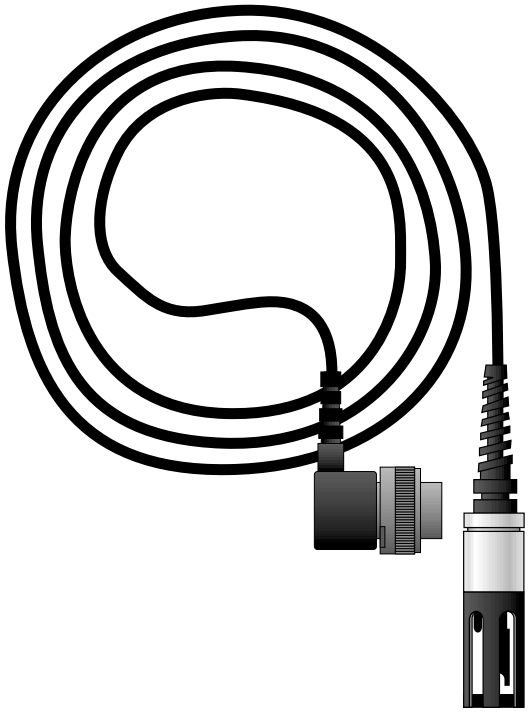
YSI *incorporated*



YSI Model 5239

Dissolved
Oxygen Probe

Instruction Manual

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INTRODUCTION

The YSI Model 5239 probe is used for measuring dissolved oxygen in the field. It is the first field probe that features cap membranes for easy membrane replacement (YSI 5906 membrane caps). The probe is rugged, with the DO and temperature sensors enclosed in a heavy duty probe guard. A 10, 25 or 50 foot cable is directly connected to the probe body making it waterproof. A 5-pin MS connector at the end of the cable makes the 5239 fully compatible with all YSI 50 series DO meters retaining the accuracy of the system. The 5239 has been optimized for YSI meters which have a micro-processor for sampling and processing data, such as YSI Models 50B and 52. The system specifications, when used with a YSI 50 Series DO meter, are as follows:

PROBE CONFIGURATION

- Cathode: Gold
- Anode: Silver
- Membrane: FEP Teflon
- Electrolyte: YSI standard probe solution (Half saturated KCl)
- Polarizing voltage: -0.8 V vs. the potential of the Ag anode/reference electrode

SYSTEM SPECIFICATIONS

- Temperature range: -5° to 45° C
- Temperature accuracy: ±0.2° C
- Temperature response time: 30 sec for 95% of change.

- DO range: 0 to 200 % air saturation or 0 to 20 mg/L.
- DO accuracy: ±2 % or ±0.2 mg/L whichever is greater.
- DO response time: 30 sec for 95% of change at 25°C.

TEMPERATURE COMPENSATION

Temperature compensation of DO readings is provided by the YSI DO meter. For best results, calibrate within ±5° C of the sample temperature.

PROBE OPERATION

NOTE: The 5239 probe is shipped dry. A shipping membrane was installed to protect the electrodes. **A new membrane cap must be installed before first use.**

MEMBRANE INSTALLATION

Follow the steps below to install a membrane cap:

1. Unscrew and remove the probe guard. See Figure 1.
2. Unscrew the old membrane cap and remove it from the probe.
3. Thoroughly rinse the entire area of the silver anode, gold cathode and threads with clean water (distilled or deionized) to remove any dry crystals of the old electrolyte.
4. Hold the membrane cap and fill it with 6 to 7 drops of YSI standard electrolyte (KCl probe solution) provided.

5. Tap the bottom of the membrane cap with your finger a few times (don't touch the membrane) to shake loose any trapped air bubbles.
6. Screw the membrane cap onto the probe moderately tight. A small amount of electrolyte should overflow.
7. Rinse off the excess electrolyte with clean water.
8. Screw the probe guard onto the probe body.
9. Place the probe in the calibration bottle provided. Verify that sponge in the bottle is wet.

