Optical Oxygen Sensors
VisiFerm, VisiTrace
80% of sensor costs come after the initial purchase

Polarographic Sensors

Traditional polarographic membrane sensors use a chemical reaction to generate a small electrical current that is correlated to oxygen concentration in the sample. Keeping the sensor in top condition requires skilled troubleshooting, expensive replacement parts, and considerable time waiting for the sensor to polarize.

TROUBLESHOOT IN 3-8 HOURS

- POLARIZE
- TEST IN 100% AIR
- SERVICE
- CALIBRATE
Optical Sensors

Optical sensors measure using an oxygen-sensitive fluorescent dye. The dye requires no equilibration time so it is instantly ready for use. A quality indicator displays the health of the sensor cap, and maintenance is as simple as removing and reinstalling the cap.

TROUBLESHOOT IN ≤ 20 MINUTES

- WARM UP
- SERVICE
- CALIBRATE

No-Polarization Required
Can You Trust Your Oxygen Measurement?

Are polarographic and optical measurements comparable?

Yes, when run in parallel, the data gathered from optical and polarographic sensors is often identical. However, below is one example of when the readings differ. Can you tell which sensor is reading accurately?

The graph above shows data from a side-by-side comparison of optical (monitoring) and polarographic (controlling) values over a long fermentation run. The divergence at the end of the run is a result of CO₂ fouling of the polarographic control sensor, causing the mass flow control to add too much O₂ during the run.

ADDITIONAL ADVANTAGES OF OPTICAL MEASUREMENT

Low DO and No Flow
More accurate measurement because optical sensors do not consume oxygen

Inverted Installations
Without electrolyte the sensor reading is not affected by mounting orientation

Response Time
Quicker response time results in less wasted product
WHAT IS CO\textsubscript{2} FOULING?

Over long fermentation runs, sensors are exposed to CO\textsubscript{2} gas used for pH control or resulting from cellular respiration. The gas travels through the membrane of a polarographic sensor and changes the pH of the electrolyte. This change results in a lower nA reading.

\begin{itemize}
  \item \textbf{CO\textsubscript{2} Respired by Cells}
  \item \textbf{CO\textsubscript{2} Enters Sensor, Forms H\textsubscript{2}CO\textsubscript{3} and Neutralizes the Electrolyte}
\end{itemize}

\begin{itemize}
  \item \textbf{Pressure Spikes}
  \hfill Improved mechanical and measurement stability with a glass window instead of a membrane
  \item \textbf{nA Noise}
  \hfill Signal is not influenced by electrostatics and mechanical stress
  \item \textbf{H\textsubscript{2}S Fouling}
  \hfill No impact on measurement or sensor life
\end{itemize}
Intelligent Sensors

Eliminate more than costly transmitters

The integrated micro transmitter eliminates signal noise and enables predictive estimates of sensor life, calibration and troubleshooting. These can be conducted in a controlled lab or at line, and documentation is simplified with automatic report generation.
Eliminate more than costly transmitters

Optional Wireless Adapter
Galvanic Isolator
For enhanced signal quality

Improved Signal Reliability
Simplify wiring to the control system

Cost of Calibration
- At Line
- In Lab

Reduced Calibration Costs

Eliminate Costly Transmitters

Integrated Micro Transmitter
The Visi Family of Sensors

The right tool for the job

The optical VisiFerm sensors are available in a variety of configurations to meet the needs of your challenging application. The core measurement principal is consistent across all models with various electrical connections, sensor caps, and firmware versions to ensure superior performance and reliability.

SIGNAL PROCESSING & TRANSMISSION

VisiFerm DO
Seamless integration with existing analog bioreactors and transmitters
Output: ECS, 4-20 mA, and Modbus outputs

VisiFerm DO Arc
Improve signal with direct connection to the control system
Output: 4-20 mA and Modbus output

VisiFerm mA
Less frequent calibration and longer lifetime. Two wire loop powered 4-20mA / HART for GMP production environments. Rated for explosive environments.
Output: 2 wire 4-20 mA, HART, and Bluetooth integrated

VisiTrace mA
Detect from 0 to 2 ppm with a stability of < 1% week @ 100 ppb and accuracy of ± 0.5 ppb or 2%, whichever is greater (@ 25°C)
Output: 2 wire 4-20 mA, HART and Bluetooth integrated
The Visi Family of Sensors

MEASURING PRINCIPAL

Blue light excites a fluorescent dye (luminophore) in the sensor cap. In the absence of oxygen the energy is fluoresced as red light. In the presence of oxygen some energy is transferred to the oxygen molecule and less red light is emitted. The partial pressure of oxygen is reliably given by the phase shift between excitation and emission.

SENSOR CAP OPTIONS

H0 Cap
The fastest response time and compatibility with most fermentation and culture media

H2 Cap
Chemically resistant with hygienic design to simplify cleaning and minimize bubble accumulation

L0 Trace Cap
Optimized for trace measurement from 1 to 2,000 ppb and stable against active chlorine and chlorine dioxide
Only compatible with VisiTrace mA

H3 Cap
Strengthened luminophore matrix for better temperature stability with fast response time. The perfect cap for most biopharmaceutical applications
Only compatible with the VisiFerm mA sensor

H4 Cap
Strengthened luminophore matrix for better temperature stability with chemically resistant and hygienic design
Only compatible with the VisiFerm mA sensor

HOW IT WORKS
MEASURING PRINCIPAL

Blue light excites a fluorescent dye (luminophore) in the sensor cap. In the absence of oxygen the energy is fluoresced as red light. In the presence of oxygen some energy is transferred to the oxygen molecule and less red light is emitted. The partial pressure of oxygen is reliably given by the phase shift between excitation and emission.
Unprecedented Connectivity

Eliminate the middle man; talk directly to the sensor

New installations are abandoning dedicated transmitters in favor of computer screens. The Visi family of sensors transitions seamlessly with analog options for existing installations and a variety of digital protocols for future needs.

CALIBRATION & DIAGNOSTICS

Wirelessly communicate with the sensor via Bluetooth. Setup, troubleshoot, and calibrate multiple sensors from a single handheld device or PC.
REPLACE TRADITIONAL OXYGEN SENSORS

Enjoy the benefits of optical oxygen measurement with your existing equipment. VisiFerm DO can simulate the output of a traditional polarographic sensor (ECS Mode, ElectroChemical Signal) for integration into any system with minimal effort.

Validated Cables for Most Bioreactors*

<table>
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<tr>
<th>Bioreactor Manufacturer</th>
<th>LEMO</th>
<th>BINDER</th>
<th>BNC</th>
<th>AMP</th>
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<tr>
<td>Sartorius</td>
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<td>DASGIP (Eppendorf)</td>
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* All Cables have integrated power supplies with selectable country specific plugs

FLEXIBILITY AND SIGNAL INTEGRITY

All process data is communicated through a hard wired connection. The Visi family communicates with a variety of open communication protocols enabling connection directly to a PCS or computer. Hamilton provides control software, FDT drivers, and a programmer’s guide for custom development.