

# VisiPro™ DO Sensors

## Operating Instructions

Apply for:

VisiPro DO

VisiPro DO Ex



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## Hamilton Warranty

Please refer to the General Terms of Sales (GTS).

## Important note

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# 1 General Information

## 1.1 Intended Use

The VisiPro DO Ex sensors are intended for the measurement of dissolved oxygen (DO) and oxygen in gas phase (dust environment) The VisiPro DO Ex sensor is certified for use in explosive atmosphere. If these sensors are used in explosive atmospheres, the instructions in the chapter 3.3 must be followed.

If the sensor is used in contact with gaseous or liquid organic solvents, the resulting measurement accuracy in this application must be separately checked and validated by the customer.

**⚠ ATTENTION! The VisiPro DO Ex sensor has a built-in temperature sensor (NTC 22kΩ). This temperature sensor is to be used only for monitoring the sensor conditions, not for controlling the process temperature.**

**⚠ ATTENTION! The measurement values transmitted over wireless communication are not intended to be used for process control.**

## 1.2 About this Operating Instruction

These Operating Instructions are designed to support the integration, operation and qualification of the VisiPro DO Ex and VisiPro DO (non Ex) sensors.

To achieve this, it will describe the features of VisiPro DO Ex and its integration in Process Control Systems (PCS). Both the hardware and the communication between the VisiPro DO Ex and Process Control Systems are detailed in this manual. After reading this manual the user should be capable of installing and operating VisiPro DO Ex sensors.

**⚠ ATTENTION! Essential information for avoiding personal injury or damage to equipment.**

**📄 NOTE: Important instructions or interesting information.**

# 2 Liability

The liability of Hamilton Bonaduz AG is detailed in the document «General Terms and Conditions of Sale and Delivery».

Hamilton is expressly not liable for direct or indirect losses arising from use of the sensors. It must in particular be insured in this conjunction that malfunctions can occur on account of the inherently limited useful life of sensors contingent upon their relevant applications. The user is responsible for the calibration, maintenance and regular replacement of the sensors. In the case of critical sensor applications, Hamilton recommends using back-up measuring points in order to avoid consequential damages. The user is responsible for taking suitable precautions in the event of a sensor failure.



**📄 NOTE:** The VisiPro DO Ex sensor is not intended and specified as a safety device. A SIL (Safety Integrity Level) certification is not available. It is in the sole responsibility of the user to validate the VisiPro DO Ex sensor according to the safety requirements of his application.

# 3 Safety Precautions and Hazards

**⚠ ATTENTION! Read the following safety instructions carefully before installing and operating the VisiPro DO sensor.**

## 3.1 General Precautions

For safe and correct use of VisiPro DO Ex, it is essential that both operating and service personnel follow generally accepted safety procedures as well as the safety instructions given in this document, the VisiPro DO Ex operation instruction manual.

The specification given in the «Specification Sheet» as regards temperature, pressure etc. may under no circumstances be exceeded. Inappropriate use or misuse can be dangerous.

The lifetime of the VisiPro DO Ex highly depends on the specific conditions of the application. Temperature, pressure, chemicals used may accelerate the ageing of both the sensor and its ODO cap. See chapter 7 for replacement conditions.

Cleaning, assembly and maintenance should be performed by personnel trained in such work. Before removing the sensor from the measuring setup, always make sure the no process medium can be accidentally spilled. When removing and cleaning the sensor, it is recommended to wear safety goggles and protective gloves.

The sensor can not be repaired by the operator and has to be sent back to Hamilton for inspection.

Necessary precautions should be taken when transporting the sensors. For repair or shipment the sensor should be sent back in the original reusable packaging box. Every VisiPro DO Ex sent back for repair must be decontaminated.

If the conditions described in these operating instructions manual are not adhered to or if there is any inappropriate interference with the equipment, all of our manufacturer's warranties become obsolete.

## 3.2 Operation of VisiPro DO Ex Sensor

When using the VisiPro DO sensors in process environment suitable protective clothing, safety glasses and protective gloves must be worn, particularly when dealing with a malfunction where the risk of contamination from spilled liquids exists. Installation and maintenance of sensors must be performed only by trained personnel. The mobile devices and sensors must be used for their intended applications, and in optimum safety and operational conditions.

Use only wired digital or analog connection for the process control. The Arc wireless interface is designed for sensor monitoring, maintenance and service purposes.

Make sure that the PG13,5 thread and the O-ring are not damaged when screwing the sensor into the process. O-rings are consumable parts which must be exchanged regularly (at least once per year). Even when all required safety measures have been complied with, potential risks still exist with respect to leaks or mechanical damage to the armature. Wherever there are seals or screws, gases or liquids may leak out undetected. Always make sure that no process medium can be accidentally spilled before removing the sensor from its measurement setup. Make sure that no air or gas bubbles sticks to the sensitive part of the sensor. As a consequence, the measurement value could be unstable. Do not put stress on the system by vibration, bending or torsion. Before use, verify that the sensor is properly configured for your application.

Failure to observe and carry out the maintenance procedures may impair the reliability and correct functioning of the measurement system.

**⚠ ATTENTION! When unscrewing the PG 13.5 thread connection never turn the sensor at the connector head because you can loosen the ODO Cap from the sensor shaft and fluid can reach the interior of the sensor.**

**⚠ ATTENTION! To avoid humidity problems, make sure that the ODO Cap is always attached firmly to the sensor shaft, and that the O-ring between the shaft and cap is undamaged.**

The integrated 4–20 mA analog output has been configured according to factory defaults. You can find full details, including serial number and most important specifications, on the certificate provided with each sensor. Before use, verify that the sensor is properly configured for your application.

Make sure that following cross sensitivities and resistances of ODO Caps are respected.

#### Cross sensitivities and resistances of ODO Cap H0

Measurement not influenced by	Carbon Dioxide
Wetted parts resistant to	Ethanol
Wetted parts not resistant to	Chlorine, Ozone and Organic Solvents such as Acetone, Tetrahydrofuran THF*

#### Cross sensitivities and resistances of ODO Cap H2

Measurement not influenced by	Carbon Dioxide, lipophilic compounds
Wetted parts resistant to	Organic Solvents such as Ethanol*, Acetone*, THF*
Wetted parts not resistant to	Chlorine and Ozone Gases

\*Tested for 30 min at 25°C

If the sensor is used in contact with gaseous or liquid organic solvents, the resulting measurement accuracy in this application must be separately checked and validated by the customer.

## 3.3 Instructions for Use in Potentially Explosive Atmospheres

The VisiPro DO Ex sensor is certified for use in explosive atmosphere with following Marking:

CE 0035 ⚡ II 1G Ex ia IIC T6/T5/T4/T3 Ga

CE 0035 ⚡ II 1D Ex ia IIIC T135 °C Da

Hamilton Bonaduz AG, CH-7402 Bonaduz, Switzerland

ATEX EC-type Examination Certificate: BVS 13 ATEX E 065 X  
IECEx Certificate of Conformity: BVS 13.0075X

The certificates and the declaration of conformity can be downloaded from [www.hamiltoncompany.com](http://www.hamiltoncompany.com)

### 3.3.1 General Conditions for Safe Operation

Conditions described in the ATEX EC-Type Examination Certificate or the IECEx Certificate of Conformity must be adhered to.

The operator of equipment in potentially explosive atmospheres is responsible for ensuring that all components of the system are certified for that area classification and are compatible with each other. The regulation of erection (e.g. EN 60079-14) which apply to systems and plants used in potentially explosive atmospheres have to be strictly adhered to. Perform regular visual inspection of the sensor, its installation and cable for intactness and correct operational conditions.

