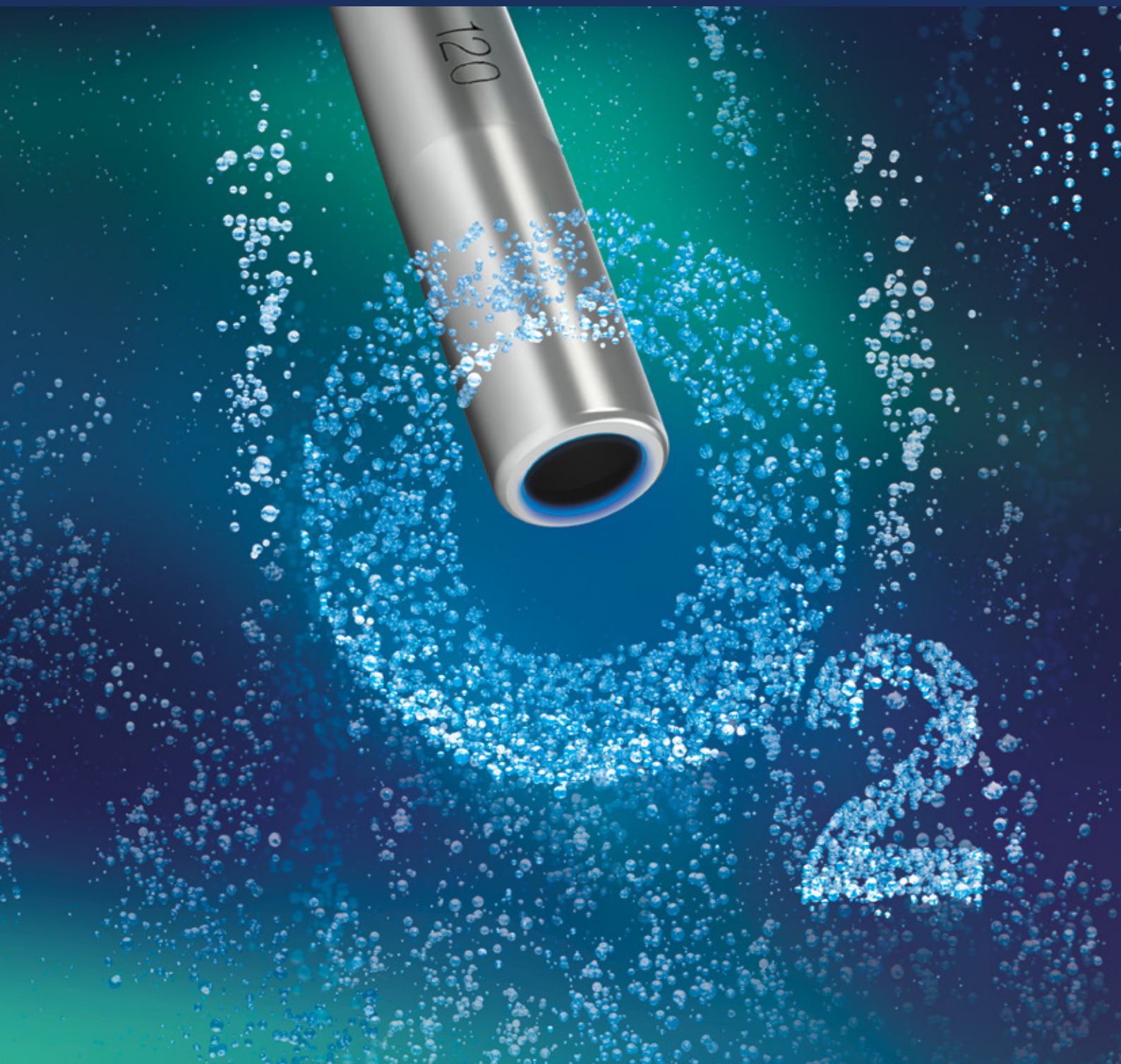
HAMILTON

Optical Oxygen Sensors

VisiFerm, VisiTrace



The Real Cost of Dissolved Oxygen Measurement

80%

Of sensor costs come after the initial purchase.

