Field Devices For
Measurement & Instrumentation

Analytical
I have to decrease costs associated with maintenance of pH sensors. The constant cleaning and replacement of sensors is eating up our maintenance budget.

The Foxboro 871FT Flow-through Conductivity Sensor is equipped with a calibration port on the outside of the sensor body. When the sensor needs to be calibrated, you can access the calibration port without breaking the process line, thereby eliminating the risk to your operators from exposure to dangerous fluids.

Operator safety is paramount in our facility. We have to find ways to reduce operator exposure to hazardous fluids like strong acids.

We’re being driven to reduce inventory. Unfortunately, when a pH sensor fails, we need a replacement right away. I can’t live with delivery times of 4 weeks or more.

Foxboro’s factory provides shipment within 24 hours for a long list of measurement equipment, including several types of pH sensors. This service, referred to as “Rocket Delivery”, is provided to our customers at no extra charge. All elements of sensor manufacturing are performed in the Foxboro factory, allowing us to provide rapid delivery and predictable high quality.

I have to decrease costs associated with maintenance of pH sensors. The constant cleaning and replacement of sensors is eating up our maintenance budget.

Foxboro pH sensors are designed to reduce maintenance. Our patented DolpHin® sensor provides a Nafion ion barrier which protects the internal reference electrode and reduces clogging of the outer junction due to silver ion migration. Its nonmetallic solution ground allows for sensor diagnostics and provides excellent chemical compatibility. Its unique glass pH electrode provides long life in high temperature and temperature cycling applications. All of these design features have been carried through to our new 12mm PH12 sensor as well.

“We can now complete a pH adjustment in 3 hours rather than the 18 to 24 hours it previously took.”

Senior Technical Supervisor
Gilead Sciences
We have some very aggressive chemicals where we need to measure conductivity and concentration. Most of the sensors we have tried only last a few months before they fail due to chemical attack from the process.

Foxboro’s Technical Assistance Center is staffed 24/7 with experts in analytical products and applications. We also have an analytical laboratory where we can accept customer samples to perform analyses such as conductivity temperature compensation profiling.

Analytical measurements are a problem for us because we don’t have our own experts. I am looking for a partner who can provide reliable technical support and help us select the correct equipment for the application.

Foxboro’s 875PH and 876PH Analyzers are equipped with a host of diagnostics for pH sensors. In addition to failure diagnostics, these analyzers include predictive diagnostics for reference fouling, low slope and electrode aging. By monitoring these diagnostics, the pH sensor can be scheduled for maintenance before failure occurs.

Foxboro offers the broadest range of electrodeless conductivity sensors on the market. Our PEEK body sensors use a proprietary sealing technique that eliminates the need for internal seals. With no metallic wetted parts, the PEEK sensors do not suffer from leakage due to different coefficients of thermal expansion, a weakness often seen in other suppliers’ sensors.

I’d like to be able to tell when the pH or reference electrode is in need of maintenance, before it is too late.
Conductivity sensing is really ideal for this application. A conductivity measurement system is relatively inexpensive, very clean, and maintenance free. We brought in Invensys to discuss its Foxboro products and decided these were the solutions we needed.

Scott Nisula Chief Technical Officer Delta BioFuels Inc

**Customer Challenge**
- To ensure that the production process of Delta BioFuel’s biodiesel would not be interrupted during the fuel separation process. Sustainable alternative energy sources demands an immediate technology solution that would produce a very pure biodiesel product quickly and efficiently.

**Solution**
- Foxboro 871EC Series Electrodeless Conductivity Sensors

**Customer Benefits**
- The 871EC sensor enabled production of between 80-100 million gallons of biodiesel per year, making it one of the largest biodiesel plants in the country.
- Delta BioFuels achieved the production goals of its four 20,000-gallon reactors and controls the delicate separation process through accurate conductivity measurements.
- By implementing a reliable and accurate process automation system, Delta BioFuels has been able to eliminate human error and enhance overall product quality.

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Foxboro 871PH sensor improves pharmaceutical product, process and profits for Raylo Gilead

“We found many vendors offered quality sensors, Foxboro was the only one that could provide a robust design that could stand up to all the reagents and solvents in our solutions.”

Rob Pastushak Snr Technical Supervisor of Pharmaceutical Manufacturing

**Customer Challenge**
- Improve efficiency of manufacturing process, specifically pH measurement in caustic solutions, without impacting company bottom line.

**Solution**
- Foxboro 871PH Sensor

**Customer Benefits**
- Accurate pH measurement in demanding application, accurate to ±0.03 pH units.
- cGMP and FDA compliance & certification.
- Less time for pH adjustment, three hours rather than the 18 to 24 it took before.
- Less sampling - no longer need 40 samples to confirm measurement accuracy, only one is needed now, as a matter of quality assurance protocol.

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Foxboro conductivity sensing sparks automated, efficient biodiesel fuel processing

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Our pH sensors cut costs & optimize operations at Eastman Chemical company

“Eastman’s equipment and maintenance costs were eight times lower than with previous sensors, and efficiency of our scrubber operation was optimized.”

