# Chemical transfer pumps

Chemical transfer pumps are used to pump liquids from tank A to tank B. Different media have very different chemical properties so the feed pumps need different functional principles. Liquid and pump must be fully compatible. The same ProMinent standards of maximum diligence and quality are applied to every single task.



### Eccentric Screw Pump SPECTRA

The eccentric screw pump SPECTRA meters liquid polyelectrolytes in concentrated and dilute form. It can be used, for example, in wastewater treatment or sludge dewatering.

■ Capacity range 2.4 – 12,000 l/h, 12 – 3 bar



### Centrifugal Pump von Taine

The solenoid-coupled centrifugal pump von Taine for the pumping of liquid media works safely and reliably: liquid media are pumped leak-free.

■ Capacity range up to 22,500 l/h, discharge lift up to 23.5 m WC



### Air-Operated Diaphragm Pump DUODOS

Air-operated Diaphragm Pump DUODOS for pumping liquid media.

■ Capacity range up to 12,000 l/h, discharge lift up to 70 m WC

### Barrel pump DULCOTRANS

The field of application of DULCOTRANS depends on the chemical resistance of the materials used.

- Pump capacity according to size from 2,800 – 6,600 l/h



### Rotary Lobe Pump ROTADOS

The compact rotary lobe pump pumps viscose and even abrasive media at up to 100 m$^3$/h and also with reversible pumping direction thanks to its valveless construction. Housing, plunger and seals are available in different materials to match the medium.

- Capacity range 25–100 m$^3$/h, 10–4 bar

# Tanks and collection pans

Standard tanks for chemical storage and transfer are a fixed element of the ProMinent range. However, if you have specific requirements ProMinent can also supply tanks customised to a wide range of specifications.



### Dosing Tanks

PE storage tanks produced in a rotation process. ProMinent metering pumps, suction lances and stirrers can all be added. The stackable PE collecting pans are available in matching sizes.

- Capacity 35 – 1,000 l



### Storage Tanks

Our plastic storage tanks guarantee compliance with statutory specifications taking into account country-specific approvals, which regulate the production and operation of systems for storage and metering of environmentally hazardous substances.

- Useful capacity 500 l – 50,000 l, indoor and outdoor installation

# Peristaltic pumps

Peristaltic pumps DULCOFLEX are amongst the most adaptable pumps available from ProMinent. They are suitable for a very wide pump capacity range. The smaller pumps of types DF2 to DF4 have been specially designed for metering tasks in swimming pools, hot tubs or spa and wellness zones. The large peristaltic pumps DULCOFLEX DFBa, DFCa and DFDa are ideal for specific tasks using maximum pump capacities and pressures in the laboratory and in industry. All models are based on a simple operating principle and are extremely safe and easy to use.

### Peristaltic Pump DULCOFLEX DF2a

The peristaltic pump DULCOFLEX DF2a meters chemicals functionally, cost-effectively and quietly – ideal for use in swimming pools, hot tubs, and in spa and wellness facilities.

- Capacity range 0.4 – 2.4 l/h at max. 1.5 bar back pressure

### Peristaltic Pump DULCOFLEX DF4a

The peristaltic pump DULCOFLEX DF4a for metering flocculants and activated charcoal treats water precisely and accurately. It is ideal for use in swimming pools, hot tubs or spa and wellness facilities. An operating pressure up to 4 bar is possible.

- Capacity range 1.5 – 12 l/h, 4 – 2 bar

### Peristaltic Pump DULCOFLEX DFBa

The peristaltic pump DULCOFLEX DFBa is designed for low and medium pump capacities of up to 800 l/h. Depending on application, the pump can be set for a back pressure of up to 8 bar.

- Pump capacity of up to 800 l/h; back pressures of up to 8 bar.



### Peristaltic Pump DULCOFLEX DFCa

High pump capacities are not a problem with the peristaltic pump DULCOFLEX DFCa. It is equipped with extra rollers and fabric-reinforced hoses for industrial use.

- Pump capacity up to 25,000 l/h. Back pressure up to 8 bar.



### Peristaltic Pump DULCOFLEX DFDa

The peristaltic pump DFDa is designed for maximum pump capacities and high pressures and is winning customers over with its noiselessness and long service life. It is fitted with shoes and fabric-reinforced hoses – perfect for industrial use.

- Pump capacity up to 35,000 l/h. Back pressure up to 15 bar.

# Metering systems DULCODOS

The standard metering systems DULCODOS are the result of years of application-based development work at ProMinent. After all, you don't have to reinvent the wheel every time. With ProMinent you can reduce your costs by choosing carefully designed complete solutions.



NEW

### Metering System DULCODOS panel

The Metering System DULCODOS panel is modular & flexible - with a choice of three Metering Pumps and even more options

- Pump capacity from 0.01 to 1,000 l/h depending on the pump selected, back pressure 10 - 2 bar



### Metering system DULCODOS Compact F&B

DULCODOS Compact F&B is a ready-to-connect, compact dosing system for precise dosing of foodstuffs in accordance with European Regulation EC 1935/2004. The robust stainless steel design fulfils the highest hygiene standards and is ready for immediate use - ideal for flexible integration into beverage and food processes.

- Metering rate: 0.01 – 410 l/h



### Metering system DULCODOS Compact (DSKb)

The ready-wired metering system DULCODOS Compact is used for the ultra-precise metering of chemicals with a huge range of different motor-driven metering pumps. Thanks to its modular construction, the plug-and-play solution is ideal for replicable installations.

- Metering rate: 50 – 1040 l/h



### Metering system DULCODOS universal mini PP

The metering system DULCODOS universal mini PP combines reliable standard components, tailored precisely to your needs, in the most compact space.

- Up to 75 l/h (10 – 2 bar) pump volume depending on the pump selected

**Metering System DULCODOS eco (DSBa)**

For storing and metering liquid chemicals use a selection guide (identity code) to quickly and flexibly adapt your metering system to your metering task.

**Metering System DULCODOS Ammonia**

Metering system DULCODOS Ammonia for the low-odour and safe handling of ammonia solution. For a stable pH value and reduced corrosion in the vapour system.
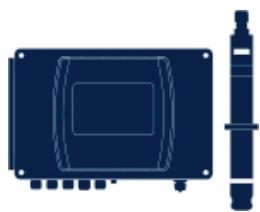
# Measuring, Control and Sensor Technology

To keep water consumption as low as possible, industry and the public sector have to treat and reuse water thereby preserving resources. Water treatment is incredibly simple and user-friendly when using our intelligent measuring and control technology.

Achieving the desired water quality requires certain values, such as pH, conductivity and chlorine, to be monitored continuously. The sensors developed and manufactured in house at ProMinent measure with precision and reliability.

## Manufacturing many components in house ensures good quality

Every year, we manufacture more than 150,000 high-quality sensors at ProMinent sites. Our high degree of vertical integration distinguishes us. It extends from in-house production of components and electronic parts to final assembly and quality checks on the finished products. Glass and plastic parts, which are used to produce electrochemical sensors and controllers, are manufactured at three European production sites with in-house glass blowing.

## The complete solution for your processes

ProMinent is therefore a provider of complete solutions for optimum metering of liquids: from reliable pump capacity and the correct measurement of all relevant parameters to precise process control.

# Overview of sensors

Using our sensors, customers can undertake simple monitoring of limit values and construct a closed control circuit – and do so in an enormous range of measuring applications. The DULCOTEST product family is application-based and ensures precise measuring of a wide range of values. These measured values are delivered in real time and can be flexibly connected to the various process interfaces via bypass, immersion or in-built fittings.

### Potentiometric sensors DULCOTEST

From simple applications in water treatment through to industrial process applications under critical conditions, DULCOTEST pH and ORP sensors fulfil all measurement tasks.

### Amperometric sensors DULCOTEST with analogue and digital output

The amperometric sensors in the DULCOTEST range deliver selective and precise measured values in real time for a very wide range of disinfectants for all important disinfectants and oxidising agents used in water treatment. The digital CAN bus sensors enable data storage and bidirectional communication with the measuring and control instrument.

### Sensors for electrolytic conductivity

Conductivity sensors for optimum process integration: DULCOTEST sensors meet a wide range of measuring requirements and allow the best solution to any given measuring task to be achieved.

- Graduated measuring ranges 0.01 µS/cm – 2000 mS/cm

### Optical sensors

Our low-maintenance and reliable sensors for dissolved oxygen enable the processes involved in treating drinking water and waste water and in fish farming to be optimised. High-precision sensors for measuring turbidity based on various international standards ensure outstanding water quality the world over.

