



DO 6 PLUS

Dissolved Oxygen/Temp



Code 5-0107-01

PREFACE

This manual serves to explain the use of the DO 6 PLUS hand held meter.

This manual functions in two ways: first as a step by step guide to operating the meter; second, as a handy reference guide.

This manual is written to cover as many anticipated applications of the DO 6 PLUS meter as possible. If there are questions about the use of this meter contact the LaMotte Tech Service Department.

LaMotte Company will not accept any responsibility for damage or malfunction to the meter caused by improper use of the instrument.

The information presented in this manual is subject to change without notice as improvements are made, and does not represent a commitment on the part of LaMotte Company.

<p>WARNING! This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.</p>
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1. INTRODUCTION

The DO 6 PLUS microprocessor-based handheld meter is economical and easy to use. It has a large custom LCD (Liquid Crystal Display) for clear and easy reading.

The DO 6 PLUS offers measurement of dissolved oxygen (DO) as percentage saturation or concentration. Temperature measurement is available in degrees Celsius. The meter ensures accurate measurement of the dissolved oxygen values through the temperature, barometric pressure and salinity compensation features.

Meter kits include a dissolved oxygen probe, refill solution, a rubber boot/stand, 4 alkaline “AAA” batteries and instruction manual. For additional information, see Section 11 — *Replacement Parts and Accessories*.

Read this manual thoroughly before operating the meter.

2. GETTING STARTED

2.1 Description of Keypad Functions

The meter has 6 keys on a splash-proof keypad. Some buttons have multiple functions depending on the mode of operation.

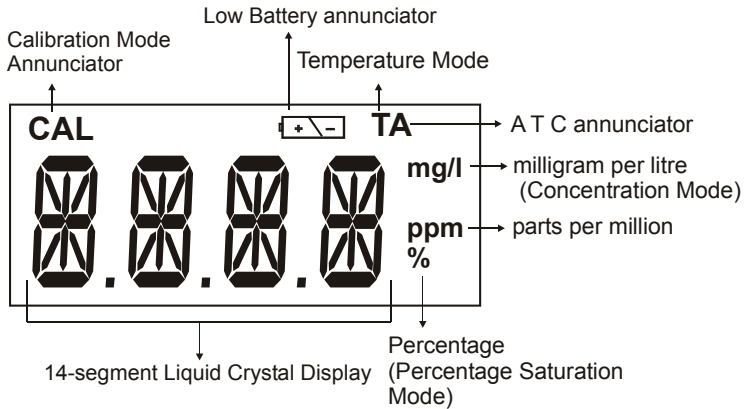
ON/OFF	Powers meter on and off. Meter starts up in the measurement mode that was last used.
CAL	Enters into calibration mode. Pressing while in calibration mode will abort calibration without confirming value.
MODE	Selects desired measurement mode. When pressed simultaneously with ON/OFF, it will go to the SETUP mode.
HOLD	Freezes measured reading. Press again to resume live reading.
ENTER	Confirms calibration value in calibration mode and confirm selections in SETUP mode.
▲ ▼	Increments/decrements values during calibration mode or scroll through SETUP menus. Set offset adjustments and configuration settings.



2.2 Description of LCD Annunciators

The meter has a large custom LCD that consists of 4-digit segments plus annunciators for percentage saturation (%), concentration (mg/L or ppm) and Temperature in degrees Celsius (T).

Other annunciators include “A” (when the ATC function is activated), “CAL” (when meter is in calibration mode) and low battery condition.



2.3 Inserting & Removing the Rubber Boot/Stand

1. To remove the meter from the rubber boot, push out the bottom edge of the meter until it is completely out of the boot. Ensure that the probe cables are not connected. See Figure 1.
2. To insert the meter into the rubber boot, slide in the top of the meter before pushing the bottom edge of the meter down to set it into position. Lift up the stand at the back of the meter for bench applications. See Figure 2.

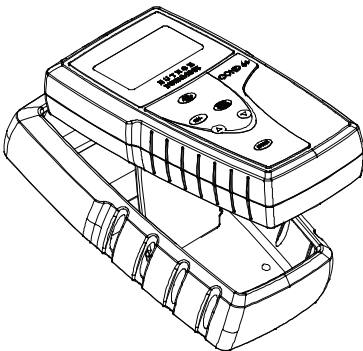


Figure 1

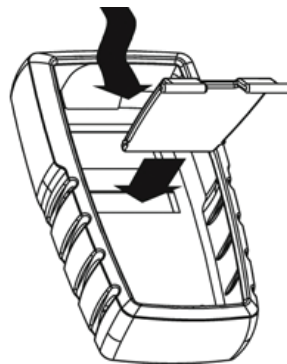
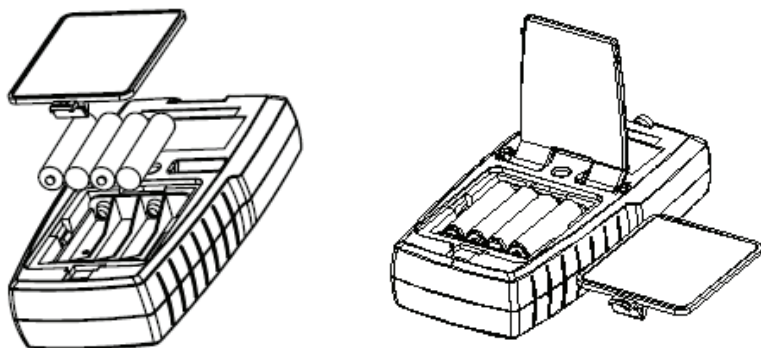


Figure 2

2.4 Inserting New Batteries

The battery compartment is found at the back of the instrument. To open the battery compartment, push the cover in the direction of the arrow and lift up. Note the polarity of batteries before inserting them into position. After the batteries have been replaced, reposition the cover and press down until it locks.



