Instruction Sheet

Hach LDO™ Sensor

Safety Precautions

Please read this entire instruction sheet before operating this sensor. Pay particular attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the sensor.

Do not use or install this sensor in any manner other than that which is specified in this instruction sheet.

Use of Hazard Information

If multiple hazards exist, this instruction sheet will use the signal word (Danger, Caution, Note) corresponding to the greatest hazard.

DANGER
Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
Indicates a potentially hazardous situation that may result in minor or moderate injury or instrument damage.

Important Note: *Information that requires special emphasis.*

Note: *Information that supplements points in the main text.*

Precautionary Labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.

This symbol, if noted on the instrument, references the instruction sheet for operational and/or safety information.

Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the Producer for disposal at no charge to the user.

Note: *For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.*

Introduction

The luminescent dissolved oxygen (Hach LDO, Figure 1) sensor is an in-situ optical probe that determines the dissolved oxygen concentration in a given water sample. The sensor cap is coated with a luminescent material. Blue light from a LED is transmitted to the sensor surface. The blue light excites the luminescent material. As the luminescent material relaxes it emits red light. The time from when the blue light was sent and the red light is emitted is measured. The more oxygen that is present, the shorter the time it takes for the red light to be emitted. This time is measured and correlated to the oxygen concentration. Between the flashes of blue light a red LED is flashed on the sensor and used as an internal reference to help validate each measurement. The sonde can display the oxygen either as a concentration from 0–20 mg/L or as a percent saturation with either air saturated water or water-saturated air serving as the 100% reference point.

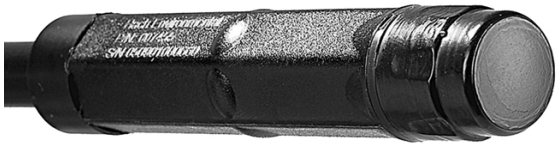


Figure 1 Hach LDO Sensor

Maintenance

Important Note: *Do not use organic solvent solutions such as acetone or methanol with the Hach LDO sensor. These solvents will damage the plastic sensor cap.*

The Hach LDO sensor is not affected by fouling or other debris, unless the growth is an organism that locally consumes or produces oxygen, such as barnacles, or algae growing on the sensor cap. Nevertheless, the manufacturer recommends periodic maintenance to remove contaminants such as oil, biological growth, dirt, etc. Sensor maintenance should be conducted after every deployment cycle.

1. Flush the entire instrument with clean, fresh water. Use soapy water and a soft brush to clean the outside surfaces of the instrument.

2. Soak the entire instrument in fresh water for at least 30 minutes.

3. Visually inspect the sensor cap. Use optical tissue or a cotton swab with soapy water to clean the sensor cap. Rinse with fresh water.

It is not advised to remove the sensor cap unless the cap is being replaced. If the cap is sealed properly using the top O-ring seal, no water should be present between the sensor cap and the clear plastic window at the top of the probe. If water is present between the sensor cap and the clear plastic window at the top of the probe, remove the cap and thoroughly dry the inside of the cap and the clear plastic window. The cap may require replacement.

