General Operating Instructions
Measuring/Control Stations DULCOTROL®
Drinking Water/F&B

These general operating instructions facilitate the installation and calibration of the measuring panel inclusive of its individual component parts. All further processes such as for example the setting of specific limit and control parameters are described in the individual operating instructions of the ProMinent® components. The individual operating instructions are enclosed with the measuring/control station DULCOTROL® drinking water/F&B.

Please enter the Identcode of your device

DULCOTROL® drinking water/F&B

Please enter the Identcode of your device

These general operating instructions apply only in conjunction with the individual operating instructions of all supplied individual components.

Please completely read through all operating instructions! Do not discard! The operator shall be liable for any damage caused by installation or operating errors!

Part no. 986421
ProMinent Dositechnik GmbH · 69123 Heidelberg · Germany

BA DR 001 02/09 GB
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One Measured Variable

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<td>C000</td>
<td>Free chlorine (at pH-value &lt; 8.0)</td>
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<td>C001</td>
<td>Free chlorine (at pH value &gt; 8.0 or unstable)</td>
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<td>G000</td>
<td>Total chlorine (free + combined chlorine)</td>
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<tr>
<td>P000</td>
<td>pH</td>
</tr>
<tr>
<td>R000</td>
<td>ORP</td>
</tr>
<tr>
<td>D000</td>
<td>Chlorine dioxide</td>
</tr>
<tr>
<td>G001</td>
<td>Chlorine</td>
</tr>
<tr>
<td>L000</td>
<td>Conductivity (only “water to be measured” 1)</td>
</tr>
<tr>
<td>Z000</td>
<td>Ozone</td>
</tr>
<tr>
<td>F000</td>
<td>Fluoride (pH min. = 5.5, pH max. = 8.5)</td>
</tr>
<tr>
<td>H000</td>
<td>Hydrogen peroxide</td>
</tr>
<tr>
<td>A000</td>
<td>Peracetic acid</td>
</tr>
<tr>
<td>X000</td>
<td>Dissolved oxygen</td>
</tr>
</tbody>
</table>

Water to be measured

1 Drinking water / product water, T< 45 °C
2 Rinsing water / service water / process water, T< 45 °C
3 Drinking water / product water T= 45 °C and < 55 °C (only measured variable D000, H000, A000, others only with accessory: heat exchanger)
4 Rinsing water / service water / process water T= 45 °C and <55 °C (only measured variable D000, H000, A000, others only with accessory: heat exchanger)
5 Drinking water / product water T= 55 °C and <80 °C (only measured variable: heat exchanger)
6 Rinsing water / Industrial water / process water T= 55 °C and <80 °C (only with accessory: heat exchanger)

Usage category

0 All measured variables only measurable
9 All measured variables two-way controllable

Power supply

A 230 V, 50/60 Hz
C 115 V, 50/60 Hz

Sensor equipment

0 With sensors
1 Without sensors

Version

0 With ProMinent Logo
1 Stainless steel cabinet

Sample water treatments

0 None
1 With filter
2 With peristaltic pump
3 With filter and peristaltic pump

Accessories

0 None
1 With pressure reducer
2 With heat exchanger
3 With sample water pump
4 With pressure reducer and heat exchanger
5 With heat exchanger and sample water pump

Language

DE German
EN English
FR French
NL Dutch
ES Spanish, not for H000 / A000
PL Polish, not for H000 / A000
SV Swedish, not for H000 / A000
HU Hungarian, not for H000 / A000
PT Portuguese, not for H000 / A000
CS Czech, not for H000 / A000

Approvals

ICE
### Identcode Measuring/Control Station DULCOTROL® Drinking Water/F&B – Two Measured Variables

<table>
<thead>
<tr>
<th>PWCA</th>
<th>Measured variable</th>
<th>Water to be measured</th>
<th>Usage category</th>
<th>Power supply</th>
<th>Sensor equipment</th>
<th>Sample water treatments</th>
<th>Language</th>
<th>Approvals</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWCA</td>
<td></td>
<td></td>
<td></td>
<td>A 230 V, 50/60 Hz</td>
<td>0 Without sensors</td>
<td>0 None</td>
<td>DE German</td>
<td>1C E</td>
</tr>
<tr>
<td>CP00</td>
<td>Free chlorine / 2. pH (at pH-value &lt; 8.0)</td>
<td>Drinking water / product water, T&lt; 45 °C</td>
<td>0 All measured variables only measurable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP01</td>
<td>Free chlorine / 2. pH (at pH-value &gt; 8.0 or unstable)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN00</td>
<td>Free chlorine / 2. ORP (at pH-value &lt; 8.0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CN01</td>
<td>Free chlorine / 2. ORP (at pH-value &gt; 8.0 or unstable)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CP00</td>
<td>Total chlorine / 2. pH (free+combined chlorine)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RP00</td>
<td>ORP / 2. pH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RP01</td>
<td>Hydrogen peroxide / 2. pH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RP02</td>
<td>Fluoride / 2. pH (pH min. = 5.5, pH max. = 8.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AP00</td>
<td>Peracetic acid / 2. pH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LP00</td>
<td>Conductivity / 2. pH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AU00</td>
<td>Peracetic acid / 2. conductivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP00</td>
<td>Chlorine dioxide / 2. pH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DP01</td>
<td>Chlorine dioxide / 2. ORP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GP00</td>
<td>Total chlorine / 2. ORP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RP00</td>
<td>ORP / 2. pH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Water to be measured
1. Drinking water / product water, T< 45 °C
2. Drinking water / product water, T> 45 °C and < 55 °C (only measured variable RP00, HP00, AP00, LP00, AL00, DP00, DR00, others only with accessory: heat exchanger)
3. Drinking water / product water, T> 45 °C and < 55 °C (only measured variable RP00, HP00, AP00, LP00, AL00, DP00, DR00, others only with accessory: heat exchanger)
4. Drinking water / product water, T> 45 °C and < 60 °C (only with accessory: heat exchanger)
5. Drinking water / industrial water / process water, T> 55 °C and < 80 °C (only with accessory: heat exchanger)

#### Usage category
0 All measured variables only measurable
1 1st measured variable two-way controllable, 2nd measured variable only measurable
2 2nd measured variable two-way controllable, 1st measured variable only measurable
3 Both measured variables one-way controllable with two-channel controller D2C (only for CP00, CP01, GP00, RP00, DP00)
9 All measured variables two-way controllable

#### Power supply
A 230 V, 50/60 Hz
C 115 V, 50/60 Hz

#### Sensor equipment
0 Without sensors
1 With sensors

#### Sample water treatments
0 None
1 With filter
2 With peristaltic pump
3 With filter and peristaltic pump

#### Language
DE German
EN English
FR French
IT Italian
NL Dutch
ES Spanish, not for H and A in HP00 / AP00/ AL00
PL Polish, not for H and A in HP00 / AP00/ AL00
SV Swedish, not for H and A in HP00 / AP00/ AL00
HU Hungarian, not for H and A in HP00 / AP00/ AL00
PT Portuguese, not for H and A in HP00 / AP00/ AL00
CS Czech, not for H and A in HP00 / AP00/ AL00

#### Approvals
1C E
Identcode Measuring/Control Station DULCOTROL® Drinking Water/F&B – Three Measured Variables

<table>
<thead>
<tr>
<th>Identcode</th>
<th>Measured variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWCA</td>
<td>CPL0: Free chlorine / pH / Conductivity (at pH-value &lt; 8.0)</td>
</tr>
<tr>
<td></td>
<td>CPL1: Free chlorine / pH / Conductivity (at pH-value &gt; 8.0 or unstable)</td>
</tr>
<tr>
<td></td>
<td>CRP0: Free chlorine / ORP / pH (at pH-value &lt; 8.0)</td>
</tr>
<tr>
<td></td>
<td>CRP1: Free chlorine / ORP / pH (at pH-value &gt; 8.0 or unstable)</td>
</tr>
<tr>
<td></td>
<td>GPL0: Total chlorine / pH / Conductivity (free+combined chlorine)</td>
</tr>
<tr>
<td></td>
<td>GRP0: Total chlorine / ORP / pH (free+combined chlorine)</td>
</tr>
<tr>
<td></td>
<td>DPR0: Chlorine dioxide / pH / ORP (with “water to be measured”: 1, 3, 5)</td>
</tr>
<tr>
<td></td>
<td>DPR1: Chlorine dioxide / pH / ORP (only “water to be measured”: 1, 3, 5)</td>
</tr>
<tr>
<td></td>
<td>DPI0: Chlorine dioxide / pH / Chlorite (only “water to be measured”: 1, 3, 5)</td>
</tr>
<tr>
<td></td>
<td>DRI0: Chlorine dioxide / ORP / Chlorite (only “water to be measured”: 1, 3, 5)</td>
</tr>
<tr>
<td></td>
<td>ZPR0: Ozone / pH / ORP</td>
</tr>
<tr>
<td></td>
<td>ALP0: Peroxid acid / Conductivity / pH</td>
</tr>
</tbody>
</table>

Water to be measured:
1. Drinking water / product water, T < 45 °C
2. Rinsing water / industrial water / process water, T < 45 °C
3. Drinking water / product water, T < 45 °C and < 55 °C (only measured variable: DPR0, DPI0, ALP0)
4. Rinsing water / industrial water / process water, T < 45 °C and < 55 °C (only measured variable: DPR0, DPI0, ALP0)
5. Drinking water / product water, T < 55 °C and < 80 °C (only with accessory: heat exchanger)
6. Rinsing water / industrial water / process water, T < 55 °C and < 80 °C (only with accessory: heat exchanger)

Usage category:
0. All measured variables only measurable
1. 1st measured variable two-way controllable, 2nd + 3rd measured variable only measurable
2. 2nd measured variable two-way controllable, 1st + 3rd measured variable only measurable
3. 1st + 2nd measured variable one-way controllable with two-channel controller D2C and 3rd measured variable only measurable (only for CPL0, CPL1, GPL0, GRP0, DPR0)
4. 1st measured variable two-way controllable, 2nd + 3rd measured variable one-way controllable with two-channel controller D2C
5. All measured variables two-way controllable

Power supply:
A 230 V, 50/60 Hz
C 115 V, 50/60 Hz

Sensor equipment:
0. With sensors
1. Without sensors

Version:
0. With ProMinent logo
1. Stainless steel cabinet

Sample water treatments:
0. None
1. With filter
2. With peristaltic pump
3. With filter and peristaltic pump

Accessories:
0. None
1. With pressure reducer
2. With heat exchanger
3. With sample water pump
4. With pressure reducer and heat exchanger
5. With heat exchanger and sample water pump

Language:
DE German
EN English
FR French
IT Italian
NL Dutch
ES Spanish
PL Polish
SV Swedish
HU Hungarian
PT Portuguese
CS Czech

Approvals:
CE
General User Information

Please read through the following user guidelines! Familiarity with these points ensures optimum use of the operating instructions.

Key points in the text are indicated as follows:

• Enumerations
  ▶ Hints

Working guidelines:

**NOTE**

*A note is to facilitate your work.*

Notes on safety are identified by pictographs.
1 Safety Chapter

1.1 Identification of the Notes on Safety

The following terms are used in the present operating instructions to indicate the various severity levels of the danger:

**DANGER**
Characterizes a possibly hazardous situation. There is a danger of death or serious injuries if these notes are disregarded.

**WARNING**
Characterizes a possibly hazardous situation. Your life is in danger and there is a danger of serious injury or death if these notes are disregarded!

**CAUTION**
Characterizes a possibly hazardous situation. There is a danger of slight or minor injury or damage to property if these notes are disregarded.

**NOTE**
A note provides important notes for the correct functioning of the unit or is to facilitate your work.

The following warning signs are used in the present operating instructions to indicate different types of the danger:

- **Warning of danger area**
- **Warning of hazardous electrical voltage**
- **Warning of caustic substances**
- **Warning of hot surfaces**
- **Warning of unexpected start**

1.2 General Notes on Safety

**WARNING**
- **Live parts!**
  - Disconnect from mains plug before opening the housing.
- **De-energise damaged, defective or manipulated units by disconnecting the mains plug.**

**WARNING**
- **Hot surfaces!**
  - Risk of burning at the surfaces of the measuring station.
  - For sample water > 55 °C, a temperature monitor with solenoid valve has to be installed to protect the DULCOTROL® measuring/control station. The temperature monitor is not included in the scope of delivery and must be installed by the customer.
  - Suitable measures must be taken to prevent that nobody gets into contact with hot surfaces.
WARNING

• Hazardous substances!
• Hazards from contact, inhalation or other contamination with/by substances or media!
• Observe the safety data sheet of the used substance/media.
• The operator of the DULCOTROL® measuring/control station is responsible for the fact that the safety data sheets are available and up-to-date.

WARNING

• Unexpected start of the DULCOTROL® measuring/control station after failure, malfunction of the control/voltage supply or as intended action because of a control process!
• Hazards from unexpected actions of the stations!
• In case of malfunction/failure of the control or voltage supply, the DULCOTROL® measuring/control station is to be disconnected from the voltage supply. For further information see the operating instructions of the DULCOMETER® D1C units and sensors.

WARNING

• Operating error!
• Hazards from operating errors!
• The DULCOTROL® measuring/control stations may only be operated by sufficiently qualified and trained personnel.

WARNING

• Electrical hazards from lightning!
• Hazards from overvoltage because of lightning stroke into external installations which are connected to the DULCOTROL® measuring/control station.
• Do neither directly nor indirectly use the DULCOTROL® measuring/control station for use in the open.
• Provide for sufficient potential to ground when installing electrical components.

NOTE

• Protect the DULCOTROL® measuring/control stations against unauthorised access!
• Please also read the operating instructions of the controllers and fittings and any other existing assemblies such as sensors, sample water pump ... !
• Please observe the resistance of the materials of all assemblies in contact with the media. (see e.g. the ProMinent resistance list in the product catalogue or at www.prominent.com.)
• Protect the DULCOTROL® measuring/control station against direct exposure to the sun and other UV sources!
• Please observe the basic rules of ergonomic principles!

1.3 Information for Emergencies

• Electrical emergency: Switch off the DULCOTROL® measuring/control station via the mains switch, at the terminal box or at the place specified by the operator!
• Hydraulical emergency: Close the DULCOTROL® measuring/control station at the inlet- or outlet-side ball valve, observe the safety data sheet of the medium!
Safety Chapter / Storage and Transport

1.4 Proper Use

• The DULCOTROL® measuring/control stations are only designed to measure or control liquid metering media in accordance with the Identcode feature specified on the rating plate of the measuring/control station.
• The DULCOTROL® measuring/control stations are not designed to meter or control gaseous or solid media.
• The DULCOTROL® measuring/control stations may only be used in compliance with the technical data and specifications stated in these operating instructions and the operating instructions of the individual components!
• You are obliged to observe the information in the operating instructions on the various life phases of the DULCOTROL® measuring/control stations (such as assembly, installation, ...)! 
• The DULCOTROL® measuring/control stations may not be used for applications in the open.
• All other uses or modifications of the DULCOTROL® measuring/control stations require the prior written consent of ProMinent Dositechnik GmbH, Heidelberg, Germany.
• The DULCOTROL® measuring/control stations may only be operated by sufficiently qualified personnel (see table below). The operator of the DULCOTROL® measuring/control station is responsible for the qualification of the personnel.

1.5 Qualification of the Personnel

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting, installation, hydraulic</td>
<td>Qualified employee</td>
</tr>
<tr>
<td>Installation, electrical</td>
<td>Qualified employee</td>
</tr>
<tr>
<td>Commissioning</td>
<td>Trained user</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Trained person</td>
</tr>
<tr>
<td>Troubleshooting</td>
<td>Qualified employee</td>
</tr>
<tr>
<td>Disposal</td>
<td>Trained person</td>
</tr>
</tbody>
</table>

2 Storage and Transport

CAUTION

• Before storing or transporting, the DULCOTROL® measuring/control stations must be free from metering media and water!
• Only transport and store the DULCOTROL® measuring/control station in its original packaging!
• Protect the packaged DULCOTROL® measuring/control station also against moisture and exposure to chemicals and mechanical influences!
• Please also read the operating instructions of the controllers and fittings and any other existing assemblies such as sensors, sample water pump ...

Environmental conditions for storage and transport of measuring panel without sensors

Temperature 5 ... 50 °C

Relative humidity < 95 % relative humidity, non-condensing

Sensors Store and transport the sensors within the sensor-specific parameters. For information on the individual cases, please see the documentation for the individual sensors.

NOTE

If the DULCOTROL® measuring/control stations are stored together with the sensors as an assembly, the storage and transport conditions should be adjusted to the component part with the lowest resistance to external influences!
3 About this Product

3.1 DULCOTROL® Drinking Water/F&B

DULCOTROL® measuring/control stations are complete and compact online process measuring/control stations mounted on a PE panel which are installed into a process water bypass. 1-3 measured variables can be configured on one single panel specific to the sample water. The measuring devices can be equipped with a measuring function and numerous control functions as required.

Optionally, a filter, pressure reducer, heat exchanger, and/or a sample water pump can be ordered for sample water conditioning. These are installed beyond the panel.

Measurement panels from two controllers onward include a terminal box for a safe electrical connection. All connecting cables are routed in a cable conduit.

The measuring/control stations DULCOTROL® drinking water/F&B are specifically designed for the drinking water industry as well as the food and beverages industry. Furthermore, the special requirements are met which are given on the part of the drinking water / product water treatment and the rinsing water, industrial water, and process water treatment.

In the following Identcode, the feature “water to be measured” is thus differentiated into:

- “drinking/product water treatment”: this means the final treatment (e.g. disinfection) of water similar to drinking water as performed in the production of drinking water or in the production of beverages or food
- rinsing/industrial/process water: this includes e.g. all rinsing processes in the food and beverages industry aimed at the cleaning and disinfection of pipings, vessels and machines or process or industrial water with a higher level of contamination.

Scope of delivery Check the scope of delivery based on the delivery note and the Identcode!

4 Overview of Measuring Stations

4.1 DULCOTROL® Measuring/Control Station with In-line Probe DGMa
Overview of Measuring Stations

The measuring panel DULCOTROL® measuring/control station with fitting and in-line probe DGMa is produced in a customer-specific configuration. It consists of at least one D1C controller, a sensor and the in-line probe DGMa with one measuring module. Depending on the customer’s needs it can be extended by further components which are greyed out here. In case of more than one controller, a terminal box is added for the electrical installation.

Optionally, a compatible filter, pressure reducer, heat exchanger, and/or a sample water pump can be ordered for sample water conditioning.

4.2 DULCOTROL® Measuring/Control Station with Fitting and In-line Probe DLG III

The measuring panel DULCOTROL® measuring/control station with fitting and in-line probe DLG III is produced in a customer-specific configuration. It consists of at least one D1C controller, a sensor and the in-line probe DLG III. Depending on the customer’s needs it can be extended by further components which are greyed out here. In case of more than one controller, a terminal box is added for the electrical installation.

Optionally, a compatible filter, pressure reducer, heat exchanger, and/or a sample water pump can be ordered for sample water conditioning.
Overview of Measuring Stations / Mounting/Installation

4.3 DULCOTROL® Measuring/Control Station, Installation Diagram

Diagram of the components of a DULCOTROL® measuring/control station which are installed beyond the measuring panel in the sequence represented here. The sequence of the installation is binding and must be absolutely adhered to.

Components:
1  Sample water pump “vonTaine”
2  Heat exchanger
3  Pressure reducer
4  Dirt filter
5  Measuring panel
6  Free outlet
7  Process line
8  Shut-off valve
9  Temperature monitor with shut-off valve

Not included in delivery scope, to be installed by the customer at media temperatures > 55 °C

5 Mounting / Installation

CAUTION
Please also read the operating instructions of the fittings and any other existing assemblies such as sensors, sample water pump ...

5.1 Mounting (mechanical)

WARNING
- Live parts!
- Please make sure that there are no concealed wirings when drilling holes to mount the DULCOTROL® measuring/control station.

CAUTION
- Remove any water from the DULCOTROL® measuring/control station and the supplied components before assembly if metering media are used which may not come into contact with water!
- Install the DULCOTROL® measuring/control station vertically and upright at a wall or a stable support bracket! Make sure that the wall or support bracket can support the station!
- The DULCOTROL® measuring/control station must be easily accessible!
CAUTION

- Metering media may be metered in excess.
- If the float of the flow module gets stuck because of contaminations, the DULCOTROL® measuring/control station may meter in excess!
- Install a filter, depending on the type and composition of the sample water.
- If the circulating pump does not deliver, the DULCOTROL® measuring/control station may meter in excess!
- Interlock the control via the potential-free contact of the circulating pump. If the circulating pump is “OFF”, the DULCOTROL® measuring/control station goes to “PAUSE” via the pause input of the controller.
- Alternatively, the metering pumps can be switched such that they only work together with the circulating pumps.

5.1.1 Measuring Station

The mounting height should be selected such that:

- the LCD panel of the control is well readable
- the cover of the controller can still be parked in “park position” (145 mm)
- there is still enough space below the in-line probe to carry out maintenance work (100 mm)
- there is enough space for the mounting of accessories beyond the panel

The following drilling dimensions are to be observed in accordance with the panel size:

<table>
<thead>
<tr>
<th>Number of measured variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>595</td>
<td>695</td>
<td>1000</td>
</tr>
<tr>
<td>B</td>
<td>745</td>
<td>695</td>
<td>850</td>
</tr>
<tr>
<td>C</td>
<td>555</td>
<td>655</td>
<td>960</td>
</tr>
<tr>
<td>D</td>
<td>705</td>
<td>655</td>
<td>760</td>
</tr>
</tbody>
</table>

Mounting/Installation
Mounting/Installation

- Install the DULCOTROL® measuring/control station as close as possible to the metering station using hanger screws.

1. Plugs (type depending on the surface and according to the plug manufacturer’s specifications)
2. Hanger screw
3. U-washer
4. Hexagon nut

5.1.2 Accessories

With accessories: From the hydraulic point of view, install supplied accessories such as heat exchanger, sample water pump, pressure reducer or filter upstream of the DULCOTROL® measuring/control station, observing the respective operating instructions. The sequence of the installation of the accessories is binding and must be absolutely adhered to.

1. Sample water pump (not in connection with pressure reducer)
2. Heat exchanger (water/water)
3. Filter
4. Pressure reducer (not in connection with sample water pump)
5. Temperature monitor with shut-off valve

Not included in delivery scope, to be installed by the customer at media temperatures > 55 °C
5.2 Installation (hydraulic)

**CAUTION**
- Observe the maximum permissible operating parameters of the entire installation of the DULCOTROL® measuring/control station (e.g. pressure, temperature, flow rate)!
- Observe the lowest maximum permissible operating parameters of the component parts of the DULCOTROL® measuring/control station and the installed sensors (and their operating instructions)!
- Please also read the operating instructions of the controllers and fittings and any other existing assemblies such as sensors, sample water pump ... !
- Ensure a correct flow direction of the sample water.
- The maximum operating pressure (1 bar) may not be exceeded.
- A pressure reducer must be installed.
- Hazards from media under pressure.
- Before starting work at the hydraulic part of the DULCOTROL® measuring/control station, this part is to be depressurised in a controlled way using the sampling valve.
- Wear safety goggles.

**Fittings**
The bypass fitting (in-line probe) used depends in particular on the sample water, sometimes also on the measured variable or the combination of the measured variables. For all clear waters, the type DGMA with flow monitoring, and for contaminated waters, DLG III also with upstream flow monitoring are always used.

The DGMA bypass fitting always includes in addition to the required measuring modules an additional measuring module for refitting a correction variable.

**Hydraulic Connection, Piping**
The hydraulic connection of the sample water is made via a 8x5mm hose connection. Shut-off ball valves are installed upstream and downstream of the bypass fitting. Upstream of the bypass fitting, the optionally available sample water filter will be positioned. The bypass fittings include a sampling valve. For an equipotential bonding circuit, a metal pin is integrated in the bypass fittings (see operating instructions DULCOMETER® D1C, Part 1).

5.2.1 DULCOTROL® Measuring/Control Station
- Connect the in-line probe or fitting to the sample water (see operating instructions of the in-line probe or documentation of the fitting).

5.3 Installation of DULCOTROL® Measuring/Control Station (electrical)

**WARNING**
- Live parts!
- Disconnect from mains plug before opening the housing.
- De-energise damaged, defective or manipulated units by disconnecting the mains plug.
- The electrical installation of the electrical assemblies may only be performed by a qualified electrician!
- The controller may only be opened by a qualified electrician!
- With only one controller: Install a mains switch to be able to quickly disconnect from the mains supply in case of emergency! For stations with two or more controllers, the switch is installed at the terminal box.

**CAUTION**
- Please also read the operating instructions of the controllers and fittings and any other existing assemblies such as sensors, sample water pump ... !
5.3.1 Measuring Panel

► Install a mains cable at the terminal box or at the controller in case of only one controller.
► Electrically install the flow meter (cables are pre-installed at the controller).

5.3.2 Sample Water Pump

► With terminal box: Connect the sample water pump to the terminal box in accordance with the terminal diagram.
► Without terminal box: Connect the sample water pump to the supply voltage as described in its operating instructions.

5.4 Mounting of the Sensors

Depending on the Identcode (Identcode feature “Sensor assembly”), some sensors will be delivered already installed in the fitting. If no sensors are installed, the holes in the fitting are tightly sealed.

The following sensors are not delivered as installed because of their sensitivity but enclosed in the original packaging of the DULCOTROL® measuring/control station.
- All pH/ORP sensors
- All amperometric sensors
- The oxygen sensor DO 1 will be installed, the sensor module will be separately enclosed.

The sensors for oxygen, conductivity, and temperature are pre-installed.

Before installing the sensors, the respective blanking plugs are to be removed from the DULCOTROL® measuring/control station and the respective sensors are then to be installed. The installation of the sensors is described in the respective chapter for the measured variable.

5.5 Hydraulic Test Run after Installation

Having completed the installation, a hydraulic test run of the DULCOTROL® measuring/control station is to be performed.
- The sampling valve must be closed! Otherwise, sample water may leak!
- Check all screw fittings before the first commissioning!
- Open the shut-off ball valve on the inlet and outlet side.
- The station must be hydraulically leak-proof. No liquids may escape.

Should liquid escape, the cause is to be identified and remedied.
5.6 Installation of the Sensor (electrical)

The cable ends of the connecting lines are identified by measured variables. The identification is made with cable markers at the cable end. These markers are assigned to the measured variables as follows:

<table>
<thead>
<tr>
<th>Measured variable</th>
<th>Controller identification</th>
<th>Sensor type</th>
<th>Cable identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>pH</td>
<td>PHE</td>
<td>P</td>
</tr>
<tr>
<td>ORP</td>
<td>Redox/ORP</td>
<td>RHE</td>
<td>R</td>
</tr>
<tr>
<td>Conductivity, conductive</td>
<td>Conductivity</td>
<td>LFT1</td>
<td>Pre-installed</td>
</tr>
<tr>
<td>Conductivity, inductive</td>
<td>Conductivity</td>
<td>ICT</td>
<td>Pre-installed</td>
</tr>
<tr>
<td>Conductivity</td>
<td>Cool Control</td>
<td>ICT</td>
<td>Pre-installed</td>
</tr>
<tr>
<td>Chlorine</td>
<td>CL</td>
<td>CLE, CTE</td>
<td>CL</td>
</tr>
<tr>
<td>Bromine</td>
<td>Br</td>
<td>BRE</td>
<td>BR</td>
</tr>
<tr>
<td>Chlorine dioxide</td>
<td>ClO₂</td>
<td>CDE, CDP</td>
<td>CD</td>
</tr>
<tr>
<td>Chlorite</td>
<td>ClH₂O₃</td>
<td>CLT</td>
<td>CT</td>
</tr>
<tr>
<td>Ozone</td>
<td>O₃</td>
<td>OZE</td>
<td>OZ</td>
</tr>
<tr>
<td>Peracetic acid</td>
<td>PES/PAA</td>
<td>PAA</td>
<td>PA</td>
</tr>
<tr>
<td>Hydrogen peroxide</td>
<td>H₂O₂</td>
<td>PER</td>
<td>PE</td>
</tr>
<tr>
<td>Dissolved oxygen</td>
<td>O₂</td>
<td>DO1</td>
<td>Pre-installed</td>
</tr>
<tr>
<td>Temperature</td>
<td>Temperature</td>
<td>PT</td>
<td>PT</td>
</tr>
<tr>
<td>Fluoride</td>
<td>Fluoride</td>
<td>FLE</td>
<td>F</td>
</tr>
</tbody>
</table>

6 Commissioning of the Sensors

**WARNING**
- Hazardous substances!
- Hazards from contact, inhalation or other contamination with/by substances or media!
- Observe the safety data sheet of the used substance/media.
- The operator of the DULCOTROL® measuring/control station is responsible for the fact that the safety data sheets are available and up-to-date.

**CAUTION**
- The sampling valve must be closed! Otherwise, sample water may leak!
- The sample water may not contain any airlocks to guarantee reliable measuring and controlling!
- Should air be contained in the sample water due to processes, the air is to be separated with suitable technical means.
- Please also read the operating instructions of the controllers and fittings and any other existing assemblies such as sensors, sample water pump ...

maximum permissible operating pressure: 1 bar at max. 55 °C

Preparation
- Retighten all screw fittings and check for leakages.
- Check the positions of all shut-off valves. The position of the shut-off valves must guarantee that the DULCOTROL® measuring/control station is leak-proof and that the sample water flows.
- Connect the mains plugs to their corresponding socket-outlets and switch on the power.
6.1 Setting of the Flow Meter Switching Point

- Reduce the flow rate for the test - the alarm device must engage.
- Check the screw fitting for leakages.

For in-line probe DLG III and DGMa:

Objective: Flow rate reduction is to switch – “Pause” at controller given closed input

- Set the flow rate at the ball valve.
- Setting value: 40 l/h
- Test value: 30 to 60 l/h (read at the upper edge of the float)
- Loosen the flow rate sensor.
- Move the flow rate sensor in the rail from the top to the bottom until the controller goes to “Pause”.
- Move the flow rate sensor to the top until “Pause” at the controller is just cancelled.
- Secure the flow rate sensor.
- Reduce the flow rate for the test - the controller must go to “Pause”.

6.2 Running-In Period

A running-in period is to be observed for all amperometric sensors. Depending on the sensor, this may vary between 1 hour and 24 hours. The respective sensor, electrically connected, must be positioned in the sample water to be measured. This sample water must already contain the measured variable in the quality and quantity sufficient for the process.

Running-in of the sensors is described in the respective chapter for the measured variable.
1 Respective measured variable
2 Display

5 UP button
To increase a displayed numerical value and to change variables (flashing display).

7 BRANCH BACK button
Back to permanent display or to start of relevant setting menu.

6 DOWN button
To decrease a displayed numerical value and to change variables (flashing display).

8 CHANGE button
To change over within a menu level and to change from one variable to another within a menu point.

3 START/STOP button
Start/stop of control and metering function.

4 ENTER button
To accept, confirm or save a displayed value or status. For alarm acknowledgement.
# Measuring Parameters

## 8.1 Measuring Parameter Free Chlorine

### 8.1.1 DULCOMETER® D1C Measured Variable Chlorine, Setting and Operation

**Display Symbols**

The display of the DULCOMETER® D1C measured variable chlorine controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td>Symbol left</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 1, upper</td>
<td>Symbol left</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 1, lower</td>
<td>Symbol right</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 2, upper</td>
<td>Symbol right</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 2, lower</td>
<td>Symbol right</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Metering pump 1 (chlorine)</td>
<td>Symbol left</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol left</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Metering pump 2 (dechlorine)</td>
<td>Symbol right</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol right</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Solenoid valve 1 (chlorine)</td>
<td>Symbol left</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol left</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Solenoid valve 2 (dechlorine)</td>
<td>Symbol right</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol right</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Servomotor</td>
<td></td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Control, open relay</td>
<td></td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Control, close relay</td>
<td></td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Without control</td>
<td></td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Position feedback</td>
<td>Thickness of bar increases from left to right during opening</td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Stop button pressed</td>
<td></td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Manual metering</td>
<td></td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
</tbody>
</table>
NOTE

Access to the setting menus can be barred with the access code!
The number and scope of setting menus is dependent on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!
If within a period of 10 minutes no button is pressed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.
Restricted Operating Menu / Layout

**Permanent display 1**
- Positive values of control variable: Cl
- Negative values of control variable: DPD

**Permanent display 2**
- Only with control
- (w = setpoint)

**Positive values of control variable:**
- Cl
- DPD

**Negative values of control variable:**
- Cl
- DPD

**Zero point:**
- 0.45 ppm

**Slope:**
- 25 °C

**Calibration pH probe in buffer:**
- 4.00 pH

**Calibration pH buffer 1:**
- 12.00 pH

**Calibration pH buffer 2:**
- 12.00 pH

**Temperature:**
- 12.30 °C

**Setting in complete operating menu**
- Access to setting menus can be blocked with access code.

**Proportional control**
- Control parameter:
  - Upper setpoint: 1.00 ppm
  - Lower setpoint: 0.10 ppm
  - Dead zone: 0.00 ppm

**Control with dead zone**
- Upper setpoint: 1.00 ppm
- Lower setpoint: 0.10 ppm

**Manual control**
- Upper setpoint: 1.00 ppm
- Lower setpoint: 0.10 ppm

**Alarm relay access c:**
- Reduced operating menu: 5000

**Software version**
- D1C-A1  FW-5.00

**Ident-code:**
- D1CA

**Current regulation value:**
- 30 %

**Regulated range:**
- 0 % - 70 %

**Operating menu:**
- Access active

**General setting information**
- D1C2-Cl-009-GB

**Chlorine destruction**
- (chlorine destruction)
8.1.2 DULCOTEST® CLE Chlorine Sensor for Free Chlorine, Commissioning

8.1.2.1 DULCOTEST® CLE Chlorine Sensor for Free Chlorine, Assembly

Assembly

Pouring electrolyte

**IMPORTANT**
- Do not touch, damage or bring into contact with greasy substances the white membrane or the electrodes on the electrode shaft. The sensor will not, in such cases, work accurately.
- Replace the membrane cap or send the sensor to ProMinent to have the electrodes cleaned.

**NOTE**

Carry out the following actions over a washbasin.

- Remove the red cap completely from the nozzle and cut the nozzle at the marked position to open the nozzle canal.
- Remove the membrane cap cover and unscrew the membrane cap from the electrode shaft.
- Fill the membrane cap up to the rim with electrolyte.
- Rinse the membrane cap and the electrode with a little electrolyte.
- Remove air bubbles by lightly tapping the membrane cap on an even surface.
- Place the electrode shaft upright onto the filled membrane cap and twist until the thread bites.
- Slowly screw in the membrane cap by hand up to the stop. Excess electrolyte will seep out of the vent hole as you screw the parts together.
- Rinse away the excess electrolyte from your fingers and from the sensor under running water.

Assembling sensor

**IMPORTANT**
- When removing and inserting the sensor from or into the in-line probe housing, do so slowly to prevent damaging the membrane.
- The sensor must be kept damp after commissioning, e.g. the in-line probe housing should never be allowed to run dry.

Assemble the sensor as described in the operating instructions manual for the in-line probe housing.

8.1.2.2 DULCOTEST® CLE Chlorine Sensor for Free Chlorine, Electrical Installation

**IMPORTANT**

Do not switch the measuring system off when using intermittently. If necessary, use a timer to switch on metering equipment.

When connecting to a ProMinent® device

Safety conditions at the interface are automatically fulfilled when connecting to ProMinent® controllers (e.g. DULCOMETER® D1C, DMT, CLD).

The CLE 3-mA is a sensor with a passive 4-20 mA two-wire interface, i.e. the power supply is external, e.g. via the controller.
Free Chlorine

Electrical Installation

- Rotate the sensor adapter a quarter-turn anticlockwise and pull off (bayonet fitting).
- Unscrew the locking screw of the PG 7 threaded connector and feed through the signal cable from the controller.
- Strip the cable ends and connect to the 2-wire connector: 1 = plus, 2 = minus.
- Insert approx. 5 mm of the signal cable into the sensor and tighten the PG7 threaded connector locking screw.
- Push the sensor adapter right into the housing and rotate carefully clockwise until the stop.

Take care not to break the tips of the bayonet fitting.

Electrical connection to sensor

8.1.2.3 DULCOTEST® CLE Chlorine Sensor for Free Chlorine, Running-In

IMPORTANT

- The sensor must not be operated in water or solutions containing surfactants.
- Do not switch off the measuring system during interval operation! After any operation without chlorine, running-in periods are to be reckoned with. If required, switch on metering unit time-delayed! If no chlorine is metered for a longer period of time, the sensor must be disconnected from the mains and stored in a dry condition.

Running-In Period

To acquire a stable display value the sensor should be run in for a predetermined period.

- When first commissioned: 1 - 3 h
- When re-commissioned: 0.5 - 2 h
- When membrane/electrolyte replaced: approx. 0.5 h

8.1.2.4 DULCOTEST® CLE Chlorine Sensor for Free Chlorine, Calibration

IMPORTANT

- A slope test must be carried out after replacing the membrane cap or electrolyte.
- Slope tests must be repeated at regular intervals to ensure that the sensor is working correctly! When used in the treatment of swimming pool or drinking water it is generally sufficient to re-calibrate the sensor every 3-4 weeks.
- Avoid incorrect dosing due to air bubbles in the sample water! Air bubbles clinging to the sensor membrane can result in a measured variable that is too low and thus lead to incorrect dosage.
- Observe applicable national directives for calibration intervals!

Preconditions

- Constant flow through in-line probe housing
- Constant sample water temperature
- Similar sample water and sensor temperatures (wait approx. 15 min.)
- The sensor has been run in
- Constant pH value
Free Chlorine

Zero Point Calibration
If a ProMinent controller is being used to operate the sensor, zero point calibration is not usually necessary. Zero point calibration should be carried out, however, if operating the sensor at the lower measurement threshold or when using the 0.5 ppm variant.

► Immerse the sensor in a container of clean, chlorine-free tap water.
► Stir with the sensor until the measured variable displayed at the controller has remained stable for 5 min.
► Calibrate the controller to zero in accordance with the operating instructions.
► Reinstall the sensor in the in-line probe housing (DGM; DLG) as described in "Installation".

Slope Test
► Determine the chlorine content in the sample water using an appropriate measurement system (e.g. DPD 1).
► Set the resulting value at the controller in accordance with the operating instructions.

Repeat calibration after 1 day!

Possible values
<table>
<thead>
<tr>
<th>Initial value</th>
<th>Increment</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>0.01 ppm</td>
<td>0 ppm</td>
<td>100 ppm</td>
<td></td>
</tr>
</tbody>
</table>

Error message
- Calibration Cl not possible! Sensor slope too low (<25 % of norm slope)
- Calibration Cl not possible! Sensor slope too high (>300 % of norm slope)
- DPD value too low! DPD > x.xx ppm

Condition
- Cl slope too low
- Cl slope too high
- DPD <2 % of measuring range

Remarks
- Calibrate again
- Calibrate again after adding chlorine

Calibration of the Chlorine Sensor
During the calibration, the D1C sets the controller outputs to "0". Exception: If a base load or manual controller output was set, these are maintained during the calibration. The standard signal outputs mA (measured value or correction value) are frozen. The measured value registered during the start of the calibration is proposed as the DPD value; this value is adjustable (arrow keys!).

Calibration is only possible if the DPD value is ≥ 2 % of the measuring range. On successful completion of calibration, all error checks which refer to the measured value are restarted.

IMPORTANT
The measuring range of the chlorine sensor must correspond to the adjusted measuring range (factory setting: 0–2 ppm). A change of the measuring range must be done before calibration!
### 8.1.3 DULCOMETER® D1C and DULCOTEST® CLE Chlorine Sensor for Free Chlorine, Troubleshooting

**Controller**

<table>
<thead>
<tr>
<th>Fault (Probe Output)</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Error with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>Check Cl sensor</td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>Yes</td>
<td>Function detachable</td>
<td>Check function of sensor, measured chemical time</td>
</tr>
<tr>
<td></td>
<td>Check Cl sensor</td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>Yes</td>
<td>Signal &lt;3 x 0.2 mA or &gt;23 ±0.2 mA</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td>Calibration sensor</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>Measuring conditions in case of error with available measurement values</td>
<td>Check sensor, replace if necessary, recalibrate if necessary</td>
</tr>
</tbody>
</table>

**Correction variable**

<table>
<thead>
<tr>
<th>Fault (Probe Output)</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Error with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Check Cl sensor</td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>Yes</td>
<td>Signal &lt;3 x 0.2 mA or &gt;23 ±0.2 mA</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td></td>
<td>Check Cl sensor</td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>Yes</td>
<td>&lt;25 % &gt; sensor slope</td>
<td>Check sensor, replace if necessary, recalibrate if necessary</td>
</tr>
</tbody>
</table>

**Operation**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Note test</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Error with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pause contact</td>
<td></td>
<td></td>
<td>Pause/Pause Hold</td>
<td>Uncharged</td>
<td>No</td>
<td>No further fault check</td>
<td>--</td>
</tr>
<tr>
<td>Step button</td>
<td></td>
<td></td>
<td>Step</td>
<td>Step</td>
<td>No</td>
<td>Relay drops out</td>
<td>--</td>
</tr>
<tr>
<td>Measuring value</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>No error processing of measured variable</td>
<td>--</td>
</tr>
<tr>
<td>Sensor slope too low</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>25 % &lt; sensor slope</td>
<td>Check sensor, replace if necessary, recalibrate if necessary</td>
</tr>
<tr>
<td>Sensor zero point too high</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>&gt;200 % of norm slope</td>
<td>Recalibrate in sample water without chlorine</td>
</tr>
<tr>
<td>Calibration pH with error</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>pH &gt; 9.5</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td>Limit pH-transgression</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>&lt;5 % &lt; sensor slope</td>
<td>Check sensor, replace if necessary, recalibrate if necessary</td>
</tr>
<tr>
<td>Sequence forward/reverse</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>Sensor sequence faulty</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td>Electronic error</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>Electronic data faulty</td>
<td>Call in service</td>
</tr>
</tbody>
</table>

**Diagnosis (Probe Output)**

<table>
<thead>
<tr>
<th>Diagnosis (Probe Output)</th>
<th>Diagnosis text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Error with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>Check Cl sensor</td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>No further fault check</td>
<td>Check function of sensor, measured chemical time</td>
</tr>
<tr>
<td></td>
<td>Check Cl sensor</td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>Yes</td>
<td>Signal &lt;3 x 0.2 mA or &gt;23 ±0.2 mA</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td>Calibration sensor</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>Measuring conditions in case of error with available measurement values</td>
<td>Check sensor, replace if necessary, recalibrate if necessary</td>
</tr>
</tbody>
</table>

**Operation (Probe Output)**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Note test</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Error with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pause contact</td>
<td></td>
<td></td>
<td>Pause/Pause Hold</td>
<td>Uncharged</td>
<td>No</td>
<td>No further fault check</td>
<td>--</td>
</tr>
<tr>
<td>Step button</td>
<td></td>
<td></td>
<td>Step</td>
<td>Step</td>
<td>No</td>
<td>Relay drops out</td>
<td>--</td>
</tr>
<tr>
<td>Measuring value</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>No error processing of measured variable</td>
<td>--</td>
</tr>
<tr>
<td>Sensor slope too low</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>25 % &lt; sensor slope</td>
<td>Check sensor, replace if necessary, recalibrate if necessary</td>
</tr>
<tr>
<td>Sensor zero point too high</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>&gt;200 % of norm slope</td>
<td>Recalibrate in sample water without chlorine</td>
</tr>
<tr>
<td>Calibration pH with error</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>pH &gt; 9.5</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td>Limit pH-transgression</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>&lt;5 % &lt; sensor slope</td>
<td>Check sensor, replace if necessary, recalibrate if necessary</td>
</tr>
<tr>
<td>Sequence forward/reverse</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>Sensor sequence faulty</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td>Electronic error</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Step</td>
<td>No</td>
<td>Electronic data faulty</td>
<td>Call in service</td>
</tr>
</tbody>
</table>

---

* Depending on whether “Alarm on” or “Alarm off” set in “General settings”  
** Function P7 stable
**Free Chlorine**

**Sensor: Troubleshooting**

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>The sensor cannot be calibrated - measuring device/controller</td>
<td>Run-in period too short</td>
<td>▶ See “Run-in period”</td>
</tr>
<tr>
<td>display value is greater than DPD-1 measurement</td>
<td>Membrane cap damaged</td>
<td>▶ Replace membrane cap. Allow sensor to run in, calibrate</td>
</tr>
<tr>
<td></td>
<td>Interference from water contaminants</td>
<td>▶ Identify interfering contaminant and implement remedy</td>
</tr>
<tr>
<td></td>
<td>Short circuit in signal cable</td>
<td>▶ Identify short circuit and repair</td>
</tr>
<tr>
<td></td>
<td>DPD-chemicals spent</td>
<td>▶ Use new DPD chemicals, repeat calibration</td>
</tr>
<tr>
<td></td>
<td>pH-value &lt; pH 5.5</td>
<td>▶ Increase pH-value (pH 5.5-8.0)</td>
</tr>
</tbody>
</table>

**The sensor cannot be calibrated - measuring device/controller**

| Display value is smaller than DPD-1 measurement                        | Run-in period too short                            | ▶ See “Run-in period”                                                  |
|                                                                        | Membrane cap deposits                               | ▶ Remove deposits (see “Maintenance”), Replace membrane cap. Run-in sensor, calibrate |
|                                                                        | Sample water flow inadequate                        | ▶ Adjust flow rate                                                     |
|                                                                        | Air bubbles on the outside of the membrane          | ▶ Tap to remove air bubbles and increase flow if necessary             |
|                                                                        | Surfactants in water (membrane is transparent)      | ▶ Remove surfactants and replace membrane cap, run in sensor and recalibrate, If necessary use CDP sensor |
|                                                                        | pH-value > pH 8.0                                   | ▶ Lower pH-value (pH 5.5-8.0)                                          |
|                                                                        | No electrolyte in membrane cap                      | ▶ Fill in new electrolyte (see “Assembly”, “Run-in period” and “Calibration”) |
|                                                                        | Electrolyte displaced by gas bubbles in the sample water | ▶ Consult ProMinent                                                  |

**Measured variable value is “zero”**

| Only bound chlorine present                                           | If chloramine is present (DPD-4 test), replace water or chlorinate | ▶ Add chlorine and then repeat calibration or use appropriate sensor |
| Chorine content below the lower measuring range limit                |                                                                    | ▶ Connect sensor correctly to controller                               |
| Sensor incorrectly connected to controller                            |                                                                    | ▶ Run in for at least 3 h                                              |
| Run-in period inadequate                                              |                                                                    | ▶ Replace sensor                                                       |
| Sensor defective                                                      |                                                                    | ▶ If chloramine is present (DPD-4 test), replace water or chlorinate |
|                                                                        |                                                                    | ▶ Add chlorine and then repeat calibration or use appropriate sensor |
|                                                                        |                                                                    | ▶ Connect sensor correctly to controller                               |
|                                                                        |                                                                    | ▶ Run in for at least 3 h                                              |
|                                                                        |                                                                    | ▶ Replace sensor                                                       |

**Measured variable display unstable**

| Air bubbles on the outside of the membrane                            | ▶ Tap to remove air bubbles and increase flow if necessary | ▶ Consult ProMinent                                                  |
| Membrane damaged                                                     | ▶ Replace membrane cap. Run-in sensor, calibrate           | ▶ If chloramine is present (DPD-4 test), replace water or chlorinate |
| Cause lies with the controller                                       | ▶ Identify cause and remedy                                | ▶ Add chlorine and then repeat calibration or use appropriate sensor |
|                                                                        |                                                                    | ▶ Connect sensor correctly to controller                               |
|                                                                        |                                                                    | ▶ Run in for at least 3 h                                              |
|                                                                        |                                                                    | ▶ Replace sensor                                                       |
Free Chlorine

Troubleshooting / Maintenance
Once you have tried everything, check whether the reference electrode is brownish grey at the tip of the electrode shaft. If it is silvery white it is spent and should be reconditioned by ProMinent.

8.1.4 DULCOMETER® D1C Measured Variable Chlorine and DULCOTEST® CLE Chlorine Sensor, Maintenance

Controller
The DULCOMETER® controller type D1C for the measured variable chlorine is maintenance-free.

Sensor

**IMPORTANT**
- The sensor must be regularly serviced in order to avoid exceeding dosage due to sensor failure!
- Observe applicable national directives for service intervals!
- Do not touch the sensors or bring into contact with substances containing grease.

Maintenance interval Daily/weekly depending upon application

**Maintenance Work**
- Check the sensor display value on the controller using an appropriate chlorine measuring system (e.g. DPD-1).
- If necessary recalibrate the sensor.

Cleaning the Membrane
If it is no longer possible to calibrate the sensor you can try to clean the membrane carefully.
Firstly disassemble the sensor. Observe the safety instructions.

Loose dirt clinging to the cap:
- Rinse the membrane under a gentle stream of cold tap water.

Removing deposits (scale, rust):
- Disassemble the membrane cap.
- Place the membrane cap in a bath of 5 % hydrochloric acid (e.g. overnight).
- Rinse the membrane cap under plenty of water.