2.5 Battery Replacement

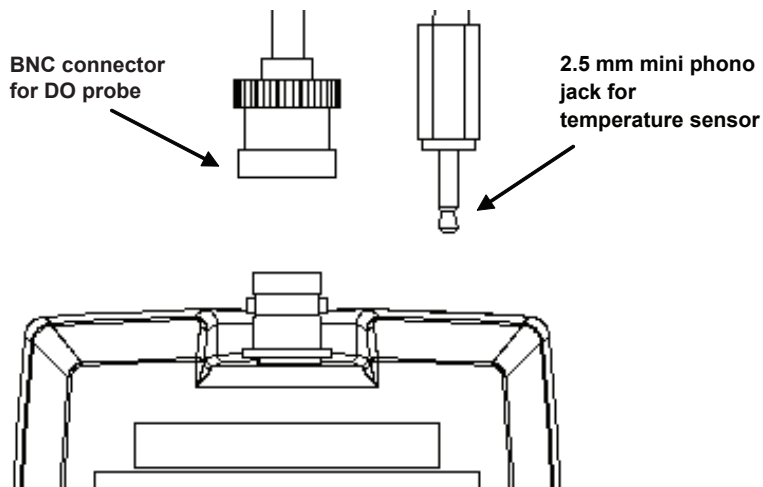
A low battery annunciator on the LCD alerts when the battery power is running low. Caution: Power off the meter before replacing the batteries.



Low Battery Condition

2.6 Connecting the Probe

1. To connect the probe, align the connector slots with the posts of the meter socket and rotate the connector clockwise until it locks.
2. To remove the probe, rotate the connector in an anti-clockwise direction until it unlocks, and slide the connector off the socket.
3. Insert the mini phono jack of the temperature sensor into the socket on the meter as shown below.



2.7 Electrode Information

The DO 6 PLUS includes a galvanic DO electrode which does not require warm-up. It generates a millivolt signal proportional to the amount of oxygen in the solution.

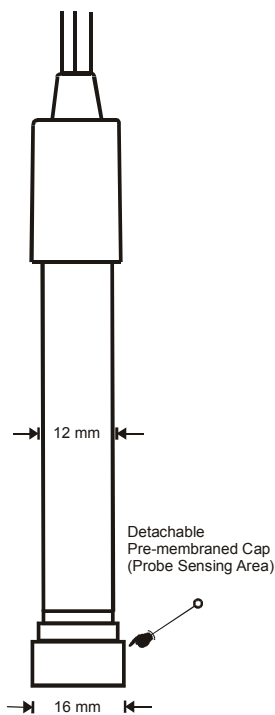
The probe has a dual cable; a BNC connector for DO measurement and a phono jack plug for temperature. The sensor utilizes a cathode, anode, and electrolyte that are separated from the sample by an oxygen permeable membrane. The membrane is pre-assembled and fixed to a detachable cap. The pre-assembled cap design allows simple replacement and fast conditioning.

The probe is lightweight and includes a built-in temperature sensor. The epoxy body of the probe is 12mm in diameter while the detachable Noryl cap is 16mm in diameter. The compact sensing area reduces air entrapment resulting in quick, accurate, and stable readings.

The pre-assembled cap must be completely submersed in the solution to obtain an accurate reading. Provide simple stirring for best results—ideally achieve a minimum water flow rate of 2 inch/second on the membrane. The probe is not recommended for use in samples outside of the range of 0 to 50 °C.

Shaking the probe will aid in removing bubbles, if needed, before taking a reading. When calibrating in air, shake to remove water from the membrane.

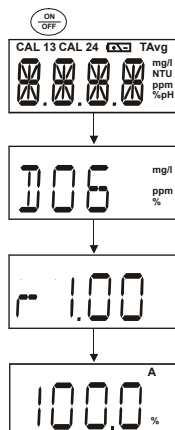
The membrane is thin and can not be repaired if it is damaged. Use care to protect from scratches, abrasions, or contact with solids. For best results keep the membrane clean by rinsing it after daily use. See Section 6 – *Probe Maintenance*.



2.8 Switching the Meter On

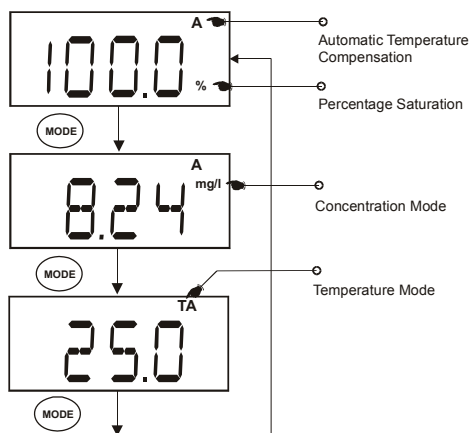
Press ON/OFF to power up the meter. The meter will cycle through various setup parameters.

1. All LCD segments will briefly illuminate.
2. The model name [DO 6] will display next along with mg/l, ppm, and % annunciators.
3. Next, the meter revision number [r #.##] is shown briefly before beginning measurement.
4. The meter will be in the measurement mode that was in use when it was powered off—%, mg/l, ppm, or T.



2.9 Changing the Mode

Press **MODE** to switch between percentage saturation (%), concentration (mg/L)(ppm), and temperature (T) measurement.



3. CALIBRATION

3.1 General Information

The DO 6 PLUS has three measurement modes; DO as % saturation, DO as mg/L (or ppm) concentration, and temperature.

Dissolved oxygen levels vary with temperature, barometric pressure, and salinity, so the calibration must be performed with consideration of these factors. **It is necessary to set the proper temperature, barometric pressure and salinity values prior to performing any DO calibration or measurement.**

See Section 3.2 — *Temperature Calibration*

See Section 5.2 — *Automatic Temperature Compensation*

See Section 5.9 — *Pressure & Salinity Adjustment*

The DO 6 PLUS will accept two % saturation calibration points; 100% using saturated air or air-saturated water, and 0% using a zero oxygen solution. When the 100% calibration is performed, the corresponding concentration is adjusted simultaneously. Therefore, it is not necessary to calibrate the concentration mode. If calibrating for 0% oxygen, note that the meter will take several minutes to reach 0% saturation value and constant stirring is not required.