Installing the Sensor Cap

1. Place the cap seal (item 1, Figure 2) and the O-ring (item 2, Figure 2) on the probe.

2. Screw on the sensor cap (Figure 2) so that the o-ring seal is compressed. Do not over-tighten the sensor cap.

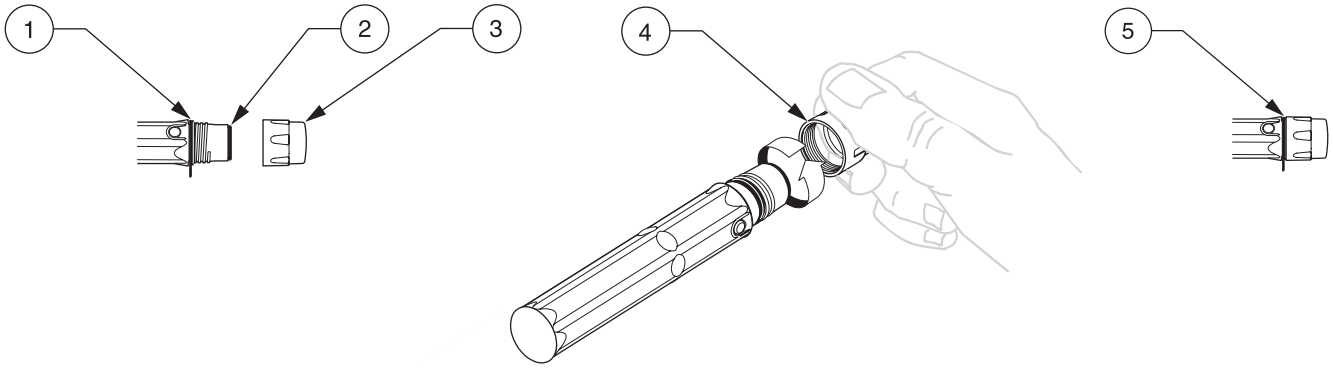


Figure 2 Installing the Sensor Cap

1	Cap Seal; Place the narrow shoulder towards probe tip.	**3**	Sensor cap	**5**	Narrow shoulder is inside the cap.
2	O-ring in place on probe tip	**4**	Screw sensor cap onto probe tip.		

Hach LDO Sensor Calibration

Dissolved oxygen concentration is associated with either a concentration in mg/L or a percent saturation, relative to 100% water saturated air or air saturated water.

There are three standard methods for calibrating the Hach LDO sensor. Each method requires a single point calibration for measurement of concentration in mg/L. In order to calibrate the sensor for percent saturation reading, the local barometric pressure must be determined independently by the user and input into the software during calibration.