You should now refill the sensor with electrolyte, run in and recalibrate.

Replacing the Membrane
If the sensor fails to calibrate even after cleaning the membrane, or if the membrane is damaged, you must replace the membrane cap.
8.2 Measuring Parameter Ozone

8.2.1 DULCOMETER® D1C Measured Variable Ozone, Setting and Operation

Display Symbols
The display of the DULCOMETER® D1C measured variable ozone controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td>left</td>
<td>⬇️</td>
</tr>
<tr>
<td>Relay 1, upper</td>
<td>left</td>
<td>⬆️</td>
</tr>
<tr>
<td>Relay 2, lower</td>
<td>right</td>
<td>⬇️</td>
</tr>
<tr>
<td>Metering pump 1 (ozone)</td>
<td>left</td>
<td>⬆️</td>
</tr>
<tr>
<td>Control off</td>
<td>left</td>
<td>⬇️</td>
</tr>
<tr>
<td>Metering pump 2 (De-ozone)</td>
<td>right</td>
<td>⬆️</td>
</tr>
<tr>
<td>Control on</td>
<td>right</td>
<td>⬇️</td>
</tr>
<tr>
<td>Solenoid valve 1 (ozone)</td>
<td>left</td>
<td>⬆️</td>
</tr>
<tr>
<td>Control off</td>
<td>right</td>
<td>⬇️</td>
</tr>
<tr>
<td>Solenoid valve 2 (De-ozone)</td>
<td>left</td>
<td>⬆️</td>
</tr>
<tr>
<td>Control on</td>
<td>right</td>
<td>⬇️</td>
</tr>
<tr>
<td>Servomotor, control</td>
<td>⬆️</td>
<td></td>
</tr>
<tr>
<td>Control, open relay</td>
<td>⬇️</td>
<td></td>
</tr>
<tr>
<td>Control, close relay</td>
<td>⬆️</td>
<td></td>
</tr>
<tr>
<td>Without control</td>
<td>⬇️</td>
<td></td>
</tr>
<tr>
<td>Position feedback</td>
<td>Thickness of bar increases from left to right during opening</td>
<td></td>
</tr>
<tr>
<td>Stop button pressed</td>
<td>⬇️</td>
<td></td>
</tr>
<tr>
<td>Manual metering</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Fault</td>
<td>E</td>
<td></td>
</tr>
</tbody>
</table>
NOTE
Access to the setting menus can be barred with the access code!
The number and scope of setting menus is dependent on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus
are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back
from the calibrating menu or a setting menu to the permanent display 1!
Restricted Operating Menu / Layout

The restricted operating menu permits simple operation of the most important parameters. The following overview shows the settings which can be selected.

- **Ozone control current regulat.**
  - Value: 30%
  - With dead zone

- **Manual control current regulat.**
  - Value: 30%

- **Normal control**
  - PID control
  - Setpoint: 0.20 ppm
  - Control with dead zone
  - Positive O3 regulated value: 50%
  - Negative De-O3 regulated value: 0%

- **Calibration O3**
  - Zero point: 4.00 mA
  - Span: 6.00 mA/ppm

- **Setting in complete operating menu**
  - Access code: D1CA
  - Software version: D1C-B1 FW-5.00
  - Alarm relay: off
  - Active menu: 5000

- **Mea. val.**
  - Forward: 70%
  - Reg. val.: 59%
  - Zero point: 4.00 mA
  - Slope: 6.75 mA/ppm

- **Limits**
  - Limit 1: 0.10 ppm
  - Limit 2: 0.50 ppm

Access to setting menus can be blocked with access code.
8.2.2 DULCOTEST® OZE Ozone Sensor, Commissioning

8.2.2.1 DULCOTEST® OZE Ozone Sensor for Ozone, Assembly

Assembly

Pouring electrolyte

**CAUTION**

- When handling ozone-containing water and solutions wear appropriate safety goggles and protective clothing!
- In case of eye contact with the electrolyte, rinse immediately with a lot of clean water for at least 10 min. In case of eye irritation, contact an eye specialist!
- Do not swallow the electrolyte! Drink a lot of water. Trigger vomiting. Seek medical advice in case of indisposition!
- Protect yourself and your clothing against contact with the electrolyte (acid!) by suitable protective equipment!
- The skin might be chemically burnt or the clothing might be damaged! Rinse immediately with a lot of cold water.

**IMPORTANT**

- Do not touch, damage or bring into contact with greasy substances the membrane at the bottom of the membrane cap and the electrodes at the bottom of the electrode shaft! The sensor will then no longer function accurately. Replace the membrane cap by a new one or return the sensor for cleaning of the electrodes.
- The electrolyte should not be kept in excess of 2 years! (For date of expiry, see label)

/\ - Remove the red cap from the spout and cut the spout at the marked position to open the spout channel.
/\ - Remove the protective membrane cover and unscrew the membrane cap from the electrode shaft.
/\ - Rinse the membrane cap and the electrode with some of the electrolyte.
/\ - Fill the membrane cap up to the brim with the electrolyte.
/\ - Slightly tap the membrane cap onto an even surface to remove any air bubbles.

Assembling the membrane cap

- Place the electrode shaft vertically on the filled membrane cap and turn until the thread is locked.
- Turn the electrode shaft such that the vent hole is positioned to the top.
- Slowly screw in the membrane cap finger tight by hand up to the stop. The excessive electrolyte flows out through the vent hole when screwing together the parts.
- Rinse the leaked electrolyte from the sensor and your fingers under running water.
- No air should be trapped in the membrane cap and the electrolyte. If air is trapped, repeat the above described steps.

Assembling sensor

**IMPORTANT**

- Depressurise the in-line probe before installing the sensor!
- Insert or remove the sensor only slowly into or from the in-line probe! Otherwise the membrane may be damaged!
- The membrane may not come into contact with the flow plug of the in-line probe!
- Ensure that the tensioning ring of the sensor is positioned within the in-line probe after installation! Otherwise, the sensor might be ejected from the in-line probe due to the water pressure.
- After commissioning, the sensor must always be kept wet – e.g. the in-line probe may never run dry!

- Install the sensor as described in the operating instructions of the in-line probe.
8.2.2.2 DULCOTEST® OZE Ozone Sensor, Electrical Installation

**IMPORTANT**
- Do not switch off the measuring system during interval operation!
- If required, switch on metering unit time-delayed!
- In case of sensor failure, an incorrect measuring value may be present at the input of the control unit. Design the electrical installation such that it will not result in any uncontrolled metering and consequential damages!

When connecting to ProMinent® devices

When connecting to ProMinent control units (e.g. DULCOMETER® D1C), the safety requirements on the interface are automatically met. The OZE 3-mA is a sensor with a passive 4-20 mA two-wire interface, i.e. the power is supplied externally, e.g. via the control unit.

**Electrical Installation**
- Turn the adapter of the sensor one quarter turn anti-clockwise and pull off (bayonet mount).
- Loosen the clamping screw of the M12 screw fitting and feed through the measuring line from the control unit.
- Strip the cable ends and connect to the 2-wire connector: 1 = Plus, 2 = Minus.

Electrical connection to sensor

- Position approx. 5 cm of the measuring line in the sensor and tighten the clamping screw of the M12 screw fitting.
- Fully insert the sensor into the housing and gently turn clockwise up to the stop. Ensure that the lugs of the bayonet mount do not break.

8.2.2.3 DULCOTEST® OZE Ozone Sensor, Running-In

**IMPORTANT**
- The sensor may not be used in surfactant-containing water or solutions!
- Do not switch off the measuring system during interval operation!
- After any operation without ozone, running-in periods are to be reckoned with.
- If required, switch on metering unit time-delayed!
- If no ozone is metered for a longer period of time, the sensor must be disconnected from the power supply and stored dry.

**Running-In Period**
The sensor requires a certain running-in period to be able to provide a stable reading.

- Initial commissioning: 2 - 6 h
- Recommissioning: 1 - 3 h
- Replacement of diaphragm/electrolyte: approx. 0.5 h
8.2.2.4 DULCOTEST® OZE Ozone Sensor, Calibration

After expiry of the running-in period, the sensor can be calibrated.

**IMPORTANT**
- A slope calibration must be carried out after having replaced a diaphragm cap or electrolyte!
- For a perfect functioning of the sensor, the slope calibration must be repeated in regular intervals! For swimming pools, a calibration of the sensor every 3-4 weeks is sufficient.
- Avoid incorrect metering because of airlocks in the sample water! Air bubbles sticking to the diaphragm of the sensor might cause a low measuring value and thus might result in incorrect metering.
- Observe the valid national regulations for calibration intervals!

**Preconditions**
- Constant flow at the in-line probe
- Operating pressure of max. 1 bar maintained
- Constant temperature of the sample water
- Identical temperatures of sample water and sensor (wait for approx. 15 min.)
- Constant pH value

**Zero Point Calibration**
If the sensor is operated at a ProMinent control unit, a zero point calibration is normally not required. Perform a zero point calibration if you use the sensor at the lower measuring range limit.

**Preconditions**
- The sensor has been run-in
- Constant flow at the in-line probe
- Dip the sensor in a bucket with clean, ozone-free tap water.
- Stir with the sensor until the reading at the control unit has been stable for 5 min.
- Calibrate the control unit to zero according to its operating instructions.
- Reinstall the sensor into the in-line probe (DGM; DLG).

**Slope Test**
Determine the ozone content of the sample water using a suitable measuring tool (e.g. DPD 4).
Set the determined value at the control unit according to the unit’s operating instructions.
Repeat the calibration the next day!

**NOTE**
**Calibration at increased temperature**
Because ozone is only physically solved in water, it quickly outgasses from the medium at increased temperatures (> 30 °C). The DPD measurement must thus be performed quickly.
After sample-taking, the reagents should be added within 1 minute. In this case, the red dye is to be directly generated at the sampling site by adding reagents and then the measurement is to be performed in the laboratory as quickly as possible.
Calibration of the Ozone Sensor

During the calibration, the D1C sets the control variable to "0". Exception: If a base load or manual control variable was set, these are maintained during the calibration. The standard signal outputs mA (measured value or correction value) are frozen. The measured value registered during the start of the calibration is proposed as the DPD value; this value is adjustable (arrow keys). Calibration is only possible if the DPD value is ≥ 2 % of the measuring range. On successful completion of calibration, all error checks which refer to the measured value are restarted.

IMPORTANT

The measuring range of the sensor must agree with the set measuring range (factory setting: 0-2 ppm). The measuring range must be reset prior to calibration.

### Possible values

<table>
<thead>
<tr>
<th>Initial value</th>
<th>Possible values</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>0.01 ppm</td>
<td>0 ppm</td>
<td>100 ppm</td>
<td></td>
</tr>
</tbody>
</table>

### Error message

<table>
<thead>
<tr>
<th>Error message</th>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>O3 sensor too low</td>
<td>O3 slope too low (&lt;25% of norm slope)</td>
<td>Calibrate again</td>
</tr>
<tr>
<td>DPD value too low</td>
<td>DPD &lt;2 % of the measuring range</td>
<td>Calibrate again after adding ozone</td>
</tr>
</tbody>
</table>
### 8.2.3 DULCOMETER® D1C and DULCOTEST® OZE Ozone Sensor for Ozone, Troubleshooting

#### Controller

<table>
<thead>
<tr>
<th>Fault</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect on control</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>Check O3 sensor</td>
<td>€</td>
<td>Basic load Stop Yes Function defeatable</td>
<td>Check function of sensor, invalid check time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal exceeded/drops below value</td>
<td>Check O3 input</td>
<td>€</td>
<td>Basic load Stop Yes at &lt;3 % or at &gt;21 mA</td>
<td>Check sensor, transmitter and cable connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration sensor with error</td>
<td>Check O3 calibrator</td>
<td>€</td>
<td>Basic load Stop No Measuring extinction of stability measured value</td>
<td>Check sensor, replace if necessary, recalibrate if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correction variable</td>
<td>Check O3 output</td>
<td>€</td>
<td>Basic load Stop Yes</td>
<td>PT05 signal between 0.5 and 2 mA Signal &lt;5 % or &gt;21 % or &gt;21 % or &gt;21 mA</td>
<td>Check sensor, transmitter and cable connection</td>
<td></td>
</tr>
<tr>
<td>Feed forward control</td>
<td>Check feed forward input</td>
<td>€</td>
<td>Stop Yes</td>
<td>Function defeatable</td>
<td>Definition cause, reset values if necessary</td>
<td></td>
</tr>
<tr>
<td>Limit transgression</td>
<td>Check O3 output</td>
<td>€</td>
<td>Stop or Basic load Stop Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servomotor</td>
<td>Servomotor defective</td>
<td>€</td>
<td>Stop Stop No Servomotor bias</td>
<td>Check servomotor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronics error</td>
<td>System error</td>
<td>€</td>
<td>Stop Stop Yes Electronic data defective</td>
<td>Call in service</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Operation

<table>
<thead>
<tr>
<th>Operation</th>
<th>Note text</th>
<th>Symbol</th>
<th>Effect on control</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pause contact</td>
<td>Pause/Resume Operation</td>
<td>€</td>
<td>Stop</td>
<td>Stop No Yes* No further fault check</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Stop below</td>
<td>Stop stop</td>
<td>€</td>
<td>No</td>
<td>Relay stops out</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Servo calibration</td>
<td>Servo</td>
<td>€</td>
<td>Basic load Stop No</td>
<td>No error processing of measured variable</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Sensor slope too low</td>
<td>Sensor slope too low</td>
<td>€</td>
<td>Basic load Stop No</td>
<td>25% + sensor slope &gt; 30% of sensor slope</td>
<td>Check sensor, replace if necessary</td>
<td></td>
</tr>
<tr>
<td>Sensor slope too high</td>
<td>Sensor slope too high</td>
<td>€</td>
<td>Basic load Stop No</td>
<td>25% - sensor slope &gt; 30% of sensor slope</td>
<td>Check sensor, replace if necessary</td>
<td></td>
</tr>
<tr>
<td>DPD value &lt;2 % measuring range</td>
<td>DPD value too low</td>
<td>€</td>
<td>Stop</td>
<td>Na</td>
<td>Recall data after setting 0</td>
<td></td>
</tr>
<tr>
<td>During servomotor setting</td>
<td>Servomotor check</td>
<td>€</td>
<td>Basic load Stop Yes</td>
<td>Without correct adjustment the last valid values are still used</td>
<td>Check connection of rings, potentiometer. Adjust theservomotor correctly</td>
<td></td>
</tr>
</tbody>
</table>

*depending on whether “Alarm on” or “Alarm off” set in “General settings”
Sensor: Troubleshooting

For troubleshooting, the entire sensor is to be considered. The sensor consists of:

1) Measuring/control unit
2) Electrical lines and connections
3) In-line probe and hydraulic connections
4) Sensor

The possible causes listed in the following table predominantly refer to the sensor. Before troubleshooting, ensure that the operating conditions are observed:

- a) ozone content 0.02 - 2 mg/l
- b) pH value in the stability range ozone and constant
- c) temperature 5 - 45 °C and constant
- d) flow rate 30 - 60 l/h

For locating the failure in the measuring and control unit, the sensor simulator (DULCOMETER® Simulator order no. 1004042) can be used. A detailed troubleshooting at the measuring and control unit is described in the operating instructions of DULCOMETER® D1C, Ozone.

In case of excessive deviations of the sensor readings from the result of the DPD method, first all possible error causes of the photometric DPD method should be considered. If required, the DPD measurement is to be repeated several times.

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor cannot be calibrated - Reading</td>
<td>Running-in period too low</td>
<td>► see &quot;Running-in period&quot;</td>
</tr>
<tr>
<td>measuring/</td>
<td>Diaphragm cap damaged</td>
<td>► Replace diaphragm cap; run in sensor, calibrate</td>
</tr>
<tr>
<td>control device</td>
<td>Interfering substances in water</td>
<td>► Check water for interfering substances and remedy</td>
</tr>
<tr>
<td>greater than</td>
<td>Short in the measuring line</td>
<td>► Locate short and remedy</td>
</tr>
<tr>
<td>DPD-4 measurement</td>
<td>Distance between diaphragm and</td>
<td>► Tighten diaphragm cap up to stop</td>
</tr>
<tr>
<td></td>
<td>diaphragm cap too large</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DPD chemicals past shelf life</td>
<td>► Use new DPD chemicals, repeat calibration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor cannot be calibrated - Reading</td>
<td>Running-in period too low</td>
<td>► see &quot;Running-in period&quot;</td>
</tr>
<tr>
<td>measuring/</td>
<td>Deposits on the diaphragm cap</td>
<td>► Remove deposits see &quot;Maintenance&quot;; replace diaphragm cap; run-in sensor, calibrate</td>
</tr>
<tr>
<td>control device</td>
<td>Sample water flow rate too low</td>
<td>► Adjust flow rate</td>
</tr>
<tr>
<td>smaller than</td>
<td>Air bubbles on the exterior of</td>
<td>► Remove air bubbles by tapping and increase flow rate, if required</td>
</tr>
<tr>
<td>DPD-4 measurement</td>
<td>the diaphragm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interfering substances in the</td>
<td>► Contact ProMinent</td>
</tr>
<tr>
<td></td>
<td>sample water (surfactants, oils,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>alcohol, corrosion inhibitors)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Surfactants in water (diaphragm</td>
<td>► Remove surfactants and replace diaphragm cap; run-in sensor and calibrate</td>
</tr>
<tr>
<td></td>
<td>is transparent)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No electrolyte in diaphragm cap</td>
<td>► Fill in new electrolyte see &quot;Assembly&quot;, &quot;Running-in period&quot; and &quot;Calibration&quot;</td>
</tr>
<tr>
<td></td>
<td>Electrolyte displaced by gas</td>
<td>► Contact ProMinent</td>
</tr>
<tr>
<td></td>
<td>bubbles in sample water</td>
<td></td>
</tr>
</tbody>
</table>
**Ozone**

**8.2.4 DULCOMETER® D1C Measured Variable Ozone and DULCOTEST® OZE Sensor for Ozone, Maintenance**

**Controller**
The DULCOMETER® controller type D1C for the measured variable ozone is maintenance-free.

**Sensor**

* The sensor is to be regularly serviced to avoid any excess metering caused by a sensor failure!
* Observe the valid national regulations for maintenance intervals!
* Do not touch the electrodes or bring into contact with greasy substances!

**Maintenance interval**
Daily/weekly, depending on application

**Maintenance Work**
* Check the reading of the sensor at the control unit using a suitable ozone measuring tool (e.g. DPD 4).
* If required calibrate the sensor again (see Chapter "Calibration").

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading of the sensor is 0 ppm and error message at DULCOMETER® D1C controller &quot;Check O₃ input&quot; is displayed</td>
<td>Sensor connected to the control unit with wrong polarity</td>
<td>Correctly connect sensor to control unit</td>
</tr>
<tr>
<td></td>
<td>Measuring line broken</td>
<td>Replace measuring line</td>
</tr>
<tr>
<td></td>
<td>Sensor faulty</td>
<td>Return sensor</td>
</tr>
<tr>
<td></td>
<td>Control unit faulty</td>
<td>Check control unit with sensor simulator (DULCOMETER® Simulator, order no. 1004042), return if faulty</td>
</tr>
<tr>
<td>Reading of the sensor is 0 ppm and the sensor current is 3.0 – 4.0 mA</td>
<td>Running-in period too low</td>
<td>Note running-in period</td>
</tr>
<tr>
<td></td>
<td>Interfering substances in water</td>
<td>Check water for interfering substances and replace water, if required</td>
</tr>
<tr>
<td></td>
<td>Zero point shifted</td>
<td>Calibrate zero point</td>
</tr>
<tr>
<td></td>
<td>Reference electrode faulty*</td>
<td>Return sensor for regeneration</td>
</tr>
<tr>
<td>Reading of the sensor is 0 ppm and the sensor current is larger than 20 mA**</td>
<td>Ozone content above the upper measuring range limit</td>
<td>Check system, remedy fault, repeat calibration</td>
</tr>
<tr>
<td></td>
<td>Distance between diaphragm and electrode too large</td>
<td>Tighten diaphragm cap fully</td>
</tr>
<tr>
<td></td>
<td>Sensor faulty</td>
<td>Return sensor</td>
</tr>
<tr>
<td>Reading of the sensor is unstable</td>
<td>Pressure fluctuations in the sample water line</td>
<td>Check installation site and change, if required. Change procedure, if required</td>
</tr>
<tr>
<td></td>
<td>Reference electrode faulty*</td>
<td>Return sensor for regeneration</td>
</tr>
</tbody>
</table>

* If the reference electrode is of a silvery bright or white colour, it must be regenerated. Brownish-grey or yellow-green discolorations, however, are common.
** The DULCOMETER® D1C can be used to display the sensor current for a sensor which is electrically connected. Please read the value in the field "Zero point" in the complete operating menu, see operating instructions DULCOMETER® D1C, Ozone, Chapter 8 in the setting menu "Calibration ozone". Do not confirm by pressing the Enter key but exit the menu by pressing the Return key.
Cleaning the Membrane

IMPORTANT

- Before removing the sensor, switch off downstream control devices or switch to manual operation. In case of sensor failure, an incorrect measuring value may be present at the input of the control/measuring unit and result in an uncontrolled metering in a control circuit.
- Depressurise the system before removing the sensor! For this purpose, close the shut-off valves upstream and downstream of the fitting. When removing the sensor, liquid might leak if the system is pressurised.
- Read the safety notes of the system operator before opening the DGM/DLG III!

If the membrane is contaminated and the sensor cannot be calibrated, try to gently clean the membrane.
First remove the sensor.
Remove loosely adhering deposits

- Rinse the membrane under a gentle flow of cold water, remove lime deposits
- For this purpose, immerse the membrane cap into a 1 % hydrochloric acid (e.g. over night).
- Rinse the membrane cap with a lot of water.

Now, fill the sensor with electrolyte, let the sensor run in and calibrate again.

Replacing the Membrane

If a calibration is not possible even after cleaning or if the membrane is damaged, it has to be replaced (see "Assembly").
### Display Symbols

The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td>Symbol left</td>
<td>1</td>
</tr>
<tr>
<td>Relay 1, upper</td>
<td>Symbol left</td>
<td>1</td>
</tr>
<tr>
<td>Relay 1, lower</td>
<td>Symbol left</td>
<td>1</td>
</tr>
<tr>
<td>Relay 2, upper</td>
<td>Symbol right</td>
<td>1</td>
</tr>
<tr>
<td>Relay 2, lower</td>
<td>Symbol right</td>
<td>1</td>
</tr>
<tr>
<td>Metering pump 1 (H₂O₂) Control off</td>
<td>Symbol left</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol left</td>
<td></td>
</tr>
<tr>
<td>Metering pump 2 (De-H₂O₂) Control off</td>
<td>Symbol right</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol right</td>
<td></td>
</tr>
<tr>
<td>Solenoid valve 1 (H₂O₂) Control off</td>
<td>Symbol left</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol left</td>
<td></td>
</tr>
<tr>
<td>Solenoid valve 2 (De-H₂O₂) Control off</td>
<td>Symbol right</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol right</td>
<td></td>
</tr>
<tr>
<td>Servomotor Control, open relay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control, close relay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position feedback</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop button pressed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual metering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness of bar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increases from left to right during opening.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Operation

Permanent display 1

Permanent display 2

Setting menus

Access code

Calibration menu

Access code

Calibration notes

NOTE

Access to the setting menus can be barred with the access code!
The number and scope of setting menus is dependent on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.

BRANCH BACK without saving setting

CHANGE from selection to selection

BRANCH BACK to start of setting

CHANGE numbers or settings of selection

Variables flash

Text 1: Selection 1
                Text 2: Selection 2

ENTER and save setting, continue to next menu

Text 1: Selection 1
                Text 2: Selection 2
Restricted Operating Menu / Layout

The restricted operating menu permits simple operation of the most important parameters. The following overview shows the settings which can be selected:

- **PID Control**
  - Set Point (SP): 100.0 ppm
  - Desired Value (VP): 155.0 ppm
  - Alarm Relay: Active
  - Access Code: 5000
  - Operating Menu: English

- **Control with Dead Zone**
  - Control Output Value: 30%

- **Permanent Display**
  - Setting 1: 2000 ppm
  - Setting 2: 150.0 ppm

- **Calibration H2O2**
  - Zero Point: 4.00 mA
  - Slope: 60.0 μA/ppm

- **Limit**
  - Limit 1 Upper: 150.0 ppm
  - Limit 1 Lower: 10.0 ppm

- **Control Settings**
  - Normal Control
    - Control Output Value: 30%
  - Manual Control
    - Control Output Value: 30%

- **Control Output**
  - Positive H2O2
  - Negative De-H2O2

- **Identity Code**
  - D1CA-DxHxxxxxxxxx

- **Software Version**
  - D1C-C1 FW-5.01

- **Number and Scope of Setting Menus**
  - Access to setting menus can be blocked with access code.
8.3.2 DULCOTEST® PER Sensor for Hydrogen Peroxide, Commissioning

Assembly

CAUTION

- Protective goggles and protective clothing should be worn when handling water and solutions containing H₂O₂!
- Do not swallow the electrolyte. If electrolyte comes into contact with the eyes or skin, rinse the affected areas thoroughly with water! If reddening of the eyes occurs, consult an eye specialist!

IMPORTANT

- Do not touch or damage the membrane and electrodes!
- Always keep electrolyte bottles tightly closed after use! Do not transfer electrolyte into any other bottles or containers.
- The electrolyte should not be kept for more than 1 year! (See label for use-by date).
- The membrane cap may only be used once!

Pouring electrolyte

- Remove the membrane protection cap and unscrew the membrane cap from the electrode shaft.
- Fill the membrane cap with electrolyte up to the lower thread, if possible bubble-free.

If you wish to considerably reduce the running-in time, you must expel the air between the gauze and the membrane (as the air is expelled, the membrane is visible by reflecting through the electrolyte as it is being filled).

There are two ways of doing this:

1. Tap the membrane cap lightly from the side, from the bottom and from the top with the sensor shaft until the air bubbles stop rising (you can see this in good light).

2. Fill the enclosed pipette with electrolyte from the membrane cap, if possible up to the top. Please ensure that no air is taken in.

- Take the opening of the pipette as close as possible to the membrane (through the electrolyte) and place a couple of drops on it from the pipette (do not release any air from the pipette when doing this!)

IMPORTANT

After using the pipette, rinse thoroughly with water and store in the original sensor packaging!

Assembling membrane cap

- Insert the finger nail below both rubber seals at the semi-circular pocket in the membrane cap (the vent is positioned there) and pull the rubber seals to the bottom until the needle top-sized vent becomes visible and hold the seals. When screwing together, excess electrolyte should escape freely through the vent such that the membrane is not damaged by excess pressure.

- Position the electrode shaft vertically on the filled membrane cap.

- Do not obstruct the vent with your fingers.

- Screw the electrode shaft manually into the membrane cap up to the stop such that there is no free gap between the membrane cap and the electrode shaft.

- Re-insert the rubber seals flush into the groove of the membrane cap.
**IMPORTANT**

- Depressurise the system before installing the sensor in the flow housing. Close stop valves to the front and rear of the in-line probe housing.
- Placing/removing the sensor into/from the in-line probe housing should be done slowly.
- Do not exceed the maximum permitted operating pressure of 1 bar!
- Ensure the flow does not fall below the minimum flow rate of 30 l/h!

Monitor the flow on the connected measurement and control equipment. If the measured value is used as a control, switch off the control by reducing to below the minimum flow rate or switch to basic load.

- Avoid installations which allow air bubbles to build up in the sample water.

Air bubbles that cling to the diaphragm of the sensor can cause the measured value to be too small and thus may lead to incorrect metering in the control system.

**Fitting the sensor in the in-line probe housing**

Observe the operation and safety instructions contained in the operating instructions manual for the in-line probe housing!

**DLG III**
- Push the O-ring up over the sensor as far as the terminal block.
- Insert the sensor into the DLG III.
- Tighten the sensor with thread plugs.

**DGM**
- Push the O-ring up over the sensor as far as the terminal block; leave a plain washer in the DGM.
- Insert the sensor into the DGM and fit tightly with terminal screw until the O-ring is sealed: the terminal block determines the correct depth for fitting the sensor.

---

**8.3.2.2 DULCOTEST® PER Sensor for Hydrogen Peroxide, Electrical Installation**

**General Safety Instructions**

**IMPORTANT**

- Install the equipment so that the power supply for the controller never falls below the minimum! A power supply that is too low causes errors in measured values and can lead to over metering in a control system!
- The sensor PER is a sensor with a passive 4-20 mA two-wire interface. The power is supplied externally or from a measuring and control system. Connection to the DULCOMETER® D1C controller from ProMinent ensures automatic compliance with interface safety requirements.
- When electrically connecting the sensor to the measuring equipment, only use signal cables with a diameter of 4 mm.

**Electrical Installation**

- Turn the upper section of the sensor anti-clockwise through 90° and remove.
- Strip the outer insulation back by about 5 cm so that both connectors are visible.
- Loosen the M-12 connection and feed the 2-connector cable through it. Whilst doing this, keep the two-connector signal cable in the sensor (5 cm).
- Strip the insulation from both ends of the cable and connect to the terminal, as shown in the fig. (use the screwdriver provided). 1 = plus, 2 = minus
- Tighten the M-12 connection.
- Turn the upper section of the sensor clockwise firmly as far as the stop.
Commissioning

CAUTION

- Please note that for regulation tasks, the response time $T_{90}$ is 8 min.
- The power supply for the measuring equipment and the sensor must not be interrupted. If power is interrupted for a long period (>24 hrs), commissioning should be re-started (run-in and calibrate the sensor).
- Do not switch off the measuring system during intermittent operation!
  Connect the metering device after any time-delay. However, if there is a long period (weeks) during which no disinfectant is metered, disconnect the sensor from the power supply and store in a dry place.
- The current signal should not exceed 20 mA!
  Otherwise the current signal can drop, the sensor can become damaged and this can cause dangerous over metering in a control system! In order to avoid this, install a monitoring system, which turns off the remaining $H_2O_2$ control and triggers an alarm. The monitoring system should not be automatically reset.
- Avoid installations that can cause air bubbles in the sample water! Air bubbles clinging to the sensor diaphragm can cause the measured value to be too small and thus lead to dangerous over metering in a control system!
- After commissioning, the sensor should always be stored in a moist environment.

After successful installation, the measuring equipment can be activated. After that you need to wait for the designated running-in time for the sensor.

8.3.2.3 DULCOTEST® PER Sensor for Hydrogen Peroxide, Running-In

Running-In Period

In order to obtain a stable reading, the sensor requires the following running-in times:

- Initial commissioning: approx. 2 - 6 hours
- After changing the diaphragm: approx. 2 - 6 hour
- Re-commissioning: approx. 1 - 3 hours

If air between the gauze and the diaphragm was not expelled then, naturally, running-in times will be longer!

8.3.2.4 DULCOTEST® PER Sensor for Hydrogen Peroxide, Calibration

CAUTION

- You must perform a slope test after changing a diaphragm cap or electrolyte.
- You should perform a slope test at regular intervals to ensure flawless operation of the sensor.
- You should observe the relevant national regulations in force for calibration intervals!
Preconditions

Operation of the sensor is stable (no possible drift or fluctuating measured values during a minimum period of 5 minutes). This is generally guaranteed when the following conditions are fulfilled:

- the \( \text{H}_2\text{O}_2 \) concentration of the sample water is isochronically sufficiently constant (please note the sensor’s response time of 8 min!)
- the relevant running-in time has been allowed
- permitted flow is present in the in-line probe housing
- Temperature compensation is given between sensor and sample water (wait approx. 15 minutes).

Zero Point Calibration

A zero point calibration is only required at the lower limit of the measuring range.

Slope Test

**IMPORTANT**

- After an initial commissioning, check calibration after 24 hours.
- Repeat calibration if the \( \text{H}_2\text{O}_2 \) concentration varies by more than 15 % from the reference value.

On Photometry

- If not yet installed, install the sensor into the in-line probe DLG III or DGM.
- Perform sampling. This must be performed in direct proximity to the sensor. Recommendation: in case of the in-line probe DGM use the sampling valve.
- Determine the \( \text{H}_2\text{O}_2 \) concentration as quickly as possible with a Photometer (please observe operating instructions! E.g. use the Photometer DULCOTEST® DT3).
- Set the determined \( \text{H}_2\text{O}_2 \) concentration in ppm at the control device according to its operating instructions (see operating instructions DULCOMETER® D1C, measured variable \( \text{H}_2\text{O}_2 \).

Calibration of the \( \text{H}_2\text{O}_2 \) Sensor

During calibration, the D1C sets the positioning outputs to “0”. The exception to this is that when a base load or a manual controller output has been set, these are retained during the calibration. The mA standard output signals (measured value or correcting value) are frozen. The measured value frozen at the start of the calibration is suggested as the \( \text{H}_2\text{O}_2 \) value; this value is adjustable (arrow keys!). Calibration is only possible when the \( \text{H}_2\text{O}_2 \) value \( \geq 2 \) % of the range. When the calibration is successfully completed, all fault diagnoses that relate to the measured value are started afresh.

**IMPORTANT**

The measuring range of the sensor must agree with the set measuring range (factory setting: 0–200.0 ppm). The measuring range must be reset prior to calibration.
### Fault Table

<table>
<thead>
<tr>
<th>Fault</th>
<th>Symbol</th>
<th>Effect</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measured value exceeded</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>H₂O₂ slope too low</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>H₂O₂ slope too high</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Calibration sensor with error</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
</tr>
<tr>
<td>Calibration sensor too low</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>H₂O₂ value too low</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>H₂O₂ value too high</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Calibration sensor too high</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Signal too low</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Signal too high</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Feed forward control</td>
<td></td>
<td>Stop</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Servomotor position not reached</td>
<td></td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Possible Values

<table>
<thead>
<tr>
<th>Initial value</th>
<th>Measured value</th>
<th>Increment</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>0.01 %</td>
<td>-0.20 %</td>
<td>2.20 %</td>
<td></td>
<td>for measurement range up to 2 %</td>
</tr>
<tr>
<td></td>
<td>0.01 %</td>
<td>-0.10 %</td>
<td>1.10 %</td>
<td></td>
<td>for measurement range up to 1 %</td>
</tr>
<tr>
<td></td>
<td>1 ppm</td>
<td>-200 ppm</td>
<td>2200 ppm</td>
<td></td>
<td>for measurement range up to 2000 ppm</td>
</tr>
<tr>
<td></td>
<td>0.1 ppm</td>
<td>-20.0 ppm</td>
<td>220.0 ppm</td>
<td></td>
<td>for measurement range up to 200 ppm</td>
</tr>
<tr>
<td></td>
<td>0.01 ppm</td>
<td>-5.00 ppm</td>
<td>55.00 ppm</td>
<td></td>
<td>for measurement range up to 50 ppm</td>
</tr>
<tr>
<td></td>
<td>0.01 ppm</td>
<td>-2.00 ppm</td>
<td>22.00 ppm</td>
<td></td>
<td>for measurement range up to 20 ppm</td>
</tr>
</tbody>
</table>

### Error Message Table

<table>
<thead>
<tr>
<th>Error message</th>
<th>Condition</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibrate H₂O₂ not possible!</td>
<td>H₂O₂ slope too low (≥20 % of norm slope)</td>
<td>Calibrate again</td>
</tr>
<tr>
<td>Calibrate H₂O₂ not possible!</td>
<td>H₂O₂ slope too high (&gt;300 % of norm slope)</td>
<td>Calibrate again</td>
</tr>
<tr>
<td>H₂O₂ value too low</td>
<td>H₂O₂ &lt; 2 % measuring range</td>
<td></td>
</tr>
</tbody>
</table>

### 8.3.3 DULCOMETER® D1C and DULCOTEST® PER Sensor for Hydrogen Peroxide, Troubleshooting

#### Controller

<table>
<thead>
<tr>
<th>Fault</th>
<th>Symbol</th>
<th>Effect</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measured value exceeded</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Sensor slope too low</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Sensor slope too high</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Calibration sensor with error</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
</tr>
<tr>
<td>Calibration sensor too low</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>H₂O₂ value too low</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>H₂O₂ value too high</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Calibration sensor too high</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Signal too low</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Signal too high</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Feed forward control</td>
<td></td>
<td>Stop</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Servomotor position not reached</td>
<td></td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Operation</td>
<td>Note text</td>
<td>Symbol</td>
<td>Effect on control</td>
<td>Alarm with acknowledge</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------</td>
<td>--------</td>
<td>-------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Pause contact</td>
<td>Floor</td>
<td>Stop</td>
<td>Stop</td>
<td>No/Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step before</td>
<td></td>
<td>Stop</td>
<td>Stop</td>
<td>No/Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During calibration sensor</td>
<td></td>
<td>Stop</td>
<td>Basic load &amp; input control</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor slope too low</td>
<td></td>
<td>Stop</td>
<td>Basic load &amp; input control</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor slope too high</td>
<td></td>
<td>Stop</td>
<td>Basic load &amp; input control</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zero point</td>
<td></td>
<td>Stop</td>
<td>Basic load &amp; input control</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During servomotor setting</td>
<td></td>
<td>Stop</td>
<td>Basic load &amp; input control</td>
<td>No</td>
</tr>
</tbody>
</table>

*Dependent on whether “Alarm on” or “Alarm off” is set in “General settings”.

**Sensor: Troubleshooting**

Troubleshooting includes the complete measuring station. This consists of:

1. Measuring/control equipment
2. Electrical cable and connections
3. In-line probe housing and hydraulic connections
4. Sensor

Possible causes for faults shown in the table below mainly refer to the sensor. Before beginning to look for any faults, you should ensure that all operating instructions have been carried out in accordance with the Technical data:

- a) $\text{H}_2\text{O}_2$ content in accordance with the measurement range
- b) Sample water temperature 0 - 50 °C and constant
- c) Flow rate 30 - 60 l/h

You can use the sensor simulator (DULCOMETER® simulator order no. 1004042) to locate the fault in the measuring and control system. The operating instructions manual for the DULCOMETER® D1C measured value $\text{H}_2\text{O}_2$ gives full details on how to locate a fault in the measuring and control equipment.

Where there are major discrepancies between the measured values of the sensor and the measured value of the reference methods, you should first consider all possible faults relating to the reference methods. You should repeat the reference measurement several times if necessary.

**Fault**

- Sensor cannot be calibrated and measured value of the sensor is greater than the reference measurement
- Sensor cannot be calibrated and measured value of the sensor is smaller than the reference measurement

**Possible cause**

- Running-in time too short
- Diaphragm cap damaged
- Short circuit in the signal cable
- Interfering substances

**Remedy**

- ▶ See “Running-in time”
- ▶ Change diaphragm cap; run in the sensor, calibrate
- ▶ Locate the short circuit and remove
- ▶ Contact ProMinent

- Running-in time too short
- Coating/deposits on the diaphragm cap
- No sample water flow
- Air bubbles outside on the diaphragm
- Harmful substances in sample water
- Coating/deposits (manganese, iron oxide) at the diaphragm cap

- ▶ See “Running-in time”
- ▶ Clean or change diaphragm cap; run in the sensor, calibrate
- ▶ Correct the flow
- ▶ Increase the flow within the permitted levels
- ▶ Consult ProMinent

- ▶ Clean or change diaphragm cap; run in the sensor, calibrate
**If the reference electrode has a silvery sheen or looks white, it needs to be regenerated. Brownish-grey discolouration is however normal.**

To isolate faults, the current in the sensor can be displayed via the DULCOMETER® D1C whilst the latter is electrically connected to the sensor. For this purpose read the value in “zero point” in the setting menu “H₂O₂ calibration” in the complete operation menu, see operating instructions DULCOMETER® D1C, chap. 8. Do not confirm by pressing the Enter key, but exit the menu using the Back key.

**8.3.4 DULCOMETER® D1C Measured Variable H₂O₂ and DULCOTEST® PER Sensor for Hydrogen Peroxide, Maintenance**

**Controller**

The DULCOMETER® controller type D1C for the measured variable H₂O₂ is maintenance-free.

**Sensor**

**IMPORTANT**

- Maintain the sensor regularly in order to avoid over metering in a control system resulting from an incorrect measured value!
- Observe the relevant national regulations in force for frequency of maintenance!
- Do not touch the electrodes or bring them into contact with greasy substances!
- Do not unscrew the membrane cap when cleaning the membrane!

**Maintenance Interval**

Figures based on experience for: media with minor dirt contamination: 1 month
Other applications: depending on operating conditions

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor measured value is 0 ppm</td>
<td>No electrolyte in the diaphragm cap</td>
<td>Use new diaphragm cap and fill in new electrolyte (see “Mounting”, “Running-in Period” and “Calibration”)</td>
</tr>
<tr>
<td>Sensor measured value is 0 ppm and error message appears at the DULCOMETER® D1C controller “H₂O₂ input &lt; 3 mA”</td>
<td>Sensor connected to controller with incorrect polarity, Signal cable broken, Defective sensor, Defective control equipment</td>
<td>Connect the sensor correctly to the controller, Change signal cable, Return the sensor, Check the control equipment with sensor simulator (DULCOMETER® Simulator, order no.1004042), return if defective</td>
</tr>
<tr>
<td>Sensor measured value is 0 ppm and sensor current is between 3.0 and 4.0 mA**</td>
<td>Running-in time too short, Defective reference electrode*</td>
<td>See “Running-in time” and Return the sensor for regeneration</td>
</tr>
<tr>
<td>Error message at DULCOMETER® D1C controller “H₂O₂ input &gt; 23 mA”</td>
<td>H₂O₂ content exceeds upper limit of measuring range, Defective sensor</td>
<td>Check system, remedy the defect repeat calibration, Return the sensor</td>
</tr>
<tr>
<td>Sensor measured value is unstable</td>
<td>Defective reference electrode*</td>
<td>Return the sensor for regeneration</td>
</tr>
<tr>
<td></td>
<td>Process-related</td>
<td>Optimise control process</td>
</tr>
</tbody>
</table>
Maintenance Work

- Check the sensor regularly for dirt, deposits and air bubbles!
  Avoid, as far as is possible, contamination of the membrane with particles, deposits/
  sediments, etc. Eliminate air bubbles by increasing the flow.
- Check the sensor display value at the control equipment regularly using suitable reference
  methods (Photometry).
- If necessary, re-calibrate the sensor.
- If calibration is no longer possible, clean or replace the membrane cap and then repeat
  calibration (see “Assembly”, “Running-in time” and “Calibration”).

Cleaning the Membrane

- Do not unscrew the membrane cap!
- Wipe the membrane with a damp cloth.
## Display Symbols

The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td>left</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Relay 1, upper</td>
<td>Symbol</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Relay 1, lower</td>
<td>left</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Relay 2, upper</td>
<td>Symbol</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Relay 2, lower</td>
<td>right</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Metering pump 1 (PAA)</td>
<td>Control off left</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Metering pump 2 (De-PAA)</td>
<td>Control off right</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Control on</td>
<td>left</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Solenoid valve 1 (PAA)</td>
<td>Control off left</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Solenoid valve 2 (De-PAA)</td>
<td>Control off right</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Control on</td>
<td>left</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Servomotor</td>
<td>Control, open relay</td>
<td>![Symbol] ![Symbol]</td>
</tr>
<tr>
<td>Control, close relay</td>
<td>![Symbol] ![Symbol]</td>
<td></td>
</tr>
<tr>
<td>Without control</td>
<td>![Symbol] ![Symbol]</td>
<td></td>
</tr>
<tr>
<td>Position feedback</td>
<td>Thickness of bar increases from left to right during opening.</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Stop button pressed</td>
<td>![Symbol]</td>
<td></td>
</tr>
<tr>
<td>Manual metering</td>
<td>![Symbol]</td>
<td></td>
</tr>
<tr>
<td>Fault</td>
<td>![Symbol]</td>
<td></td>
</tr>
</tbody>
</table>
Operation

NOTE
Access to the setting menus can be barred with the access code!
The number and scope of setting menus is dependent on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.
**Peracetic Acid (PAA)**

### Restricted Operating Menu / Layout

The restricted operating menu permits simple operation of the most important parameters. The following overview shows the settings which can be selected:

- **Permanent display 1**
  - Setting in complete operating menu
    - General setting information
      - Start-code: D1C2
        - License version: D1C2-PES-010-GB
      - Alarm relay
        - Active: +
      - Access code: 5000
  - Positive values of setting variable: PAA
  - Negative values of setting variable: De-PAA

- **Permanent display 2**
  - Only with control
    - REL 1 lower
    - REL 2 upper
    - Setting with dead zone
      - Normal control
        - Current regulation value: 30 %
        - Setpoint: 100.0 ppm
        - Ti = off
        - Td = off
  - PID Control
    - Control with dead zone
      - Setpoint 2 upper
      - Setpoint 1 lower
      - For Manual Control
        - Manual dosing
          - Setpoint: 200.0 ppm
          - Regulated range: 5-10 %
    - Control with normal regulation
      - Value: 30 %
      - Setpoint: 100.0 ppm
      - Ti = off
      - Td = off
  - Proportional control
    - Current regulation value: 30 %
    - Setpoint: 100.0 ppm
    - Ti = off
    - Td = off
  - Feeding
    - Set feedfwd: 70 %
    - Measured value: 200.0 ppm
    - Ctrlout: 59 %
  - Control with dead zone
    - Current regulation value: 30 %
    - Setpoint 2 upper
    - Setpoint 1 lower
    - For Manual Control
      - Manual dosing
        - Setpoint: 200.0 ppm
        - Regulated range: 5-10 %
  - Calibration PAA
    - Value: 1.55 ppm
    - Zero point: 4.00 mA
    - Slope: 60.0 μA/ppm
  - Calibration PAA
    - Value: 1.55 ppm
    - Zero point: 4.00 mA
    - Slope: 6.00 mA/ppm

- **Set REL 1 lower**
  - REL 2 upper
  - Setting with dead zone
    - Normal control
      - Current regulation value: 30 %
      - Setpoint: 100.0 ppm
      - Ti = off
      - Td = off
    - PID Control
      - Control with dead zone
        - Setpoint 2 upper
        - Setpoint 1 lower
        - For Manual Control
          - Manual dosing
            - Setpoint: 200.0 ppm
            - Regulated range: 5-10 %
        - Control with normal regulation
          - Value: 30 %
          - Setpoint: 100.0 ppm
          - Ti = off
          - Td = off
    - Proportional control
      - Current regulation value: 30 %
      - Setpoint: 100.0 ppm
      - Ti = off
      - Td = off
  - Calibration PAA
    - Value: 1.55 ppm
    - Zero point: 4.00 mA
    - Slope: 60.0 μA/ppm
  - Calibration PAA
    - Value: 1.55 ppm
    - Zero point: 4.00 mA
    - Slope: 6.00 mA/ppm

- **Alarm relay**
  - Active: +

- **Access code**
  - 5000

- **Operating menu**
  - = English
  - = Reduced

### General Setting Information

- **Ident-code**: D1CA
- **Software version**: D1C-C1 FW-5.00

### Access to Setting Menus

Access to setting menus can be blocked with access code.
8.4.2 DULCOTEST® PAA Sensor for Peracetic Acid, Commissioning

8.4.2.1 DULCOTEST® PAA Sensor for Peracetic Acid, Assembly

Assembly

**CAUTION**

- Protective goggles and protective clothing should be worn when dealing with water and solutions containing peracetic acid!
- Do not swallow the electrolyte. If electrolyte comes into contact with the eyes or skin, rinse the affected areas thoroughly with water! If reddening of the eyes occurs, consult an eye specialist!

**IMPORTANT**

- Do not touch or damage the membrane and electrodes!
- Always keep electrolyte bottles tightly closed after use! Do not transfer electrolyte into any other bottles or containers.
- The electrolyte should not be kept for more than 2 years! (See label for use-by date).

**Pouring electrolyte**

- Remove the membrane protection cap and unscrew the membrane cap from the electrode shaft.
- Fill the membrane cap up to the bottom of the thread.
- If you wish to considerably reduce the running-in time, you must expel the air between the gauze and the membrane (as the air is expelled, the membrane is visible by reflecting through the electrolyte as it is being filled).
- There are two ways of doing this:
  1. Tap the membrane cap lightly from the side with the sensor shaft until the air bubbles stop rising (you can see this in a good light).
  2. Fill the enclosed pipette as far as possible with electrolyte from the membrane cap.
- Take the opening of the pipette as close as possible to the membrane (through the electrolyte) and place a couple of drops on it from the pipette (do not release any air from the pipette when doing this).

**IMPORTANT**

After using the pipette, rinse thoroughly with water and store in the original sensor packaging!

**Assembling membrane cap**

- Set the electrode shaft vertically on the filled membrane cap.
- Ensure your fingers do not cover the bleed hole located beneath the rubber seal.
- Screw in the membrane cap by hand so that there is no empty space visible between the membrane cap and electrode shaft. As the membrane cap is screwed into position, any excess electrolyte should be able to escape freely through the bleed hole beneath the rubber seal.

