FOR HIGHEST STANDARDS INSTRUMENTATION

GLASS-LINED

-60°C TO +200°C

ION SENSITIVE PH VALUE 2.0

PLC CONTROLS

MAX

MIN

Pfaunder Defining the standard
Pfaudler Group
One single source responsibility with access to all Pfaudler Technologies, Solutions, Services worldwide

Since 1884, Pfaudler has grown to be a truly global, multinational and diverse company with approximately 1,400 employees and manufacturing facilities in nine countries on four continents, encompassing the Pfaudler, Montz, Edlon, GMM Pfaudler and Mavag brands.

Pfaudler Technologies and Solutions can be found around the globe. They are installed in more than 100 countries and across six continents. Chemical and pharmaceutical companies around the world rely on the quality, durability and performance of our Technologies to ensure their chemical process systems are efficient, reliable, profitable and safe.

The name Pfaudler has become synonymous with chemical processing and corrosion resistance. You will find examples

of the results of our advanced thinking throughout all areas of typical chemical and pharmaceutical plants because our portfolio of technologies covers all chemical unit operations.

Years of experience and highly qualified services are the basis for innovative and economic solutions for your requirements in the area of process equipment and systems.
Pfaudler Technologies
We help make the world around us. Much of what you see, taste and touch in the world was created or improved using Pfaudler Technologies.

Pfaudler Services
We provide 24/7 support for your entire plant.

Pfaudler Solutions
We design and build turn-key process.

Pfaudler Innovation
Our innovative spirit continuously drives us to develop the next great technology.
Sectors and Applications
Advantages of the glass-lined measurement technology

**Sectors**
In the *chemical and pharmaceutical industries*, Pfaudler has been synonymous with glass-lined vessels and components for decades. But glass-lined measurement technology offers **decisive benefits in other sectors** as well.

**Applications**
Did you know that many *daily consumer products* are made using Pfaudler technology? Here are just a few examples.

Beer · Yoghurt · Cheese · Rice · Sugar · Mayonnaise · Cheese spread · Herb butter · Ketchup · Mustard · Crème fraîche · Jam · Syrup · Paper · Glue · Cream · Shampoo / shower gel · Hair perming products · Plant protection products

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemicals</td>
<td>Daily consumer products</td>
</tr>
<tr>
<td>Petrochemicals</td>
<td>(Beer · Yoghurt · Cheese · Rice · Sugar ·</td>
</tr>
<tr>
<td></td>
<td>Mayonnaise · Cheese spread · Herb butter ·</td>
</tr>
<tr>
<td>Pharma</td>
<td>Ketchup · Mustard · Crème fraîche · Jam ·</td>
</tr>
<tr>
<td>Energy</td>
<td>Syrup · Paper</td>
</tr>
<tr>
<td>Food</td>
<td>Cosmetics</td>
</tr>
<tr>
<td></td>
<td>Metal industry</td>
</tr>
</tbody>
</table>

4
Overview

Liquid analysis

Corrosion monitoring

Level measurement

Sampling Systems
Technology and Benefits
Advantages of the glass-lined measurement technology

**Technology**
Glass lining is a unique composite material that optimally combines the advantages of steel and glass. As a result, it not only offers outstanding protection against many aggressive media, but it is also abrasion-, pressure- and temperature-resistant. **This makes glass lining the perfect material for protecting measurement technology in demanding applications.**

But glass lining can do even more. Specially developed formulations react to H+ ions in liquid media, which makes them suitable for **pH measurement.**

Embedding sensors in the glass lining not only delivers **redox potential** and **conductivity measurements** but also ultra-fast reacting **temperature measurements** and **corrosion monitoring.**

**Benefits**

<table>
<thead>
<tr>
<th>Highly resistant glass layer</th>
<th>Robust steel body</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Resistant to aggressive acids, organic solvents and proteins</td>
<td>• Withstands turbulences, shear forces and high process pressures</td>
</tr>
<tr>
<td>• Resistant to Cleaning In Place (CIP) and Sterilisation In Place (SIP) processes</td>
<td>• Allows continuous inline monitoring</td>
</tr>
<tr>
<td>• Resistant to abrasion</td>
<td>• No need for bypass lines, pumps, shutoff devices or retractable holders</td>
</tr>
<tr>
<td>• Resistant to high temperatures</td>
<td></td>
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<tr>
<td>• Resistant to thermal shocks</td>
<td></td>
</tr>
<tr>
<td>• No catalytic or biological effects</td>
<td></td>
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</tbody>
</table>

**Self-cleaning**

• Prevents deposit formation with adequate flow velocity
• Suitable for adhesive products

**Durable**

• Service life limited only by glass corrosion or abrasion

**Analytical Data**

<table>
<thead>
<tr>
<th>PH Value</th>
<th>MIN</th>
<th>MAX</th>
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</thead>
<tbody>
<tr>
<td>2.0</td>
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</table>