### Sensor bypass fitting Modular BAMa

The modular bypass armature BAMa accommodates ProMinent sensors for water treatment. The armature is simply installed in a bypass of the main process line. It is available in various variants, each perfectly designed for special water treatment applications – from drinking water, water for pool & wellness to industrial water.

- Up to 9 functional modules can be freely configured in a single fitting.

# Sensor technology

Monitoring a limit value or building a closed control circuit is standard practice for our sensors – in an enormous range of measuring applications. The product family DULCOTEST is application-based and ensures precise measuring of a wide range of values. In real time

## Selection guide for DULCOTEST pH sensors

| Sensor type | Typical applications | Remarks | pH range | Max. temperature and max. pressure | Loading with particles/solid matter in the application | Reference | Diaphragm |
|---|---|---|---|---|---|---|---|
| PHES | Drinking water, swimming pool water | | 1 to 12 | 60°C / 3 bar | None to low levels | Ag/AgCl | 1x ceramic |
| PHEK | Swimming pool water, aquariums | Plastic sensor shaft for greater safety during handling, e.g. end customers in the private swimming pool sector | 1 to 12 | 60°C / 3 bar | None to low levels | Ag/AgCl | 1x ceramic |
| PHEP/PHEPT | Drinking water, process water | PHEPT with integrated temperature sensor | 1 to 12 | 80°C / 6 bar | None to low levels | Ag/AgCl with AgCl reservoir | 1x ceramic |
| PHED | Process water, electroplating | Chemically contaminated water, e.g. Cr6+, CN- | 1 to 12 | 80°C / 8 bar | None to low levels | Ag/AgCl with AgCl reservoir | 2x ceramic; double junction |
| PHEN | Process water, cooling water, waste water: chemically contaminated, clear PHEN-3D type for conductivities > 50 μS/cm | Reference electrolyte is introduced into the sensor using external bottles and can be topped up | 1 to 12 | 80°C / no overpressure | None to low levels | Ag/AgCl with AgCl reservoir | 1x ceramic |
| PHER | Industrial and public waste water, cooling water, process water: containing solids | Dirt-repellent PTFE diaphragm | 1 to 12 | 80°C / 6 bar | Low to medium levels | Ag/AgCl with AgCl reservoir | 1x PTFE |
| PHER-DJ | Waste water, cooling water, process water: contaminated with solids and chemicals, reverse osmosis (conductivity ≥ 10 μS/cm), acid and alkaline gas scrubbers (without fluoride, HF) | Dirt-repellent PTFE diaphragm and a double junction to protect the reference system | 1 to 12 | 80°C / 6 bar | Low to medium levels | Ag/AgCl with AgCl reservoir | 2xPTFE; double junction |
| PHEI | Waste water, cooling water, process water: contaminated with solids and chemicals | Long service life thanks to large volume of reference electrolyte, double junction and large PTFE diaphragm, 3/4" NPT screw-in thread | 1 to 12 | 80°C / 6 bar | Low to medium levels | Ag/AgCl with AgCl reservoir | 1x PTFE; 1x ceramic; double junction |
| PHEX | Waste water, process water: high solids content, no chemical contamination. Suspensions, sludge, emulsions | Open ring diaphragm | 1 to 12 | 25°C / 16 bar and 100°C / 6 bar | Medium to high levels | Ag/AgCl with AgCl reservoir | Open ring diaphragm |
| PHEF | Media containing fluoride with low pH values, e.g. etching solutions containing fluoride in electroplating | Special pH glass with increased resistance to HF | 0 to 12 | 50°C / 7 bar | Low to medium levels | Ag/AgCl | 1x HDPE |
| PHEF-DJ | Media containing fluoride with low pH values, e.g. gas scrubbers where gases containing fluoride are scrubbed | Special pH glass with increased resistance to HF | 1 to 12 | 60°C / 6 bar | Low to medium levels | Ag/AgCl with AgCl reservoir | 2xPTFE; double junction |
| PHEP-H | Process water with high pH values (> pH 12) | Special pH glass with increased resistance to high pH values | 3 to 14 | 80°C / 6 bar | None to low levels | Ag/AgCl with AgCl reservoir | 1x ceramic |

Note: All DULCOTEST pH and ORP sensors are made using lead-free glass (RoHS-compliant)

# Selection guide for DULCOTEST ORP sensors

| Sensor type | Typical applications | Remarks | Material of sensor pin | Max. temperature and max. pressure | Loading with particles/solid matter in the application | Reference | Diaphragm |
|---|---|---|---|---|---|---|---|
| RHES Pt | Drinking water, swimming pool water | | Platinum (Pt) | 60°C / 3 bar | None to low levels | Ag/AgCl | 1x ceramic |
| RHES Au | Swimming pool water | ORP sensors with gold electrodes are not susceptible to hydrogen, which is produced through the generation of chlorine by open electrolysis systems. What's more, gold electrodes are well suited to ozone applications. | Gold (Au) | 60°C / 3 bar | | | |
| RHEK Pt | Swimming pool water, aquariums | Plastic sensor shaft for greater safety during handling; e.g. end customers in the private swimming pool sector | Platinum (Pt) | 60°C / 3 bar | None to low levels | Ag/AgCl | 1x ceramic |
| RHEKL Pt | Swimming pool water, aquariums | Two diaphragms mean that horizontal installation is possible | Platinum (Pt) | 60°C / 3 bar | None to low levels | Ag/AgCl | 2x ceramic |
| RHEP Pt | Drinking water, process water | | Platinum (Pt) | 80°C / 6 bar | None to low levels | Ag/AgCl with AgCl reservoir | 1x ceramic |
| RHEP Au | Drinking water, process water | ORP sensors with gold electrodes are not susceptible to hydrogen, which is produced through the generation of chlorine by open electrolysis systems What's more, gold electrodes are well suited to ozone applications | Gold (Au) | 80°C / 6 bar | None to low levels | Ag/AgCl with AgCl reservoir | 1x ceramic |
| RHEN Pt | Process water, cooling water, waste water: chemically contaminated, clear | Reference electrolyte is introduced into the sensor using external bottles and can be topped up | Platinum (Pt) | 80°C / no overpressure | None to low levels | Ag/AgCl with AgCl reservoir | 1x ceramic |
| RHER Pt | Industrial and public waste water, cooling water, process water: containing solids | Dirt-repellent PTFE diaphragm | Platinum (Pt) | 80°C / 6 bar | Low to medium levels | Ag/AgCl with AgCl reservoir | 1x PTFE |
| RHER-DJ | Waste water, cooling water, process water: contaminated with solids and chemicals, reverse osmosis (conductivity ≥ 10 µS/cm), acid and alkaline gas scrubbers (without fluoride, HF) | Dirt-repellent PTFE diaphragm and a double junction to protect the reference system | Platinum (Pt) | 80°C / 6 bar | Low to medium levels | Ag/AgCl with AgCl reservoir | 2xPTFE; double junction |
| RHEIC | Waste water, cooling water, process water: contaminated with solids and chemicals | Long service life thanks to large volume of reference electrolyte, double junction and large PTFE diaphragm 3/4" NPT screw-in thread | Platinum (Pt) | 80°C / 6 bar | Low to medium levels | Ag/AgCl with AgCl reservoir | 1x PTFE; 1x ceramic; double junction |
| RHEX | Waste water, process water: high solids content, no chemical contamination. Suspensions, sludge, emulsions | Open ring diaphragm | Platinum (Pt) | 25°C / 16 bar and 100°C / 6 bar | Medium to high levels | Ag/AgCl with AgCl reservoir | Open ring diaphragm |

**Note: All DULCOTEST pH and ORP sensors are made using lead-free glass (RoHS-compliant)**

# Conductivity sensor selection guide

**Conductivity > 20 mS/cm and/or film-forming medium and/or chemically aggressive medium**

Yes ↓          ↓ No

| Inductive conductivity measurement | Conductive conductivity measurement |
|---|---|

↓          ↓

**Compact controller can be used in the application?**

**Further selection according to summary table:**

- Measuring range
- Material (chemical compatibility)
- Temperature
- Hydraulic process connection
- Electrical connection
- Compatibility of measuring and control units

Yes ↓          ↓ No

**Do the following conditions exist?**
**Aggressive chemicals,**
**with the exception of lyes and/or**
**temperatures > 80 °C and/or**
**measured value < 200 µS/cm**

**Type ICT 8**
**for installation in pipes**
**with adapter accessory,**
**for immersion with**
**immersion fitting accessory**