The following table lists calibration values in % saturation calibration mode with two different barometric pressures. Note that the saturation value (92.1%) has decreased due to the lower barometric pressure entered.

% Saturation (per factory default value)	Calibration Value (760mmHg)	Calibration Value (700mmHg)
less than 10%	0%	0%
10.1% to 49.9%	Err.1 (error 1)	Err.1 (error 1)
50% to 200%	100%	92.1%

If calibration is attempted from 10.1% to 49.9%, the “Err.1” message will be shown. The calibration will be rejected and the display will return to the measurement mode.

The DO 6 PLUS will accept one calibration point in concentration mode. The minimum value is 2 mg/L (ppm), and the calibration window is $\pm 40\%$ of the factory default value.

Temperature and % saturation calibration should take place **before** attempting to perform mg/L (ppm) concentration calibration.

Calibration of the concentration mode will only replace the previous concentration calibration and does not affect the % saturation calibration.

To offset the % saturation reading to match another instrument, see Section 5.8 — *% Saturation Offset Adjustment*.

New calibration values will automatically override the existing data. Perform a daily calibration for best results. To completely recalibrate the meter and when installing a replacement probe, it is best to clear all calibration data prior to performing the calibration. See Section 5.7 *Reset to Factory Default*.

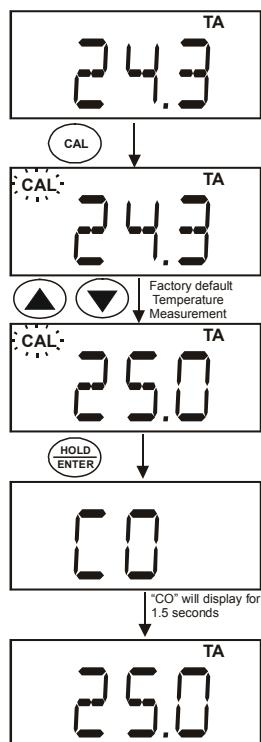
3.2 Temperature Calibration

For the most accurate DO readings, ensure that the temperature is accurate. The temperature sensor of the DO 6 PLUS probe has been factory calibrated, however if it changes over time, or if the probe is replaced, calibration may be necessary. To protect from erroneous calibrations, the allowable tolerance is limited to $\pm 5^{\circ}\text{C}$ adjustment of the factory default value.

Most users utilize the automatic temperature compensation feature that uses the sensor that is built into the probe. However, manual temperature compensation can be used to input a fixed, known temperature.

1. Press **MODE** to select the temperature mode. The display will show “T” for temperature and “A” for automatic temperature compensation.
2. Dip the probe into a solution with a known, accurate temperature (i.e. a temperature bath). Allow enough time for the temperature reading to stabilize.
3. Press **CAL**. The CAL indicator will blink above the display. The temperature value shown is the value based on the factory default.
4. Press **▲** or **▼** to adjust the reading to match the correct temperature value (i.e. of the temperature bath).
5. Press **HOLD/ENTER** to confirm the calibration and return to the measurement mode.

Press **CAL** as needed to exit calibration without confirmation at any time.



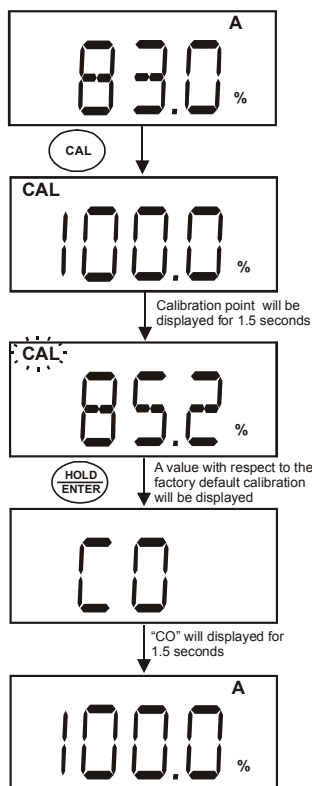
3.3 % Saturation Calibration

The DO 6 PLUS can be easily calibrated in air. For the most accurate DO readings, ensure that the barometric pressure value is accurate.

The barometric pressure factory default is 760 mm Hg, which results in a theoretical calibration value of 100% saturation in air. If the barometric pressure setting has been changed from 760 mm Hg, the meter will automatically adjust to a new % saturation calibration value instead of 100%. This new value is correct for the adjusted barometric pressure.

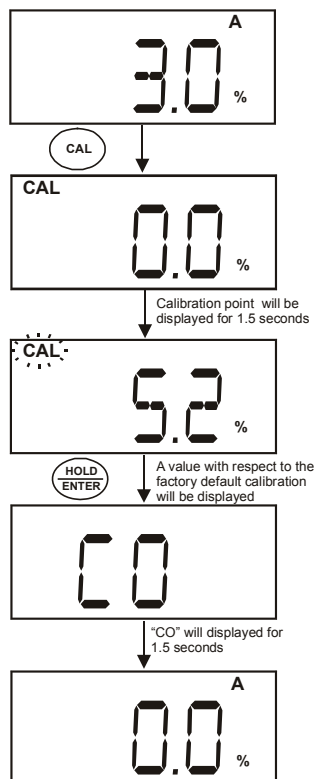
3.3.1 100% Calibration

1. Rinse the probe thoroughly with DI water or rinse solution.
2. Press **MODE** to select % saturation.
3. Hold the probe in the air with the tip facing downwards. Wait for the reading to stabilize.
4. Press **CAL**. The CAL indicator and intended percentage calibration point (100%) will display briefly, before CAL flashes. The % value based on the factory default calibration is shown.
5. Press **HOLD/ENTER** to confirm the calibration. The meter will display “CO”, automatically calibrate to 100.0% air saturation, and then return to the measurement mode.