If the sensor is being operated in gas atmosphere, the following process and ambient temperatures have to be observed:

Temp. Class	Process Temperature range [T <sub>p</sub> ]	Ambient Temperature in Direct Vicinity of Sensor head [T <sub>a</sub> ]
T3	-20 °C ≤ T <sub>p</sub> ≤ 130 °C	-20 °C ≤ T <sub>a</sub> ≤ 60 °C
T4	-20 °C ≤ T <sub>p</sub> ≤ 125 °C	-20 °C ≤ T <sub>a</sub> ≤ 60 °C
T5	-20 °C ≤ T <sub>p</sub> ≤ 85 °C	-20 °C ≤ T <sub>a</sub> ≤ 60 °C
T6	-20 °C ≤ T <sub>p</sub> ≤ 35 °C	-20 °C ≤ T <sub>a</sub> ≤ 35 °C

If the sensor is being operated in dust environment, the following process and ambient temperature have to be observed:

Maximum input power P <sub>i</sub>	Process temperature range	Ambient temperature range
750 mW	-20 °C ≤ T <sub>p</sub> ≤ + 40 °C	-20 °C ≤ T <sub>a</sub> ≤ +40 °C
650 mW	-20 °C ≤ T <sub>p</sub> ≤ + 70 °C	-20 °C ≤ T <sub>a</sub> ≤ +60 °C
550 mW	-20 °C ≤ T <sub>p</sub> ≤ +100 °C	-20 °C ≤ T <sub>a</sub> ≤ +60 °C

If the sensor is electrically disconnected, the following temperature has to be observed for the process.

Temperature Class	If the sensor is electrically disconnected
T3	$-20\text{ °C} \leq T_s \leq 130\text{ °C}$
T4	$-20\text{ °C} \leq T_s \leq 130\text{ °C}$
T5	$-20\text{ °C} \leq T_s \leq 130\text{ °C}$
T6	$-20\text{ °C} \leq T_s \leq 80\text{ °C}$

The operator has to ensure protection against lightning in compliance with the locally applicable regulations.

Along to the intrinsically safe circuit potential equalization has to be provided, because in case of a fault the intrinsically safe circuit has to be regarded as connected to the metal housing.

Intense vapor or dust directly impacting on the cable must be avoided when the cable is running through zones of category 1G, 1D or 2D. Assembly and maintenance are to be done only if the atmosphere is Ex-free and according to the current local regulations. After maintenance works have been performed all barriers and notes remove for that purpose have to be put back in their original place.

The sensor has to be powered with a power supply unit with an intrinsically safe output circuit of Ex ia IIC. For the selection, consider the conditions stated in EN 60079-25. This is also applicable for operation of the sensor in non-ex environment. In non-ex environment, VisiPro DO Ex can be operated with the Sensor Power Cable M12.

The maximal input parameters of the sensor operated in gas atmospheres:

Description	Units	Limited value
Max. Input Sensor Voltage	$U_i$	30 V (DC)
Max. Input Sensor Current	$I_i$	100mA
Max. Input Sensor Output	$P_i$	750 mW
Input Sensor Capacitance	$C_i$	1.2nF
Input Sensor Inductance	$L_i$	negligible

The maximal input parameters of the sensor operated in dust atmospheres:

Description	Units	Limited value
Maximum input voltage	$U_i$	30 V
Maximum input current	$I_i$	100 mA
Maximum input power	$P_i$	see table above with max input power
Maximum internal capacity	$C_i$	1.2 nF
Maximum internal inductivity	$L_i$	negligible

Hamilton recommends the following power supply units:

Description	Ordering Information (Type)
Pepperl + Fuchs	KCD2-STC-Ex1
Pepperl + Fuchs	KFD2-STC4-Ex1
Phoenix Contact MACX	MCR-EX-SL-RPSSI-I-UP

**NOTE:** The table above is only a recommendation. Hamilton is not responsible for changes in the specifications of the power supply units.

**ATTENTION!** In case the sensor is not working correctly disconnect the sensor immediately from the power supply.

### 3.3.2 Earthing

The sensor has to be mounted at the mounting location electrostatically conductive ( $< 1M\Omega$ ). It is recommended to assign the sensor shaft and/or M12 cable shield to ground or earth especially in electromagnetically noisy environments. This significantly improves noise immunity and signal quality. The M12 thread is connected to the metallic housing of the VisiPro DO Ex sensor. Two options for connecting the sensor to the process environment are available.

#### Option 1: The Metal tank is connected to earth

The sensor shaft is connected to the metal tank over the PG 13.5 thread. Do not connect the green yellow shield wire of the M12 cable to earth. It must remain unconnected and can be cut off.

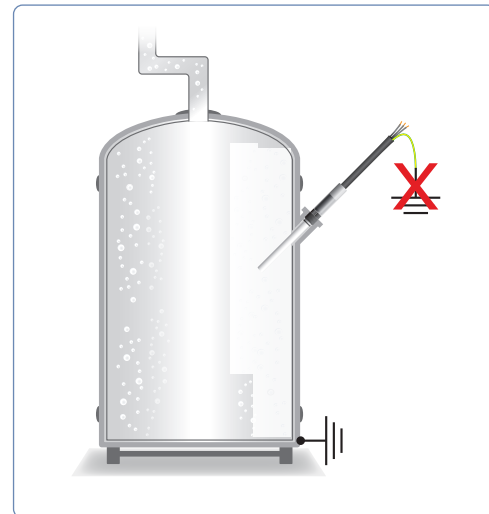


Figure 1: Metal tank with earth connection

**NOTE:** If the tank is not connected to earth, Option 2 has to be applied.

#### Option 2: Glass or plastic tank (not connected to earth)

The glass or plastic tank has no connection to earth and therefore it is necessary to connect the sensor shaft via a screw clamp to earth.

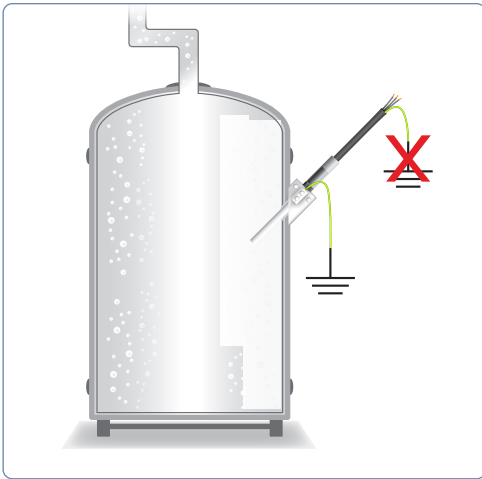


Figure 2: Glass or plastic tank with no earth connection

Below are shown several examples how to connect the shaft of the sensor directly to earth as required in Figure 2.



Figure 3: Example clamps for connecting the earth to armature and metallic housing of the tank.

### 3.4 Electrical Safety Precautions

Do not connect the sensor to a power source of any voltage beyond the range stated in the power rating Technical Specifications ([www.hamiltoncompany.com](http://www.hamiltoncompany.com)).

Always use Hamilton M12 cables for safe connection. Cables are available in a broad range of lengths (Chapter 10). Make sure the cable is intact and properly plugged to avoid any short circuit.

Keep VisiPro DO Ex away from other equipment which emits electromagnetic radio frequency fields, and minimize static electricity in the immediate environment of the optical measuring parts. Carefully follow all the instructions in chapter 5.3 to avoid electrical damage to the sensor. The contacts must be clean and dry before sensor is connected to the cable.

