STEAM STERILIZABLE GALVANIC OXYGEN ELECTRODES

INTRODUCTION

This series of DO probes is a steam sterilizable galvanic type electrode designed to be interchangeable with LSL Biolafitte. The DO probe is used to measure pO_2 in biochemical processing. The probe is designed to withstand the severe conditions of high temperature, high pressure and high moisture during sterilization.

CONSTRUCTION

The external portion of the electrode is comprised of a polished stainless steel cylinder. The functional portion of the probe is constituted of a teflon chamber enclosing the ultra pure lead anode and a cathode in the form of a perforated silver disc.

A thin teflon membrane at the tip provides for efficient sealingof the system and is in contact with the silver cathode. The membrane is permeable to oxygen but impermeable to water and electrolytes. Inside the membrane, the oxygen content is kept very low by the electrochemical reaction. The rate-limiting step for electrochemical oxygen reduction becomes the rate of oxygen diffusion through the membrane. The rate is proportional to the oxygen partial pressure (tension) outside the membrane. The chamber is readily refilled with sterilizable electrolyte by the use of two silicone tubes extending from the cap of the electrode. The assembly forms a galvanic couple when actuated by oxygen diffusing the membrane and causing oxidation of the lead anode. The probe delivers an electrical signal proportional to the percentage of saturation of dissolved oxygen present in the fluid.

The potential delivered by the probe is measured across a resistance and transmitted to an amplifier module.

SPECIFICATIONS

Maximum output signal (medium saturated with air) Approximately 20 to 25 mV.

Residual signal: 1 mV

Response time nitrogen to air

0-90% - less than 15 seconds
0-100% - less than 60 seconds

Stability: Better than 2% at constant temperature and pressure

Maximum operating pressure:	3 Bar
Maximum operating temperature:	130 °C
Membrane thickness:	2mm
Electrolyte volume:	2ml

INSTALLATION

The DO probes are shipped filled with electrolyte and a protective shorting cap in place and shipped with the following spares:

1 - 1mm membrane
1 - 2mm membrane
1 - set of membrane seals
1 - syringe for filling
1 - bottle electrolyte

Inspect the dissolved oxygen probe for shipping damage. If damage is observed, notify the service department immediately. The following items should be checked: the shorting protective cap should be installed on the electrode, teflon membrane at the probe tip should be free from wrinkles or punctures and appear tightly stretched over the silver cathode.

PREPARATION

The DO probe is shipped filled with electrolyte and with teflon membrane in place. However, during handling and shipping, some electrolyte may have been lost. The electrolyte should be topped off prior to sterilization. Note: Also should be topped off after autoclaving.

During the filling of the probe with electrolyte, the corner of the membrane end of the probe held at a 15° angle should be tapped lightly on the benchtop. This will help air bubbles to rise to the top of the probe.

Caution: Be careful not to puncture the membrane tip of the probe. The filling of the electrode has to be done very carefully so that the membrane will not burst. Protective shorting cap should be on the electrode head connector. The o-ring should be fitted in place on the underside of the probe. Screw the probe into the head plate and tighten finger tight.

STERILIZATION

Sterilize the probe with a shorting and protective cap installed. Caution: at no time should the probe be subjected to conditions that would cause the electrolyte to boil. Particular care should be exercised during autoclaving when localized boiling tends to occur. Either maintain a slow cooling rate or pressurize the autoclave during sterilization. Consult your autoclave manufacturer for information regarding a pressure balancing feature and proper autoclaving techniques to eliminate localized boiling during the cooling cycle.

CALIBRATION

Connect the electrode cable to the DO probe and to the DO amplifier, recorder or data processor. As the probe is not temperature compensated, it is essential that the culture medium is temperature controlled.

Signal output varies as a function of temperature (See temperature variation chart).

Prior to inoculation of the culture, the probe must be calibrated. Allow the vessel to reach operating temperature and then saturate the medium by sparging air at the maximum flow rate, approximately 20 minutes. Allow the output signal to stabilize. Using a potentiometer, adjust the display module or recorder to read 100%, or a multiple from 21%.