**Level Measurement**

<table>
<thead>
<tr>
<th>MIN</th>
<th>MAX</th>
<th>TO</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>+200°C</td>
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</table>

**Corrosion Monitoring**

<table>
<thead>
<tr>
<th>GLAS</th>
<th>STEEL</th>
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</table>

**Anti-Sampling Systems**

**Low maintenance**

• No change in the pH characteristic curve over the entire service life
• Lower costs for recalibrations and cleaning processes
• Positive pressure effectively prevents diaphragm and electrolyte section contamination
• Maintenance intervals of up to one year
• Can be stored dry
Liquid Analysis
Because glass has its limits

Online liquid analysis permits automated monitoring and regulation of industrial processes in many sectors. In addition to pH, other important process control parameters include redox potential and conductivity. Pfaudler offers solutions for challenging applications in this field – because anyone can do the easy ones!

**pH measurement**
Whenever robustness and chemical resistance are key, Pfaudler’s low-maintenance and durable pH measurement systems are your first choice. We supply probes in various designs for virtually all process engineering applications. For hygienic processes, we offer specially developed probes with EHEDG certification.

**Redox potential measurement**
The redox potential generated in oxidation and reduction processes can be determined by means of robust glass-lined probes. For this purpose, a rhodium electrode is embedded in the glass lining. By combining two measurement systems on one probe you can measure the pH and the redox potential concurrently.

**Conductivity measurement**
The conductivity of a medium can be determined with a durable glass-lined probe in a 4-conductor circuit. To achieve this, four rhodium electrodes are arranged behind each other on a measuring probe and fused into the probe carrier’s glass lining.

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- High mechanical strength and suitable for use in high temperatures
- Proof against glass breakage
- Can be used without a retractable system or bypass installation
- CIP and SIP compliant
- Self-cleaning and low-maintenance

- High mechanical strength and chemical resistance through the use of glassed steel and fused-in rhodium electrodes
- Suitable for high temperatures
- Dirt-resistant
- Combination with pH measurement possible

- Wide measurement range 0.01 mS to 2000 mS
- Suitable for high temperatures
- Standard use at up to 40 bar positive pressure
- Dirt-resistant
- Suitable as ring probe for phase separation and ‘empty’ signal
The pH value is one of the most important and commonly measured values in many fields of process engineering. The stability of the entire production process can be increased by regulating the pH value in a targeted way. Thanks to their maintenance-free operation and long service lives, robust glass lined pH probes are a cost-effective option for constant use.

**Steel probe body**

The glass lined pH probe comprises a steel probe body with a highly-resistant, anti-adhesive technical glass lining to protect the surface in contact with the product. This makes the probe resistant to mechanical strain by flows, pressure, abrasion and vibrations. Probes can therefore be installed in piping and vessels where they are directly exposed to the flow, enabling direct continuous online measurement in the main product stream. Moreover, the smooth surface the glass lining gives the probe protects it against corrosion and product build-up. Combined with a pressurised electrolyte system, these properties allow the probe to be installed in any position and direction, so the pH sensor can be installed directly at the point of use.

**No aging**

Unlike in glass electrodes, there is no internal buffer (discharge electrode). In contrast to conventional glass electrodes, the ion-sensitive glass area is only in contact with the process medium on one side. This prevents ageing and drift of the pH sensor.

The operating life of a Pfaudler pH probe is depending of chemical corrosion and abrasion (diagram corrosion resistance).
**Structure of pH-Glass-lining**

- **Steel**
- **Pfaudler-Glass**
- **pH-glass-lining**
- **Aqueous solution**
- **potential dissipation**
- **Metal-contact zone** (Transition of ions to electron conduction)
- **pH-glass-mainzone**
- **pH-Glass-Transition zone** (Depletion of alkali ions by hydration)

**Characteristic curve of pH measurement**

![Characteristic curve of pH measurement](image)

- Zeropoint = Isothermpoint
- $\Delta mV = \Delta pH$
- $S = \frac{\Delta mV}{\Delta pH}$
- $T = 25 ^\circ C$
- $T = 80 ^\circ C$
**Absolute pH-measurement principal**

pH determination is a potentiometric (electrochemical) analysis method. A typical measuring setup with absolute pH probes comprises two electrodes – a measuring electrode immersed in a process medium and a reference electrode immersed in an electrolyte liquid. The measuring electrode generates a potential that clearly identifies the chemical condition (hydrogen ion concentration) of the medium to be measured. The reference electrode provides a constant known potential that is independent of the composition of the process medium. A transmitter connected to the pH measuring probe calculates the medium’s pH value from the difference in potential between the two electrodes, depending on the measured temperature.

The pH value is now an absolute ph value.