3.3.2 0% Calibration

1. Rinse the probe thoroughly with DI water or rinse solution.
2. Press **MODE** to select % saturation.
3. Dip the probe into a zero oxygen solution. Stir gently with the probe. Wait for the reading to stabilize.
4. Press **CAL**. The CAL indicator and intended percentage calibration point (0%) will display briefly, before CAL flashes. The % value based on the factory default calibration will be shown.
5. Press **HOLD/ENTER** to confirm the calibration. The meter will display “CO”, automatically calibrate to 0.0% saturation, and then return to the measurement mode.

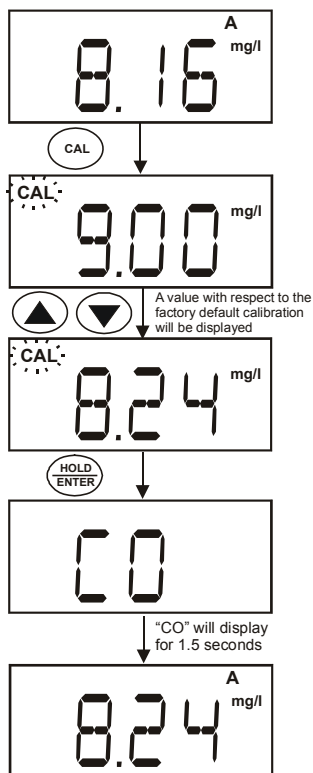


3.4 mg/L or ppm Calibration

Performing a 100% saturation calibration will simultaneously calibrate the corresponding mg/L (ppm) concentration value. Therefore, an additional mg/L (ppm) calibration isn't required in most circumstances.

If desired, a calibration adjustment in mg/L (ppm) can be performed without affecting the % saturation calibration value.

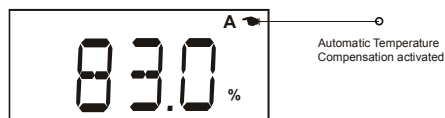
1. Perform the 100% Saturation Calibration. See Section 3.3.1 — *100% Calibration*.
2. Rinse the probe thoroughly with DI water or rinse solution.
3. Dip the probe into a sample of known oxygen concentration (i.e. determined by titration or another instrument). Stir the solution gently with the probe. Wait for the reading to stabilize.
4. Press **MODE** to select mg/L (ppm).
5. Press **CAL**. The CAL indicator and current concentration will display briefly, before CAL flashes. The concentration value based on the factory default calibration will be shown.
6. Press **▲** or **▼** to adjust the reading to match the known oxygen concentration value.
7. Press **HOLD/ENTER** to confirm the calibration. The meter will display “CO”, and automatically calibrate to the entered value, then return to the measurement mode.



NOTE: The minimum calibration value is 2 mg/L. To prevent erroneous calibrations, the calibration is limited to $\pm 40\%$ adjustment of the factory default value.

4. MEASUREMENT

The DO 6 PLUS offers automatic or manual temperature compensation. See Section 5.2 — *Automatic Temperature Compensation*.



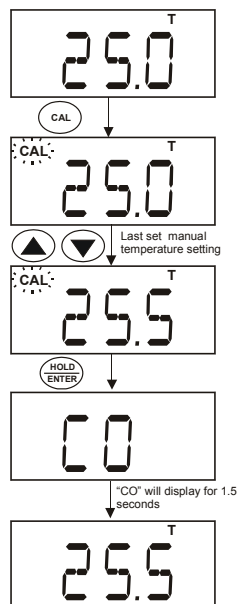
4.1 Temperature Compensation

Insert the phono plug of the probe for Automatic Temperature Compensation (ATC). The “A” annunciator will display normally when active, or blink if the phono plug is disconnected.

Deactivate “A.ATC” for manual temperature compensation. The “A” annunciator will not be displayed when the meter is in manual temperature compensation mode.

For manual temperature compensation, manually enter the desired process temperature from 0 to 50 °C into the meter. The default is 25 °C.

1. Press **MODE** to select temperature.
2. Press **CAL**. The “CAL” indicator will start blinking and the display will show the last manually set temperature value.
3. Check the temperature of the sample using an accurate reference thermometer. Wait for the value to stabilize. Press ▲ or ▼ to manually set the temperature value.
4. Press **HOLD/ENTER** to confirm the calibration. The meter will display “CO” and automatically set the entered value, then return to the measurement mode.

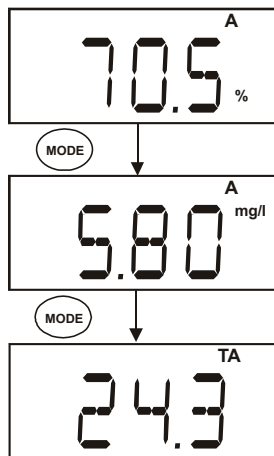


4.2 Taking Measurements

Follow these general rules when taking measurements: keep the membrane free from contact with solid objects, provide stirring of the solution—this helps to overcome the oxygen consumption of the probe and prevents air bubble entrapment, do not strike the probe against hard surfaces, and do not submerge the cable for extended periods.

1. Rinse the probe thoroughly with DI water or rinse solution.
2. Select the appropriate measurement mode. Press **MODE** to toggle between modes:
 - a. Percentage Saturation (%)
 - b. Concentration (mg/L) or (ppm)
 - c. Temperature (T)
3. Dip the probe into the sample. Stir the solution gently with the probe.
4. Allow the reading to stabilize and observe the reading.

To change the concentration units see Section 5.3—*Selection of mg/L or ppm*.

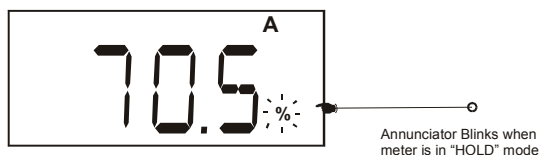


4.3 Pressure & Salinity Compensated Measurements

During measurement the dissolved oxygen reading is automatically compensated for salinity and pressure based on values entered in the setup menu. For the most accurate DO readings, ensure that pressure and salinity are adjusted accordingly from the setup menu. The factory default values are 760 mm Hg (101.3 kPa) barometric pressure (sea level) and 0.0 ppt salinity (no salinity). See Section 5.9 — *Pressure & Salinity Adjustment*.