MAINTENANCE

- Clamp the probe upside down in a laboratory support clamp and remove the stainless steel membrane cap at the tip of the probe.
- Three silicone 0-rings are employed to mount the membrane. The biggest one is at the bottom of the cap, medium is around the silver disc, and the smallest to wrap the membrane.
- Cut the old o-ring which wraps the membrane, and discard the old membrane.
- Check the condition of the other two o-rings and replace as necessary.
- Clean the silver cathode with a tissue. If the silver is badly discolored, rub gently with very fine emery paper to restore a bright surface. If the holes in the silver are blocked by media, clean them out with blunt pin.
- Put the medium size o-ring along the teflon-tip which is around the silver disc. Wet the silver surface with a little electrolyte.
- Put the smallest o-ring on the cone-shaped membrane mounting device, and slide it down to the bottom of the cone.
- Lay a piece of new membrane on the silver, fold it downward. Hold one side of the membrane against the electrode body and gently pull the other side to make sure the membrane is tightly stretched on the silver surface.
- Put the cone on the membrane and slide the o-ring which is already on the cone, into the groove on the teflon.
- Take the electrode off the clamp. Trim off excessive membrane, put the biggest o-ring on the cap, laying straight at the bottom, and screw on the cap until finger-tight.

TROUBLESHOOTING

The probe when saturated with air generates no potential (zero output).

FAULT

a) Check that all signal cable connections are correct.
   Check that the probe is filled with electrolyte.

b) The output signal is reversed
   Reverse the signal wires connected to display module or recorder.

c) The calibration potentiometer is on maximum but the signal does not reach 100%.
   Change the membrane.
   Change the electrolyte.
   If the fault persists, send back to factory to be rebuilt.

NOTE

The output signal may not reach 100% if the ambient temperature is less than 15°C.

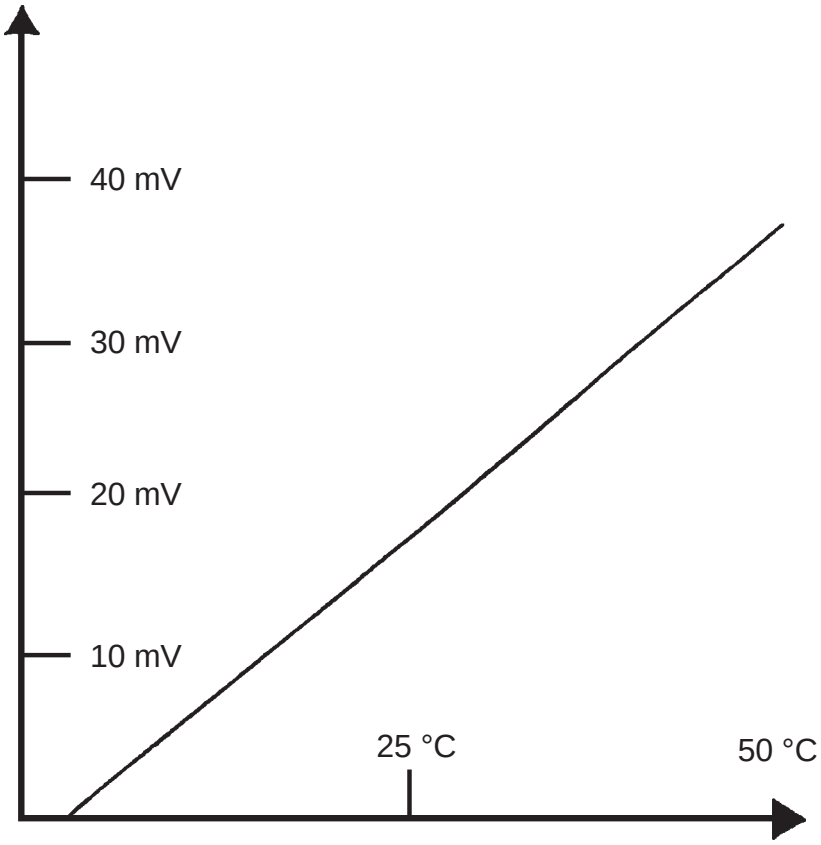
TROUBLESHOOTING DURING FERMENTATION

0.5-1.0 ml of electrolyte will be lost during the sterilization process due to expansion.

a) The output signal is unstable and shows a random drift.
Check the grounding of the fermentor and the instrumentation.
Check that the signal is not being effected by external switchgear, power relays, etc.
Check that the slow random drift is not due to poor mixing of the culture medium.
If the fault persists, it may be due to a badly fitted membrane, incorrectly tightened.

b) The output signal is stable but shows a regular sinusoidal drift.
Check the temperature control on the fermentor
Check the proportional band settings of the D.O. control.

c) During a long fermentation the signal drifts to a value that appears incorrect.
In most cases this is caused by splitting or fouling of the membrane by the culture medium.