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**Glass-lined pH Probes**

For highest heavy-duty process standards

- **ROD PH-PROBE TYPE 03 N**
- **ROD PH-PROBE TYPE 03 K**
- **RING PH-PROBE TYPE 03 N**
Relative pH-measurement principal

Differential pH probes provide values measured against a product-dependent reference parameter. The measured value is therefore a product-specific value (relative pH measurement) that allows a statement as to whether a process is performed according to defined specifications. This measured value is therefore ideal for controlling and monitoring recurring batch processes (e.g. formulations without changes) or continuous measurement. Differential pH probes are simple in structure: two ion-sensitive enamels are fused onto a steel probe carrier and form the measuring part of the sensor. One sensor surface responds to H+ ions and provides a potential that depends only on the pH value; this is called the pH glass.

The other sensor surface – the reference glass or reference electrode – responds to the salts dissolved in the liquid, especially the Na+ ions present, and thus provides a product-specific reference potential. Once the transmitter has been configured with data from the measurement and test report provided, the pH differential probe is calibrated in its installed position using a product sample. The probe then works like a “normal absolute” pH measurement device in the specified range. The special relative measurement principle means that the probe functions without an electrolytic liquid. This eliminates the risk of the product being contaminated by the electrolyte and ensures practically maintenance-free operation.

PH-PROBE TYPE 18

ROD PH-PROBE TYPE 40

RING PH-PROBE TYPE 40
Glass-lined pH Probes
For highest hygienic process standards

In food production, the pH value is an important indicator of consistent quality, taste and reproducibility in a product, and a significant variable during and after cleaning of the production facilities. The compact probe named pH-Reiner was consistently matched to the needs of the foodstuffs, pharmaceutical and biotech industries.

The measuring electrode with a large surface area consists of pH-sensitive glass that is fused on to the lower end of the glassed probe carrier in an annular shape. The area of the measuring electrode is a multiple of that of glass electrodes. Therefore, precision measurements of the pH value can even be carried out in those media in which measurement ceased to be possible using other methods. In contrast to conventional glass electrodes, the pH glass is in contact with the fluid on one side only. Aging of the probe or measured value drifts are not possible with this probe. The reference electrode necessary for the pH measuring chain is integrated in the probe head. The electrolyte connection between the reference electrode and the product is made using a tube and a shrink, aseptic ground diaphragm. The electrolyte is contained in a PE bottle that is placed in a stainless steel pressure vessel and the electrolyte bottle can be replaced without affecting sterile conditions.

A special, sterile Pfaudler electrolyte is used as a standard. If necessary, infusion solutions such as a sterile saline solution, may also be used as electrolyte. The electrolyte system is pressurized, therefore, the pressure inside the electrolyte system is always higher than the operating pressure inside the reactor or piping. Therefore, no product can enter the probe or contaminate the diaphragm. The pH Reiner probe can be cleaned and sterilized in-line (up to 134 °C) without losing its characteristics.

Easy to clean

Reconditioning the pH Reiner probe after cleaning with alkali
Regeneration time (min) After 30min CIP using 2% NaOH at 85 °C

\[ \Delta pH \text{ (min)} \]

<table>
<thead>
<tr>
<th>Temperature</th>
<th>pH Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>135 °C steam</td>
<td>0</td>
</tr>
<tr>
<td>95 °C water</td>
<td>-0.1</td>
</tr>
<tr>
<td>80 °C water</td>
<td>-0.2</td>
</tr>
<tr>
<td>25 °C water</td>
<td>-0.3</td>
</tr>
</tbody>
</table>

0 10 20 30 40 50 60 70 80 min
**Redox potential measurement**

Several variants of our probes are designed for measuring redox potential. Like other Pfaudler measuring probes, these are robust and resistant to attack. Their function is to measure the redox potential arising in oxidation or reduction processes. This measurement is carried out with a noble metal electrode against a reference electrode.

The redox potential is measured between a rhodium electrode embedded in the enamel and a pH enamel reference electrode. The magnitude of the potential occurring at the reference electrode depends on the pH value of the product. Thus, a redox voltage is obtained which is not dependent on the pH value. The rH measuring probe is chemically highly resistant: the measuring electrode is made of rhodium, the reference electrode of pH enamel.

**The combined measuring probe pH/rH**

The combination of both measuring systems on one carrying tube makes possible the simultaneous measurement of pH value and redox potential.
Conductivity measurement

In the LF measuring probe, four metal (rhodium) electrodes are aligned longitudinally and fused into the enamel coating of the probe carrier. Thermometer tubes, baffles or spacer rings may be used as probe carriers. The cell constant is dependent on the geometry and location of the probe and cannot be predetermined. For this reason, a fourwire circuit is used. A constant alternating current flows across the two outer electrodes and through the product. The resultant voltage drop is sensed by the two inner electrodes and transmitted to a high-impedance measuring transmitter.
## Technical Data