**⚠ ATTENTION! Switch off the power supply and unplug the connector before dismantling the VisiPro DO Ex.**

**⚠ ATTENTION! If the power supply (220 VAC/24VDC) is switched off or disconnected the reading on the PCS is wrong.**

### 3.5 Chemical, Radioactive or Biological Hazard Precautions

Selection of the appropriate safety level and implementation of the required safety measures for working with VisiPro DO Ex is the sole responsibility of the user.

If working with hazardous liquids observe and carry out the maintenance procedures, paying particular attention to cleaning and decontamination. If VisiPro DO Ex becomes contaminated with biohazardous, radioactive or chemical material, it should be cleaned. Failure to observe and carry out the maintenance procedures may impair the reliability and correct functioning of the measuring module.

## 4 Product Description

### 4.1 General Description

The VisiPro DO Ex was the first optical dissolved oxygen (DO) sensor for use in explosive environment. With their integrated transmitter, VisiPro DO Ex sensors enable direct communication to the process control system via 2 wire 4-20 mA standard signal or digital HART. Wireless communication directly from the sensor may be used for monitoring, configuration and calibration, and saves time without compromising the quality of the wired connection. The sensor features furthermore an integrated Bluetooth 4.0, enabling in this way wireless data exchange with smartphones and tablets.

VisiPro DO Ex optical technology improves the measuring performance and simplifies maintenance. Improvements compared to conventional electrochemical (amperometric) sensors include flow independence, rapid start-up with no polarization time, and simplified maintenance.

With the transmitter integrated, VisiPro DO Ex sensors provide more reliable measurements directly to your process control system. The  $\mu$ -transmitter located in the sensor head stores all relevant sensor data, including calibration and diagnostic information, simplifying calibration and maintenance. The integrated quality indicator predicts the remaining sensor and cap life time.

Key benefits include:

- Optical measurement in explosive environment with ATEX / IECEx certification
- No separate transmitter needed
- Simple maintenance with robust industrial design
- Easy to install 2-wire connection
- Direct analog or digital HART communication to the process control system via 2 wire 4-20mA standard signal.
- Full online wireless option via Bluetooth 4.0 for easy monitoring, configuration and calibration

### 4.2 Hardware Description

The VisiPro DO Ex sensor consists of a sensor head with integrated electronic and a sensor shaft in contact with the measured medium. The sensor shaft is terminated by the optical dissolved



oxygen (ODO) cap, carrying the oxygen sensitive luminophore. During development, special attention was paid to an optimum sanitary design. All materials in contact with the solution meet the FDA requirement.

Sensor status LED of the sensor:

LED Status	Case
Two yellow LEDs light permanently	RF connection is active and sensor is selected in the ArcAir
All LEDs light up shortly one by one in a circle	Power Up
Red LEDs are flashing	Minimum one error is active
Yellow LEDs are flashing	Minimum one warning is active

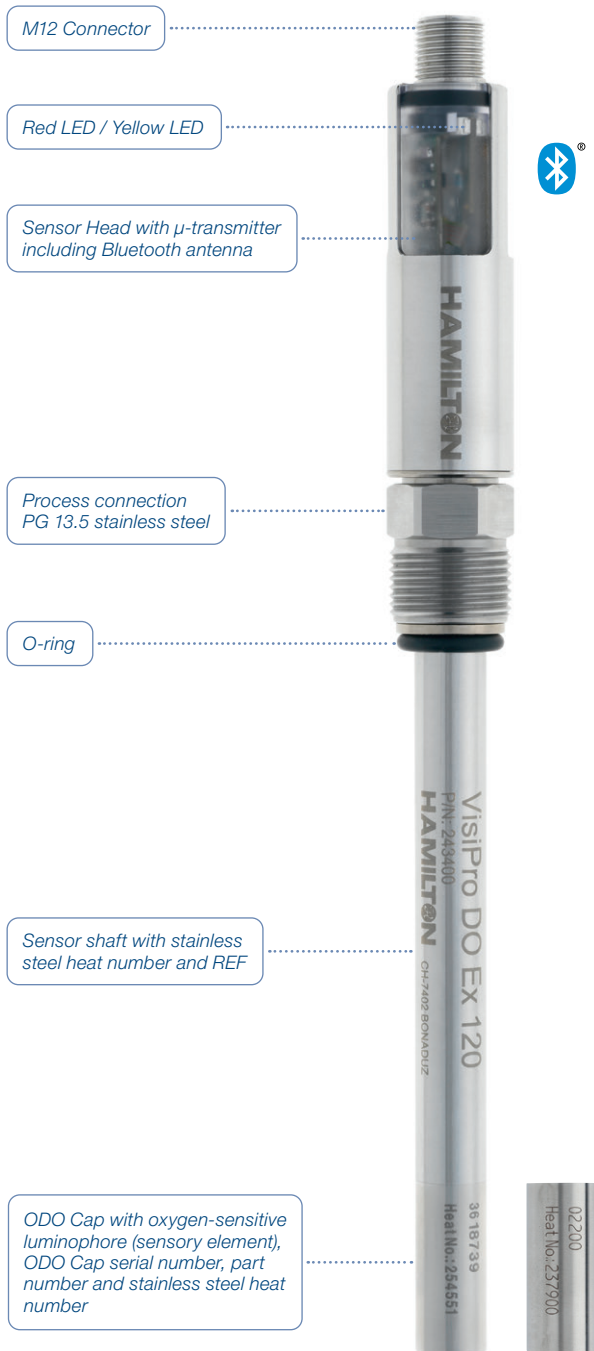


Figure 4: VisiPro DO description

### 4.3 Optical DO measurement

The optical measurement principle is based on the so-called luminescence quenching. The luminescence of certain organic pigments (luminophore) is quenched in the presence of oxygen. The luminophore absorbs the excitation light and release a part of the absorbed energy by emission of fluorescence. In the presence of oxygen, energy transfer takes place from the excited luminophore to oxygen. The luminophore does not emit fluorescence and the measurable fluorescence signal decreases.

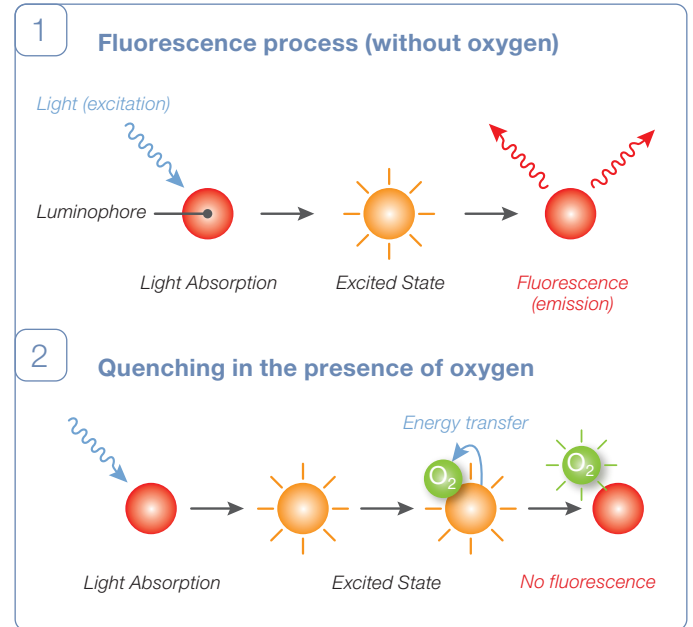


Figure 5: Fluorescence quenching by oxygen

### 4.4 VisiPro DO Ex with μ-Transmitter inside

With the μ-Transmitter integrated, VisiPro DO Ex sensors offer fully compensated signal directly to the process control system. Communication protocols include standard analog 4-20mA or digital HART. The μ-transmitter located in the sensor head stores all relevant sensor data, including calibration and diagnostic information, simplifying calibration and maintenance.