↓

**Product ranges LF, LMP, CK, CCT**

Yes ↓          ↓ No

**Series ICT 2**

Installation in pipes
with stainless
steel flange accessory

For immersion with
accessory: immersion
fitting IMA - ICT 2

**Type ICT 5**
for installation in
pipes
**Type ICT 5-IMA**
for immersion

# Selection guide for DULCOTEST® amperometric sensors

| Measured variable | Applications | Graduated measuring ranges | Compatible Controllers | Sensor type |
|---|---|---|---|---|
| Free chlorine | Drinking water, swimming pool water | 0.01-100 mg/l | diaLog C, diaLog X, dia-Log DACb, D1Cb/D1Cc, DULCOPOOL Pro | CLE 3-mA-xppm CLE 3.1-mA-xppm |
| Free chlorine | Process and waste water | 10 - 200 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc | CLR 1-mA |
| Free chlorine | Drinking water, swimming pool water | 0.01 - 10 mg/l | DULCOMARIN | CLE 3-CAN-10ppm CLE 3.1-CAN-10ppm |
| Free chlorine | Swimming pool, uncontaminated drinking and process water, inline electrolysis (tubular cell electrolysis), in case of deposits with hydrodynamic cleaning | 0.02-10 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc, DULCOPOOL Pro, AEGIS II | CLO 3-mA-xppm |
| Free chlorine | Swimming pool, uncontaminated drinking and process water, in situ electrolysis (without diaphragm), in case of deposit formation together with hydrodynamic cleaning | 0.01-10 mg/l | DULCOMARIN 3 | CLO 3-CAN-10ppm |
| Free chlorine | Hot water up to 70 °C (Legionella), in situ electrolysis, in case of scale formation together with hydrodynamic cleaning | 0.02-2 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc | CLO 4-mA-2ppm |
| Free chlorine | Drinking water, swimming pool water | 0.01-50 mg/l | DMT | CLE 3-DMT-xppm |
| Free chlorine | Drinking water, swimming pool water | 0.05-5 mg/l | Compact | CLB 4-µA-xppm |
| Free chlorine | Drinking water, swimming pool water | 0.05-5 mg/l | Compact | CLB 5-µA-xppm |
| Free chlorine | Cooling water, process water, waste water, water with higher pH values (stable); seawater (free chlorine is present as bromine) | 0.01-10 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc, AEGIS II, AEGIS S | CBR 1-mA-xppm |
| Total available chlorine/ free chlorine | Swimming pool water with organochlorine disinfectants and in situ electrolysis (without diaphragm) | 0.02 - 10 mg/l | diaLog C, diaLog X, dia-Log DACb, D1Cb/D1Cc, DULCOPOOL Pro | CGE 3-mA-ppm |
| Total available chlorine/free chlorine | Swimming pool water with organochlorine disinfectants and in situ electrolysis (without diaphragm) | 0.01-10 mg/l | DULCOMARIN 3 | CGE 3-CAN-10ppm |
| Total chlorine | Drinking water, industrial water, process water and waste water | 0.01-20 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc | CTE 2-mA-xppm |
| Total chlorine | Drinking water, service water, process water and waste water | 0.01-10 mg/l | DMT | CTE 1-DMT-xppm |
| Total chlorine | Drinking water, service water, process water and waste water | 0.01-10 mg/l | DULCOMARIN 3 | CTE 2-CAN-10ppm |
| Combined chlorine | Swimming pool water | 0.02-2 mg/l | diaLog C, diaLog DACb, DULCOPOOL Pro | CTE 2-mA-2 ppm CLE 3.1-mA-2 ppm |
| Combined chlorine | Swimming pool water | 0.01-10 mg/l | DULCOMARIN 3 | CTE 2-CAN-10ppm CLE 3.1-CAN-10ppm |
| Total available bromine | Cooling water, waste water, swimming pool, whirlpool water, bromine with BCDMH | 0.01-10 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc, DULCOPOOL Pro, AEGIS II, AEGIS S | BCR 1-mA (replaces former type BRE 1) |
| Total available bromine | Cooling, swimming pool, whirlpool water with organic or inorganic bromine compounds | 0.02-10 mg/l | DULCOMARIN 3 | BRE 3-CAN-10ppm |
| Free + bound bromine | Cooling water, process water, waste water, water with higher pH values (stable); seawater | 0.02-20 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc, AEGIS II, AEGIS S | CBR 1-mA-xppm |
| Free + bound bromine | Cooling water, process water, waste water, water with higher pH values (stable); seawater | 0.02-20 mg/l | DULCOMARIN 3 | CBR 1-CAN-10ppm |
| Chlorine dioxide | Drinking water | 0.01-10 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc | CDE 2-mA-xppm |
| Chlorine dioxide | Bottle washer | 0.02-2 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc | CDP 1-mA-xppm |

| Measured variable | Applications | Graduated measuring ranges | Compatible Controllers | Sensor type |
|---|---|---|---|---|
| Chlorine dioxide | Hot water up to 60 °C, cooling water, waste water, irrigation water | 0.01-10 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc, DULCO-MARIN 3, AEGIS II, AEGIS S | CDP 1-mA-xppm CDR 1-CAN-10ppm |
| Chlorite | Drinking water, washing water | 0.02-2 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc, DULCO-MARIN 3 | CLT 1-mA-xppm CLT-1-CAN-10ppm |
| Ozone | Drinking water, swimming pool water | 0.02-2 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc, DULCOPOOL Pro | OZE 3-mA-2 ppm |
| Ozone | Process water, service water, cooling water | 0.01-10 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc, DULCOPOOL Pro, AEGIS S | OZR 1-mA-xppm |
| Dissolved oxygen | Clarification plant|sewage plant, fish farming, drinking water, surface water | 0.1-20 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc | DO 3-mA-xppm |
| Peracetic acid | CIP (cleaning in place), aseptic food filling | 1-2,000 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc | PAA 1-mA-xppm |
| Peracetic acid | Waste water, low concentrations | 0.02-20 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc | PAA 2-3E-mA-xppm |
| Hydrogen peroxide | Clear water, rapid control | 1-2,000 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc | PEROX-H2.10 |
| Hydrogen peroxide | Cooling, waste and process water | 20-2,000 mg/l | diaLog C, diaLog X, diaLog DACb, D1Cb/D1Cc | PER1-mA-2000 ppm |
| Hydrogen peroxide | Swimming pool water, plant water, low concentrations | 0.2-500 mg/l | diaLog C, diaLog X, diaLog DACb, DULCOPOOL Pro | PEROX H-3E-mA-xppm |

# Selection guide for controllers for water treatment

The selection guide for the measuring and control technology DULCOMETER is divided into tables and applications to help you find the right solution for your application at a glance.

| Function | diaLog C | diaLog X | DACb | Compact | D1Cb/D1Cc |
|---|---|---|---|---|---|
| **Measured variables** | | | | | |
| pH / ORP | + | + | + | + | + |
| Turbidity (digital) | + | | | | |
| Chlorine | + | + | + | + | + |
| Chlorine dioxide | + | + | + | | + |
| Chlorite | + | + | + | | + |
| Bromine | + | + | + | | + |
| Conductivity conductive | + | + | + | + | |
| Conductivity inductive | + | | | + | |
| Conductivity via mA | + | + | + | | + |
| Peracetic acid | + | + | + | | + |
| Hydrogen peroxide | + | + | + | | + |
| Ozone | + | + | + | | + |
| Dissolved oxygen | + | + | + | | + |
| Fluoride | + | + | + | | + |
| Ion-selective sensors | + | + | + | | |
| 0/4...20 mA standard signal general measured variables | + | + | + | | + |
| **Power supply** | | | | | |
| 90 - 253V~ | + | + | + | + | + |
| 24 V DC | | | + | | |
| **Mounting type, degree of protection** | | | | | |
| Wall mounting IP 65 | | | | | + |
| Wall and pillar assembly (combined housing) IP 66 / IP 67 | + | + | + | + | |
| Control cabinet mounting IP 54 | 1/4 DIN | | 1/4 DIN | 1/2 DIN | 1/4 DIN |
| **Measurement** | | | | | |
| Number of measuring channels | 1 | up to 16 (with extension) | 2/3 | 1 | 1 |
| Sensor monitoring for pH | + | + | + | + | d1Cb only |
| Temperature compensation for pH | + | + | + | + | + |
| Temperature compensation for conductivity | + | + | + | + | |
| pH compensation for chlorine | manual | + | + | | |
| **Control** | | | | | |
| PID controller | + | + | + | + | + |
| 1-side controller (e.g. for pH acid or alkali) | + | + | + | + | |
| 2-sided controller (e.g. for pH acid and alkali) | + | + | + | | + |

# Controllers for water treatment

Measuring and control instruments from ProMinent are adapted to the relevant application in virtually every process environment. They are available in different performance classes and can be integrated in every process environment.