### Product overview

<table>
<thead>
<tr>
<th>Type</th>
<th>pH 03 N/K/Ring</th>
<th>pH 03 N/Dual</th>
<th>pH Reiner</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measured value</strong></td>
<td>Absolute pH</td>
<td>Absolute pH (2x)</td>
<td>Absolute pH</td>
</tr>
<tr>
<td><strong>Reference system</strong></td>
<td>Diaphragm + reference electrode</td>
<td>Diaphragm + reference electrode</td>
<td>Ground-joint diaphragm (ceramics), reference electrode AgAgCl</td>
</tr>
<tr>
<td><strong>Measuring range</strong></td>
<td>0 to 10 pH</td>
<td>0 to 10 pH</td>
<td>Linear range 0 to +10* pH / application range -2 to +14** pH</td>
</tr>
<tr>
<td><strong>Operating temp.</strong></td>
<td>0 to +140 °C</td>
<td>0 to +140 °C</td>
<td>0 to +140 °C</td>
</tr>
<tr>
<td><strong>Temperature compensation</strong></td>
<td>Pt 100</td>
<td>Pt 100</td>
<td>Pt 1000</td>
</tr>
<tr>
<td><strong>Operating pressure</strong></td>
<td>-1 to +9 bar</td>
<td>-1 to +9 bar</td>
<td>-1 bis +6 bar</td>
</tr>
<tr>
<td><strong>Ex. protection</strong></td>
<td>II 1/2 G EEx ia IIB T6 or II 2G EEx ia IIC T6</td>
<td>II 1/2 G EEx ia IIB T6 or II 2G EEx ia IIC T6</td>
<td>--</td>
</tr>
<tr>
<td><strong>Electrical connection</strong></td>
<td>5-pin, Lemo</td>
<td>5-pin, Lemo</td>
<td>6-pin gold-plated, interconnex Variopin</td>
</tr>
<tr>
<td><strong>Degree of protection</strong></td>
<td>IP66 to IP68</td>
<td>IP66 to IP68</td>
<td>IP68</td>
</tr>
<tr>
<td><strong>Electrolyte</strong></td>
<td>Special Pfaudler KCL solution</td>
<td>Special Pfaudler KCL solution</td>
<td>Special sterile Pfaudler KCL solution</td>
</tr>
</tbody>
</table>

* depends on temperature  
** depends on alkali error  
*** other dimensions on request  
**** higher pressure on request
### pH 40 / pH 40 Ring

<table>
<thead>
<tr>
<th>Relative pH</th>
<th>Relative pH</th>
<th>Absolute pH and Redox potential</th>
<th>Redox potential</th>
<th>Conductivity</th>
</tr>
</thead>
</table>

### pH 18

| Reference enamel | Reference enamel | Diaphragm + reference electrode | Reference enamel | – |

### pH/ORP

| 3 to 12 pH | 3 to 12 pH | -1200 to +1500 mV 0 to 10 pH | -1200 to +1500 mV | 0.01 to 2000 mS/cm |

### rh

| 0 to +140 °C | 0 to +140 °C | 0 to +140 °C | 0 to +140 °C | -25 to +200 °C |

### LF/LF Ring

| Pt 100 | Pt 100 (optional) | Pt 100 | Pt 100 (optional) | Pt 100 |

### Measuring range

| 0 to 10 pH | 0 to 10 pH | -1200 to +1500 mV 0.01 to 2000 mS/cm |

### Operating temp.

| 0 to +140 °C | 0 to +140 °C | 0 to +140 °C | 0 to +140 °C | 0 to +140 °C | 0 to +140 °C | 0 to +140 °C | 0 to +140 °C |

### Temperature compensation

| Pt 100 | Pt 100 | Pt 100 (optional) | Pt 100 | Pt 100 (optional) | Pt 100 |

### Operating pressure

| -1 to +9 bar | -1 to +9 bar | -1 to +9 bar | -1 to +40**** bar | -1 to +40**** bar |

### Ex. protection

| II 1/2 G EEx ia IIB T6 or II 2G EEx ia IIC T6 | II 1/2 G EEx ia IIB T6 or II 2G EEx ia IIC T6 | II 1/2 G EEx ia IIB T6 or II 2G EEx ia IIC T6 | II 1/2 G EEx ia IIB T6 or II 2G EEx ia IIC T6 |

### Dimensions (mm)


### Electrical connection

| 5-pin, Lemo | 5-pin, Lemo | 6-pin gold-plated, interconnex Variopin | 5-pin, Lemo | 5-pin, Lemo |

### Degree of protection

| IP66 to IP68 | IP66 to IP68 | IP68 | IP66 to IP68 | IP66 to IP68 |

### Electrolyte

| Special Pfaudler KCL solution | Special Pfaudler KCL solution | No KCL solution is needed | No KCL solution is needed | No KCL solution is needed |

### Temperature measurement

| Liquid analysis | Overview | Corrosion monitoring | Level measurement | Sampling Systems |

