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B: http://wiki.oroboros.at/index.php/MiPNet19.18B_POS-service

Service of the Polarographic Oxygen Sensor OroboPOS

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Section

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Summary Service of the polarographic oxygen sensors (**OroboPOS**, POS) is the basis of signal stability, low noise and high time-resolution. Performance specifications of the Oroboros O2k can be met only with oxygen sensors that are maintained in a well-monitored functional state.

POS service may only need to be performed every few months. POS service is necessary if (1) a new sensor is installed, (2) the signal during air calibration is not stable over time, (3) the signal-to-noise ratio is high, (4) the time response is prolonged and biphasic (time constant >10s), (5) the oxygen signal at zero calibration does not decline rapidly to 0 %-. 5% of the signal at air saturation. For each sensor, the frequency of POS service is optimized based on long-term calibration records for **quality control** (O2-calibration.xlsx).

1. OroboPOS-Service Kit

20610-02 OroboPOS-Service Kit - Oxygraph-2k

① 26300-01 OroboPOS-Electrolyte Powder, KCl
② 26200-01 OroboPOS-Membranes, FEP 25 µm; 40/Pck.
③ 26520-01 OroboPOS-Polishing Powder for cathode cleaning
④ 26510-01 OroboPOS-Polishing Cloth for cathode cleaning
⑤ 26400-01 OroboPOS-Mounting Tool for membrane application
⑥ 26800-01 Pipette\Plastic\1 ml ungraded for electrolyte
⑦ 26600-01 O_2-Zero Powder, dithionite ($Na_2S_2O_4$)

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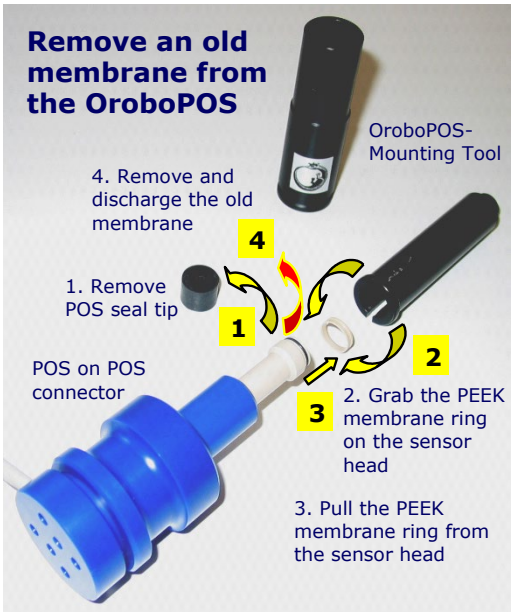
Clip B1a

Accessories for sensor service are provided in the OroboPOS-Service Kit. In addition, distilled water and 25 % ammonia solution are required. To ensure premium quality of the content, the OroboPOS-Service Kit should be stored in the dark.



Removal of a used membrane from the OroboPOS.

2. Cleaning

Prevent damage by electrostatic discharge (ESD) when handling the OroboPOS-Connector or cable connections to the O2k (MiPNet14.01).

For sensor service, remove the black POS seal tip 1. It is normal to observe many small bubbles in the electrolyte reservoir. This does not indicate that the bubbles caused a problem while the sensor was in use. Remove the OroboPOS-membrane ring 2, 3 and membrane 4. Wash off electrolyte with distilled water.

For cleaning the anode and cathode, the sensor head is removed from the OroboPOS-Connector and mounted onto the blue base of the Perspex housing of the POS (OroboPOS-Service Kit).

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➲Clip B1b

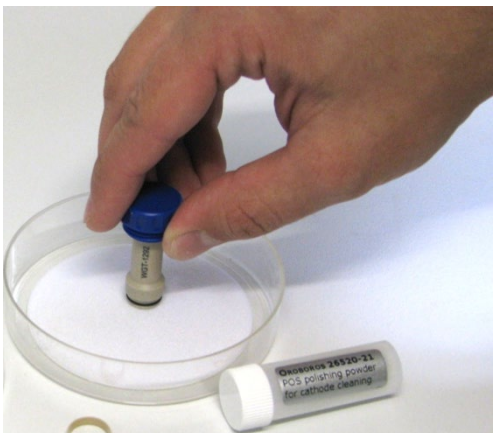
The cathode needs to be cleaned if its gold surface appears to be coated by a colored layer. The silver/silver chloride anode darkens after long-term operation, inadequate storage of the sensor, or contact with hydrogen sulfide. This may cause high signal-to-noise ratio or reduce the signal output by >30 %, reflected by the requirement to increase the gain. Such sensor problems can be improved by cleaning the cathode, anode and gold connections.

2.1. Cathode cleaning

The cathode must be treated with extreme care. Do not touch with fingers, nor expose to detergents or greasy liquids.