4.4 Holding a Reading

To hold the displayed reading momentarily, press **HOLD/ENTER** during any measurement. The %, mg/L, ppm or T annunciator will blink, indicating that the value is being held.



Press **HOLD/ENTER** again to deactivate the HOLD function. The meter will revert to the current active measurement and the annunciator will stop blinking.

If the auto-off feature is activated, the meter will turn off automatically after 20 minutes of non use. The HOLD value is not retained when the meter is shut off automatically or manually.

5. SETUP

There are two setup menus. One menu is derived from the **% saturation and temperature modes**; the other menu is derived from the **mg/L (or ppm) concentration mode**.

1. Press **MODE** to display % saturation or temperature. Press **ON/OFF** to power off.

OR

Press **MODE** to display mg/L (or ppm). Press **ON/OFF** to power off.

2. With the meter off, keep the **MODE** key pressed. Press and release **ON/OFF**, then release **MODE**. The meter should display “**Set.P**” after **ON/OFF** is released and “**COF.1**” after **MODE** is released.

Press **CAL** one or more times as needed during setup mode to exit and return to measurement mode at any time.



Setup Menu



Configuration Menu

A. ATC Automatic Temperature Compensation

b. DO Select mg/L or ppm units for concentration mode

(available from concentration setup only)



View the latest calibration data according to the respective setup menu.



View the electrode properties

FACT View the slope factor

OFS View the % saturation offset adjustment.

(available from % saturation concentration setup only)

HI.mV View the mV value at 100% saturation

LO.mV View the mV value at 0% saturation



Selection of automatic power-off (20 min from the last key press)



Reset Menu

A.CAL Calibration only reset to factory default

b.USR User settings reset to factory default



% saturation offset adjustment

(available from % saturation concentration setup only)



Dissolved Oxygen Parameters

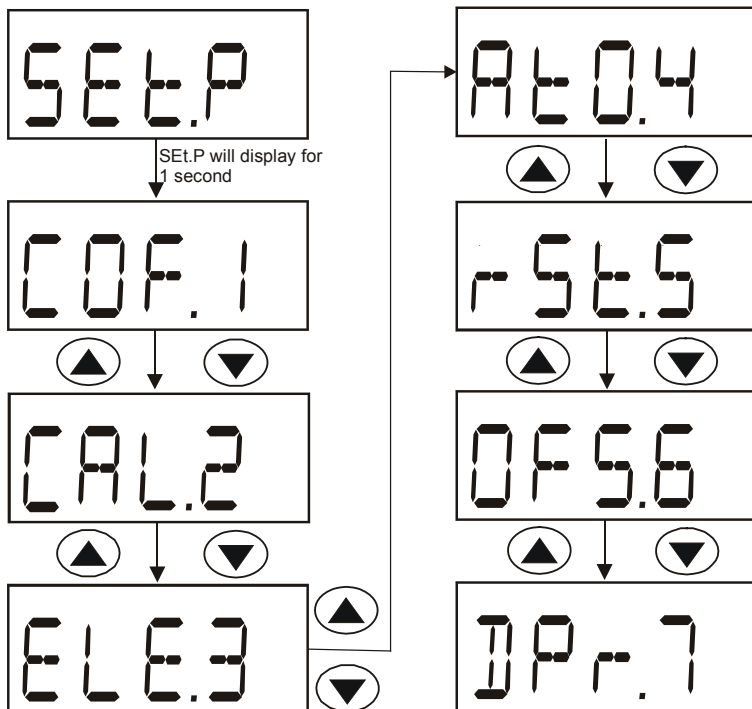
A.HG Barometric pressure adjustment in mmHg

A.PA Barometric pressure adjustment in kilopascal

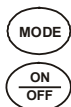
b.SAL Salinity adjustment

(available from concentration setup only)

(MODE) Switch off from % Saturation or Temperature measurement mode. Press and hold MODE key and then switch on.
 (ON/OFF)



% or Temperature Setup Menu



Switch off from Concentration measurement mode. Press and hold MODE key and then switch on.

SEt.P

SEt.P will display for 1 second

COF.1



CAL.2



ELE.3



At0.4



r-SE.5



DP r.7

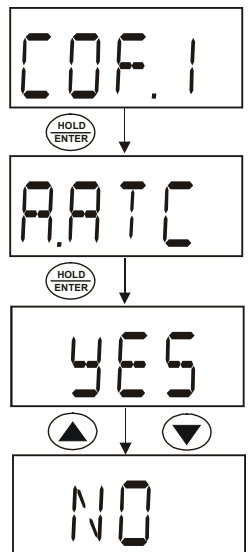
mg/L (ppm) Concentration Setup Menu

5.1 Configuration Menu (COF.1)

5.2 Automatic Temperature Compensation (A.ATC)

Use this menu to change automatic temperature compensation (A) or units of concentration (mg/L or ppm). ATC is recommended for most applications.

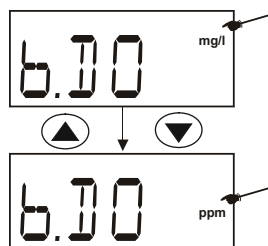
1. From “COF.1” of either setup menu, press **HOLD/ENTER** to display “A.ATC”.
2. Press **HOLD/ENTER** to enter the selection menu.
3. Use ▲ or ▼ to select YES (activate ATC) or NO (deactivate ATC and activate manual temperature compensation).
4. Press **HOLD/ENTER** to confirm.
5. Press **CAL** to return to measurement mode.



Selection of
Automatic or
Manual Temperature
Compensation

5.3 Selection of mg/L or ppm (b.DO)

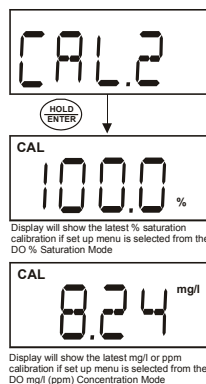
1. From “COF.1” of the mg/L (ppm) setup menu, press **HOLD/ENTER** three times to display “b.DO”.
2. Use ▲ or ▼ to select the desired units of measurement.
3. Press **HOLD/ENTER** to confirm.
4. Press **CAL** to return to measurement mode.