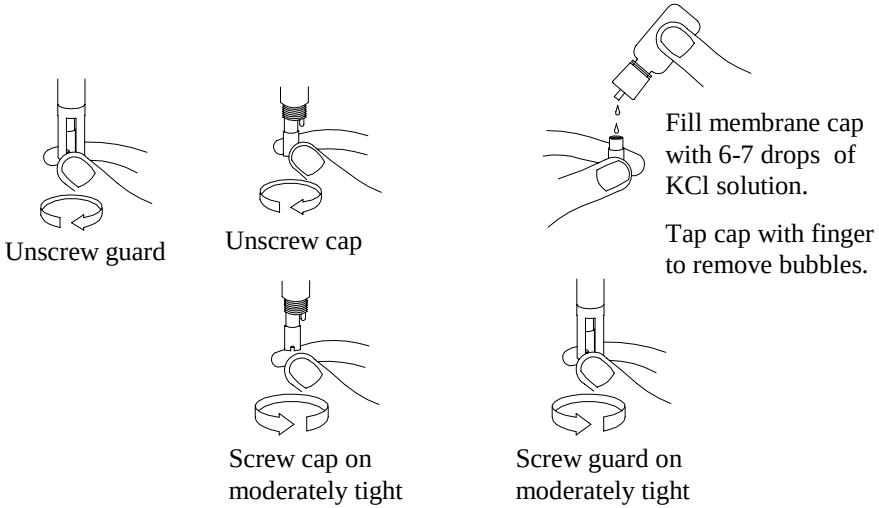

Figure 1

CALIBRATION

Dissolved oxygen calibration must be done in an environment with a known oxygen content. Three such environments will be discussed here: calibration in air (water-saturated), calibration in air-saturated water and calibration by Winkler

titration. Choose the **one** which best fits your application. Calibration in air is the simplest and most accurate method of calibration.

- For **air calibration**, place the probe in air at 100% relative humidity. To achieve this, place the probe in the plastic calibration bottle (provided) with a wet sponge or paper towel in the bottom.
- For **air-saturated water calibration**, air-saturate a volume of water (300 to 500 ml) by aerating for at least 15 minutes at a relatively constant temperature. Place the probe in the aerated water and provide adequate stirring (at least 1 foot per second) while calibrating.
- To calibrate **to a Winkler-titrated sample**, determine the dissolved oxygen value of a sample by Winkler titration. Place the probe in the sample and provide adequate stirring (at least 1 foot per second) while calibrating.

YSI recommends that the following procedure to calibrate the 5239 probe:

1. Connect the 5239 probe to one of the YSI 50 series DO meters.
2. Turn on the meter and wait for the probe to polarize and the reading to stabilize. Depending on the condition of the probe, the time for stabilization could vary between 15 and 30 minutes. For a new probe with clean electrodes and a properly installed membrane cap, it usually takes 15 to 20 minutes. If the electrodes are fouled or the membrane or electrolyte are not in good condition, it may take longer to stabilize than anticipated.

3. Check the membrane to make sure there are no water beads attached to it. Wipe to remove the water beads with a soft tissue if necessary.

   NOTE: Make sure that the probe has been in the calibration bottle for more than 2 minutes before calibrating so that both the thermistor and DO sensor are at the same temperature.

4. Calibrate the system according to the instructions in the operations manual for the particular YSI 50 series meter you are using. Be sure to take into consideration the local barometric pressure and adjust to the proper calibration value. All YSI 50 series DO meters have a table on the back which relates barometric pressures to %-air saturation values.

Checking the Probe Zero

The probe zero (background current) is checked by immersing the probe in a sodium sulfite solution (0.08M or 3g Na_2SO_3/300 ml), or in an inert gas (e.g. nitrogen, argon). The meter should read less than 1% dissolved oxygen in either of these environments. If it does not, change the membrane or clean the probe.

ERRONEOUS READINGS

Erratic readings will result from loose, wrinkled or fouled membranes, or from bubbles larger than 1/8” in the electrolyte solution. Erroneous readings may occur if the membrane is coated with oxygen consuming bacteria or oxygen evolving algae. Heavy residue may coat the membrane causing incorrect readings. Frequent membrane changes will eliminate this problem.

INTERFERENCES

Hydrogen sulfide, sulfur dioxide, halogens, carbon monoxide, chlorine, nitric oxide, and nitrous oxide can cause the probe to give erroneous readings. If you suspect erroneous readings, it may be necessary to determine if these are the cause.

ACIDS

Avoid any environment that contains substances such as concentrated acids, caustics, and strong solvents that may attack the probe. Probe materials that may be damaged by these substances include FEP Teflon, EPR rubber, ABS plastic, and stainless steel.

STORAGE

When the probe is not in use, store the probe in a humid environment, such as the plastic calibration bottle (with a wet sponge or paper towel inside) or a BOD bottle containing at least 1 inch of water (remove probe guard first).

PRINCIPLES OF OPERATION

THE CLARK OXYGEN SENSOR

The 5239 probe is a Clark type polarographic (voltammetric) dissolved oxygen sensor. The sensor is made of a silver anode and a gold cathode (see Figure 2), and is separated from the measured medium by a semi-permeable Teflon membrane. The temperature sensing element (thermistor assembly) is mounted next to the oxygen sensor vertically, providing temperature readings for the DO system.

