OIM Oxygen Probe for In-Line Measurement PSt3 / PSt6









OIM Oxygen Probe for In-Line Measurement PSt3 / PSt6

Specification:

Oxygen probe with an Oxygen Exchange Cap (OEC) and a standardized thread compatible with most bioreactors and port adapters

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Table of Contents

1	Preface	7
2	Safety Notes	8
3	Description of the OIM	9
3.1	Scope of Delivery	
3.2	Measurement Set-up	11
3.3	OIM Accessories	11
3.3.1	OEC Oxygen Exchange Cap	11
3.3.2	OAD-25 Adapter for 25 mm Ports	12
4	Operation	13
4.1	Mounting the OIM	
4.2	Autoclavation	13
4.3	Calibration	14
4.3.1	Calibration of an OIM Type PSt3 - Preparation of Calibration Standards	14
4.3.2	Calibration of an OIM Type PSt6 – Preparation of Calibration Standards	15
5	Technical Data	17
6	Abbreviations	18
7	Concluding Remarks	18

1 Preface

You have chosen a new, innovative technology for measuring oxygen.

Chemical optical sensors (also called optodes) have several important features:

- They are small.
- Their signal does not depend on the flow rate of the sample.
- They can be physically divided from the measuring system which allows a noninvasive measurement.
- They can be used in disposables.

Therefore, they are ideally suited for the examination of small sample volumes, for highly parallelized measurements in disposables, and for biotechnological applications. A set of different minisensors, flow-through cells and integrated sensor systems is available to make sure you have the sensor which matches your application.

Please feel free to contact our service team to find the best solution for your application.

Your PreSens Team

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY BEFORE WORKING WITH THIS ITEM.

2 Safety Notes

It is the customer's responsibility to validate the sensor and transmitter under end-user conditions according to safety precautions of the application to ensure that the use of the sensor is safe and suitable for the intended purpose.

PreSens is explicitly not liable for direct or indirect losses caused by the application of these measurement systems. In particular it has to be considered that malfunctions can occur due to the naturally limited lifetime of the sensor depending on the respective application. The set-up of backup measurement stations is recommended when using the sensors in critical applications to avoid consequential losses. It is the customer's responsibility to install a suitable safety system in the event of sensor failure.

3 Description of the OIM

The OIM oxygen probe for in-line measurement consists of a fitting made of stainless steel. The oxygen sensor is integrated into an exchangeable cap (oxygen exchange cap OEC), which has to be screwed to the top of the metal fitting. OECs are available with sensor coatings type PSt3 (detection limit 15 ppb, 0 - 100 % oxygen), and type PSt6 (detection limit 1 ppb, 0 - 4.2 % oxygen). The OIM is connected to the instrument via an optical fiber. It has a standardized thread Pg 13.5 which is compatible with most bioreactors and port adapters. In addition, customized fittings for e. g. sight glasses are offered.



Fig. 1 OIM Oxygen probe for in-line measurement

OIM features:

- No time for polarization needed
- The system can be used after autoclavation without recalibration
- The system is fully autoclavable up to 100 times (120 °C, 1.5 atm)
- No membrane cleaning and replacement necessary
- No electrolyte solutions to poison or replenish
- Long shelf-life
- Easy exchange of the OEC, if required

3.1 Scope of Delivery

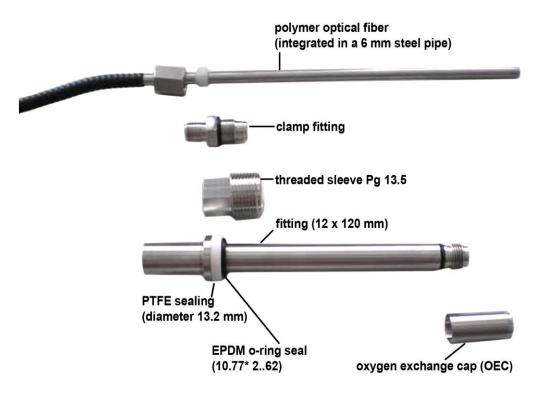


Fig. 2 Individual parts of an OIM

The OIM consists of the following parts:

- Light guide integrated in steel pipe (The standard POF length is 2.5 m but other POF lengths are also available: 0.70 m / D12-L70, 1.20 m / D12-L120, 2.15 m / D12-L215, or 3.25 m / D12-L325.)
- Clamp fitting
- Threaded sleeve Pg 13.5
- Fitting 12 x 120 mm with PTFE sealing
- Oxygen exchange cap

Additionally required equipment (not supplied):

- Fiber optic oxygen transmitter, e. g. Fibox 3 (more oxygen transmitters can be found on www.presens.de/products/o2/meters.html)
- PC / Notebook
- additional OECs have to be ordered separately

3.2 Measurement Set-up

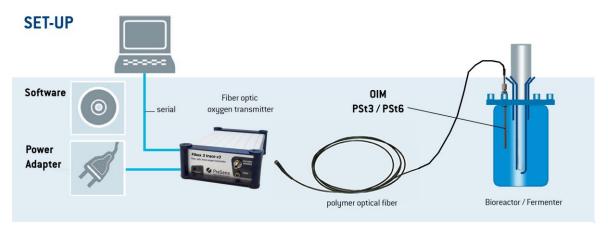


Fig. 3 Set-up for measurement with an OIM

The OIM is screwed to the bioreactor port or port adapter. The OIM's polymer optical fiber is connected to a fiber optic oxygen transmitter (e. g. Fibox 3 trace), which is connected via a serial COM port to a PC.