**Assembling sensor**

**IMPORTANT**

- Depressurise the system before installing the sensor in the flow housing. Close stop valves to the front and rear of the in-line probe housing.
- Place/removing the sensor into/from the in-line probe housing should be done slowly.
- Do not exceed the maximum permissible operating pressure of 1 bar!
- Ensure the flow does not fall below the minimum flow rate of 30 l/h! Monitor the flow on the connected measurement and control equipment. If the measured value is used as a control, switch off the control by reducing to below the minimum flow rate or switch to basic load.
- Avoid installations, which allow air bubbles to build up in the sample water. Air bubbles that cling to the diaphragm of the sensor can cause the measured value to be too small and thus lead to incorrect metering in the control system.
8.4.2.2 DULCOTEST® PAA Sensor for Peracetic Acid, Electrical Installation

General Safety Instructions

IMPORTANT
Install the equipment so that the power supply for the controller never falls below the minimum! A power supply that is too low causes errors in measured values and can lead to overmetering in a control system!

The sensor PAA is a sensor with a passive 4-20 mA two-wire interface. The power is supplied externally or from a measuring and control system. Connection to the DULCOMETER® D1C controller from ProMinent ensures automatic compliance with interface safety requirements.

IMPORTANT
When electrically connecting the sensor to the measuring equipment, only use signal cables with a diameter of 4 mm.

Electrical Installation

Turn the upper section of the sensor anti-clockwise through 90° and remove.
Strip the outer insulation back by about 5 cm so that both connectors are visible.
Loosen the M-12 connection and feed the 2-connector cable through it. Whilst doing this, keep the two-connector signal cable in the sensor (5 cm).
Strip the insulation from both ends of the cable and make a clear connection with the terminal (use the screwdriver provided). 1 = plus, 2 = minus
Tighten the M-12 connection.
Turn the upper section of the sensor clockwise firmly as far as the stop.

Fitting the sensor in the in-line probe housing

Ensure you also observe the operation and safety instructions contained in the operating instructions manual for the in-line probe housing!

DLG III
Push the O-ring up over the sensor as far as the terminal block.
Put the sensor into the DLG III.
Tighten the sensor with thread plugs.

DGM
Push the O-ring up over the sensor as far as the terminal block; leave a plain washer in the DGM.
Put the sensor into the DGM and fit tightly with terminal screw until the O-ring is sealed: the terminal block determines the correct depth for fitting the sensor.
Peracetic Acid (PAA)

Commissioning

**CAUTION**
- The power supply for the measuring equipment and the sensor must not be interrupted. If power is interrupted for a long period (>24 hrs) commissioning should be re-started (run-in and calibrate the sensor).
- Do not switch off the measuring system during interval operation! After operation without peracetic acid, running-in periods are to be reckoned with. If required, switch on metering unit time-delayed!
- If no peracetic acid is metered for a longer period of time, the sensor must be disconnected from the power supply and stored dry.
- The current signal should not exceed 20 mA!
  Otherwise the current signal can drop, the sensor can become damaged and this can cause dangerous over metering in a control system!
  In order to avoid this, install a monitoring system, which turns off the remaining peracetic acid control and raises an alarm. The monitoring system should not be automatically reset.
- Avoid installations that can cause air bubbles in the sample water! Air bubbles clinging to the sensor diaphragm can cause the measured value to be too small and thus lead to dangerous over metering in a control system!
- After commissioning, the sensor should always be stored in a moist environment.

After successful installation, you can switch on the measuring equipment. After that you need to wait for the designated running-in time for the sensor.

### 8.4.2.3 DULCOTEST® PAA Sensor for Peracetic Acid, Running-In

#### Running-In Period

In order to achieve a stable reading, the sensor requires the following running-in times:

- Initial commissioning: approx. 1-2 hours
- after changing the diaphragm: approx. 1 hour
- Re-commissioning: approx. 1-2 hours

If air between the gauze and the diaphragm was not expelled then, naturally, running-in times will be longer!

### 8.4.2.4 DULCOTEST® PAA Sensor for Peracetic Acid, Calibration

**CAUTION**
- You must perform a slope test after changing a diaphragm cap or electrolyte.
- You should perform a slope test at regular intervals to ensure flawless operation of the sensor.
- You should observe the relevant national regulations in force for calibration intervals!

#### Preconditions

Operation of the sensor is stable (no possible drift or fluctuating measured values during a minimum period of 5 minutes). This is generally guaranteed when the following conditions are fulfilled:

- The relevant running-in time has been allowed
- Permitted flow is present in the in-line probe housing
- Temperature compensation achieved between sensor and sample water (wait approx. 15 minutes).

#### Zero Point Calibration

Zero point calibration is not required.
Slope Test

IMPORTANT

- After an initial commissioning, check calibration after 24 hours.
  - Repeat calibration if the PAA concentration varies by more than 15% from the reference value.

There are two ways of performing a slope test for the peracetic acid (PAA) sensor:
  - via two-stage titration
  - via a PAA standard solution (with a known PAA concentration)

Regarding Two-Stage Titration

NOTE

Calibration on a bottle-washing machine should only be performed after a long uninterrupted period of operation, or when the bottle-washing machine has stopped (PAA concentration remains constant).

If calibrating whilst the bottle-washing machine is running, you should prepare everything for titration in the laboratory in advance and measure the sample as soon as possible after taking it.

- If it has not already been done, fit the sensor in the in-line probe housing DLG III or DGM.
- Take a sample for titration. You should do this in the immediate vicinity of the sensor. Tip: for the DGM in-line probe housing, use the sample extraction valve.
- Determine the PAA concentration as quickly as possible.
- Adjust the value ascertained for PAA concentration in ppm on the control equipment in accordance with the relevant operating instructions manual (see operating instructions manual for DULCOMETER® D1C for the measured value peracetic acid, chap. 8, complete operating menu, set-up menu “PAA calibration”).

Regarding PAA Standard Solution

- Add a known concentration of PAA to a standard solution e.g. in the cup of the DLG III in-line probe housing.
- Stir the contents of the cup using a magnetic stirring rod.
- Immerse the sensor in the cup until the measured value remains constant (15 minutes).
- Set the given PAA concentration value for the standard solution in ppm in the control equipment in accordance with the operating instructions manual (see operating instructions manual for the DULCOMETER® D1C for the measured value peracetic acid, chap. 8, complete operating menu, set-up menu “PAA calibration”).
Peracetic Acid (PAA)

Calibration of the PAA Sensor
During calibration, the D1C sets the positioning outputs to "0". The exception to this is that when a base load or a manual controller output has been set, these are retained during the calibration. The mA standard output signals (measured value or correcting value) are frozen. The measured value registered during the start of the calibration is proposed as the PAA value; this value is adjustable (arrow keys!). Calibration is only possible if the PAA value is ≥ 2 % of the measuring range. On successful completion of calibration, all error checks which refer to the measured value are restarted.

**IMPORTANT**
The measuring range of the sensor must agree with the set measuring range (factory setting: 0–200.0 ppm). The measuring range must be reset prior to calibration.

### Possible values

<table>
<thead>
<tr>
<th>Initial value</th>
<th>Possible values</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>0.1 ppm</td>
<td>-20 ppm</td>
<td>220 ppm</td>
<td>for measurement range up to 200 ppm</td>
</tr>
<tr>
<td></td>
<td>1 ppm</td>
<td>-200 ppm</td>
<td>2200 ppm</td>
<td>for measurement range up to 2000 ppm</td>
</tr>
</tbody>
</table>

### Error message

<table>
<thead>
<tr>
<th>Error message</th>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration PAA not possible! PAA slope too low</td>
<td>PAA slope too low (&lt;25 % of norm slope)</td>
<td>Calibrate again</td>
</tr>
<tr>
<td>Calibration PAA not possible! Sensor slope too high</td>
<td>PAA slope too high (&gt;300 % of norm slope)</td>
<td>Calibrate again</td>
</tr>
<tr>
<td>PAA value too low PAA &gt; x.xx ppm</td>
<td>PAA &lt;2 % measuring range</td>
<td></td>
</tr>
</tbody>
</table>
### Peracetic Acid (PAA)

8.4.3 DULCOMETER® D1C and DULCOTEST® PAA Sensor for Peracetic Acid, Troubleshooting

#### Controller

<table>
<thead>
<tr>
<th>Fault</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value exceeded</td>
<td>Check PAA sensor</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Function defeatable</td>
</tr>
<tr>
<td>Signal exceeds or drops below level value</td>
<td>PAA input &lt; 3 mA or PAA input &gt; 22 mA</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Signal &lt; 0.3 ± 0.2 mA or &gt; 22 ± 0.2 mA</td>
</tr>
<tr>
<td>Calibration sensor with error</td>
<td>PAA cable defective</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>Block error continues in case of error with an identity measured value</td>
</tr>
<tr>
<td>Correction variables exceed level value</td>
<td></td>
<td></td>
<td></td>
<td>Stop</td>
<td>Yes</td>
<td>Signal &lt; 3.0 ± 0.2 mA or &gt; 22 ± 0.2 mA</td>
</tr>
<tr>
<td>Feed forward control</td>
<td>Signal input = 0 or N</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Basic load stop No Relay drops out</td>
</tr>
<tr>
<td>Limit transgression</td>
<td>PAA input &lt; 3 mA or &gt; 23 ± 0.2 mA</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Signal &lt; 0.3 ± 0.2 mA or &gt; 22 ± 0.2 mA</td>
</tr>
<tr>
<td>Servomotor</td>
<td>Servomotor defective</td>
<td></td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Servomotor closed</td>
</tr>
<tr>
<td>Electronics error</td>
<td>System error</td>
<td></td>
<td></td>
<td>Stop</td>
<td>Stop</td>
<td>Electronic data defective</td>
</tr>
</tbody>
</table>

#### Operation

<table>
<thead>
<tr>
<th>Operation</th>
<th>Note text</th>
<th>Symbol</th>
<th>Effect</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pause</td>
<td>Pause/OFF</td>
<td>Basic load</td>
<td>Stop</td>
<td>Stop</td>
<td>No further fault check</td>
<td>–</td>
</tr>
<tr>
<td>Stop button</td>
<td></td>
<td></td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Relay drops out</td>
</tr>
<tr>
<td>During calibration probe</td>
<td></td>
<td></td>
<td>No</td>
<td></td>
<td>No error processing of measured variables</td>
<td>–</td>
</tr>
<tr>
<td>Slew rate too low</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Stop</td>
<td>Slow for correct recalibration</td>
</tr>
<tr>
<td>Sensor slope too high</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Stop</td>
<td>20% &gt; Sensor slope</td>
</tr>
<tr>
<td>PA-value too low</td>
<td>PAA input &gt; 22</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Stop</td>
<td>c. 2 % from max. range</td>
</tr>
<tr>
<td>Zero position</td>
<td>Zero point slow</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Stop</td>
<td>Zero point too slow</td>
</tr>
<tr>
<td>Setting sensor setting</td>
<td></td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>Stop</td>
<td>Without correct adjustment the last valid values are still used</td>
</tr>
</tbody>
</table>

*Dependent on whether “Alarm on” or “Alarm off” is set in “General settings”*
Sensor Troubleshooting

You must look at the entire measurement station in order to locate any faults. This consists of:

1) Measuring/control equipment
2) Electrical cable and connections
3) In-line probe housing and hydraulic connections
4) Sensor

Possible causes for faults shown in the table below mainly refer to the sensor. Before beginning to look for any faults, you should ensure that all operating instructions have been carried out in accordance with the technical data.

- Peracetic acid content in accordance with the area of measurement
- Sample water temperature 5 - 45 °C and constant
- Flow 30 - 60 l/h

You can use the sensor simulator (DULCOMETER® simulator order no. 1004042) to locate the fault in the measuring and control system. The operating instructions manual for the DULCOMETER® D1C measured value peracetic acid gives full details on how to locate a fault in the measuring and control equipment.

Where there are large discrepancies between the measured values of the sensor and the measured value of the reference methods, you should first consider all possible faults relating to the reference methods. You should repeat the reference measurement several times if necessary.

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor cannot be calibrated and measured value of the measuring cell is greater than the reference measurement</td>
<td>Running-in time too short</td>
<td>See “Running-in time”</td>
</tr>
<tr>
<td></td>
<td>Diaphragm cap damaged</td>
<td>Change diaphragm cap; run in the sensor, calibrate</td>
</tr>
<tr>
<td></td>
<td>Short circuit in the signal cable</td>
<td>Locate the short circuit and remove</td>
</tr>
<tr>
<td>Sensor cannot be calibrated and measured value of the measuring cell is smaller than the reference measurement</td>
<td>Running-in time too short</td>
<td>See “Running-in time”</td>
</tr>
<tr>
<td></td>
<td>Coating/deposits on the diaphragm cap</td>
<td>Clean or change diaphragm cap; run in the sensor, calibrate</td>
</tr>
<tr>
<td></td>
<td>No sample water flow</td>
<td>Correct the flow</td>
</tr>
<tr>
<td></td>
<td>Air bubbles outside on the diaphragm</td>
<td>Tap to remove air bubbles and increase flow if necessary</td>
</tr>
<tr>
<td></td>
<td>Harmful substances in sample water</td>
<td>Consult ProMinent</td>
</tr>
<tr>
<td></td>
<td>Coating/deposits (manganese, iron oxide) on the diaphragm</td>
<td>Clean or change diaphragm cap; run in the sensor, calibrate</td>
</tr>
</tbody>
</table>
| Sensor measured value is 0 ppm | No electrolyte in the diaphragm cap | Fill with electrolyte (see “Assembly”, “Running-in time” and “Calibration”)
| Sensor measured value is 0 ppm and error message appears on the DULCOMETER® D1C controller “PES input < 3 mA” | Sensor connected to controller with incorrect polarity | Connect the sensor correctly to the controller |
| | Signal cable broken | Change signal cable |
| | Defective sensor | Return the sensor |
| | Defective control equipment | Check the control equipment with sensor simulator (DULCOMETER® Simulator, order no. 1004042), return if faulty |
**Fault Possible cause Remedy**

* If the reference electrode has a silvery sheen or looks white, it needs to be regenerated. Brownish-grey discoloration is however normal.

** To isolate faults, the current in the sensor can be displayed via the DULCOMETER® D1C whilst the latter is electrically connected to the sensor. You can read about this in the complete operation menu, see operating instructions manual for DULCOMETER® D1C chap. 8 in the set-up menu “PAA calibration” the value under “zero point”. You should then confirm, not with the Enter key, but leave the menu using the Back key.

<table>
<thead>
<tr>
<th>Sensor measured value is 0 ppm and sensor current is between 3.0 and 4.0 mA**</th>
<th>Running-in time too short</th>
<th>See &quot;Running-in time&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defective reference electrode*</td>
<td>Return the sensor for regeneration</td>
<td></td>
</tr>
</tbody>
</table>

**Error message on DULCOMETER® D1C controller “PES input >23 mA”**

PES content exceeds upper limit of instrument measuring range

Defective sensor

Check system, fix the fault, repeat calibration

Return the sensor

**Sensor measured value is unstable**

Defective reference electrode* ➔ Return the sensor for regeneration

Restricted operation ➔ Optimise control operation

* If the reference electrode has a silvery sheen or looks white, it needs to be regenerated. Brownish-grey discoloration is however normal.

** To isolate faults, the current in the sensor can be displayed via the DULCOMETER® D1C whilst the latter is electrically connected to the sensor. You can read about this in the complete operation menu, see operating instructions manual for DULCOMETER® D1C chap. 8 in the set-up menu “PAA calibration” the value under “zero point”. You should then confirm, not with the Enter key, but leave the menu using the Back key.

8.4.4 DULCOMETER® D1C Peracetic Acid (PAA) and DULCOTEST® PAA

Sensor for Peracetic Acid, Maintenance

Controller

The DULCOMETER® controller type D1C for the measured variable peracetic acid is maintenance-free.

**Sensor**

**IMPORTANT**

- Maintain the sensor regularly in order to avoid over metering in a control system resulting from an incorrect measured value!
- Observe the relevant national regulations in force for frequency of maintenance!
- Do not disturb the electrodes or bring them into contact with greasy substances!
- Do not unscrew the membrane cap when cleaning the membrane!

**Maintenance interval**

Figures based on experience for: CIP: 1 month

Other applications: according to operating instructions

**Maintenance Work**

- Check the sensor regularly for dirt, deposits and air bubbles! Avoid, as far as is possible, contamination of the membrane with particles, deposits/sediments, etc. Eliminate air bubbles by increasing the flow.
- Check the sensor display value on the control equipment regularly using suitable reference methods (e.g. titration).
- If necessary, re-calibrate the sensor (see “Calibration”).
- If calibration is no longer possible, you must clean or change the membrane cap and then repeat calibration (see "Assembly", "Running-in time" and "Calibration").

**Cleaning the Membrane**

- Do not unscrew the membrane cap!
- Wipe the membrane with a damp cloth.
8.5 Measuring Parameter Chlorine Dioxide

8.5.1 DULCOMETER® D1C Measured Variable Chlorine Dioxide, Setting and Operation

Display Symbols
The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td>Symbol left</td>
<td>![Symbol 1]</td>
</tr>
<tr>
<td>Relay 1, lower</td>
<td>Symbol left</td>
<td>![Symbol 2]</td>
</tr>
<tr>
<td>Relay 2, upper</td>
<td>Symbol right</td>
<td>![Symbol 3]</td>
</tr>
<tr>
<td>Relay 2, lower</td>
<td>Symbol right</td>
<td>![Symbol 4]</td>
</tr>
<tr>
<td>Metering pump 1 (chlorine dioxide)</td>
<td>Symbol left</td>
<td>![Symbol 5]</td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol left</td>
<td>![Symbol 6]</td>
</tr>
<tr>
<td>Metering pump 2 (De-ClO₂)</td>
<td>Symbol right</td>
<td>![Symbol 7]</td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol right</td>
<td>![Symbol 8]</td>
</tr>
<tr>
<td>Solenoid valve 1 (chlorine dioxide)</td>
<td>Symbol left</td>
<td>![Symbol 9]</td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol left</td>
<td>![Symbol 10]</td>
</tr>
<tr>
<td>Solenoid valve 2 (De-ClO₂)</td>
<td>Symbol right</td>
<td>![Symbol 11]</td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol right</td>
<td>![Symbol 12]</td>
</tr>
<tr>
<td>Servomotor</td>
<td>Symbol right</td>
<td>![Symbol 13]</td>
</tr>
<tr>
<td>Without control</td>
<td>Symbol right</td>
<td>![Symbol 14]</td>
</tr>
<tr>
<td>Position feedback</td>
<td>Thickness of bar increases from left to right during opening</td>
<td>![Symbol 15]</td>
</tr>
<tr>
<td>Stop button pressed</td>
<td>Symbol</td>
<td>![Symbol 16]</td>
</tr>
<tr>
<td>Manual metering</td>
<td>Symbol</td>
<td>![Symbol 17]</td>
</tr>
<tr>
<td>Fault</td>
<td>Symbol</td>
<td>![Symbol 18]</td>
</tr>
</tbody>
</table>
NOTE
Access to the setting menus can be barred with the access code.
The number and scope of setting menus depends on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.
Restricted Operating Menu / Layout
The restricted operating menu permits simple operation of the most important parameters. The following overview shows the settings which can be selected:

- Positive values of setting variable: chlorine dioxide
- Negative values of setting variable: De-ClO₂ (chlorine dioxide destruction)

**Permanent display 1**
- Auto.: 30.0 °C
- Calibration ClO₂:
  - Zero p.: 4.00 mA
  - Slope: 6.50 mA/ppm
- Temp.: 30.0 °C

**Permanent display 2**
- Only with control
- Positive values of setting variable: chlorine dioxide
- Negative values of setting variable: De-ClO₂ (chlorine dioxide destruction)

**Limits**
- Setting ?
- Control?

**Setting in complete operating menu**
- Control output:
  - Positive ClO₂
  - Negative De-ClO₂
- For normal control:
  - Set point: < 0.60 ppm
- For control with dead zone:
  - Set point 2: upper < 0.60 ppm
  - Set point 1: lower ≤ 0.60 ppm
- Manual output value: <= 30 %
- Manual dosing: 15 %

**General setting information**
- Ident code: D1CA
- Software version: D1C-B1 FW-5.00
- Alarm relay:
  - Active
  - Access code: 5000
  - Operating menu:
    - English
    - Reduced

Access to setting menus can be blocked with access code.

Number and scope of setting menus depends on the device.
Chlorine Dioxide

8.5.2 DULCOTEST® CDE Chlorine Dioxide Sensor, Commissioning

8.5.2.1 DULCOTEST® CDE Chlorine Dioxide Sensor, Assembly

Assembly

Pouring electrolyte

**IMPORTANT**
- The membrane at the lower end of the membrane cap and the electrodes at the lower end of the electrode shaft should not be touched, damaged or brought into contact with greasy substances! Otherwise the sensor will not work correctly. If this is the case, replace membrane cap or return the sensor for cleaning the electrodes.
- Protect yourself and your clothing from contact with the electrolyte (acid!) using appropriate protective equipment. The electrolyte can cause irritation to skin and damage to clothing. In case of contact, rinse immediately with plenty of cold water.

**NOTE**
Carry out the following steps at the washbasin!

1. Open the electrolyte bottle and screw on the nozzle.
2. Remove the red cap completely from the nozzle and cut off the end of the nozzle.
3. Remove the membrane cap and unscrew the membrane cap from the electrode shaft.
4. Rinse the membrane cap and the electrode with a small amount of electrolyte.
5. Fill the membrane cap up the top with electrolyte and allow electrolyte to overflow down the inside wall.

Assembling membrane cap

1. Locate the electrode shaft vertically onto the filled membrane cap and turn until the thread bites.
2. Rotate the membrane cap so that the vent hole is at the top.
3. Slowly screw on the membrane cap by hand up to the stop. In the process the excess electrolyte will seep out of the vent hole.
4. Rinse sensor under running water to remove excess electrolyte from the sensor and from hands.

Assembling sensor

**IMPORTANT**
- The sensor must be slowly inserted into or withdrawn from the in-line probe housing! The membrane could otherwise be damaged.
- Do not touch the in-line probe housing flow resistor with the membrane!
- The sensor must be kept wet at all times once commissioned - e.g. the in-line probe housing must not be allowed to run dry.

Assemble the sensor as described in the operating instructions supplied with the in-line probe housing.

8.5.2.2 DULCOTEST® CDE Chlorine Dioxide Sensor, Electrical Installation

**IMPORTANT**
- The sensor is not electrically isolated from the sample water. All other elements must be isolated! The controller must be isolated both from the sensor and from the supply voltage!
- The supply voltage must not fall below 16 V DC, even for a short period! The current source must be able to sustain 35 mA at a min. 16 V DC! Insufficient supply voltage will result in an inaccurate reading!
- After the electrical connection of the sensor, the sensor has to be inserted into the sample water which has to contain chlorine dioxide.
The sensor incorporates a passive 4-20 mA two-wire interface, i.e. the power supply is provided externally e.g. via the controller.

- Safety requirements are automatically met if the sensor is connected to a ProMinent® controller (e.g. DULCOMETER® D1C).
- Do not switch off the measuring system when in intermittent use! If necessary, dosing equipment should be timer-controlled!

**Electrical Installation**

- Rotate the sensor adapter anticlockwise by 90 °C and remove (bayonet fitting).
- Unscrew the PG-7 threaded connector tensioning screw and insert the signal cable leading from the controller.
- Strip the ends of the cable and attach to the two-wire connector: 1 = positive, 2 = negative.
- Insert approx. 5 cm of signal cable into the sensor and tighten the PG-7 threaded connector tensioning screw.
- Insert the sensor adapter completely into the housing and screw together carefully to prevent damage to the ends of the bayonet connector.

**Electrical connection to sensor**

---

8.5.2.3 DULCOTEST® CDE Chlorine Dioxide Sensor, Running-In

**IMPORTANT**

- The sensor must be used only in surfactant-free water or solutions!
- When operating the sensor, the sample water must permanently contain chlorine dioxide.
- Do not switch off the measuring system during interval operation!
  After operation without chlorine dioxide, running-in periods are to be reckoned with.
  If required, switch on metering unit time-delayed!
  If no chlorine dioxide is metered for a longer period of time, the sensor must be disconnected from the power supply and stored dry.

**Running-In Period**

The sensor requires a run-in period before it will display stable readings.

Commissioning: 2 - 6 h
Re-commissioning: 1 - 3 h
Diaphragm-/electrolyte replacement: approx. 0.5 h
8.5.2.4 DULCOTEST® CDE Chlorine Dioxide Sensor, Calibration

The sensor can be calibrated after the run-in period.

**IMPORTANT**
- A slope test must be carried out after replacing the diaphragm cap or electrolyte!
- Slope tests must be carried out at regular intervals to ensure correct functioning of the sensor! For testing drinking water, calibration of the sensor every 3 - 4 weeks is sufficient.
- Avoid incorrect dosing due to air bubbles in the water. Air bubbles clinging to the sensor diaphragm can reduce the measured variable and thereby lead to overdosing.
- Observe applicable national directives for calibration intervals!

**Preconditions**
- Constant flow to the in-line probe housing
- Constant sample water temperature
- Same sample water and sensor temperatures (wait approx. 15 min.)

**Zero Point Calibration**
If a ProMinent controller is being used to operate the sensor there is no need for zero point calibration. Zero point calibration should be carried out, however, if operating the sensor in the lower measurement range, or if using the 0.5 ppm variant.

**Preconditions**
- The sensor has been run in
- Flow to the in-line probe housing is constant and complies with technical datas
  - Insert the sensor into a container of clean, ozone- and ClO₂-free water.
  - Stir with the sensor until the measured variable displayed at the controller has remained stable for 5 min.
  - Calibrate the controller to zero in accordance with the operating instructions.
  - Replace sensor into the in-line probe housing (DGM; DLG).

**Slope Test**
- Determine the chlorine dioxide content in the sample water using an appropriate measurement device (e.g. DPD-1).
- Set the resulting value at the controller in accordance with the operating instructions.

Repeat calibration after 1 day!

**NOTE**
**Calibration at high temperatures**
As chlorine dioxide, in contrast to chlorine, is only physically dissolved in water, it evaporates out of the liquid very quickly at high temperatures (> 30 °C). We therefore recommend that you act quickly when carrying out the DPD measurement. There should be no more than 1 min. between the sample extraction and the addition of reagents. Therefore the reagent should be added directly at the sample extraction point and measurement should follow as soon as possible afterwards in the laboratory.
### Chlorine Dioxide

#### Calibration of the Chlorine Dioxide Sensor

During the calibration the DULCOMETER® D1C switches the control outputs to "0". Exception: where a basic load or a manual control variable has been entered it is retained throughout the calibration.

The standard mA signal outputs (measured value or correction value) are frozen. The measured value registered during the start of the calibration is proposed as the DPD value; this value is adjustable (arrow keys!). Calibration is only possible if the DPD value is ≥ 2 % of the measuring range. On successful completion of calibration, all error checks which refer to the measured value are restarted.

**IMPORTANT**

The measuring range of the sensor must agree with the set measuring range (factory setting: 0–2 ppm). The measuring range must be reset prior to calibration.

### Table: Possible Values

<table>
<thead>
<tr>
<th>Error message</th>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration ClO₂ not possible</td>
<td>ClO₂ slope too low (&lt;25 % of standard slope)</td>
<td>Calibrate again</td>
</tr>
<tr>
<td>Sensor slope too low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration ClO₂ not possible</td>
<td>ClO₂ slope too high (&gt;300 % of standard slope)</td>
<td>Calibrate again</td>
</tr>
<tr>
<td>Sensor slope too high</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ClO₂ &gt; x.xx ppm</td>
<td>ClO₂ &lt; 2 % measuring range</td>
<td>Calibrate again after adding chlorine dioxide</td>
</tr>
</tbody>
</table>

### Diagrams

- Permanent display 1
- Permanent display 2

**Note:**

- Positive values of setting variable: chlorine dioxide (ClO₂)
- Negative values of setting variable: De-ClO₂ (chlorine dioxide destruction)
### 8.5.3 DULCOMETER® D1C and DULCOTEST® CDE Chlorine Dioxide Sensor, Troubleshooting

#### Controller

<table>
<thead>
<tr>
<th>Fault</th>
<th>Fault Text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>Checked time measured value exceeded</td>
<td>Check ClO₂ sensor</td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Function defeatable</td>
</tr>
<tr>
<td>Signal measured value</td>
<td>Signal measured value exceeded</td>
<td>Check ClO₂ input</td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Signal &gt; 5 ± 0.2 mA</td>
</tr>
<tr>
<td>Calibration sensor error</td>
<td>Check ClO₂ calibration</td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>No further fault check</td>
<td>Replace if necessary, recalculate if necessary</td>
</tr>
<tr>
<td>Correction variable</td>
<td>Signal exceeds alarm limits</td>
<td>Temp. input</td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Check sensor, transmitter and cable connection</td>
</tr>
<tr>
<td>Feedforward control</td>
<td>Signal exceeds alarm limits</td>
<td>Check feed forward input</td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Check sensor, transmitter and cable connection</td>
</tr>
<tr>
<td>Limit transgression</td>
<td>After checkout time limit value Exceeded</td>
<td>ClO₂, level 1 ClO₂, level 2</td>
<td>€</td>
<td>Stop or Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Function defeatable</td>
</tr>
<tr>
<td>Servomotor</td>
<td>Position not reached</td>
<td>Servomotor defective</td>
<td>¥</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Servomotor defective</td>
</tr>
<tr>
<td>Electronics error</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Electronic data defective</td>
</tr>
</tbody>
</table>

### Operation

<table>
<thead>
<tr>
<th>Operation</th>
<th>Note text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please</td>
<td></td>
<td>¥</td>
<td>Stop</td>
<td>Stop</td>
<td>No Further fault check</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>Stop button</td>
<td></td>
<td>€</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Relay drops out</td>
<td></td>
</tr>
<tr>
<td>During calibration of sensor</td>
<td></td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>No error processing of measured variable</td>
<td></td>
</tr>
<tr>
<td>Sensor slope too low</td>
<td></td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>No error processing of measured variable</td>
<td></td>
</tr>
<tr>
<td>Sensor slope too high</td>
<td></td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>25% &gt; sensor of slope</td>
<td>Check sensor, recalibrate if necessary</td>
</tr>
<tr>
<td>DPD value &lt; 2% measuring range</td>
<td></td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>No</td>
<td>Check sensor, recalibrate if necessary</td>
</tr>
<tr>
<td>Zero point</td>
<td></td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>Signal &lt; 5 mA</td>
<td>Check sensor, recalibrate if necessary</td>
</tr>
<tr>
<td>During servomotor setting</td>
<td></td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>No</td>
<td>Check sensor, recalibrate if necessary</td>
</tr>
</tbody>
</table>

### Remarks

*Depending on whether “Alarms on” or “Alarms off” set in “General settings”.

---

**Chlorine Dioxide**

Pr: Minent®
<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>The sensor cannot be calibrated - meter/controller display value is greater than DPD-1 measurement</td>
<td>Run-in period too short, Diaphragm cap damaged</td>
<td>See “Run-in Period”</td>
</tr>
<tr>
<td></td>
<td>Interference from water contaminant</td>
<td>Replace diaphragm cap. Run-in sensor, calibrate</td>
</tr>
<tr>
<td></td>
<td>Short circuit in signal cable</td>
<td>Identify interfering contaminant and implement remedy</td>
</tr>
<tr>
<td></td>
<td>DPD chemicals spent</td>
<td>Identify short circuit and repair</td>
</tr>
<tr>
<td></td>
<td>Measuring value readout is “Zero”</td>
<td>Use new DPD chemicals, repeat calibration</td>
</tr>
<tr>
<td>The sensor cannot be calibrated - meter/controller display value is smaller than DPD-1 measurement</td>
<td>Run-in period too short, Diaphragm cap deposits</td>
<td>See “Run-in Period”</td>
</tr>
<tr>
<td></td>
<td>Sample water flow inadequate</td>
<td>Remove deposits (see “Maintenance”). Replace diaphragm cap. Run-in sensor, calibrate</td>
</tr>
<tr>
<td></td>
<td>Air bubbles on the outside of the diaphragm</td>
<td>Adjust flow rate</td>
</tr>
<tr>
<td></td>
<td>Reference electrode spent (shiny patches showing)</td>
<td>Tap to remove air bubbles and increase flow if necessary</td>
</tr>
<tr>
<td></td>
<td>Surfactant in water (diaphragm is translucent)</td>
<td>Return sensor to ProMinent</td>
</tr>
<tr>
<td></td>
<td>No electrolyte in diaphragm cap</td>
<td>Identify surfactant and replace diaphragm cap. Run-in sensor, calibrate; use CDP sensor</td>
</tr>
<tr>
<td></td>
<td>Electrolyte is penetrating sample water via gas bubbles</td>
<td>Add new electrolyte (see “Assembly”, “Run-in Period” and “Calibration”)</td>
</tr>
<tr>
<td>Measuring value readout unstable</td>
<td>Interference from water contaminant</td>
<td>Identify interfering contaminant and if necessary replace water</td>
</tr>
<tr>
<td></td>
<td>ClO₂ content below the lower measuring range limit</td>
<td>Add ClO₂ and then repeat calibration or use appropriate sensor</td>
</tr>
<tr>
<td></td>
<td>Sensor incorrectly connected to controller</td>
<td>Connect sensor correctly to controller</td>
</tr>
<tr>
<td>Measuring value readout unstable</td>
<td>Air bubbles on the outside of the diaphragm</td>
<td>Tap to remove air bubbles and increase flow if necessary</td>
</tr>
<tr>
<td></td>
<td>Diaphragm damaged</td>
<td>Replace diaphragm cap. Run-in sensor, calibrate</td>
</tr>
<tr>
<td></td>
<td>Cause lies with the controller</td>
<td>Identify cause and remedy</td>
</tr>
</tbody>
</table>
8.5.4  DULCOMETER® D1C Measured Variable Chlorine Dioxide and DULCOTEST® CDE Chlorine Dioxide Sensor, Maintenance

Controller
The DULCOMETER® controller type D1C for the measured variable chlorine dioxide is maintenance-free.

Sensor

**IMPORTANT**
- The sensor must be regularly serviced in order to avoid overdosing due to sensor failure!
- Observe applicable national directives for servicing intervals!
- Do not touch the electrodes or bring them into contact with greasy substances!

**Maintenance interval**
Daily/weekly servicing intervals depending upon application.

**Maintenance Work**
- Check the sensor display value at the controller using an appropriate chlorine dioxide measuring system (e.g. DPD-1).
- Recalibrate the sensor if necessary

**Cleaning the Membrane**
If the membrane is dirty and is preventing calibration of the sensor you can try to clean the membrane gently.
First dismantle the sensor as described in the sensor dismantling section. Observe safety guidelines! Removal of surface contamination
- Rinse the membrane under a gentle stream of cold water.

**Removal of Lime Deposits**
- Place the membrane cap in 1% hydrochloric acid (e.g. overnight).
- Rinse the membrane cap with plenty of water.
Now fill the sensor with electrolyte, run in and recalibrate.

**Replace the Membrane**
If calibration is no longer possible after cleaning the membrane, or if the membrane is damaged it must be replaced.
### 8.6 Measuring Parameter Chlorite

#### 8.6.1 DULCOMETER® D1C Measured Variable Chlorite, Setting and Operation

#### Display Symbols

The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay 1, upper left</td>
<td>Symbol</td>
<td>left</td>
</tr>
<tr>
<td>Relay 1, lower left</td>
<td>Symbol</td>
<td>left</td>
</tr>
<tr>
<td>Relay 2, upper right</td>
<td>Symbol</td>
<td>right</td>
</tr>
<tr>
<td>Relay 2, lower right</td>
<td>Symbol</td>
<td>right</td>
</tr>
<tr>
<td>Metering pump 1 (chlorite)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control off left</td>
<td>Symbol</td>
<td>left</td>
</tr>
<tr>
<td>Control on left</td>
<td>Symbol</td>
<td>left</td>
</tr>
<tr>
<td>Metering pump 2 (De-Clt)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control off left</td>
<td>Symbol</td>
<td>right</td>
</tr>
<tr>
<td>Control on left</td>
<td>Symbol</td>
<td>right</td>
</tr>
<tr>
<td>Solenoid valve 1 (chlorite)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control off left</td>
<td>Symbol</td>
<td>left</td>
</tr>
<tr>
<td>Control on left</td>
<td>Symbol</td>
<td>left</td>
</tr>
<tr>
<td>Solenoid valve 2 (De-Clt)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control off left</td>
<td>Symbol</td>
<td>right</td>
</tr>
<tr>
<td>Control on left</td>
<td>Symbol</td>
<td>right</td>
</tr>
<tr>
<td>Servomotor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control, open relay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control, close relay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position feedback</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness of bar increases from left to right</td>
<td></td>
<td></td>
</tr>
<tr>
<td>during opening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop button pressed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual metering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NOTE
Access to the setting menus can be barred with the access code!
The number and scope of setting menus is dependent on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus
are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back
from the calibrating menu or a setting menu to the permanent display 1.
Restricted Operating Menu / Layout

The restricted operating menu permits simple operation of the most important parameters. The following overview shows the settings which can be selected:

- **Positive values of setting variable**: chlorite
- **Negative values of setting variable**: De-Clt (chlorite destruction)

### Permanent display 1
- **0.55 ppm**

### Permanent display 2
- Only with control (w = setpoint)
- **Positive**
- **Negative**

### Calibration C1
- Zero: 0.00 mA
- Slope: 6.50 mA/ppm

### DPD-value
- 1.55 ppm

### Setting limits
- **Upper limit 2**: 5.00 ppm
- **Lower limit 1**: 1.00 ppm

### Control setting
- **Normal current regulation value**: 30 %
- Setpoint: 0.50 ppm
- **Proportional control parameter**: \( xp = 10 \% \)
- **PID control**
  - \( ap = -1.5 \% \)
  - \( Td = -2 \) off

### Access to setting menus
- Access code can be blocked with access code.

#### General setting information
- **Ident-code**: D1C2-Clt-010-GB
- **Software version**: D1C-B1 FW-5.00
- **Alarm relay**: Active
- **Access code**: 5000

Number and scope of setting menus is dependent on the device.

For manual control or

Setting in complete operating menu

- **Control with dead zone current regulation value**: 30 %
- **Manual regulation value**: 30 %
- **Manual dosing**: 15 %
- **Regulated range**: 15 %

Access to setting menus can be blocked with access code.
8.6.2 DULCOTEST® CLT1 Sensor for Chlorite, Commissioning

8.6.2.1 DULCOTEST® CLT1 Sensor for Chlorite, Assembly

Assembly

**Pouring electrolyte**

**IMPORTANT**
- Do not touch or damage the membrane contained within the membrane cap or the electrodes within the electrode shaft and do not allow them to come into contact with grease, otherwise sensor precision will be lost! Replace the membrane cap with a new one or return the sensor for cleaning the electrodes.
- The electrolyte gel is non-toxic and can easily be washed off skin/clothing with water.

**NOTE**
Carry out the following tasks over a washbasin!

- Open the attached electrolyte cylinder and screw the socket onto it.
- Remove the red sealing cap from the socket and cut off the socket above to open the socket channel.
- Remove the membrane protection cap and unscrew the membrane cap from the electrode shaft.
- Place the electrolyte cylinder socket perpendicularly to the lower edge inside the membrane cap without touching the membrane.
- Fill the membrane cap with the electrolyte right up to where the threads start, tighten the socket, ensuring it remains in the electrolyte. When doing this, a few very small bubbles may form.
- Check that the membrane is completely moist – the previously milky membrane becomes transparent. Wait for a few moments, if necessary. Speed up the process, if required, by carefully tapping the membrane cap several times on a firm, even surface, which will not damage the cap. If filling is unsuccessful, repeat the process.

**IMPORTANT**
After filling the membrane cap, it should be screwed onto the electrode shaft only after completely moistening the membrane with gel (becomes transparent)!

- Carefully place the electrode shaft perpendicularly to the filled membrane cap and turn until it is inserted into the screw thread.
- Turn the electrode shaft so that the small hole underneath the rubber seal is showing above.
- Manually screw in the membrane cap, slowly, as far as the buffer, (membrane cap should not touch the rubber seal). The membrane should not bend under internal pressure, otherwise it will be unfit for use! When screwing together, the excess electrolyte escapes through the small hole underneath the rubber seal.
- Any electrolyte that has leaked onto the measuring cell or your own fingers should be rinsed off under running water.
Assembling sensor

IMPORTANT

- Depressurise the system before inserting the sensor into the in-line probe housing.
- Close the stop valves before and after the in-line probe housing.
- Insertion and withdrawal of the sensor into or out of the in-line probe housing should be carried out slowly.
- Do not exceed the maximum operating pressure of 1 bar.
- Do not allow the flow to fall below the minimum rate of 30 l/h. Monitor the flow with the connected measuring device/controller. If the sensor’s signal is used for controlling, switch off the controller or adjust it to constant load when the flow rate falls below the lower limit.
- Avoid installations which allow air bubbles to enter the sample water. Air bubbles clinging to the sensor membrane can lower the resultant measured value and cause incorrect dosing within the control system.

Fitting the sensor in the in-line probe housing

Note also the instructions and safety guidelines in the operating instructions of the in-line probe housing.

DLG III

- Slide the O-ring from below over the sensor up to the clamping ring.
- Insert the sensor into the DLG III.
- Fix the sensor tightly by screwing in the plug.

DGM

- Slide the O-ring from below over the sensor up to the clamping ring. Leave a flat washer inside the DGM.
- Insert the sensor in the DGM and screw on the plug until the O-ring seals. The clamping ring determines the installation depth of the sensor.

8.6.2.2 DULCOTEST® CLT1 Sensor for Chlorite, Electrical Installation

General Safety Guidelines

IMPORTANT

Install in such as way as to ensure a totally reliable, uninterrupted power supply to the controller! Too low a voltage supply can cause measuring failures, which may result in dangerous overdosing within a control system!

The CLT 1 sensor has a passive 4-20 mA two-wire interface. The power supply is provided externally or by the controller. When the sensor is connected to the DULCOMETER® D1C chlorite controller the interface’s safety requirements are met automatically.

IMPORTANT

For electrical connection of the sensor to the controller, only use wires with a diameter of 4 mm.

Electrical Installation

- Turn the top part of the sensor a quarter of a turn anticlockwise and remove.
- Remove the outer isolation of the cable for about 5 cm from the end so that the two wires appear.
- Loosen the M12 threaded connector and guide the 2-wire cable into the sensor, providing a surplus length of 5 cm inside the sensor.
- Strip the two wires at their ends and connect them to the terminal block by using the screwdriver provided: 1 = plus, 2 = minus
- Tighten up the M12 connector.
- Insert the top part of the sensor right into the housing and turn the top part clockwise as far as it will go.
8.6.2.3 DULCOTEST® CLT1 Sensor for Chlorite, Running-In

**CAUTION**
- The power supply to the measuring device and to the sensor must not be interrupted. If the power supply is interrupted (> 2 hours) the sensor must be re-commissioned.
- Do not switch off the measuring system during interval operation! After operation without chlorite, running-in periods are to be reckoned with. If required, switch on metering unit time-delayed! If no chlorite is metered for a longer period of time, the sensor must be disconnected from the power supply and stored dry.
- The sensor’s current signal must not exceed 20 mA. Otherwise the sensor may be damaged, which may result in dangerous overdosing within a control system.
- To avoid this, install a monitor, which permanently switches off the chlorite control system and triggers an alarm. The monitoring equipment must not be automatically re-setting.
- Once the sensor has been commissioned it must be kept permanently wet.

After completed installation the controller can be switched on. The system should then be allowed to run in for the set run-in period.

**Running-In Period**
In order to achieve a stable display value the sensor should be run in for the following run-in periods.
- First commissioning: 6-12 h
- After changing membrane: 3-6 h
- Re-commissioning: approx. 6-12 h

8.6.2.4 DULCOTEST® CLT1 Sensor for Chlorite, Calibration

**CAUTION**
- Carry out a slope test every time the membrane or electrolyte is changed.
- Avoid air-bubbles in the sample flow. They can attach at the sensor membrane, which may cause too low measured values. Within a control system this may lead to dangerous overdosing.
- For proper function of the sensor, the slope test has to be repeated regularly.
- If installing the sensor outside Germany, please comply with the local regulations for calibration intervals.

**Preconditions**
The sensor reading is stable (no drifts or unsteady values for at least 5 min.). This is normally fulfilled, when
- The system has been allowed to run-in for the specified period
- The flow through the in-line probe housing is constant
- The sample medium and the sensor are at the same temperature
- The pH value is constant and within the admissible range (pH 6.5 - 9.5).
Zero Point Calibration
A zero point calibration relating to the DULCOMETER® D1C Chlorite is only necessary if the sensor is used at the lower limit of the measuring range.

1. Remove the sensor from the DLG III or DGM in-line probe housing (see DLG III, DGM operating instructions)
2. Immense the sensor in a container filled with clean water, free from chlorine and oxidising agents (Fe²⁺, Mn²⁺, nitrite, …).
3. Stir by using the sensor, until the measured value remains stable.
4. Adjust the controller (DULCOMETER® D1C, Chlorite) to zero, according to its operating instructions (see operating instructions DULCOMETER® D1C, Chlorite, chapter 8, complete operating menu, settings menu “Calibrating Clt zero point”)
5. Reinstall the sensor into the in-line-probe-housing (DGM, DLG III).

Slope Test
1. Insert the sensor into the DLG III or DGM in-line probe housing, if not already done.
2. Take a water sample for DPD-measurement. Sampling location has to be close to the installed sensor. Recommendation: use the sampling tap in the case of the DGM in-line probe housing.
3. Determine the chlorite content with a suitable DPD-Method (e.g. DPD).
4. Input the measured value into the controller according to its operating instructions (see operating instructions DULCOMETER® D1C, Chlorite, chapter 8, complete operating menu, settings menu “Calibrating Clt”)
5. After initial installation of the sensor, check the calibration by DPD-measurement 24 hours later.

Recommended frequency of calibration: weekly

Calibration of the Chlorite Sensor
During the calibration the DULCOMETER® D1C switches the control outputs to “0”. Exception: where a basic load or a manual control variable has been entered it is retained throughout the calibration. The standard signal outputs (measured value or correction value) are frozen. The measured value registered during the start of the calibration is proposed as the DPD value; this value is adjustable (arrow keys!). Calibration is only possible if the DPD value is ≥ 2 % of the measuring range. On successful completion of calibration, all error checks which refer to the measured value are restarted.

IMPORTANT
The measuring range of the sensor must agree with the set measuring range (factory setting: 0–2 ppm). The measuring range must be reset prior to calibration.
### Chlorite

#### Initial values

<table>
<thead>
<tr>
<th>Possible values</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>0.01 ppm</td>
<td>0.001 ppm</td>
<td>2.20 ppm</td>
</tr>
<tr>
<td></td>
<td>-0.20 ppm</td>
<td>-0.050 ppm</td>
<td>0.550 ppm</td>
</tr>
</tbody>
</table>

#### Error messages

<table>
<thead>
<tr>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration Clt not possible!</td>
<td>Clt slope too low (&lt;25 % of norm slope) Calibrate again</td>
</tr>
<tr>
<td>Sensor slope too low</td>
<td>Clt slope too high (&gt;300 % of norm slope) Calibrate again</td>
</tr>
<tr>
<td>DPD value too low DPD &gt; x. xx ppm</td>
<td></td>
</tr>
</tbody>
</table>

### 8.6.3 DULCOMETER® D1C and DULCOTEST® CLT1 Sensor for Chlorite, Troubleshooting

#### Controller

<table>
<thead>
<tr>
<th>Fault</th>
<th>Error text</th>
<th>Symbol</th>
<th>Effect</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Checked time exceeded</td>
<td>Check Clt sensor &amp; Basic load &amp; Stop</td>
<td>No</td>
<td>Function defeatable</td>
<td>Check function of sensor, exceed checkout time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal exceeded/drops below value Clt</td>
<td>-0.01 ppm ≤ -0.001 ppm</td>
<td>≤</td>
<td>Signal ≤ 0.3 ± 0.2 mA</td>
<td>Check sensor, transmitter and cable connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration sensor with error</td>
<td>≤ 0.01 ppm ≤ 0.001 ppm</td>
<td>≤</td>
<td>Signal ≤ 0.3 ± 0.2 mA</td>
<td>Check sensor, transmitter and cable connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correction variable Signal exceeded/drops below value</td>
<td>Temp. &gt; 35 °C</td>
<td>≤</td>
<td>PT100 signal &gt; 158.5°C</td>
<td>Check sensor, transmitter and cable connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed forward control Signal exceeds below value multiplicative</td>
<td>≤ 0.01 ppm ≤ 0.001 ppm</td>
<td>0.01 ppm</td>
<td>Signal ≤ 0.3 ± 0.2 mA</td>
<td>Check sensor, transmitter and cable connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Link transgression after checkout time limit value</td>
<td>≤ 0.01 ppm ≤ 0.001 ppm</td>
<td>≤</td>
<td>Signal ≤ 0.3 ± 0.2 mA</td>
<td>Check sensor, transmitter and cable connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servomotor Position not reached</td>
<td>Servomotor defective</td>
<td>Yes</td>
<td>Function defeatable</td>
<td>Define cause, reset after checkout time limit value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic error</td>
<td>System error</td>
<td>Stop &amp; Stop</td>
<td>Yes</td>
<td>Electronic data defective</td>
<td>Call in service</td>
<td></td>
</tr>
</tbody>
</table>

#### Operations

<table>
<thead>
<tr>
<th>Note text</th>
<th>Symbol</th>
<th>Effect</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please contact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>Stop</td>
<td>Basic load</td>
<td>Stop</td>
<td>No error</td>
<td>No further fault check</td>
</tr>
<tr>
<td>Power/NO</td>
<td>Stop</td>
<td>Stop</td>
<td>Stop</td>
<td>No error</td>
<td>–</td>
</tr>
<tr>
<td>Stop button</td>
<td>Stop</td>
<td>Stop</td>
<td>Stop</td>
<td>No error</td>
<td>–</td>
</tr>
</tbody>
</table>

#### During calibration sensor

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Effect</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop at close to range</td>
<td>Stop</td>
<td>No error</td>
<td>Printing of measured variable</td>
<td>–</td>
</tr>
</tbody>
</table>

#### During sensor setting

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Effect</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop at close to range</td>
<td>Stop</td>
<td>No error</td>
<td>Printing of measured variable</td>
<td>–</td>
</tr>
</tbody>
</table>

#### During sensor setting

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Effect</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop at close to range</td>
<td>Stop</td>
<td>No error</td>
<td>Printing of measured variable</td>
<td>–</td>
</tr>
</tbody>
</table>

*Depending on whether “Alarm on” or “Alarm off” set in “General settings”.