### Analytical data

<table>
<thead>
<tr>
<th>PH value</th>
<th>Ion sensitive</th>
<th>pH value</th>
<th>Ion sensitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>ION SENSITIVE</td>
<td>2.0</td>
<td>ION SENSITIVE</td>
</tr>
</tbody>
</table>
# Features and Benefits

## Product overview

### Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Indicates Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical robust, abrasion-resistant, chemically resistant</td>
<td>✓</td>
</tr>
<tr>
<td>Extremely high pressure ranges possible</td>
<td>✓</td>
</tr>
<tr>
<td>Suitable for high temperatures</td>
<td>✓</td>
</tr>
<tr>
<td>Self-cleaning</td>
<td>✓</td>
</tr>
<tr>
<td>CIP- / SIP-compliant</td>
<td>✓</td>
</tr>
<tr>
<td>Slope is maintained throughout service life</td>
<td>✓</td>
</tr>
<tr>
<td>Positive pressure effectively prevents diaphragm clogging and contamination</td>
<td>✓</td>
</tr>
<tr>
<td>No reference electrode poisoning possible</td>
<td>✓</td>
</tr>
<tr>
<td>Glass-lined sodium ion sensitive reference electrode without diaphragm and electrolyte line</td>
<td>✓</td>
</tr>
<tr>
<td>Stainless steel pressure vessel</td>
<td>✓</td>
</tr>
<tr>
<td>Electrolyte in sterile bottle with septum</td>
<td>✓</td>
</tr>
<tr>
<td>EHEDG certification</td>
<td>✓</td>
</tr>
<tr>
<td>Certified for explosion zone 0</td>
<td>✓</td>
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</tbody>
</table>

### Benefits

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Indicates Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent inline monitoring in applications with high mechanical and chemical stress</td>
<td>✓</td>
</tr>
<tr>
<td>No retractable holder / bypass installation required</td>
<td>✓</td>
</tr>
<tr>
<td>Low life-cycle costs due to minimal maintenance expense</td>
<td>✓</td>
</tr>
<tr>
<td>Service life limited only by glass corrosion and / or abrasion</td>
<td>✓</td>
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<tr>
<td>No electrolyte contamination of the product</td>
<td>✓</td>
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<tr>
<td>No need for consumables</td>
<td>✓</td>
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<tr>
<td>Permanent inline monitoring in hygienic applications</td>
<td>✓</td>
</tr>
<tr>
<td>Combined pH / ORP measurement possible</td>
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<tr>
<td>No catalytic or biological effects</td>
<td>✓</td>
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<tr>
<td>Can be stored dry</td>
<td>✓</td>
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</tbody>
</table>
### Features

<table>
<thead>
<tr>
<th>pH 03, pH 03 Dual, pH Ring</th>
<th>pH 40, pH 18</th>
<th>pH Reiner</th>
<th>rH, pH /ORP</th>
<th>LF, LF Ring</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
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### Benefits

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<td>✓</td>
</tr>
</tbody>
</table>

### Corrosion monitoring

- Permanent inline monitoring in applications with high mechanical and chemical stress
- No retractable holder / bypass installation required
- Low life-cycle costs due to minimal maintenance expense
- Service life limited only by glass corrosion and / or abrasion
- No electrolyte contamination of the product
- No need for consumables
- Permanent inline monitoring in hygienic applications
- Combined pH / ORP measurement possible
- No catalytic or biological effects
- Can be stored dry
Temperature Measurement
Sometimes speed is key

Early recognition of process temperatures enables you to regulate it precisely and minimise fluctuations. Lower energy input and lower energy losses result in well-balanced energy management and therefore lower costs. Various technologies are available, depending on the application.

Quick measurement results are essential for optimal temperature control. Pfaudler’s fused-in glass lining solutions offer a clear advantage – they are in contact with the medium. Sometimes speed is key!

**Fused-in resistance thermometer**
The functionality of Pfaudler’s type TW temperature probe relies on the temperature dependence of the electric resistance of platinum. The platinum measuring unit, a PT 100 resistance thermometer, is fused into the glass lining of baffles or thermometer wells, providing an optimal heat transfer. Compared to conventional glass lined temperature measurements the heat transfer coefficient of fused-in sensors is lower, ensuring extremely low half-value times.

**Fused-in thermocouple**
In the Pfaudler type T temperature probe, the temperature is measured exactly where it is needed. A Pallaplat thermocouple is fused into the glass lining of C-baffles or valve cones, providing an optimal heat transfer.

**Inserted temperature sensor**
Pfaudler’s type TMI temperature probe is a robust, simple and cost-effective solution for measuring temperature. The measuring insert – a resistance thermometer – is pressed by spring action to the bottom of the baffle or valve cone.

