

Troubleshooting + Maintenance of LDO and Clark Probes

1. Incorrect temperature reading

- Check that the temperature sensor is covered with a minimum **20 mm** of sample solution.
- Check sensor with calibrated thermometer or with temperature sensor of known accuracy. If the deviation to reference value is greater than **0.3 °C**, replace oxygen probe.

2. Incorrect ambient pressure reading

Check sensor with calibrated barometer or with pressure sensor of known accuracy. If the deviation to reference value is greater than **30 hPa**, replace oxygen probe.

3. Incorrect oxygen reading

Measured in sample:

- Check that the probe is sufficiently immersed in the sample and that the temperature sensor is covered with a minimum **20 mm** of sample. Otherwise the temperature reading is incorrect.
- Clark probe: Probe must be in a stirred or medium flowing sample. Adjust stirring and avoid any vortex, which can change the reading by adding oxygen from the ambient air.
- Calibrate oxygen probe in 100% water saturated air.
- If the oxygen concentration of the sample is below 1 mg/L, do a 0% calibration. For 0% standard recipes see section [10].
- LDO: Make sure that the optical oxygen probe is not exposed to direct sunlight.

Measured in oxygen standard:

- Check that the oxygen probe is in the 100% water saturated air, but not in water.
- After inserting the probe into the calibration chamber, wait **10 minutes** for temperature stabilisation, before starting calibration.
- Prepare a fresh 0% oxygen standard. For 0% standard recipes see section [10].
- Check Clark probe membrane or LDO sensor cap and replace if necessary, e.g. if damaged or broken. Check the correct fit of the o-rings to avoid sample getting inside the membrane or sensor cap.
- Finally check that cables, plugs and connectors are not influencing any reading, e.g. by moving the cable or plug.



Lab LDO

Rugged LDO

Calibration of oxygen probes in water saturated air. BOD bottle with funnel and approximately 5 mL de-ionised water to cover the bottom. Do not dip the probe membrane into the water!

4. No calibration possible or incorrect calibration

- Check that the temperature sensor is covered with a minimum **20 mm** of sample solution.
- If water saturated air (in BOD bottle) and oxygen probe have different temperatures, it may take up to **10 minutes** to have a stable temperature reading. Wait and then repeat calibration.
- Clark probe membrane or LDO sensor cap may be damaged. Replace if necessary.
- If HQD meter software does not allow the desired calibration, select "User calibration" in LDO options menu and identify standard

5. Unstable reading or too long stabilisation time

- Check that the temperature sensor is covered with a minimum **20 mm** of sample solution.
- If water saturated air (in BOD bottle) and oxygen probe have different temperatures, it may take up to **10 minutes** to get a stable temperature reading. Wait and then repeat the calibration.
- Clark probe membrane or LDO sensor cap may be damaged. Replace if necessary.
- In case of low oxygen concentrations in the sample (<1 mg/L) the oxygen probe needs more time to adjust for that low oxygen content. A stable and accurate reading may take **5 minutes** and more.
- LDO: Make sure that the optical oxygen probe is not exposed to direct sunlight. This may influence the oxygen reading.
- Clark probe: Probe must be in a stirred or medium flowing sample. Adjust stirring and avoid any vortex, which can change the reading by adding oxygen from the ambient air.



Clark probe membrane cap

6. LDO: end of sensor lifetime after 365 days

Based on the use model, the cleaning and maintenance frequency, the LDO sensor cap must be replaced after 365 days. After one year of exposure to wastewater, cold and abrasive samples, the normal performance of the LDO sensor cap can no longer be guaranteed. To ensure optimal performance we recommend a change of the sensor cap for the optical oxygen sensor at least every year. With the new cap, replace also the "i-button", which contains the calibration data.



Used/damaged LDO caps



Assembling o-rings and LDO sensor cap

7. Clark probe membrane or LDO sensor cap damaged or broken

Clark probe:

- Check that the membrane is not damaged or contaminated with sample etc. Clean membrane if possible, otherwise replace it.

LDO:

- The sensor cap is made of plexiglass, which is durable and resistant to many chemicals. Mechanical/physical forces can damage or break the cap. Replace cap and i-button.
- The sensor cap has a black coating above the oxygen sensitive (pink) chemical. If more than ¼ of the black/pink area is scratched or damaged, replace cap and i-button.
- The reason for the sensor cap's coating being damaged or scratched, is often that the protective shroud was not used or had not been mounted correctly. When dropping the LDO probe (especially the heavy rugged probe) to the ground of a tank or surface water, the shroud can move up, allowing access to abrasive particles and dirt. Those can scratch and damage the coating. Replace cap and i-button.

8. LDO: probe shows no red/blue flashing light

- Check that the LDO probe has been recognised by HQD meter.
- Check cable and plug/connector for damage or loose contact.
- Check that the sensor cap is clean and that no sample is inside the cap or probe body. Check o-rings.



Red and blue flashing LDO probe in a BOD bottle during calibration.

Otherwise replace LDO probe.

9. LDO: probe not recognised by HQD meter

- Check cable and plug/connector for damage or loose contact.
- Check power or battery status of HQD meter. Replace batteries.

Otherwise replace LDO probe.