## 5 Installation

### 5.1 Unpacking

- 1) Unpack carefully the VisiPro DO Ex sensor. Enclosed you will find the VisiPro DO Ex sensor, the Declaration of Quality, the VisiPro DO Ex Instruction Manual, and the Stainless Steel Inspection Certificate.
- 2) Inspect the sensor for shipping damages or missing parts.



## 5.2 Configuring the VisiPro DO Ex with ArcAir Application

VisiPro DO sensors require application specific configuration. Following parts are required to configure and calibrate Arc sensors:

- Arc View Mobile (Ref 243690) or ArcAir computer Software Solution.
- External Power supply with Arc USB Power Cable (Ref 355288).

To configure and set up the VisiPro DO sensors at least ArcAir Basic is required. Below in this table you will find the different ArcAir licenses and its functionality:

ArcAir	Read	Calibrate	Configure	Documentation
Free	✓	-	-	-
Basic	✓	✓	✓	-
Advanced	✓	✓	✓	✓

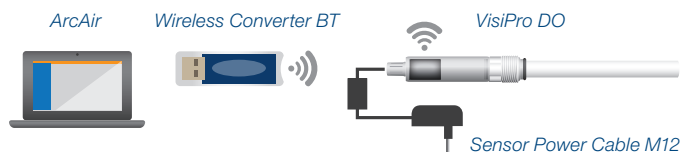


Figure 6: VisiPro DO configuration with ArcAir

**NOTE:** For more detail information and configuration see Hamilton Arc System Operating Instructions.

### 5.2.1 Installing ArcAir Basic on the Computer

- 1) Download the Zip file «ArcAir» from the Hamilton webpage [www.hamiltoncompany.com](http://www.hamiltoncompany.com) (search for ArcAir).
- 2) Unpack the ZIP-File.
- 3) Do not plug in the Wireless Converter before the installation of ArcAir is completed.
- 4) Install «ArcAir» by double clicking «ArcAir.exe» and follow the instructions on the screen.

### 5.2.2 Connecting an VisiPro DO Sensor to ArcAir

- 1) Connect a sensors with the power supply, e.g. Sensor Power Cable M12 Ref 355288)
- 2) Switch on the mobile's Bluetooth connection or connect a Wireless Converter BT to USB Port of your computer (only for wireless connection
- 3) The ArcAir application recognizes and displays the connected sensors automatically

**⚠ ATTENTION!** For automatic sensor login a unique and global Operator Level S password for all intelligent sensors is required. Please make sure you have added the same Operator Level S Password for all Arc sensors in the ArcAir application under Backstage/Settings/Operator Level S Password.

### 5.2.3 Create User Accounts

- 1) Start ArcAir application on computer
- 2) Click on «Backstage» left upper corner
- 3) Select «User Management»
- 4) Click the «Add» Button for opening the user editor
- 5) Type in the user details and password
- 6) Select the specific rights for the user

**⚠ ATTENTION!** First user is the administrator and all user rights are assigned as default.

**NOTE:** Initial operation of ArcAir is in the laboratory mode as long as no user account is created. Laboratory mode does not require a login password and enable all features in the installed license version.

### 5.2.4 Configuring the VisiPro DO Ex Sensor Parameters

- 1) Start the ArcAir application
- 2) Select the desired sensor
- 3) Open the drawer «Settings» (make sure you have the «Sensor Settings» user right)
- 4) Configure the sensor.

A description of the available settings is given below:

Parameter Name	Description	Default Value	Configuration	Location
DO Unit	These are the measurement physical units	%vol. %sat. ug/l ppb mg/l ppm mbar ppm gas	Required	Measurement/ Values
T unit	These are the temperature physical units	K °F °C	Required	Measurement/ Values





Parameter Name	Description	Default Value	Configuration	Location
Salinity	The concentration of dissolve oxygen in saturated water is dependent on the salinity	0 mS/cm	Default parameter recommended	Measurement/Parameter
Air pressure	The partial pressure of oxygen is proportional to the atmospheric pressure or the pressure of the air supply to the process	1013 mbar	Required, application dependent	Measurement/Parameter
Measuring interval	The measuring interval can be set between 1-300 sec. The LED flashes once in the set measure interval	3 sec.	Recommended default parameter	Measurement/Parameter
Standby interval	The standby interval can be set between 10-300 sec. The sensor switch to standby mode if the measurement is higher than 50mbar (2ppm @ 25°C and 1013mbar)	60 sec.	Recommended default parameter	Measurement/Parameter
Moving average	The sensor uses a moving average 1-30 over the measuring points	10	Recommended default parameter	Measurement/Parameter
Sensing Material	Sensing Material are different types of ODO Cap which can be set by entering the REF of the ODO Caps	243530	Must	Measurement/Parameter
Resolution	The resolution interval can be set between 8-16. The measuring interval is on itself an average over 8-16 individual sub-measurements.	8	Recommended default parameter	Measurement/Parameter

### 5.2.5 Configuring the calibration settings

Parameter Name	Description	Default Value	Configuration	Location
Drift DO	Higher drift will interrupt the calibration process. Warning comes up «drift oxygen»	0.05%/min	Recommend default parameter	Calibration/Calibration Settings
Drift T	Higher drift will interrupt the calibration process. Warning comes up «drift temperature»	0.5 K/min	Recommend default parameter	Calibration/Calibration Settings

### 5.2.6 Configuring the temperature settings of SIP / CIP process

Parameter Name	Description	Default Value	Configuration	Location
Customer temperature range	User defines temperature range for DO reading. No DO reading above 85°C possible	-20°C – 85°C	Recommend default parameter	Status/Quality, Counters and Temperatures
SIP process definition	User defines conditions for the SIP counter	Temp. min: 120°C Temp. max: 130°C Time: 20min	Recommend default parameter	Status/SIP / CIP
CIP process definition	User defines conditions for CIP counter	Temp. min: 80°C Temp. max: 100°C Time: 20min	Recommend default parameter	Status/SIP / CIP

### 5.2.7 Configuring the analog interface for your process control system

Parameter Name	Description	Default Value	Configuration	Location
Interface Mode	The output of the 4–20 mA can be configure linear, bilinear or with a fix value	4–20 mA linear	Recommended default	Interface/Analog
Value at 4mA	Defined measurement value for 4 mA output	0%-vol	Must application dependent	Interface/Analog Output
Value at 20mA	Defined measurement value for 20 mA output	62.85-%vol	Must application dependent	Interface/Analog Output
Mode in event of warning	Current output mode in case of warnings	No output	Recommended default parameter	Interface/Analog Output
Mode in event of errors	Current output mode in case of errors	Continuous output	Recommended default parameter	Interface/Analog Output
Output in event of warning	Current output in case of warnings	3.6 mA	Recommended default parameter	Interface/Analog Output
Output in event of error	Current output in case of error	3.6 mA	Recommended default parameter	Interface/Analog Output
Output for T out of limit	Current output in case of temperature out of limit	3.6 mA	Recommended default parameter	Interface/Analog Output



\* humidity set to 0%

## 5.2.8 Defining a measuring point name for identification of the process

Parameter Name	Value	Default Settings	Location	Descriptions
Measuring point	User can define a sensor name for better identification of the measuring point	243400 – 1234	Optional	Information / Info Userspace

## 5.3 Install VisiPro DO Ex in your Measuring Loop

### 5.3.1 Mechanical Process Connection

The VisiPro DO Ex mechanical design is compatible with all Hamilton process housings, including Flexifits, Retractable, Retractablefits and Hygienic Sockets.