- **Fastest** glass-lined temperature probe
- **No sealing** elements
- **Long service life**, excellent long-term stability and maintenance free

- **Up to** six measurement points
- **No sealing** elements
- **Long service life**, excellent long-term stability and maintenance free

- **Reduced wall thickness** and coated contact point for improved heat transfer
- Measuring insert is easy to replace and recalibrate
**Time response**

- **T or TW** sensor on thermometer well diam. 40 mm.
- **TMI** glassed tube diam. 40 mm.
- **E** Reference measurement with unprotected pallaplat element

Measure in vessel 100 l with water at 120 rpm
# Features and Benefits

Early detection. Precise control

## Features

<table>
<thead>
<tr>
<th>Features</th>
<th>TW</th>
<th>T</th>
<th>TMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fastest glass-lined temperature probe</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No sealing elements in the wetted area</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Can be fused into the glass lining layer of a baffle, a Quatro-Pipe or a thermometer well</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Up to three measurement points can be arranged on a single probe carrier</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature measurement for complex component designs</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Small measuring element – excellent for installing on small components, e.g. valve cones or spacer rings</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Up to six measurement points can be arranged on a single probe carrier</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Optimised heat transfer realised by a permanent contact pressure, a reduced wall thickness and a gold coated contact point</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Can be plugged into a baffle, a thermometer well or a valve stem</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Accuracy at 1/3 class B to DIN 43 760 / IEC 751</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

## Benefits

<table>
<thead>
<tr>
<th>Benefits</th>
<th>TW</th>
<th>T</th>
<th>TMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permits exact reactor temperature regulation</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Optimal operational reliability</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Long service life and long-term stability</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Maintenance free</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Measuring insert is easy to replace</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

## Technical Data

### Technology

- Fused-in Pt 100 thermometer
- Fused-in thermocouple
- Inserted Pt 100 sensor

### Measuring range

-60 to +200 °C

### Operating temp.

-60 to +200 °C

### Operating pressure

-1 to +40* bar

### Ex. protection

II 1/2G Ex ia IIB T6
II 2G Ex ia IIC T6
II 2 G Ex ia IIB T6
II 2G Ex ia IIC T6
II 2 G Ex ia IIC T6,
T5, T4

*depending on component or nozzle size

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Corrosion Monitoring
The right decision

The Pfaudler technology not only enables to monitor glass-lined surfaces but also other corrosion-resistant surfaces (e.g. PTFE-coated) of reactors including fittings.

Thanks to the implemented algorithm false alarms are ruled out. Reliable information about the condition of the reactor are obtained and the systems connected components. Solutions are available for continuous corrosion monitoring and systems for periodical mobile corrosion testing. It is thus possible to storage vessels regularly for corrosion damage at low costs and effort.

Corrosion monitoring must be above all – reliable!

**Continuous corrosion monitoring**
Continuous corrosion monitoring can be carried out with measuring electrodes fused into the glass lining – the P probe – in conjunction with the associated electronics – the Corrosion Detector. The measuring electronics are connected to the parts being monitored by means of two rhodium point-type electrodes and the product. These can be embedded in glass-lined baffles, thermo-wells or glass-lined valve stems.

**Corrosion Detector (CD)**
The Corrosion Detector works on the principle of the decomposition voltage analysis. This enables the use of corrosion-resistant conductive fittings without causing a false alarm. The electronics provides four output signals – stand-by, ready, alarm, error.

- Principle of decomposition voltage analysis
- Measurement not influenced by electrically conductive fittings
- Monitors all corrosion-resistant surfaces
- Control measurements rule out false alarms
- Displays operating conditions based on defined current thresholds
- Certified for explosion zone 0
CORROSION DETECTOR PORTABLE

CORROSION DETECTOR

P-PROBE

ON VALVE STEM

ON ROD-PROBE OR BAFFLE

GLASTEEL

ANTI CORROSION STICK STATIC

Overview

Temperature measurement

Liquid analysis

Corrosion monitoring

Level measurement

Sampling Systems

27
Mobile Corrosion Testing
Corrosion Detector Portable (CDP)

The **Corrosion Detector Portable** offers corrosion testing according to a maintenance plan or when required, and tolerates electrically conductive fittings. The hand-held device is supplied with a PTFE dip probe, a reference electrode and an earthing clamp. Measurements can be transmitted to a PC using the USB adapter cable provided. The associated software is provided on a USB stick.

**Mobile corrosion testing**
The hand-held device is supplied with a PTFE dip probe, a reference electrode and an earthing clamp. Measurements can be transmitted to a PC using the USB adapter cable provided. The associated software helps to administrate the measuring results and to create a test certificate if required.