Calibrating Optical Sensors

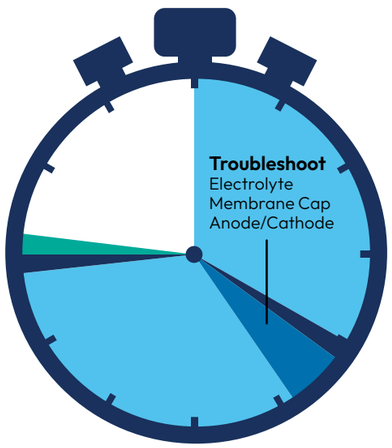
One point, two point, and product calibrations can all be performed using existing polarographic procedures.

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

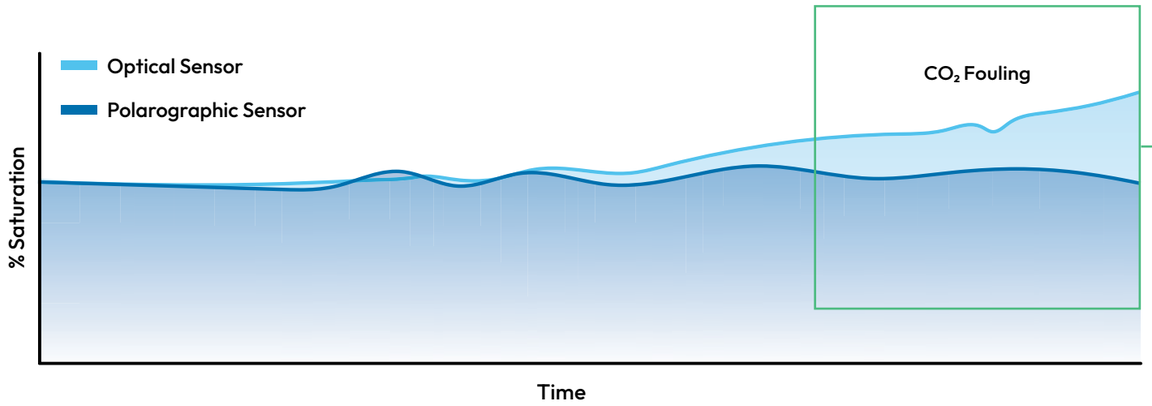
Optical sensors measure using an oxygen-sensitive fluorescent dye. The dye requires no equilibration time so it is instantly ready for use. A quality indicator displays the health of the sensor cap, and maintenance is as simple as removing and reinstalling the cap.

Troubleshoot in ≤ 20 Minutes

- Warm Up
- Service
- Calibrate

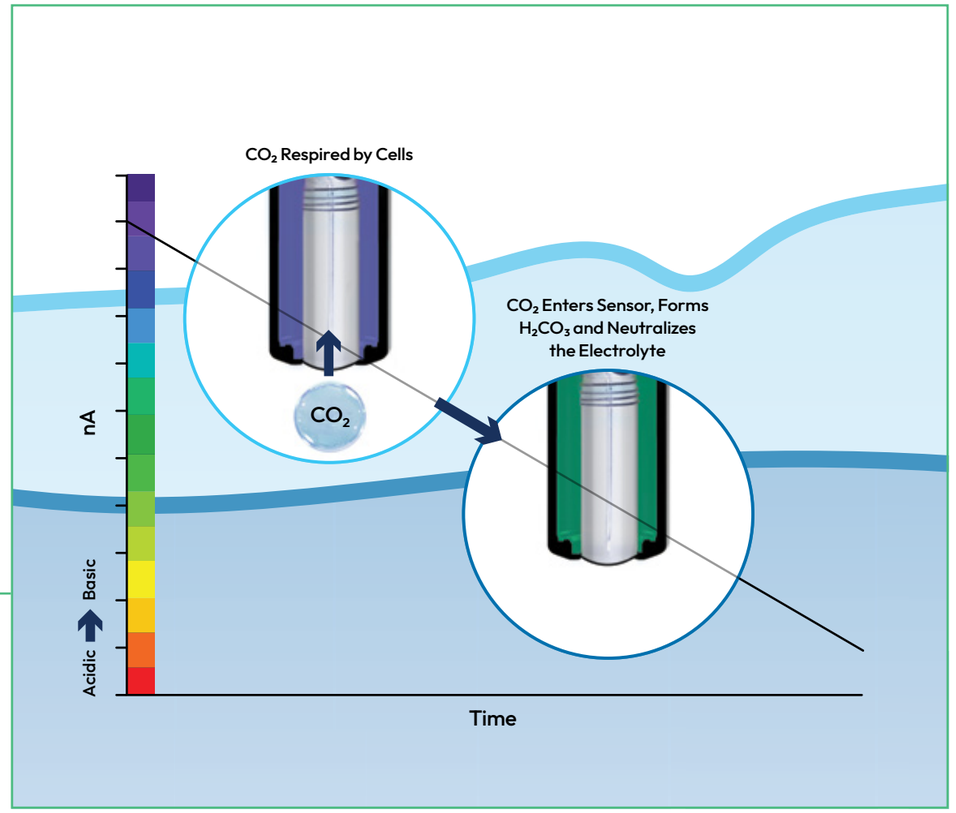
Can You Trust Your Oxygen Measurement?