10. Recipes for 0% oxygen standard solutions

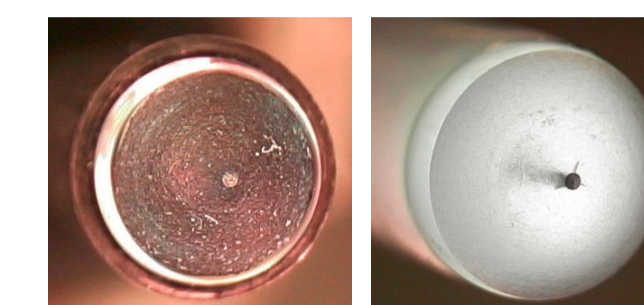
- 1 g Na₂SO₃ + 1 mg CoCl₂ in 1000 mL de-ionised water, stir until salts are dissolved (minimum 3 minutes).
- 2 g ascorbic acid + 25 mL 1 M NaOH + 85 mL de-ionised water, stir until salts are dissolved (minimum 3 minutes).
- Pure N₂ gas (99.99%)

Cleaning solutions
 Renovo N = alkaline solution of surfactants and polyphosphates
 Renovo X = sodium hypochlorite solution
 KS400 = pepsin in HCl solution
 KS410 = thiourea solution



11. Clark probe: incorrect or no reading

- Clark probes have to be polarised before any oxygen measurement. Check that sufficient electrolyte solution is inside the membrane. Connect the probe to the meter for at least 4 hours, or preferably overnight.
- Unscrew the membrane and check the electrode condition. Typically gold and silver are used for polarographic oxygen probes. Because of the chemical reaction, the silver electrode inside may be grey-brown coated with silver oxide or silver sulfide (last from sample contamination). This layer can reduce the current flow generated by oxygen, until no oxygen can be detected. The inner electrodes must be cleaned. The silver electrode must be cleaned specifically, read information [12].
- In order to start and maintain the electrochemical reaction inside the oxygen probe, the membrane must be filled with electrolyte solution. Check that there is sufficient electrolyte in the membrane. There must be no air bubbles as this can cause incorrect/unstable oxygen readings.
- Finally check cable and plug/connector for damage or loose contacts. Replace probe if necessary.



Platinum and gold electrode: equivalent to the silver electrode

12. Cleaning Clark and LDO probes

Clark probe: Cleaning the contaminated silver electrode

Insert the Clark probe (silver electrode) in a glass beaker, with an aluminium foil inside (like a tube), the bottom covered with NaCl. Fill with hot tap water (<70 °C) and wait for 10 minutes. Rinse the probe with de-ionised water and wipe the silver electrode clean with a soft cloth. Assemble the Clark probe and polarise over night. Then calibrate with 0% and 100% oxygen standard.



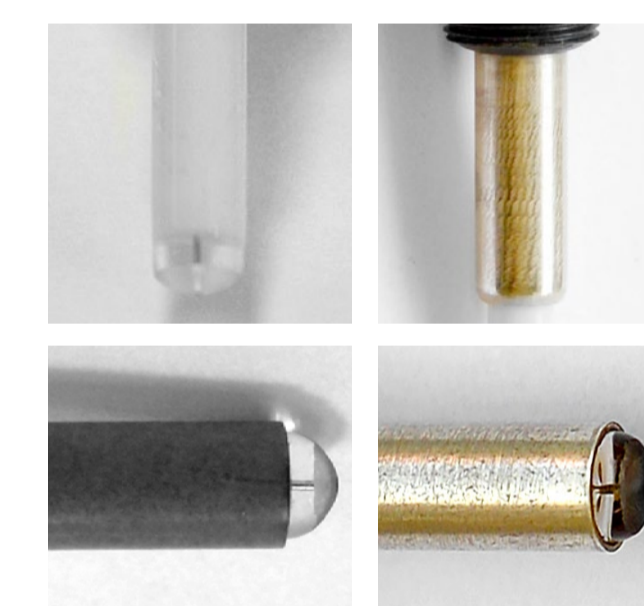
Contaminated silver electrodes can be cleaned using aluminium foil, salt (NaCl) and hot water.

Cleaning probe bodies

Due to the plastic body of the probes, no organic solvents should be used to remove contamination. Use mild detergent solution (e.g. Renovo N) to remove oil and fat layers. Never do a physical/mechanical cleaning and do not use abrasive methods to remove the contamination. For peptides or other biological contamination use e.g. KS400 (pepsin in HCl) and KS410 (thiourea) solution.

Disinfection of LDO/Clark probes

The maximum temperature for LDO/Clark probes is 50 °C. This is why a thermal disinfection is not possible. Due to the plastic body, only a short-term (max. 3 minutes) cleaning with a mixture of 95% ethanol and 5% 1-propanol is possible.



Silver electrodes of dissolved oxygen probes, contaminated (left) and cleaned (right)



13. Storage

For quick response during daily operation it is recommended to store probes in their storage chamber or tube with some drops of water to maintain a humid environment. In some cases there is a little sponge inside to hold the water.

Clark probes: For long-term storage empty the membrane, rinse membrane and inner electrodes with de-ionised water. Then store in dry storage chamber. Before next measurement, the probe has to be refilled with electrolyte and then must be polarised again.