3.3 OIM Accessories

3.3.1 OEC Oxygen Exchange Cap

The OEC oxygen exchange cap is available separately. It is coated with the oxygen sensitive material and available in sensor type PSt3 and PSt6. It can be screwed to the top of the OIM, if the delivered OEC has to be exchanged or you want to use a different sensor coating.



Fig. 4 OEC Oxygen exchange cap

3.3.2 OAD-25 Adapter for 25 mm Ports

To use the OIM in fermenters a 25 mm port, the OAD-25, is available. All OIMs from PreSens are designed for 12 mm ports (PG 13.5 thread). The OAD-25 adapter is offered as an accessory so the sensor probe can be connected to 25 mm ports.







OIM inside the OAD-25

4 Operation

4.1 Mounting the OIM

Remove the rubber cap from the oxygen exchange cap before inserting the OIM in the respective port. Tighten the thread of the OIM to the port.



Fig. 6 Remove the rubber cap from the OEC

4.2 Autoclavation

! The polymer optical fiber does not stand autoclavation procedures.

Pull back the fiber until almost the whole length of the steel pipe it is integrated in is removed from the OIM housing or remove it completely during autoclavation.



Fig. 7 OIM with pulled back polymer optical fiber

4.3 Calibration

The OIM has to be calibrated before it is used for the first time. A conventional two-point calibration in oxygen-free environment (nitrogen / CO_2 , or sodium sulfite), and air saturated (sensor type PSt3) or 1 – 2 % oxygen (sensor type PSt6) environment has to be performed. The oxygen sensor requires no re-calibration up to 100,000 measurement points.

Please see the respective transmitter instruction manual for more detailed information about software settings and calibration procedure.

4.3.1 Calibration of an OIM Type PSt3 – Preparation of Calibration Standards

1st Calibration Point:

Nitrogen- or CO₂-saturated atmosphere
 You can use nitrogen- or CO₂-saturated atmosphere as calibration standard cal 0.
 Use a commercially available test gas N₂ / CO₂ (5.0) (suppliers are e. g. Air Liquide, Linde, Westfalen AG).

Introduce the gas in the vessel with the OIM (see Fig. 8). Then follow the instructions in the respective transmitter manual for calibration.

2nd Calibration Point:

20.9 % O₂ (humidified gas)
 The second calibration value cal 2nd for a PSt3 sensor is 100 % air sat. (ca. 20.9 % O₂ → % air sat. = % O₂ x 100/20.95). Use a commercially available test gas of 20.9 % O₂ as a second calibration standard cal 2nd.

One option to humidify the gas is leading it into a vessel filled with distilled water before introducing it in the vessel with the OIM (see Fig. 8). Then follow the instructions in the respective transmitter manual for calibration.

Alternative for the 1st Calibration Point:

As an alternative you can use oxygen-free water for the first calibration point.

Oxygen-free water To prepare oxygen-free water dissolve 1 g of sodium sulfite (Na₂SO₃) and 50 μL cobalt nitrate (Co(NO₃)₂) standard solution (p(Co) = 1000 mg/L; in nitric acid 0.5 mol/L) in 100 mL water. Use a suitable vessel with a tightly fitting screw top and label it cal 0. Make sure there is only little headspace in your vessel. Due to a chemical reaction of oxygen with the Na₂SO₃ the water becomes oxygen-free. Additional oxygen, diffusing from air into the water, is removed by surplus Na_2SO_3 . Close the vessel with the screw top and shake it for approximately one minute to dissolve Na_2SO_3 and to ensure that the water is oxygen-free. To prepare oxygen-free water you also can use sodium dithionite ($Na_2S_2O_4$).

Fill the calibration solution **cal 0** in the vessel you have mounted the OIM in. Make sure the oxygen probe tip is covered completely with the liquid. To minimize the response time, you can slightly stir the solution. Then follow the instructions in the respective transmitter manual for calibration. After recording the first calibration point remove the calibration solution **cal 0**, fill the vessel with distilled water and stir it for 1 minute. Repeat this procedure at least 5 times to clean the OIM from sodium sulfite.

For storing the calibration solution **cal 0** keep the vessel closed after calibration with a screw top to minimize oxygen contamination. The shelf life of **cal 0** is about 24 hours provided that the vessel has been closed with the screw top.

4.3.2 Calibration of an OIM Type PSt6 – Preparation of Calibration Standards

Calibration of PSt6 sensor spots is performed with certified gases (suppliers are e. g. Air Liquide, Linde, Westfalen AG).

1st Calibration Point:

Nitrogen- or CO₂-saturated atmosphere
 Use nitrogen or CO₂ (N₂ / CO₂ 5.0) as a first calibration standard cal 0.