Wyatt Partney Senior Control Systems Technician

**Customer Challenge**
- Existing sensors had to be replaced every 2 weeks—often 3 times a week. Inaccurate readings meant unacceptably high manufacturing and maintenance costs.

**Solution**
- Foxboro DolpHin pH sensors

**Customer Benefits**
- New sensors gave improved stability, accuracy, performance with up to fivefold increase in sensor response speed while measuring 8.8 million pounds of chemicals per day.
- Our pH glass formulation increased sensor life to six months; this longevity reduced equipment and related maintenance/replacement costs eightfold.
- Increased accuracy also meant operators reduced caustic, slashing caustic use levels by a remarkable 50%.

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Pharmaceutical industry

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Chemical industry

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BioFuels industry

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Success stories commercial benefits

fielddevices.foxboro.com/success
The primary measurement challenge is holding tight, temperature-compensated conductivity accuracy as this measurement has a direct effect on white liquor strength which is used as a control parameter in the digester charging process. Inaccuracy will occur due to electrode corrosion, polarization or the conductivity sensor itself can become fouled. Foxboro 871FT offers longer sensor life due to corrosion resistant PEEK material and coating effects are minimized due to the use of electrodeless conductivity technology. Longer intervals between calibrations are possible and they are faster and safer due to the built-in calibration port. In addition improved accuracy is possible due to optimized temperature compensation.

In gypsum production sensors are exposed to thousands of tons of flowing sludge, which is maintained at temperatures of approximately 160°F (71°C). Gypsum forms as a crystalline, abrasive substance, adding additional wear and tear. One power facility tested our rugged pH sensors that can last up to four times longer than conventional sensors, and became one of the first sites in the world to implement a prototype. Other advantages include accurate, reliable pH measurement in demanding applications, improved production and operational efficiency, reduced waste disposal costs for environmental compliance and the extended service life reduces maintenance and materials costs.

The demand for upgrading paper quality and uniformity has introduced tougher challenges to on-line sensors with hundreds of hours spent each year cleaning pH sensors in this very aggressive process area. Between the thick consistency stock and the periodic cleaning process, known as a boil-out, pH electrodes typically have a very short life. The Foxboro pH sensor range ensures longer sensor life due to a flat ruggedized pH electrode. A retractable sensor installation isolates the sensor during boil-out. Resistance to coatings allows longer intervals between cleanings and improved maintenance efficiency due to predictive sensor diagnostics such as coated reference or low slope.

Producing sulfuric acid is a particularly demanding application. The closer you come to 100 percent, the more difficult it is to accurately measure acid strength: The higher the strength of sulfuric acid, the greater its market value. The Electrodeless sensor design significantly minimizes the difficulties of build-up of process material. This provides an invasive sensor of extraordinary integrity, which is robust even in this aggressive application. This means improved process efficiency and lower production expenses plus reduced material and maintenance costs. In addition, precise and reliable measurement of high-strength sulfuric acid means consistent high-end product quality for improved profitability.

In pulp & paper industry: White Liquor Strength production

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### Selection guide

#### Foxboro pH and ORP Electrochemical Sensors

<table>
<thead>
<tr>
<th>Model</th>
<th>PH DolPhin</th>
<th>ORP10 DolPhin</th>
<th>PH12</th>
<th>871A</th>
<th>871PH</th>
<th>EP462A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor Type</td>
<td>pH</td>
<td>ORP</td>
<td>pH/ORP</td>
<td>pH/ORP</td>
<td>pH/ORP</td>
<td>pH low conductivity</td>
</tr>
<tr>
<td>pH Range</td>
<td>0 - 14</td>
<td>N/A</td>
<td>0 - 14</td>
<td>2 - 12</td>
<td>0 - 14</td>
<td>0 - 14</td>
</tr>
<tr>
<td>Max Temperature</td>
<td>121 °C</td>
<td>121 °C</td>
<td>140 °C</td>
<td>85 °C</td>
<td>121 °C</td>
<td>100 °C</td>
</tr>
<tr>
<td>Installation Type</td>
<td>Universal slip fit, Submersion, In-line, Retractable</td>
<td>Universal slip fit, Submersion, In-line, Retractable</td>
<td>PG13 connection to accessories, In-line, Retractable</td>
<td>Submersion, In-line, Retractable</td>
<td>Submersion, In-line, Retractable</td>
<td>Twist-lock, Submersion, In-line, Retractable</td>
</tr>
<tr>
<td>Electrode Type</td>
<td>Domed or flat</td>
<td>Flat</td>
<td>Domed or flat</td>
<td>Flat</td>
<td>Selectable</td>
<td>Domed</td>
</tr>
<tr>
<td>Maintenance Type</td>
<td>Disposable</td>
<td>Disposable</td>
<td>Disposable</td>
<td>Disposable</td>
<td>Rebuildable</td>
<td>Disposable</td>
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<tr>
<td>Integral Pre-amp</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Features</td>
<td>High performance</td>
<td>High performance</td>
<td>12mm form factor, available lengths 120mm - 425mm</td>
<td>Totally flat sensing surface</td>
<td>$\text{Small, inexpensive plug-in electrodes}$</td>
<td>$\text{Stable measurements in high purity water}$</td>
</tr>
</tbody>
</table>