5.4 Calibration Data (CAL.2)

To view the % saturation or mg/L (ppm) concentration calibration data, proceed from the corresponding setup menu.

1. From the setup menu, press ▲ or ▼ to select “CAL.2” for the most recent calibration data.
2. Press **HOLD/ENTER** to view calibration data.
3. Press **HOLD/ENTER** or **CAL** to exit.
4. Press **CAL** to return to measurement mode.



Note: “-- -- -- --” indicates no calibration data exists for the selected mode.

5.5 Electrode Data (ELE.3)

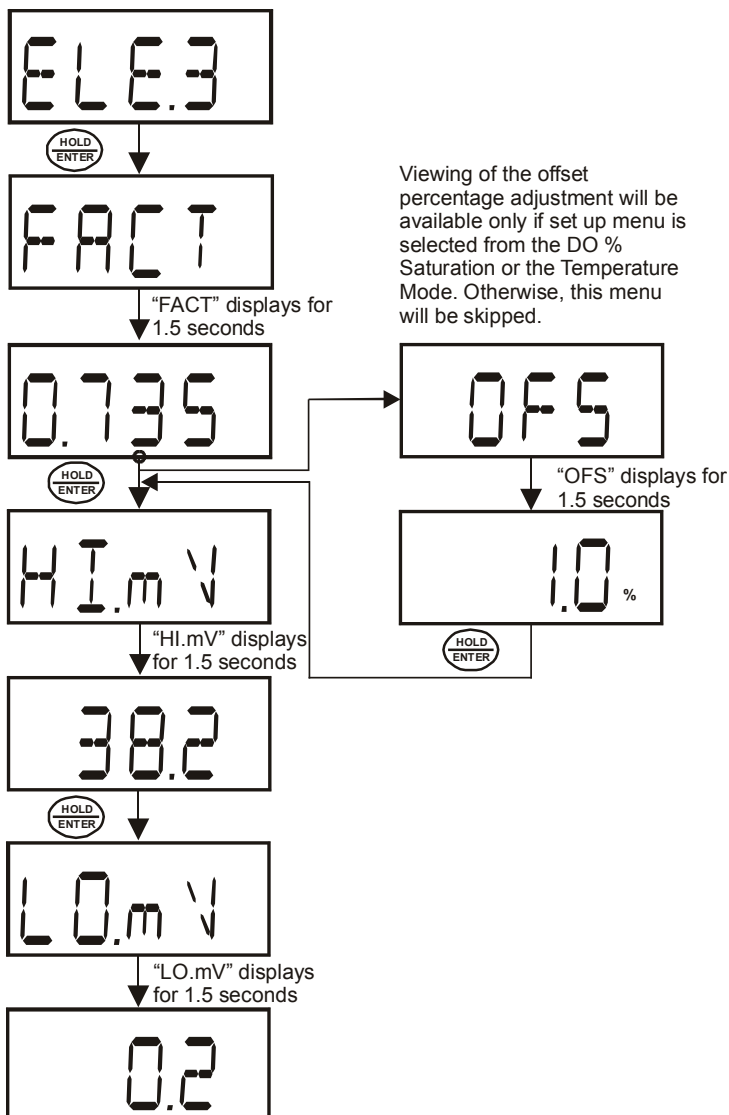
Use this menu to view the electrode data for diagnostic purposes. The data includes; slope factor (FACT), % saturation offset (OFS), 100% saturation mV value (HI.mV), and 0% saturation mV value (LO.mV). To view the electrode data for % saturation or mg/L (ppm) modes, enter from the corresponding setup menu.

The electrode slope factor will give an indication of the probe efficiency. It is the ratio of the actual mV produced by the probe to the theoretical mV value. The ratio displays from 0.5 to 1.999.

The % saturation offset allows the electrode offset adjustment made in Section 5.8 — *% Saturation Offset Adjustment* to be viewed.

1. From the setup menu, press ▲ or ▼ to select “ELE.3”.
2. Press **HOLD/ENTER** to enter the menu. “FACT” will be momentarily shown before the slope factor is displayed.
3. Press **HOLD/ENTER** again. “OFS” will be momentarily shown before the % saturation offset is displayed. Note: this is not available from the mg/L (ppm) concentration setup menu.
4. Press **HOLD/ENTER** again. “HI.mV” will be momentarily shown before the electrodes mV output at 100% is displayed.
5. Press **HOLD/ENTER** again. “LO.mV” will be momentarily shown before the electrode mV output at 0% is displayed.

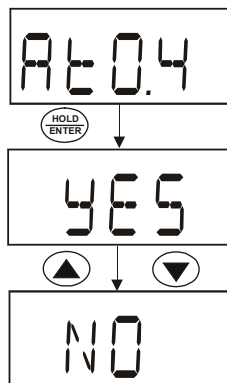
Press **CAL** to exit the setup mode and return to the measurement mode at any time.



5.6 Automatic Shut Off (AtO.4)

Use this feature to conserve batteries. When active, the meter will automatically shut off 20 minutes after the last key press.

1. From the setup menu, press ▲ or ▼ to select “AtO.4”.
2. Press **HOLD/ENTER** to enter the menu.
3. Use ▲ or ▼ to select YES (activate automatic off) or NO (activate automatic off).
4. Press **HOLD/ENTER** to confirm.
5. Press **CAL** to return to the measurement mode.



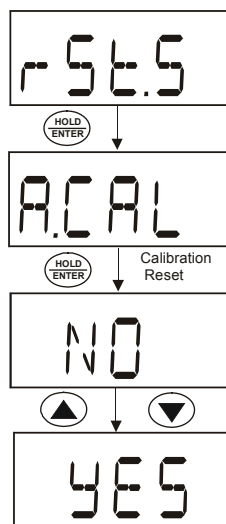
5.7 Reset to Factory Default (rSt.5)

Use this mode to reset the meter to the factory default settings. There are two levels of reset:

Calibration (A.CAL) resets calibration values only.