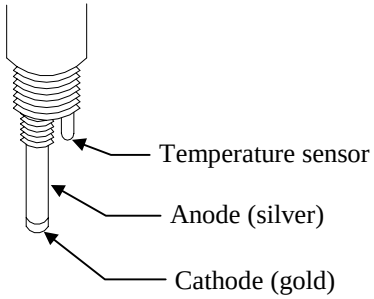

Figure 2

The membrane selectively allows oxygen to permeate into the sensor, but prevents most interfering molecules and fouling materials from entering. Upon permeating through the membrane, oxygen is reduced at the gold cathode. The current resulting from this reduction is diffusion-limited and is proportional to the partial pressure of oxygen in the sample. The counter reaction is the oxidation of silver at the

anode/reference electrode which completes the overall electrolytic reaction in the chloride medium (KCl electrolyte) behind the membrane. These reactions, at the cathode and the anode, are as follows:

Cathode reaction: $O_2 + 2H_2O + 4e^- ==> 4OH^-$

Anode reaction: $Ag + Cl^- ==> AgCl$

THE DO READINGS FROM THE CATHODE REDUCTION

The oxygen reduction current is sampled and processed, by the meter, and displayed as either %-air saturation or mg/L. While the parameter of %-air (partial pressure) is independent of temperature and salinity, mg/L (solubility of oxygen) is a function of temperature and salinity. For instance, the same %-air reading (same partial pressure) would give a higher mg/L reading at a lower temperature than at a higher temperature. Also, the higher the salinity, the lower the solubility for the same %-air reading at the same temperature.

THE FORMATION OF AgCl AT THE ANODE

While the oxygen reduction current passes through the internal circuit to be reported as the DO reading, it also passes through the anode oxidizing the silver and forming a thin layer of silver chloride. This oxidation of silver at the chloride medium provides a stable potential which the cathode potential is referenced to (for instance, the polarization potential of the cathode is -0.8 V versus the potential of the Ag/AgCl redox couple at the silver anode). As more and more silver chloride

(an insoluble solid and poor conductor of electricity) accumulates at the anode, it begins to block the passage of current in the electrolytic cell. The silver anode must be cleaned periodically to prevent this thick layer of silver chloride from reducing the sensitivity of the sensor.

THE FUNCTION OF THE ELECTROLYTE

There are two main functions for the electrolyte:

1. Supply the chloride (Cl^-) to the anode/reference electrode for the counter reaction of the oxygen reduction at the cathode.
2. Provide the ionic conduction of electricity inside the cell, especially in the thin layer between the gold cathode and the membrane.

Under normal operating conditions, such as measuring oxygen around 100 %-air (8.27 mg/L) at 25° C, the strength of the chloride concentration should last up to 500 hours before the chloride becomes a limiting factor in the operation of the oxygen sensor. 500 hours translates into about 62.5 working days at 8 hours per day operation.

MAINTENANCE AND TROUBLESHOOTING

MEMBRANE CAP LIFE

If the probe is properly maintained, one membrane cap should last two to four weeks depending on how often the probe is used and the type of samples measured. Keep the probe in a moist atmosphere as much as possible to avoid drying out the electrolyte. Erratic readings will result from loose, wrinkled or fouled membranes, or from bubbles larger than 1/8” in the electrolyte solution. The following things are likely to cause short membrane life:

1. The electrolyte has dried out because the membrane cap was not tight or the probe was exposed to dry air for a long time.
2. The membrane was not properly installed. For instance, wrinkles have formed after membrane installation.
3. The probe was not properly rinsed with water after a field measurement, allowing mud or algae to attach to the membrane.
4. The membrane was damaged by an object, such as reeds or small sticks in the water.
5. The probe has struck a hard object and the sensor or membrane has been damaged.

ELECTRODE CLEANING

It is always a good practice to keep the probe in good operating condition.

Silver Anode

After extended use, a thick layer of AgCl builds up on the silver anode reducing the sensitivity of the sensor. The anode must be cleaned to remove this layer and restore proper performance. The cleaning can be chemical or mechanical:

- **Chemical cleaning:** Remove the membrane cap and soak the entire anode section in a 14% ammonium hydroxide solution for 2 to 3 minutes, followed by a thorough rinsing with distilled or deionized water. The anode should then be thoroughly wiped with a wet paper towel to remove the residual layer from the anode.
- **Mechanical cleaning:** Sand off the dark layer from the silver anode with 400 grit wet/dry sandpaper. Wrap the wet sandpaper around the anode and twist the probe. Rinse the anode with clean water after sanding, followed by wiping thoroughly with a wet paper towel.