---

**Pr: Minent®**
Sensor: Troubleshooting
Troubleshooting must take account of the whole measuring system. The measuring system consists of:
1) Measurement/control device
2) Electrical leads and connectors
3) In-line probe housing and hydraulic connections
4) Sensor

The possible causes of failure listed in the following table primarily refer to the sensor. Before commencing troubleshooting please ensure that the operating conditions in "Technical data" are met:
a) Chlorite content 0.1 - 2 mg/l resp. 0.02 - 0.5 mg/l
b) Constant pH in the range 6.5 - 9.5
c) Temperature 1 - 40 °C, no sudden rises in temperature
d) Conductivity: 0.05 - 5 mS/cm
e) Flow: 30 - 60 l/h

The sensor simulator (DULCOMETER® Simulator order no. 1004042) is recommended for locating a controller malfunction. You will find a detailed description of troubleshooting of the controller in the operating instructions of DULCOMETER® D1C, Chlorite. If the value measured by the sensor differs significantly from that of the DPD method you need to first consider all possible malfunctions of the DPD photometric method. If necessary, repeat the DPD measurement several times.

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor can not be calibrated and measured value greater than DPD-measurement</td>
<td>Run-in time too short, Membrane cap damaged</td>
<td>See &quot;Run-in period&quot;</td>
</tr>
<tr>
<td></td>
<td>Interfering substances in sample water</td>
<td>Replace membrane cap, run in sensor and calibrate</td>
</tr>
<tr>
<td></td>
<td>Short-circuit in signal lead</td>
<td>Examine sample water for interfering substances and remedy</td>
</tr>
<tr>
<td></td>
<td>Distance between working electrode and membrane too great</td>
<td>Locate and eliminate short circuit</td>
</tr>
<tr>
<td></td>
<td>DPD chemicals spent</td>
<td>Screw the membrane cap tightly onto the electrode shaft</td>
</tr>
<tr>
<td></td>
<td>No electrolyte present in membrane cap</td>
<td>Use new DPD chemicals, repeat calibration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor can not be calibrated and measured value smaller than DPD-measurement</td>
<td>Run-in time too short, Built-up of deposits on membrane cap</td>
<td>See &quot;Run-in period&quot;</td>
</tr>
<tr>
<td></td>
<td>Flow rate of sample water too low</td>
<td>Clean membrane cap resp. replace, run-in the sensor, calibrate</td>
</tr>
<tr>
<td></td>
<td>Air bubbles on the outside of the membrane</td>
<td>Adjust flow rate</td>
</tr>
<tr>
<td></td>
<td>Interfering substances in sample water (surfactants, oil, alcohols, corrosion inhibitors)</td>
<td>Tap to remove air bubbles and increase flow if necessary</td>
</tr>
<tr>
<td></td>
<td>Deposits (carbonate, manganese, iron oxide) have blocked membrane</td>
<td>Confer with ProMinent</td>
</tr>
<tr>
<td></td>
<td>pH-value &gt; pH 9.5</td>
<td>Replace membrane cap run-in sensor, calibrate</td>
</tr>
<tr>
<td></td>
<td>No electrolyte present in membrane cap</td>
<td>Lower the pH value (pH 6.5-pH 9.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fill membrane cap with new electrolyte (see &quot;Assembly&quot;, &quot;Run-in period&quot; and &quot;Calibration&quot;)</td>
</tr>
</tbody>
</table>
### Chlorite Faults

<table>
<thead>
<tr>
<th>Measured value of sensor is 0 ppm and error message “Check Clt Input” appears on DULCOMETER® D1C display</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sensor is connected to controller with wrong polarity</td>
<td>▶ Correctly connect sensor to the controller</td>
</tr>
<tr>
<td></td>
<td>Signal lead is broken</td>
<td>▶ Replace signal lead</td>
</tr>
<tr>
<td></td>
<td>Sensor defective</td>
<td>▶ Return sensor to ProMinent</td>
</tr>
<tr>
<td></td>
<td>Controller defective</td>
<td>▶ Check controller with the sensor simulator (DULCOMETER® Simulator, order no. 1004042, return to dealer if faulty)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measured value of sensor is 0 ppm and sensor current is 3.0 - 4.0 mA</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Run-in time too short</td>
<td>▶ See “Run-in period”</td>
</tr>
<tr>
<td></td>
<td>Substances causing interference, e.g. reduced effectiveness of connections</td>
<td>▶ Examine sample water for interfering substances and remedy</td>
</tr>
<tr>
<td></td>
<td>Reference electrode defective*</td>
<td>▶ Return sensor to ProMinent for regeneration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measured value of sensor is arbitrary and sensor current is greater than 20 mA**</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chlorite content exceeds the upper limit of measuring range</td>
<td>▶ Check the whole system, remedy fault and then calibrate sensor</td>
</tr>
<tr>
<td></td>
<td>Distance between working electrode and membrane too great</td>
<td>▶ Screw the membrane cup tightly onto the electrode shaft</td>
</tr>
<tr>
<td></td>
<td>Sensor defective</td>
<td>▶ Return sensor to ProMinent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measured value of sensor is not stable</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pressure fluctuations in sampling line</td>
<td>▶ Check installation position and change the process if necessary</td>
</tr>
<tr>
<td></td>
<td>Reference electrode defective*</td>
<td>▶ Return sensor to ProMinent for regeneration</td>
</tr>
</tbody>
</table>

* When the reference electrode turns shiny silver or white it must be regenerated. Brown-grey or yellow green coloration is normal.
** The DULCOMETER® D1C can be used to display the sensor current when the sensor is built into the system. For this enter the complete operating menu (see Operating Instructions DULCOMETER® D1C, Chapter 8). Access the “Calibrating Clt” settings menu and only read the mA-value measured under “Zero point”. Do not finish the zero point calibration but leave the menu by pushing the branch back button.
8.6.4 DULCOMETER® D1C Measured Variable Chlorite and DULCOTEST® CLT1 Sensor for Chlorite, Maintenance

Controller
The DULCOMETER® controller type D1C for the measured variable chlorite is maintenance-free.

Sensor

IMPORTANT
- Service the sensor regularly to avoid overdosing within a control system, due to incorrect measured value.
- Observe the current national regulations for maintenance intervals.
- Do not touch the electrodes or allow them to come into contact with greasy substances.
- Never attempt to clean the membrane with acid/alkaline solutions, cleaning reagents or mechanical aids (brushes or similar).

Maintenance interval weekly (recommended)

Maintenance Work
- Check the sensor regularly for dirt, algae and air bubbles. As far as possible, avoid contamination of the membrane with solid particles, deposits etc. Eliminate air bubbles by increasing the flow rate.
- Check the sensor’s reading on the controller regularly, using an appropriate instrument for measuring bromine (e.g. DPD).
- If necessary, recalibrate the sensor.
- If calibration cannot be carried out properly, the membrane cap must be replaced and calibration must be repeated.
## 8.7 Measuring Parameter Oxygen

### 8.7.1 DULCOMETER® D1C Measured Variable Oxygen, Setting and Operation

#### Display Symbols

The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td></td>
<td><img src="symbol1.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 1, upper</td>
<td></td>
<td><img src="symbol2.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 1, lower</td>
<td></td>
<td><img src="symbol3.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 2, upper</td>
<td></td>
<td><img src="symbol4.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 2, lower</td>
<td></td>
<td><img src="symbol5.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Metering pump 1 (Oxygen)</td>
<td></td>
<td><img src="symbol6.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td></td>
<td><img src="symbol7.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Metering pump 2 (De-O2)</td>
<td></td>
<td><img src="symbol8.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td></td>
<td><img src="symbol9.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Solenoid valve 1 (Oxygen)</td>
<td></td>
<td><img src="symbol10.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td></td>
<td><img src="symbol11.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Solenoid valve 2 (De-O2)</td>
<td></td>
<td><img src="symbol12.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td></td>
<td><img src="symbol13.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Servomotor Control, open relay</td>
<td></td>
<td><img src="symbol14.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Control, close relay</td>
<td></td>
<td><img src="symbol15.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Without control</td>
<td></td>
<td><img src="symbol16.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Position feedback</td>
<td></td>
<td><img src="symbol17.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Stop button pressed</td>
<td></td>
<td><img src="symbol18.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Manual metering</td>
<td></td>
<td><img src="symbol19.png" alt="Symbol" /></td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td><img src="symbol20.png" alt="Symbol" /></td>
</tr>
</tbody>
</table>
**Operation**

Access to the setting menus can be barred with the access code!

The number and scope of setting menus is dependent on the device version!

If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!

If within a period of 10 minutes no button is pushed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.

**NOTE**

**Access to the setting menus can be barred with the access code!**

The number and scope of setting menus is dependent on the device version!

If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!

If within a period of 10 minutes no button is pushed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.
Restricted Operating Menu / Layout

The restricted operating menu permits simple operation of the most important parameters. The following overview shows the settings which can be selected:

Permanent display 1

- Number and scope of setting menus is dependent on the device.
- Access to setting menus can be blocked with access code.

Permanent display 2

- Positive values of setting variable: Oxygen
- Negative values of setting variable: De-O2 (Oxygen-destruction)

Positive values of setting variable: Oxygen

- Only with control
- (w = setpoint)

Negative values of setting variable: De-O2 (Oxygen-destruction)

- Only with control
- (w = setpoint)

For normal control

- Setpoint
- Control with dead zone

Positive De-O2 regulated value:

- Upper control parameter
- Lower control parameter

For manual control

- Manual dosing
- Manual regulated range

General setting information

- Setting in complete operating menu
- Permanent display 1
- Permanent display 2
- Permanent display 3
- Permanent display 4

Oxygen

De-O2 (Oxygen-destruction)
8.7.2 DULCOTEST® Sensor for Dissolved Oxygen, Commissioning

8.7.2.1 DULCOTEST® Sensor for Dissolved Oxygen, Assembly

Assembly of the Sensor DO 1

IMPORTANT
- Do not remove the silicone compound on the back of the sensor cartridge! It protects the contacts against short-circuit, even if some water gets in their surroundings.
- Only loosen and tighten the retainer of the sensor cartridge by hand! (The retainer of the sensor cartridge has a bayonet lock.)

Place the sensor cartridge in the transmitter as shown (place the sensor cartridge with the two pins at the bottom in the respective holes on the transmitter).

Screw the retainer of the sensor cartridge onto the transmitter until the bayonet lock engages.

8.7.2.2 DULCOTEST® Sensor for Dissolved Oxygen, Electrical Installation

IMPORTANT
- Only connect the sensor after having disconnected the supply voltage!
- Please observe the relevant local regulations for the installation!
- When extending the cable, a total length of 1,000 m may not be exceeded! Always use a two-core, shielded cable (at least 2 x 0.2 mm² (24 AWG))

Connect the sensor to the controller D1C using the two-core, shielded cable.

Initialisation
- Supply the sensor with voltage
- Hold the sensor to the top - after a few seconds it emits a 4 mA signal (≈ 0 ppm). After 2 min., the sensor is initialised. Subsequently, let the sensor run in.

8.7.2.3 DULCOTEST® Sensor for Dissolved Oxygen, Running-In

Hold the sensor in atmospheric air to the bottom until the measured value at the DULCOMETER® D1C has stabilised. A running-in time of 2 min. is sufficient in most cases. Subsequently, calibrate the sensor!
8.7.2.4  DULCOTEST® Sensor for Dissolved Oxygen, Calibration

**IMPORTANT**
- The sensor should not be subjected to direct sunlight or other heat source during calibration. This will prevent temperature compensation.
- The sensor is calibrated in the normal atmosphere (oxygen content = 20.9 vol. %).
- Observe relevant national legislation when calibrating, e.g. in Germany EN 25814.

**NOTE**
- Do not calibrate the sensor with a DULCOMETER® D1C controller for longer than 10 min. The D1C will otherwise display an error (error text "O₂ input ≤ 4 mA").
- If you cancel the calibration within 3 min. the sensor will continue to operate with the previous calibration values.

1. Clean the sensor.
2. Check whether the DULCOMETER® D1C displays a stable value in the normal atmosphere.
3. Hold the sensor up in the atmosphere to calibrate. The sensor will emit a 4 mA signal throughout this phase and the DULCOMETER® D1C will display "0" ppm. In the calibration menu of the DULCOMETER® D1C, chap. 8, “Calibrating the O₂ sensor up”, the remaining calibration time is counted down.
4. After approx. 5 min. lower the sensor again. Calibration is now complete. The sensor will start to measure again.

Calibrate the sensor every six months or more frequently if the application requires it.

Influences on the measured variable

The integrated temperature sensor compensates temperature influences on the measured variable.

To minimise the effect of the following parameters on the accuracy of the measured values you can enter actual values in the DULCOMETER® D1C “Measurement parameters setting?” menu during calibration and in the interim period (see operating instructions manual for DULCOMETER® D1C, measured variable oxygen, part 2):
- Local atmospheric pressure at the measuring point related to the height above sea level in mbar
- Height of measurement point above sea level in m
- Relative humidity of the atmosphere at the measuring point in %
- Air temperature at the measuring point in °C
- Water temperature in °C
- Water salt content in g/l

The “Factory settings” table in the Appendix of the individual operating instructions of the sensors gives the influence of these parameters on the measured value where these deviate from the set values.

The table also shows how to determine the parameters.
8.7.3 DULCOMETER® D1C and DULCOTEST® Sensor for Dissolved Oxygen, Troubleshooting

Controller

<table>
<thead>
<tr>
<th>Fault</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured variable</td>
<td>Checkout time measured value exceeded</td>
<td>E</td>
<td>Stop</td>
<td>Yes</td>
<td>Function defeatable</td>
<td>Check function of sensor</td>
</tr>
<tr>
<td>- Out of range signal</td>
<td>&lt; 0 mA</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td><strong>Check sensor, transducer, and cable connection.</strong></td>
<td></td>
</tr>
<tr>
<td>- Underlimiting signal</td>
<td>≤ 0 mA</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td><strong>Check sensor, transducer, and cable connection.</strong></td>
<td></td>
</tr>
<tr>
<td>- Excess signal</td>
<td>&gt; 4 mA</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td><strong>Check sensor, transducer, and cable connection.</strong></td>
<td></td>
</tr>
<tr>
<td>- Calibration error</td>
<td>&gt; 22 mA</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Excess signal: Excess signal in the range of 0 to 4 mA indicates a sensor problem. If the signal exceeds 4 mA, the sensor is probably malfunctioning.

Limit transgression after checkout time:

<table>
<thead>
<tr>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control “on”</td>
<td>System error</td>
<td>≤ 4 mA</td>
<td>Stop</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Control “off”</td>
<td>System error</td>
<td>≤ 4 mA</td>
<td>Stop</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

Sensor: Troubleshooting

<table>
<thead>
<tr>
<th>Output signal = 0 mA</th>
<th>Output signal = 4.0 mA</th>
<th>Output signal &gt; 3.8 mA (after 10 min the DULCOMETER® D1C displays an error message)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible Cause</td>
<td>Initialisation error</td>
<td>Initialisation error</td>
</tr>
<tr>
<td></td>
<td>Faulty wiring</td>
<td>Sensor insert contacts are damp</td>
</tr>
<tr>
<td></td>
<td>Insufficient power supply</td>
<td>Sensor insert defective (membrane)</td>
</tr>
<tr>
<td></td>
<td>Transmitter defective</td>
<td>Sensor insert spent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measured value lower than minimum lower limit</td>
</tr>
</tbody>
</table>

Remedy:

- Switch off for 5 sec., hold sensor downward and switch on.
- Check wiring.
- Check input voltage at transmitter (input voltage must be greater than 12 V).
- Replace transmitter.
- Switch off for 5 sec., hold sensor downward and switch on.
- Dry the contacts of the transmitter and the sensor insert.
- Replace sensor insert.
- Replace sensor insert.
- Lower the minimum measurement limit on the D1C (see operating instructions manual for DULCOMETER® D1C, measured variable oxygen).
Checking Measured Value

- Remove the sensor from the water and hold downwards at all times.
- Clean the sensor and the membrane and rub dry with a soft cloth.
- Wait until the measured value is stable (keep away from direct sunlight and any other heat source) if “Measurement range exceeded” appears (output signal = 22 mA) raise the maximum upper value limit to 20 ppm (mg/l).
- Measure the air temperature at the sensor and enter in “Measurement parameters setting?” menu.
- If the DULCOMETER® D1C is correcting the salt content, set the salt content temporarily to “0” in the “Measurement parameters setting?” menu.
- Read off the measured value.
- Compare the measured value with the corresponding value at the measured temperature from the saturation table (in the Appendix); if the measured value deviates less than ±15 % from this the sensor is operating correctly.
- Reset the salt content in the “Measurement parameters setting?” menu to the original value.

Checking Zero Point

- Produce oxygen-free water:
  - What you need
    1 clean container for 1 l liquid (the sensor unit holder must be immersed in the liquid later)
    1 stirrer
    1 l distilled water
    1 g sodium sulphite (NaSO₃)*
    1 mg cobalt (II) salt (cobalt(II)chloride hexahydrate; CoCl₂ · 6H₂O)*
  - *Purity rating “for analysis”
  - Mix the salts into the distilled water and stir.
  - Dip in the sensor and stir.
  - Read off the measured value when it is stable.

If the measured value is 0.00 ppm or 4.00 mA the sensor is functioning correctly.
If the measured value is more than 5 mA, replace the sensor unit.

NOTE
- A minimal deviation (± 0.2 mA) from 4.00 mA may be due to insufficient mixing of the solution.
- Minor and stable deviations from the zero point at 4.00 mA can be compensated on the DULCOMETER® D1C in the “Calibration O₂” menu.
8.7.4 DULCOMETER® D1C Measured Variable Oxygen and DULCOTEST® Sensor for Dissolved Oxygen, Maintenance

Controller
The DULCOMETER® controller type D1C for the measured variable oxygen is maintenance-free.

Sensor

Every 2-3 months
- Clean the sensor membrane

Every 6 months
- Calibrate the DO sensor

Every 2-3 years
- Replace the sensor unit (if used under normal operating conditions)

Cleaning the Sensor Membrane

**IMPORTANT**
- Do not scratch the sensor membrane.
- If the sensor is pointing upwards for longer than 3 min. during cleaning it will automatically replace the existing calibration data with new values. Try therefore to clean the sensor with it pointing downwards.
- Check that there is clearance all around the gold pin electrode in the hole in the side of the sensor (membrane rupture detector).

**NOTE**
If the sensor is pointing upward during cleaning it will emit a 4 mA signal.

- Remove the sensor from the pool.
- Rinse the sensor membrane in clean water – if necessary add a little washing up detergent.
- Dry the sensor membrane with a soft cloth.
- Place the sensor back into the pool.

Replacing Sensor Insert

**IMPORTANT**
- If the sensor is in use, it is essential to avoid water from reaching the contacts when replacing the sensor insert. If this cannot be avoided, dry the water off carefully using a hairdryer.
- Do not remove the silicon paste on the back of the sensor insert. It protects the contacts from short circuit even if some water has penetrated.
- The bracket of the sensor insert must be tightened and slackened only by hand (the bracket of the sensor holder has a bayonet fitting).

- Switch off the power.
- Remove the sensor from the pool and lay on a firm surface with the membrane underneath.
- Rinse the sensor with clean water
- Dry the sensor with a soft cloth until every drop has been removed.
- Remove the old sensor insert
- Place a new sensor insert (insert the two lugs on the bottom of the sensor into the corresponding holes on the transmitter).
- Switch on the power once more then run in and calibrate the sensor.
8.8 Measuring Parameter Redox/ORP

8.8.1 DULCOMETER® D1C Measured Variable Redox/ORP, Setting and Operation

Display Symbols
The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td>Symbol left</td>
<td>1</td>
</tr>
<tr>
<td>Relay 1, upper</td>
<td>Symbol left</td>
<td>↓</td>
</tr>
<tr>
<td>Relay 1, lower</td>
<td>Symbol right</td>
<td>1</td>
</tr>
<tr>
<td>Relay 2, upper</td>
<td>Symbol right</td>
<td>↓</td>
</tr>
<tr>
<td>Relay 2, lower</td>
<td>Symbol left</td>
<td>↓</td>
</tr>
<tr>
<td>Metering pump 1 (oxidant) Control off</td>
<td>Symbol left</td>
<td>↓</td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol left</td>
<td>↓</td>
</tr>
<tr>
<td>Metering pump 2 (reducing agent) Control off</td>
<td>Symbol right</td>
<td>↓</td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol right</td>
<td>↓</td>
</tr>
<tr>
<td>Solenoid valve 1 (oxidant) Control off</td>
<td>Symbol left</td>
<td>↓</td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol left</td>
<td>↓</td>
</tr>
<tr>
<td>Solenoid valve 2 (reducing agent) Control off</td>
<td>Symbol right</td>
<td>↓</td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol right</td>
<td>↓</td>
</tr>
<tr>
<td>Servomotor Control, open relay</td>
<td></td>
<td>↓</td>
</tr>
<tr>
<td>Control, close relay</td>
<td></td>
<td>↑</td>
</tr>
<tr>
<td>Without control</td>
<td></td>
<td>↓</td>
</tr>
<tr>
<td>Position feedback Thickness of bar increases from left to right during opening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop button pressed</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>Manual metering</td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td>E</td>
</tr>
</tbody>
</table>
NOTE
Access to the setting menus can be barred with the access code!
The number and scope of setting menus is dependent on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.
Restricted Operating Menu / Layout

The restricted operating menu permits simple operation of the most important parameters. The following overview shows the settings which can be selected.

- **Redox/ORP limit 2**
  - Upper: 900 mV
  - Lower: 100 mV

- **Check probe ORP**
  - Measurement act.:
    - Adjust probe: 460 mV

- **Permanent display 1**
  - Only with control

- **Permanent display 2**
  - Only with control

- **Control with dead zone**
  - For normal control:
    - Setpoint: 750 mV
  - Proportional control:
    - Set parameter 1: 750 mV
      - Td = 0 s
      - Ti = 0 s

- **Manual dosing**
  - Positive values: 30 %
  - Negative values: 15 %

- **General setting information**
  - Ident-code: D1CA
  - Software version: D1C-A1 FW-5.00
  - Alarm relay: Access: 5000
8.8.2 DULCOTEST® Sensor for Redox/ORP, Commissioning

8.8.2.1 DULCOTEST® Sensor for Redox/ORP, Assembly

Assembly
Prior to commissioning, the protective cap or quiver must be removed from the glass or metal electrode. The glass or metal electrode must be free of contaminations, oils and greases. The diaphragm of the reference electrode must also be free of deposits, contaminations and crystallisations. For this reason, the electrodes should not be touched with bare hands. Should contaminations exist, please see “Cleaning and Care” in the individual operating instructions.

8.8.2.2 DULCOTEST® Sensor for Redox/ORP, Electrical Installation

Electrically connect the DULCOTEST® sensor for Redox/ORP with the marked cable of the respective controller D1C.

8.8.2.3 DULCOTEST® Sensor for Redox/ORP, Running-In

The DULCOTEST® sensor for Redox/ORP must not be run-in. The DULCOTEST® sensor for Redox/ORP can be readily used.

8.8.2.4 DULCOTEST® Sensor for Redox/ORP, Calibration

Having connected the sensor to the transmitter by means of the sensor cable (taking care that connectors and cable remain absolutely dry), dip the sensor into a redox standardizing solution, e.g. of 465 mV. The reading should reach or exceed this value within not more than 30 seconds. If the reading rises rather sluggishly or falls short more than 20 mV, clean the sensor as described and repeat check. If again unsuccessful, replace the sensor with a new one.

Checking the Redox/ORP Sensor
During calibration, the D1C sets the command outputs to “0”. Exception: if a basic load or a manual control variable was set, these are maintained during calibration. The standard signal outputs mA (measuring value or correction value) are frozen. The measured value or the standard buffer value 220 mV or 465 mV is proposed as the buffer value; this value is adjustable (arrow keys). After everything has been checked, all error tests which refer to the measured value are restarted.
### 8.8.3 DULCOMETER® D1C and DULCOTEST® Sensor for Redox/ORP, Troubleshooting

#### Controller

<table>
<thead>
<tr>
<th>Fault value</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Control</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>£</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Function defeatable</td>
<td>Check function of sensor</td>
</tr>
<tr>
<td>Signal exceeded/drops below value</td>
<td>£</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Signal &lt;5 ±0.2 mA or &gt; 25 ±0.2 mA</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td>Check sensor with error</td>
<td>£</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>Measuring continues in range of error with constantly measured values</td>
<td>Check sensor, replace if necessary if necessary</td>
</tr>
<tr>
<td>Correction measured variable</td>
<td>£</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>Measuring continues in range of error with constantly measured values</td>
<td>Check sensor, replace if necessary if necessary</td>
</tr>
<tr>
<td>Forward control signal drops below value</td>
<td>£</td>
<td>step or basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>PI-part frozen</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td>Signal exceeded</td>
<td>£</td>
<td>continue</td>
<td>continue</td>
<td>Yes</td>
<td>Signal &gt;3.8 ±0.2 mA or &lt;138.5 ±0.2 mA</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td>Limit transgression</td>
<td>£</td>
<td>Stop or basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Function defeatable</td>
<td>Definite cause, after checkout time, reset values if necessary</td>
</tr>
<tr>
<td>Servomotor position not reached</td>
<td>£</td>
<td>Stop or basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Servomotor class</td>
<td>Check servomotor</td>
</tr>
<tr>
<td>Electronics error</td>
<td>£</td>
<td>Stop or basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Electronic data defective</td>
<td>Call in service</td>
</tr>
</tbody>
</table>

#### Operations

<table>
<thead>
<tr>
<th>Operator</th>
<th>Note text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Control</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pause</td>
<td>£</td>
<td>£</td>
<td>Step</td>
<td>Stop</td>
<td>No</td>
<td>No further fault check</td>
<td>–</td>
</tr>
<tr>
<td>Stop</td>
<td>£</td>
<td>£</td>
<td>Step</td>
<td>Stop</td>
<td>No</td>
<td>Relay drops out</td>
<td>–</td>
</tr>
<tr>
<td>During checking sensor</td>
<td>£</td>
<td>£</td>
<td>Step</td>
<td>Stop</td>
<td>No</td>
<td>No sensor processing of measured values</td>
<td>–</td>
</tr>
<tr>
<td>Measured 40 mV &gt; buffer</td>
<td>£</td>
<td>£</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>Check sensor, replace if necessary</td>
<td>–</td>
</tr>
<tr>
<td>Probe signal too low</td>
<td>£</td>
<td>£</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>Check sensor, replace if necessary</td>
<td>–</td>
</tr>
<tr>
<td>During servomotor setting Upper position &gt; 40%</td>
<td>£</td>
<td>£</td>
<td>Stop</td>
<td>Stop</td>
<td>No</td>
<td>Check servomotor</td>
<td>–</td>
</tr>
</tbody>
</table>

* Depends on whether “alarm off” or “alarm on” in “General Settings”.

#### Table: Possible Values

<table>
<thead>
<tr>
<th>Initial value</th>
<th>Possible values</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer values 185–265 mV</td>
<td>Measured value 220 mV</td>
<td>-2000 mV</td>
<td>±2000 mV</td>
<td></td>
</tr>
<tr>
<td>425–505 mV</td>
<td>Measured value 465 mV</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Error Message

<table>
<thead>
<tr>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value high</td>
<td>Measured value 40 mV &gt; buffer</td>
</tr>
<tr>
<td>Measured value low</td>
<td>Measured value 40 mV &lt; buffer</td>
</tr>
</tbody>
</table>

* Returns to permanent display: Basic metering load
8.8.4 DULCOMETER® D1C Measured Variable Redox/ORP and DULCOTEST® Sensor for Redox/ORP, Maintenance

Controller
The DULCOMETER® controller type D1C for the measured variable redox/ORP is maintenance-free.

Sensor

**IMPORTANT**
- The sensor is to be regularly serviced to avoid any excess metering caused by a sensor failure!
- Observe the valid national regulations for maintenance intervals!
- Do not touch the electrodes or bring into contact with greasy substances!

**Maintenance interval**
monthly

**Maintenance Work**
The sensor should regularly (once a month) undergo a visual check and be cleaned if necessary.

If deposits on the glass electrode withstand cleaning with a soft, moistened cloth, the following cleaning agents may be used:

<table>
<thead>
<tr>
<th>Kind of deposit</th>
<th>Agent and duration of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>General deposits</td>
<td>Non-abrasive household cleaner</td>
</tr>
<tr>
<td>Scale or metal hydroxides</td>
<td>Diluted hydrochloric acid (approx. 0.1-3 %, 1-5 minutes)</td>
</tr>
<tr>
<td>Oil, grease</td>
<td>Solvents, like alcohol or acetone</td>
</tr>
<tr>
<td>Biofouling</td>
<td>Mixture of diluted hydrochloric acid and pepsin, several hours</td>
</tr>
<tr>
<td></td>
<td>Solvents (e.g. acetone) must not be used to clean electrodes as they can damage the plastic stems.</td>
</tr>
</tbody>
</table>

It is essential that the sensors are rinsed thoroughly after having been cleaned.

In addition, the metal surfaces of redox sensors may be cleaned by sanding and polishing. If the laterally arranged ceramic diaphragm of the reference electrode is blocked, it may be cleaned like the glass electrode. In addition it may be cleaned by cautious scraping with a finger nail, a razor blade or a fine file, but care must be taken that the diaphragm is not scratched.
### 8.9 Measuring Parameter pH

#### 8.9.1 DULCOMETER® D1C Measured Variable pH, Setting and Operation

**Display Symbols**

The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 1, upper</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 1, lower</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 2, upper</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 2, lower</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Metering pump 1 (alkali) Control off</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Metering pump 2 (acid) Control off</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Solenoid valve 1 (alkali) Control off</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Solenoid valve 2 (acid) Control off</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Servomotor Control, open relay</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Control, close relay</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Without control</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Position feedback</td>
<td>The bar increases from left to right during opening.</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Stop button pressed</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Manual metering</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Fault</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
</tbody>
</table>
Operation

NOTE

Access to the setting menus can be barred with the access code!
The number and scope of setting menus is dependent on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus
are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically reverts from the
calibrating menu or a setting menu to the permanent display 1.

The various menus are selected with the CHANGE button
The menu is started with the ENTER button
BRANCH BACK to permanent display or to relevant setting menu

Change from selection to selection
Change numbers or settings of selection

Variable flash
ENTER and save setting, continue to next menu

BRANCH BACK without saving setting
BRANCH BACK to start of setting

Access code, correct
Access code
Parameter setting

Permanent display 1
Permanent display 2
Calibration menu
Various Setting menus
Access code
Calibration notes
Restricted Operating Menu / Layout

Operating Menu

The DULCOMETER® D1C controller permits settings to be made in two different menus. All values are preset and can be changed in the complete operating menu.

The controller is delivered with a reduced operating menu so that the DULCOMETER® D1C controller can be used effectively in many applications from the very onset. If adaptations prove to be necessary, all relevant parameters can then be accessed by switching over to the complete operating menu (see "General settings information").
**Error Messages**

Error messages and information are indicated on the bottom line in the permanent display 1. Errors to be acknowledged (acknowledgement switches off the alarm relay) are indicated by the " \( \Box \) ". Errors/notes which still apply after acknowledgement are indicated alternately. During correction variable processing (temperature for correction of pH-value), the value is indicated in the same line as the error/note. Faults which are rectified of their own accord due to changed operating situations are removed from the permanent display without the need for acknowledgement.
8.9.2 DULCOTEST® PHEP or PHER Sensor for pH, Commissioning

8.9.2.1 DULCOTEST® PHEP or PHER Sensor for pH, Assembly
Remove the blanking plug of the respective measuring module at the fittings of the measuring/ control station DULCOTROL® drinking water/F&B and install the DULCOTEST® PHEP or PHER sensor for pH.

8.9.2.2 DULCOTEST® PHEP or PHER Sensor for pH, Electrical Installation
Connect the DULCOTEST® PHEP or PHER sensor for pH with the marked cable of the respective controller D1C.

8.9.2.3 DULCOTEST® PHEP or PHER Sensor for pH, Running-In
The DULCOTEST® PHEP or PHER sensor for pH must not be run-in. The DULCOTEST® PHEP or PHER sensor for pH can be readily used.

8.9.2.4 DULCOTEST® PHEP or PHER Sensor for pH, Calibration
Since pH sensors are subject to certain manufacturing tolerances, they must be tuned to the pertinent pH transmitter. The adjustment intervals depend on relevant operating conditions. They can vary from a few days to up to 8 weeks. Having connected the sensor to the transmitter by means of the sensor cable (taking care that connectors and cable remain absolutely dry), dip the sensor into a pH 7 standardizing solution and adjust transmitter exactly to read this value. Remove the sensor, rinse it with water, preferably distilled water, and dry it by swabbing it with soft, non-fluffing tissue paper.

**IMPORTANT**
*Do not rub since this might cause static electricity and false readings.*

Immerse the sensor in a buffer solution differing by a least 2 pH from pH 7 and calibrate after the value on the display has stabilised. If within 30 seconds a steady-state value is not produced or calibration has proved impossible, clean sensor and repeat calibration. If again unsuccessful, replace sensor with a new one.
Calibration of the pH Sensor

Temperature setting and specification only with correction value

<table>
<thead>
<tr>
<th>Calibration</th>
<th>Initial value</th>
<th>Possible values</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>temperature</td>
<td>Measured value</td>
<td>Rounded-off value</td>
<td>0.1 °C</td>
<td>0 °C</td>
<td>100 °C</td>
</tr>
<tr>
<td>Buffer values</td>
<td>0.01 pH</td>
<td>-2 pH</td>
<td>16 pH</td>
<td>Error messages when both buffers too close (&lt;2 pH-values)</td>
<td></td>
</tr>
</tbody>
</table>

Error message Condition Remarks

Buffer distance too small Buffer < 2 pH During calibration procedure: Recalibrate buffer 2!

pH zero point low < -60 mV Return to permanent display: Basic metering load Warning, old zero point and slope retained

pH zero point high > +60 mV
pH slope low < -40 mV/pH
pH slope high > 65 mV/pH
Measured value pH unsteady
Measured value °C unsteady

During calibration the DULCOMETER® D1C sets the adjustment outputs to "0". Exception: if a basic load or manual variable has been set, these are maintained during calibration. The output signals mA (measured value or adjustment value) are frozen.

The recommended buffer value is the measured value rounded-off to the nearest whole number or the last recorded buffer value. Buffer values are adjustable (arrow keys).

With successful calibration, all fault finding relating to the measured values is re-started. The DULCOMETER® D1C stores the data established for zero point and slope.
## 8.9.3 DULCOMETER® D1C and DULCOTEST® PHEP or PHER Sensor for pH, Troubleshooting

### Controller and Sensor

<table>
<thead>
<tr>
<th>Fault</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Harm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td></td>
<td>£</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Function can be switched off</td>
<td>Check function of sensor, adjusted check line</td>
</tr>
<tr>
<td>Signal exceeded/below value</td>
<td></td>
<td>£</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Signal &gt;32 mV or &lt;30 mV</td>
<td>Check sensor, replace if necessary</td>
</tr>
<tr>
<td>Calibration with error</td>
<td></td>
<td>£</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>No further fault check</td>
<td>Recalibrate if necessary</td>
</tr>
<tr>
<td>Correction variable</td>
<td></td>
<td>£</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>pH &gt;13.5 or &lt;12.5</td>
<td>Check sensor, replace if necessary</td>
</tr>
<tr>
<td>Feed forward control</td>
<td></td>
<td>£</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Signal &lt;4.0 mV or &gt;23.0 mV</td>
<td>Check sensor, replace if necessary</td>
</tr>
<tr>
<td>Limit transgression</td>
<td>£</td>
<td></td>
<td>Stop or Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Function can be switched off</td>
<td>Delete cause, read values if necessary</td>
</tr>
<tr>
<td>Servomotor</td>
<td>£</td>
<td></td>
<td>Position not reached</td>
<td>Servomotor defective</td>
<td>Yes</td>
<td>Servomotor closed</td>
<td>Check servomotor</td>
</tr>
<tr>
<td>Electronics error</td>
<td>£</td>
<td></td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Electronics data defective</td>
<td>Call in service</td>
</tr>
</tbody>
</table>

### Operations

<table>
<thead>
<tr>
<th>Operation</th>
<th>Note text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Harm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pause contact</td>
<td>Press</td>
<td>£</td>
<td>Stop</td>
<td>Stop</td>
<td>No/Yes*</td>
<td>No further fault check</td>
<td>–</td>
</tr>
<tr>
<td>Place/hold</td>
<td>Press/Hold</td>
<td>£</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Relay drops out</td>
<td>–</td>
</tr>
<tr>
<td>Stop button</td>
<td>Stop</td>
<td>£</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>During calibration</td>
<td>Buffer gap too small</td>
<td>£</td>
<td>Stop or Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>No error processing of measured variable</td>
<td>–</td>
</tr>
<tr>
<td>Buffer solution too small</td>
<td>£</td>
<td></td>
<td>Stop</td>
<td>Stop</td>
<td>No/Yes*</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Sensor zero point too low</td>
<td>£</td>
<td></td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Recalibrate</td>
<td></td>
</tr>
<tr>
<td>Sensor zero point too high</td>
<td>£</td>
<td></td>
<td>Stop</td>
<td>Stop</td>
<td>No/Yes*</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Sensor slope too low</td>
<td>£</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>No/Yes*</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Sensor slope too high</td>
<td>£</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>No/Yes*</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>During alarm setting</td>
<td>Direction check too low or too high</td>
<td>£</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Without correct adjustment the last valid values are still used</td>
<td>Check correction of relay, admirerator, relay, direction of the servomotor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Depending on whether “Alarm on” or “Alarm off” is set in “General settings”.

### Error Messages

Error messages and information are indicated on the bottom line in the permanent display 1. Errors to be acknowledged (acknowledgement switches off the alarm relay) are indicated by the £. Errors/notes which still apply after acknowledgement are indicated alternately. During correction variable processing (temperature for correction of pH-value), the value is indicated in the same line as the error/notice. Faults which are rectified of their own accord due to changed operating situations are removed from the permanent display without the need for acknowledgement.
8.9.4 DULCOMETER® D1C Measured Variable pH and DULCOTEST® PHEP or PHER Sensor for pH, Maintenance

Controller
The DULCOMETER® controller type D1C for the measured variable pH is maintenance-free.

Sensor

IMPORTANT
- The sensor is to be regularly serviced to avoid any excess metering caused by a sensor failure!
- Observe the valid national regulations for maintenance intervals!
- Do not touch the electrodes or bring into contact with greasy substances!

Maintenance interval monthly

Maintenance Work
The sensor should regularly (once a month) undergo a visual check and be cleaned if necessary. If deposits on the glass electrode withstand cleaning with a soft, moistened cloth, the following cleaning agents may be used.

<table>
<thead>
<tr>
<th>Kind of deposit</th>
<th>Agent and duration of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>General deposits</td>
<td>Non-abrasive household cleaner</td>
</tr>
<tr>
<td>Scale or metal hydroxides</td>
<td>Diluted hydrochloric acid (approx. 0.1-3 %, 1-5 minutes)</td>
</tr>
<tr>
<td>Oil, grease</td>
<td>Solvents, like alcohol or acetone</td>
</tr>
<tr>
<td>Biofouling</td>
<td>Mixture of diluted hydrochloric acid and pepsin, several hours</td>
</tr>
<tr>
<td></td>
<td>Solvents (e.g. acetone) must not be used to clean electrodes as they can damage the plastic stems.</td>
</tr>
</tbody>
</table>

It is essential that the sensor are rinsed thoroughly after having been cleaned.
8.10 Measuring Parameter Conductive Conductivity

8.10.1 DULCOMETER® D1C Measured Variable Conductive Conductivity, Setting and Operation

Display Symbols

The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Relay 1 upper</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Relay 1 lower</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Relay 2 upper</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Relay 2 lower</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Metering pump 1 (increase conductivity)</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Control off</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Metering pump 2 (reduce conductivity)</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Control off</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Solenoid valve 1 (increase conductivity)</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Control off</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Solenoid valve 2 (reduce conductivity)</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Control off</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Servomotor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control, open relay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control, close relay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position feedback</td>
<td>Thickness of bar increases from left to right during opening</td>
<td></td>
</tr>
<tr>
<td>Stop button pressed</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>Manual metering</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>Fault</td>
<td>Ε</td>
<td></td>
</tr>
</tbody>
</table>
NOTE
Access to the setting menus can be barred with the access code!
The number and scope of setting menus depends on the device version!
If the access code is selected correctly in a setting menu, the following setting menus are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.

Operation

Permanent display 1

Permanent display 2

Various Setting menus

Access code, correct Parameter setting

Access code, correct Parameter setting

Access code, correct Parameter setting

The various menus are selected with the CHANGE button

The menu is started with the ENTER button

BRANCH BACK to permanent display or to relevant setting menu

BRANCH BACK without saving setting

BRANCH BACK to start of setting

Variables flash

Text 1

Text 2

Selection 1

Selection 2

Text 1

Text 2

Selection 1

Selection 2

Text 1

Text 2

Selection 1

Selection 2

CHANGE from selection to selection

Change numbers or settings of selection

ENTER and save setting, continue to next menu
Conductive Conductivity

Restricted Operating Menu / Layout

The restricted operating menu permits simple operation of the most important parameters. The following overview shows the settings which can be selected:

Permanent display 1
- 100 μS/cm

Permanent display 2
- Only with control

Positive values of setting variable: Increase conductivity
Negative values of setting variable: Reduce conductivity

Positive values of setting variable:
- Increase conductivity
Negative values of setting variable:
- Reduce conductivity

Access to setting menus can be blocked with access code.
Conductive Conductivity

8.10.2 Conductivity Sensor Type LF 1 DE/LFT 1 DE, Commissioning

8.10.2.1 Conductivity Sensor Type LF 1 DE/LFT 1 DE, Assembly

Assembly
A PG 13.5/" adapter (order no. 1002190) is required when installing into the in-line probe housing type DLG. During the installation it is to be ensured that the measuring sensor is always completely covered with liquid. For a correct measurement it must be guaranteed that no air bubbles are trapped in the gap (i.e. between the measuring electrodes).

8.10.2.2 Conductivity Sensor Type LF 1 DE/LFT 1 DE, Electrical Installation

Connect the sensor with the marked cable.

8.10.2.3 Conductivity Sensor Type LF 1 DE/LFT 1 DE, Running-In

Before commissioning, the sensor is to be placed in distilled or deionised water for 5-10 minutes.

8.10.2.4 Conductivity Sensor Type LF 1 DE/LFT 1 DE, Calibration

Calibration

Positive values of setting variable:
Increase conductivity

Negative values of setting variable:
Reduce conductivity

The measured value can be adjusted to the actual conductivity value by changing the cell constants (arrow keys).
8.10.3 DULCOMETER® D1C Measured Variable Conductive Conductivity and Conductivity Sensor Type LF 1 DE/LFT 1 DE, Troubleshooting

**Controller**

<table>
<thead>
<tr>
<th>Fault</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect</th>
<th>On metering</th>
<th>On control</th>
<th>Alarm with</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>eD-meas. defect</td>
<td>E</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Measured value out of measuring range</td>
<td>Check range adjustment</td>
<td>Stop</td>
</tr>
<tr>
<td>Correction measured variable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal exceeds/electrode below value</td>
<td>Check in-input</td>
<td>E</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Signal &lt; 0.5 or 2 nA or ≤ 4 °C</td>
<td>Check sensor, transducer and cable connection</td>
<td>Stop</td>
</tr>
<tr>
<td>Signal drops below multiplications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit value violation</td>
<td>elf-limit 1</td>
<td>E</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>elf-limit 2</td>
<td>Function detachable</td>
<td>Define cause, reset values if necessary</td>
</tr>
<tr>
<td>Servomotor</td>
<td>Position not reached</td>
<td>E</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Servomotor closing</td>
<td>Check servomotor</td>
<td>Stop</td>
</tr>
<tr>
<td>Electronics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Operations**

<table>
<thead>
<tr>
<th>Note text</th>
<th>Symbol</th>
<th>Effect</th>
<th>On metering</th>
<th>Alarm with</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pause contact</td>
<td></td>
<td>E</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>No further fault check</td>
</tr>
<tr>
<td>Pause/Hold</td>
<td></td>
<td>E</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Relay switch out</td>
</tr>
<tr>
<td>During servomotor setting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position feedback wiring</td>
<td></td>
<td>E</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Relay switch out</td>
</tr>
<tr>
<td>Upper position &gt; 40 % max. value</td>
<td>Direction check</td>
<td>E</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>No further fault check</td>
</tr>
<tr>
<td>Lower position ≤ 30 % range</td>
<td>Final value [coul</td>
<td>E</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>No further fault check</td>
</tr>
</tbody>
</table>

*Depends on whether “alarm off” or “alarm on” in “General Settings”.

Sensor: Troubleshooting

Should the sensor malfunction, clean it as described in “Maintenance”. Should the sensor behaviour does not change after the cleaning, the sensor is to be replaced.

8.10.4 DULCOMETER® D1C Measured Variable Conductive Conductivity and Conductivity Sensor Type LF 1 DE/LFT 1 DE, Maintenance

**Sensor**

The sensor function is to be checked regularly or the sensor is to be calibrated. The gap between the measuring electrodes must be regularly checked for contaminations. Adhering contaminations may be removed by a soft water jet, 2-3 times dipping into diluted (1% w/v) acids or by rubbing with a cloth or a soft brush (e.g. toothbrush/bottle brush).
8.11 Measuring Parameter Inductive Conductivity

8.11.1 DULCOMETER® D1C Measured Variable Inductive Conductivity, Setting and Operation

Display Symbols
The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td>Symbol left</td>
<td>▲</td>
</tr>
<tr>
<td>Relay 1 upper</td>
<td>Symbol left</td>
<td>▼</td>
</tr>
<tr>
<td>Relay 1 lower</td>
<td>Symbol right</td>
<td>▲</td>
</tr>
<tr>
<td>Relay 2 upper</td>
<td>Symbol right</td>
<td>▼</td>
</tr>
<tr>
<td>Relay 2 lower</td>
<td>Symbol left</td>
<td>▲</td>
</tr>
<tr>
<td>Relay 2 lower</td>
<td>Symbol right</td>
<td>▼</td>
</tr>
<tr>
<td>Metering pump 1 (Increase conductivity)</td>
<td>Symbol left</td>
<td>▲</td>
</tr>
<tr>
<td>Metering pump 1 (Decrease conductivity)</td>
<td>Symbol right</td>
<td>▼</td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol left</td>
<td>▲</td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol right</td>
<td>▼</td>
</tr>
<tr>
<td>Solenoid valve 1 (Increase conductivity)</td>
<td>Symbol left</td>
<td>▲</td>
</tr>
<tr>
<td>Solenoid valve 1 (Decrease conductivity)</td>
<td>Symbol right</td>
<td>▼</td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol left</td>
<td>▲</td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol right</td>
<td>▼</td>
</tr>
<tr>
<td>Servomotor</td>
<td></td>
<td>▲</td>
</tr>
<tr>
<td>Control, open relay</td>
<td></td>
<td>▼</td>
</tr>
<tr>
<td>Control, close relay</td>
<td></td>
<td>▲</td>
</tr>
<tr>
<td>Without control</td>
<td></td>
<td>▼</td>
</tr>
<tr>
<td>Position feedback</td>
<td></td>
<td>▲</td>
</tr>
<tr>
<td>Thickness of bar increases from left to right</td>
<td></td>
<td>▲</td>
</tr>
<tr>
<td>Stop button pressed</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>Manual metering</td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td>E</td>
</tr>
</tbody>
</table>
Inductive Conductivity

Operate

Permanent display 1

Permanent display 2

Various
Setting menus

Access code, correct
Parameter setting

NOTE

Access to the setting menus can be barred with the access code!
The number and scope of setting menus depends on the device version!
If the access code is selected correctly in a setting menu, the following setting menus are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1!
**Inductive Conductivity**

**Restricted Operating Menu / Layout**

The restricted operating menu permits simple operation of the most important parameters. The following overview shows the settings which can be selected:

- **Permanent display 1**
  - Positive values of setting variable: Increase conductivity
  - Negative values of setting variable: Reduce conductivity

- **Parameter record setting 1**
  - Only with control

- **Parameter record setting 2**
  - Only with parameter record

- **Parameter setting information**
  - Only with control

- **Setting in complete operating menu**

Number and scope of setting menus depends on the device.

