Product Data Sheet
PDS-003, A-1

Optical Oxygen Sensors

Polestar’s optical Oxygen Sensors are designed specifically to work with Polestar’s DSP Series Optical Process Monitors. A fully configured Polestar Process Monitoring system includes a DSP Series transmitter, an optical cable (available in a variety of lengths), a probe housing (available in a range of traditional and single-use formats), and a sensor.

Oxygen sensors are available in two detection ranges:

- Standard membrane: 0-500% air sat.
- Chemically resistant membrane: 0-150% air sat.

Features and Benefits

- Rugged, glass-free construction suitable for use where glass electrodes are not
- Versatile sensing chemistry measures in both liquid and gas-phase
- Compatible with 0-100% ethanol, as well as numerous other organic chemicals
- Rapid response: $\tau_0 < 15$ sec
- Available in two detection ranges: standard and chemically resistant
- Made from USP Class VI materials
- Compatible with real-world process conditions, including CIP
- Sterilizable by gamma, autoclave, SIP
- Available in any of Polestar’s traditional or single-use probe configurations
- Pre-calibrated for plug-and-play use (or simple 1- or 2-point user calibration)
- Minimal maintenance
- Dry storage
- Suitable for use in lab, pilot and/or production plants, and outdoors.

Applications

- Bioprocessing
- Food and beverage
- High-purity water
- Fuels and Biofuels
- Environmental monitoring

Basis of Detection

Polestar’s optical oxygen sensors operate on the principle of fluorescence quenching. Fluorescence properties of the organo-metallic indicator are reversibly and predictably quenched by oxygen. Fluorescence intensity and lifetime vary inversely with oxygen content.

The detector measures the phase shift of fluorescence excitation relative to a reference condition, and from this it computes fluorescence lifetime. From lifetime it computes PO$_2$, which is then displayed in the user-specified units.

Because it is inherently self-referencing, this detection approach eliminates the potential for measurement error arising from changes in sample turbidity, refractive index, viscosity, or color. This ensures stable, drift-free calibration and hence reliable measurements throughout the lifespan of a sensing element. The inverse relationship between oxygen content and fluorescence quenching makes this method extremely sensitive at low PO$_2$, in stark contrast to traditional electrode-based methods.
# Optical Oxygen Sensor Specifications

<table>
<thead>
<tr>
<th>Performance</th>
<th>Standard Membrane</th>
<th>Chemically Resistant Membrane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection range (gas phase)</td>
<td>0 - 100% O₂ (1 atm)</td>
<td>0 - 30% O₂ (1 atm)</td>
</tr>
<tr>
<td>Detection range (dissolved)</td>
<td>0 - 40 ppm (Water, 25°C)</td>
<td>0 - 130 ppm (Ethanol, 25°C)</td>
</tr>
<tr>
<td>Limit of Detection</td>
<td>20 ppb (Water, 25°C)</td>
<td>0.5 ppm (Ethanol, 25°C)</td>
</tr>
<tr>
<td>Precision</td>
<td>0.3% air sat. (25°C)</td>
<td>0.8 ppm @ 85 ppm (Ethanol, 25°C)</td>
</tr>
<tr>
<td>Accuracy (as delivered)</td>
<td>&lt; 2% air sat. (25°C)</td>
<td>2 ppm or 5% of reading (25°C)</td>
</tr>
<tr>
<td>Accuracy (with standardization)</td>
<td>&lt; 0.5% air sat. (25°C)</td>
<td>1 ppm or 1% of reading (25°C)</td>
</tr>
<tr>
<td>( t_{50} ) response</td>
<td>&lt; 15 sec</td>
<td></td>
</tr>
<tr>
<td>Calibration</td>
<td>Ships pre-calibrated; optional 1- or 2-point user standardization</td>
<td></td>
</tr>
<tr>
<td>Cross-sensitivity</td>
<td>SO₂ and Cl₂ gas</td>
<td></td>
</tr>
<tr>
<td>Chemical incompatibility</td>
<td>Organic solvents, (eg Toluene, DMF)</td>
<td>Hot DMF</td>
</tr>
</tbody>
</table>

## Environmental Specifications

- Operating temperature: -10–50°C
- Operating pressure: Sensing element has been integrity tested to 1200 psi
- Operating humidity: 0 – 100% RH
- Storage conditions: Wet or Dry, Dark
- Materials: USP Class VI-certified\(^2\)
- Chemical incompatibility: DMF (> 50°C)
- Clean-in-Place: Yes\(^3\)
- Sterilizable: Autoclave, Steam-in-Place, Gamma

\(^1\) These specifications are for stated conditions. Performance may vary under different application conditions.

\(^2\) Certification documents available upon request

\(^3\) Details available upon request