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 CO_2 fouling of the polarographic control sensor, causing the mass flow control to add too much O_2 during of the run.



What is CO_2 Fouling?
Over long fermentation runs, sensors are exposed to CO_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.

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

Pressure Spikes
Improved mechanical and measurement stability with a glass window instead of a membrane

nA Noise
Signal is not influenced by electrostatics and mechanical stress

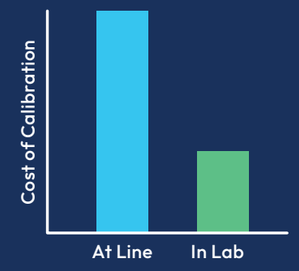
H_2S Fouling
No impact on measurement or sensor life

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.

1. **Optional Wireless Adapter**
2. **Galvanic Isolator**
   For enhanced signal quality
3. **Integrated Micro Transmitter**
4. **Improved Signal Reliability**
   Simplify wiring to the control system

Reduced Calibration Costs



Eliminate Costly Transmitters

Wireless Calibration and Diagnostics

Up to 30 Sensors

Automatic Calibration and GMP Documentation

The Visi Family of Sensors

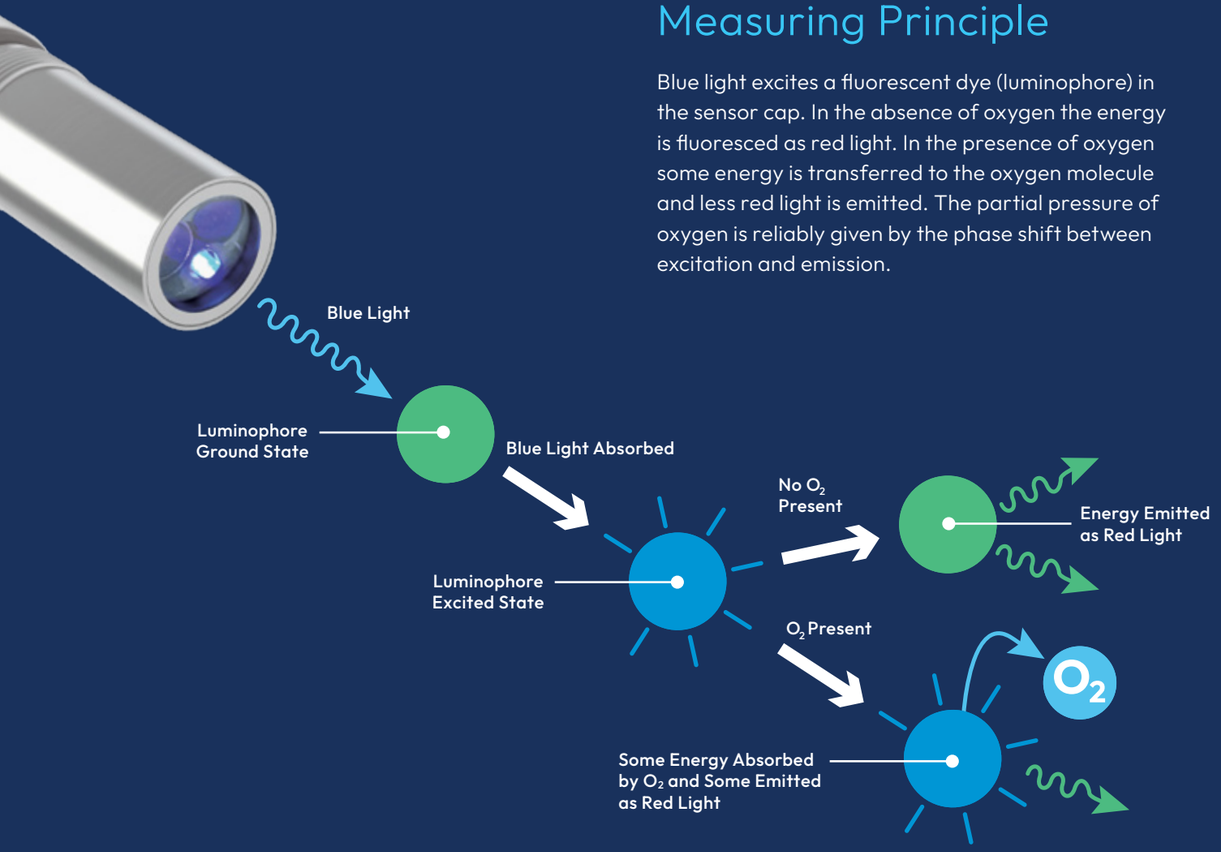
The right tool for the job

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.

How It Works

Measuring Principle

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.



Signal Processing and Transmission

VisiFerm RS485-ECS

Seamless integration to control systems and existing analog bioreactors. Less frequent calibration and longer lifetime.

Output: Modbus RS485 RTU, ECS, 4-20 mA (only with Arc Wi 2G Adapter)

VisiTrace RS485

Seamless integration to control systems. Trace detection: 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: Modbus RS485 RTU, 4-20 mA (only with Arc Wi 2G Adapter)

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). Rated for explosive environments.