Access to setting menus can be blocked with access code.

---

**Access to setting menus**

Access code: D1CA

**Software version**

DxL6xxxxxxxxx

**Input HW:**

rev. y xx.xx.xx

**Input SW:**

D1C-L0 FW-2.03

---

**Calibration cc**

cc: 8.54 /cm

cond: 100 μS/cm

**Grenzwert2 oben**

5.00 ppm

**Grenzwert1 unten**

1.00 ppm

---

**Positive values of setting variable**

- Increase conductivity

**Negative values of setting variable**

- Reduce conductivity

---

**Positive values of setting variable**

- Increase conductivity

**Negative values of setting variable**

- Reduce conductivity
8.11.2 DULCOTEST® ICT 2 Inductive Conductivity Sensor, Commissioning

8.11.2.1 DULCOTEST® ICT 2 Inductive Conductivity Sensor, Assembly

**WARNING**
- Ensure that the axes of the sensor and pipe are perpendicular to one another. Ensure that the thread is aligned correctly. It will otherwise affect the stability of the measurement points in pressurised processes.
- The axis through the hole of the sensor tip must line up with the pipe axis.
- The sensor tip must be covered by the water sample at all times during measurement.
- The measurement results will otherwise be incorrect.

**IMPORTANT**
If you later require measurement accuracy better than 10 %, fit a tap near the sensor to take water samples.

The sensor ICT 2 can be directly installed in tanks and pipes or via a flange and/or an in-line probe housing.
- Before installing the sensor, carry out commissioning up to and including zero point calibration.
- Insert the sensor into the opening of the media tubing or the tank (the flat seal must sit on the inside of the tubing or tank). If used in flowing media, the sensor tip bore must be placed in the centre of the tube cross section.
- Rotate the sensor so that the bore of the sensor tip is facing in the direction of the flow.
- Tighten the union nut.

8.11.2.2 DULCOTEST® ICT 2 Inductive Conductivity Sensor, Electrical Installation

**IMPORTANT**
- Connect the sensor only when the mains power supply is switched off.
- Do not shorten the connection lead. The measurement result will otherwise be incorrect. The warranty is void in this case.
- If using a DULCOMETER® D1C controller use a mains cable with earth lead! The sensor cable screening must be earthed by the earth lead if there is potential interference!
- Install according to the relevant national directives.

- Break open the large opening in the middle of the base of the DULCOMETER® D1C housing (see Operating instructions DULCOMETER® D1C, part 1)
- Screw in a 13.5 skintop connector (supplied with the DULCOMETER® D1C controller)
- Cut off the brown and the yellow cable
- Earth the total cable screen via the power lead of the mains cable of the DULCOMETER® D1C controller if there is potential interference. For this purpose crimp e.g. a screen connector onto the total screen.
- Connect the sensor to the DULCOMETER® D1C controller in accordance with the terminal connection diagram
- Tighten the skintop connector until watertight, ensuring that there is still sufficient cable inside the DULCOMETER® D1C controller.
8.11.2.3 DULCOTEST® ICT 2 Inductive Conductivity Sensor, Running-In

The sensor DULCOTEST® ICT 2 inductive conductivity can be readily used for further measures such as calibration and measurement without requiring any running-in.

8.11.2.4 DULCOTEST® ICT 2 Inductive Conductivity Sensor, Calibration

Presets

Check first that the sensor is correctly connected to the DULCOMETER® D1C (do not open the sensor).

> Check that the right sensor type has been selected.

▶ Set the measurement range of the sensor.

**IMPORTANT**

Check settings in all menus when changing the range allocation.

Zero Point Calibration

>>> IMPORTANT

• The zero point must be calibrated during commissioning.
• The zero point must be calibrated if the measurement range is changed.
• Calibrate the zero point only when the sensor tip is completely dry.
• Calibrate the zero point in the air when dismantled only.
• Hold the sensor tip more than 40 mm away from all objects during calibration.
• Calibrate the zero point before the slope.

▶ To calibrate the zero point of the sensor, dismantle the sensor and then completely dry the sensor tip and the sensor shaft.
▶ Select the first menu option in the "cali. zero point" in the setting menu and wait approx. 30 s until the measured value is stable – then press Enter.
Slope Test

**IMPORTANT**
- Always follow the handling instructions below.
  - During calibration the water sample must be flowing evenly without bubbles or turbulence or at a standstill.
  - If calibrating in flowing water, the electrolytic conductivity of the water sample must be constant.
  - The axis through the bore of the sensor tip must line up with the direction of the flow.
- Cover the sensor tip completely with the water sample (immerse or flood the environment)

There are now three alternative procedures for different requirements:

**Measurement Accuracy to within approx. 10 %**
- Set the temperature coefficient \( u \) of the water sample in the "meas. parameter setting?" setting menu (related to 25 °C. Arrow keys.) or determine using the "calibration?" setting menu (see Operating instructions DULCOMETER® D1C, Inductive Conductivity)

**High Measurement Accuracy**
- Calibration with Reference Metering Equipment
  - Calibration of the sensor is normally carried out once it has been installed with a reference metering device (e.g. a hand-held meter for conductive conductivity).

**Measurement Accuracy of Reference Meter**
- The reference metering equipment must have a corresponding measurement accuracy (see operating instructions of the reference metering equipment with respect to the measurement range and measurement accuracy for conductivity and temperature). In order to exploit the measurement accuracy of the sensor it must be calibrated to an accuracy of at least 1 %.
- The reference metering equipment itself must be calibrated using calibration solutions with a measurement accuracy better than ±1 % (see operating instructions of the reference metering equipment).

ProMinent recommends a reference metering device with a four-electrode sensor and a temperature measurement accuracy better than ±0.5 °C at 25 °C (e.g. Portamess 911 Cond (order no. 1008713) with sensor type LF 204 (order no. 1008723)) for all measurements in conductivity range above 1 mS/cm.

**CAUTION**
- Take suitable precautions when taking samples (safety gear ...)!
Inductive Conductivity

- Set the temperature coefficient \( \alpha \) of the water sample in the "meas. parameter setting?" setting menu (related to 25 °C. Arrow keys!)
- Set the temperature coefficient \( \alpha \) of the water sample at the reference metering equipment (to the same value)

Select the first menu option in the "calibration cc" setting menu and press Enter
- the temperature of the water sample must remain constant within ±0.5 °C for 20 min. and the measured conductivity value must not fluctuate
- Remove a sample from the water and determine the electrolytic conductivity using reference metering equipment (stir for 30 s with its sensor)
- Enter the measured conductivity reference value in the second menu option under "LF" (arrow keys!) and press Enter
- "please wait" is displayed for a few seconds. The DULCOMETER® D1C then displays the current calculated cell constant.
- The new cell constant is accepted when you press Enter to exit the last menu option ("calibration cc - cc = ..."). If you do not want to accept the new cell constant, exit this menu option with the back key.

Calibration with Calibration Solution
Important precondition: You need a calibration solution of the corresponding accuracy (better than 1 % absolute reproducibility; at least 500 ml).

CAUTION
Take the necessary precautions when dismantling the sensors (safety gear...!)

IMPORTANT
- Handle the calibration solution with extreme care. Adequate accuracy will not otherwise be achieved.
- Ensure cleanliness and avoid carry-over or evaporation of the liquid (evaporation even after 20 min. can be too much).

- Dismantle the sensor from the tubing
- Wipe deposits off the sensor and rinse
- then rinse the sensor with deionised water until the displayed conductivity value is less than 20 \( \mu \)S/cm
- Dry the sensor thoroughly (including inside the bore of the sensor tip)
- Place the sensor in a clean standard glass beaker along with the calibration solution
- Stir with the sensor until the air bubbles have been expelled from the bore and the displayed conductivity value on the DULCOMETER® D1C is stable
- Fix the sensor in the centre of the beaker so that the sensor tip is at least 30 mm from the glass in all directions (preferably 40 mm). The sensor tip must be immersed at least 30 mm (top edge of sensor tip)
- Wait 20 min. until the temperature has equalised between the sensor and calibration solution (1 °C temperature deviation equals approx. 2 \% measurement error)
- Set the temperature coefficient \( \alpha \) at the DULCOMETER® D1C to the value specified by the manufacturer for the calibration solution (e.g. approx. 1.86 %/K for KCl solutions around 25 °C)
Inductive Conductivity

*Select "install. factor setting?" in the setting menu, note the set installation factor and then set to 1.00*
*Select the first menu option in the "calibration cc" setting menu and press Enter*  
*"please wait!" appears for a few seconds, then the DULCOMETER® D1C displays the current calculated cell constant*  
*The new cell constant is accepted when you press Enter to exit the last menu option ("calibration cc: cc = ..."). Exit this menu option with the back key if you do not want to accept the new cell constant.*  
*Select "install. factor setting?" in the setting menu and restore the installation factor noted earlier.*  
*Next, restore the temperature coefficient \(a\) of the water sample used*  
*It is highly recommended that you check the conductivity of the calibration solution with suitable reference metering equipment to be sure that the conductivity of the calibration solution has not changed due to carry-over of liquid or evaporation.*

- **Possible values**
  - **Initial value**
  - **Increment**
  - **Lower value**
  - **Upper value**
  - **Remarks**

<table>
<thead>
<tr>
<th>Cell constant cc</th>
<th>depending on sensor type used</th>
<th>0.0001/cm</th>
<th>0.0006/cm</th>
<th>0.01/cm</th>
<th>0.015/cm</th>
<th>0.1499/cm</th>
<th>1.499/cm</th>
<th>12.00/cm</th>
<th>cc can be adjusted for all (mr) over the complete area</th>
</tr>
</thead>
</table>

The measured value can be calibrated by changing the cell constant to the actual conductivity value (arrow keys).

Cell Constant Calibration (cc)

*Permanent display 1*

<table>
<thead>
<tr>
<th>Possible values</th>
<th>Initial value</th>
<th>Increment</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive values of setting variable: Increase conductivity</td>
<td>0.0001/cm</td>
<td>0.0006/cm</td>
<td>0.01/cm</td>
<td>0.015/cm</td>
<td>0.1499/cm</td>
</tr>
</tbody>
</table>

*Permanent display 2*

only with control  
(w = setpoint)

---

Conductivity Calibration

**Measurement Parameters**

- **Access to all setting menus can be blocked with an access code!**

<table>
<thead>
<tr>
<th>meas. parameter setting</th>
<th>mr = meas. range</th>
</tr>
</thead>
<tbody>
<tr>
<td>cc = cell constant</td>
<td></td>
</tr>
</tbody>
</table>

---

**Cell Constant Calibration (cc)**

*Please wait!*

**Calibration cc**

- **Probe in buffer! accept value?**
- **Calibration cc**

*Please wait!*

**Calibration cc**

- **cc: 8.50/cm**
To determine the precise cell constant (cc) of the sensor, place the sensor in a calibration solution (sample 1) with a known conductivity and select the second menu option. The DULCOMETER® D1C displays the conductivity it has calculated with the updated parameters. Press Enter when the value is constant. Select the next menu option and enter the conductivity of the calibration solution (arrow keys). Press Enter. The D1C displays the recalculated cell constant and saves the value. The setting menu is inactive when "PAR2" appears.

During the calibration, the metering is reduced to the set basic load and control stops. The limit value monitor and the fault diagnosis system are reset. The standard signal of the "measured value" output is frozen.

**Possible values**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Initial value</th>
<th>Possible values</th>
<th>Increment</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductivity Calibration solution (LF)</td>
<td>Measured value</td>
<td>0.1 μS/cm</td>
<td>0 μS/cm</td>
<td>200 μS/cm</td>
<td></td>
<td>Measuring range</td>
</tr>
<tr>
<td></td>
<td>1 μS/cm</td>
<td>0 μS/cm</td>
<td>2000 μS/cm</td>
<td></td>
<td></td>
<td>Measuring range</td>
</tr>
<tr>
<td></td>
<td>0.01 mS/cm</td>
<td>0 μS/cm</td>
<td>20 mS/cm</td>
<td></td>
<td></td>
<td>Measuring range</td>
</tr>
<tr>
<td></td>
<td>0.1 mS/cm</td>
<td>0 μS/cm</td>
<td>200 mS/cm</td>
<td></td>
<td></td>
<td>Measuring range</td>
</tr>
<tr>
<td></td>
<td>1 mS/cm</td>
<td>0 μS/cm</td>
<td>2000 mS/cm</td>
<td></td>
<td></td>
<td>Measuring range</td>
</tr>
</tbody>
</table>

**Parameter Record**

This setting menu can be used to temporarily enable additional parameters of the second parameter record PAR2 to be edited (in addition to the parameters from the setting menu "measurement parameter setting?"). I.e. the "limit setting?" and "mA output 1 (2) setting?" setting menus are enabled to allow editing of PAR2 (designation PS2) until you exit the series of setting menus from "parameter record" to "general setting".

It is possible to switch between the parameter records for operation using the "feed forward control" contact input, e.g. during a flushing process (contact open = PAR1, contact closed = PAR2). When switching between the parameter records, the current parameter record in the setting menu "measurement parameter setting?", "limit setting?" and "mA output 1 (2) setting" is replaced by the other parameter record (designation PS1 or PS2).

There is no access to the calibration menus in the case of PAR2 (designation PS2).

**NOTE**

- The designation PAR1 indicates that the parameter record 1 is actively measuring (contact input "feed forward control" e.g. open).
- The designation PS1 indicates that the parameter record 1 can be edited.
  - Exception: The parameter record 1 cannot be edited while it is actively measuring (designation PAR1). If your controller switches the D1C to parameter set 1 while it is being edited, the D1C returns to the permanent display.
- PAR2, no control, no standard signal outputs.
## 8.11.3 DULCOMETER® D1C Measured Variable Inductive Conductivity and DULCOTEST® ICT 2 Inductive Conductivity Sensor, Troubleshooting

### Controller

<table>
<thead>
<tr>
<th>Error</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Cancelation</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value exceedd</td>
<td>Signal exceeded or drops below value</td>
<td>$\Delta$</td>
<td>Basic load</td>
<td>Stop</td>
<td>yes</td>
<td>Measured value outside range</td>
<td>Check measured variable setting, check sensor and cable connection</td>
</tr>
<tr>
<td>Checksum time exceeded</td>
<td>Check sum</td>
<td>$\Delta$</td>
<td>Basic load</td>
<td>Stop</td>
<td>yes</td>
<td>Function detached</td>
<td>Check sensor function, extend symbol line</td>
</tr>
<tr>
<td>Corrective measured variable exceedd</td>
<td>Signal exceeded or drops below value</td>
<td>$\Delta$</td>
<td>Basic load</td>
<td>Stop</td>
<td>yes</td>
<td>Signal $&lt;3.8 \pm 0.2 \text{mA}$ or $&gt;23 \pm 0.2 \text{mA}$</td>
<td>Check sensor and cable connection</td>
</tr>
<tr>
<td>Upper Ts. limit exceeded</td>
<td>$\Delta$</td>
<td>Basic load</td>
<td>Stop</td>
<td>yes</td>
<td>Function detached</td>
<td>Check sensor and cable connection</td>
<td></td>
</tr>
<tr>
<td>Feed forward control</td>
<td>Signal exceeded or drops below value</td>
<td>$\Delta$</td>
<td>Basic load</td>
<td>Stop</td>
<td>yes</td>
<td>Signal $&lt;3.5 \pm 0.2 \text{mA}$ or $&gt;23 \pm 0.2 \text{mA}$</td>
<td>Check sensor and cable connection</td>
</tr>
<tr>
<td>Limit value violation</td>
<td>after control time</td>
<td>$\Delta$</td>
<td>Yes</td>
<td>Function detached</td>
<td>Defect causes</td>
<td>Repeat values if necessary</td>
<td></td>
</tr>
<tr>
<td>Servomotor</td>
<td>Position not reached</td>
<td>$\Delta$</td>
<td>Yes</td>
<td>Servomotor class</td>
<td>Check servomotor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic error</td>
<td>No feedback, amplifier defective, check SPI</td>
<td>Yes</td>
<td>Yes</td>
<td>Sensor cable defect</td>
<td>Change sensor cable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Operating step

<table>
<thead>
<tr>
<th>Operating step</th>
<th>Note text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Cancelation</th>
<th>Comment</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please contact</td>
<td></td>
<td></td>
<td>Stop</td>
<td>Stop</td>
<td>No further fault check</td>
<td>–</td>
</tr>
<tr>
<td>Control input</td>
<td>Parameter set 1 and 2</td>
<td>$\Delta$</td>
<td>Stop</td>
<td>Stop</td>
<td>no</td>
<td>Relay resets out</td>
</tr>
<tr>
<td>Switch off</td>
<td></td>
<td></td>
<td>Stop</td>
<td>Stop</td>
<td>no</td>
<td>–</td>
</tr>
<tr>
<td>Calibration</td>
<td>Calibration mode on</td>
<td>$\Delta$</td>
<td>Basic load</td>
<td>Stop</td>
<td>–</td>
<td>Repeat calibration, Check sensor feedback, sensor setting</td>
</tr>
<tr>
<td>Gain parameter setting</td>
<td>Position feedback</td>
<td>$\Delta$</td>
<td>Basic load</td>
<td>Stop</td>
<td>–</td>
<td>Without correct adjustment, the last valid values are still used</td>
</tr>
</tbody>
</table>

### 8.11.4 DULCOMETER® D1C Measured Variable Inductive Conductivity and DULCOTEST® ICT 2 Inductive Conductivity Sensor, Maintenance

### Controller

The DULCOMETER® controller type D1C for the measured variable inductive conductivity is maintenance-free.

### Sensor

Thanks to its configuration without electrodes and a flow-technically favourable design, this is a very low-maintenance sensor. Regularly remove deposits at the sensor to maintain a reliable measuring operation.

**NOTE**

The formation of deposits can be prevented in most cases. For this purpose, install the sensor in flowing media and make sure that the hole at the sensor head is correctly orientated to the flow direction.
8.12 Measuring Parameter Fluoride

8.12.1 DULCOMETER® D1C Measured Variable Fluoride, Setting and Operation

Display Symbols

The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td>Relay 1, upper</td>
<td>⬆</td>
</tr>
<tr>
<td>Relay 1, lower</td>
<td>Relay 1, lower</td>
<td>⬇</td>
</tr>
<tr>
<td>Relay 2, upper</td>
<td>Relay 2, upper</td>
<td>⬆</td>
</tr>
<tr>
<td>Relay 2, lower</td>
<td>Relay 2, lower</td>
<td>⬇</td>
</tr>
<tr>
<td>Metering pump 1 (Fluoride)</td>
<td>Control off</td>
<td>⬆</td>
</tr>
<tr>
<td>Control on</td>
<td>Control on</td>
<td>⬆</td>
</tr>
<tr>
<td>Metering pump 2 (deFluor)</td>
<td>Control off</td>
<td>⬆</td>
</tr>
<tr>
<td>Control on</td>
<td>Control on</td>
<td>⬆</td>
</tr>
<tr>
<td>Solenoid valve 1 (Fluoride)</td>
<td>Control off</td>
<td>⬆</td>
</tr>
<tr>
<td>Control on</td>
<td>Control on</td>
<td>⬆</td>
</tr>
<tr>
<td>Solenoid valve 2 (deFluor)</td>
<td>Control off</td>
<td>⬆</td>
</tr>
<tr>
<td>Control on</td>
<td>Control on</td>
<td>⬆</td>
</tr>
<tr>
<td>Servomotor</td>
<td>Control, open relay</td>
<td>⬆ ⬆</td>
</tr>
<tr>
<td>Control, close relay</td>
<td></td>
<td>⬆ ⬆</td>
</tr>
<tr>
<td>Without control</td>
<td></td>
<td>⬆ ⬆</td>
</tr>
<tr>
<td>Position feedback</td>
<td></td>
<td>The bar increases from left to right during opening</td>
</tr>
<tr>
<td>Stop button pressed</td>
<td></td>
<td>⬇</td>
</tr>
<tr>
<td>Manual metering</td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td>E</td>
</tr>
</tbody>
</table>
NOTE
Access to the setting menus can be barred with the access code!
The number and scope of setting menus is dependent on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus
are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back
from the calibrating menu or a setting menu to the permanent display 1.
Restricted Operating Menu / Layout

Permanent display 1
Temperature indication only with correction value
Fluoride signal in mV (changing display)

Permanent display 2
Positive values of setting variable: Fluoride
Negative values of setting variable: defFluor

Temperature setting and specification only with correction value
Number and scope of setting menus is dependent on the device.
Access to setting menus can be blocked with access code.

Setting in complete operating menu

For normal control

Control with dead zone

PID control

Proportional control

For manual control

Manual closing

General setting information

Ident-code: D1CA
Software version: D1C-C1, FW-5.00

For normal control

Control with dead zone

PID control

Proportional control

For manual control

Manual closing

General setting information

Ident-code: D1CA
Software version: D1C-C1, FW-5.00

For normal control

Control with dead zone

PID control

Proportional control

For manual control

Manual closing

General setting information

Ident-code: D1CA
Software version: D1C-C1, FW-5.00
8.12.2 Fluoride Sensor FLEP 010 SE/FLEP 0100 SE, Commissioning

8.12.2.1 Fluoride Sensor FLEP 010 SE/FLEP 0100 SE, Assembly

**IMPORTANT**

- The LaF$_3$ crystal must not be soiled!
- The LaF$_3$ crystal must not be scratched or touched by hand!
- When screwing on the measuring transducer, always hold the sensor by its head - never on the shaft!
- When dipping the sensor into the measuring water take care that no gas bubbles adhere to the LaF$_3$ crystal!

Unscrew the blanking cap on the measuring vessel DLG IV, screw down the sensor and fasten it using a 17 mm spanner.

Screw down the reference electrode REFP-SE (part no.1018458) into the adjacent opening of the DLG IV. For measurements with automatic temperature correction, screw down a PT 100 into one of the remaining openings.

**Measuring Transducer, Assembly**

**IMPORTANT**

- The device must not be used without further protection (outer casing, weather protection roof) in outdoor applications.
- The interior of the measuring transducer must be protected against moisture during installation!
- Screw the measuring transducer by hand down to the stop on the sensor. Never screw down the measuring transducer in any other way!
- When screwing-on the measuring transducer, always hold the sensor by its head - never on the shaft!
- Proceed cautiously when screwing the measuring transducer onto sensors made by other manufacturers, to avoid crossing the threads!
- Incorrect connection of the measuring transducer to the sensor can lead to a falsified output signal!
- Operate the sensor with the reference electrode only within the specified measuring range of the measuring transducer!
- When the potential measuring range of the measuring transducer is exceeding due to too high fluoride concentrations, the output signal of the measuring transducer remains fixed at 3.2 mA irrespective of the true concentration. The measuring device would then indicate too low a concentration!
- When evaluating the output signal of the measuring transducer using a PLC device or a computer pay attention to the logarithmic relation between the output signal and the fluoride concentration! (cf. operating instruction of the sensor)

**Connecting to ProMinent® units DULCOMETER® D1C**

- Release the clamp screw of the PG cable union (only the clamp screw!)
- Turn the upper part of the measuring transducer through a quarter turn in the counter-clockwise direction and then pull it off (bayonet fitting).
- Insert the 2-wire sensor cable into the PG cable union. If necessary, dust the cable with talcum powder to aid fitting.
- Strip the cable ends and clamp 0.25 mm cable sleeves onto the stripped cable ends.
- Connect the cable ends to the terminals 1 and 2:

<table>
<thead>
<tr>
<th>Clamps Measuring Transducer</th>
<th>Clamps D1C</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1:1 + sensor cable (mA signal)</td>
<td>X2:9</td>
</tr>
<tr>
<td>X1:2 - sensor cable (mA signal)</td>
<td>X2:10</td>
</tr>
<tr>
<td>X2:1 bridge</td>
<td>X2:2 reference electrode</td>
</tr>
</tbody>
</table>
Tighten the clamping screw of the PG cable union.
Push the top section into the middle section as far as it will go and then carefully turn it in the clockwise direction until it reaches the stop (take care not to break off the pins on the bayonet fitting).
Screw the measuring transducer by hand down to the stop on the sensor.
Screw the SN6-socket onto the reference electrode.
Determine the standard potential and make the slope adjustment (calibration) on the control unit (cf. operating instructions there).

8.12.2.2 Fluoride Sensor FLEP 010 SE/FLEP 0100 SE, Electrical Installation

IMPORTANT
Before using a potential compensation pin, contact ProMinent Dosiertechnik GmbH! Otherwise the sensor can be damaged irreversibly.

Make sure that the SN6 contacts on the sensor and the transducer resp. are clean and dry.
Screw down the transducer 4 … 20 mA FP V1 or FP 100 V1 onto the sensor by hand. Screw down the SN6 plug of the transducer measuring cable onto the reference electrode.

8.12.2.3 Fluoride Sensor FLEP 010 SE/FLEP 0100 SE, Running-In

Running-In Period of the Sensor
Allow the sensor to run in for 1 h at minimum 0.4 ppm F⁻.

8.12.2.4 Fluoride Sensor FLEP 010 SE/FLEP 0100 SE, Calibration

IMPORTANT
The sensor must be checked regularly and if necessary calibrated!
Observe legal requirements in force!
Before the first calibration the sensor must be run in!
Obey the instruction manual of the measuring instrument!
Carry out a two-point calibration at first start-up!

For calibration the sensor, the reference electrode and - if present – the PT 100 must be immersed in the calibration solution. During calibration the solution must be uniformly stirred by a magnetic stirrer. For faster potential equilibration the solution must have a conductivity > 1000 μS/cm (e.g. by using a corresponding Na₂SO₄ solution, e.g., 1 g/l).

For the determination of the slope (two-point calibration), the two calibration solutions must differ in their fluoride content by at least 0.5 ppm.
The two-point calibration has to be performed less often than the one-point calibration.
Fluoride

Calibration of the Fluoride Sensor

Immerse the fluoride sensor (and the reference electrode if applicable) in the calibration buffer. Once the mV signal which is visible in the changing display is stable (fluctuation < 0.05 mV/min), go to settings menu “Calibration F” and press the “Enter” key. The flashing temperature display in the following menu must be the temperature at which calibration is carried out. Press the “Enter” key again to start calibration. When the next menu option appears, the most recently calibrated fluoride concentration is suggested in the “Buffer” menu option (limits 0.25 – 1.25 ppm); now enter the fluoride content of the calibration buffer (arrow keys) and confirm 2x. The calibration is now complete.

Temperature setting and specification only with correction value

<table>
<thead>
<tr>
<th>Initial value</th>
<th>Possible values</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoride conc.</td>
<td>Measured temp.</td>
<td>0.1 °C</td>
<td>0 °C</td>
<td>100 °C</td>
</tr>
<tr>
<td>of the buffer</td>
<td>value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(measuring range 10 ppm)</td>
<td>Last calibration value entered</td>
<td>0.01 ppm</td>
<td>0.25 ppm</td>
<td>1.25 ppm</td>
</tr>
<tr>
<td>(measuring range 99.99 ppm)</td>
<td>Last calibration value entered</td>
<td>0.01 ppm</td>
<td>0.75 ppm</td>
<td>12.50 ppm</td>
</tr>
</tbody>
</table>

Error message

<table>
<thead>
<tr>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential low*</td>
<td>&lt; 90.0 mV</td>
</tr>
<tr>
<td>Potential high*</td>
<td>&gt; 150.0 mV</td>
</tr>
<tr>
<td>Buffer missing</td>
<td>Back to permanent display: basic load metering</td>
</tr>
</tbody>
</table>

*For the measuring range 0...99.99 ppm, the plausibility statement is deactivated!
<table>
<thead>
<tr>
<th>Fault</th>
<th>Error text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on Control</th>
<th>Error with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>- Check F sensor</td>
<td>€</td>
<td>Basic load Stop Yes</td>
<td>Function defeatable</td>
<td>Check function of sensor, exceed checkout time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Range infringement</td>
<td>- Check F input</td>
<td>€</td>
<td>Basic load Stop Yes</td>
<td>at &lt; 3.8 mA</td>
<td>Check sensor, transducer and cable connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Value below minimum</td>
<td>- Check F input</td>
<td>€</td>
<td>Basic load Stop Yes</td>
<td>at &lt; 3.8 mA - 0.1 °C</td>
<td>Check sensor, replace if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Value above maximum</td>
<td>- Check F input</td>
<td>€</td>
<td>Basic load Stop Yes</td>
<td>at &gt; 23 mA</td>
<td>Check sensor, replace if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration with error</td>
<td>F cells defect</td>
<td>€</td>
<td>Basic load Stop No</td>
<td>- Monitoring continues in case of error with unsteady measured value</td>
<td>Check sensor, replace if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correction variable</td>
<td>- Range infringement</td>
<td>€</td>
<td>Basic load Stop Yes</td>
<td>at &lt; 3.8 mA - 0.1 °C</td>
<td>Check sensor, transducer and cable connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Value below minimum</td>
<td>- Value above maximum</td>
<td>€</td>
<td>Basic load Stop Yes</td>
<td>at &gt; 23 mA</td>
<td>Check sensor, replace if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Value above maximum</td>
<td>- Value below maximum</td>
<td>€</td>
<td>Basic load Stop Yes</td>
<td>at &gt; 23 mA</td>
<td>Check sensor, replace if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feedforward control mA</td>
<td>- Value below minimum</td>
<td>€</td>
<td>Step Stop Yes</td>
<td>&gt; 3.8 mA, Feed forward control &gt; 70%</td>
<td>Check sensor, replace if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Value above maximum</td>
<td>- Value below maximum</td>
<td>€</td>
<td>Step Stop Yes</td>
<td>&gt; 23 mA, Feed forward control &gt; 100%</td>
<td>Check sensor, replace if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land transgression</td>
<td>- Value below minimum</td>
<td>€</td>
<td>Step Stop Yes</td>
<td>&gt; 3.8 mA, Feed forward control &gt; 70%</td>
<td>Check sensor, replace if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Value above maximum</td>
<td>- Value below maximum</td>
<td>€</td>
<td>Step Stop Yes</td>
<td>&gt; 23 mA, Feed forward control &gt; 100%</td>
<td>Check sensor, replace if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servomotor</td>
<td>- Servomotor defect</td>
<td>€</td>
<td>Step Stop Yes</td>
<td>Servomotor class</td>
<td>Check servomotor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronics error</td>
<td>- System error</td>
<td>€</td>
<td>Step Stop Yes</td>
<td>Electronics cable defective</td>
<td>Call in service</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation</th>
<th>Role text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Error with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pause contact (Pause)</td>
<td>Pause</td>
<td>€</td>
<td>Stop Stop Stop No/Yes</td>
<td>No/Yes</td>
<td>No further fault check</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pause contact (Pause/Hold)</td>
<td>Pause/Hold</td>
<td>€</td>
<td>Stop Stop No/Yes No</td>
<td>No/Yes</td>
<td>No further fault check</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop (via button)</td>
<td>Stop</td>
<td>€</td>
<td>Stop Stop Stop No</td>
<td>Relay drops out</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During calibration</td>
<td>Basic load</td>
<td>€</td>
<td>Stop Stop Stop No</td>
<td>No error provision of measured variable</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential low</td>
<td>Potential high</td>
<td>€</td>
<td>Basic load Stop No</td>
<td>&gt; 110 °C or &gt; 150 °C</td>
<td>Check sensor, replace if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential high</td>
<td>Potential low</td>
<td>€</td>
<td>Basic load Stop No</td>
<td>&gt; 45 °C or &gt; 65 °C</td>
<td>Check sensor, replace if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slope low</td>
<td>Slope high</td>
<td>€</td>
<td>Basic load Stop No</td>
<td>&gt; 30 °C or &gt; 35 °C</td>
<td>Check sensor, replace if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During servomotor setting</td>
<td>Position feed back setting</td>
<td>€</td>
<td>Stop Stop Stop No</td>
<td>Without correct adjustment the last valid values are still used</td>
<td>Check connection of relay and potentiometer</td>
<td>Adjust this operation region of the servomotor correctly</td>
<td></td>
</tr>
</tbody>
</table>

*depending on whether “Alarm on” or “Alarm off” and in “General settings”*
Sensor: Troubleshooting

**Error**

<table>
<thead>
<tr>
<th>Unstable measuring signal</th>
<th>Cause of error</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring transducer loose</td>
<td>Screw the measuring transducer firmly onto the sensor</td>
<td></td>
</tr>
<tr>
<td>Defective reference electrode</td>
<td>Change the reference electrode</td>
<td></td>
</tr>
<tr>
<td>Wet connection between measuring transducer and sensor</td>
<td>Dry the connection</td>
<td></td>
</tr>
<tr>
<td>Ground circuit</td>
<td>Change the wiring</td>
<td></td>
</tr>
<tr>
<td>Air bubbles below the LaF₃ crystal</td>
<td>Depressurize the in-line probe housing, twist the sensor. Prevent bubble formation, if necessary increase flow</td>
<td></td>
</tr>
<tr>
<td>Contaminated LaF₃ crystal</td>
<td>Cleaning of the LaF₃ crystal</td>
<td></td>
</tr>
</tbody>
</table>

**The display reading does not react to different calibration solutions**

| Sensor is not connected | Connect the sensor |
| Defective sensor | Change the sensor |
| Defective cable | Change the cable |
| Defective measuring transducer | Change the measuring transducer |

**Slope too low/high**

| Sensor leaking | Change the sensor |
| Contaminated LaF₃ crystal | Cleaning of the LaF₃ crystal |
| Wrong calibration solution | Use correct calibration solution |
| Exceeding the allowed pH range | Adjust pH of the measuring water to pH 5,5 and 9,5 |
| Interfering ingredients | Avoid interfering substances |

**Drifting sensor signal**

| Defective reference electrode | Change the reference electrode |
| Leaking sensor | Change the sensor |

8.12.4 DULCOMETER® D1C Measured Variable Fluoride and Fluoride Sensor FLEP 010 SE/FLEP 0100 SE, Maintenance

**Controller**

The DULCOMETER® controller type D1C for the measured variable fluoride is maintenance-free.

**Sensor**

**IMPORTANT**

The sensor must be inspected regularly!

Observe current local guidelines!

Check whether the sensor is damaged or the LaF₃ crystal is contaminated or covered with gas bubbles!

**Cleaning**

**IMPORTANT**

If organic solvents are used to clean the sensor, the polymeric shaft material and the adhesive of the LaF₃ Crystal can be damaged!

Wipe contamination carefully away with help of a lint-free paper towel and rinse thoroughly. Remove any remaining contamination by polishing the LaF₃ crystal with the help of a soft lint-free paper towel and polishing paste (order no. 559810). Remove the residual polishing paste by carefully rinsing with lukewarm water. Immerse the sensor over night in tap water with 1 ppm fluoride and calibrate again.

**Fluoride**
8.13 Measuring Parameter Temperature

8.13.1 DULCOMETER® D1C Measured Variable Temperature, Setting and Operation

Display Symbols
The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td>left</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Relay 1, upper</td>
<td>left</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Relay 1, lower</td>
<td>right</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Relay 2, upper</td>
<td>right</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Relay 2, lower</td>
<td>right</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Metering pump 1 (heat) Control</td>
<td>left</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Control off</td>
<td>left</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Control on</td>
<td>right</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Metering pump 2 (cool) Control</td>
<td>left</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Control off</td>
<td>right</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Control on</td>
<td>right</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Solenoid valve 1 (heat) Control</td>
<td>left</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Control off</td>
<td>right</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Control on</td>
<td>right</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Solenoid valve 2 (cool) Control</td>
<td>left</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Control off</td>
<td>right</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Control on</td>
<td>right</td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Servomotor</td>
<td></td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Control, open relay</td>
<td></td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Control, close relay</td>
<td></td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Without control</td>
<td></td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Position feedback</td>
<td></td>
<td>![Symbol]</td>
</tr>
<tr>
<td>The bar increases from left to right during opening</td>
<td></td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Stop button pressed</td>
<td></td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Manual metering</td>
<td></td>
<td>![Symbol]</td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td>![Symbol]</td>
</tr>
</tbody>
</table>
NOTE
Access to the setting menus can be barred with the access code!
The number and scope of setting menus depends on the device version!
If the access code is selected correctly in a setting menu, the following setting menus are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.
Restricted Operating Menu / Layout

The restricted operating menu permits simple operation of the most important parameters. The following overview shows the settings which can be selected:

- **Temperature**
  - Positive values of setting variable: chlorine dioxide
  - Negative values of setting variable: De-ClO₂ (chlorine dioxide destruction)
  - Permanent display 1: Temperature, 30.0 °C
  - Permanent display 2: Positive values of setting variable: chlorine dioxide
  - Negative values of setting variable: De-ClO₂ (chlorine dioxide destruction)
  - Calibration CO₂: zero p.: 4.00 mA, slope: 6.50 mA/ppm
  - Calibration CO₂: zero p.: 4.00 mA, slope: 6.75 mA/ppm
  - Calibration CO₂: zero p.: 4.00 mA, slope: 6.75 mA/ppm
  - Calibration CO₂: zero p.: 4.00 mA, slope: 6.75 mA/ppm

- **Limits**
  - Limit 1: upper = 1.50 ppm; lower = 0.10 ppm
  - Limit 2: upper = 0.80 ppm; lower = 0.60 ppm

- **Control**
  - Control: normal, control output value: 30 %, control parameter: xp = 10 %, Ti = off, Td = off
  - Control: manual, control output value: 30 %, manual dosing: 15 %

- **Access to setting menus**
  - Access to setting menus can be blocked with access code.

- **General setting information**
  - Identcode: D1CA
  - DxDxxxxxxxxxx
  - Software version: D1C-B1 FW-5.00
  - Alarm relay: active
  - Access code: <5000>
  - Operating menus: = english, = reduced

Number and scope of setting menus depend on the device.

Access to setting menus can be blocked with access code.
Temperature

8.13.2 Temperature Sensor PT 100 SE, Commissioning

8.13.2.1 Temperature Sensor PT 100 SE, Assembly

Remove the blanking plug of the respective measuring module at the fittings of the measuring/ control station DULCOTROL® and install the temperature sensor PT 100 SE.

8.13.2.2 Temperature Sensor PT 100 SE, Electrical Installation

Connect the temperature sensor PT 100 SE with the marked cable of the respective controller D1C.

8.13.2.3 Temperature Sensor PT 100 SE, Running-In

The temperature sensor PT 100 SE must not be run-in. The temperature sensor PT 100 SE can be readily used.

8.13.2.4 Temperature Sensor PT 100 SE, Calibration

Calibration of the PT100

During calibration, the control function persists. The standard signal of the output (measured value) remains unchanged. The measured value registered during the start of the calibration is proposed as value; this value is adjustable.

**IMPORTANT**

A change of the measuring unit must be done before calibration!

<table>
<thead>
<tr>
<th>Initial value</th>
<th>Possible values</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>0.1 °C</td>
<td>-5 °C</td>
<td>105 °C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.1 °F</td>
<td>23 °F</td>
<td>221 °F</td>
<td></td>
</tr>
</tbody>
</table>
### 8.13.3 DULCOMETER® D1C Measured Variable Temperature and Temperature Sensor PT 100 SE, Troubleshooting

#### Controller

<table>
<thead>
<tr>
<th>Fault Variable</th>
<th>Fault Text</th>
<th>Symbol</th>
<th>Effect</th>
<th>Alarm with acknowledgment</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured variable</td>
<td>Checkout time measured value exceeded</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Signal overexcursion below value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Signal overexcursion above value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pause contact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stop button</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Servomotor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electronics error</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Limit transgression</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(灿限值)2</td>
<td>Stop</td>
<td>No</td>
<td>Yes</td>
<td>Function detachable</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td></td>
<td>(灿限值)1</td>
<td>Stop or hold</td>
<td>Stop</td>
<td>No</td>
<td>Yes</td>
<td>Function detachable</td>
</tr>
</tbody>
</table>

#### Operation

<table>
<thead>
<tr>
<th>Mode</th>
<th>Note text</th>
<th>Symbol</th>
<th>Effect on control</th>
<th>Alarm with acknowledgment</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pause contact</td>
<td>Pause</td>
<td>Stop</td>
<td>Stop</td>
<td>No</td>
<td>Function detachable</td>
<td>Check servomotor</td>
</tr>
<tr>
<td>Stop button</td>
<td>Stop</td>
<td>Stop</td>
<td>Stop</td>
<td>No</td>
<td>Relay drops out</td>
<td></td>
</tr>
</tbody>
</table>

*Depending on whether “Alarm on” or “Alarm off” set in “General settings”*

#### 8.13.4 DULCOMETER® D1C Measured Variable Temperature and Temperature Sensor PT 100 SE, Maintenance

#### Controller

The DULCOMETER® controller type D1C for the measured variable temperature is maintenance-free.

#### Sensor

**IMPORTANT**

- The sensor is to be regularly serviced to avoid any incorrect controlling caused by a sensor failure!
- Observe the valid national regulations for maintenance intervals!

#### Maintenance Work

Check the reading of the sensor at the control unit using a suitable temperature measuring tool. The sensor is to be regularly cleaned to prevent any corruption of the measured value due to deposits or growth.
8.14 Measuring Parameter Total Chlorine

8.14.1 DULCOMETER® D1C Measured Variable Chlorine, Setting and Operation

Display Symbols
The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td>left</td>
<td><img src="image1" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 1, upper</td>
<td>Symbol</td>
<td><img src="image2" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 1, lower</td>
<td>Symbol</td>
<td><img src="image3" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 2, upper</td>
<td>Symbol</td>
<td><img src="image4" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 2, lower</td>
<td>Symbol</td>
<td><img src="image5" alt="Symbol" /></td>
</tr>
<tr>
<td>Metering pump 1 (chlorine) Control off</td>
<td>left</td>
<td><img src="image6" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td><img src="image7" alt="Symbol" /></td>
</tr>
<tr>
<td>Metering pump 2 (dechlorine) Control off</td>
<td>Symbol</td>
<td><img src="image8" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td><img src="image9" alt="Symbol" /></td>
</tr>
<tr>
<td>Solenoid valve 1 (chlorine) Control off</td>
<td>right</td>
<td><img src="image10" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td><img src="image11" alt="Symbol" /></td>
</tr>
<tr>
<td>Solenoid valve 2 (dechlorine) Control off</td>
<td>right</td>
<td><img src="image12" alt="Symbol" /></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td><img src="image13" alt="Symbol" /></td>
</tr>
<tr>
<td>Servomotor Control, open relay</td>
<td><img src="image14" alt="Symbol" /></td>
<td><img src="image15" alt="Symbol" /></td>
</tr>
<tr>
<td>Control, close relay</td>
<td><img src="image16" alt="Symbol" /></td>
<td><img src="image17" alt="Symbol" /></td>
</tr>
<tr>
<td>Without control</td>
<td><img src="image18" alt="Symbol" /></td>
<td><img src="image19" alt="Symbol" /></td>
</tr>
<tr>
<td>Position feedback</td>
<td>Thickness of bar increases from left to right during opening</td>
<td><img src="image20" alt="Symbol" /></td>
</tr>
<tr>
<td>Stop button pressed</td>
<td><img src="image21" alt="Symbol" /></td>
<td><img src="image22" alt="Symbol" /></td>
</tr>
<tr>
<td>Manual metering</td>
<td><img src="image23" alt="Symbol" /></td>
<td><img src="image24" alt="Symbol" /></td>
</tr>
<tr>
<td>Fault</td>
<td><img src="image25" alt="Symbol" /></td>
<td><img src="image26" alt="Symbol" /></td>
</tr>
</tbody>
</table>
Operation

Permanent display 1
Permanent display 2
Calibration menu
Various Setting menus Access code

The various menus are selected with the CHANGE button
The menu is started with the ENTER button
BRANCH BACK to permanent display or to relevant setting menu
Access code, correct Parameter setting

NOTE

Access to the setting menus can be barred with the access code!
The number and scope of setting menus is dependent on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!
If within a period of 10 minutes no button is pressed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.

CHANGE from selection to selection
Change numbers or settings of selection
ENTER and save setting, continue to next menu

BRANCH back without saving setting
BRANCH back to start of setting

Variables flash
Total Chlorine

Restricted Operating Menu / Layout

0.45 ppm

Permanent display 1

0.45 ppm

Positive values of control variable: Chlorine

Negative values of control variable: Dechlorine

(Chlorine destruction)

Access to setting menus can be blocked with access code.

Number and scope of setting menus is dependent on the device.

Only with correction variable pH

Number and scope of setting menus is dependent on the device.

Access to setting menus can be blocked with access code.

Only with control

Setting in complete operating menu

General setting information

Control with dead zone

Controller with dead zone

Positive values of control variable:

Negative values of control variable:

Setting in complete operating menu

General setting information

Control with dead zone

Controller with dead zone

Positive values of control variable:

Negative values of control variable:

Access to setting menus can be blocked with access code.

Number and scope of setting menus is dependent on the device.

Access to setting menus can be blocked with access code.

Number and scope of setting menus is dependent on the device.

Access to setting menus can be blocked with access code.

Number and scope of setting menus is dependent on the device.

Access to setting menus can be blocked with access code.

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Access to setting menus can be blocked with access code.

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Access to setting menus can be blocked with access code.

Number and scope of setting menus is dependent on the device.

Access to setting menus can be blocked with access code.

Number and scope of setting menus is dependent on the device.

Access to setting menus can be blocked with access code.

Number and scope of setting menus is dependent on the device.

Access to setting menus can be blocked with access code.

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Access to setting menus can be blocked with access code.

Number and scope of setting menus is dependent on the device.

Access to setting menus can be blocked with access code.

Number and scope of setting menus is dependent on the device.

Access to setting menus can be blocked with access code.

Number and scope of setting menus is dependent on the device.

Access to setting menus can be blocked with access code.

Number and scope of setting menus is dependent on the device.

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8.14.2 DULCOTEST® CTE Sensor for Total Chlorine, Commissioning

8.14.2.1 DULCOTEST CTE Sensor for Total Chlorine, Assembly

Assembly

**CAUTION**

Do not swallow the electrolyte. Avoid contact of the electrolyte with skin and eyes. Otherwise wash with a lot of water. In case of eye inflammation, contact a doctor.

**IMPORTANT**

- Do not touch or damage the membrane or electrodes.
- The electrolyte is sensitive to oxidation: always keep the electrolyte bottle closed after use. Do not transfer the electrolyte into other containers.
- The electrolyte should not be stored for more than 1 year and should not yellow (use by date, see label).
- As far as possible avoid forming air bubbles when pouring the electrolyte into the membrane cap.
- The membrane cap must be used once only.

**NOTE**

- Store the electrolyte bottle upside down in order that the viscous electrolyte can be poured easily and bubble free into the membrane cap.
- Smaller bubbles will not interfere, larger bubbles leave the electrolyte by rising to the surface.

**Pouring electrolyte**

- Open the electrolyte bottle and unscrew the nozzle.
- Squeeze out excess air.
- Fill the membrane cap with electrolyte, avoiding air bubbles as far as possible: Place the electrolyte bottle completely onto the membrane cap. Slowly squeeze the electrolyte out of the bottle in one steady stream, while continuously retracting the bottle. The cap is completely full when the electrolyte reaches the lower edge of the thread.

**Assembling membrane cap**

- Place the electrode shaft vertically onto the filled membrane cap.
- Do not cover the vent hole below the rubber seal with your fingers.
- Screw on the membrane cap by hand as far as possible. There should not be a visible gap between the electrode shaft and membrane cap. When you screw on the cap, excess electrolyte will leak out through the hole below the rubber seal.
- Wipe away any electrolyte with a soft paper tissue or similar.
- Rinse the nozzle thoroughly with a clean, warm water jet so that no electrolyte remains on the inside and outside of the nozzle.

**Assembling sensor**

**IMPORTANT**

- Depressurise the system before inserting the sensor into the in-line probe housing. Close the stop valves before and after the in-line probe housing.
- Insertion and withdrawal of the sensor into or out of the in-line probe housing should be carried out slowly.
- Do not exceed the maximum operating pressure of 1 bar.
- Do not allow the flow to fall below the minimum rate of 30 l/h. Monitor the flow with the connected measuring device/controller. If the sensor's signal is used for controlling, switch off the controller or adjust it to constant load when the flow rate falls below the lower limit.
- Avoid installations which allow air bubbles to enter the sample water.
- Air bubbles clinging to the sensor membrane can lower the resultant measured value and cause incorrect dosing within the control system.
Total Chlorine

8.14.2.2 DULCOTEST® CTE Sensor for Total Chlorine, Electrical Installation

General Safety Guidelines

IMPORTANT
Install in such a way as to ensure a totally reliable, uninterrupted power supply to the controller. Too low a voltage supply can cause measuring failures, which may result in dangerous overdosing within a control system.