Before installing the armatures, you should test that the seal is tight and the parts are all in working order. Ensure that there is no damage to the sensor or the armature. Check whether all O-rings are in place in the appropriate grooves and are free of damage. To avoid any mechanical damage to O-rings on assembly, they should be slightly greased.

Please note that O-rings are wetted parts and greasy compounds must comply to your FDA application needs.

### 5.3.2 M12 Pin Designation

The VisiPro DO Ex sensor is fitted with a M12 male, A coded connector. The four golden contacts are denoted as pin 1 to pin 4. For easy identification of each pin the M12 has a mark between pin 1 and pin 2 (Figure 7). Always use Hamilton M12 sensor cables for safe connection, which are available in different lengths (Chapter 11).



Figure 7: Requirements for electrical connection of VisiPro DO Ex sensors



\*Shaft potential is isolated from the 4-20mA + and – connection. Max isolation voltage is 500 V.

M12 PIN	Function	Color	Description
3	HART/4-20 mA +	Blue	4-20 mA two-wire interface, functions as a current sink.
2	HART/4-20 mA –	White	If there is no resistor in the HART Interface Card integrated, an external 250 Ω resistor is essential for HART communication.
4	n.c.	Black	–
1	n.c.	Brown	–
Housing	Shield	Green/ Yellow	Connected to the housing including the M12 female connector.

### 5.3.3 Required Power Supply

VisiPro DO Ex sensors are specified with a minimal power supply as follows:

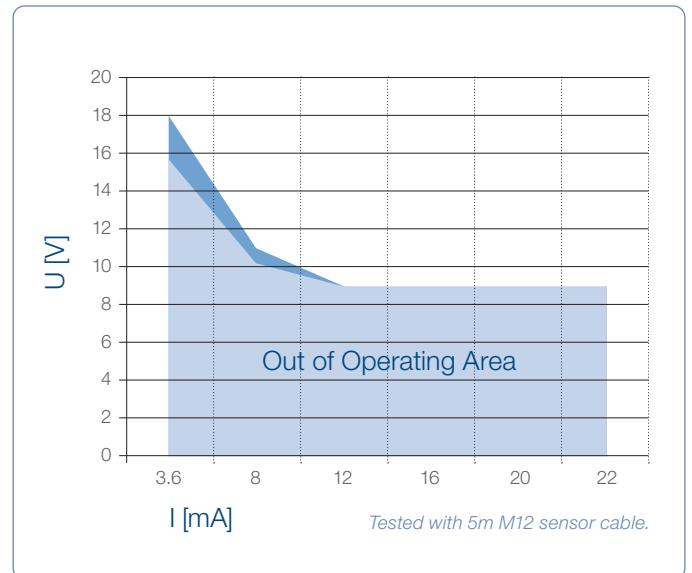


Figure 8: Minimal power supply as function of the output current.

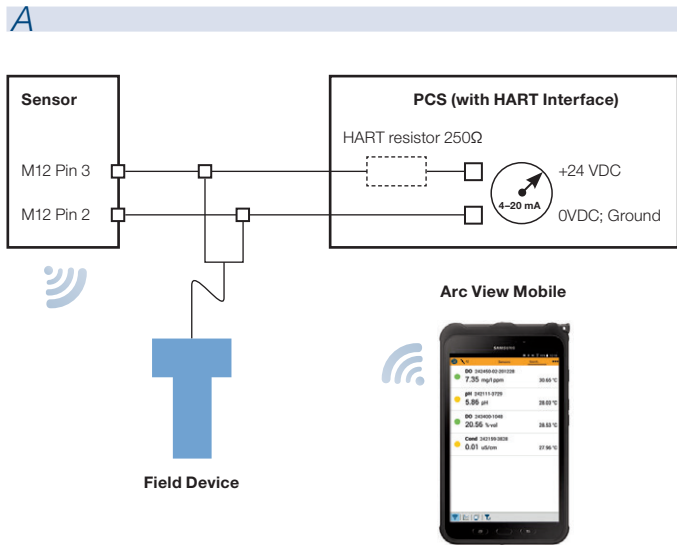
■ Without HART communication ■ With HART communication

### 5.3.4 Electrical Connection for HART Communication

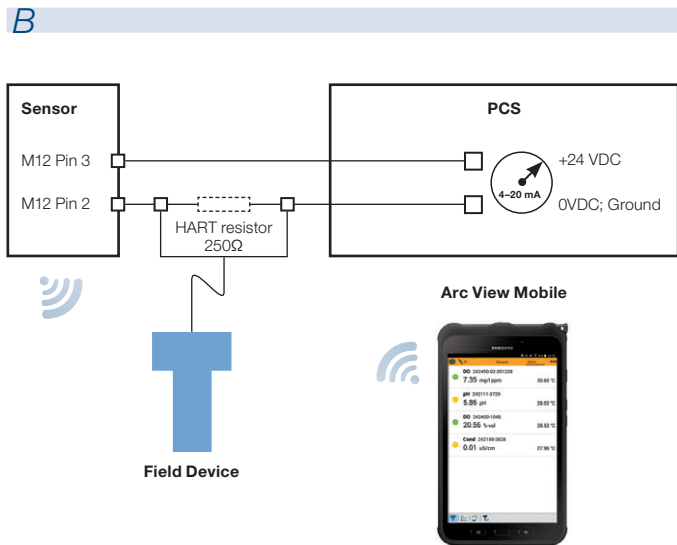
VisiPro DO Ex sensor supports the platform-independent HART 7.0 communication protocol. In most cases a HART resistor is already installed in the HART Interface Card of the process control system (Figure 9 A). If no resistor in the HART interface card is integrated, an external 250 Ω resistor has to be installed in series between the sensor and the process control system as described on Figure 9 B.

For more details about the HART commands and configuration please refer to the HART® Field Device Specification P/N: 624622 document available on the webpage [www.hamiltoncompany.com](http://www.hamiltoncompany.com) (search for HART® Field Device Specification).

The device description or DD can be download on the HART Communication Foundation webpage [www.hartcomm.org](http://www.hartcomm.org) (search for Device Descriptions / DD Library) or on the Hamilton webpage [www.hamiltoncompany.com](http://www.hamiltoncompany.com).



A HART resistor is available in the HART interface card.



A HART resistor is required in series between the sensor and the process control system.

Figure 9: Wiring diagram for integration in the process control system

### 5.3.5 Electrical Connection for Analog 4-20mA Communication

The 4–20 mA interface enables direct connection of the VisiPro DO Ex sensor to a data recorder, indicator, control unit or PCS with analog I/O. The VisiPro DO works as a current sink sensor and is passive. Connect the sensor according to the pin designations (Chapter 5.3.2). The 4–20 mA interface of the VisiPro DO Ex sensors is pre-configured with default values for the 4-20 mA range, and measurement unit. Configure the 4.20 mA interface according to your requirements for proper measurement (Chapter 5.2.4).