### Controller DULCOMETER diaLog C

The DULCOMETER diaLog C sets new standards in measuring and control technology. Whether as a transmitter or 2-side controller (PID) with one channel - it is ideal for use in industrial water treatment. Thanks to its intuitive operation and digital networking, it is smartly integrated into your processes.



### Controller DULCOMETER diaLog DACb

Do you wish for a simple controller for water analysis? One that is easy to operate and with which you can freely select between all common measured variables per channel? There is one: our all-rounder DULCOMETER diaLog DACb! What is more, it is Ethernet-/LAN-capable and can be ideally integrated into existing networks.



### Controller DULCOMETER D1Cb/D1Cc

The controller DULCOMETER D1Cb/D1Cc can be used for control tasks in potable water treatment, wastewater treatment and many other areas. Safe, convenient and clear, thanks to the large illuminated graphic display, plain text operating menu and pH sensor monitoring.



### Controller DULCOMETER Compact

As a controller in water analysis, the DULCOMETER Compact is the correct controller for control tasks that require only a 1-way control.

### Transmitter DULCOMETER DMTa

The transmitter DULCOMETER DMTa converts the sensor signals for pH, ORP value, chlorine concentration and conductivity into an interference-insensitive 4-20 mA analogue signal. Flexible, safe and always the optimum resolution of measured value.

# Selection guide for controllers for cooling tower control

The selection guide for controllers suited to cooling tower applications provides an overview of the most important functions.

| Function | diaLog X | AEGIS II | SlimFLEX 5a | AEGIS S |
|---|---|---|---|---|
| **Number of cooling towers controlled** | 6 | 2 | 1 | 1 |
| **Bleeding/desludging** | | | | |
| Conductive conductivity-dependent | + | + | + | + |
| Inductive conductivity-dependent (via mA) | + | + | | + |
| Alternatively, dependent on the volume of water added | + | + | + | + |
| Alternatively, as a percentage based on a time base of 5 minutes | + | + | + | |
| **Biocide metering** | Free configurable | Up to 2 per cooling tower | Up to 2 | Up to 2 |
| Forced bleeding with timer-controlled biocide metering | Time-dependent and/or measured value-dependent | Time-dependent and/or measured value-dependent | Time-dependent and/or measured value-dependent | Time-dependent and/or measured value-dependent |
| Bleed lock after timer-controlled biocide metering | + | + | + | + |
| **Metering of chemicals (inhibitors, dispersants)** | Free configurable | Up to 4 | Up to 2 | Up to 2 |
| Contact water meter-controlled | + | + | + | + |
| Alternatively, dependent on the bleed valve opening time | + | + | + | + |
| Alternatively, as a percentage based on a time base of 5 minutes | + | + | + | - |
| Controlled via fluorescence sensor | + | + | + | - |
| **Control of metering pumps and bleed dampers** | | | | |
| Pulse frequency outputs for metering chemicals | 4-12 | 4 | - | - |
| Changeover contact output relay, with power supply, for controlling a bleed damper or metering pumps | 3-9 | 2 | 2 | 1 |
| Changeover contact output relay, potential-free for controlling metering pumps | 3-9 | 3 | 3 | 4 |
| **Corrosion measurement** | | | | |
| For two different metals, e.g. stainless steel, copper, construction steel, admiralty metal | + | + | - | - |
| 0/4…20 mA analogue outputs | Free configurable | Up to 4 | Up to 2 | 2 |
| **Special functions** | | | | |
| Fieldbus, Modbus | | +, RTU | | +, RTU and TCP |
| PROFIBUS-DP, BACnet® via external gateways on request | + | + | - | - |
| Subsequent function upgrade via plug-in modules | + | + | + | - |
| LAN connector | +, web server | +, web server | +, web server | + |
| WLAN/Wi-Fi | +, web server | +, web server | +, web server | + |
| E-mail reporting/alerts | + | + | + | - |
| Graphic display of metering and bleeding on the web server | + | + | + | - |
| Data logger | + | + | + | + |
| **Power supply** | | | | |
| 100 - 230 V AC | + | + | + | + |
| **Method of installation, degree of protection** | | | | |
| Wall mounting | IP 66, IP 67 | IP 65 | IP 65 | IP 65 |

# Controllers for cooling tower control

Controllers for evaporation cooling systems ensure that these systems are run as efficiently as possible. They contribute firstly to reducing cooling water consumption and secondly to improving the entire system's protection from corrosion, deposits and biological growth. The controllers are available in various performance classes.



### Controller DULCOMETER diaLog X

The DULCOMETER diaLog X multi-parameter controller ensures that complex water treatment systems are operated as efficiently as possible. The controller is highly flexible and suitable for many sensor parameters.



### Controller AEGIS II

Controller AEGIS II continuously measures and controls the conductivity and biocide concentration to keep pipework and heat exchangers clean.



### Controller SlimFLEX 5a

The SlimFLEX 5a cooling tower controller continuously measures and regulates electrical conductivity and controls the dosing of biocides. This keeps the pipework clean and prevents legionella infestation.



### Controller AEGIS S

AEGIS S is an easy-to-use water treatment controller for evaporative cooling systems. It is designed to keep the cooling process running reliably. AEGIS S measures conductivity and controls dosing of biocides and corrosion inhibitor, thus preventing biological growth and keeping pipelines and heat exchangers clean.

# Controllers for swimming pool water treatment

**ProMinent provides a complete range of measuring and control systems, which have been developed especially to treat water for swimming pools, spas and other leisure activities.**



### Measuring and Control System DULCOMARIN 3

The measuring and control system DULCOMARIN 3 is your digital link to the technology of the future. It controls the entire range of swimming pools – from adventure pools to private pools – and is used as a multi-pool system for up to 16 filter circuits.



### Controller DULCOPOOL

The controller DULCOPOOL enables simple management of private swimming pools. It is operated using a touch display. DULCOPOOL uses two peristaltic pumps, which are integrated in the device, to control the pH and chlorine concentration totally automatically.

- Measurement parameters: pH, ORP



**DULCONNEX**

### Controller DULCOPOOL Pro

The controller DULCOPOOL Pro controls various sizes of swimming pool ranging from private and hotel pools to Olympic-sized pools and all the attractions that come with them. Thanks to its touch display and web interface, the controller can be operated with ease and integrated into SmartHome systems or PLCs.

- Measurement parameters: pH, ORP, free chlorine, total chlorine, bromine, ozone and hydrogen peroxide



**NEW**

### DULCOMETER AirGuard - Measurement of trichloramine in the air in the swimming pool hall

The DULCOMETER AirGuard measuring system continuously monitors the concentration of trichloramine in the air in real time. It is ideally suited for public indoor swimming pools. In the event of increased concentrations, the innovative system reacts immediately and triggers the adjustment of the fresh air supply.

- Measurement of trichloramine in the range of: 0.00 to 2.00 mg/m$^3$

# Panel-mounted measuring and control systems, monitoring systems

**Complete measuring, control and monitoring systems for easy integration in water treatment processes.**



NEW

### Measuring and control point for low turbidity DULCOTROL LT

The new DULCOEYE Turbidity Sensor from ProMinent is a high-precision solution for the optical measurement of low turbidity. With state-of-the-art technology and intelligent design, this sensor simplifies liquid analysis.

■ Ideal for applications up to 100 NTU



### Measuring and control system DULCODOS Cooling Water

Monitoring and treatment of cooling water with DULCO-DOS Cooling Water–the compact measuring and control system specially designed for the treatment of cooling water in evaporation cooling systems and wet separators.



### Measuring and control system DULCOTROL Drinking Water / F&B

Monitoring and treatment of potable and similar types of water with DULCOTROL Potable water/F&B – the compact measuring and control system specially designed for water treatment in waterworks and in the food and beverage industry.



### Measuring and control system DULCOTROL Waste Water

Monitoring and treatment of wastewater with DULCOTROL Wastewater – the compact measuring and control system specially designed for applications in municipal and industrial wastewater treatment.

**DULCONNEX**

## DULCOZERO FCL monitoring system for the absence of free chlorine

Reliably measure the absence of free chlorine with the innovative monitoring system DULCOZERO FCL: Accurate measured values and a high degree of monitoring and process reliability are guaranteed.

# Metering systems for swimming pool water treatment

The metering systems DULCODOS are the result of years of application-based development work at ProMinent. With ProMinent you can reduce your costs by choosing carefully designed complete solutions.

### Metering System DULCODOS Pool Soft

Chlorine-free water treatment system for environmentally operated private pools. Safe water disinfection with active oxygen as a turnkey complete solution.