The CTE 1-mA sensor has a passive 4-20 mA two-wire interface. The power supply is provided externally or by the controller. When the sensor is connected to the DULCOMETER® D1C controller the interface’s safety requirements are met automatically.

IMPORTANT
For electrical connection of the sensor to the controller, only use wires with a diameter of 4 mm.

Electrical Installation

Turn the top part of the sensor a quarter of a turn anticlockwise and remove.

Remove the outer isolation of the cable for about 5 cm from the end so that the two wires appear.

Loosen the M12 threaded connector and guide the 2-wire cable into the sensor. Leave an approx. 5 cm length of the 2-core measuring line in the sensor.

Strip the two wires at their ends and connect them to the terminal block by using the screwdriver provided: 1 = plus, 2 = minus

Tighten up the M12 connector.

Insert the top part of the sensor right into the housing and turn the top part clockwise as far as it will go.

Electrical connection to sensor

Insert the 5-pin plug into the socket.
8.14.2.3 DULCOTEST® CTE Sensor for Total Chlorine, Running-In

**CAUTION**
- The power supply to the measuring device and to the sensor must not be interrupted. If the power supply is interrupted (> 2 hours) the sensor must be re-commissioned.
- Do not switch off the measuring system during interval operation. After any operation without chlorine, running-in periods must be reckoned with. If required, switch on metering unit time-delayed! If no chlorine is metered for a longer period of time (weeks), the sensor must be disconnected from the power supply and stored dry.
- The sensor’s current signal must not exceed 20 mA. Otherwise the sensor may be damaged, which may result in dangerous overdosing within a control system.
- To avoid this, install a monitor, which permanently switches off the chlorine control system and triggers an alarm. The monitoring equipment must not be automatically re-setting.
- Once the sensor has been commissioned it must be kept permanently wet.

After completed installation the controller can be switched on. The system should then be allowed to run in for the set run-in period.

**Running-In Period**
In order to achieve a stable display value the sensor should be run in for the following run in periods.
- First commissioning: 24 hour
- After changing membrane: 1-6 h
- Re-commissioning: approx. 4-24 hours

8.14.2.4 DULCOTEST® CTE Sensor for Total Chlorine, Calibration

**IMPORTANT**
The specified calibration method depending on the type of chlorination agent used must be observed.

**CAUTION**
- Carry out a slope test every time the membrane or electrolyte is changed.
- Avoid air-bubbles in the sample flow. They can attach at the membrane, which may cause too low measured values. Within a control system this may lead to dangerous overdosing.
- For proper function of the sensor, the slope test has to be repeated regularly.
- If installing the sensor outside Germany, please comply with the local regulations for calibration intervals.

**Preconditions**
The sensor reading is stable (no drifts or unsteady values for at least 5 minutes). This is normally fulfilled, when
- The system has been allowed to run-in for the specified period
- The flow through the in-line probe housing is constant and corresponds with the technical data
- The sample medium and the sensor are at the same temperature
- The pH value is constant and within the admissible range (pH 6.5 - 9.5)

**Zero Point Calibration**
Zero point calibration is necessary only when the sensor is used at the lower limit of the measuring range.
- Remove the sensor from the DLG III or DGM in-line probe housing (see DLG III, DGM operating instructions)
- Immerse the sensor in a container with clean water, free of chlorine and bromine.
- Stir by using the sensor, until the measured value remains stable.
- Adjust the controller (DULCOMETER® D1C, chlorine) to zero, according to it’s operating instructions (DULCOMETER® D1C, chlorine Operating Instructions: Chapter 8, complete operating menu, settings menu “Calibrating chlorine zero point”)
- Reinstall the sensor into the in-line probe housing (DGM, DLG III)
Total Chlorine

Slope Test
- Insert the sensor into the DLG III or DGM in-line probe housing, if not already done (see Assembly).
- Take a water sample for DPD-measurement. Sampling location has to be close to the installed sensor. Recommendation: use the sampling tap in the case of the DGM in-line probe housing.
- Determine total chlorine content with an appropriate chlorine measurement kit according to the DPD-4 method (e.g. Photometer DT1, order no. 1003473).
- Input the measured value into the controller according to it's operating manual Operating Instructions: DULCOMETER® D1C, chlorine Chapter 8, complete operating menu, settings menu "Calibrating chlorine".
- After initial installation of the sensor, check the calibration by DPD-measurement 24 hours later.
- The following maintenance intervals based on experiences are recommended:
  - Potable, industrial, process and cooling water depending on the specific conditions (1-4 weeks)
  - swimming pools: weekly
  - spa pools (whirlpools): daily

Calibration of the Chlorine Sensor
During the calibration, the D1C sets the controller outputs to “0”. Exception: If a base load or manual controller output was set, these are maintained during the calibration. The standard signal outputs mA (measured value or correction value) are frozen. The measured value registered during the start of the calibration is proposed as the DPD value; this value is adjustable (arrow keys!).
Calibration is only possible if the DPD value is ≥ 2 % of the measuring range. On successful completion of calibration, all error checks which refer to the measured value are restarted.

**IMPORTANT**
The measuring range of the sensor must correspond to the adjusted measuring range (factory settings 0–2 ppm). A change of the measuring range must be done before calibration!
### 8.14.3 DULCOMETER® D1C and DULCOTEST® CTE Sensor for Total Chlorine, Troubleshooting

#### Controller

<table>
<thead>
<tr>
<th>Fault</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Error with auto-alignment</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>Checked times exceeded</td>
<td>(\square)</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Function detachable</td>
<td>Check function of sensor, exceed checkout time</td>
</tr>
<tr>
<td></td>
<td>Signal exceed/drops below value</td>
<td>(\square)</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Signal (&lt; -0.3 \pm 0.2 \text{mA} ) or (&gt;23 \pm 0.2 \text{mA} ) Check sensor, transmission and cable connection</td>
<td></td>
</tr>
<tr>
<td>Calibration sensor multi-effect</td>
<td>(\square)</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>Function remains up to cause of error with available measured values</td>
<td>Check sensor, replace if necessary, recalibrate if necessary</td>
<td></td>
</tr>
<tr>
<td>Correction variable</td>
<td>Signal exceed/drops below value</td>
<td>(\square)</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Signal (&lt; -0.3 \pm 0.2 \text{mA} ) or (&gt;23 \pm 0.2 \text{mA} ) Check sensor, transmission and cable connection</td>
<td></td>
</tr>
<tr>
<td>Calibration pH with error</td>
<td>(\square)</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit (C_L)</td>
<td>(\square)</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit (C_T)</td>
<td>(\square)</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Servomotor</td>
<td>(\square)</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronics error</td>
<td>System error</td>
<td>(\square)</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Operation

<table>
<thead>
<tr>
<th>Operation</th>
<th>Note text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Error with auto-alignment</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pause contact</td>
<td>(\square)</td>
<td>Stop</td>
<td>Stop</td>
<td>No/Yes*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Step</td>
<td>Stop</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Pause HOLD</td>
<td>Stop</td>
<td>Stop</td>
<td>No/Yes</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td></td>
<td>Step button</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Relay drops out</td>
<td>-</td>
<td>-</td>
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<tr>
<td></td>
<td>Step</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Position not reached</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Signal exceeded</td>
<td>(\square)</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Function detachable</td>
<td>Check sensor, replace if necessary</td>
</tr>
<tr>
<td></td>
<td>Sensor zero point too low</td>
<td>(\square)</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Sensor slope too low</td>
<td>Replace if necessary</td>
</tr>
<tr>
<td></td>
<td>Sensor zero point too high</td>
<td>(\square)</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Sensor zero point too high</td>
<td>Replace if necessary</td>
</tr>
<tr>
<td></td>
<td>Buffer distance too small</td>
<td>(\square)</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Buffer distance too small</td>
<td>Resset calibration</td>
</tr>
<tr>
<td></td>
<td>Buffer point too high</td>
<td>(\square)</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Buffer point too high</td>
<td>Resset calibration</td>
</tr>
<tr>
<td></td>
<td>Buffer point too high</td>
<td>(\square)</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Buffer point too high</td>
<td>Resset calibration</td>
</tr>
<tr>
<td></td>
<td>Buffer point too high</td>
<td>(\square)</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Buffer point too high</td>
<td>Resset calibration</td>
</tr>
<tr>
<td></td>
<td>Buffer value too unstable</td>
<td>(\square)</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Buffer value too unstable</td>
<td>Resset calibration</td>
</tr>
<tr>
<td></td>
<td>Servomotor setting</td>
<td>Position feedback too high</td>
<td>(\square)</td>
<td>Stop</td>
<td>Stop</td>
<td>No</td>
<td>Check sensor, replace if necessary</td>
</tr>
<tr>
<td></td>
<td>Position feedback too low</td>
<td>(\square)</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Check sensor, replace if necessary</td>
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</tbody>
</table>

* depending on whether “Alarm on” or “Alarm off” set in “General settings” ** Function PI stable

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**Total Chlorine**

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### Total Chlorine

**Sensor: Troubleshooting**

Troubleshooting must take account of the whole measuring system. The measuring system consists of:

1. Measurement/control device
2. Electrical leads and connectors
3. In-line probe housing and hydraulic connections
4. Sensor

The possible causes of failure listed in the following table primarily refer to the sensor. Before commencing troubleshooting please ensure that the operating conditions are met:

- Chlorine content lies within the corresponding measurement range of the sensor
- Constant pH in the range 6.5 - 9.5
- Constant temperature in the range 4 - 45 °C
- Conductivity: 0.03 - 40 mS/cm
- Flow: 30 - 60 l/h

The sensor simulator (DULCOMETER® Simulator order no. 1004042) is recommended for locating a controller malfunction. You will find a detailed description of troubleshooting of the controller in the operating instructions of DULCOMETER® D1C, chlorine.

If the value measured by the sensor differs significantly from that of the DPD method you need to first consider all possible malfunctions of the DPD photometric method. If necessary, repeat the DPD measurement several times.

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor can not be calibrated. Measured value greater than DPD-measurement</td>
<td>Run-in time too short</td>
<td>See “Run-in period”</td>
</tr>
<tr>
<td></td>
<td>Membrane cap damaged</td>
<td>Replace membrane cap, run in sensor and calibrate</td>
</tr>
<tr>
<td></td>
<td>Interfering substances in sample water</td>
<td>Examine sample water for interfering substances and remedy</td>
</tr>
<tr>
<td></td>
<td>Short-circuit in signal lead</td>
<td>Locate and eliminate short circuit</td>
</tr>
<tr>
<td></td>
<td>Distance between membrane and electrode too great</td>
<td>Screw the membrane cap tightly onto the electrode shaft</td>
</tr>
<tr>
<td></td>
<td>DPD chemicals spent</td>
<td>Use new DPD chemicals, repeat calibration</td>
</tr>
<tr>
<td></td>
<td>pH-value &lt; pH 6.5</td>
<td>Raise pH-value (6.5-9.5)</td>
</tr>
</tbody>
</table>

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<th>Remedy</th>
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</thead>
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<tr>
<td>Sensor can not be calibrated. Measured value smaller than DPD-measurement</td>
<td>Run-in time too short</td>
<td>See “Run-in period”</td>
</tr>
<tr>
<td></td>
<td>Deposits on membrane cap</td>
<td>Remove deposits, see “Maintenance”. Replace membrane cap, run-in sensor, calibrate</td>
</tr>
<tr>
<td></td>
<td>Flow rate of sample water too low</td>
<td>Correct flow rate</td>
</tr>
<tr>
<td></td>
<td>Air bubbles on the outside of the membrane</td>
<td>Remove air bubbles by tapping and increase flow, if required, within the permitted range</td>
</tr>
<tr>
<td></td>
<td>Interfering substances in sample water (surfactants, oil, alcohols, corrosion inhibitors)</td>
<td>Confer with ProMinent</td>
</tr>
<tr>
<td></td>
<td>Value substantially exceeds measurement range</td>
<td>Replace membrane cap, run-in sensor, calibrate</td>
</tr>
<tr>
<td></td>
<td>Deposits (carbonate, manganese, iron oxide) have blocked membrane</td>
<td>Replace membrane cap, run-in sensor, calibrate</td>
</tr>
<tr>
<td></td>
<td>pH-value &gt; pH 9.5</td>
<td>Lower the pH value (pH 6.5-pH 9.5)</td>
</tr>
<tr>
<td></td>
<td>No electrolyte present in membrane cap</td>
<td>Fill membrane cap with new electrolyte see “Assembly”, “Run-in period” and “Calibration”</td>
</tr>
</tbody>
</table>
Total Chlorine

Fault | Possible Cause | Remedy
---|---|---
Measured value of sensor is 0 ppm and error message “Check Cl input” appears on DULCOMETER® D1C display | Sensor is connected to controller with wrong polarity<br>Signal lead is broken<br>Sensor defective<br>Controller defective | Correctly connect sensor to the controller<br>Replace signal lead<br>Return sensor to ProMinent<br>Check controller with the sensor simulator (DULCOMETER® Simulator, order no. 1004042, return to dealer if faulty)

Measured value of sensor is 0 ppm and sensor current is 3.0 - 4.0 mA | Run-in time too short<br>Interfering substances which consume chlorine<br>Zero point has shifted<br>Reference electrode defective* | See “Run-in period”<br>Examine sample water for interfering substances and remedy<br>Carry out zero point calibration<br>Return sensor to ProMinent for regeneration

Measured value of sensor is arbitrary and sensor current is greater than 20 mA** | Chlorine concentration exceeds the upper limit of measuring range<br>Distance between working electrode and membrane too great<br>Sensor defective | Check the whole system, remedy fault and then calibrate sensor<br>Screw the membrane cup tightly onto the electrode shaft<br>Return sensor to ProMinent

Measured value of sensor is not stable | Pressure fluctuations in sampling line<br>Reference electrode defective* | Check installation position and change the process if necessary<br>Return sensor to ProMinent for regeneration

* When the reference electrode turns shiny silver or white it must be regenerated. Brown-grey or yellow green coloration is normal.

** The DULCOMETER® D1C can be used to display the sensor current when the sensor is built into the system. For this enter the complete operating menu (see Operating Instructions DULCOMETER® D1C, Chlorine, Chapter 8). Access the “Calibrating chlorine” settings menu and only read the mA-value measured under “Zero point”. Do not finish the zero point calibration but leave the menu by pushing the branch back button.
8.14.4 DULCOMETER® D1C Measured Variable Chlorine and DULCOTEST® CTE Sensor for Total Chlorine, Maintenance

Controller
The DULCOMETER® controller type D1C for the measured variable total chlorine is maintenance-free.

Sensor

**IMPORTANT**
- Service the sensor regularly to avoid overdosing within a control system, due to incorrect measured value.
- Observe the current national regulations for maintenance intervals.
- Do not touch the electrodes or allow them to come into contact with greasy substances.
- Never attempt to clean the membrane with acid/alkaline solutions, cleaning reagents or mechanical aids (brushes or similar).

**Maintenance interval** based on experience are:
- Potable, industrial, process and cooling water: depending on the specific conditions (1-4 weeks)
- Swimming pools: weekly
- Spa pools (whirlpools): daily

**Maintenance Work**
- Check the sensor regularly for dirt, algae and air bubbles. As far as possible, avoid contamination of the membrane with solid particles, deposits etc. Eliminate air bubbles by increasing the flow rate.
- Check the displayed sensor value on the controller regularly according to the DPD-4 method using an appropriate chlorine measurement kit.
- If necessary, recalibrate the sensor.
- If calibration cannot be carried out properly, the membrane cap must be replaced and calibration must be repeated.
# Measuring Parameter pH/Chlorine

## DULCOMETER® D2C Measured Variable pH/Chlorine, Setting and Operation

### Display Symbols

The display of the DULCOMETER® D2C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Limit value transgression measured value 1</td>
<td>Symbol left</td>
</tr>
<tr>
<td></td>
<td>Relay 1 upper or zone</td>
<td></td>
</tr>
<tr>
<td>▼</td>
<td>Limit value transgression measured value 2</td>
<td>Symbol left</td>
</tr>
<tr>
<td></td>
<td>Relay 2 upper or zone</td>
<td></td>
</tr>
<tr>
<td>▼</td>
<td>Limit value transgression measured value</td>
<td>Symbol right</td>
</tr>
<tr>
<td></td>
<td>Relay 2 lower</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Metering pump measured value 1</td>
<td>Symbol left</td>
</tr>
<tr>
<td></td>
<td>Control off</td>
<td></td>
</tr>
<tr>
<td>▼</td>
<td>Control on</td>
<td>Symbol left</td>
</tr>
<tr>
<td></td>
<td>Metering pump measured value 2</td>
<td>Symbol right</td>
</tr>
<tr>
<td></td>
<td>Control off</td>
<td></td>
</tr>
<tr>
<td>▼</td>
<td>Control on</td>
<td>Symbol right</td>
</tr>
<tr>
<td></td>
<td>Solenoid valve measured value 1</td>
<td>Symbol left</td>
</tr>
<tr>
<td></td>
<td>Control off</td>
<td></td>
</tr>
<tr>
<td>▼</td>
<td>Control on</td>
<td>Symbol left</td>
</tr>
<tr>
<td></td>
<td>Solenoid valve measured value 2</td>
<td>Symbol right</td>
</tr>
<tr>
<td></td>
<td>Control off</td>
<td></td>
</tr>
<tr>
<td>▼</td>
<td>Control on</td>
<td>Symbol right</td>
</tr>
<tr>
<td></td>
<td>Manual metering</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>Pause</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Delay time „td“</td>
<td>Control starts after expiry of „td“</td>
</tr>
<tr>
<td>E</td>
<td>Fault</td>
<td></td>
</tr>
</tbody>
</table>
NOTE
Access to the setting menus can be barred with the access code!
The number and scope of setting menus is dependent on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus
are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back
from the calibrating menu or a setting menu to the permanent display 1.
Operating Menu / Layout

The setting menus highlighted in grey and the adjustable parameters are only visible in the complete operating menu.
Operating Menu / Layout (Continuation)

- relay setting?
  - relay 1 meas. value 1 pH
  - relay 2 meas. value 2 chlorine

- solenoid valve 2 setting?
  - chlorine period 10 s min. time 1 s
  - solenoid valve 1 setting?
  - acid period 10 s min. time 1 s

- pump setting?
  - pump 1 acid
  - pump 2 chlorine

- setpoint
  - pump 1: 180
  - pump 2: 180

- dosing direction
  - chlorine setpoint 7.20 pH
  - acid setpoint 0.40 ppm

- automatic dosing direction
  - chlorine manual dosing 0 %
  - acid manual dosing 0 %

- ctrl parameter
  - xp = 10 %
  - Ti = off
  - Td = off

- additional load
  - chlorine manual dosing 0 %

- limit value
  - chlorine limit 1 upper 0.10 ppm
  - chlorine limit 2 lower 0.60 ppm
  - chlorine limit relay: LV1 active closed

- hysteresis limit:
  - chlorine

- checkout time limit:
  - chlorine
Operating Menu / Layout (Continuation)

- pH correction value setting?
- pH/mV
- mA output 1
  - measured value
    - 4 mA = 2.00 pH
    - 20 mA = 12.00 pH
- mA output 1
  - pH
  - measured value
    - 4 mA = 0%
    - 20 mA = 100%
- pH correction value
  - 4 mA = 0.0
  - 20 mA = 100

- mA output 2
  - chlorine
  - measured value
    - 4 mA = 0.00 ppm
    - 20 mA = 2.00 ppm
- mA output 2
  - chlorine
  - measured value
    - 4 mA = 0%
    - 20 mA = 100%

Ident-Code: D2CA W 0 PC 100 A 10 E
software version D2C-A1 FW.2.10

General setting information
- alarm relay
  - active closed
  - alarm off
  - td: 10 min.
- software version
  - D2C-A1 FW.2.10
- permanent display
  - 1
- control input
  - active closed
  - sample flow
- control input
  - active closed
  - Cl const. load
    - 0 %
- high chlorine
  - 1.50 ppm
- access c.: 5000
- operating menu:
  - english
  - complete

D2C-003-pH-Cl-D
Operating Menu / Description

Permanent displays

The permanent displays 1 to 4 serve information on fault messages/causes as well as on operating values/settings.

8.15.2 DULCOTEST® CTE Sensor for Total Chlorine and DULCOTEST® Sensor PHEP or PHER for pH, Commissioning

8.15.2.1 DULCOTEST® CTE Sensor for Total Chlorine and DULCOTEST® Sensor PHEP or PHER for pH, Assembly

Assembly

DULCOTEST® CTE sensor for total chlorine

CAUTION

Do not swallow the electrolyte. Avoid contact of the electrolyte with skin and eyes. Otherwise wash with a lot of water. In case of eye inflammation, contact a doctor.

IMPORTANT

- Do not touch or damage the membrane or electrodes.
- The electrolyte is sensitive to oxidation: always keep the electrolyte bottle closed after use. Do not transfer the electrolyte into other containers.
- The electrolyte should not be stored for more than 1 year and should not yellow (use by date, see label).
- As far as possible avoid forming air bubbles when pouring the electrolyte into the membrane cap.
- The membrane cap must be used once only.

NOTE

- Store the electrolyte bottle upside down in order that the viscous electrolyte can be poured easily and bubble free into the membrane cap.
- Smaller bubbles will not interfere, larger bubbles leave the electrolyte by rising to the surface.

Pouring electrolyte

- Open the electrolyte bottle and unscrew the nozzle.
- Squeeze out excess air.
- Fill the membrane cap with electrolyte, avoiding air bubbles as far as possible: Place the electrolyte bottle completely onto the membrane cap. Slowly squeeze the electrolyte out of the bottle in one steady stream, while continuously retracting the bottle. The cap is completely full when the electrolyte reaches the lower edge of the thread.

Assembling membrane cap

- Place the electrode shaft vertically onto the filled membrane cap.
- Do not cover the vent hole below the rubber seal with your fingers.
- Screw on the membrane cap by hand as far as possible. There should not be a visible gap between the electrode shaft and membrane cap. When you screw on the cap, excess electrolyte will leak out through the hole below the rubber seal.
- Wipe away any electrolyte with a soft paper tissue or similar.
- Rinse the nozzle thoroughly with a clean, warm water jet so that no electrolyte remains on the inside and outside of the nozzle.
Assembling sensor

IMPORTANT

• Depressurise the system before inserting the sensor into the in-line probe housing.
• Insertion and withdrawal of the sensor into or out of the in-line probe housing should be carried out slowly.
• Do not exceed the maximum operating pressure of 1 bar.
• Do not allow the flow to fall below the minimum rate of 30 l/h. Monitor the flow with the connected measuring device/controller. If the sensor's signal is used for controlling, switch off the controller or adjust it to constant load when the flow rate falls below the lower limit.
• Avoid installations which allow air bubbles to enter the sample water. Air bubbles clinging to the sensor membrane can lower the resultant measured value and cause incorrect dosing within the control system.

Fitting the sensor in the in-line probe housing

Note also the instructions and safety guidelines in the operating instructions of the in-line probe housing.

DLG III

► Slide the O-ring from below over the sensor up to the clamping ring.
► Insert the sensor into the DLG III.
► Fix the sensor tightly by screwing in the plug.

DGM

► Slide the O-ring from below over the sensor up to the clamping ring. Leave a flat washer inside the DGM.
► Insert the sensor in the DGM and screw on the plug until the O-ring seals. The clamping ring determines the installation depth of the sensor.

Assembly

Installation of the DULCOTEST® PHEP or PHER sensor for pH

Remove the blanking plug of the respective measuring module at the fittings of the measuring/control station DULCOTROL® and install the DULCOTEST® PHEP or PHER sensor for pH.

8.15.2.2 DULCOTEST® CTE Sensor for Total Chlorine and DULCOTEST® Sensor PHEP or PHER for pH, Electrical Installation

DULCOTEST® CTE sensor for total chlorine

General Safety Guidelines

IMPORTANT

Install in such a way as to ensure a totally reliable, uninterrupted power supply to the controller. Too low a voltage supply can cause measuring failures, which may result in dangerous overdosing within a control system.

The CTE 1-mA sensor has a passive 4-20 mA two-wire interface. The power supply is provided externally or by the controller. When the sensor is connected to the DULCOMETeR® D1C controller the interface’s safety requirements are met automatically.

IMPORTANT

For electrical connection of the sensor to the controller, only use wires with a diameter of 4 mm.

Electrical Installation

► Turn the top part of the sensor a quarter of a turn anticlockwise and remove.
► Remove the outer isolation of the cable for about 5 cm from the end so that the two wires appear.
Loosen the M12 threaded connector and guide the 2-wire cable into the sensor. Leave an approx. 5 cm length of the 2-core measuring line in the sensor.

Strip the two wires at their ends and connect them to the terminal block by using the screwdriver provided: 1 = plus, 2 = minus.

Tighten up the M12 connector.

Insert the top part of the sensor right into the housing and turn the top part clockwise as far as it will go.

Electrical connection to sensor

Installation

Electrical installation of the DULCOTEST® PHEP or PHER sensor for pH

Connect the DULCOTEST® PHEP or PHER sensor for pH with the marked cable of the respective controller DULCOMETER® D2C.

8.15.2.3 DULCOTEST® CTE Sensor for Total Chlorine and DULCOTEST® Sensor PHEP or PHER for pH, Running-In

Running-In

DULCOTEST® CTE sensor for total chlorine

CAUTION

- The power supply to the measuring device and to the sensor must not be interrupted. If the power supply is interrupted (> 2 hours) the sensor must be re-commissioned.
- Do not switch off the measuring system during interval operation. After any operation without chlorine, running-in periods must be reckoned with. If required, switch on metering unit time-delayed. If no chlorine is metered for a longer period of time (weeks), the sensor must be disconnected from the power supply and stored dry.
- The sensor’s current signal must not exceed 20 mA. Otherwise the sensor may be damaged, which may result in dangerous overdosing within a control system. To avoid this, install a monitor, which permanently switches off the chlorine control system and triggers an alarm. The monitoring equipment must not be automatically re-setting.
- Once the sensor has been commissioned it must be kept permanently wet.

After completed installation the controller can be switched on. The system should then be allowed to run in for the set run-in period.

Running-In Period

In order to achieve a stable display value the sensor should be run in for the following run in periods.

First commissioning: 24 hour
After changing membrane: 1-6 h
Re-commissioning: approx. 4-24 hours
Running-in
DULCOTEST® sensor PHEP or PHER for pH

The DULCOTEST® PHEP or PHER sensor for pH must not be run-in. The DULCOTEST® PHEP or PHER sensor for pH can be readily used.

8.15.2.4 DULCOTEST® CTE Sensor for Total Chlorine and DULCOTEST® Sensor PHEP or PHER for pH, Calibration

**Calibration**
DULCOTEST® CTE sensor for total chlorine

**IMPORTANT**
The specified calibration method depending on the type of chlorination agent used must be observed.

**CAUTION**
- Carry out a slope test every time the membrane or electrolyte is changed.
- Avoid air-bubbles in the sample flow. They can attach at the membrane, which may cause too low measured values. Within a control system this may lead to dangerous overdosing.
- For proper function of the sensor, the slope test has to be repeated regularly.
- If installing the sensor outside Germany, please comply with the local regulations for calibration intervals.

**Preconditions**
The sensor reading is stable (no drifts or unsteady values for at least 5 minutes). This is normally fulfilled, when
- The system has been allowed to run-in for the specified period
- The flow through the in-line probe housing is constant and corresponds with the Technical data
- The sample medium and the sensor are at the same temperature
- The pH value is constant and within the admissible range (pH 6.5 - 9.5)

**Zero Point Calibration**
Zero point calibration is necessary only when the sensor is used at the lower limit of the measuring range.
- Remove the sensor from the DLG III or DGM in-line probe housing (see DLG III, DGM operating instructions).
- Immerse the sensor in a container with clean water, free of chlorine and bromine.
- Stir by using the sensor, until the measured value remains stable.
- Adjust the controller (DULCOMETER® D1C, chlorine) to zero, according to it’s operating instructions (DULCOMETER® D1C, chlorine Operating Instructions: Chapter 8, complete operating menu, settings menu "Calibrating chlorine zero point").
- Reinstall the sensor into the in-line probe housing (DGM, DLG III).

**Slope Test**
- Insert the sensor into the DLG III or DGM in-line probe housing, if not already done.
- Take a water sample for DPD-measurement. Sampling location has to be close to the installed sensor. Recommendation: use the sampling tap in the case of the DGM in-line probe housing.
- Determine total chlorine content with an appropriate chlorine measurement kit according to the DPD-4 method (e.g. Photometer DT1, order no. 1003473).
- Input the measured value into the controller according to it’s operating manual (DULCOMETER® D1C, chlorine Operating Instructions: Chapter 8, complete operating menu, settings menu “Calibrating chlorine”
- After initial installation of the sensor, check the calibration by DPD-measurement 24 hours later.
- The following maintenance intervals based on experiences are recommended
  - Potable, industrial, process and cooling water: depending on the specific conditions (1-4 weeks)
  - Swimming pools: weekly
  - Spa pools (whirlpools): daily
Calibration of the Chlorine Sensor (Continuation)

The calibration (slope calibration) of the chlorine sensor uses the DPD method. When starting calibration, the frozen measuring value is proposed; this value may be adjusted to the measured DPD value using the Up and Down buttons. A calibration will only be possible if the DPD value is ≥ 2% of the measuring range. During calibration, control function and metering are maintained. After successful calibration, all fault determinations relating to the measuring value are started again.

With a measuring range adjusted to 0 - 0.5 ppm, the zero point may be calibrated in the entire operating menu in addition to the slope. The zero point calibration should be performed under realistic condition with chlorine-free water. In this case, control will be stopped and metering will be reduced to the set base load.

The output 0/4...20 mA (measuring value) will be frozen.

**IMPORTANT**

The measuring range of the chlorine sensor must correspond to the adjusted measuring range of the DULCOMETER® D2C (factory setting 0 - 2.00 ppm). A possible alteration of the measuring range must be done prior to calibration. If the measuring range is altered, all settings are reset to the factory settings.

<table>
<thead>
<tr>
<th>pH/Chlorine</th>
<th>Possible values</th>
<th>Initial value</th>
<th>Increment</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPD-value</td>
<td>Measured value</td>
<td>0.01 ppm</td>
<td>–</td>
<td>0 ppm</td>
<td>20 ppm</td>
<td>–</td>
</tr>
<tr>
<td>Zero point</td>
<td>Measured value (mA)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

**Error message**

- **Calibration Cl not possible!**
  - Sensor slope too low
  - Sensor slope too high
  - DPD value too low!
  - DPD > x.xx ppm
  - Zero point too high
  - Zero point too low

**Condition**

- Cl slope too low (<25% of standard slope)
- Cl slope too high (>300% of standard slope)
- DPD < 2% of measuring range
- Sensor signal > 5 mA
- Sensor signal < 3 mA

**Remarks**

- Repeat calibration
- Repeat calibration
- Repeat calibration after addition of chlorine
- Repeat calibration in chlorine-free water
- Check sensor connection replace sensor, if necessary
Calibration of the pH Sensor

The calibration of the pH sensor uses a two-point calibration method (zero point, slope). As buffer pH 7 (zero point calibration) and pH 4 (slope calibration) are factory-set. If other buffers are to be used, the defaults in the complete operating menu (menu A, B) may be altered. During calibration control is stopped and metering is reduced to the set base load. The output 0/4...20 mA (measuring value) will be frozen. After successful calibration, all fault determinations relating to the measuring value are started again. The current sensor data (zero point/slope) will be displayed.

Calibration of the pH Sensor (Continuation)

### Possible values

<table>
<thead>
<tr>
<th>Buffer values</th>
<th>Initial value</th>
<th>Possible values</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH 7</td>
<td>pH 4</td>
<td>0.01 pH</td>
<td>-2 pH</td>
<td>16 pH</td>
<td>Error messages when both buffers too close (&lt;2 pH-values)</td>
</tr>
</tbody>
</table>

### Error message

<table>
<thead>
<tr>
<th>Buffer distance too small</th>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH zero point low</td>
<td>&lt; -60 mV</td>
<td>Return to permanent display: Basic metering load</td>
</tr>
<tr>
<td>pH zero point high</td>
<td>&lt; +60 mV</td>
<td>Warning, old zero point and slope retained</td>
</tr>
<tr>
<td>pH slope low</td>
<td>&lt;45 mV/pH</td>
<td></td>
</tr>
<tr>
<td>pH slope high</td>
<td>&gt;65 mV/pH</td>
<td></td>
</tr>
<tr>
<td>Measured value pH unsteady</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 8.15.3 DULCOMETER® D2C, DULCOTEST® CTE Sensors for Total Chlorine and DULCOTEST® Sensors PHEP or PHER for pH, Troubleshooting

#### Controller

<table>
<thead>
<tr>
<th>Fault</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value 1</td>
<td>Signal exceeded/too high measured value</td>
<td>pH-input ▶️▶️</td>
<td>Basic load Stop yes</td>
<td>3 mA &lt; Signal &lt; 23 mA or -499 mV &lt; Signal &lt; 499 mV</td>
<td>Check sensor, transducer and cable connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration with sensor</td>
<td>Calibration defect</td>
<td>pH calibration defect</td>
<td>Basic load Stop no</td>
<td>3 mA &lt; Signal &lt; 23 mA</td>
<td>Check sensor, replace if necessary, recalibrate if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measured value 2</td>
<td>Signal exceeded/too high measured value</td>
<td>Cl-input ▶️▶️</td>
<td>Basic load Stop no</td>
<td>3 mA &lt; Signal &lt; 23 mA</td>
<td>Check sensor, transducer and cable connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration with sensor</td>
<td>Calibration defect</td>
<td>Cl calibration defect</td>
<td>Basic load Stop no</td>
<td>3 mA &lt; Signal &lt; 23 mA</td>
<td>Check sensor, replace if necessary, recalibrate if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit transgression after checkout time</td>
<td>pH-lim value 1</td>
<td>pH-lim value 1</td>
<td>Basic load Stop yes</td>
<td>3 mA &gt; Signal &gt; 23 mA</td>
<td>Check sensor, transducer and cable connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit transgression after checkout time</td>
<td>Cl-lim value 2</td>
<td>Cl-lim value 2</td>
<td>Basic load Stop no</td>
<td>3 mA &gt; Signal &gt; 23 mA</td>
<td>Check sensor, transducer and cable connection</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Operation

<table>
<thead>
<tr>
<th>Operation</th>
<th>Note text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop button</td>
<td>Stop button</td>
<td>❌</td>
<td>Pause</td>
<td>Start device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pause contact</td>
<td>Pause</td>
<td>❌</td>
<td>Pause</td>
<td>Start device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring water</td>
<td>Measuring water</td>
<td>❌</td>
<td>Pause</td>
<td>Start device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High chlorination</td>
<td>High chlorination</td>
<td>❌</td>
<td>Pause</td>
<td>Start device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base load chlorine</td>
<td>Base load chlorine</td>
<td>❌</td>
<td>Pause</td>
<td>Start device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic fault</td>
<td>EEPROM defective</td>
<td>❌</td>
<td>Pause</td>
<td>Start device</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**pH/Chlorine**

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8.15.4 DULCOMETER® D2C Measured Variable Chlorine, DULCOTEST® CTE Sensor for Total Chlorine and DULCOTEST® Sensor PHEP or PHER for pH, Maintenance

Controller
The DULCOMETER® controller type D2C for the measured variable pH/chlorine is maintenance-free.

Sensor
DULCOTEST® CTE sensor for total chlorine

IMPORTANT
• Service the sensor regularly to avoid overdosing within a control system, due to incorrect measured value.
• Observe the current national regulations for maintenance intervals.
• Do not touch the electrodes or allow them to come into contact with greasy substances.
• Never attempt to clean the membrane with acid/alkaline solutions, cleaning reagents or mechanical aids (brushes or similar).

Maintenance interval based on experience are:
• Potable, industrial, process and cooling water: depending on the specific conditions (1-4 weeks)
• Swimming pools: weekly
• Spa pools (whirlpools): daily

Maintenance Work
▶ Check the sensor regularly for dirt, algae and air bubbles. As far as possible, avoid contamination of the membrane with solid particles, deposits etc. Eliminate air bubbles by increasing the flow rate.
▶ Check the displayed sensor value on the controller regularly according to the DPD-4 method using an appropriate chlorine measurement kit.
▶ If necessary, recalibrate the sensor.
▶ If calibration cannot be carried out properly, the membrane cap must be replaced and calibration must be repeated.

DULCOTEST® Sensor PHEP or PHER for pH, Maintenance

IMPORTANT
The sensor is to be regularly serviced to avoid any excess metering caused by a sensor failure!
Observe the valid national regulations for maintenance intervals!
Do not touch the electrodes or bring into contact with greasy substances!

Maintenance interval monthly

Maintenance Work
The sensor should regularly (once a month) undergo a visual check and be cleaned if necessary. If deposits on the glass electrode withstand cleaning with a soft, moistened cloth, the following cleaning agents may be used:

<table>
<thead>
<tr>
<th>Kind of deposit</th>
<th>Agent and duration of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>General deposits</td>
<td>Non-abrasive household cleaner</td>
</tr>
<tr>
<td>Scale or metal hydroxides</td>
<td>Diluted hydrochloric acid (approx. 0.1-3 %, 1-5 minutes)</td>
</tr>
<tr>
<td>Oil, grease</td>
<td>Solvents, like alcohol or acetone</td>
</tr>
<tr>
<td>Biofouling</td>
<td>Mixture of diluted hydrochloric acid and pepsin, several hours</td>
</tr>
</tbody>
</table>

It is essential that the sensor are rinsed thoroughly after having been cleaned.
### 8.16 Measuring Parameter pH/Redox (ORP)

#### 8.16.1 DULCOMETER® D2C Measured Variable pH/Redox (ORP), Setting and Operation

**Display Symbols**

The display of the DULCOMETER® D2C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Symbol" /></td>
<td>Limit value transgression measured value 1</td>
<td>Symbol left</td>
</tr>
<tr>
<td><img src="image2" alt="Symbol" /></td>
<td>Relay 1 upper or zone</td>
<td></td>
</tr>
<tr>
<td><img src="image3" alt="Symbol" /></td>
<td>Limit value transgression measured value 2</td>
<td>Symbol right</td>
</tr>
<tr>
<td><img src="image4" alt="Symbol" /></td>
<td>Relay 2 upper or zone</td>
<td></td>
</tr>
<tr>
<td><img src="image5" alt="Symbol" /></td>
<td>Metering pump measured value 1</td>
<td>Symbol left</td>
</tr>
<tr>
<td><img src="image6" alt="Symbol" /></td>
<td>Control off</td>
<td></td>
</tr>
<tr>
<td><img src="image7" alt="Symbol" /></td>
<td>Metering pump measured value 2</td>
<td>Symbol right</td>
</tr>
<tr>
<td><img src="image8" alt="Symbol" /></td>
<td>Control off</td>
<td></td>
</tr>
<tr>
<td><img src="image9" alt="Symbol" /></td>
<td>Control on</td>
<td>Symbol right</td>
</tr>
<tr>
<td><img src="image10" alt="Symbol" /></td>
<td>Solenoid valve measured value 1</td>
<td>Symbol left</td>
</tr>
<tr>
<td><img src="image11" alt="Symbol" /></td>
<td>Control off</td>
<td></td>
</tr>
<tr>
<td><img src="image12" alt="Symbol" /></td>
<td>Solenoid valve measured value 2</td>
<td>Symbol right</td>
</tr>
<tr>
<td><img src="image13" alt="Symbol" /></td>
<td>Control off</td>
<td></td>
</tr>
<tr>
<td><img src="image14" alt="Symbol" /></td>
<td>Stop button pressed</td>
<td></td>
</tr>
<tr>
<td><img src="image15" alt="Symbol" /></td>
<td>Manual metering</td>
<td></td>
</tr>
<tr>
<td><img src="image16" alt="Symbol" /></td>
<td>Delay time „td“</td>
<td>Control starts after expiry of „td“</td>
</tr>
<tr>
<td><img src="image17" alt="Symbol" /></td>
<td>Fault</td>
<td></td>
</tr>
</tbody>
</table>
pH/Redox (ORP)

Operation

The various menus are selected with the CHANGE button.

The menu is started with the ENTER button.

BRANCH BACK to permanent display or to relevant setting menu.

NOTE

Access to the setting menus can be barred with the access code!

The number and scope of setting menus is dependent on the device version!

If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!

If within a period of 10 minutes no button is pushed, the unit automatically branches back from the setting menu to the permanent display 1.

NOTE

Access to the setting menus can be barred with the access code!

The number and scope of setting menus is dependent on the device version!

If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!

If within a period of 10 minutes no button is pushed, the unit automatically branches back from the setting menu to the permanent display 1.
Operating Menu / Layout

The setting menus highlighted in grey and the adjustable parameters are only visible in the complete operating menu.
Operating Menu / Layout (Continuation)

- pH/Redox (ORP)
- Setting pH
  - Value: 7.20
  - Dosing direction: acid
  - Control: automatic
- Setting ORP
  - Value: 650 mV
  - Dosing direction: oxidation
  - Control: automatic
- Relay settings
  - Relay 1: pH
  - Relay 2: ORP
- Pump settings
  - Pump 1: acid
  - Pump 2: oxidation
  - Max. dosage: 180 pulse/minute
  - Control: automatic
- Additional load
  - Dosing direction: acid
  - Control: automatic
- Ctrl parameter
  - xp = 10%
  - Ti = off
  - Td = off

D2C2-pH-Re-M2-D
Operating Menu / Layout (Continuation)

pH/Redox (ORP)

- Permanent display 1
- Alarm relay active
- General setting information
- Correcting value setting?
- mA output 1
  - pH measured value
  - 4 mA = 2.00 pH
  - 20 mA = 12.00 pH
  - 4 mA = 0 %
  - 20 mA = 100 %
- mA output 2
  - ORP measured value
  - 4 mA = 0 mV
  - 20 mA = 1000 mV
  - 4 mA = 0 %
  - 20 mA = 100 %

- Pause
  - active closed
  - alarm off
  - td: 10 min.
  - Control input active closed
  - Sample flow active closed
  - Cl const. load 0 %
  - High chlorine 800 mV

- Correction value
  - 4 mA = 0 °C
  - 20 mA = 100.0 °C

- Correcting value
  - Automatic
  - 25 °C

- Operating menu:
  - English
  - Complete

- Access c.: 5000

- D2C2-pH-Re-M3-D

[Diagram of operating menu and layout with specific settings and values]
Operating Menu / Description

Permanent displays

The permanent displays 1 to 4 serve information on fault messages/causes as well as on operating values/settings.

8.16.2 DULCOTEST® Redox (ORP) Sensor RHER-Pt-SE and DULCOTEST® Sensor PHEP or PHER for pH, Commissioning

8.16.2.1 DULCOTEST® Redox (ORP) Sensor RHER-Pt-SE and DULCOTEST® Sensor PHEP or PHER for pH, Assembly

Assembly

Redox (ORP) Sensor
Before putting into operation, the protective cap or case must be removed from the glass or metal electrode. The glass or metal electrode must be free from oil, grease and other contaminations. Likewise, the diaphragm of the reference electrode must be free from scale deposits, dirt or crystallized matter. For these reasons, electrodes should never be touched by hand.

Remove the blanking plug of the respective measuring module at the fittings of the measuring/control station DULCOTROL® and install the DULCOTEST® RHER-Pt-SE sensor for redox (ORP).

pH Sensor
Before putting into operation, the protective cap or case must be removed from the glass or metal electrode. The glass or metal electrode must be free from oil, grease and other contaminations. Likewise, the diaphragm of the reference electrode must be free from scale deposits, dirt or crystallized matter. For these reasons, electrodes should never be touched by hand.

Remove the blanking plug of the respective measuring module at the fittings of the measuring/control station DULCOTROL® and install the DULCOTEST® PHEP or PHER sensor for pH.

8.16.2.2 DULCOTEST® Redox (ORP) Sensor RHER-Pt-SE and DULCOTEST® Sensor PHEP or PHER for pH, Electrical Installation

Installation

Redox (ORP) Sensor
Connect the DULCOTEST® RHER-Pt-SE sensor for redox (ORP) with the marked cable of the respective controller DULCOMETER® D2C.

pH Sensor
Connect the DULCOTEST® PHEP or PHER sensor for pH with the marked cable of the respective controller DULCOMETER® D2C.
8.16.2.3 DULCOTEST® Redox (ORP) Sensor RHER-Pt-SE and DULCOTEST® Sensor PHEP or PHER for pH, Running-In

**Running-In**

**Redox (ORP) Sensor**

The DULCOTEST® RHER-Pt-SE sensor for redox (ORP) must not be run-in. The DULCOTEST® RHER-Pt-SE sensor for redox (ORP) can be readily used.

**pH Sensor**

The DULCOTEST® PHEP or PHER sensor for pH must not be run-in. The DULCOTEST® PHEP or PHER sensor for pH can be readily used.

8.16.2.4 DULCOTEST® Redox (ORP) Sensor RHER-Pt-SE and DULCOTEST® Sensor PHEP or PHER for pH, Calibration

**Redox (ORP) Sensor**

Having connected the sensor to the transmitter by means of the sensor cable (taking care that connectors and cable remain absolutely dry), dip the sensor into a redox standardizing solution, e.g., of 465 mV. The reading should reach or exceed this value within not more than 30 seconds. If the reading rises rather sluggishly or falls short more than 20 mV, clean the sensor and repeat check. If again unsuccessful, replace the sensor with a new one.

**pH Sensor**

Since pH sensors are subject to certain manufacturing tolerances, they must be tuned to the pertinent pH transmitter. The adjustment intervals depend on relevant operating conditions. They can vary from a few days to up to 8 weeks.

Having connected the sensor to the transmitter by means of the sensor cable (taking care that connectors and cable remain absolutely dry), dip the sensor into a pH 7 standardizing solution and adjust transmitter exactly to read this value.

Remove the sensor, rinse it with water, preferably distilled water, and dry it by swabbing it with soft, non-irritating tissue paper.

**IMPORTANT**

Do not rub since this might cause static electricity and false readings.

Immerse the sensor in a buffer solution differing by at least 2 pH from pH 7 and calibrate after the value on the display has stabilised. If within 30 seconds a steady-state value is not produced or calibration has proved impossible, clean sensor and repeat calibration. If again unsuccessful, replace sensor with a new one.

**Calibration D2C**

**Calibration of the pH Sensor**

The calibration of the pH sensor uses a two-point calibration method (zero point, slope). As buffer pH 7 (zero point calibration) and pH 4 (slope calibration) are factory-set. If other buffers are to be used, the defaults in the complete operating menu (menu A, B) may be altered. During calibration control is stopped and metering is reduced to the set base load. The output 0/4...20 mA (measuring value) will be frozen. After successful calibration, all fault determinations relating to the measuring value are started again. The current probe data (zero point/slope) will be displayed.
Checking the Redox (ORP) Sensor

The redox sensor is checked with the aid of a redox buffer solution. The standard buffer value is set at the factory to 465 mV. If a different buffer is to be used (e.g. 220 mV), the default in the complete operating menu (menu A) can be changed accordingly. Control is stopped and metering is reduced to the set basic load during the test. The 0/4...20 mA output (measured value) is frozen. If the test is concluded successfully, all error checks concerning the measured values are restarted.

Possible values

<table>
<thead>
<tr>
<th>Initial value</th>
<th>Possible values</th>
<th>Increment</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer values</td>
<td>pH 7</td>
<td>pH 0.01</td>
<td>pH -2</td>
<td>pH 16</td>
<td>Error messages when both buffers too close (&lt;2 pH-values)</td>
</tr>
</tbody>
</table>

Error message

<table>
<thead>
<tr>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer distance too small</td>
<td>During calibration procedure: Recalibrate buffer 2!</td>
</tr>
<tr>
<td>pH zero point low &lt; -60 mV</td>
<td>Return to permanent display: Basic metering load</td>
</tr>
<tr>
<td>pH zero point high &lt; 60 mV</td>
<td>&quot;</td>
</tr>
<tr>
<td>pH slope low &lt; 45 mV/pH</td>
<td>&quot;</td>
</tr>
<tr>
<td>pH slope high &gt; 65 mV/pH</td>
<td>&quot;</td>
</tr>
<tr>
<td>Measured value pH unsteady</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

Checking the Redox (ORP) Sensor

The redox sensor is checked with the aid of a redox buffer solution. The standard buffer value is set at the factory to 465 mV. If a different buffer is to be used (e.g. 220 mV), the default in the complete operating menu (menu A) can be changed accordingly. Control is stopped and metering is reduced to the set basic load during the test. The 0/4...20 mA output (measured value) is frozen. If the test is concluded successfully, all error checks concerning the measured values are restarted.