- Principle of **decomposition voltage analysis**
- Measurement **not influenced by electrically conductive fittings**
- Monitors all corrosion-resistant surfaces
- Control measurements **rule out false alarms**
- Earthing clamp with electronic contact monitoring
- Can store up to 10,000 measurements
- Certified for **explosion zone 1**

Regular and preventive control play a key role in terms of avoiding long downtimes and detect potential damages in an early stage.
Overview

Corrosion monitoring

Level measurement

Sampling Systems

Liquid analysis

Temperature measurement

Corrosion monitoring

Level measurement

Sampling Systems

Liquid analysis

Temperature measurement
Continuous monitoring of the glass lining inside a vessel during operation is indispensable in highly corrosive processes, in order to rule out large and costly tantalum repairs or even rupture of vessels. A corrosion detection system is the solution. Where multi-piece glass-lined agitators are used, it has never before been possible to monitor the entire agitator assembly.

The use of the Corrosion Detector in conjunction with Pfaulder’s new Conductive Cryo-Lock (CryCo-Lock) technology has now made this possible.

**Conductive Cryo-Lock Connection**

The moving parts in a reactor are most prone to damage, but can now be monitored for integrity with Pfaudler’s new Conductive Cryo-Lock technology. This continuous in-process glass lining monitoring system is suitable for all Pfaudler Cryo-Lock agitators.

- **Monitoring of all wetted parts** incl. the turbine
- **Homogeneous surface** due to the same thermal expansion coefficients
- **Zero weak point** compared to competitive solutions?
- **Reduces the need to enter the vessel** for maintenance purposes to a minimum
GLASTEEL

ANTI CORROSION STICK STATIC

CD
CORROSION DETECTOR

CCL
CRYO-LOCK CONNECTION

GLASS DAMAGE
NONE CONDUCTIVE

GLASS DAMAGE
CONDUCTIVE GLASS SPOT

CRYCO-LOCK
Functional Principle
Features and benefits

The analysis of the decomposition voltage happens in a recurring cycle as changing conditions like the temperature or the pH value have to be considered.

A voltage is applied at regular intervals between the two rhodium electrodes of the P probe, and a base curve is created. Starting from this reference line, the Corrosion Detector calculates a so-called Corrosion Alarm Window. If the current/voltage values are within the Corrosion Alarm Window in two successive control cycles, an alarm message is provided.

Corrosion monitoring must be above all – reliable!
With Pfaudler technology, false alarms are a thing of the past. Whether you monitor your equipment continuously or check it periodically, you can depend on the result every time.

Potentiometric glass-lined monitoring

Function in a typical installation situation
Features and benefits

<table>
<thead>
<tr>
<th>Features</th>
<th>P / CD</th>
<th>CDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle of decomposition voltage analysis</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Displays operating conditions based on defined current thresholds</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Electronics is integrated into the probe’s IP65 terminal box</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Earthing clamp with electronic contact monitoring</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Damage localisation possible to a limited extent</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Integrated conductivity calculator for easier quantitative calculation of conductive additives</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Can store up to 10,000 measurements</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Data transmission via a USB interface</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Visualized directly on handheld display</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Benefits</th>
<th></th>
<th>✓</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitors all corrosion-resistant surfaces</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>No false alarms – unambiguous alarm message only if corrosion is detected</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Installation of corrosion-resistant metals is tolerated</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Type

<table>
<thead>
<tr>
<th>P probe (P) / Corrosion Detector (CD)</th>
<th>Corrosion Detector Portable (CDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring task</td>
<td>Continuous corrosion monitoring</td>
</tr>
<tr>
<td>Technology</td>
<td>Decomposition voltage analysis</td>
</tr>
<tr>
<td>Measuring range (mS/cm)</td>
<td>&gt;= 6-7</td>
</tr>
<tr>
<td>Operating temperature (°C)</td>
<td>&gt;= 0.8</td>
</tr>
<tr>
<td>Operating pressure (bar)</td>
<td>0 to +50</td>
</tr>
<tr>
<td>Explosion protection</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>II 1/2 G EEx ia IIB T6 or II 2G EEx ia IIC T6</td>
</tr>
<tr>
<td></td>
<td>II 2 G Ex ib IIB T3</td>
</tr>
</tbody>
</table>

* depending on component or nozzle size

Explosion protection

II 1/2 G Ex ia IIB T6 or II 2G EEx ia IIC T6

II 2 G Ex ib IIB T3

* depending on component or nozzle size
Continuous level measurement

**Capacitive**

Our FS probe type uses the capacitive method. A fused-in electrode strip forms a capacitor with the steel tube. If the probe comes into contact with product instead of air in the vicinity of the electrode, the capacitance changes.

- High mechanical strength and chemical resistance through the use of glassed steel
- No sealing elements

Radar

Levelpulse radar sensors emit microwave signals, and are used for continuous level monitoring of corrosive fluids in reactors.

- Low transmission frequency – insensitive to product deposits
- Accurate measurement even in the presence of temperature fluctuations
- Adjustment without filling or emptying the reactor

Limit level measurement

**Capacitive**

The FT measuring probes follow the capacitive principle. The electrode used for this purpose is annular. Applications range from full and empty alerts for vessels and detection of interlayers to protecting pumps from running dry.