■ Swimming pools with a circulation performance of up to 100 m³/h

### Metering System DULCODOS Pool Basic

The chlorine metering system DULCODOS Pool Basic is a complete solution for private pools where the chlorine content is controlled using the low-maintenance measurement of the redox potential.

■ For swimming pools with a circulation capacity of up to 100 m³/h

### Metering System DULCODOS Pool Comfort

The chlorine metering system DULCODOS Pool Comfort is the convenient solution for pH adjustment and disinfection of swimming pool water with liquid chlorine products. Remote access to the in-built web server via Wi-Fi and LAN.

■ For swimming pools with a circulation capacity of up to 225 m³/h

### Metering System DULCODOS Pool Professional

Chlorine metering system for individual adjustment and monitoring of all common hygiene auxiliary parameters in public pools. DULCODOS Pool Professional ensures crystal-clear water quality and lowers operating costs thanks to Eco!Mode.

■ For swimming pools with a circulation capacity of up to 350 m³/h

# Water treatment and disinfection

ProMinent specialises in reliable solutions for water treatment and disinfection. Our modern metering technology removes bacteria, viruses and harmful substances in an effective and environmentally-friendly way. The result is hygienically clean water involving little effort and simple handling.

## The right solution for every application

Our water treatment solutions are as individual as the industries we serve: the chemical industry, industrial and municipal water treatment, food and beverage industry, swimming pools, oil and gas as well as the process industry.

ProMinent experts put together the system that best supports your application. Our product offering extends from metering pumps for all capacity ranges and measuring and control technology to membrane filtration systems and established disinfection processes as well as digital fluid management. We deliver safe and high-performance complete solutions. And of course we also offer worldwide technical support.
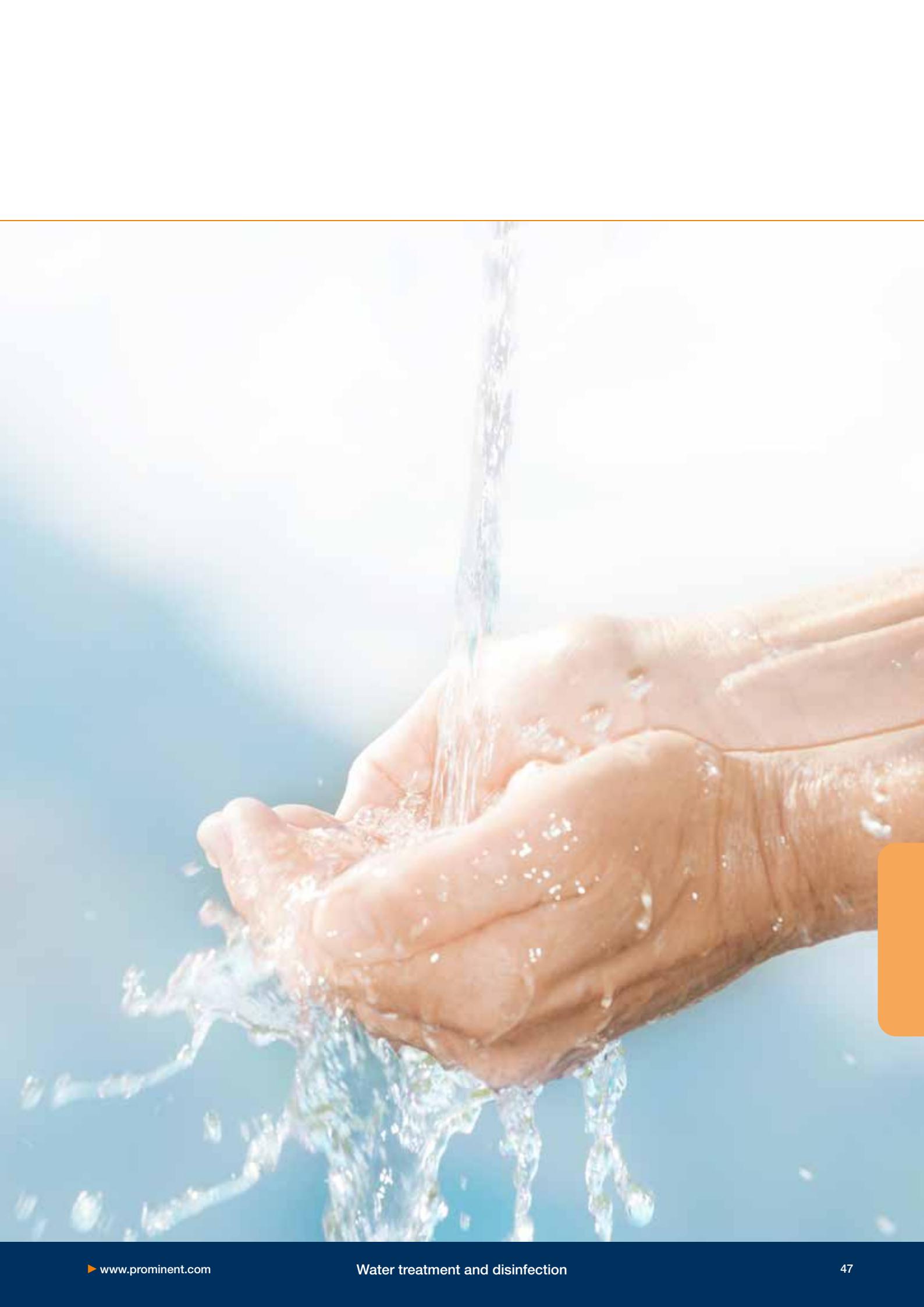
# Performance overview of UV systems

This overview shows the performance and typical applications of ProMinent UV standard systems. Need more details? Don't hesitate to contact us. We're here to help.

| Output [m³/h] | Typ LP Standard | Typ LP Certified | Typ LP F&B | Typ LP Plastic | Typ MP High flow |
|---|---|---|---|---|---|
| 1.000 | | | | | |
| 400 J/m², 98%/cm transmission | 500 | | | | |
| 200 | | | | | |
| 100 | | | | | |
| 50 | | | | | |
| 20 | | | | | |
| 10 | | | | | |
| 5 | | | | | |
| 2 | | | | | |

## Applications

| | Typ LP Standard | Typ LP Certified | Typ LP F&B | Typ LP Plastic | Typ MP High flow |
|---|---|---|---|---|---|
| Drinking water | ■ | ■ | | | |
| Process water | ■ | ■ | | ■ | ■ |
| Swimming pool water | ■ | | | ■ | ■ |
| Salt water | | | | ■ | |
| Food and beverage industry | | | ■ | | |

# UV Systems

UV technology is a chemical-free process that has proven itself in water treatment. UV treatment can be used for safety disinfection or for the photochemical degradation of ingredients such as combined chlorine or residual ozone. The technology is efficient and without by-products. The DULCODES UV systems from ProMinent make optimum use of these versatile possibilities and thus warrant the highest water quality in a wide variety of processes.



### UV System DULCODES MP

The UV system DULCODES MP eliminates combined chlorine and therefore the odour typically associated with swimming pools. Say goodbye to irritated eyes, nose and skin. Apart from improving the water quality, the low investment costs and high fresh water and energy consumption savings result in short payback times.

- Flow up to 809 m³/h



### UV System DULCODES LP

The unique UV systems DULCODES LP are synonymous with pioneering water treatment – efficient and free of chemicals.

- Flow up to 523 m³/h



### UV System DULCODES LP certified

UV system DULCODES LP for drinking water disinfection, comprehensively certified to internationally-recognised DVGW/SVGW/UVDGM standards. Looking to the future, the systems have already been type-tested in accordance with the latest DIN 19294-1:2020-08 test regulation. Successful certification officially confirms the precise 50-100% control range of the highly efficient VARIO-Flux lamps with dynamic lamp heating.

- Flow up to 406 m³/h



### UV System DULCODES LP F&B

UV system with hygienic design of radiation chamber. For reliable disinfection and constant quality in your production process.

- Flow up to 168 m³/h

**DULCONNEX**

## UV System DULCODES LP-PE

Disinfection of saline/seawater or thermal water with corrosion-resistant reactor the UV system DULCODES LP-PE. The UV system consists of a reactor and a UV sensor made of highly UV-resistant plastic.

■ Flow up to 505 m³/h



## UV System DULCODES LP TL

The UV system DULCODES LP TL for syrup disinfection declares war on heat-resistant germs. In instances when standard heat pasteurisation isn't up to the job, UV light provides a very quick and efficient form of disinfection without the need for heat.