Output: 2 wire 4-20 mA, HART and Bluetooth integrated

Sensor Cap Options

ODO Cap H3*

Strengthened luminophore matrix for better temperature stability with fast response time. The perfect cap for most biopharmaceutical applications.

***Only compatible with the VisiFerm mA and VisiFerm RS485 sensors.**

ODO Cap H0*

The fastest response time and compatibility with most fermentation and culture media.

***Only compatible with the VisiFerm RS485 sensors.**

ODO Cap H4*

Strengthened luminophore matrix for better temperature stability with chemically resistant and hygienic design to simplify cleaning and minimize bubble accumulation.

***Only compatible with the VisiFerm mA and VisiFerm RS485 sensors.**

ODO Cap L1 Trace*

Optimized for trace measurement from 1 to 2,000 ppb and stable against active chlorine and chlorine dioxide. Designed for fast response time, lower than 15 ppb measurement.

***Only compatible with VisiTrace mA and VisiTrace RS485.**

ODO Cap H2*

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

***Only compatible with the VisiFerm RS485 sensors.**

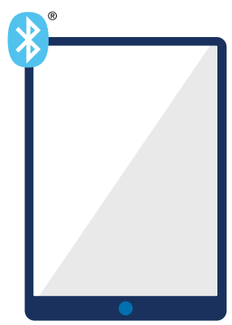
Unprecedented Connectivity

Eliminate the middle man; Talk directly to the sensor

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

Calibration and Diagnostics

The Arc Wi converters enable Bluetooth 4.0+ connectivity for easy sensor configuration and calibration using smart devices. For VisiFerm mA, Bluetooth is already integrated. Diagnostics are transmitted wirelessly as well, enabling remote troubleshooting directly from your device. Easily manage and monitor sensors from anywhere for added convenience.



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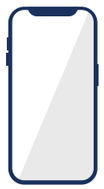
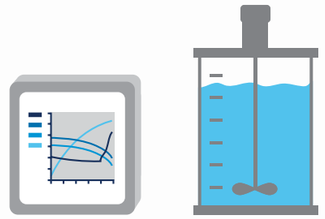


Smartphone

USB Wireless Converter

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.