In order to retain calibration accuracy between multiple deployments, store with sensor fully immersed in water at all times or at a minimum stored in a sealed container with water saturated air such as a sealed storage cup. Make sure the storage cap has at least 10cc of water and is sealed to prevent evaporation. It is important that the end of the sensor cap and the sonde temperature sensor are at the same temperature during calibration. When calibrating in water saturated air, the temperature sensor should be in air. When calibrating in air saturated water or water with a known oxygen concentration, the temperature sensor should be immersed in water.

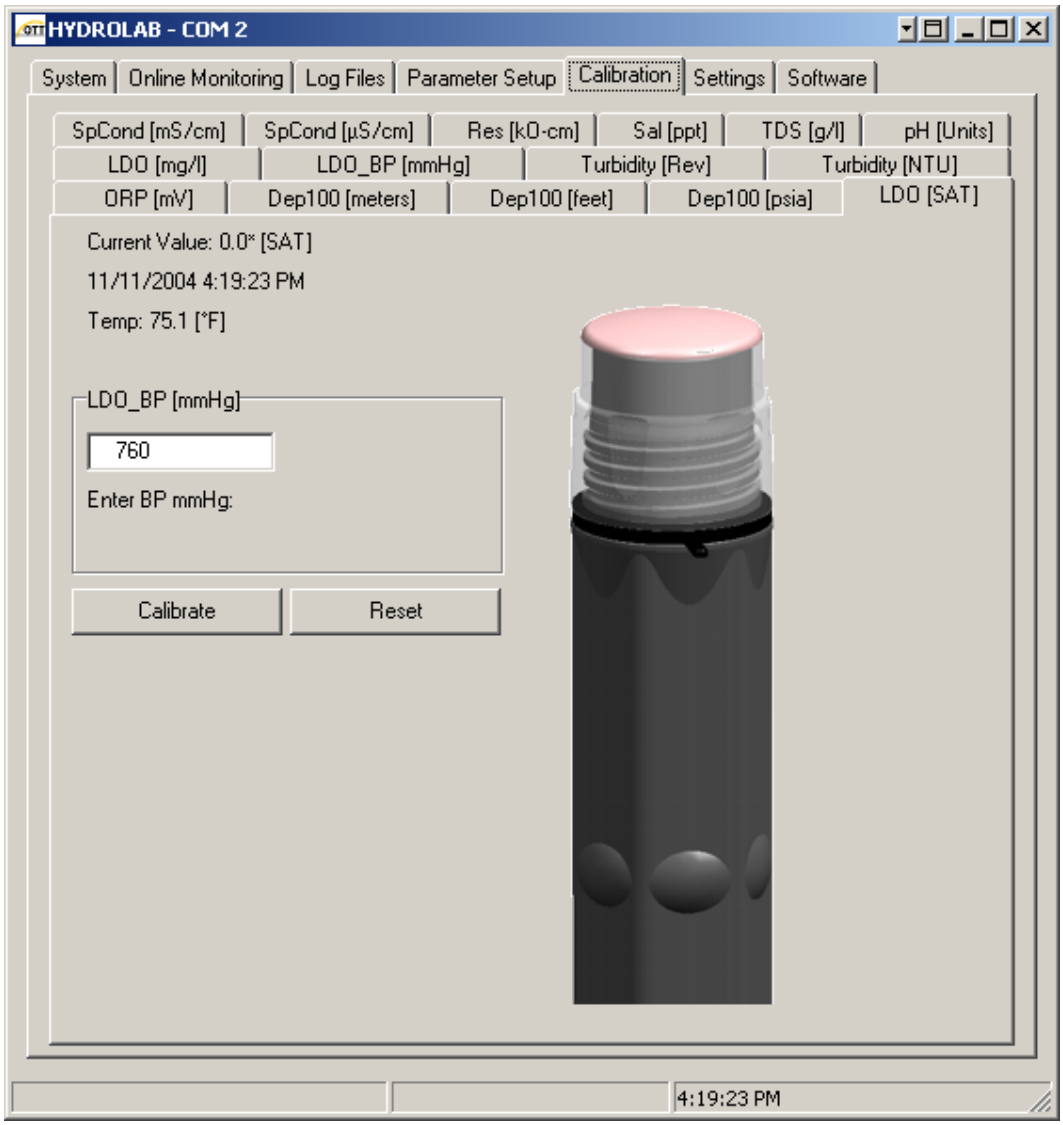
Method 1
Use this method when air saturated water is applied to the sensor.