■ Flow up to 36 m³/h

# Performance overview of ozone systems

The feed gas and the desired ozone concentration are key here. In this performance overview you can discover which ozone system is best suited to your purposes.

| Output [g/h] | OZVb | OZMa 1-6 A | OZLa |
|---|---|---|---|
| 6.000 | | | |
| 4.000 | | | |
| 2.000 | | | |
| 1.000 | | | |
| 500 | | | |
| 200 | | | |
| 100 | | | |
| 50 | | | |
| 20 | | | |
| 10 | | | |
| 5 | | | |
| 2 | | | |
| Feed gas | Air | Air | Oxygen |
| Ozone concentration | 20 g/Nm$^3$ | 20 g/Nm$^3$ | 150 g/Nm$^3$ |

# Ozone Systems

Ozone systems are normally used for the treatment of potable water, swimming pool water, water in the food and beverage industry, aquarium and pool water in zoos as well as cooling water and process water.

### Ozone System OZONFILT OZVb

OZONFILT OZVb is powerful and compact and is ideal for efficient ozone generation from compressed air in the output range of up to 70 g/h. The turnkey ozone system including mixing equipment offers everything you need for safe and seamless operation.

- Ozone capacity 10 – 70 g ozone/h

### Ozone System OZONFILT OZMa

OZONFILT OZMa is synonymous with maximum operational safety and minimal operating costs. The ozone generator is maintenance-free and generates up to 420 g/h of ozone from compressed air.

- Ozone capacity 70 – 420 g ozone/h

### Ozone System DULCOZON OZLa

DULCOZON OZLa is an ozone generator with low life cycle costs. It combines a high ozone concentration with unbeatable efficiency.

- Ozone output 360 - 5,760 g ozone/h

### System Solution OZONFILT Compact OMVb

OZONFILT Compact OMVb is a complete, ready-to-use system solution for the generation and metering of ozone.

- Ozone capacity 20 – 70 g/h

# Performance Overview of Chlorine Dioxide Systems

In the performance overview you will find the right system for every application. Can't find your application? No problem! Our specialists love a challenge.

| Output [g/h] | CDLb | CDLb H$_2$SO$_4$ | CDEb | CDVd | CDKd |
|---|---|---|---|---|---|
| 15,000 | | | | | |
| 10,000 | | | | | |
| 5,000 | | | | | 15–12,000 |
| 1,000 | | | | | |
| 500 | | | | 3–2,000 | |
| 100 | 0–120 | | 5–200 | | |
| 50 | | 8–89 | | | |
| 10 | | | | | |
| 5 | | | | | |

## Production Process

| | CDLb | CDLb H$_2$SO$_4$ | CDEb | CDVd | CDKd |
|---|---|---|---|---|---|
| | Diluted hydrochloric acid 7.5 % NaClO$_2$ + 9 % HCl | Sodium chlorite – sulphuric acid 7.5 % NaClO$_2$ + 25 % H$_2$SO$_4$ | Diluted hydrochloric acid 7.5 % NaClO$_2$ + 9 % HCl | Diluted hydrochloric acid 7.5 % NaClO$_2$ + 9 % HCl | Concentrated hydrochloric acid 24.5 % NaClO$_2$ + 25–37 % HCl |

## Applications

| | CDLb | CDLb H$_2$SO$_4$ | CDEb | CDVd | CDKd |
|---|---|---|---|---|---|
| Legionella control | ■ | | | | |
| Food and beverage industry | ■ | ■ | ■ | ■ | |
| Municipal drinking water and waste water treatment | ■ | | ■ | ■ | ■ |
| Industry (cooling tower waste water/process water etc.) | ■ | ■ | ■ | ■ | ■ |

# Chlorine Dioxide Systems



### Chlorine Dioxide System Bello Zon CDLb

Chlorine dioxide system for production of a chlorine-free chlorine dioxide solution, especially suitable for multiple points of injection. Bello Zon CDLb produces $ClO_2$ discontinuously using the acid/chlorite process with diluted chemicals.

- 0 – 120 g/h capacity with storage of up to 60 g of chlorine dioxide for peak metering. Max. flow rate at 0.2 ppm $ClO_2$ metering capacity of 600 $m^3$/h



### Chlorine Dioxide System Bello Zon CDLb $H_2SO_4$

Bello Zon CDLb $H_2SO_4$ especially for applications critical with regard to corrosion for the production of low-chloride chlorine dioxide liquid. With the chlorine dioxide system, $ClO_2$ is produced discontinuously following the acid/chlorite procedure.

- 8 – 89 g/h chlorine dioxide generation



### Chlorine Dioxide System Bello Zon CDLb with Multiple Points of Injection

Flexible solutions for the production and metering of $ClO_2$ adapted to our customer's tasks, requirements and anticipated pricing.

- 0 – 120 g/h capacity with storage of up to 60 g of chlorine dioxide for peak metering. Max. flow rate at 0.2 ppm $ClO_2$ metering capacity of 600 $m^3$/h, up to 6 points of injection possible as standard



### Chlorine Dioxide System Bello Zon CDEb

Chlorine dioxide system, which continuously produces $ClO_2$ according to the acid/chlorite method with diluted chemicals. Extremely simple operation, clear construction, analogue control, manual control or via contacts.

- 5-200 g/h chlorine dioxide. Max. flow at 0.2 ppm $ClO_2$ metering is 1,000 $m^3$/h

## Chlorine Dioxide System Bello Zon CDVd

Chlorine dioxide system for the metering of chlorine dioxide with diluted starting chemicals. The certified yield guarantees efficient chlorine dioxide production. Bello Zon CDVd can be easily and safely integrated into any water treatment process.

- 2.5 – 2,000 g/h chlorine dioxide. Maximum volume of water that can be treated with metering of 0.2 ppm $ClO_2$, depending on the size of the system: 50 - 10,000 $m^3/h$



## Chlorine Dioxide System Bello Zon CDKd

Chlorine dioxide system for the metering of chlorine dioxide with concentrated starting chemicals. The proven safety concept protects people and the environment. The certified yield guarantees efficient chlorine dioxide production. Bello Zon CDKd can be easily and safely integrated into any water treatment process.

- 7.5 – 12,000 g/h chlorine dioxide. Maximum volume of water that can be treated with metering of 0.2 ppm $ClO_2$, depending on the size of the system: 60,000 $m^3/h$

# Performance overview of electrolysis systems

In the performance overview you will find the right system for every application. Can't find your application? No problem! Our specialists love a challenge.

| Output [g/h] | CHLORINSITU IIa | CHLORINSITU IIa XL | CHLORINSITU III | CHLORINSITU V | CHLORINSITU V Plus |
|---|---|---|---|---|---|
| Production of HOCl | | | | ■ | ■ |
| Production of NaOCl | ■ | ■ | ■ | | ■ |

**Applications**

| Applications | CHLORINSITU IIa | CHLORINSITU IIa XL | CHLORINSITU III | CHLORINSITU V | CHLORINSITU V Plus |
|---|---|---|---|---|---|
| Drinking water | ■ | ■ | ■ | ■ | ■ |
| Wastewater | ■ | ■ | ■ | ■ | ■ |
| Process water | ■ | ■ | ■ | ■ | ■ |
| Swimming pool | ■ | ■ | ■ | ■ | ■ |
| Cooling towers | | | ■ | ■ | ■ |

(Output scale [g/h]: 1.000 · 2.000 · 3.000 · 4.000 · 5.000 · 6.000 · 7.000 · 8.000 · 9.000 · 10.000 · 20.000 · 30.000 · 40.000)

| Output [g/h] | DULCOLYSE | CHLORINSITU III & V Compact |
|---|---|---|
| Food and beverage industry | ■ | |
| Drinking water | | ■ |
| Cooling towers | | ■ |
| Swimming pool | | ■ |

**Application**

(Output scale [g/h]: 100 · 200 · 300 · 400 · 600 · 800)

# Electrolysis Systems

What a great idea: no chemicals to be transported and no need to store and handle hazardous substances. Instead: sophisticated systems use harmless sodium chloride – ordinary salt – to produce chlorine, hydrogen and sodium hydroxide solution.

DULCONNEX

### Electrolysis System CHLORINSITU IIa 60 – 2,500 g/h

CHLORINSITU IIa is a compact on-site electrolysis system for the production of a low-chlorate hypochlorite solution from salt and electricity. Key advantages are its simple process management and excellent system safety through integrated ventilation and bleeding.

■ Output 60 – 2,500 g/h of chlorine

### Electrolysis System CHLORINSITU IIa XL

CHLORINSITU IIa XL is the tubular cell electrolysis system for on-site production of large quantities of hypochlorite. Users cannot fail to be impressed by its ease of operation and outstanding efficiency combined with optimum process stability for the reliable disinfection of large volumetric flows.