BIO CONTROLLER

ECS (nA)

4-20 mA, Modbus RS485 RTU, PROFINET®, PROFIBUS®, OPC UA, FOUNDATION Fieldbus, HART

PROCESS CONTROL SYSTEM (PCS)

Validated Cables for Most Bioreactors*

LEMO

Bioreactor Manufacturer:
- Sartorius
- Bioengineering

BINDER

Bioreactor Manufacturer:
- Applikon
- DASGIP (Eppendorf)

BNC

Bioreactor Manufacturer:
- Applikon

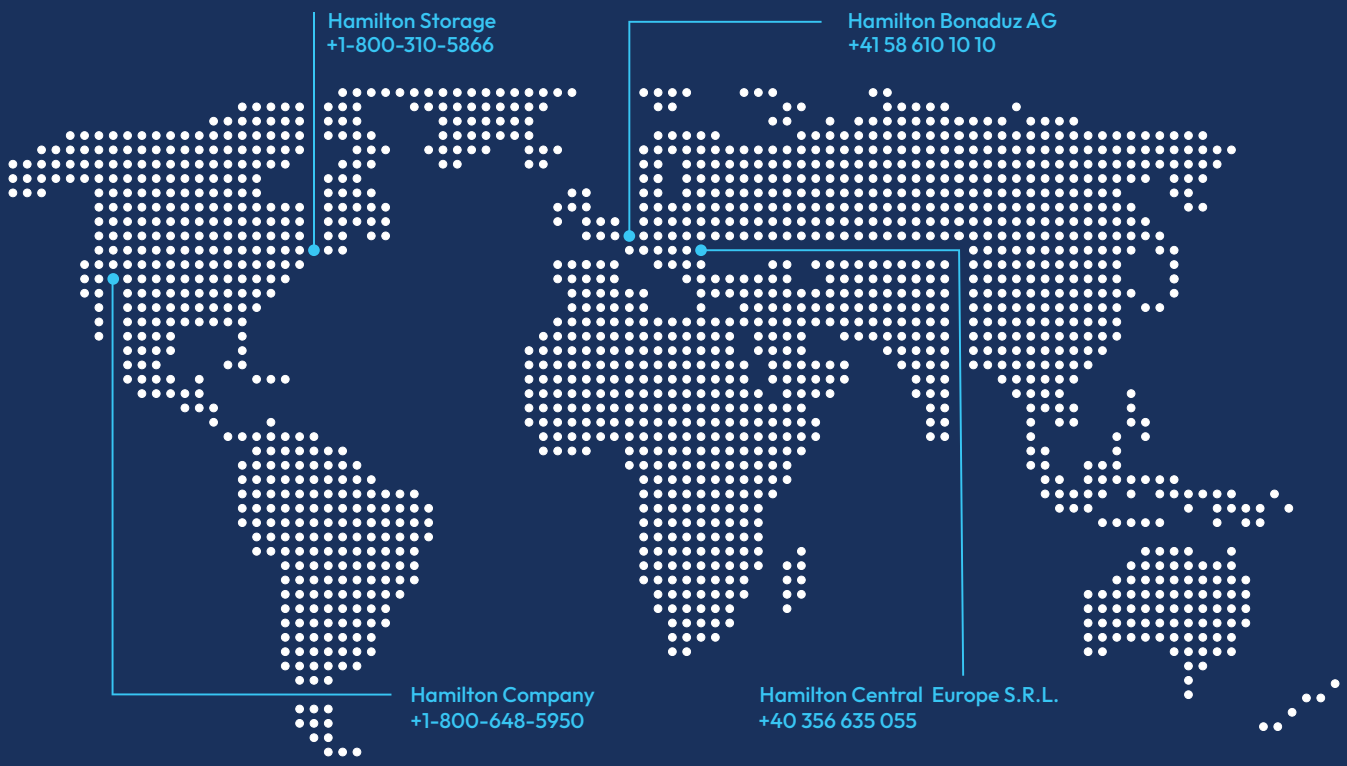
AMP

Bioreactor Manufacturer:
- New Brunswick (Eppendorf)

* 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 VisiFerm family communicates with a variety of open communication protocols enabling connection directly to a Process Control System (PCS) or computer. Hamilton provides control software, Field Device Tool (FDT) drivers, and a programmer's guide for custom development.



Years of Experience
75+

Locations Worldwide
22+

Employees Internationally
3,000+

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