Gold Cathode

For correct probe operation, the gold cathode must be textured properly. It can become tarnished or plated with silver after extended use. The gold cathode can be cleaned by using the adhesive backed sanding disc and tool provided in the YSI 5238 probe reconditioning Kit.

Stick the disc to the sanding tool, then wet sand the gold with a twisting motion about 3 times or until all silver deposits are removed and the gold appears to have a matte finish. If the cathode remains tarnished, return the probe for service.

Wipe the gold cathode thoroughly with a wet paper towel before putting on a new membrane cap.

TROUBLE SHOOTING GUIDE

Below is a quick reference of symptoms with steps to follow to cure these symptoms.

Symptoms	*Actions*
Unable to calibrate	• Extend the stabilization time from 15 min. to 30 min. before calibrating • Change membrane • Check for loose or wrinkled membrane or deposits between gold cathode and membrane, especially after changing membrane • Clean probe (see instructions under Electrode Cleaning)

Symptoms	*Actions*
Does not hold calibration	• Allow sufficient time for temperature and oxygen stabilization before calibration
	• Check for water droplets on membrane
	• Check membrane for a pinhole or split
	• Change membrane
	• Clean probe (see instructions under Electrode Cleaning)
Unstable readings	• Check membrane for a pinhole or split
	• Allow 60 sec. for reading to stabilize
	• Change membrane
	• Clean probe (see instructions under Electrode Cleaning)
Membrane cap is tight	• Use pliers to loosen the cap (turn counter clockwise while facing sensor tip)

SERVICING

The 5239 probe has only two replaceable parts (other than the membrane cap), the probe guard and the 5-pin MS connector on the end of the cable. The cable is permanently attached to the probe and cannot be replaced.

YSI part number	**Description**
110275	5-pin MS connector kit
059956	Probe guard
5238	Probe reconditioning kit

WARRANTY AND REPAIR

YSI Model 5239 Dissolved Oxygen Probes are warranted for one year from date of purchase by the end user against defects in materials and workmanship. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

Limitation of Warranty

This Warranty does not apply to any YSI product damage or failure caused by (i) failure to install, operate or use the product in accordance with YSI's written instructions, (ii) abuse or misuse of the product, (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure, (iv) any improper repairs to the product, (v) use by you of defective or improper components or parts in servicing or repairing the product, or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI's LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

YSI Authorized Service Centers

For the nearest authroized service center contact:

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Phone: +1 937 767-7241 • Fax: 937 767-9353 • environmental@ysi.com • www.ysi.com

CLEANING INSTRUCTIONS

NOTE: Before they can be serviced, equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected. Biological contamination is presumed for any instrument, probe, or other device that has been used with body fluids or tissues, or with waste water. Radioactive contamination is presumed for any instrument, probe or other device that has been used near any radioactive source.

If an instrument, probe, or other part is returned or presented for service without a Cleaning Certificate, and if in our opinion it represents a potential biological or radioactive hazard, our service personnel reserve the right to withhold service until appropriate cleaning, decontamination, and certification has been completed. We will contact the sender for instructions as to the disposition of the equipment. Disposition costs will be the responsibility of the sender.

When service is required, either at the user's facility or at YSI, the following steps must be taken to insure the safety of our service personnel.

1. In a manner appropriate to each device, decontaminate all exposed surfaces, including any containers. 70% isopropyl alcohol or a solution of 1/4 cup bleach to 1 gallon tap water are suitable for most disinfecting. Instruments used with waste water may be disinfected with .5% Lysol if this is more convenient to the user.
2. The user shall take normal precautions to prevent radioactive contamination and must use appropriate decontamination procedures should exposure occur.

3. If exposure has occurred, the customer must certify that decontamination has been accomplished and that no radioactivity is detectable by survey equipment.
4. Any product being returned to the YSI Repair Center, should be packed securely to prevent damage.
5. Cleaning must be completed and certified on any product before returning it to YSI.

PACKING INSTRUCTIONS

1. Clean and decontaminate items to insure the safety of the handler.
2. Complete and include the Cleaning Certificate.
3. Place the product in a plastic bag to keep out dirt and packing material.
4. Use a large carton, preferably the original, and surround the product completely with packing material.
5. Insure for the replacement value of the product.

Cleaning Certificate

Organization _____

Department _____

Address _____

City _____ State _____ Zip _____

Country _____

Model No. of Device _____ Lot Number _____

Contaminant (if known) _____

Cleaning Agent(s) used _____

Radioactive Decontamination Certified?

(Answer only if there has been radioactive exposure)

___ Yes ___ No

Cleaning Certified By _____

Name Date

YSI *incorporated*

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