■ Output 5 – 45 kg/h of chlorine

### Electrolysis System CHLORINSITU III

Ultra-pure or low-chloride and low-chlorate sodium hypochlorite requires specialist plant engineering. The electrolysis system CHLORINSITU III is the solution for you.

■ Output 100 – 10,000 g/h of chlorine

### Electrolysis System CHLORINSITU III Compact

Generation of sodium hypochlorite solution for smaller swimming pools and pools.

■ Output 25 – 50 g/h of chlorine

**Electrolysis System CHLORINSITU V Compact**

Produce high-purity chlorine gas in a vacuum process. Cost-effective, robust and compact.

■ Output 25 – 50 g/h of chlorine



**Electrolysis System CHLORINSITU V**

Electrolysis systems of type CHLORINSITU V take the place of the chlorine gas system in the swimming pool and only need salt, water and electricity to do so.

■ Output 100 – 3,500 g/h of chlorine



**Electrolysis System CHLORINSITU V Plus**

Electrolysis systems of type CHLORINSITU V Plus generate ultra-pure chlorine gas directly on site and only need salt, water and electricity to do so. Peaks in demand can be covered by this system (Plus system). They are especially well suited to systems for disinfecting potable water, wastewater, process water and water in swimming pools and cooling towers.

■ Output 100 – 3,500 g/h of chlorine



**Electrolysis System DULCOLYSE**

Efficient production of the highly effective disinfectant DULCOLYT 400 with an exceptionally low chloride and chlorate content. Ideal for particularly sensitive applications in the beverage and food industry, e.g. for the production of beer, soft drinks and baby food. Maximum protection against corrosion and very good cost efficiency.

■ Output: up to 800 g/h

# Metering Systems for Polymers

The elimination of solids from liquids requires the use of liquid or powder polymers. This is achieved using polymer preparation and metering systems. The experts in waste water treatment at ProMinent understand how to provide the efficient technology to implement this specialist application. Our metering systems were developed for the most stringent requirements, and are also especially easy to assemble and operate.

## Metering system ULTROMAT ULFb (continuous flow system)

The polymer preparation system ULFb processes powdered and liquid polymers to produce a matured polymer solution. Wins customers over with its novel round tank design with 3 chambers, which improves mixing efficiency, operation and maintenance.

■ Extraction rate of 500 to 10,000 l/h

## Metering System ULTROMAT ULPa

The metering system ULTROMAT ULPa (oscillating system) is ideal for batching flocculation aids for the preparation of a ready-to-use polymer solution.

■ Extraction rates from 400 to 4,000 l/h

## Metering System ULTROMAT ULDa

The ProMinent metering system ULTROMAT ULDa is an automatic polyelectrolyte preparation system. It is useful wherever polymers need to be automatically prepared as polymer solutions to act as flocculation aids.

■ Extraction rates of up to 2,000 l/h

## Metering System DULCODOS ULIa (Inline System Liquid)

The polymer preparation system DULCODOS ULIa is an inline system and processes liquid polymers to produce a fully activated solution. It is ideally equipped for your application with integrated mixing and maturing chamber and novel peristaltic metering pump.

■ Extraction volume 100 – 400 l/h against 4.5 bar

### Metering System ULTROMAT MT for Batch Operation

Manual polymer batching station ULTROMAT MT: Perfect metering system for the processing of small quantities of liquid and powdered polymers: extremely robust and cost-effective.

- Capacity range 120 – 3,800 l/h



### Metering System PolyRex

The metering system PolyRex is a double-decker batching station for the processing of liquid and powdered polymers. It consists of the feed and mixer unit and the two stainless steel double-decker tanks. The polymers used are ideally utilised.

- Capacity range up to 10,200 l/h



### Metering System POLYMORE

The metering system POLYMORE is an inline batching station in which the liquid polymer is introduced into the pressure-encapsulated multi-zone mixing equipment with the dilution water through a peristaltic pump. The result is a prepared and homogeneous polymer solution.

- Capacity range of up to 18,000 l/h

# Tanks, metering and emptying stations

**DULCODOS SAFE-IBC is a special metering and emptying station for Intermediate Bulk Containers (IBC) with almost complete residual drainage.**



### Metering and emptying station DULCODOS SAFE-IBC F&B

The metering and emptying station DULCODOS SAFE-IBC provides your process with chemicals with no interruptions. Thanks to the specially developed, new design, we can now offer systems conforming to common requirements for installations in the food & beverage industry.

- We deliver in conformity with EN 1935/2004 and EN 10/2011



### Metering and emptying station DULCODOS SAFE-IBC

The metering and emptying station DULCODOS SAFE-IBC provides your process with chemicals interruption-free. It conforms to the modified legislature for liquids harmful to water in accordance with the German Ordinance for Systems Handling Substances Harmful to Water AwSV.

- Storage and drainage of IBCs up to 1,000 l – metering of chemicals up to 1,000 l/h



### Storage Tanks

Our plastic storage tanks guarantee compliance with statutory specifications taking into account country-specific approvals, which regulate the production and operation of systems for storage and metering of environmentally hazardous substances.

- Useful capacity 500 l – 50,000 l, indoor and outdoor installation

# Metering Systems for Solids

ProMinent supplies everything you need for metering and treating solids in your production process. We even have cost-effective solutions for problematic applications, for example substances with noticeable weight fluctuations or problems with bridging.



### TOMAL® Big Bag Emptying Unit

This emptying unit is used to accommodate and empty Big Bags weighing up to 1,000 kg. The Big Bags are suspended in the frame with the aid of a lifting cross bar. The 30-litre powder storage tank is used to transfer the powder into a feed unit.

■ Emptying of Big Bags up to 1,000 kg
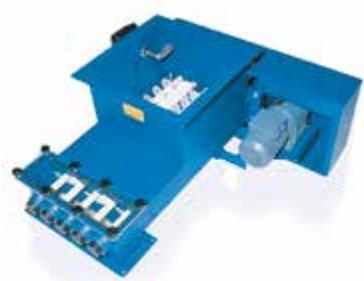


### TOMAL® Multi-Screw Feeder

Its unique construction makes the multi-screw feeder ideally suited for metering powders and granulates.

■ Capacity range 0.4 – 215 m³/h

# Membrane Filtration Plants

ProMinent is an expert in membrane filtration and supplies a wide range of high-quality plant engineering. Combined with the extensive ProMinent product range, made-to-measure solutions can be developed. ProMinent membrane technology covers ultrafiltration, nanofiltration and reverse osmosis, including pre- and post-treatment precisely matched to the membrane system.



### Ultrafiltration system DULCOCLEAN UF

Ultrafiltration system DULCOCLEAN UF reliably and safely uses membrane technology to remove turbidity, particles and microbiological contamination.

- 8 – 75 $m^3$/h filtrate output



### Nanofiltration System DULCOSMOSE NF

As a nanofiltration system, the DULCOSMOSE NF, a compact and value-for-money unit, can handle partial desalination in industrial applications. Maximum permeate output at low operating pressures ensures low operating costs thanks to the "ultra low pressure" diaphragm.

- Permeate outputs from 1 to 50 $m^3$/h, higher outputs possible on request



### Reverse Osmosis System DULCOSMOSE TW

Reverse osmosis system DULCOSMOSE TW is the all-purpose model for modern potable water desalination. Maximum permeate output at low operating pressures ensures low investment and operating costs.

- Permeate output 0.1 – 50 $m^3$/h

**Reverse Osmosis System DULCOSMOSE BW**

Reverse osmosis system DULCOSMOSE BW is the standard model for the modern desalination of brackish water. Equipped with the latest generation of 'high rejection low-pressure' membranes, this system achieves maximum permeate output with moderate operating pressures, thereby lowering investment and operating costs.

■ Permeate output 2,000 – 50,000 l/h



**Reverse Osmosis System DULCOSMOSE SW**

The reverse osmosis system DULCOSMOSE SW is the standard model for modern desalination of salt water. Equipped with the latest generation of 'high rejection low-pressure' membranes, this system achieves maximum permeate output with moderate operating pressures, thereby lowering investment and operating costs.

■ Permeate output 780 – 29,000 l/h

Water treatment and disinfection

# Customer services

ProMinent provides an expert full-service for all products, solutions and systems. Our experts will help you with everything from commissioning, maintenance and repairs to technical product and process advice.

Our experts work tirelessly to improve our services in order to provide rapid and targeted assistance. No matter whether you want assistance on-site at your plant, by phone, e-mail or remotely via the new ProMinent Smart-Support – we will quickly and expertly help you find the right solution.