Introduce the gas in the vessel with the OIM (see Fig. 8). Then follow the instructions in the respective transmitter manual for calibration.

2nd Calibration Point:

1 − 2 % O₂ (humidified gas)

The second calibration value **cal 2nd** for a PSt6 sensor is ideally in the range between 5 and 10 % air sat. (ca. 1-2 % $O_2 \rightarrow$ % air sat. = % O_2 x 100/20.95). Use a commercially available test gas of 1-2 % O_2 as a second calibration standard **cal 2nd**.

One option to humidify the gas is leading it into a vessel filled with distilled water before introducing it in the vessel with the OIM (see Fig. 8). Then follow the instructions in the respective transmitter manual for calibration.

If it is not possible to use gases or to build a suitable calibration chamber, a manual calibration can be performed, using calibration values obtained from the final inspection protocol delivered with the sensor spots. You can find more information about manual calibration in the instruction manual of the respective transmitter.

CALIBRATION SET-UP for Calibration with Certified Gases

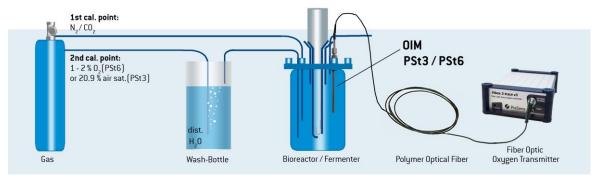


Fig. 8 Calibration set-up: Two-point calibration of an OIM using gases

5 Technical Data

	Sensor Type	e PSt3	Sensor Type PSt6		
Specifications	Gaseous & Dissolved O ₂	Dissolved O ₂	Gaseous & Dissolved O ₂	Dissolved O ₂	
Measurement range	0 – 100 % O ₂	0 – 45 mg/L	0 – 4.2 % O ₂	0 – 1.8 mg/L	
	0 – 1000 hPa	0 – 1400 µmol	0 – 41.4 hPa	0 – 56.9 µmol	
Limit of detection	0.03 % oxygen	15 ppb	0.002 % oxygen	1 ppb	
Resolution	± 0.01 % O ₂ at 0.21 % O ₂	± 0.14 µmol at 2.83	± 0.0007 % O ₂ at 0.002 % O ₂	± 0.010 µmol at	
	$\pm~0.1~\%~O_2$ at 20.9 $\%~O_2$	μmol	$\pm~0.0015~\%~O_2$ at 0.2 % O_2	0.03 µmol	
	± 0.1 hPa at 2 hPa	±1.4 µmol at 283.1	± 0.007 hPa at 0.023 hPa	± 0.020 µmol at 2.	
	± 1 hPa at 207 hPa	μmol	± 0.015 hPa at 2.0 hPa	μmol	
Accuracy	± 0.4 % O ₂ at 20.9 % O ₂		± 1ppb or ± 3 % of the respective concentration; whichever is higher		
	± 0.05 % O ₂ at 0.2 % O ₂				
Drift at 0 % oxygen	$<0.03~\%~O_{2}$ within 30 days (sampling interval of 1 min.)		< 2 ppb within 30 days (sampling interval of 1 min.)		
Measurement temperature range	0 – 50 °C		0 – 50 °C		
Response time (t ₉₀)	< 6 sec.	< 40 sec.	< 6 sec.	< 40 sec.	
Properties					
Compatibility	Aqueous solutions, ethanol,	methanol			
No cross-sensitivity	pH 1 – 14				
with	CO ₂ , H ₂ S, SO ₂				
	Ionic species				
Cross-sensitivity to	Organic solvents, such as a	cetone, toluene, chloro	form or methylene chloride		
	Chlorine gas				
Sterilization	Steam sterilization				
procedure	Ethylene oxide (EtO)				
	Ethylorio oxido (Eto)				
	Gamma irradiation				
Cleaning procedures	Gamma irradiation	NaOH, 90 °C, 194 °F)			
Cleaning procedures	Gamma irradiation	NaOH, 90 °C, 194 °F)			
Cleaning procedures	Gamma irradiation Cleaning in place (CIP, 5 %				
Cleaning procedures Calibration	Gamma irradiation Cleaning in place (CIP, 5 % 3 % H ₂ O ₂	max. 4 – 5 % xygen-free	Two-point calibration in oxygen (nitrogen) and a second calibra between 1 and 2 % oxygen		

6 Abbreviations

ABBREVIATION	DESCRIPTION
OAD-25	Adapter for 25 mm ports
OEC	Oxygen Exchange Cap
OIM	Oxygen Probe for In-Line Measurement
PSt3	Sensor type PSt3, normal oxygen range (detection limit 15 ppb, 0 - 100 % oxygen)
PSt6	Sensor type PSt6, trace oxygen range (detection limit 1 ppb, 0 - 4.2 % oxygen)

7 Concluding Remarks

Dear Customer,

With this manual, we hope to provide you with an introduction to work with the oxygen sensor spots type PSt3 and PSt6.

This manual does not claim to be complete. We are endeavored to improve and supplement this version.

We are looking forward to your critical review and to any suggestions you may have.

You can find the latest version at www.PreSens.de.

With best regards,

Your PreSens Team



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