Possible values

<table>
<thead>
<tr>
<th>Initial value</th>
<th>Possible values</th>
<th>Increment</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer value 465 mV</td>
<td>1 mV</td>
<td>0 mV</td>
<td>1000 mV</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Error messages

<table>
<thead>
<tr>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor ORP defective measured value too low 10 % measured value &lt; buffer value</td>
<td>Clean sensor repeat calibration</td>
</tr>
<tr>
<td>Sensor ORP defective measured value too high 15 % measured value &gt; buffer value</td>
<td>Buffer too old repeat calibration</td>
</tr>
</tbody>
</table>
### 8.16.3 DULCOMETER® D2C, DULCOTEST® Redox (ORP) Sensor RHER-Pt-SE and DULCOTEST® Sensor PHEP or PHER for pH, Troubleshooting

#### Controller

<table>
<thead>
<tr>
<th>Fault</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Acknowledgment</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value 1</td>
<td>Signal exceeded/</td>
<td>Signal below value</td>
<td>E</td>
<td>Basic load</td>
<td>Stop</td>
<td>yes</td>
<td>3 mA&lt;Signal&lt;23 mA</td>
</tr>
<tr>
<td>Calibration with sensors</td>
<td>pH-calibration defect</td>
<td>E</td>
<td>Basic load</td>
<td>Stop</td>
<td>no</td>
<td></td>
<td>Check sensor, replace if necessary, recalibrate if necessary</td>
</tr>
<tr>
<td>Measured value 2</td>
<td>Signal exceeded/</td>
<td>Signal below value</td>
<td>E</td>
<td>Basic load</td>
<td>Stop</td>
<td>yes</td>
<td>3 mA&lt;Signal&lt;23 mA</td>
</tr>
<tr>
<td>Calibration with sensors</td>
<td>sensor ORP defective</td>
<td>E</td>
<td>Basic load</td>
<td>Stop</td>
<td>no</td>
<td></td>
<td>Check sensor, clean or if necessary, replace if necessary</td>
</tr>
<tr>
<td>Limit transgression after checkout time</td>
<td>pH-limit value 1</td>
<td>E</td>
<td>none</td>
<td>Stop</td>
<td>yes</td>
<td>Function switchable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>pH-limit value 2</td>
<td>E</td>
<td>none</td>
<td>Stop</td>
<td>yes</td>
<td>Function switchable</td>
<td></td>
</tr>
<tr>
<td>Correcting value</td>
<td>Signal exceeded/</td>
<td>Signal below value</td>
<td>E</td>
<td>Basic load</td>
<td>Stop</td>
<td>pH</td>
<td>Signal ~ 100 Ω or ~ 138.5 Ω</td>
</tr>
</tbody>
</table>

#### Operation

<table>
<thead>
<tr>
<th>Operation</th>
<th>Note text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Acknowledgment</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop button</td>
<td>Stop/pause</td>
<td>E</td>
<td>none</td>
<td></td>
<td></td>
<td>Start device</td>
<td></td>
</tr>
<tr>
<td>Pause contact</td>
<td>Pause</td>
<td>E</td>
<td>none</td>
<td></td>
<td></td>
<td>Start device</td>
<td></td>
</tr>
<tr>
<td>Prime</td>
<td>Prime</td>
<td>E</td>
<td>none</td>
<td></td>
<td></td>
<td>Start device</td>
<td></td>
</tr>
<tr>
<td>Error sample line</td>
<td>Error sample line</td>
<td>E</td>
<td>none</td>
<td></td>
<td></td>
<td>Function switchable</td>
<td></td>
</tr>
<tr>
<td>High chlorination</td>
<td>High chlorine</td>
<td>E</td>
<td>Max. frequency</td>
<td></td>
<td></td>
<td>Function switchable</td>
<td></td>
</tr>
<tr>
<td>Basic load chlorine</td>
<td>Cl constant load</td>
<td>E</td>
<td>Frequency adjustable</td>
<td></td>
<td></td>
<td>Function switchable</td>
<td></td>
</tr>
<tr>
<td>Electronic fault</td>
<td>E</td>
<td>none</td>
<td>Start device</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8.16.4 DULCOMETER® D2C Measured Variable pH, Redox (ORP), DULCOTEST® Redox (ORP) Sensor RHER-Pt-SE and DULCOTEST® Sensor PHEP or PHER for pH, Maintenance

Controller
The DULCOMETER® controller type D2C for the measured variable pH/redox (ORP) is maintenance-free.

Assembly
Sensor: DULCOTEST® sensor RHER-Pt-SE / DULCOTEST® sensor PHEP or PHER

IMPORTANT
► The sensor is to be regularly serviced to avoid any excess metering caused by a sensor failure!
► Observe the valid national regulations for maintenance intervals!
► Do not touch the electrodes or bring into contact with greasy substances!

Maintenance interval monthly

Maintenance Work
All sensors should regularly (once a month) undergo a visual check and be cleaned if necessary. If deposits on the glass electrode withstand cleaning with a soft, moistened cloth, the following cleaning agents may be used:

<table>
<thead>
<tr>
<th>Kind of deposit</th>
<th>Agent and duration of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>General deposits</td>
<td>Non-abrasive household cleaner</td>
</tr>
<tr>
<td>Scale or metal hydroxides</td>
<td>Diluted hydrochloric acid (approx. 0.1-3 %, 1-5 minutes)</td>
</tr>
<tr>
<td>Oil, grease</td>
<td>Solvents, like alcohol or acetone</td>
</tr>
<tr>
<td>Biofouling</td>
<td>Mixture of diluted hydrochloric acid and pepsin, several hours</td>
</tr>
</tbody>
</table>

It is essential that the sensors are rinsed thoroughly after having been cleaned. In addition, the metal surfaces of redox sensors may be cleaned by sanding and polishing. If the laterally arranged ceramic diaphragm of the reference electrode is blocked, it may be cleaned like the glass electrode. In addition it may be cleaned by cautious scraping with a finger nail, a razor blade or a fine file, but care must be taken that the diaphragm is not scratched.
8.17 Measuring Parameter pH/Chlorine Dioxide

8.17.1 DULCOMETER® D2C Measured Variable pH/Chlorine Dioxide, Setting and Operation

Display Symbols

The display of the DULCOMETER® D2C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑</td>
<td>Limit value transgression measured value 1</td>
<td>Symbol left</td>
</tr>
<tr>
<td>↓</td>
<td>Relay 1 lower</td>
<td>Symbol left</td>
</tr>
<tr>
<td>↑</td>
<td>Limit value transgression measured value 2</td>
<td>Symbol right</td>
</tr>
<tr>
<td>↓</td>
<td>Relay 2 lower</td>
<td>Symbol right</td>
</tr>
<tr>
<td>■</td>
<td>Metering pump measured value 1</td>
<td>Control on left</td>
</tr>
<tr>
<td>■</td>
<td>Metering pump measured value 2</td>
<td>Control on left</td>
</tr>
<tr>
<td>■</td>
<td>Control on</td>
<td>Symbol left</td>
</tr>
<tr>
<td>▲</td>
<td>Solenoid valve measured value 1</td>
<td>Control off left</td>
</tr>
<tr>
<td>▲</td>
<td>Solenoid valve measured value 2</td>
<td>Control off left</td>
</tr>
<tr>
<td>▲</td>
<td>Control on</td>
<td>Symbol left</td>
</tr>
<tr>
<td>▼</td>
<td>Control on</td>
<td>Symbol right</td>
</tr>
<tr>
<td>○</td>
<td>Stop button pressed</td>
<td>Control starts after expiry of „td“</td>
</tr>
<tr>
<td>M</td>
<td>Manual metering</td>
<td></td>
</tr>
<tr>
<td>Pause</td>
<td>Delay time „td“</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Fault</td>
<td></td>
</tr>
</tbody>
</table>
NOTE
Access to the setting menus can be barred with the access code!
The number and scope of setting menus is dependent on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.
Operating Menu / Layout

The setting menus highlighted in grey and the adjustable parameters are only visible in the complete operating menu.
Permanent displays

The permanent displays 1 to 4 serve information on fault messages/causes as well as on operating values/settings.
8.17.2 DULCOTEST® CDE Chlorine Dioxide Sensor and DULCOTEST® Sensor PHEP or PHER for pH, Commissioning

8.17.2.1 DULCOTEST® CDE Chlorine Dioxide Sensor and DULCOTEST® Sensor PHEP or PHER for pH, Assembly

Assembly

DULCOTEST® CDE Chlorine Dioxide Sensor

Pouring electrolyte

**IMPORTANT**

- The membrane at the lower end of the membrane cap and the electrodes at the lower end of the electrode shaft should not be touched, damaged or brought into contact with greasy substances! Otherwise the sensor will not work correctly. If this is the case, replace membrane cap or return for refurbishing the electrodes.

- Protect yourself and your clothing from contact with the electrolyte (acid!) using appropriate protective equipment. The electrolyte can cause irritation to skin and damage to clothing. In case of contact, rinse immediately with plenty of cold water.

**NOTE**

Carry out the following steps at the washbasin!

- Open the electrolyte bottle and screw on the nozzle.
- Remove the red cap completely from the nozzle and cut off the end of the nozzle.
- Remove the membrane cap and unscrew the membrane cap from the electrode shaft.
- Rinse the membrane cap and the electrode with a small amount of electrolyte.
- Fill the membrane cap up the top with electrolyte and allow electrolyte to overflow down the inside wall.

Assembling membrane cap

- Locate the electrode shaft vertically onto the filled membrane cap and turn until the thread bites.
- Rotate the membrane cap so that the vent hole is at the top.
- Slowly screw on the membrane cap by hand up to the stop. In the process the excess electrolyte will seep out of the vent hole.
- Rinse sensor under running water to remove excess electrolyte from the sensor and from hands.

Inserting the sensor

**IMPORTANT**

- The sensor must be slowly inserted into or withdrawn from the in-line probe housing! The diaphragm could otherwise be damaged.
- Do not touch the in-line probe housing flow resistor with the membrane!
- The sensor must be kept wet at all times once commissioned - e.g. the in-line probe housing must not be allowed to run dry.

Assemble the sensor as described in the operating instructions supplied with the in-line probe housing.

Assembly

DULCOTEST® Sensor PHEP or PHER for pH

Before putting into operation, the protective cap or case must be removed from the glass or metal electrode. The glass or metal electrode must be free from oil, grease and other contaminations. Likewise, the membrane of the reference electrode must be free from scale deposits, dirt or crystallized matter. For these reasons, electrodes should never be touched by hand.

Remove the blanking plug of the respective measuring module at the fittings of the measuring/ control station DULCOTROL® and install the DULCOTEST® PHEP or PHER sensor for pH.
8.17.2.2 DULCOTEST® CDE Sensor and DULCOTEST® Sensor PHEP or PHER for pH, Electrical Installation

Installation

DULCOTEST® CDE Chlorine Dioxide Sensor

**IMPORTANT**

- The sensor is not electrically isolated from the sample water. All other elements must be isolated! The controller must be isolated both from the sensor and from the supply voltage!
- The supply voltage must not fall below 16 V DC, even for a short period! The current source must able to sustain 35 mA at a min. 16 V DC! Insufficient supply voltage will result in an inaccurate reading!
- After the electrical connection of the sensor, the sensor has to be inserted into the sample water which has to contain chlorine dioxide.

The sensor incorporates a passive 4-20 mA two-wire interface, i.e. the power supply is provided externally e.g. via the controller.
- Safety requirements are automatically met if the sensor is connected to a ProMinent® controller (e.g. DULCOMETER® D1C).
- Do not switch off the measuring system when in intermittent use! If necessary, dosing equipment should be timer-controlled!

**Electrical Installation**

- Rotate the sensor adapter anticlockwise by 90° and remove (bayonet fitting).
- Unscrew the PG-7 threaded connector tensioning screw and insert the signal cable leading from the controller.
- Strip the ends of the cable and attach to the two-wire connector: 1 = positive, 2 = negative
- Insert approx. 5 cm of signal cable into the sensor and tighten the PG-7 threaded connector tensioning screw.
- Insert the sensor adapter completely into the housing and screw together carefully to prevent damage to the ends of the bayonet connector.

Electrical connection to sensor

pH Sensor

Connect the DULCOTEST® PHEP or PHER sensor for pH with the marked cable of the respective controller DULCOMETER® D2C.
8.17.2.3 DULCOTEST® CDE Chlorine Dioxide Sensor and DULCOTEST® Sensor PHEP or PHER for pH, Running-In

Running-In

DULCOTEST® CDE Chlorine Dioxide Sensor

**IMPORTANT**
- The sensor must be used only in surfactant-free water or solutions!
- When operating the sensor, the sample water must permanently contain chlorine dioxide.
- Do not switch off the measuring system during interval operation! After operation without chlorine dioxide, running-in periods are to be reckoned with. If required, switch on metering unit time-delayed! If no chlorine dioxide is metered for a longer period of time, the sensor must be disconnected from the power supply and stored dry.

Running-In Period
The sensor requires a run-in period before it will display stable readings.

**Commissioning:** 2 - 6 h
**Re-commissioning:** 1 - 3 h
**Diaphragm-/electrolyte replacement:** approx. 0.5 h

pH Sensor

The DULCOTEST® PHEP or PHER sensor for pH must not be run-in. The DULCOTEST® PHEP or PHER sensor for pH can be readily used.

8.17.2.4 DULCOTEST® CDE Chlorine Dioxide Sensor and DULCOTEST® Sensor PHEP or PHER for pH, Calibration

Calibration

DULCOTEST® CDE Chlorine Dioxide Sensor

The sensor can be calibrated after the run-in period.

**IMPORTANT**
- A slope test must be carried out after replacing the diaphragm cap or electrolyte!
- Slope tests must be carried out at regular intervals to ensure correct functioning of the sensor! For testing drinking water, calibration of the sensor every 3 - 4 weeks is sufficient.
- Avoid incorrect dosing due to air bubbles in the water. Air bubbles clinging to the sensor diaphragm can reduce the measured variable and thereby lead to overdosing.
- Observe applicable national directives for calibration intervals!

Preconditions
- Constant flow to the in-line probe housing.
- Constant sample water temperature.
- Same sample water and sensor temperatures (wait approx. 15 min.).

Zero Point Calibration
If a ProMinent controller is being used to operate the sensor there is no need for zero point calibration. Zero point calibration should be carried out, however, if operating the sensor in the lower measurement range, or if using the 0.5 ppm variant.

Preconditions
- The sensor has been run in.
- Flow to the in-line probe housing is constant and complies with technical data.
  - Insert the sensor into a container of clean, ozone- and ClO₂-free water.
  - Stir with the sensor until the measured variable displayed at the controller has remained stable for 5 min.
  - Calibrate the controller to zero in accordance with the operating instructions.
  - Replace sensor into the in-line probe housing (DGM; DLG).
Slope Test

- Determine the chlorine dioxide content in the sample water using an appropriate measurement device (e.g. DPD-1).
- Set the resulting value at the controller in accordance with the operating instructions.

Repeat calibration after 1 day!

NOTE

Calibration at high temperatures

As chlorine dioxide, in contrast to chlorine, is only physically dissolved in water, it evaporates out of the liquid very quickly at high temperatures (> 30 °C). We therefore recommend that you act quickly when carrying out the DPD measurement. There should be no more than 1 min. between the sample extraction and the addition of reagents. Therefore the reagent should be added directly at the sample extraction point and measurement should follow as soon as possible afterwards in the laboratory.

Calibration

Calibration of the DULCOTEST® Sensor PHEP or PHER for pH

pH Sensor

Since pH sensors are subject to certain manufacturing tolerances, they must be tuned to the pertinent pH transmitter. The adjustment intervals depend on relevant operating conditions. They can vary from a few days to up to 8 weeks.

Having connected the sensor to the transmitter by means of the sensor cable (taking care that connectors and cable remain absolutely dry), dip the sensor into a pH 7 standardizing solution and adjust transmitter exactly to read this value.

Remove the sensor, rinse it with water, preferably distilled water, and dry it by swabbing it with soft, non-fluffing tissue paper.

IMPORTANT

Do not rub since this might cause static electricity and false readings.

Immerse the sensor in a buffer solution differing by a least 2 pH from pH 7 and calibrate after the value on the display has stabilised. If within 30 seconds a steady-state value is not produced or calibration has proved impossible, clean sensor and repeat calibration. If again unsuccessful, replace sensor with a new one.

Calibration of the pH Sensor

The calibration of the pH sensor uses a two-point calibration method (zero point, slope). As buffer pH 7 (zero point calibration) and pH 4 (slope calibration) are factory-set. If other buffers are to be used, the defaults in the complete operating menu (menu A, B) may be altered. During calibration control is stopped and metering is reduced to the set base load. The output 0/4...20 mA (measuring value) will be frozen. After successful calibration, all fault determinations relating to the measuring value are started again. The current sensor data (zero point/slope) will be displayed.
Calibration of the Chlorine Dioxide Sensor

The calibration (slope calibration) of the chlorine sensor uses the DPD method. When starting calibration, the frozen measuring value is proposed; this value may be adjusted to the measured DPD value using the Up and Down buttons. A calibration will only be possible if the DPD value is \( \geq 2\% \) of the measuring range. During calibration, control function and metering are maintained. After successful calibration, all fault determinations relating to the measuring value are started again.

With a measuring range adjusted to 0 - 0.5 ppm, the zero point may be calibrated in the entire operating menu in addition to the slope. The zero point calibration should be performed under realistic conditions with chlorine dioxide-free water. In this case, control will be stopped and metering will be reduced to the set base load. The 0/4...20 mA output (measured value) is frozen at the start of the calibration.

**IMPORTANT**

The measuring range of the chlorine dioxide sensor must correspond to the adjusted measuring range of the DULCOMETER® D2C (factory setting 0 - 2.00 ppm). A possible alteration of the measuring range must be done prior to calibration. If the measuring range is altered, all settings are reset to the factory settings.

<table>
<thead>
<tr>
<th>Error message</th>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer distance too small</td>
<td>( \Delta \text{Buffer} &lt; 2 \text{ pH} )</td>
<td>During calibration procedure: Recalibrate buffer !</td>
</tr>
<tr>
<td>pH zero point low</td>
<td>(&lt; -60 \text{ mV})</td>
<td>Return to permanent display: Basic metering load</td>
</tr>
<tr>
<td>pH zero point high</td>
<td>(&lt; +60 \text{ mV})</td>
<td>Warning, old zero point and slope retained</td>
</tr>
<tr>
<td>pH slope low</td>
<td>(&lt; 45 \text{ mV/pH})</td>
<td></td>
</tr>
<tr>
<td>pH slope high</td>
<td>(&gt; 85 \text{ mV/pH})</td>
<td></td>
</tr>
<tr>
<td>Measured value pH unsteady</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature measured value unsteady</td>
<td></td>
<td>Warning, old zero point and slope retained</td>
</tr>
</tbody>
</table>

### Possible values

<table>
<thead>
<tr>
<th>Initial value</th>
<th>Possible values</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer values</td>
<td>pH 7 pH 4</td>
<td>-2 pH</td>
<td>16 pH</td>
<td>Error messages when both buffers too close (&lt;2 pH-values)</td>
</tr>
<tr>
<td>Temperature</td>
<td>Measured value</td>
<td>0.1 °C</td>
<td>0 °C</td>
<td>100.0 °C</td>
</tr>
</tbody>
</table>
**8.17.3 DULCOMETER® D2C, DULCOTEST® CDE Chlorine Dioxide Sensor and DULCOTEST® Sensor PHEP or PHER for pH, Troubleshooting**

### Controller

<table>
<thead>
<tr>
<th>Fault</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Alarm (acknowledgment)</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured variable 1</td>
<td>Signal exceeded/</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>yes</td>
<td>3 mA &gt; signal &gt; 23 mA</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td>Calibration with sensor</td>
<td>pH calibration defect</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>no</td>
<td>pH input</td>
<td></td>
</tr>
<tr>
<td>Measured variable 2</td>
<td>Signal exceeded/</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>no</td>
<td>ClO₂ input</td>
<td></td>
</tr>
<tr>
<td>Calibration with sensor</td>
<td>ClO₂ calibration defect</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>no</td>
<td>ClO₂ input</td>
<td></td>
</tr>
<tr>
<td>Limit transgression after checkout time</td>
<td>pH limit value</td>
<td></td>
<td>no metering</td>
<td>Stop</td>
<td>yes</td>
<td>Function may be deactivated after checkout time</td>
<td></td>
</tr>
<tr>
<td>Correcting variable</td>
<td>Signal exceeded/</td>
<td></td>
<td>Basic load</td>
<td>Stop</td>
<td>yes</td>
<td>°C input</td>
<td></td>
</tr>
</tbody>
</table>

### Operating step

<table>
<thead>
<tr>
<th>Operating step</th>
<th>Note text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Alarm (acknowledgment)</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop button</td>
<td>Stop button</td>
<td></td>
<td>no metering</td>
<td>Stop</td>
<td>no</td>
<td></td>
<td>Start unit, run-on time “td” stops, shock dosing stops</td>
</tr>
<tr>
<td>Pause contact</td>
<td>Pause</td>
<td></td>
<td>no metering</td>
<td>Stop</td>
<td>yes</td>
<td>Display Displays “td”</td>
<td></td>
</tr>
<tr>
<td>Fault sample water</td>
<td>Fault sample water</td>
<td></td>
<td>no metering</td>
<td>Stop</td>
<td>yes</td>
<td>Frequency adjustable</td>
<td></td>
</tr>
<tr>
<td>CO₂ shock dosing</td>
<td>High CO₂</td>
<td></td>
<td>no metering</td>
<td>Stop</td>
<td>yes</td>
<td>Frequency adjustable</td>
<td></td>
</tr>
<tr>
<td>Base load ClO₂</td>
<td>Base load ClO₂</td>
<td></td>
<td>no metering</td>
<td>Stop</td>
<td>yes</td>
<td>Frequency adjustable</td>
<td></td>
</tr>
<tr>
<td>Electronic fault</td>
<td>DPD/PHEP indicator</td>
<td></td>
<td>no metering</td>
<td>Stop</td>
<td>yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### pH/Chlorine Dioxide

<table>
<thead>
<tr>
<th>Error message</th>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration ClO₂ not possible!</td>
<td>ClO₂ slope too low (&lt;25% of standard slope)</td>
<td>Repeat calibration</td>
</tr>
<tr>
<td>Sensor slope too high</td>
<td>ClO₂ slope too high (&gt;300% of standard slope)</td>
<td>Repeat calibration</td>
</tr>
<tr>
<td>DPD value too low!</td>
<td>DPD &lt; 0.0005 ppm</td>
<td>Repeat calibration after addition of chlorine dioxide</td>
</tr>
<tr>
<td>Zero point too high</td>
<td>Sensor signal &gt; 5 mA</td>
<td>Repeat calibration in chlorine dioxide-free water</td>
</tr>
<tr>
<td>Zero point too low</td>
<td>Sensor signal &lt; 3 mA</td>
<td>Check sensor connection, replace sensor if necessary</td>
</tr>
</tbody>
</table>

### Possible values

<table>
<thead>
<tr>
<th>DPĐ-value</th>
<th>Measured value</th>
<th>Initial value</th>
<th>Possible values</th>
<th>Increment</th>
<th>Lower value</th>
<th>Upper value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.000 ppm</td>
<td>-0.050 ppm</td>
<td>-0.01 ppm</td>
<td>-0.00 ppm</td>
<td>0.000 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.01 ppm</td>
<td>-0.02 ppm</td>
<td>-0.01 ppm</td>
<td>-0.00 ppm</td>
<td>0.000 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.01 ppm</td>
<td>-1.00 ppm</td>
<td>-0.01 ppm</td>
<td>-0.00 ppm</td>
<td>0.000 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.01 ppm</td>
<td>-2.00 ppm</td>
<td>-0.01 ppm</td>
<td>-0.00 ppm</td>
<td>0.000 ppm</td>
</tr>
</tbody>
</table>

### Zero point

<table>
<thead>
<tr>
<th>Measured value (mA)</th>
<th>Measured value</th>
<th>Initial value</th>
<th>Possible values</th>
<th>Increment</th>
<th>Lower value</th>
<th>Upper value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

### Calibration ClO₂ not possible!

- **ClO₂ slope too low (<25% of standard slope)**
  - Repeat calibration

### Sensor slope too high

- **ClO₂ slope too high (>300% of standard slope)**
  - Repeat calibration

### DPD value too low!

- **DPD < 0.0005 ppm**
  - Repeat calibration after addition of chlorine dioxide

### Zero point too high

- **Sensor signal > 5 mA**
  - Repeat calibration in chlorine dioxide-free water

### Zero point too low

- **Sensor signal < 3 mA**
  - Check sensor connection, replace sensor if necessary

### pH/ClO₂ calibration defect

- **Basic load**
  - Start unit, run-on time “td” stops, shock dosing stops

### ClO₂ input

- **Basic load**
  - Start unit, run-on time “td” stops, shock dosing stops

### °C input

- **Basic load**
  - Start unit, run-on time “td” stops, shock dosing stops

### Fault sample water

- **Fault sample water**
  - Start unit, run-on time “td” stops, shock dosing stops

### CO₂ shock dosing

- **High CO₂**
  - Start unit, run-on time “td” stops, shock dosing stops

### Base load ClO₂

- **Base load ClO₂**
  - Start unit, run-on time “td” stops, shock dosing stops

### Electronic fault

- **DPD/PHEP indicator**
  - Start unit, run-on time “td” stops, shock dosing stops
8.17.4 DULCOMETER® D2C Measured Variable pH/Chlorine Dioxide, DULCOTEST® CDE Chlorine Dioxide Sensor and DULCOTEST® Sensor PHEP or PHER for pH, Maintenance

Controller
The DULCOMETER® controller type D2C for the measured variable pH/chlorine dioxide is maintenance-free.

Sensor
DULCOTEST® CDE Chlorine Dioxide Sensor

**IMPORTANT**
- The sensor must be regularly serviced in order to avoid overdosing due to sensor failure!
- Observe applicable national directives for servicing intervals!
- Do not touch the electrodes or bring them into contact with greasy substances!

Maintenance interval Daily/weekly servicing intervals depending upon application.

Maintenance Work
- Check the sensor display value at the controller using an appropriate chlorine dioxide measuring system (e.g. DPD-1).
- Recalibrate the sensor if necessary.

Cleaning the Membrane
If the membrane is dirty and is preventing calibration of the sensor you can try to clean the diaphragm gently.
First dismantle the sensor as described in the sensor dismantling section. Observe safety guidelines! Removal of surface contamination.
- Rinse the membrane under a gentle stream of cold water.

Removal of Lime Deposits
- Place the membrane cap in 1% hydrochloric acid (e.g. overnight).
- Rinse the membrane cap with plenty of water.
Now fill the sensor with electrolyte, run in and recalibrate.

Replacing the Membrane
If calibration is no longer possible after cleaning the membrane, or if the membrane is damaged it must be replaced.

Sensor DULCOTEST® PHEP or PHER for pH

**IMPORTANT**
- The sensor is to be regularly serviced to avoid any excess metering caused by a sensor failure!
- Observe the valid national regulations for maintenance intervals!
- Do not touch the electrodes or bring into contact with greasy substances!

Maintenance interval monthly

Maintenance Work
The sensor should regularly (once a month) undergo a visual check and be cleaned if necessary. If deposits on the glass electrode withstand cleaning with a soft, moistened cloth, the following cleaning agents may be used:

<table>
<thead>
<tr>
<th>Kind of deposit</th>
<th>Agent and duration of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>General deposits</td>
<td>Non-abrasive household cleaner</td>
</tr>
<tr>
<td>Scale or metal hydroxides</td>
<td>Diluted hydrochloric acid (approx. 0.1-3 %, 1-5 minutes)</td>
</tr>
<tr>
<td>Oil, grease</td>
<td>Solvents, like alcohol or acetone</td>
</tr>
<tr>
<td>Biofouling</td>
<td>Mixture of diluted hydrochloric acid and pepsin, several hours</td>
</tr>
<tr>
<td></td>
<td>Solvents (e.g. acetone) must not be used to clean electrodes as they</td>
</tr>
<tr>
<td></td>
<td>can damage the plastic stems.</td>
</tr>
</tbody>
</table>

It is essential that the probes are rinsed thoroughly after having been cleaned.
## 8.18 Measuring Parameter pH/pH

### 8.18.1 DULCOMETER® D2C Measured Variable pH/pH, Setting and Operation

### Display Symbols

The display of the DULCOMETER® D2C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>↑</td>
<td>Limit value transgression</td>
<td>Symbol left</td>
</tr>
<tr>
<td>↓</td>
<td>Relay 1 upper or zone</td>
<td>Symbol left</td>
</tr>
<tr>
<td>↑</td>
<td>Relay 1 lower</td>
<td>Symbol left</td>
</tr>
<tr>
<td>↓</td>
<td>Limit value transgression</td>
<td>Symbol right</td>
</tr>
<tr>
<td>↑</td>
<td>Relay 2 upper or zone</td>
<td>Symbol right</td>
</tr>
<tr>
<td>↓</td>
<td>Relay 2 lower</td>
<td>Symbol right</td>
</tr>
<tr>
<td>⬠</td>
<td>Metering pump 1 (acid)</td>
<td>Symbol left</td>
</tr>
<tr>
<td></td>
<td>Control off left</td>
<td></td>
</tr>
<tr>
<td>⬠</td>
<td>Control on left</td>
<td>Symbol left</td>
</tr>
<tr>
<td>⬡</td>
<td>Metering pump 2 (alkali)</td>
<td>Symbol right</td>
</tr>
<tr>
<td></td>
<td>Control off right</td>
<td></td>
</tr>
<tr>
<td>⬡</td>
<td>Control on right</td>
<td>Symbol right</td>
</tr>
<tr>
<td>⬠</td>
<td>Solenoid valve 1 (acid)</td>
<td>Symbol left</td>
</tr>
<tr>
<td></td>
<td>Control off left</td>
<td></td>
</tr>
<tr>
<td>⬠</td>
<td>Solenoid valve 2 (alkali)</td>
<td>Symbol right</td>
</tr>
<tr>
<td></td>
<td>Control off right</td>
<td></td>
</tr>
<tr>
<td>⬠</td>
<td>Control on left</td>
<td>Symbol right</td>
</tr>
<tr>
<td>⬠</td>
<td>Stop button pressed</td>
<td></td>
</tr>
<tr>
<td>⬡</td>
<td>Manual metering</td>
<td></td>
</tr>
<tr>
<td>⬠</td>
<td>Pause symbol</td>
<td></td>
</tr>
<tr>
<td>⬡</td>
<td>Delay time „td“</td>
<td>Control starts after expiry of „td“</td>
</tr>
<tr>
<td>⬠</td>
<td>Fault</td>
<td></td>
</tr>
</tbody>
</table>
**Operation**

NOTE
Access to the setting menus can be barred with the access code!
The number and scope of setting menus depends on the device version!
If the access code is selected correctly in a setting menu, the following setting menus are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back from the setting menu to the permanent display 1.
The setting menus highlighted in grey and the adjustable parameters are only visible in the complete operating menu.
Operating Menu / Layout (Continuation)

Limit value 2

Only with limit relay

Hysteresis limit: 0.04 ppm

Checkout time limit: off

Limit value Δ

Hysteresis limit: 0.05 pH

Checkout time limit: off

Limit end

Limit 2: upper MV

Δ

Control setting?

Control with dead zone

Control value 1

Control setting?

Manual control

Ctrl parameter

XP = 10 %

Ti = off

Td = off

Additional load

MV1: 0 %

Dosing direction:

Acid/Alkali

Setpoint

MV1: 7.20 pH

Dosing direction:

Acid/Alkali

Setpoint 1: upper

MV1: 9.00 pH

Manual dosing

MV1: 0 %

Dosing direction:

Acid/Alkali

Limit 2: upper MV

Limit 1: lower

LV relay 2: LV1

Δ

Automatic control

Manual control

Dosing pump max.

Pump 1: 180 pulse/minute

Pump 2: 180 pulse/minute

Manual control

Dosing pump max.

Pump 1: 180 pulse/minute

Pump 2: 180 pulse/minute

Automatic control

Manual control

Pump 1: acid

Pump 2: alkali

Manual control
The permanent displays 1 to 4 serve information on fault messages/causes as well as operating values/settings.

### 8.18.2 DULCOTEST® Sensor PHEP or PHER for pH, Commissioning

#### 8.18.2.1 DULCOTEST® Sensor PHEP or PHER for pH, Assembly

**pH Sensor**

Before putting into operation, the protective cap or case must be removed from the glass or metal electrode. The glass or metal electrode must be free from oil, grease and other contaminations. Likewise, the diaphragm of the reference electrode must be free from scale deposits, dirt or crystallized matter. For these reasons, electrodes should never be touched by hand.

Remove the blanking plug of the respective measuring module at the fittings of the measuring/control station DULCOTROL® and install the DULCOTEST® PHEP or PHER sensor for pH.

#### 8.18.2.2 DULCOTEST® Sensor PHEP or PHER for pH, Electrical Installation

Connect the DULCOTEST® PHEP or PHER sensor for pH with the marked cable of the respective controller DULCOMETER® D2C.

#### 8.18.2.3 DULCOTEST® Sensor PHEP or PHER for pH, Running-In

The DULCOTEST® PHEP or PHER sensor for pH must not be run-in. The DULCOTEST® PHEP or PHER sensor for pH can be readily used.
8.18.2.4 DULCOTEST® Sensor PHEP or PHER for pH, Calibration

Since pH sensors are subject to certain manufacturing tolerances, they must be tuned to the pertinent pH transmitter. The adjustment intervals depend on relevant operating conditions. They can vary from a few days to up to 8 weeks.

Having connected the sensor to the transmitter by means of the sensor cable (taking care that connectors and cable remain absolutely dry), dip the sensor into a pH 7 standardizing solution and adjust transmitter exactly to read this value. Remove the sensor, rinse it with water, preferably distilled water, and dry it by swabbing it with soft, non-fluffing tissue paper.

**IMPORTANT**

Do not rub since this might cause static electricity and false readings.

Immerse the sensor in a buffer solution differing by at least 2 pH from pH 7 and calibrate after the value on the display has stabilised. If within 30 seconds a steady-state value is not produced or calibration has proved impossible, clean sensor and repeat calibration. If again unsuccessful, replace sensor with a new one.

**Calibration**

Calibration of pH sensors (measuring value 1, 2):

The calibration of the pH sensors MV 1 and MV 2 uses a two-point calibration method (zero point, slope). As buffer pH 7 (zero point calibration) and pH 4 (slope calibration) are factory-set. If other buffers are to be used, the defaults in the complete operating menu (menu A, B) may be altered. If the temperature correction takes place manually or automatically, the actual buffer temperature must be entered or the PT 100 immersed in the buffer solution. During calibration, control is stopped and metering is reduced to the set basic load. The output 0/4...20 mA (measuring value and correcting value) will be frozen. After successful calibration, all fault determinations relating to the measuring value are started again. The current sensor data (zero point/slope) will be displayed.
ProMinent®

### pH/pH

<table>
<thead>
<tr>
<th>Fault</th>
<th>Initial value</th>
<th>Possible values</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer values</td>
<td>pH 7</td>
<td>pH 0.01</td>
<td>pH -2</td>
<td>pH 16</td>
<td></td>
</tr>
<tr>
<td>Measured value 1</td>
<td>Signal exceeded/</td>
<td>MV 1-input</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
</tr>
<tr>
<td>Measured value 2</td>
<td>Signal exceeded/</td>
<td>MV 2-input</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
</tr>
<tr>
<td>Limit transgression</td>
<td>MV 1-limit 1</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>Stop function detachable after checkout time</td>
</tr>
<tr>
<td>Limit transgression</td>
<td>MV 1-limit 2</td>
<td>Confirmation cancels the fault.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit transgression</td>
<td>MV 2-limit 1</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>Stop function detachable after checkout time</td>
</tr>
<tr>
<td>Limit transgression</td>
<td>MV 2-limit 2</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>Stop function detachable after checkout time</td>
</tr>
<tr>
<td>Limit transgression</td>
<td>MV 3-limit 1</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>Stop function detachable after checkout time</td>
</tr>
<tr>
<td>Limit transgression</td>
<td>MV 3-limit 2</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>Stop function detachable after checkout time</td>
</tr>
<tr>
<td>Correction variable</td>
<td>MV 4-limit 1</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>Signal &gt; 100 °C or &lt; 138.5 °C</td>
</tr>
</tbody>
</table>

### Error message

<table>
<thead>
<tr>
<th>Error message</th>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer &lt; pH 2</td>
<td>Buffer &lt; pH 2</td>
<td>During calibration procedure: recalibrate buffer 2!</td>
</tr>
<tr>
<td>pH 2</td>
<td>Buffer &lt; pH 2</td>
<td>Return to permanent display: Basic metering load</td>
</tr>
<tr>
<td>pH zero point low</td>
<td>&lt; 60 mV</td>
<td>Warning, old zero point and slope retained</td>
</tr>
<tr>
<td>pH zero point high</td>
<td>&gt; 60 mV</td>
<td></td>
</tr>
<tr>
<td>pH slope low</td>
<td>&lt; 60 mV</td>
<td></td>
</tr>
<tr>
<td>pH slope high</td>
<td>&gt; 60 mV</td>
<td></td>
</tr>
<tr>
<td>Measured value pH unsteady</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measured value temperature unsteady</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 8.18.3 DULCOMETER® D2C, DULCOTEST® Sensor PHEP or PHER for pH,

#### Troubleshooting

### Controller

<table>
<thead>
<tr>
<th>Fault</th>
<th>Fault test</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value 1</td>
<td>Signal exceeded/</td>
<td>MV 1-input</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>3 mA &gt; signal &gt; 23 mA</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td>Calibration with error</td>
<td>MV 1-calibration</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>Check sensor, clean, replace if necessary, recalibrate if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measured value 2</td>
<td>Signal exceeded/</td>
<td>MV 2-input</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>3 mA &gt; signal &gt; 23 mA</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td>Calibration with error</td>
<td>MV 2-calibration</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>Check sensor, clean, replace if necessary, recalibrate if necessary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit transgression</td>
<td>MV 3-limit 1</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>Stop function detachable after checkout time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit transgression</td>
<td>MV 3-limit 2</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>Stop function detachable after checkout time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limit transgression</td>
<td>MV 3-limit 3</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>Stop function detachable after checkout time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correction variable</td>
<td>Signal exceeded/</td>
<td>MV 4-input</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>Signal &gt; 100 °C or &lt; 138.5 °C</td>
<td></td>
</tr>
</tbody>
</table>

#### Operation

<table>
<thead>
<tr>
<th>Operation</th>
<th>Test text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop button</td>
<td>Stop button</td>
<td>None</td>
<td>Stop</td>
<td>No</td>
<td>Signal too big</td>
<td>Shut down</td>
<td></td>
</tr>
<tr>
<td>Pause contact</td>
<td>Pause</td>
<td>None</td>
<td>Stop</td>
<td>No</td>
<td>Can be deselected</td>
<td>Display blinking to</td>
<td>Delay before pause, display blinking till</td>
</tr>
<tr>
<td>Fault sample water</td>
<td>Fault sample water</td>
<td>None</td>
<td>Stop</td>
<td>No</td>
<td>Function available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic fault</td>
<td>Electronic fault</td>
<td>None</td>
<td>Stop</td>
<td>Yes</td>
<td>Send in device</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

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8.18.4 DULCOMETER® D2C Measured Variable pH/pH, DULCOTEST® Sensor PHEP or PHER for pH, Maintenance

Controller
The DULCOMETER® controller type D2C for the measured variable pH/pH is maintenance-free.

DULCOTEST® Sensor PHEP or PHER for pH

**IMPORTANT**
- The sensor is to be regularly serviced to avoid any excess metering caused by a sensor failure!
- Observe the valid national regulations for maintenance intervals!
- Do not touch the electrodes or bring into contact with greasy substances!

**Maintenance Interval**
Monthly

**Maintenance Work**
The sensor should regularly (once a month) undergo a visual check and be cleaned if necessary.
If deposits on the glass electrode withstand cleaning with a soft, moistened cloth, the following cleaning agents may be used:

<table>
<thead>
<tr>
<th>Kind of deposit</th>
<th>Agent and duration of application</th>
</tr>
</thead>
<tbody>
<tr>
<td>General deposits</td>
<td>Non-abrasive household cleaner</td>
</tr>
<tr>
<td>Scale or metal hydroxides</td>
<td>Diluted hydrochloric acid (approx. 0.1-3 %, 1-5 minutes)</td>
</tr>
<tr>
<td>Oil, grease</td>
<td>Solvents, like alcohol or acetone</td>
</tr>
<tr>
<td>Biofouling</td>
<td>Mixture of diluted hydrochloric acid and pepsin, several hours</td>
</tr>
</tbody>
</table>

Solvents (e.g. acetone) must not be used to clean electrodes as they can damage the plastic stems.
### 8.19 Measuring Parameter Bromine

#### Display Symbols

The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 1, upper</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 1, lower</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 2, upper</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Relay 2, lower</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Metering pump 1 (bromine) Control off</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Metering pump 2 (De-bromine) Control off</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Solenoid valve 1 (bromine) Control off</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Solenoid valve 2 (De-bromine) Control off</td>
<td>Symbol</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Servomotor Control, open relay</td>
<td></td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Servomotor Control, close relay</td>
<td></td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Without control</td>
<td></td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Position feedback</td>
<td>Thickness of bar increases from left to right during opening</td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Stop button pressed</td>
<td></td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Manual metering</td>
<td></td>
<td><img src="image" alt="Symbol" /></td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td><img src="image" alt="Symbol" /></td>
</tr>
</tbody>
</table>
Operation

- Permanent display 1
- Permanent display 2
- Calibration menu
- Various setting menus

**NOTE**

Access to the setting menus can be barred with the access code!
The number and scope of setting menus is dependent on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!

If within a period of 10 minutes no button is pushed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.

**Access code, correct**

Parameter setting

- Access code, correct
- Parameter setting

**Access code, selected**

The various menus are selected with the CHANGE button
The menu is started with the ENTER button
BRANCH BACK to permanent display or to relevant setting menu

**Branch Back**

- Branch Back without saving setting
- Branch Back to start of setting

**Text 1**

- Selection 1
- Selection 2

**Text 2**

- Selection 1
- Selection 2

**ENTER and save setting, continue to next menu**

**CHANGE from selection to selection**

Change numbers or settings of selection

Variables flash
 Restricted Operating Menu / Layout

Operating Menu

The DULCOMETER® D1C controller permits settings to be made in two different menus. All values are preset and can be changed in the complete operating menu.

The controller is delivered with a restricted operating menu so that the D1C controller can be used effectively in many applications from the very onset. If adaptations prove to be necessary, all relevant parameters can then be accessed by switching over to the complete operating menu.

Positive values of setting variable: bromine
Negative values of setting variable: de-brom
(bromine destruction)

Permanent display 1
Permanent display 2
only with control
(w = setpoint)

control setting ?
Setting in complete operating menu

For normal control
setpoint:
< 3.00 ppm
Control with dead zone
Control with dead zone
setpoint:
< 3.00 ppm
setpoint:
< 3.00 ppm

Proportional control
setpoint:
< 3.00 ppm
setpoint:
< 3.00 ppm
setpoint:
< 3.00 ppm

PID Control
setpoint:
< 3.00 ppm
setpoint:
< 3.00 ppm
setpoint:
< 3.00 ppm

Manual control
setpoint:
< 3.00 ppm
setpoint:
< 3.00 ppm
setpoint:
< 3.00 ppm

Alarm relay
Latching
Active

Access to setting menus can be blocked with access code.
Restricted Operating Menu / Description

Error Messages
Error messages and information are indicated on the bottom line in the permanent display 1. Errors to be acknowledged (acknowledgement switches off the alarm relay) are indicated by the "C". Errors/notes which still apply after acknowledgement are indicated alternately. During correction variable processing (temperature for correction of pH-value), the value is indicated in the same line as the error/note. Faults which are rectified of their own accord due to changed operating situations are removed from the permanent display without the need for acknowledgement.

8.19.2 DULCOTEST® BRE Sensor for Bromine BRE 1-mA-10 ppm, BRE 1-mA-2 ppm, BRE 2-mA-10 ppm, Commissioning
8.19.2.1 DULCOTEST® BRE Sensor for Bromine BRE 1-mA-10 ppm, BRE 1-mA-2 ppm, BRE 2-mA-10 ppm, Assembly

Assembly

CAUTION
- Wear safety goggles and protective clothing when handling water or solutions that contain bromine.
- Do not swallow the electrolyte. Avoid contact of the electrolyte with skin and eyes. Otherwise wash with a lot of water. In case of eye inflammation, contact a doctor.

IMPORTANT
- Do not touch or damage the membrane or electrodes.
- The electrolyte is sensitive to oxidation: always keep the electrolyte bottle closed after use. Do not transfer the electrolyte into other containers.
- The electrolyte should not be stored for more than 1 year and should not yellow (use by date, see label).
- As far as possible avoid forming air bubbles when pouring the electrolyte into the membrane cap.
- The membrane cap must be used once only.

NOTE
- Store the electrolyte bottle upside down in order that the viscous electrolyte can be poured easily and bubble free into the membrane cap.
- Smaller bubbles will not interfere, larger bubbles leave the electrolyte by rising to the surface.

Pouring electrolyte
- Open the electrolyte bottle and unscrew the nozzle.
- Squeeze out excess air.
- Fill the membrane cap with electrolyte, avoiding air bubbles as far as possible: Place the electrolyte bottle completely onto the membrane cap. Slowly squeeze the electrolyte out of the bottle in one steady stream, while continuously retracting the bottle. The cap is completely full when the electrolyte reaches the lower edge of the thread.
Bromine

Assembling membrane cap

- Place the electrode shaft vertically onto the filled membrane cap.
- Do not cover the vent hole below the rubber seal with your fingers.
- Screw on the membrane cap by hand as far as possible. There should not be a visible gap between the electrode shaft and membrane cap. When you screw on the cap, excess electrolyte will leak out through the hole below the rubber seal.
- Wipe away any electrolyte with a soft paper tissue or similar.
- Rinse the nozzle thoroughly with a clean, warm water jet so that no electrolyte remains on the inside and outside of the nozzle.

Assembling sensor

**IMPORTANT**

- Depressurise the system before inserting the sensor into the in-line probe housing.
- Close the stop valves before and after the in-line probe housing.
- Insertion and withdrawal of the sensor into or out of the in-line probe housing should be carried out slowly.
- Do not exceed the maximum operating pressure of 1 bar.
- Do not allow the flow to fall below the minimum rate of 30 l/h. Monitor the flow with the connected measuring device/controller. If the sensor's signal is used for controlling, switch off the controller or adjust it to constant load when the flow rate falls below the lower limit.
- Avoid installations which allow air bubbles to enter the sample water. Air bubbles clinging to the sensor membrane can lower the resultant measured value and cause incorrect dosing within the control system.

Fitting the sensor in the in-line probe housing

Note also the instructions and safety guidelines in the operating instructions of the in-line probe housing.

DLG III

- Slide the O-ring from below over the sensor up to the clamping ring.
- Insert the sensor into the DLG III.
- Fix the sensor tightly by screwing in the plug.

DGM

- Slide the O-ring from below over the sensor up to the clamping ring. Leave a flat washer inside the DGM.
- Insert the sensor in the DGM and screw on the plug until the O-ring seals. The clamping ring determines the installation depth of the sensor.

8.19.2.2 DULCOTEST® BRE Sensor for Bromine BRE 1-mA-10 ppm, BRE 1-mA-2 ppm, BRE 2-mA-10 ppm, Electrical Installation

General Safety Guidelines

**IMPORTANT**

Install in such a way as to ensure a totally reliable, uninterrupted power supply to the controller. Too low a voltage supply can cause measuring failures, which may result in dangerous overdosing within a control system.

The BRE sensor has a passive 4-20 mA two-wire interface. The power supply is provided externally or by the controller. When the sensor is connected to the DULCOMETER® D1C controller the interface’s safety requirements are met automatically.

**IMPORTANT**

For electrical connection of the sensor to the controller, only use wires with a diameter of 4 mm.
Electrical Installation

- Turn the top part of the sensor a quarter of a turn anticlockwise and remove.
- Remove the outer isolation of the cable for about 5 cm from the end so that the two wires appear.
- Loosen the M12 threaded connector and guide the 2-wire cable into the sensor. Leave an approx. 5 cm length of the 2-core measuring line in the sensor.
- Strip the two wires at their ends and connect them to the terminal block (see figure) by using the screwdriver provided: 1 = plus, 2 = minus.
- Tighten up the M12 connector.
- Insert the top part of the sensor right into the housing and turn the top part clockwise as far as it will go.

Commissioning

**CAUTION**

- The power supply to the measuring device and to the sensor must not be interrupted. If the power supply is interrupted (> 2 hours) the sensor must be re-commissioned.
- Do not switch off the measuring device during intermittent operation. Dosing devices may be controlled by timer switches. However, if no disinfectant is metered over a longer period of time (weeks), the sensor must be disconnected from the system and stored dry.
- The sensor’s current signal must not exceed 20 mA. Otherwise the sensor may be damaged, which may result in dangerous overdosing within a control system. To avoid this, install a monitor, which permanently switches off the bromine control system and triggers an alarm. The monitoring equipment must not be automatically re-setting.
- Once the sensor has been commissioned it must be kept permanently wet.

After completed installation the controller can be switched on. The system should then be allowed to run in for the set run-in period.