And all this according to the principle of customer services – unlimited. Ready for you – any time. Anywhere.

**50+**
service centres
worldwide

**200+**
service staff
worldwide
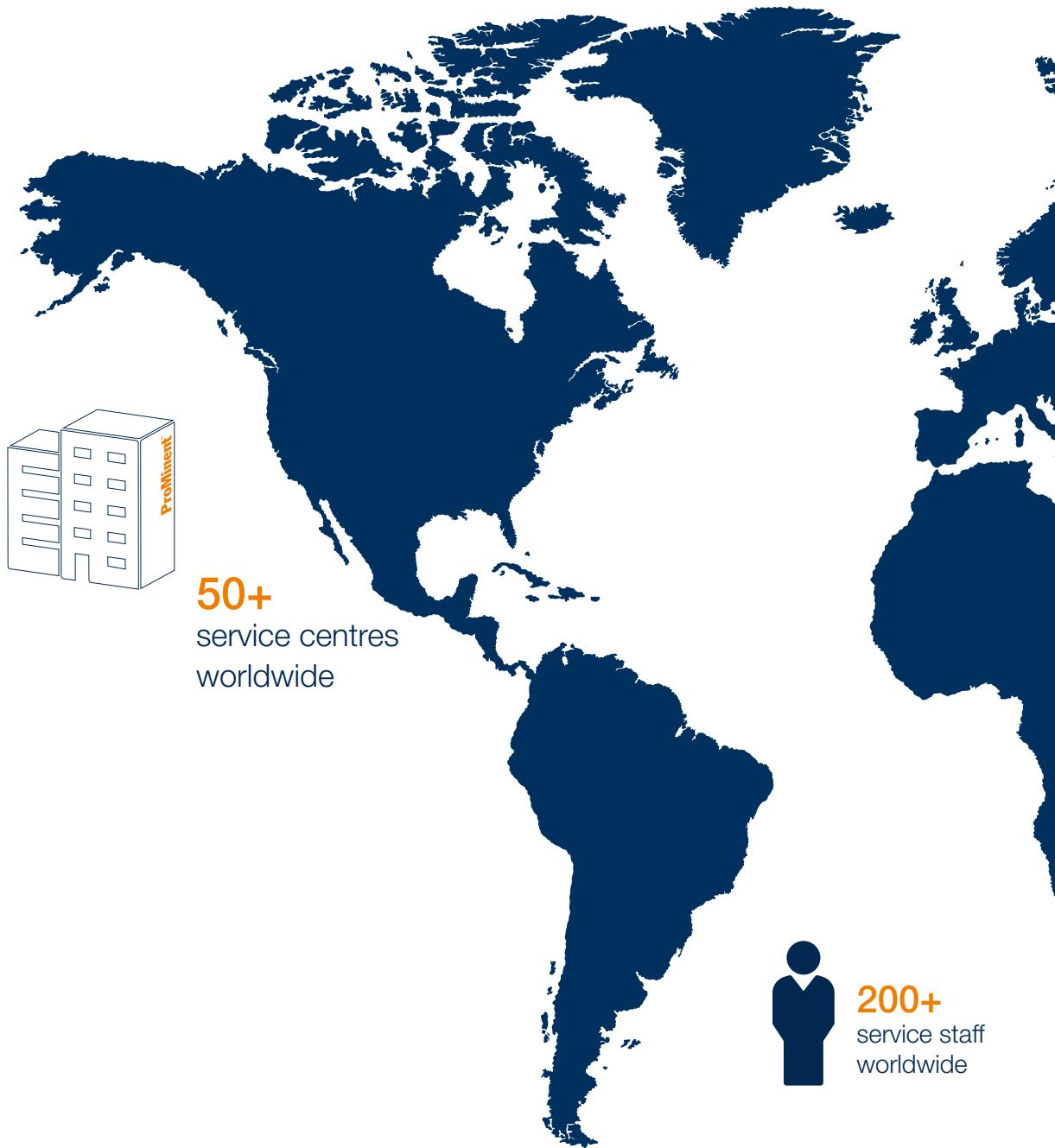
**40+**
service staff
throughout Germany

**20+**
different
services

# Recycling

Disposal

Decommissioning

Transport

Upgrades

Process optimisation

Calibration

Repair

# Optimisation

Smart Support

Ser
Lifec

**Start-up**

Installation

Start-up

Training

Inspection

Maintenance

Customised service

Spare parts service

Support Hotline **Ongoing operation**

vice
cycle
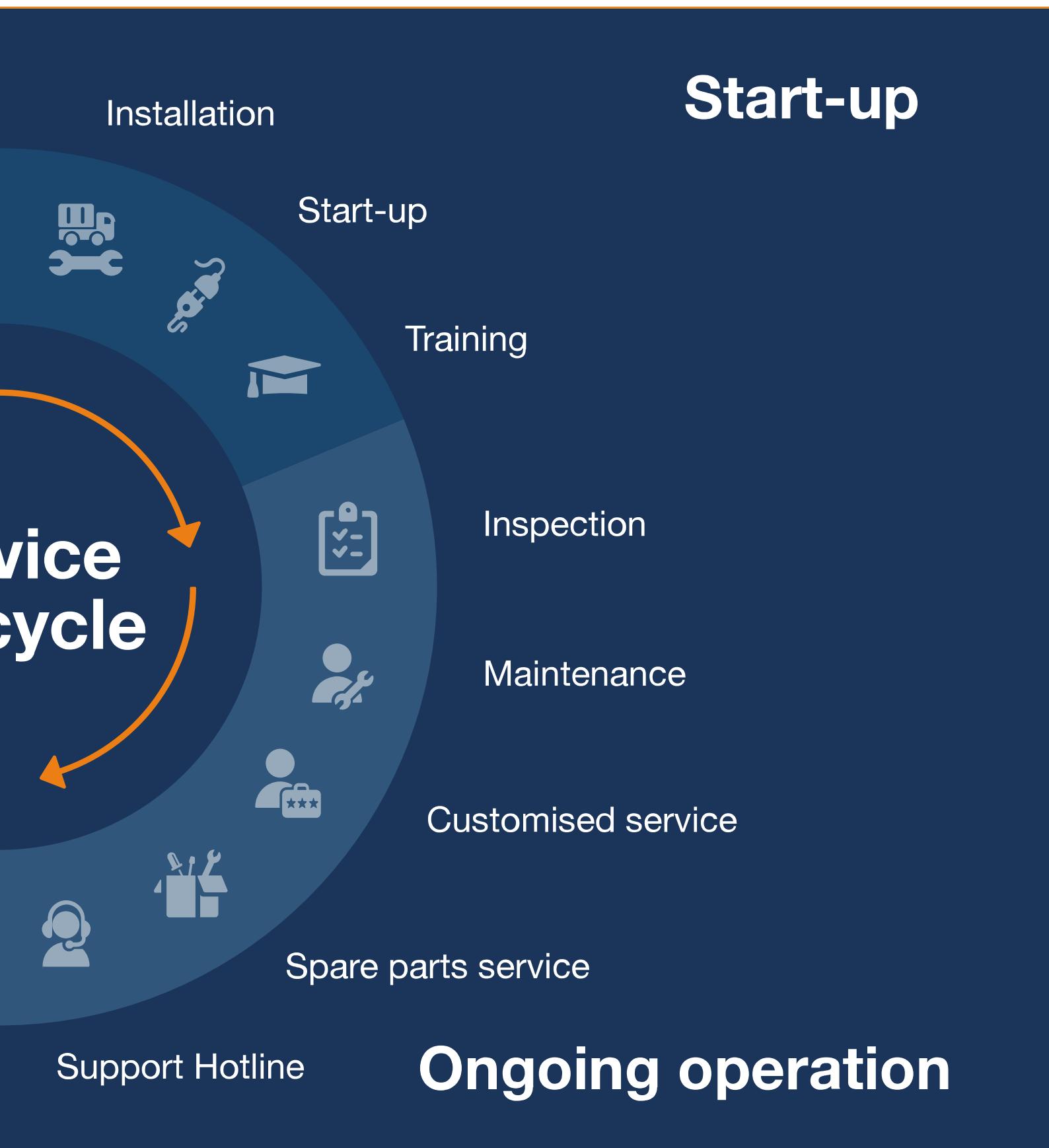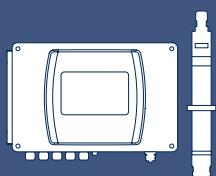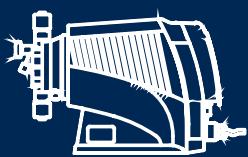
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