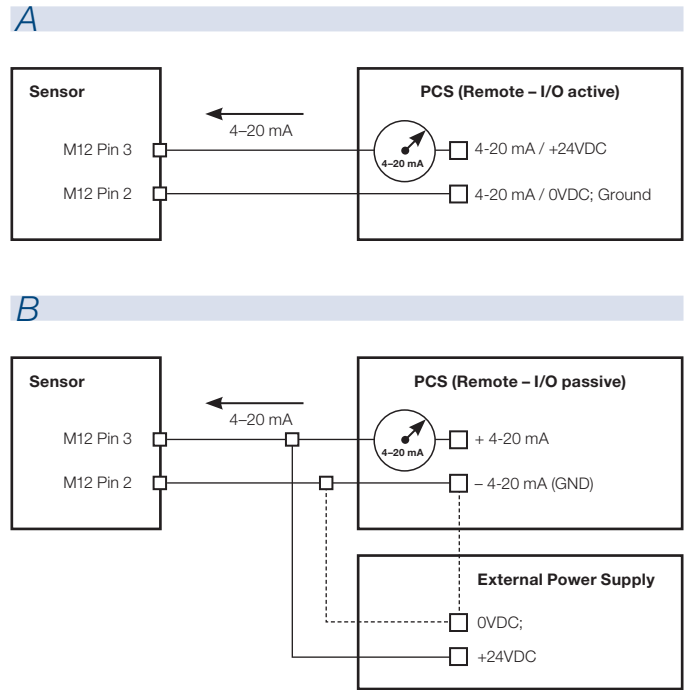


Figure 10: Two-wire loop wiring diagram for the 4-20 mA interface.

A: with an active current input card. B: with a passive current input card.

**NOTE:** If the current input card GND is internally connected to GND of the Power Supply you do not have to connect both GNDs externally.

## 6 Operation

**ATTENTION!** Only use the sensor within the specifications ([www.hamiltoncompany.com](http://www.hamiltoncompany.com)). Failure to do so may lead to damages or measurement failure.

- 1) Remove the protective caps from the VisiPro DO Ex shaft, and from the M12 sensor head
- 2) Mount the O-ring on the sensor shaft and screw the ODO Cap firmly (Chapter 9.1)
- 3) Verify the functionality of the sensor including the ODO cap (Chapter 7.1)
- 4) Calibrate the sensor (Chapter 7.3)
- 5) Connect the sensor to the process control system (Chapter 5)
- 6) Verify the measurement in air on your control system
- 7) Mount the sensor to the armature or process connection (Chapter 5.3)

**NOTE:** No oxygen measurement is performed at a temperature higher than 85°C to protect the optoelectronics and enhanced the sensor lifetime.

## 7 Maintenance

Periodic maintenance routines need to be run in order to ensure safe and reliable operation and measurement of sensor and the accessories.

**⚠ ATTENTION! Avoid any contact of the equipment with corrosive media.**

### 7.1 Verify Sensor Status and ODO Cap Functionality

- 1) Power the sensor with the M12 Sensor Power Cable and connect the sensor to ArcAir.
- 2) Control the traffic lights (Figure 11).
- 3) Please refer to the troubleshooting (Chapter 8) for the next steps if the traffic light is not green.
- 4) Control the quality of the ODO cap in Sensor Status / Quality Counter and Temperature / Quality Indicator and change the ODO Cap or sensor if required (Chapter 7.2).

**📖 NOTE: The lifetime of the VisiPro DO Ex highly depends on the specific conditions of the application. Temperature, pressure, chemicals used may accelerate the ageing of both the sensor and its ODO cap. A warning «DO Replace Sensor Cap» remains active as long as the sensor quality is below 35%. Make sure that after new cap replacement the sensor reaches at least 60% cap quality. The quality indicator takes sensor and cap into account.**

- The sensor is performing correctly. No errors or warnings have been registered.
- At least an error or a warning has been registered. Verify the sensor errors and warnings in Sensor Status.
- No communication between the sensor and ArcAir. This may be due to a hardware failure.

Figure 11: Description of the traffic lights on ArcAir

### 7.2 Replacing the ODO Cap

The exchange of ODO Cap is performed very easily:

- 1) Unscrew the ODO cap from the shaft (Figure 12).
- 2) Exchange the O-ring.
- 3) Screw firmly the new ODO Cap onto the sensor shaft again.
- 4) Perform sensor calibration (Chapter 7.3).

**📖 NOTE: If the ODO Cap is mounted very firmly on the shaft, and if you cannot obtain a good grip on the stainless steel with your fingers, a silicone tube between your fingers and metal may supply a better grip.**



Figure 12: Replacing the ODO cap

### 7.3 Calibration

The VisiPro DO Ex sensors provide two kinds of sensor calibration: automatic standard calibration, and product calibration. The automatic standard calibration and the product calibration may be performed using ArcAir (see chapter 5.2).

#### 7.3.1 Automatic Standard Calibration with ArcAir

VisiPro DO Ex sensors are calibrated at two points: in air and in an oxygen-free environment. During calibration, the sensor controls automatically the stability of the oxygen and temperature signals.

**📖 NOTE: For greater measurement accuracy insure that temperature difference between calibration medium and process medium is minimal.**

#### 7.3.2 Zero Point Calibration (Point Zero Oxygen)

- 1) Install the sensor into the calibration station and connected the Nitrogen calibration gas (Figure 13).
- 2) Power the VisiPro and connect to ArcAir via the Arc Wireless Converter BT.
- 3) Select the sensor in the sensor list.
- 4) Open the Calibration tab.
- 5) Select Zero Point calibration.
- 6) Immerse the sensor into an oxygen-free environment (Figure 13) for e.g. nitrogen. Verify that the flow rate does not exceed 0.5 L/min and avoid overpressure.
- 7) Click Start to start the calibration wizard.
- 8) Follow the instructions on the screen.

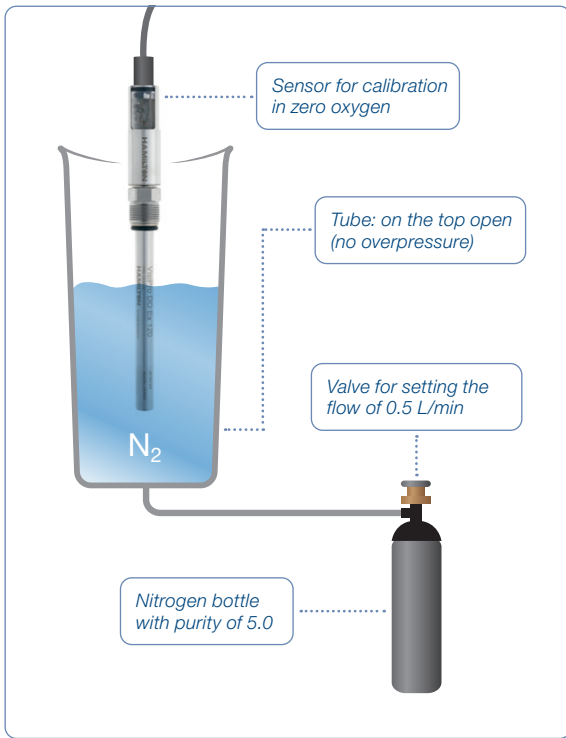


Figure 13: Zero point calibration setup

### 7.3.3 Calibration in Air (Calibration Point Air)

- 1) Install the sensor into the calibration setup with saturated medium (Figure 14).
- 2) Power the VisiPro and connect to ArcAir via the Arc Wireless Converter BT.
- 3) Select the sensor in the sensor list.
- 4) Open the Calibration tab.
- 5) Select Calibration Point Air
- 6) Click Start to start the calibration wizard.
- 7) Follow the instructions on the screen.



Figure 14: Calibration setup in saturated medium



**NOTE:** Calibration with air-saturated water is less accurate due to the slow saturation process of air in water.

**NOTE:** The value of the saturated oxygen concentration at different temperatures, different pressures and air humidity play an important role for the calibration of dissolved oxygen. VisiPro DO Ex refers to a concentration in water saturated air and from the factory settings of atmospheric pressure of 1013 mbar at 25°C. For an accurate calibration Hamilton recommends to use oxygen saturated pure water.

## 7.4 Product calibration

The product calibration is an in-process calibration procedure in order to adjust the measurement to specific process conditions. Product calibration is an additional calibration procedure to a standard calibration.