User (b.USR) resets all data, calibration, and other customized setup functions.

1. From the setup menu, press ▲ or ▼ to select “rSt.5”.
2. Press **HOLD/ENTER** to enter the menu.
3. Press **HOLD/ENTER** to enter calibration reset “A.CAL”.
4. Use ▲ or ▼ to select YES (reset calibration) or NO (do not reset calibration).
5. Press **HOLD/ENTER** to confirm. If “YES”, the meter will return to measurement mode after resetting.



Note: Both % and concentration calibrations are reset from the % saturation setup. However, when calibration reset occurs from the concentration setup, only concentration is reset.

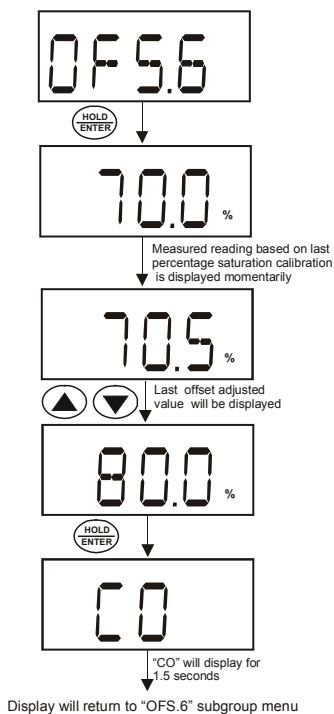
If “NO”, the User Reset menu “b.USR” is displayed.

6. Press **HOLD/ENTER** to enter the menu.
7. Use **▲** or **▼** to select **YES** (reset user) or **NO** (do not reset user).
8. Press **HOLD/ENTER** to confirm.
9. If “**YES**”, the meter will return to the measurement mode after resetting.
10. Press **CAL** to return to the measurement mode.

5.8 % Saturation Offset Adjustment (OFS.6)

Use this feature to offset the meter value when cross referenced to another DO meter. The DO 6 PLUS allows a $\pm 10.0\%$ offset adjustment. View the offset value from the Electrode Data menu “ELE.3”.

1. Using the % saturation mode of the DO 6 PLUS, measure the concentration of a sample after it has stabilized.
2. Measure the concentration the same sample using another DO meter as a reference. The probe of the reference meter should be immersed at the same depth as the probe of the DO 6 PLUS. Turn the meter off.
3. With the meter off, keep the **MODE** key pressed. Press and release **ON/OFF**, then release **MODE**. The meter should display “**SEt.P**” after **ON/OFF** is released and “**COF.1**” after **MODE** is released.
4. Press **▲** or **▼** to select “**OFS.6**”.
5. Press **HOLD/ENTER** to enter the menu. The display will momentarily show the measured reading based on the last calibration before displaying the last offset adjusted value.
6. Use **▲** or **▼** to enter the value of the reference DO meter.
7. Press **HOLD/ENTER** to confirm.
8. Press **CAL** to return to measurement mode.

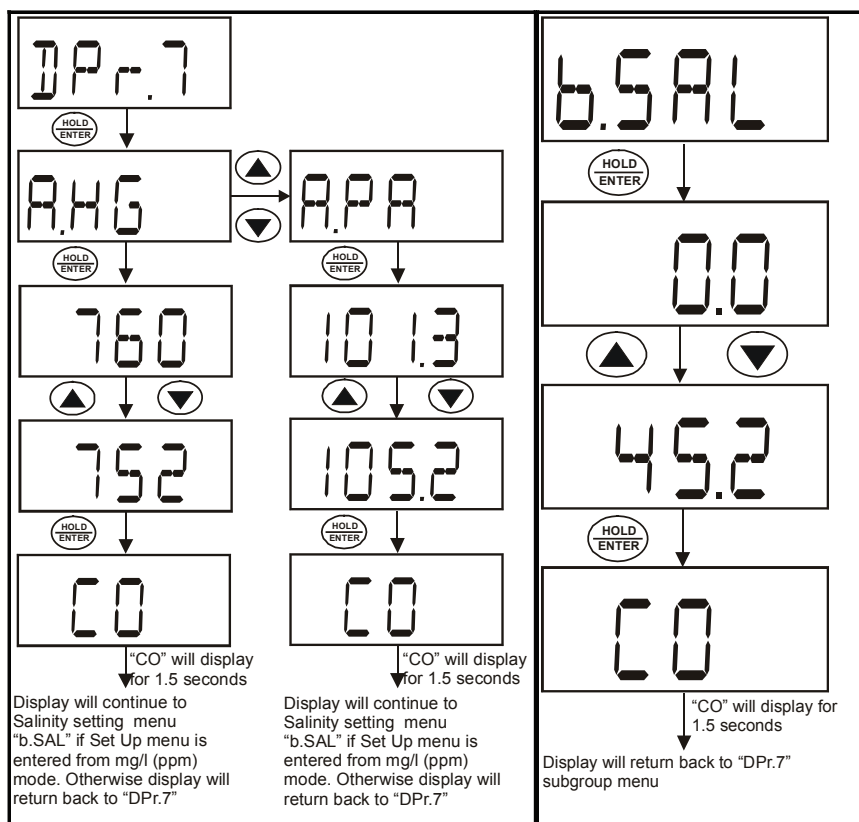


Note: User calibrations will reset the offset adjustment to 0.0 %.

5.9 Pressure & Salinity Adjustment

Use this menu to set barometric pressure and salinity values of the sample to be measured. Use mmHg (A.HG) or kilopascal (A.PA) barometric pressure units, and ppt salinity units (bSAL) from the concentration setup menu. For the most accurate results, enter the actual salinity value if the samples are at least 0.1 ppt (100 ppm). Maximum adjustment is 50 ppt (50,000 ppm or 5% salt).