1. Connect the sensor to a PC.

2. Start Hydras 3 LT. Wait for Hydras 3 LT to establish communications with the sensor. Click the **OPERATE SONDE** button.

3. Click the **Calibration** tab and select the **LDO [SAT]** tab.

Note: *It is important to maintain temperature stability during calibration. Care should be taken to keep the sonde out of direct sunlight or away from any other energy/heat source which will cause the temperature in the calibration cup to change during calibration. A reflective sun-shield is recommended if no natural shade is available. If the temperature in the calibration cup changes more than 0.5 °C during the calibration, it is recommended to recalibrate the sensor.*



4. Calibrate the sensor using temperature-stabilized air-saturated water. In a laboratory environment this is typically done by allowing water to equilibrate at least 12 hours after being run from a faucet or decanted from an opened water bottle. The water is air-saturated in a temperature-stabilized container using an air stone injecting air into the well-mixed water bath. Continuous use of compressed air can lead to super-saturation of oxygen in the water bath. To minimize this effect, it is recommended to turn off the air purge prior to final calibration.

5. A recommended method for producing air-saturated water in the field and using it to calibrate the sensor is as follows:

   a. Take a 1 liter bottle and fill 50% with water. Another possibility is a 4 liter (1 gallon) bottle with 500cc of water. Use water that has been at equilibrium with atmospheric pressure for at least 12 hours, i.e. unseal/open any bottled water or draw water from a tap well in advance of calibration.

   b. Make sure the water in the bottle is close to temperature equilibrium with the calibration environment.

c. Seal the bottle and shake it very vigorously for 40 seconds.

d. With the sonde positioned with sensors facing upright, pour the water into the calibration cup, fully submersing the Hach LDO sensor cap and the temperature sensor (Figure 3). Make sure the water comes close to the top of the calibration cup. Place the calibration cup cap upside down (concave upward) on top of the calibration cup to cover the calibration cup. This stops the exchange of air and allows the local environment to equilibrate. Do not tightly seal or otherwise raise the barometric pressure in the calibration cup. Make sure that the calibration cup is not in direct sunlight or in the presence of a heat or light source that could change the temperature in the calibration cup. If needed, protect the calibration cup with a reflective shield.