If product calibration is activated, the VisiPro DO Ex calibration curve is calculated from the data of last calibration at point 1 and from the data of the product calibration (Figure 15). In order to restore the original standard calibration curve, the product calibration can be at any time by selecting on the Product calibration command «cancel». A new standard calibration cancels a product calibration as well.

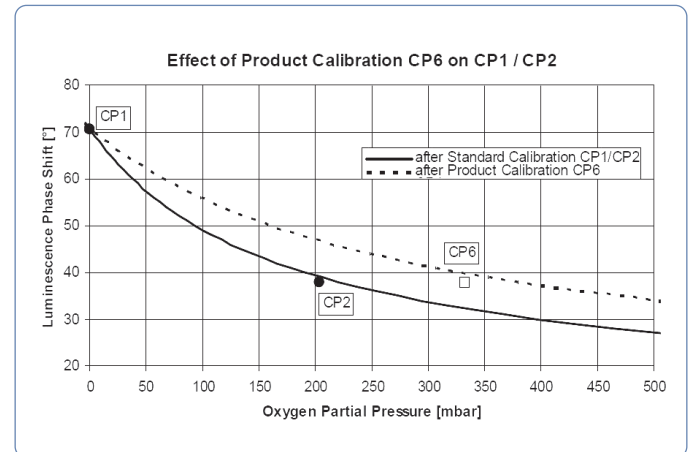



Figure 15: Effect of a product calibration (CP6) on an existing standard calibration function based on the Zero Point Calibration (CP 1) and the Air Calibration (CIP 2).

**NOTE:** The product calibration is possible for DO values in the range of 2 to 55 %-vol (20 – 550 mbar pO<sub>2</sub>).

A product calibration is performed as follows:

- 1) Connect one of the VisiPro DO sensor with the power supply, e.g. Sensor Power Cable M12 Ref 355288 t (see figure xx) and install a Wireless Converter BT Ref 242333.
- 2) Select the desired sensor from the sensor list
- 3) Go to «Process Settings»

- 4) Click «Start» to start the product calibration wizard
- 5) Follow the instruction on the screen

 **NOTE:** Alternatively, the product calibration may be performed with a field device on side the measuring point.


## 7.5 Cleaning

This chapter outlines a manual cleaning procedure for the care and maintenance of optical dissolved oxygen (ODO) sensors including a procedure for the cleaning the sensing membrane in particular.

### Cleaning the Sensor

Carry out the cleaning procedure as follows:

- 1) Remove sensor from the measuring setup.
- 2) Check if the ODO Cap is mounted firmly on the shaft.
- 3) Soak a dust-free cloth or tissue paper with water and wipe the wetted parts with it. Thoroughly rinse the wetted parts and the sensing membrane with deionised water afterwards.
- 4) Dry the wetted parts with a clean dust-free cloth or tissue and store the sensor in dry and dark conditions (ODO Caps are light-sensitive).
- 5) If the sensing-membrane on the front of the cap is contaminated with oil, grease or other organic matter, soak a clean dust-free cloth with isopropyl alcohol. Rinse residual isopropyl alcohol immediately from the membrane with deionised water and gently wipe over the membrane.
- 6) After cleaning always perform a new calibration before carrying out measurements. (See chapter 7.3 in the corresponding Operating Instruction Manual)

 **ATTENTION:** Cleaning, assembly and maintenance should be performed by personnel trained in such work. Do not use any abrasive tissues or cleaning materials and do not use any cleaning chemicals other then described above. Before removing the sensor from the measuring setup, always make sure that the setup is pressure-less and cold and that no process medium can be accidentally spilled. When removing and cleaning the sensor, it is recommended to wear safety glasses and protective gloves.

## 8 Troubleshooting

### 8.1 Sensor Self-Diagnostic

VisiPro DO Ex sensors provide a self-diagnostic functionality to detect and identify the most common sensor malfunctions. Both interfaces, analog 4-20 mA or digital HART, may provide warning and error messages. The analog 4–20 mA interface can be configured according to the NAMUR recommendations to indicate an abnormal event (See chapter 5.2.3). Use ArcAir for monitoring the sensor status and for troubleshooting. The following types of messages are provided by the self-diagnosis function.

#### 8.1.1 Warnings

Warning	Cause / Solution
DO reading below lower limit	The oxygen reading is too low (DO < 0%-sat). Make a new zero-point calibration (Chapter 7.3.2)
DO reading above upper limit	The oxygen reading is too high (DO > 300 %-sat). Make a new calibration in oxygen saturated medium. (See chapter 7.3.3). If not successful, replace the sensor cap.
DO reading unstable	If continuously happening, use a new cap or check the process regulation. If the problem still appears, call our Technical Support.
T reading below lower limit	The temperature is below the user defined measurement temperature range. If the process temperature is outside this range, the sensor will not perform DO readings.
T reading above upper limit	The temperature is above the user defined measurement temperature range. If the process temperature is outside this range, the sensor will not perform DO readings.
Measurement not running	The measurement interval is set to 0 or the measurement temperature is out of the range.
DO calibration recommended	Perform a calibration in order to ensure reliable measurement.(Chapter 8.2)
DO last calibration not successful	The last calibration failed. The sensor is using the old successful calibration values. In order to ensure reliable measurement perform a new calibration (Chapter 7.3.1)
DO replace sensor cap	Replace the ODO Cap and calibrate the sensor cap sensor. This warning remains active as long as the sensor quality is below 35%. Make sure that after new cap replacement the sensor reaches at least 60% cap quality. See chapter 7 for replacement conditions. The quality indicator takes sensor and cap into account.
4-20 mA value below 4 mA	The measurement value is below the lower limit of the 4–20 mA interface output. Reconfigure the 4-20mA interface (Chapter 5.2.3.)





Warning	Cause / Solution
4-20 mA value above 20 mA	The measurement value is above the upper limit of the 4–20 mA interface output. Reconfigure the 4-20mA interface (Chapter 5.2.3.)
4-20 mA current set-point not met	The 4–20 mA interface is not able to regulate the current requested for the current measurement value according to your 4–20 mA interface configuration. Check the 4–20 mA wiring and supply voltage (Chapter 5.3.2)
Sensor supply voltage too low	The sensor supply voltage is too low for the sensor to operate correctly. Ensure stable supply voltage within the sensors specifications (Chapter 5.3.3)
Sensor supply voltage too high	The sensor supply voltage is too high for sensor to operate correctly. Ensure stable supply voltage within the sensors specifications (Chapter 5.3.3)

## 8.1.2 Errors

Errors (failures)	Cause / Solution
DO reading failure	Sensor cap is missing or the sensor is broken.
DO p(O <sub>2</sub> ) exceeds air pressure	Measured partial pressure of oxygen is higher than the air pressure set by the operator. Reconfigure the air pressure parameter (Chapter 5.2.3)
T sensor defective	The internal temperature sensor is defect, please call our Technical Support.
DO sensor cap missing	The DO sensor cap has been removed. Do not immerse the sensor in a measurement solution. Mount an ODO Cap and calibrate the sensor prior measurement (Chapter 6).
Red channel failure	Measurement channel failure. Please call our Technical Support.
Temperature reading far below min	The measured temperature is below the operation temperature.
Temperature reading far above max	The measured temperature is above the operation temperature.

## 8.2 Getting Technical Support

If a problem persists even after you have attempted to correct it, contact Hamilton's Customer Support: Please refer to the contact information at the back of this Manual.

## 8.3 Returning VisiPro DO Ex for Repair

Before returning a VisiPro DO Ex sensor to Hamilton for repair, contact our Customer Service (see Chapter 14.2) and request:

a Returned Goods Authorization (RGA) number.

