

MEASURING DISSOLVED OXYGEN

THERMO ORION POLAROGRAPHIC AND RDO DISSOLVED OXYGEN PROBES

Dissolved oxygen is often referred to as DO. It is a measure of the amount of oxygen in a solution. While some gases react chemically with water to form new compounds, gases like nitrogen and oxygen dissolve in water, without a chemical reaction and exist as microscopic bubbles between water molecules. Air has a constant percentage of oxygen, approximately 20.9%. When air comes in contact with water, the oxygen in air will dissolve in the water. There are a number of factors that determines how much oxygen dissolves in water:

- Is there sufficient time and adequate mixing to fully saturate the water
- Are substances present in water that consume oxygen
- Water Temperature: The solubility of oxygen reduces as temperature increases; therefore, the colder the water, the more dissolved oxygen it contains
- Air Pressure: As atmospheric pressure decreases with altitude, the amount of dissolved oxygen in water decreases
- Salt Content: The amount of dissolved oxygen increases as salinity decreases; therefore, freshwater holds more oxygen than saltwater

Polarographic vs. RDO

Polarographic: Polarographic DO probes, also referred to as the Clark cell after its founder, Dr. Clark, have been around for over 50 years. Polarographic probes require a voltage from an external source such as your meter to operate and require a polarization period before use.

Polarographic probes require electrolyte solution. To add the solution, unscrew the membrane cap at the bottom of the probe and put a few drops inside the cap. Screw the membrane cap back on. The Polarographic DO probes need to be stirred/ moved around when taking a reading because they consume O₂ while they are taking their measurement. If the probe is not stirred, you will get a false low DO reading. When measuring DO in wine these probes have shorter response time than the newer RDO probes, because its response time is not affected by alcohol. Typical time to get a stable reading is about 15 – 30 seconds. These probes are preferred when measuring DO in the bottle due to the more rapid response time and fast paced nature of bottling.



RDO: Newer technology based off luminescence. These probes do not need to be constantly stirred/moved around. They do require a new RDO cap replacement every year. Once the cap is installed on the probe, it starts an internal countdown (which can be viewed on the meter to know how much life is left).



The alcohol in wine interferes with the response time of measurement, so it usually takes about 1 to 1 ½ minutes for a stable reading. These probes are usually preferred for measuring DO in tanks, barrels, etc, over measuring DO in a bottle due to the longer response time. Also, one can put the probe into a tank/barrel, walk away while the meter is measuring and come return since the probe does not need to be moved or stirred while it is taking its measurement.









Differences Between Thermo Orion Polarographic DO and Optical DO




	POLAROGRAPHIC	OPTICAL (RDO) PROBE
MAINTENANCE	Replace electrolyte and polish cathode ~ every 2 months. Clean probe as needed.	Clean, probe, cap and optical window as needed.
STORAGE	In moist calibration sleeve, long term, remove membrane cap and store dry.	In moist calibration sleeve.
MEMBRANE	Change as needed or every 2 months.	Must be replaced every 365 days – do not use with solutions that contain organic solvents.
ELECTROLYTE	Change as needed, every 2 months.	None required.
WARM-UP TIME REQUIRED	Required if just connected to meter (30-60 minutes).	None required.
STIRRING	Required.	None required.
INTERFERENCES	Ozone, sulfides, sulfur dioxide, nitrous oxide and carbon monoxide.	Alcohol greater than 5%, hydrogen peroxide greater than 3%, sodium hypochlorite greater than 3%, gaseous sulfur dioxide and gaseous chlorine.