Mount the OroboPOS onto the blue storage base. Wash off electrolyte from the POS with distilled water.

Place the Petri dish with the Polishing Cloth (OroboPOS-Service Kit) on a flat surface. Add a few drops of distilled water. Add on the tip of a spatula OroboPOS-Polishing Powder (aluminum oxide, 0.3 µm). Hold the sensor in a vertical position and polish the cathode in the thin paste for one minute in a figure-eight motion. Wash the polishing powder carefully off the sensor with distilled water. Subsequently, the anode is always cleaned as well (Section 2.2). If the noise remains high or the response time of the sensor signal is biphasic (exponential phase followed by a slow drift) after polishing the cathode and cleaning the anode with ammonia, repeat the



Cathode cleaning on the polishing cloth.

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➲Clip B2

cathode/anode cleaning cycle several times. Finally, wash the polishing cloth with distilled water and make sure that it is completely dry before storage.
In rare cases you may further clean the gold cathode with ultrasonic treatment at low power for up to 30 seconds while immersing the tip of the sensor head in distilled water. In extreme cases, the cathode may be cleaned by adding a drop of 50-75 % nitric acid onto the surface of the cathode for no longer than 15 seconds with extreme care. Carefully remove any traces of nitric acid by washing with distilled water and proceed as described above (Section 2.1).

2.2. Anode cleaning

Clip B3

Fill the electrolyte reservoir of the POS with fresh 25 % ammonia solution. Within 10 min the silver/silver chloride should appear bright gray. Wash the sensor with distilled water and repeat the ammonia solution wash twice. For older sensors it becomes necessary to prolong the exposure to ammonia up to several hours or even overnight, sealing the ammonia under a membrane and under the POS cover slip. Protect the POS from light, since the silver/silver chloride anode is light sensitive.

2.3. Clean the electrical connection

Unscrew the POS head and inspect both sides of the electrical connection (gold pin and threads). Remove any contamination such as salt crystals, grease and moisture with a fine paper cloth. If necessary, wash it gently with a small amount of 100% ethanol. Before screwing the POS head onto the OroboPOS-Connector for membrane application, clear the POS connector of moisture and any other contamination (particularly any salt crystals from the electrolyte). Similarly, clean the plug of the electrical cable connecting to the O2k-Main Unit.

3. Membrane mounting

Clip B4

The POS head is screwed onto the blue OroboPOS-Connector. Check the O-ring on the POS head to ensure that its surface is smooth and intact. In exceptional cases, apply a tiny amount of grease to the O-ring of the sensor head.

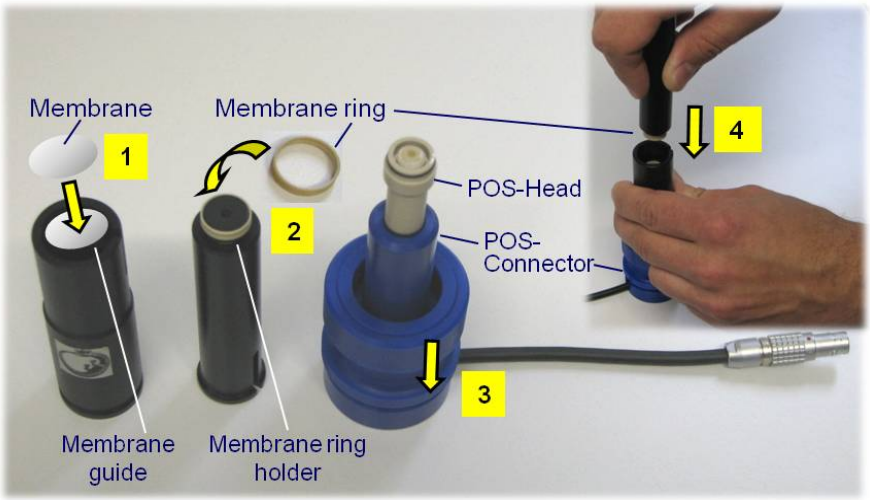
Use KCl solution as electrolyte (1 mol·dm^{-3}; 74.56 g potassium chloride per litre, in distilled water) provided in the OroboPOS-Service Kit. Add distilled water to the electrolyte powder up to the 10 mL mark. Alternatively, dissolve 1.49 g KCl in distilled water with a total volume of 20 ml. Store at 4-8 °C in a closed vial. To prevent the formation of gas bubbles in the electrolyte solution, heat the solution by gently agitating the electrolyte vial in hot water (40-70 °C) before membrane mounting.

POS membranes, which are transparent, are kept in small boxes in the OroboPOS-Service Kit. Each membrane is separated by a non-transparent white paper sheet. Do not add the paper to the oxygen sensor. Carefully separate a membrane from the stack of paper sheets and membranes,

avoiding any mechanical damage of the membrane. Do not touch the central area of the membrane.