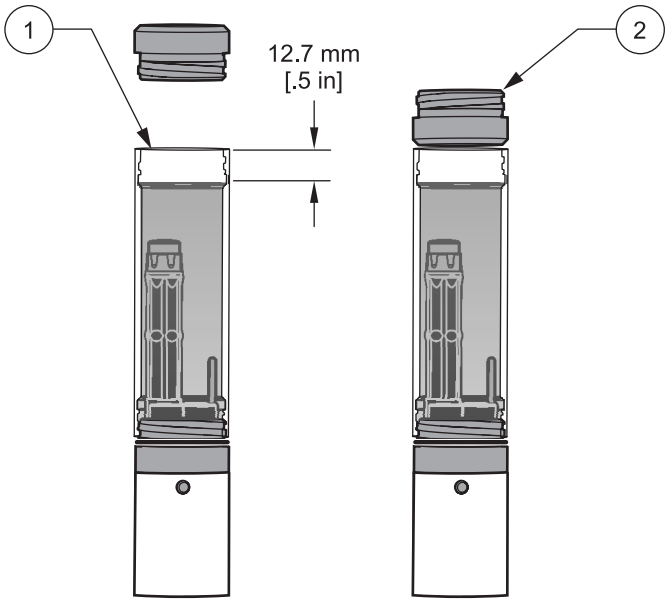


Figure 3 Method 1 Calibration

1	Calibration cup filled with temperature-stabilized air-saturated water	**2**	Proper coverage using inverted cap

6. Determine the barometric pressure for entry as the calibration standard. The barometric pressure needs to be in mmHg. 1mmHg = 0.00133322 bar = 133.322 pascal = 0.019336778 pounds/square inch [absolute].

Local Barometric Pressure, BP, in mmHG can be estimated using:

$BP' = 780 - 2.5(A_{ft}/100)$ or $BP' = 780 - 2.5(A_m/30.5)$
where:
BP’ = Barometric pressure at altitude
BP=Barometric pressure at sea level
A_{ft} = Altitude in feet
A_m = ALtitude in meters

If using the local weather bureau BP, remember these numbers are corrected to sea level. To calculate the uncorrected atmospheric pressure BP’, use the following equations:

$BP' = BP - 2.5(A_{ft}/100)$ or $BP' = BP - 2.5(A_m/30.5)$
where:
BP’ = Barometric pressure at altitude

BP=Barometric pressure at sea level
A_{ft} = Altitude in feet
A_m = ALtitude in meters

Local barometric pressure in mbar (*BPmbar*) can be converted to local barometric pressure in mmMG (*BPmmHG*) using:

$$BPmmHG = 0.75 \times BPmbar$$

7. In either laboratory or field-prepared air-saturated-water, wait 3-5 minutes to assure that the luminescent dissolved oxygen sensor material has reached the same temperature as the water bath. Enter the barometric pressure in the field provided.

8. Click **CALIBRATE**. A "Calibrate Successful!" screen will be displayed.

Method 2
Use this method when water saturated air is applied to the sensor.

1. Connect the sensor to a PC.

2. Start Hydras 3 LT. Wait for Hydras 3 LT to establish communications with the sensor. Click the **OPERATE SONDE** button.

3. Click the **Calibration** tab and select the **LDO [SAT]** tab.

4. Place the calibration cup with one end sealed so that the calibration cup opening is facing upwards. The sonde will be inserted downwards into this cup (item 1, Figure 4).