- High mechanical strength and chemical resistance through the use of glassed steel
- No sealing elements

Vibration

Safety Swings rely on the tuning fork principle to achieve a limit level measurement that is accurate to the millimetre – regardless of the medium’s density and viscosity. The probe can be used as a maximum limit switch, as an additional overfill safety device, as a minimum limit switch or as protection against running dry.

- High mechanical strength and chemical resistance through the use of glassed steel
- Works perfectly even in foam, bubbles and suspended particles
- Certified as an overfill safety device under WH (German Water Management Act)
Temperature measurement
Liquid analysis
Overview
Corrosion monitoring
Level measurement
Sampling Systems
Sampling Systems
Reliable, maintenance free, variable

Generally, sampling systems are used as an alternative for the online liquid analysis. It is crucial here that the production process is not interrupted, that no contamination occurs and that surfaces which come into contact with the product are protected against aggressive media. Yet another area in which the glass lining from Pfaudler comes into its own.

The fleXampler loop used in combination with the Pfaudler Quatro-Pipe, for example, provides a complete measuring system with which samples are taken and temperature, pH value and corrosion monitoring are measured or monitored at the same time. And all of this with just one vessel nozzle.

**fleXampler**
The fleXampler standard sampling system is the ideal solution for the reliable and closed sampling of fluid media from reactors and vessels. A Dip-Pipe or a Quatro-Pipe baffle is mounted on an available vessel nozzle. The sample can be taken by inserting the PTFE suction hose into the Quatro-Pipe or Dip-Pipe. The connection on the lower flange of the fleXampler sampling system enables the use of the Dip-Pipe or Quatro-Pipe to inject fluid media.

**fleXampler loop**
The fleXampler loop continuous sampling system really comes into its own when used with a Quatro-Pipe baffle, as this configuration only requires one vessel nozzle for two or more functionalities. The sample is taken near the agitator by means of an internal PTFE tube. All parts that come into contact with the product are metal-free. Thanks to the constant circulation (loop), there is no need to clean the sampling device. The loop circulation system also offers the option of integrating a pH-ring probe without any effort or expense.

- Modular design
- Large outlet for sampling
- Parts with PFA internal coating (FDA-certified)
- TA Luft (Clean Air Act) compliant
- Options
  - Design with recirculating pump
  - Automatic control with motorised valves
- Sampling flask cage

- Maintenance-free and self-cleaning for representative results
- Suitable for viscous substances
- Piston syringe with glass cylinder for quick visual inspection
- No escape of gas or product
- Compressed air diaphragm pump with diaphragm monitoring designed for zone 0
- Surfaces in contact with product have highly corrosion-resistant coating (glass lining, PFA, PTFE)
Global Services Capability

Pfaudler guarantees a global service during the whole process, pre and post sales, with the largest service organization in different sectors.

Our Service Centers are close to your site to guarantee fast and flexible services. More than 150 people are at your service. We are present in several countries with field engineers who can provide you with comprehensive support for installation, commissioning and maintenance of your facilities and plants.

Our Services
From comprehensive engineering and technical services to our rapid, reliable field services and aftermarket parts supply, you can count on us to keep your process system operating properly:

Engineering
- Consultancy Services
- Pilot testing / toll operation
- Process engineering

Installation, Commissioning, Start up
- Planning
- Project management
- Installations
- Lining measurement technologies

Maintenance and aftersales
- Maintenance & repair
- Troubleshooting
- Glass inspection, reglassing and repair
- Shutdown services
- Spare / Replacement parts
- Mechanical seal exchange
Pfaudler Safety First
Delivering excellent safety performance is necessary for any company operating in the process industries. Over the years, and all over the world, Pfaudler has provided security in its products and highly-qualified service teams.

We are committed to safety and our field service organization that provides installation and maintenance for your facility, has developed strict safety policies to ensure a safe working environment.

Pfaudler guarantees:
• skilled professionals properly prepared and qualified on security and risk management
• observance of international standards
• use of professional personal protective equipment
• reduced operating risks

Refurbishing, reglassing and inspection
In addition to its expertise in manufacturing and market products and engineered solutions, Pfaudler has core expertise in the service area of full equipment refurbishing. The reactors are completely reglassed, refurbished combined with a suitable retrofitting of all devices or accessories, producing an appropriate program to meet specific customer needs and timeframes. All this is in compliance with international and European standards. Our technicians provide a complete glass lining inspection program to ensure that your reactor is in proper condition for safe and efficient operation.

Our commitment to quality components means that our technologies are often in service for many years. However, our pioneering approach means that during this time we have developed new solutions. Whether your process is changing or you are looking to further optimise performance levels, an upgrade to our new technologies can improve the capabilities of your reactor.