Do not return a VisiPro DO Ex sensor to Hamilton without an RGA number. This number assures proper tracking of your sensor. VisiPro DO Ex sensors that are returned without an RGA number will be sent back to the customer without being repaired.

Decontaminate the VisiPro DO Ex sensor and remove health hazards, such as radiation, hazardous chemicals, infectious agents etc. Provide complete description of any hazardous materials that have been in contact with the sensor.

## 9 Disposal



The design of Hamilton sensors optimally considers environmental compatibility. In accordance with the EC guideline 2012/19/EU Hamilton sensors that are worn out or no longer required must be sent to a dedicated collection point for electrical and electronic devices, alternatively, must be sent to Hamilton for disposal. Sensors must not be sent to an unsorted waste disposal point.



有害物質表，請參閱[www.hamiltoncompany.com](http://www.hamiltoncompany.com)，章節過程分析，符合性聲明

## 10 Bluetooth Certification

Hamilton  
HVIN: 243667

FCC ID: 2AQYJVISIDO  
IC ID: 24225-VISIDO



This device complies with Part 15 of the FCC Rules and with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

**NOTE:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.



**NOTE:** Changes or modifications made to this equipment not expressly approved by Hamilton may void the FCC authorization to operate this equipment.

# 11 Ordering Information

Parts below may only be replaced by original spare parts.

## 11.1 VisiPro DO



Ref	Description	ODO Cap	Ex Certification
243667- 1 1 1	VisiPro DO Ex 120	H0	ATEX, IECEx
243667- 1 2 1	VisiPro DO Ex 160	H0	ATEX, IECEx
243667- 1 3 1	VisiPro DO Ex 225*	H0	ATEX, IECEx
243667- 1 4 1	VisiPro DO Ex 325	H0	ATEX, IECEx
243667- 1 5 1	VisiPro DO Ex 425	H0	ATEX, IECEx
243667- 1 1 2	VisiPro DO Ex 120	H2	ATEX, IECEx
243667- 1 2 2	VisiPro DO Ex 160	H2	ATEX, IECEx
243667- 1 3 2	VisiPro DO Ex 225*	H2	ATEX, IECEx
243667- 1 4 2	VisiPro DO Ex 325	H2	ATEX, IECEx
243667- 1 5 2	VisiPro DO Ex 425	H2	ATEX, IECEx
243667- 2 1 1	VisiPro DO 120	H0	none
243667- 2 2 1	VisiPro DO 160	H0	none
243667- 2 3 1	VisiPro DO 225*	H0	none
243667- 2 4 1	VisiPro DO 325	H0	none
243667- 2 5 1	VisiPro DO 425	H0	none
243667- 2 1 2	VisiPro DO 120	H2	none
243667- 2 2 2	VisiPro DO 160	H2	none
243667- 2 3 2	VisiPro DO 225*	H2	none
243667- 2 4 2	VisiPro DO 325	H2	none
243667- 2 5 2	VisiPro DO 425	H2	none

\*The VisiPro DO sensor family 225 have, in reality, a shaft length of 215 mm. This ensures optimal rinsing in replaceable armatures, such as Retractable.

## 11.2 Parts and Accessories



Ref	Description	Wetted Materials
243515	ODO Cap H0	Stainless steel 1.4435 Silicone (FDA approved)

**Application:** For general application in biotechnology, water treatment and monitoring as well as in breweries, wineries and soft drink processing



Ref	Description	Wetted Materials
243505	ODO Cap H2	Stainless steel 1.4435 PTFE (USP Class VI)

**Application:** For fermentation processes where sterilization in place (SIP) is performed in media containing higher amounts of lipophilic compounds. It comes with a hygienic design.



Ref	Product Name	Length
355283	Sensor Cable M12	3m
355284	Sensor Cable M12	5m
355285	Sensor Cable M12	10m

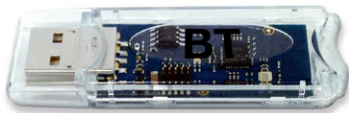
**Description:** The Sensor Cable M12 – open end is designed for connection to a data recorder, indicator, control unit or PCS (Process Control System) with analog I/O.





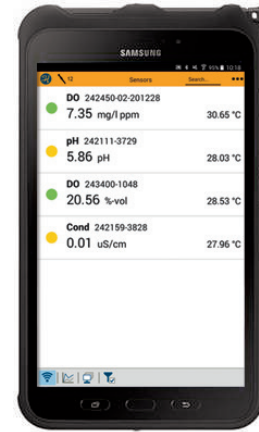
Ref	Product Name
355288	Sensor Power Cable M12

**Description:** This cable includes a power adapter to supply the sensor with operation power.



Ref	Product Name
243499	Wireless Converter BT

**Description:** Designed for wireless communication between ArcAir and VisiPro DO Ex sensor.



Ref	Product Name
1007111	Arc View Mobile Basic for none Ex environment

**Description:** The pre-configured Arc View Mobile, Hamilton's mobile solution for monitoring measurement values, calibrating Arc sensors and configuring various parameters with the unified user interface for pH, DO, Conductivity and ORP. The Arc View Mobile is based on the Samsung Galaxy Tab Active tablet and comes pre-configured with the ArcAir basic, app blocker application, power supply cable, instruction manual and Hamilton quick guide.

Ref	Product Name
1007113	Arc View Mobile Advanced for none Ex environment

**Description:** The pre-configured Arc View Mobile, Hamilton's mobile solution for monitoring measurement values, calibrating Arc sensors and configuring various parameters with the unified user interface for pH, DO, Conductivity and ORP. The Arc View Mobile is based on the Samsung Galaxy Tab Active tablet and comes pre-configured with the ArcAir advanced application, including features for CFR 21 Part 11 and Eudralex Volume 4 Annex 11 compliance, app blocker application, power supply cable, instruction manual and Hamilton quick guide.

Ref	Product Name
243688	View Ex Mobile

**Description:** View Ex Mobile is a monitoring, configuration and calibration device based on Android smartphone application technology. The View Ex Device can be used wirelessly for calibration, configuration and diagnostics in ex environment (Zone 1, 2, 21, 22) or in laboratory.

### 11.3 Services

Hamilton service engineers are available in Europe and China in order to provide customers with on-site services. Hamilton offers a wide range of services from technical support to initial operation, qualification and maintenance of the sensors.

Various tailored services are offered especially for the BioPharma, ChemPharma and brewery industries. Experienced service engineers ensure an optimal and professional service.

In order to find your local service support please visit:  
[www.hamiltoncompany.com/process-analytics/support](http://www.hamiltoncompany.com/process-analytics/support)

#### Overview of service offers



Online service



Technical support



Initial Operation/Calibration



Qualification (IQ/OQ)



Service packages



Maintenance



Training

Series of horizontal dotted lines for taking notes.



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# HAMILTON®

Web: [www.hamiltoncompany.com](http://www.hamiltoncompany.com)

USA: 800-648-5950

Europe: +41-58-610-10-10

#### **Hamilton Americas & Pacific Rim**

4970 Energy Way  
Reno, Nevada 89502 USA  
Tel: +1-775-858-3000  
Fax: +1-775-856-7259  
[sales@hamiltoncompany.com](mailto:sales@hamiltoncompany.com)

#### **Hamilton Europe, Asia & Africa**

Via Crusch 8  
CH-7402 Bonaduz, Switzerland  
Tel: +41-58-610-10-10  
Fax: +41-58-610-00-10  
[contact.pa.ch@hamilton.ch](mailto:contact.pa.ch@hamilton.ch)

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