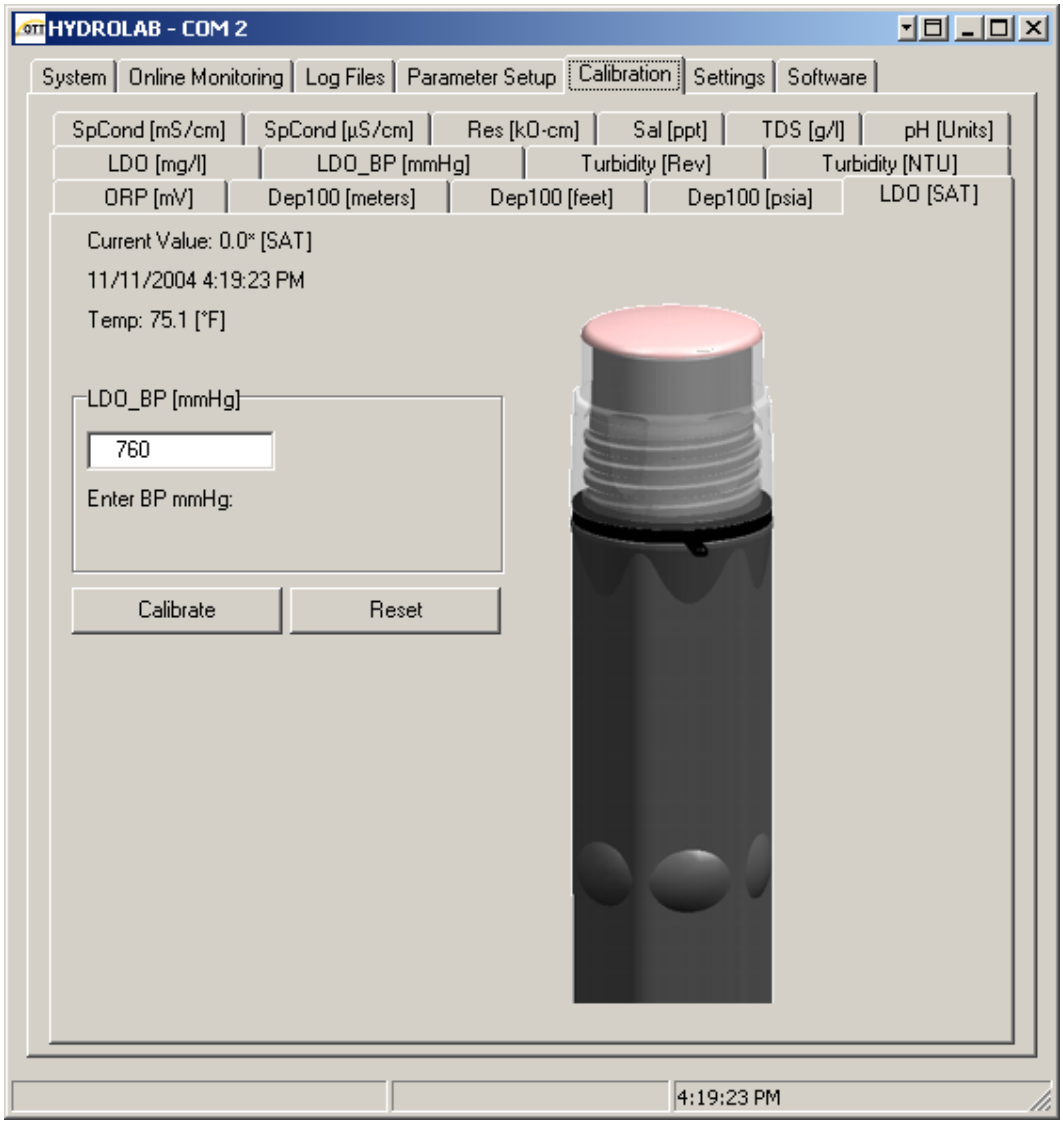
5. Fill the calibration cup with approximately ½ inches of deionized water or tap water (specific conductance less than 0.5 mS/cm) (item 2, Figure 4). Water will not touch the top of the sensor cap.

6. Carefully remove any water droplets from the sensor cap and temperature probe with the corner of a tissue or clean cotton cloth. It is important that no evaporative cooling take place either on the sensor cap or the temperature probe during calibration.

Note: *It is important to maintain temperature stability during calibration. Care should be taken to keep the sonde out of direct sunlight or away from any other energy/heat source which will cause the temperature in the calibration cup to change during calibration. A reflective sun-shield is recommended if no natural shade is available. If the temperature in the calibration cup changes more than 0.5 °C during the calibration, it is recommended to recalibrate the sensor.*

7. Gently set the sonde with sensors down into the calibration cup blocking any air exchange with the outside environment. Do not screw the calibration cup fully onto the sonde body as the compression of the o-ring will increase the pressure inside the calibration cup to above the barometric pressure and give a false 100% saturated reading. The goal is to block air exchange between the sealed calibration cup and the outside (items 3 and 4, Figure 4).

8. Allow the dissolved oxygen and temperature readings to stabilize. As the temperature sensor has a smaller thermal mass than the luminescent dissolved oxygen sensor, it is best to allow the entire unit to stabilize for an additional 3–5 minutes after the temperature sensor stabilizes. At this point,



the air inside the calibration cup should be fully saturated with water, hence the name “water saturated air.”