#### Foxboro Electrodeless and Flowthrough Conductivity Electrochemical Sensors

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor Type</td>
<td>Small and large bore</td>
<td>Barrel geometry</td>
<td>Borosilicate glass</td>
<td>Flowthrough</td>
<td>Flowthrough</td>
<td>Flowthrough</td>
</tr>
<tr>
<td>Installation Type</td>
<td>Invasive, Insertion, Immersion, Retractable</td>
<td>Invasive, Insertion, Immersion, Retractable</td>
<td>Invasive, Insertion, Immersion, Retractable</td>
<td>Non-invasive, In-line, Sanitary tri-clamp, Industrial flange</td>
<td>Non-invasive, In-line, Threaded</td>
<td>Non-invasive, In-line, Flaretek tube, NSP300 tube</td>
</tr>
<tr>
<td>Line Size</td>
<td>3” min</td>
<td>3” min</td>
<td>3” min</td>
<td>0.5 to 4”</td>
<td>3/32 to 5/8”</td>
<td>1/2, 3/4 and 1”</td>
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<tr>
<td>Calibrate In-line</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>All Thermoplastic</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
### Selection guide

**Foxboro** Contacting Conductivity and Resistivity Electrochemical Sensors

<table>
<thead>
<tr>
<th>Model</th>
<th>871CR</th>
<th>871CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting</td>
<td>Insertion, Immersion, Retractable</td>
<td>Insertion, Immersion, Retractable</td>
</tr>
<tr>
<td>Installation Type</td>
<td>Universal slip fit</td>
<td>Fixed installation type dictated by model code selection</td>
</tr>
<tr>
<td>Temperature Compensation</td>
<td>1000 ohm 3-wire platinum RTD</td>
<td>100 ohm 2-wire platinum RTD or 100 kohm 2-wire thermistor</td>
</tr>
<tr>
<td>Accuracy</td>
<td>0.1 % of 0.1 cm-1 cell factor</td>
<td>2 % of 0.1 cm-1 cell factor</td>
</tr>
<tr>
<td>Insertion Lengths</td>
<td>Model code selectable</td>
<td>Fixed length</td>
</tr>
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</table>

### Foxboro Transmitters

<table>
<thead>
<tr>
<th>Model</th>
<th>875PH</th>
<th>876PH</th>
<th>875EC</th>
<th>876EC</th>
<th>875CR</th>
<th>876CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurements</td>
<td>pH, ORP, ISE</td>
<td>pH, ORP, ISE, Combination pH/ORP</td>
<td>Conductivity, Concentration</td>
<td>Conductivity, Concentration</td>
<td>Conductivity and Resistivity</td>
<td>Conductivity and Resistivity</td>
</tr>
<tr>
<td>2 or 4 wire</td>
<td>4-wire</td>
<td>2-wire</td>
<td>4-wire</td>
<td>2-wire</td>
<td>4-wire</td>
<td>2-wire</td>
</tr>
<tr>
<td>Power</td>
<td>V ac, 24 V dc</td>
<td>V ac, 24 V dc</td>
<td>14.7 to 42 dc</td>
<td>V ac, 24 V dc</td>
<td>12.8 to 42 V dc</td>
<td></td>
</tr>
<tr>
<td>Menu Driven with Help Text</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Inputs</td>
<td>1 Sensor, 1 Temp</td>
<td>1 Sensor, 1 Temp Combination pH/ORP</td>
<td>1 Sensor, 1 Temp</td>
<td>1 Sensor, 1 Temp</td>
<td>2 Sensor, 2 Temp</td>
<td>1 Sensor, 1 Temp</td>
</tr>
<tr>
<td>Alarms</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
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<tr>
<td>Safety Certs</td>
<td>Class 1, Div 2 Non-incendive</td>
<td>Class 1, Div 1 and 2 Intrinsically safe</td>
<td>Class 1, Div 2 Non-incendive</td>
<td>Class 1, Div 1 and 2 Intrinsically safe</td>
<td>Class 1, Div 2 Non-incendive</td>
<td>Class 1, Div 1 and 2 Intrinsically safe</td>
</tr>
<tr>
<td>Output</td>
<td>Dual 4 - 20 mA, HART</td>
<td>4 - 20 mA, HART</td>
<td>Dual 4 - 20 mA, HART</td>
<td>Dual 4 - 20 mA, HART</td>
<td>Dual 4 - 20 mA, HART</td>
<td>Dual 4 - 20 mA, HART</td>
</tr>
<tr>
<td>Multi-application</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Custom curve</td>
<td>-</td>
<td>-</td>
<td>Multiple, auto-switching</td>
<td>Multiple, auto-switching</td>
<td>Multiple, auto-switching</td>
<td>Multiple, auto-switching</td>
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</table>

* 875CR version shown