Meter Setup

Turn the Star DO portable meter on. In the measurement mode, set the measurement units to mg/L. Access the setup menu and update the RDO/DO channel settings to the following, as needed:

-  Measure Mode: Auto
-  Measure Unit: mg/L
-  Resolution: 0.01
-  Read Type: Auto Read
-  Baro Pressure: Auto
-  Salinity Correct: Manual (0.0)

Update the instrument settings to the following, as needed:

-  Export Data: On
-  Data Log: On
-  Date/Time: Set current date & time



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Calibration

Calibration of polarographic or RDO optical DO probes can quickly and easily be performed using the water-saturated air method. DO probes are placed in a moist calibration sleeve. Under equilibrium, the partial pressure of oxygen in air-saturated water is equal to the partial pressure of oxygen in water-saturated air. Therefore, a DO probe calibrated in water-saturated air will read the partial pressure of oxygen in water samples. The water from the sponge will saturate the air in the calibration sleeve and act as the calibration standard. Since the diffusion rate of oxygen in water and air differs slightly, meters apply a correction factor to the water-saturated air calibration value to obtain the correct air-saturated water value. The correction factor is 102.3%. A stable reading of 100.0% saturation with RDO probes and 102.3% for Polarographic probes should be displayed when calibrating. Please note that calibration can take up to two minutes.

For low concentration samples, a second calibration with a zero standard is recommended. To make this solution dissolve 250 g of sodium sulfite into 1 liter of water. The sodium sulfite is available through Fisher Scientific, Enartis USA does not sell this chemical.

Sensor Performance Checks

The RDO and Polarographic sensor should read between 98 and 102% saturation in the calibration sleeve after calibration. Make sure to thoroughly rinse and blot dry the DO sensor after measuring samples and before placing into the calibration sleeve. Refer to the RDO or Polarographic sensor user manual if the sensor does not pass the performance checks.

Sample Preparation and Preservation

Dissolved oxygen can be measured directly in the tank. Samples cannot be preserved. Measure samples on site for the best results, or immediately following sample collection. If samples must be collected and moved, use an air-tight container, fill completely leaving no air space, and keep the container sealed until immediately before measuring the sample. After each sample measurement, rinse the sensor thoroughly with deionized water and blot the sensor dry with a lint-free cloth.

Analysis

Place the RDO sensor in the tank, barrel, bottle, etc. making sure that the temperature sensor is also submerged in the sample. Initiate a reading using the Auto Read measurement mode by pressing the measure key on the meter keypad. For best results, take a second reading to ensure the dissolved oxygen measurement is fully stabilized, as it may take the sensor one to two minutes to fully stabilize in the wine sample. Use the second stable value for the oxygen content of the wine.

Storage

For storage of dissolved oxygen probes, they should be kept in a moist calibration sleeve. Polarographic probes should remain connected to the meter or it will need to be polarized again. For long term storage of polarographic probes, they should be disconnected from the meter, with the membrane cap removed and the sensor rinsed and kept dry. Thermo Scientific Orion DO probes have calibration sleeves that can be used to protect the electrode between measurements as well as to perform calibrations. Protective guards are also available that will help protect the probe during field use and add weight to the probe to help submerge it when required.

The indications supplied are based on our current knowledge and experience, but do not relieve the user from adopting the necessary safety precautions or from the responsibility of using the product(s) properly.

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Quality Control (QC)

Recommended QC procedures include calibration, check of the thermistor (temperature sensor) response against a calibrated NIST-traceable thermometer, and recovery of an air-saturated deionized water sample.

Checking RDO Cap Life on Orion DO Meters

These instructions are for RDO/Luminescence DO probes. Polarographic DO probes do not require this check.

- ☪ Turn on Device
- ☪ Push the F3 button (Setup)
- ☪ Highlight the DO/RDO channel option on the screen and push the F3 button (select)
- ☪ Highlight the Mode/Selection and press the F3 button (select)
- ☪ Push the F2 button (page ↓)
- ☪ You will then see the RDO Cap Life on the screen. This is displayed in days.

It is highly recommended to mark your calendar one month to two weeks before the cap expires. This will ensure that you can re-order a new cap and have it arrive before the current RDO cap expires.

AND/OR

Check your RDO Cap Life on a weekly or monthly basis (especially around bottling time). This way you can re-order a new cap and have it arrive before the current RDO cap expires.