9. Determine the barometric pressure for entry as the calibration standard.

10. Enter the barometric pressure in the field provided.

11. Click **CALIBRATE**. A "Calibrate Successful!" screen will be displayed.

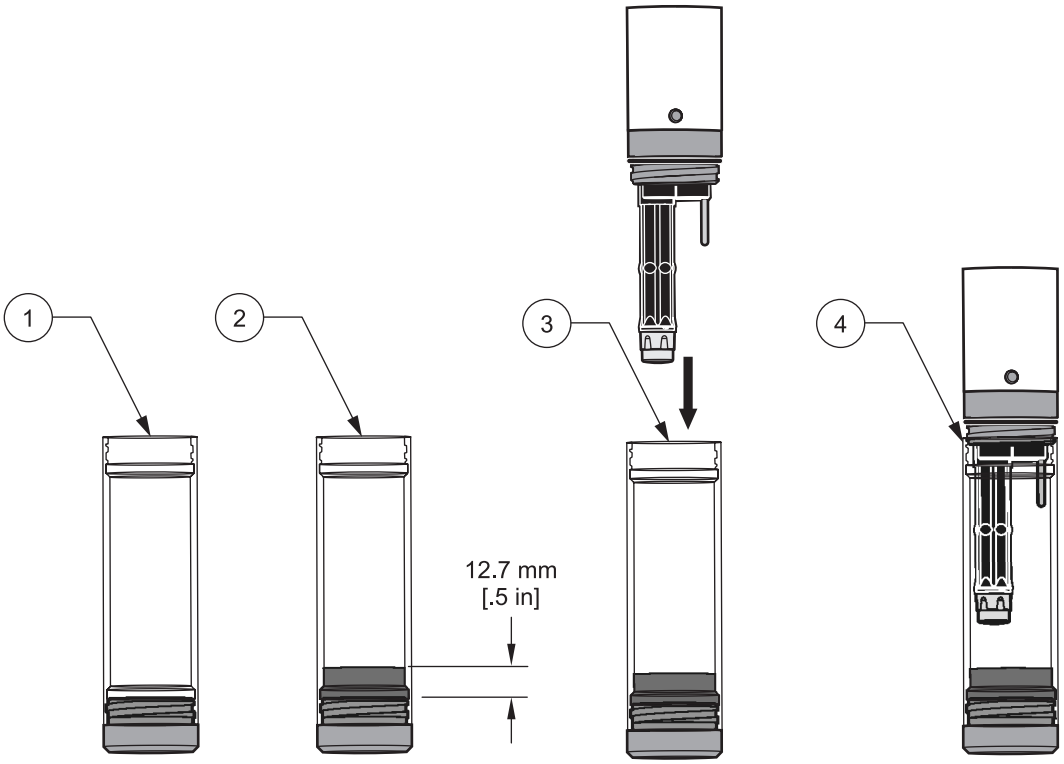
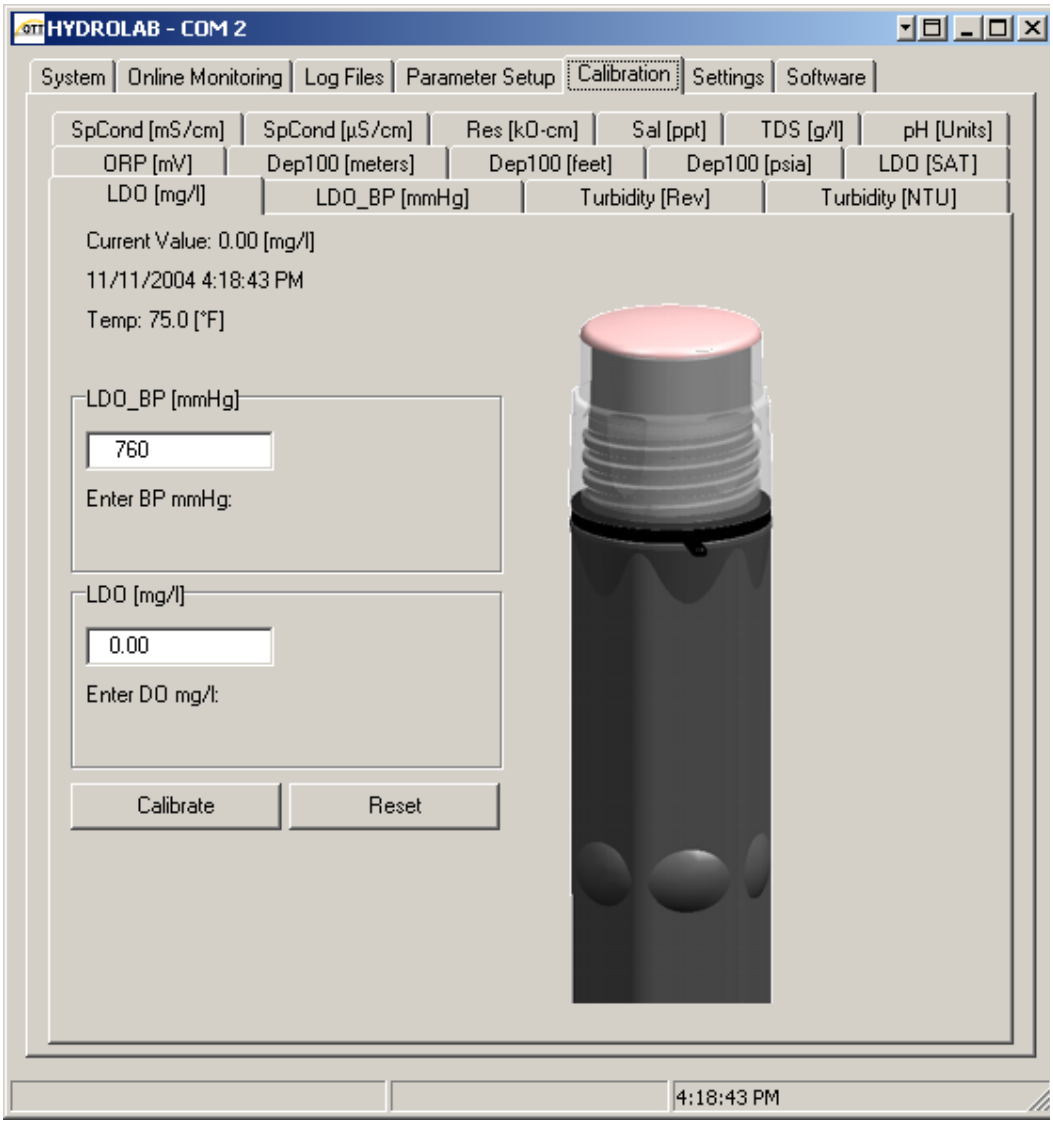