The black OroboPOS-Mounting Tool consists of two parts, (i) the membrane guide (larger diameter) and (ii) the membrane ring holder with O-ring. Wash off any electrolyte and salt crystals with distilled water.

1 Position a new membrane into the **membrane guide** using the forceps. 2 Fix the OroboPOS-Membrane Ring (which seals the membrane against the sensor body) to the **membrane ring holder**. Fill the POS head with electrolyte. 3 Slide the membrane guide downwards across the POS head while pushing the lower ring (arrow) of the blue OroboPOS-Connector strongly downwards. By releasing this ring, the membrane guide is fixed to the POS connector. 4 To slide the OroboPOS-Membrane Ring over the POS head, slide the membrane ring holder into the membrane guide, and press firmly down in a single movement to the final position.



Mounting a membrane onto the OroboPOS.
The OroboPOS-Mounting Tool consists of two parts, the membrane guide and the membrane ring holder.

No bubbles should be trapped in the electrolyte reservoir after membrane application. No folds should be visible in the membrane in the central area. Inspect the electrolyte reservoir under a binocular. Small folds in the membrane near the outer circumference have no negative effects, but large folds should be avoided. Wash excess electrolyte off the POS and POS connector. Apply a wet OroboPOS-Seal Tip and attach the OroboPOS-Connector to the OroboPOS-Holder.

4. Cable connection

For connection of the OroboPOS to the O2k Main unit, refer to the following manual:
» MiPNet22.11 O2k-FluoRespirometer manual

5. Storage of the OroboPOS

5.1. Short-term storage

For short periods of days or several weeks, the POS is maintained in the O2k-chamber. The chamber is prewashed with distilled water and completely filled with 70% ethanol for chemical sterilization. The stopper is inserted loosely without pushing it down beyond the point where the sealing ring is inserted into the glass chamber. This ensures a longer lifetime of the sealing rings. The receptacle of the stopper is completely filled with ethanol from the top and is sealed with a black cover slip to avoid evaporation of ethanol. Before an experiment, the ethanol is siphoned off and the chamber is washed with distilled water (MiPNet06.03).

For shelf storage, unplug the POS connector from the O2k-Main Unit. Clean the sealing tip and membrane with distilled water. Mount the POS to the blue storage base and seal it with the Perspex cup to **prevent the electrolyte from drying out**. Store in the dark.

5.2. Long-term storage

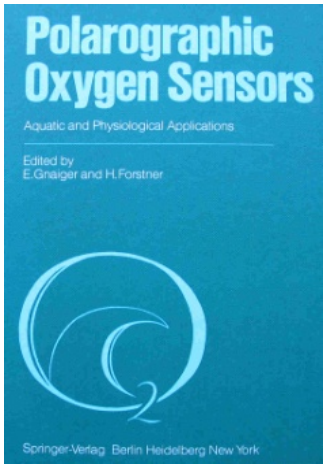
For storage of the POS for several months, the sealing tip and membrane are removed. Wash the electrolyte off the POS with distilled water. Even if the membrane is not damaged, remove it by gripping the membrane holding ring with the groove in the lower end of the membrane ring holder of the OroboPOS-Mounting Tool (see above). The POS head is **stored dry and in the dark**. Check for any moisture and salt contamination in the electrical connector of the POS head and clean with a soft tissue if needed.

6. Replacement of the OroboPOS head

After cleaning and drying the gold cathode contact or drying the sensor body at 60 °C for 24 hours the zero current should be reduced. Additionally, the zero current of the bare cable (without the sensor head connected) should be tested for any current leakage. If the latter test excludes any sources of leakage other than the POS and if repetition of POS service is not enough to solve the issue, the sensor head must be replaced.

A new sensor head can be screwed onto the sensor connector if the old sensor head has been irreversibly damaged or should be replaced.

7. References



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- https://www.bioblast.at/index.php/Hitchman_1983_POS_Membrane

O2k Manual

Related MiPNets

»MiPNet19.18A_O2k-start

»MiPNet19.18D O2k-calibration

»MiPNet22.11 O2k-FluoRespirometer manual

Acknowledgements

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NextGen-O2k

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 859770.

Supplement A. O2k-Videosupport

O2k-Videosupport can be accessed online or directly on the Oroboros USB flash drive.

» **O2k-Videosupport**
http://wiki.oroboros.at/index.php/O2k-Videosupport

- **B1a OroboPOS from housing**
- **B1b Disassembly of OroboPOS**
- **B2 Cathode cleaning**
- **B3 Anode cleaning**
- **B4 Membrane mounting**
- **B5 Insert OroboPOS**

Videos Johannes Aitzetmüller: fancy tree films, Innsbruck.