8.19.2.3 DULCOTEST® BRE Sensor for Bromine BRE 1-mA-10 ppm, BRE 1-mA-2 ppm, BRE 2-mA-10 ppm, Running-In

Running-In Period

In order to achieve a stable display value the sensor should be run in for the following run in periods:

- First commissioning: 24 hour
- After changing membrane: 1-6 h
- Re-commissioning: approx. 4-24 hours
8.19.2.4 DULCOTEST® BRE Sensor for Bromine BRE 1-mA-10 ppm, BRE 1-mA-2 ppm, BRE 2-mA-10 ppm, Calibration

**Calibration**

**IMPORTANT**

The specified calibration method depending on the type of bromination agent used must be observed.

**CAUTION**

- Carry out a slope test every time the membrane or electrolyte is changed.
- Avoid air-bubbles in the sample flow. They can attach at the sensor membrane, which may cause too low measured values. Within a control system this may lead to dangerous overdosing.
- For proper function of the sensor, the slope test has to be repeated regularly.
- If bromine is measured as chlorine with a DPD set, make sure that you convert the values into bromine.
- If installing the sensor outside Germany, please comply with the local regulations for calibration intervals.

**Preconditions**

The sensor reading is stable (no drifts or unsteady values for at least 5 minutes). This is normally fulfilled, when

- The system has been allowed to run-in for the specified period
- The flow through the in-line probe housing is constant and corresponds with the technical data
- The sample medium and the sensor are at the same temperature
- The pH value is constant and within the admissible range (pH 6.5 - 9.5)

**Zero Point Calibration**

Zero point calibration is necessary only when the sensor is used at the lower limit of the measuring range.

1. Remove the sensor from the DLG III or DGM in-line probe housing (see DLG III, DGM operating instructions).
2. Immerse the sensor in a container with clean water, free of chlorine and bromine.
3. Stir by using the sensor, until the measured value remains stable.
4. Adjust the controller (DULCOMETER® D1C, Bromine) to zero, according to it’s operating instructions manual (DULCOMETER® D1C, Bromine Operating Instructions: Chapter 8, complete operating menu, settings menu “Calibrating bromine zero point”).
5. Reinstall the sensor into the in-line-probe-housing (DGM, DLG III).

**Slope Test**

1. Insert the sensor into the DLG III or DGM in-line probe housing, if not already done.
2. Take a water sample for DPD-measurement. Sampling location has to be close to the installed sensor. Recommendation: use the sampling tap in the case of the DGM in-line probe housing
3. Determine the bromine content with a suitable DPD-Method (e.g. DPD). DPD 4 is especially recommended, when organically bound bromine like BDCMH (1-Br, 3-Cl-5,5 dimethylethyldantoin) is present. In case of high and constant ratios of free bromine (HOBr), the DPD 1 method is also suitable.
The following table shows what calibration method must be used for what type of sensor in connection with what bromination agent.

<table>
<thead>
<tr>
<th>Bromine reagent</th>
<th>Sensor type BRE 1-mA-10 ppm (calibration method)</th>
<th>Sensor type BRE 2-mA-10 ppm (calibration method)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free bromine (HOBr, e.g. by mixing sodium bromide + chlorine bleach solution)</td>
<td>Max. concentration: 5 ppm (1 ppm)/calibratable with DPD 1 or with DPD 4</td>
<td>Suitable for the entire measuring range/ calibratable with DPD 1 or with DPD 4</td>
</tr>
<tr>
<td>DBDMH: 1.3 dibromine-5,5-dimethyl-hyantoin, e.g. with trade designation Albrom 100®</td>
<td>Max. bromine concentration: 5 ppm (1 ppm)/calibratable with DPD 1 or with DPD 4</td>
<td>Suitable for the entire measuring range/ calibratable with DPD 1 or with DPD 4</td>
</tr>
<tr>
<td>BCDMH: 1-bromine-3-chlorine-5,5-dimethyl-hydantoin, e.g. with trade designation Brom-Sticks®</td>
<td>Suitable for the entire measuring range, calibratable only with DPD 4</td>
<td>Min. bromine concentration: 0.4 ppm/calibratable only with DPD 4</td>
</tr>
<tr>
<td>N-bromine-amidosulfonate, e.g. with the trade designation Albrom 100®</td>
<td>Suitable for the entire measuring range, calibratable only with DPD 4</td>
<td>Min. bromine concentration: 0.4 ppm/calibratable only with DPD 4</td>
</tr>
</tbody>
</table>

- If bromine is measured as chlorine with a DPD set, multiply the chlorine value by the factor of 2.25 to obtain the value of bromine.
- Input the measured value into the controller according to its operating manual (Operating Instructions DULCOMETER® D1C, Bromine, Chapter 8, complete operating menu, settings menu “Calibrating bromine”).
- After initial installation of the sensor, check the calibration by DPD-measurement 24 hours later.
- The following maintenance intervals based on experiences are recommended
  - swimming pools: weekly
  - spa pools (whirlpools): daily

**IMPORTANT**

The measuring range of the sensor must agree with the set measuring range of the D1C (factory setting: 0.2 - 10 ppm). The measuring range must be reset prior to calibration.

### Possible values

<table>
<thead>
<tr>
<th>Measured value</th>
<th>Initial value</th>
<th>Possible values</th>
<th>Increment</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.01 ppm</td>
<td>Increment</td>
<td>0 ppm</td>
<td>11 ppm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Error message

<table>
<thead>
<tr>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration bromine not possible! Sensor slope too low</td>
<td>Calibrate again</td>
</tr>
<tr>
<td>Calibration bromine not possible! Sensor slope too high</td>
<td>Calibrate again</td>
</tr>
<tr>
<td>DPD value too low DPD &gt; x.xx ppm</td>
<td>DPD &lt;2 % of measuring range</td>
</tr>
</tbody>
</table>
Calibration of the Bromine Sensor

During the calibration the DULCOMETER® D1C switches the control outputs to “0”. Exception: where a basic load or a manual control variable has been entered it is retained throughout the calibration.

The standard mA signal outputs (measured value or correction value) are frozen. The frozen measured value from the start of the calibration is suggested as the DPD value. The DPD values are variable (arrow keys). Calibration is possible only when the DPD value is ≥ 2 % of the measurement range.

If the calibration is successful all fault-finding operations relating to the measured value start afresh.

In the limited-access operating menu: the DULCOMETER® D1C saves the detected slope values.

In the full operating menu: the DULCOMETER® D1C saves the detected slope and zero point values.

The zero point calibration must be carried out under real conditions in bromide-free water. It is normally required only for the measurement range 0-0.5 ppm when measuring at the lower measurement range limit.
## DULCOMETER® D1C and DULCOTEST® BRE Sensor for Bromine

### Troubleshooting

#### Controller

<table>
<thead>
<tr>
<th>Fault</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect on metering</th>
<th>Effect on control</th>
<th>Alarm with acknowledgement</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measured value</strong></td>
<td>Checked time exceeded</td>
<td>Ε</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Function can be switched off</td>
<td>Check function on sensor, measured value exceeds checkout time</td>
</tr>
<tr>
<td><strong>Signal exceeded/drops below value</strong></td>
<td>Check bromine sensor</td>
<td>Ε</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Signal &lt;3.0 ±0.2 mA or &gt;23 ±0.2 mA</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td><strong>Calibration measuring cell with error</strong></td>
<td>Check bromine sensor</td>
<td>Ε</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Measurement continues in case of error with an identical measured value</td>
<td>Check sensor, replace if necessary, recalculate if necessary</td>
</tr>
<tr>
<td><strong>Signal exceeded/drops below value</strong></td>
<td>Check input</td>
<td>Ε</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Signal &lt;3.0 ±0.2 mA or &gt;23 ±0.2 mA</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td><strong>Feed forward control</strong></td>
<td>Signal exceeded/drops below value</td>
<td>Ε</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Signal &gt;3.0 ±0.2 mA</td>
<td>Check sensor, transducer and cable connection</td>
</tr>
<tr>
<td><strong>Land transgression</strong></td>
<td>After checkout time limit value</td>
<td>Ε</td>
<td>Stop or Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Function can be switched off</td>
<td>Define cause, reset values if necessary</td>
</tr>
<tr>
<td><strong>Servomotor</strong></td>
<td>Position not reached</td>
<td>Ε</td>
<td>Servomotor defective</td>
<td>Stop</td>
<td>No</td>
<td>Yes</td>
<td>Servomotor class</td>
</tr>
<tr>
<td><strong>Electronics error</strong></td>
<td>System error</td>
<td>Ε</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Electronic data defective</td>
<td>Call in service</td>
</tr>
</tbody>
</table>

#### Error messages

Error messages and information are indicated on the bottom line in the permanent display 1. Errors to be acknowledged (acknowledgement switches off the alarm relay) are indicated by the Ε. Errors/notes which still apply after acknowledgement are indicated alternately. During correction variable processing (temperature for correction of pH-value), the value is indicated in the same line as the error/notes. Faults which are rectified of their own accord due to changed operating situations are removed from the permanent display without the need for acknowledgement.

---

### Error messages

Error messages and information are indicated on the bottom line in the permanent display 1. Errors to be acknowledged (acknowledgement switches off the alarm relay) are indicated by the Ε. Errors/notes which still apply after acknowledgement are indicated alternately. During correction variable processing (temperature for correction of pH-value), the value is indicated in the same line as the error/notes. Faults which are rectified of their own accord due to changed operating situations are removed from the permanent display without the need for acknowledgement.
Bromine

Sensor: Troubleshooting

Troubleshooting

Troubleshooting must take account of the whole measuring system. The measuring system consists of:

1) Measurement/control device
2) Electrical leads and connectors
3) In-line probe housing and hydraulic connections
4) Sensor

The possible causes of failure listed in the following table primarily refer to the sensor. Before commencing troubleshooting please ensure that the operating conditions in Technical data are met:

a) Bromine concentration 0.2 - 10 mg/l
b) Constant pH in the range 6.5 - 9.5
   c) Constant temperature in the range 4 - 45 °C
   d) Conductivity: 0.03 - 40 mS/cm
   e) Flow: 30 - 60 l/h

The sensor simulator (DULCOMETER® Simulator order no. 1004042) is recommended for locating a controller malfunction. You will find a detailed description of troubleshooting of the controller in the operating instructions of DULCOMETER® D1C, Bromine.

If the value measured by the sensor differs significantly from that of the DPD method you need to first consider all possible malfunctions of the DPD photometric method. If necessary, repeat the DPD measurement several times.

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor can not be calibrated: Measured value greater than DPD-measurement</td>
<td>It was calibrated with DPD 1 in presence of organically bound bromine as disinfectant e.g. BCDMH</td>
<td>Calibrate sensor with DPD 4</td>
</tr>
<tr>
<td></td>
<td>Run-in time too short</td>
<td>Observe the run-in time</td>
</tr>
<tr>
<td></td>
<td>Membrane cap damaged</td>
<td>Replace membrane cap, run in sensor and calibrate</td>
</tr>
<tr>
<td></td>
<td>Interfering substances in sample water</td>
<td>Examine sample water for interfering substances and remedy</td>
</tr>
<tr>
<td></td>
<td>Short-circuit in signal lead</td>
<td>Locate and eliminate short circuit</td>
</tr>
<tr>
<td></td>
<td>Distance between working electrode and membrane too great</td>
<td>Screw the membrane cap tightly onto the electrode shaft</td>
</tr>
<tr>
<td></td>
<td>DPD chemicals spent</td>
<td>Use new DPD chemicals, repeat calibration</td>
</tr>
<tr>
<td></td>
<td>pH-value &lt; pH 6.5</td>
<td>Raise pH-value (6.5-9.5)</td>
</tr>
</tbody>
</table>
**Bromine**

<table>
<thead>
<tr>
<th>Fault</th>
<th>Possible Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor can not be calibrated; Measured value smaller than DPD-measurement</td>
<td>Run-in time too short, Deposits on membrane cap, Flow rate of sample water too low, Air bubbles on the outside of the membrane, Interfering substances in sample water (surfactants, oil, alcohols, corrosion inhibitors), Measuring range was noticeably exceeded. This may occur also as a consequence of calibration with DPD 1 in presence of organically bound bromine as disinfectant e.g. BCDMH</td>
<td>Correct run-in time, Replace membrane cap, run in sensor and calibrate, Correct flow rate, Increase the flow rate within the permitted range, Confer with ProMinent</td>
</tr>
<tr>
<td>Deposits (carbonate, manganese, iron oxide) have blocked membrane, pH-value &gt; pH 9.5, No electrolyte present in membrane cap</td>
<td>Replace membrane cap, run in sensor and calibrate, Lower the pH value (pH 6.5-pH 9.5), Fill membrane cap with new electrolyte see “Assembly”, “Run-in period” and “Calibration”</td>
<td></td>
</tr>
</tbody>
</table>

| Measured value of sensor is 0 ppm and error message “Check Bromine Input” appears on DULCOMETER® D1C display | Sensor is connected to controller with wrong polarity, Signal lead is broken, Sensor defective, Controller defective | Correctly connect sensor to the controller, Replace signal lead, Return sensor, Check controller with the sensor simulator (DULCOMETER® Simulator, order no. 1004042, return to dealer if faulty) |

| Measured value of sensor is arbitrary and sensor current is 3.0 - 4.0 mA | Run-in time too short, Interfering substances in sample water which deplete Bromine e.g. reducing agents like sulphur compounds, Zero point has shifted, Reference electrode defective* | Keep the run-in time, Examine sample water for interfering substances and remedy, Carry out zero point calibration, Return sensor to ProMinent for regeneration |

| Measured value of sensor is 0 ppm and sensor current is greater than 20 mA** | Bromine concentration exceeds the upper limit of measuring range, Distance between working electrode and membrane too great, Sensor defective | Check the whole system, remedy fault and then calibrate sensor, Screw the membrane cup tightly onto the electrode shaft, Return sensor |

| Measured value of sensor is not stable | Pressure fluctuations in sampling line, Reference electrode defective* | Check installation position and change the process if necessary, Return sensor to ProMinent for regeneration |

---

* When the reference electrode turns shiny silver or while it must be regenerated. Brown-grey or yellow green coloration is normal.
** The DULCOMETER® D1C can be used to display the sensor current when the sensor is built into the system. For this enter the complete operating menu (see Operating Instructions, DULCOMETER® D1C, Bromine, Chapter 8). Access the “Calibrating bromine” settings menu and only read the mA-value measured under “Zero point”. Do not finish the zero point calibration but leave the menu by pushing the branch back button.
8.19.4 DULCOMETER® D1C Measured Variable Bromine and DULCOTEST® BRE Sensor for Bromine BRE 1-mA-10 ppm, BRE 1-mA-2 ppm, BRE 2-mA-10 ppm, Maintenance

Controller
The DULCOMETER® controller type D1C for the measured variable bromine is maintenance-free.

Sensor

IMPORTANT
- Service the sensor regularly to avoid overdosing within a control system, due to incorrect measured value.
- Observe the current national regulations for maintenance intervals.
- Do not touch the electrodes or allow them to come into contact with greasy substances.
- Never attempt to clean the membrane with acid/alkaline solutions, cleaning reagents or mechanical aids (brushes or similar).

Maintenance intervals based on experience are
- swimming pools: weekly
- spa pools (whirlpools): daily

Maintenance Work
- Check the sensor regularly for dirt, algae and air bubbles. As far as possible, avoid contamination of the membrane with solid particles, deposits etc. Eliminate air bubbles by increasing the flow rate.
- Check the sensor’s reading on the controller regularly, using an appropriate instrument for measuring bromine (e.g. DPD). If using BCDMH: DPD 4, DPD 1 in case of DBDMH: DPD 1
- If necessary, recalibrate the sensor
- If calibration cannot be carried out properly, the membrane cap must be replaced and calibration must be repeated.
# Chlorine Dioxide Sensor CDP

## 8.20 Measuring Parameter Chlorine Dioxide Sensor CDP

### 8.20.1 DULCOMETER® D1C Measured Variable Chlorine Dioxide Setting and Operation

#### Display Symbols

The display of the DULCOMETER® D1C controller uses the following symbols:

<table>
<thead>
<tr>
<th>Description</th>
<th>Comment</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit value transgression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay 1, upper left</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Relay 1, lower</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Relay 2, upper</td>
<td>Symbol right</td>
<td></td>
</tr>
<tr>
<td>Relay 2, lower</td>
<td>Symbol right</td>
<td></td>
</tr>
<tr>
<td>Metering pump 1 (chlorine dioxide) Control off</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol left</td>
<td></td>
</tr>
<tr>
<td>Metering pump 2 (De-ClO₂) Control off</td>
<td>Symbol right</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol right</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Solenoid valve 1 (chlorine dioxide) Control off</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Solenoid valve 2 (De-ClO₂) Control off</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol right</td>
<td></td>
</tr>
<tr>
<td>Control on</td>
<td>Symbol</td>
<td></td>
</tr>
<tr>
<td>Servomotor Control, open relay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control, close relay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Without control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position feedback Thickness of bar increases from left to right during opening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stop button pressed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual metering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Chlorine Dioxide Sensor CDP

Operation

NOTE
Access to the setting menus can be barred with the access code!
The number and scope of setting menus depends on the device version!
If the access code is selected correctly in a setting menu, then the following setting menus are also accessible!
If within a period of 10 minutes no button is pushed, the unit automatically branches back from the calibrating menu or a setting menu to the permanent display 1.
Restricted Operating Menu / Layout

The restricted operating menu permits simple operation of the most important parameters. The following overview shows the settings which can be selected:

- Positive values of setting variable: chlorine dioxide
- Negative values of setting variable: De-ClO2 (chlorine dioxide destruction)

**Permanent display 1**
- 0.60 ppm
- 30.0 °C

**Permanent display 2**
- Only with control
- (w = setpoint)

**Positive values of setting variable:**
- Chlorine dioxide
- De-ClO2 (chlorine dioxide destruction)

**Negative values of setting variable:**
- Auto.: 30.0 °C

**Control with dead zone**
- For normal control
- Proportional control

**PID Control**
- Set point:
  - 0.60 ppm
  - < 0.60 ppm
- Control output:
  - 30 %

**Control with dead zone**
- Control output:
  - 30 %

**Control manual**
- Control output:
  - 30 %

**Setting in complete operating menu**
- Control
- Control output
- Positive ClO2
- Negative De-ClO2

**General setting information**
- Identcode: D1CA
- DxDxxxxxxxxxx
- Software version: D1C-B1 FW:5.00
- Alarm relay:
  - Active
  - Access code:
    - 5000
  - Operating menu:
    - English
    - Reduced

Access to setting menus can be blocked with access code.

Number and scope of setting menus depend on the device.
Chlorine Dioxide Sensor CDP

8.20.2 DULCOTEST® CDP Chlorine Dioxide Sensor, Commissioning

8.20.2.1 DULCOTEST® CDP Chlorine Dioxide Sensor, Assembly

Assembly

Pouring electrolyte

IMPORTANT
- The membrane at the lower end of the membrane cap and the electrodes at the lower end of the electrode shaft should not be touched, damaged or brought into contact with greasy substances! Otherwise the sensor will not work correctly. If this is the case, replace membrane cap or return the sensor for cleaning the electrodes.
- The gel electrolyte is not toxic and can be easily removed from skin/clothing with water.

NOTE
Carry out the following steps at the washbasin!

- Open the electrolyte bottle and screw on the nozzle.
- Remove the red cap completely from the nozzle and cut off the end of the nozzle.
- Remove the membrane cap and unscrew the membrane cap from the electrode shaft.
- Place the spout of the electrolyte bottle vertically on the lower edge at the inside of the membrane cap without touching the membrane.
- Fill the membrane cap with electrolyte uninterruptedly up to the start of the thread; remove the spout in doing so, but it must always stay in the electrolyte. Only a few, very small bubbles may form.
- Check whether the membrane is completely wetted – the previously white membrane becomes dark. If required, wait some time. If not successful, repeat the filling.

Assembling membrane cap
- Locate the electrode shaft vertically onto the filled membrane cap and turn until the thread bites.
- Turn the electrode shaft such that the small hole below the hose gasket is pointed to the top.
- Slowly screw in the membrane cap by hand up to the stop (do not touch the hose gasket). The membrane may not bulge caused by the internal pressure because otherwise it becomes unusable! The excessive electrolyte flows out through the small hole below the hose gasket when screwing together the parts.
- Thoroughly rinse the leaked electrolyte from the sensor and your fingers under running water.

Assembling sensor

IMPORTANT
- The sensor must be slowly inserted into or withdrawn from the in-line probe housing! The membrane could otherwise be damaged.
- Do not touch the in-line probe housing flow resistor with the membrane!
- The sensor must be kept wet at all times once commissioned - e.g. the in-line probe housing must not be allowed to run dry.

Assemble the sensor as described in the operating instructions supplied with the in-line probe housing.
8.20.2.2 DULCOTEST® CDP Chlorine Dioxide Sensor, Installation

**IMPORTANT**
- The sensor is not electrically isolated from the sample water. All other elements must be isolated! The controller must be isolated both from the sensor and from the supply voltage!
- The supply voltage must not fall below 16 V DC, even for a short period! The current source must be able to sustain 35 mA at a min. 16 V DC! Insufficient supply voltage will result in an inaccurate reading!
- After the electrical connection of the sensor, the sensor has to be inserted into the sample water which has to contain chlorine dioxide.

The sensor incorporates a passive 4-20 mA two-wire interface, i.e. the power supply is provided externally e.g. via the controller.
- Safety requirements are automatically met if the sensor is connected to a ProMinent® controller (e.g. DULCOMETER® D1C).
- Do not switch off the measuring system when in intermittent use! If necessary, dosing equipment should be timer-controlled!

**Electrical Installation**
- Rotate the sensor adapter anticlockwise by 90 °C and remove (bayonet fitting).
- Unscrew the PG-7 threaded connector tensioning screw and insert the signal cable leading from the controller.
- Strip the ends of the cable and attach to the two-wire connector:
  - 1 = positive, 2 = negative
- Insert approx. 5 cm of signal cable into the sensor and tighten the PG-7 threaded connector tensioning screw.
- Insert the sensor adapter completely into the housing and screw together carefully to prevent damage to the ends of the bayonet connector.

8.20.2.3 DULCOTEST® CDP Chlorine Dioxide Sensor, Running-In

**IMPORTANT**
Do not switch off the measuring system during interval operation!

After operation without chlorine dioxide, running-in periods are to be reckoned with.
If required, switch on metering unit time-delayed!
If no chlorine dioxide is metered for a longer period of time, the sensor must be disconnected from the power supply and stored dry.

**Running-In Period**
The sensor requires a run-in period before it will display stable readings.
- Commissioning: 4 - 12 h
- Re-commissioning: 2 - 4 h
- Membrane-/electrolyte replacement: approx. 1 h
8.20.2.4 DULCOTEST® CDP Chlorine Dioxide Sensor, Calibration

Calibration
The sensor can be calibrated after the run-in period.

IMPORTANT
• A slope test must be carried out after replacing the diaphragm cap or electrolyte!
• Slope tests must be carried out at regular intervals to ensure correct functioning of the sensor! For testing drinking water, calibration of the sensor every 3 - 4 weeks is sufficient.
• Avoid incorrect dosing due to air bubbles in the water. Air bubbles clinging to the sensor diaphragm can reduce the measured variable and thereby lead to overdosing.
• Observe applicable national directives for calibration intervals!

Preconditions
• The sensor is run-in
• Constant flow to the in-line probe housing
• Constant sample water temperature
• Same sample water and sensor temperatures (wait approx. 15 min.)

Zero Point Calibration
If a ProMinent controller is being used to operate the sensor there is no need for zero point calibration. Zero point calibration should be carried out, however, if operating the sensor in the lower measurement range.

Preconditions
• Insert the sensor into a container of clean, ozone-, chlorine and ClO₂-free water.
• Stir with the sensor until the measured variable displayed at the controller has remained stable for 5 min.
• Calibrate the controller to zero in accordance with the operating instructions.
• Replace sensor into the in-line probe housing (DGM; DLG).

Slope Test
• Determine the chlorine dioxide content in the sample water using an appropriate measurement device (e.g. DPD-1).
• Set the resulting value at the controller in accordance with the operating instructions.

Repeat calibration after 1 day!

NOTE
Calibration at high temperatures
As chlorine dioxide, in contrast to chlorine, is only physically dissolved in water, it evaporates out of the liquid very quickly at high temperatures (> 30 °C). We therefore recommend that you act quickly when carrying out the DPD measurement. There should be no more than 1 min. between the sample extraction and the addition of reagents. Therefore the reagent should be added directly at the sample extraction point and measurement should follow as soon as possible afterwards in the laboratory.
### Chlorine Dioxide Sensor CDP

#### Calibration of the Chlorine Dioxide Sensor
During the calibration the DULCOMETER® D1C switches the control outputs to "0". Exception: where a basic load or a manual control variable has been entered it is retained throughout the calibration. The standard mA signal outputs (measured value or correction value) are frozen. The measured value registered during the start of the calibration is proposed as the DPD value; this value is adjustable (arrow keys!).

Calibration is only possible if the DPD value is ≥ 2 % of the measuring range. On successful completion of calibration, all error checks which refer to the measured value are restarted.

**IMPORTANT**
The measuring range of the sensor must agree with the set measuring range (factory setting: 0–2 ppm). The measuring range must be reset prior to calibration!

#### Error Messages

<table>
<thead>
<tr>
<th>Error message</th>
<th>Condition</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration ClO₂ not possible!</td>
<td>ClO₂ slope too low (&lt;25 % of standard slope)</td>
<td>Calibrate again</td>
</tr>
<tr>
<td>Calibration ClO₂ not possible!</td>
<td>ClO₂ slope too high (&gt;300 % of standard slope)</td>
<td>Calibrate again</td>
</tr>
<tr>
<td>DPD value too low</td>
<td>DPD &lt; 2 % of measuring range</td>
<td>Calibrate again after adding chlorine dioxide</td>
</tr>
<tr>
<td>DPD &gt; x.xx ppm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Permanent Display 1**

- **CL2-CDIO2-012-GB**
- **Chlorine Dioxide Sensor CDP**

---

**Permanent Display 2**

- **Auto.:** 30.0 °C
- **DPD value:** 0.60 ppm
- **Feed fwd:** 70 %
- **Ctrl out:** 59 %
- **W:** 0.60 ppm

---

**Table of Possible Values**

<table>
<thead>
<tr>
<th>Initial value</th>
<th>Increment</th>
<th>Lower value</th>
<th>Upper value</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>0.01 ppm</td>
<td>0 ppm</td>
<td>20 ppm</td>
<td></td>
</tr>
</tbody>
</table>

---

**Diagram:**

- Calibration ClO₂
- DPD value
- Temp.: 30.0 °C
- ClO₂ zero p.: 4.00 mA
- ClO₂ slope: 6.50 mA/ppm
- DPD-value: 0.60 ppm
- Temp.: 30.0 °C
- ClO₂ zero p.: 4.00 mA
- ClO₂ slope: 6.75 mA/ppm
**8.20.3 DULCOMETER® D1C and DULCOTEST® CDP Chlorine Dioxide Sensor, Troubleshooting**

### Controller

<table>
<thead>
<tr>
<th>Fault</th>
<th>Fault text</th>
<th>Symbol</th>
<th>Effect on control</th>
<th>Alarm with self-</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value</td>
<td>Check ClO₂ sensor</td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Function defeatable</td>
</tr>
<tr>
<td>Signal excitation</td>
<td>Check ClO₂ input</td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>Signal &lt; 3 ± 0.2 mA or &gt; 25 ± 0.2 mA</td>
</tr>
<tr>
<td>Calibration sensor with error</td>
<td>Check ClO calibration</td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>Measuring deviation in case of error with already measured value</td>
</tr>
<tr>
<td>Correction variable</td>
<td>Temp. input</td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>ClO₂ signal &gt; 150 ± 5 % or signal &lt; 25 ± 0.2 mA</td>
</tr>
<tr>
<td>Feedback control</td>
<td>Check feed forward input</td>
<td>€</td>
<td>Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Signal &lt; 3 ± 0.2 mA or &gt; 25 ± 0.2 mA</td>
</tr>
<tr>
<td>Limit transgression after checkout time limit value</td>
<td>ClO₂ limit 1 / ClO₂ limit 2</td>
<td>€</td>
<td>Stop or Basic load</td>
<td>Stop</td>
<td>Yes</td>
<td>Function defeatable</td>
</tr>
<tr>
<td>Servomotor</td>
<td>Position not reached</td>
<td>€</td>
<td>Yes</td>
<td>Servomotor closes</td>
<td>Check servomotor</td>
<td></td>
</tr>
<tr>
<td>Electronics error</td>
<td>System error</td>
<td>€</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
<td>Calibrate data defective</td>
</tr>
</tbody>
</table>

### Operation

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Effect on control</th>
<th>Alarm with self-</th>
<th>Remarks</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pause contact</td>
<td>Pause</td>
<td>Stop</td>
<td>Stop</td>
<td>No/Yes</td>
</tr>
<tr>
<td>Stop button</td>
<td>Stop</td>
<td>Stop</td>
<td>Stop</td>
<td>Yes</td>
</tr>
<tr>
<td>Storing calibration of sensor</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Sensor slope too low</td>
<td>Basic load</td>
<td>Step</td>
<td>Stop</td>
<td>No</td>
</tr>
<tr>
<td>DPD value &gt; 2% measuring range</td>
<td>DPD too low</td>
<td>Step</td>
<td>Stop</td>
<td>No</td>
</tr>
<tr>
<td>Zone point</td>
<td>Zero point low</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
</tr>
<tr>
<td>Zone point high</td>
<td>Zero point high</td>
<td>Basic load</td>
<td>Stop</td>
<td>No</td>
</tr>
</tbody>
</table>

*Depending on whether “Alarm on” or “Alarm off” set in “General settings”.*
Sensor: Troubleshooting

**Fault**

**The sensor cannot be calibrated - meter/controller display value is greater than DPD-1 measurement**

- Run-in period too short
- Diaphragm cap damaged
- Interference from water contaminant
- Short circuit in signal cable
- DPD chemicals spent

**Possible cause**

**Remedy**

- See “Run-in Period”
- Replace diaphragm cap. Run-in sensor, calibrate
- Identify interfering contaminant and implement remedy
- Identify short circuit and repair
- Use new DPD chemicals, repeat calibration

**The sensor cannot be calibrated - meter/controller display value is smaller than DPD-1 measurement**

- Run-in period too short
- Diaphragm cap deposits
- Sample water flow inadequate
- Air bubbles on the outside of the diaphragm
- Reference electrode spent (shiny patches showing)
- Surfactant in water (diaphragm is translucent)
- No electrolyte in diaphragm cap
- Electrolyte is penetrating sample water via gas bubbles

**Possible cause**

**Remedy**

- See “Run-in Period”
- Remove deposits (see “Maintenance”). Replace diaphragm cap. Run-in sensor, calibrate
- Correct the flow
- Tap to remove air bubbles and increase flow if necessary
- Return sensor
- Remove surfactant and replace diaphragm cap. Run-in sensor, calibrate; use CDP sensor
- Add new electrolyte (see “Assembly”, “Run-in Period” and “Calibration”)
- Discuss with ProMinent

**Measuring value readout is “Zero”**

- Interference from water contaminant
- ClO₂ content below the lower measuring range limit
- Sensor incorrectly connected to controller

**Possible cause**

**Remedy**

- Identify interfering contaminant and if necessary replace water
- Add ClO₂ and then repeat calibration or use appropriate sensor
- Connect sensor correctly to controller

**Measuring value readout unstable**

- Air bubbles on the outside of the diaphragm
- Diaphragm damaged
- Cause lies with the controller

**Possible cause**

**Remedy**

- Tap to remove air bubbles and increase flow if necessary
- Replace diaphragm cap, Run-in sensor, calibrate
- Identify cause and remedy
Chlorine Dioxide Sensor CDP

8.20.4 DULCOMETER® D1C Measured Variable Chlordioxid and DULCOTEST® CDP Chlorine Dioxide Sensor, Maintenance

The DULCOMETER® controller type D1C for the measured variable chlorine dioxide is maintenance-free.

Sensor

**IMPORTANT**
- The sensor must be regularly serviced in order to avoid overdosing due to sensor failure!
- Observe applicable national directives for servicing intervals!
- Do not touch the electrodes or bring them into contact with greasy substances!

**Maintenance interval**
Daily/weekly servicing intervals depending upon application.

**Maintenance Work**
- Check the sensor display value at the controller using an appropriate chlorine dioxide measuring system (e.g. DPD-1).
- Recalibrate the sensor if necessary.

**Cleaning the Membrane**
If the membrane is dirty and is preventing calibration of the sensor you can try to clean the membrane gently.
First dismantle the sensor as described in the sensor dismantling section. Observe safety guidelines! Removal of surface contamination.
- Rinse the membrane under a gentle stream of cold water.

**IMPORTANT**
- Never try to clean the membrane with acids/alkalis or mechanical means (brush or similar).
- If the sensor cannot be calibrated after membrane cleaning, the membrane cap has to be replaced by a new one.

**Replacing the Membrane**
If calibration is no longer possible after cleaning the membrane, or if the membrane is damaged it must be replaced.
At first, the old membrane cap is removed and the gel adhering to the electrodes is rinsed off under running water as best as possible. Remnants of the gel can be removed using a soft paper tissue. Wipe carefully across the sensor, in particular the reference system (brown ring). Then, fill a new membrane cap with gel electrolyte and screw it on (see “Mounting”).
9 Deviating Settings of the Controller

9.1 Deviating Measuring Ranges

The D1C controllers of the measuring/control stations DULCOTROL® drinking water/F&B are delivered to the customer ready for operation. Settings for the measuring ranges are not required.

For Repair or Replacement
For many amperometric sensors, the measuring range deviates from the standard measuring range (default value) of the controller. When repairing or replacing the controller these values may have to be corrected or adjusted. For this purpose, the controller’s measuring range values, which are documented in the individual operating instructions, must be checked and modified, if required.

To do so, the respective controller must be adjusted to the measuring range of the sensor. The procedure is described in the individual operating instructions for the controller. The respective setting values with regard to controller/sensor are listed in the table below.

<table>
<thead>
<tr>
<th>Measured variable</th>
<th>Default measuring range D1C</th>
<th>Sensor type</th>
<th>Readjustment of the measuring range to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peracetic acid</td>
<td>2,000 ppm</td>
<td>PAA-1 - mA - 2,000 ppm</td>
<td>Not required 200 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PAA-1 - mA - 200 ppm</td>
<td></td>
</tr>
<tr>
<td>Free chlorine</td>
<td>2 ppm</td>
<td>CLE 3 - mA - 0.5 ppm</td>
<td>0.5 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CLE 3 - mA - 2.0 ppm</td>
<td>Not required</td>
</tr>
<tr>
<td>Total chlorine</td>
<td>CTE 1 - mA - 0.5 ppm</td>
<td>0.5 ppm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CTE 1 - mA - 2.0 ppm</td>
<td>Not required</td>
<td></td>
</tr>
<tr>
<td>Chlorine dioxide</td>
<td>CDE 2 - mA - 0.5 ppm</td>
<td>0.5 ppm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CDE 3 - mA - 0.5 ppm</td>
<td>0.5 ppm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CDP 1 - mA - 2.0 ppm</td>
<td>Not required</td>
<td></td>
</tr>
<tr>
<td>Fluoride</td>
<td>10 ppm</td>
<td>Transducer FPV 1</td>
<td>Not required</td>
</tr>
<tr>
<td>Hydrogen peroxide</td>
<td>200 ppm</td>
<td>PER 1 mA - 200 ppm</td>
<td>Not required 2,000 ppm</td>
</tr>
<tr>
<td>Oxygen</td>
<td>10 ppm</td>
<td>DO 1 - mA - 20 ppm</td>
<td>20 ppm</td>
</tr>
<tr>
<td>Ozone</td>
<td>2 ppm</td>
<td>OZE 3 - mA - 2 ppm</td>
<td>Not required</td>
</tr>
</tbody>
</table>

For the measured variable “Inductive conductivity” it may be required to adjust the sensor type when repairing or replacing the controller D1C.

<table>
<thead>
<tr>
<th>Measured variable</th>
<th>Sample water</th>
<th>Default sensor type for D1C</th>
<th>Used sensor type</th>
<th>Readjustment of the sensor type for D1C to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductive conductivity</td>
<td>2/4/6</td>
<td>ICT 1</td>
<td>ICT 3</td>
<td>ICT 3</td>
</tr>
</tbody>
</table>

The exact procedure is described in the individual operating instructions for the controller. For an exact assignment and designation of the individual operating instructions, please see the list “further applicable documents” in the annex of the present instructions.
9.2 Setting of the Pause Contact for Flow Monitoring

Flow Monitoring

**IMPORTANT**
The flow of the sample water must be monitored because varying or faulty readings may result in case of insufficient or no flow!

For a DULCOMETER® D1C as single unit, the flow monitoring is designed as make contact as standard (default). A cable break cannot be monitored.

For the DULCOMETER® D1C of the measuring/control stations DULCOTROL® drinking water/F&B, this flow monitoring is factory-designed as break contact. In case of cable break or if a certain minimum flow rate to be set is undershot, an alarm is triggered. The controlling goes to "Pause" and the display of the controller D1C shows "Pause".

<table>
<thead>
<tr>
<th>Settings menu</th>
<th>Core in the flow meter</th>
<th>Maximum limit value contact</th>
<th>Alarm relay</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;active open&quot;</td>
<td>top</td>
<td>closed</td>
<td>off</td>
<td>&quot;Pause&quot;</td>
</tr>
<tr>
<td></td>
<td>bottom</td>
<td>open</td>
<td>on</td>
<td></td>
</tr>
</tbody>
</table>

The minimum flow rate value can be adjusted by moving the limit value contact at the flow meter to the top and bottom, resp.

For all types of the flow monitoring, the alarm relay is activated:

Access to all setting menus can be blocked with an access code!
### 10 Maintenance

**CAUTION**

- Please also read the operating instructions of the fittings and any other existing assemblies such as sensors, sample water pump …!
- Please observe the safety data sheets for the media involved in your process!

The following component parts of the DULCOTROL® measuring/control stations require the following servicing:

<table>
<thead>
<tr>
<th>Component part</th>
<th>Maintenance</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>For installation with continuous flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parts with sample water flow</td>
<td>Check for leakages</td>
<td>According to internal specifications of the station’s operator</td>
</tr>
<tr>
<td>Flow monitoring</td>
<td>Test the flow monitoring:</td>
<td>According to internal specifications of the station’s operator</td>
</tr>
<tr>
<td></td>
<td>► Note the flow rate value</td>
<td></td>
</tr>
<tr>
<td></td>
<td>► Reduce the flow rate - the controller must go to “Pause”.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>► Set again the noted flow rate value</td>
<td></td>
</tr>
<tr>
<td>For rinsed and depressurised installation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample water pump</td>
<td>See operating instructions in the annex</td>
<td>See operating instructions in the annex</td>
</tr>
<tr>
<td>Filter</td>
<td>Clean, if not possible, replace cartridge</td>
<td>If required, depending on the contamination level of the sample water</td>
</tr>
<tr>
<td>Pressure reducer VB2</td>
<td>See manufacturer’s documentation in the annex</td>
<td>See manufacturer’s documentation in the annex</td>
</tr>
<tr>
<td>Pressure reducer Honeywell</td>
<td>See manufacturer’s documentation in the annex</td>
<td>See manufacturer’s documentation in the annex</td>
</tr>
<tr>
<td>Sensor</td>
<td>Maintenance: See operating instructions of the sensor</td>
<td>See operating instructions of the sensor</td>
</tr>
</tbody>
</table>
11 Troubleshooting

CAUTION

- Please also read the operating instructions of the controllers and fittings and any other existing assemblies such as sensors, sample water pump … !
- Please observe the safety data sheets for the media involved in your process!

NOTE

- With terminal box: A terminal diagram is enclosed with the documentation of the DULCOTROL® measuring/control station.

<table>
<thead>
<tr>
<th>Troubleshooting</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>No or insufficient sample water flow</td>
<td>Filter clogged</td>
<td>Clean or replace filter. See manufacturer’s documentation</td>
</tr>
<tr>
<td>Sample water pump with no or insufficient function</td>
<td>Control and repair of the electrical supply, if required. See terminal diagram.</td>
<td></td>
</tr>
<tr>
<td>Heat exchanger clogged</td>
<td>Mechanical causes:</td>
<td>See manufacturer’s documentation</td>
</tr>
<tr>
<td>Malfunction of the pressure reducer</td>
<td>Check, clean and replace, if required, pressure reducer. See manufacturer’s documentation</td>
<td></td>
</tr>
<tr>
<td>Clogging of the piping system</td>
<td>Check and clean, if required, piping system</td>
<td></td>
</tr>
<tr>
<td>Inadequate metering and control performance</td>
<td>Controller with no or insufficient function</td>
<td>Control and repair of the electrical supply, if required. See terminal diagram and operating instructions of the controller</td>
</tr>
<tr>
<td>Defective or inaccurately calibrated sensors</td>
<td>See the operating instructions of the sensor, chapter “Troubleshooting”, and the operating instructions of the controller, chapter “Errors / Notes / Troubleshooting”</td>
<td></td>
</tr>
<tr>
<td>Inadequate composition and/or concentration of the metering media</td>
<td>Control and repair of the electrical supply, if required. See terminal diagram.</td>
<td></td>
</tr>
<tr>
<td>Incorrect assignment of the metering media</td>
<td>Check the assignment of the metering media and correct, if required</td>
<td></td>
</tr>
</tbody>
</table>
12 Decommissioning and Disposal

CAUTION
- The controller may only be disconnected from the mains supply by a qualified electrician!
- Thoroughly flush the sample water line with a suitable medium (see data safety sheet)!
- Please also read the operating instructions of the controllers and fittings and any other existing assemblies such as sensors, sample water pump ...
- Also in case of a short time of decommissioning (up to 12 h): Observe the operating instructions of the sensor!
- Please observe the safety data sheets for the media involved in your process!
- In case of temporary or long-term decommissioning. Close the ball valves such that the sensors remain surrounded by sample water.

12.1 Temporary or Long-Term Decommissioning

CAUTION
- Please observe the safety data sheets for the media involved in your process!
- Please also read the operating instructions of the controllers and fittings and any other existing assemblies such as sensors, sample water pump ...

12.2 Final Decommissioning

CAUTION
- Please observe the safety data sheets for the media involved in your process!
- Please observe the respective applicable local regulations!
- In Germany, used parts can be disposed of at the municipal collection points of the cities and municipalities. You may return the used parts to the ProMinent Dosiertechnik GmbH, Heidelberg, against a low fee and prepaid postage.
- Please also read the operating instructions of the controllers and fittings and any other existing assemblies such as sensors, sample water pump ...
- The electrolyte of the sensors can be caustic!
- Collect leaking electrolyte. Wear suitable gloves and safety goggles.
- Remove contaminations with a lot of water. Dispose of waste water in a way harmless to the environment.

13 Replacement Parts

Please also note the listings in the operating instructions of the controllers and fittings and any other existing assemblies such as sensors, sample water pump ...

Any other replacement parts can be ordered from our customer service.
## 14 List of Further Applicable Documents

The following further applicable documents depending on the Identcode of the order system are listed in the annex to these operating instructions.

<table>
<thead>
<tr>
<th>Title</th>
<th>Part no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 1: Mounting and installation instructions for Wall-Mounted and Control Panel-Mounted Devices</td>
<td>987725</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D2C Part 1: Mounting and installation instructions for Wall-Mounted and Control Panel-Mounted Devices</td>
<td>987613</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation, Measured Variable Conductive Conductivity</td>
<td>987926</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation Measured Variable Inductive Conductivity</td>
<td>986954</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation, Measured Variable Ozone</td>
<td>987698</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation, Measured Variable Peroxid Acid (PAA) for PAA 1 Probe</td>
<td>986976</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation, Measured Variable Chlorine Dioxide</td>
<td>987134</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation, Measured Variable Chlorine</td>
<td>987905</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation, Measured Variable Redox/ORP</td>
<td>987850</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation, Measured Variable Hydrogen Peroxide for Sensor PER 1</td>
<td>986847</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation, Measured Variable pH</td>
<td>987867</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation, Measured Variable Fluoride</td>
<td>987306</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation, Measured Variable Bromine</td>
<td>987353</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation, Measured Variable Chlorite</td>
<td>987028</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation, Measured Variable Temperature</td>
<td>981809</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D1C Part 2: Adjustment and Operation, Measured Variable Oxygen</td>
<td>987139</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D2C Part 2: Adjustment and Operation, Measured Variables pH/Clorine</td>
<td>987855</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D2C Part 2: Adjustment and Operation, Measured Variables pH/ORP</td>
<td>987822</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D2C Part 2: Adjustment and Operation, Measured Variables pH/Chlorine Dioxide</td>
<td>986736</td>
</tr>
<tr>
<td>Operating Instructions DULCOMETER® D2C Part 2: Adjustment and Operation, Measured Variables pH/ORP</td>
<td>987661</td>
</tr>
<tr>
<td>Operating Instructions In-Line Probe Housing DGMa</td>
<td>987356</td>
</tr>
<tr>
<td>Operating Instructions In-Line Probe Housing DLG III and DLG IV</td>
<td>986461</td>
</tr>
<tr>
<td>Operating Instructions DULCOTEST® CLT 1 Sensor for Chlorite</td>
<td>987069</td>
</tr>
<tr>
<td>Operating Instructions DULCOTEST® Sensor for Dissolved Oxygen</td>
<td>987199</td>
</tr>
<tr>
<td>Operating Instructions DULCOTEST® CTE Sensor for Total Chlorine</td>
<td>987371</td>
</tr>
<tr>
<td>Operating Instructions DULCOTEST® CLE Chlorine Sensor for Free Chlorine</td>
<td>987376</td>
</tr>
</tbody>
</table>
### List of Further Applicable Documents

<table>
<thead>
<tr>
<th>Title</th>
<th>Part no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Instructions DULCOTEST® PAA Sensor for Peracetic Acid</td>
<td>986961</td>
</tr>
<tr>
<td>Operating Instructions DULCOTEST® OZE Ozone Sensor for Ozone</td>
<td>986617</td>
</tr>
<tr>
<td>Operating Instructions DULCOTEST® ICT 2 Inductive Conductivity Sensor</td>
<td>986948</td>
</tr>
<tr>
<td>Operating Instructions DULCOTEST® PER Sensor for Hydrogen Peroxide</td>
<td>986884</td>
</tr>
<tr>
<td>Operating Instructions DULCOTEST® CLE 3.1-mA Chlorine Sensor for Free Chlorine</td>
<td>987320</td>
</tr>
<tr>
<td>Operating Instructions DULCOTEST® CDE Chlorine Dioxide Sensor</td>
<td>986656</td>
</tr>
<tr>
<td>Operating Instructions DULCOTEST® CDP 1-mA-2 ppm Chlorine Dioxide Sensor</td>
<td>986477</td>
</tr>
<tr>
<td>Operating Instructions Conductivity Sensor Type LF 1 DE/LFT 1 DE</td>
<td>987825</td>
</tr>
<tr>
<td>Operating Instructions DULCOTEST® BRE Sensor for Bromine BRE 1-mA-10 ppm, BRE 1-mA-2 ppm, BRE 2-mA-10 ppm</td>
<td>987341</td>
</tr>
<tr>
<td>Recommendations for Handling and Servicing Fluoride Sensors FLEP 010 SE/FLEP 0100 SE</td>
<td>986544</td>
</tr>
<tr>
<td>Recommendations for Handling and Servicing pH and redox (ORP) combination probes</td>
<td>985830</td>
</tr>
<tr>
<td>Data Sheet pH-Combination Probes PHEP 112 SE</td>
<td>987835</td>
</tr>
<tr>
<td>Data Sheet Redox-Combination Probes RHER-Pt-SE</td>
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<td>Technical Documentation Pressure reducing valve doc.request.pdf</td>
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<td>VIESSMANN VITOTRANS 100 Plate-type heat exchanger Vítotrans_100 Wärmetauscher.pdf</td>
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EC Declaration of Conformity

ProMinent Dosiertechnik GmbH
Im Schuhmachergewann 5 - 11
D - 69123 Heidelberg

We, hereby declare that, on the basis of its functional concept and design and in the version brought into circulation by us, the product specified in the following complies with the relevant, fundamental safety and health stipulations laid down by EC regulations. Any modification to the product not approved by us will invalidate this declaration.

Product description: Measuring and control technology mounted on plates

Product type: PWCa...

Serial number: see type identification plate on device

Relevant EC regulations:
- EC - low voltage directive (2006/95/EC)
- EC - EMC - directive (2004/108/EC)

Harmonised standards used, in particular:
- EN 61010, EN 55014-1, EN 55014-2,
- EN 61000-3-3, EN 61000-6-2, EN 61000-6-3, EN 60529

Date/manufacturer’s signature: 07.01.2009

The undersigned: Dr. Johannes Hartfiel, assistant development manager
Addresses and delivery through manufacturer:

ProMinent Dosiertechik GmbH
Im Schuhmachergewann 5-11
D-69123 Heidelberg
Germany
Tel.: +49 6221 842-0
Fax: +49 6221 842-419
info@prominent.com
www.prominent.com