Signal variation as a function of temperature change

A. Detachable Lead

B. O-Ring Seal

C. 19 mm Body

D. 316 Stainless Steel Body

E. O-Ring Seal

F. Silver Cathode

G. Replaceable Teflon membrane

H. O-Ring Seal

I. Membrane Cover

J. 19mm flange body

K. M18 x 1.5 threaded body

L. 3/4” NPS (R 3/4” DIN) threaded body

M. 25 mm flange body

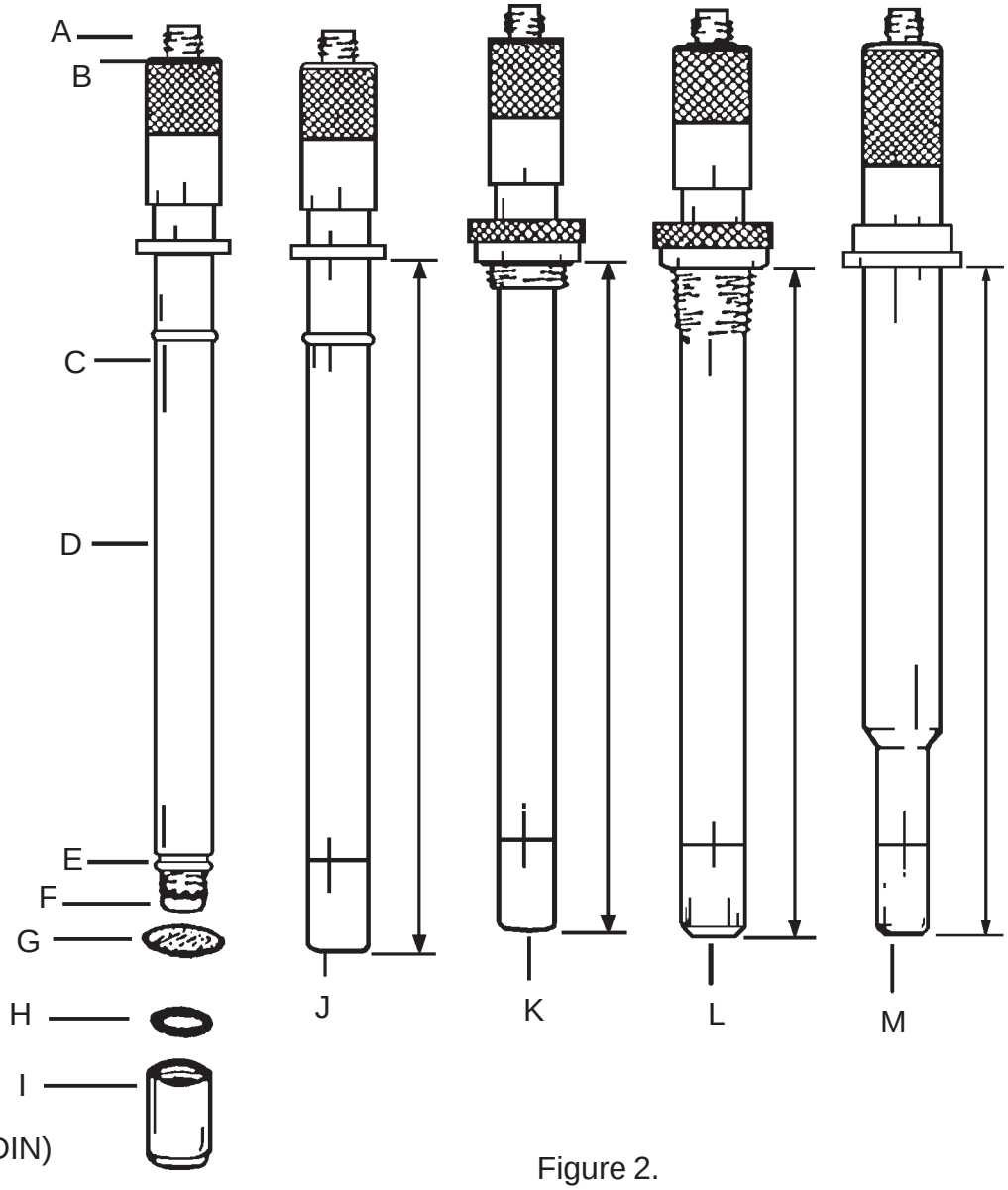


Figure 2.