Figure 4 Method 2 Calibration

1	Calibration Cup	**3**	Proper Sonde Insertion
2	Filling the Calibration Cup	**4**	Calibration Cup screwed onto the Sonde

Method 3
Use this method when a known calibration standard is applied to the sensor.

1. Connect the sensor to a PC.
2. Start Hydras 3 LT. Wait for Hydras 3 LT to establish communications with the sensor. Click the **OPERATE SONDE** button.
3. Click the **Calibration** tab and select the **LDO [mg/l]** tab.
4. Place the sensor into a solution with a known concentration of oxygen. For example, a reference tank with a calibrated Hach Luminescent Dissolved Oxygen sensor. Make sure that no bubbles are present on the face of the sensor and that the temperature probe is fully immersed.
5. Determine the barometric pressure for entry as the calibration standard.
6. After the temperature and luminescent dissolved oxygen readings have stabilized, wait an additional 3–5 minutes to assure that the luminescent dissolved oxygen sensor material has reached the same temperature as the water bath. Enter the barometric pressure in the field provided.
7. Determine dissolved oxygen in mg/L in the sample using a known reference.
8. Enter the known concentration of oxygen the Dissolved Oxygen mg/L field.

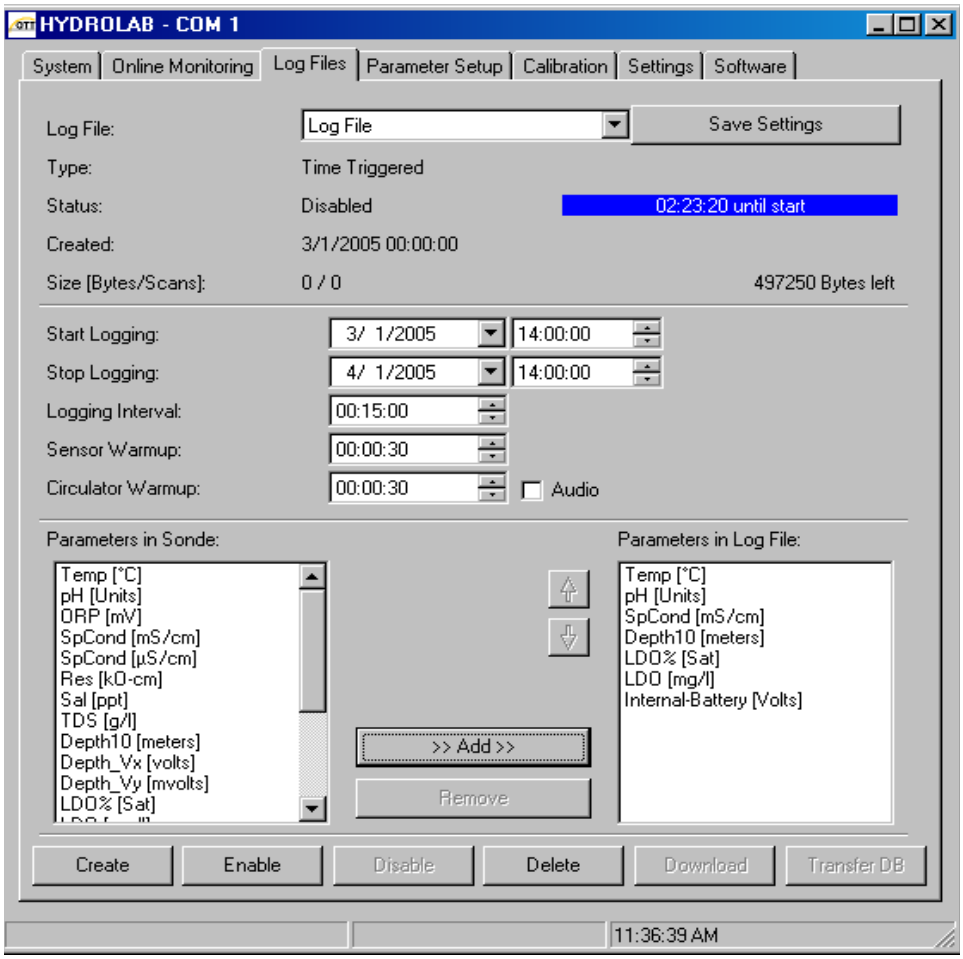


9. Click **CALIBRATE**. A "Calibrate Successful!" screen will be displayed.

Battery Life Optimization Notes

The luminescent dissolved oxygen (Hach LDO) sensor is a non-consumptive oxygen sensor. It does not require a circulator for operation in still or low-flowing water. The warm-up time for the Hach LDO sensor should be set to 30 seconds to optimize battery life. The default warm-up time setting in the sonde is 2 minutes, originally intended to accommodate the warm-up time of the polarographic dissolved oxygen sensor (Clark Cell). Two minutes allowed the Clark Cell to stabilize and the circulator to achieve a constant flow across the membrane. The Hach LDO sensor does not require the 2-minute warm-up time. Using the 2-minute warm-up time with the Hach LDO sensor will significantly decrease the deployment time for battery operated instruments.

To optimize the battery life, the manufacturer recommends setting both the sensor and circulator warm-up time to 30 seconds. For systems without circulators, it is still necessary to enter the 30 second circulator warm-up time.



Specifications

Specifications are subject to change without notice.

Minimum Detection Limit	0.1 mg/L
Range	0–20 mg/L
Accuracy	± 0.1 mg/L for 0–8 mg/L; ± 0.2 mg/L for greater than 8 mg/L
Resolution	0.01 or 0.1 mg/L
% Saturation	0.1%
Warranty	Sensor is covered by a two-year warranty. Sensor cap is covered by a one-year warranty.

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eac/kt/te/dk February 2006 Edition 4