1. Press **MODE** to display the mg/L concentration. Press **ON/OFF** to power off.
2. With the meter off, keep the **MODE** key pressed. Press and release **ON/OFF**, then release **MODE**. The meter should display “**Set.P**” after **ON/OFF** is released and “**COF.1**” after **MODE** is released.
3. Press **▲** or **▼** until the display shows “**DPr.7**”.
4. Press **HOLD/ENTER**. The display will show the current setting, either “**A.HG**” (millimeters of mercury or mm Hg) or “**A.PA**” (kilopascal or kPa).
5. Use **▲** or **▼** to select the desired barometric pressure units, then press **HOLD/ENTER** to confirm.
6. Use **▲** or **▼** to set the actual pressure value. Press **HOLD/ENTER** to confirm. If values were changed, the confirmation indicator “**CO**” will be displayed briefly.
7. Next, “**b.SAL**” (salinity adjustment) will be displayed. “**DPr.7**” (main group menu) will display if mg/L was not used in step 1). Note: If the concentration setup was not used in step 1) the meter will return to “**DPr.7**” as salinity is only accessible in the concentration setup.
8. Press **CAL** to return to the measurement mode or **HOLD/ENTER** for salinity setting adjustment.
9. Use **▲** or **▼** to enter the salinity of the solution in parts per thousand (ppt).
10. Press **HOLD/ENTER** to confirm. If values were changed, a confirmation indicator “**CO**” will be displayed briefly.
11. Press **CAL** to return to the measurement mode.



Pressure & Salinity Adjustment Sequences

6. PROBE MAINTENANCE

The DO 6 PLUS probe has a galvanic measuring element which produces an output proportional to the oxygen present in the medium in which it is placed. The galvanic probe design allows measurements to be taken immediately—without the typical 15 minute wait of polarographic dissolved oxygen probes.

The probe consists of two parts. The upper part consists of the anode, cathode, and dual cable. The lower part consists of a pre-assembled cap, and electrolyte solution.

Oxygen diffuses through the membrane onto the cathode, where the oxygen is consumed. This process produces an electrical current which flows through the cable to the meter. The electric current that is produced is proportional to the oxygen that passes through the membrane and the layer of electrolyte. This makes it possible to measure the partial pressure of oxygen in the sample at a given temperature.

Since the dissolved oxygen in the sample is consumed by the cathode it is essential to have flow past the membrane to prevent the occurrence of false readings. The probe uses very little oxygen for a measurement. This enables it to function correctly with liquid movement as low as 2 inch/sec across membrane.

The permeability of the membrane to oxygen varies greatly with temperature. Therefore compensation is needed allow for variations in temperature. The DO 6 PLUS probe has built-in temperature compensation.

Proper maintenance will maximize probe life and accurate readings. Deposits on the membrane surface will act as a barrier to oxygen diffusing through the membrane, so the membrane should be kept clean to assure maximum reliability.

After each use, the probe should be thoroughly rinsed with clean water to avoid any hardening of deposits. If growth develops on the probe, a disinfecting chemical should be used to clean it.

NOTE: Although the membrane is strong and not easily damaged, it should be wiped gently to cleaning it. If the membrane is punctured, damaged, or torn, the probe will not function properly.

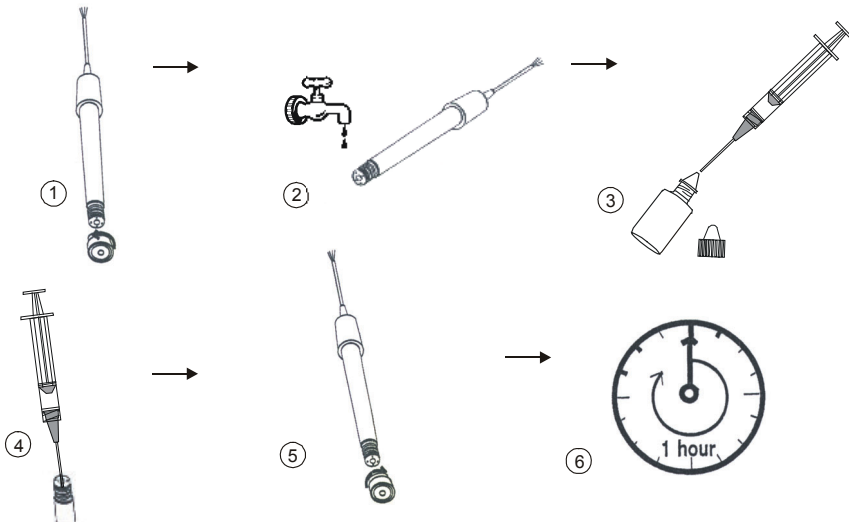
There are no special probe storage requirements.

6.1 Cap and Electrolyte Replacement

The pre-assembled cap should be replaced when the probe cannot be calibrated or the membrane is damaged. Typical membrane damages are punctures or wrinkles caused during measurements or cleaning.

For replacement parts, see Section 11 – *Replacements And Accessories*.

1. Turn the cap counter clockwise to unscrew it from the probe sensing tip.
2. Rinse the probe under running water.
3. Mount the nozzle tip onto the syringe provided. Fill the syringe with the refill solution through the tip of the plastic bottle.
4. Hold the probe upside down. Insert the nozzle tip into one of the 4 holes surrounding the silver cathode. Inject the fill solution into the probe body until solution leaks out from the fill hole (approximately 5 mL).
5. Replace the pre-assembled cap on the probe. Turn the cap clockwise until it is hand tighten.
6. Allow at least 1 hour for the electrode to equilibrate before usage.




6.2 Electrolyte Solution

The electrolyte solution in the probe cap will deplete on usage and will need to be replaced periodically. The replacement electrolyte solution included with the probe comes premixed and ready to use. To order more electrolyte solution, see Section 11 – *Replacements And Accessories*.

7. TROUBLESHOOTING

Problem	Cause	Solution
No display when turned on	a) Batteries not in place b) Batteries not in correct polarity (+ / -) position c) Weak batteries	a) Ensure batteries are in place and making good contact b) Reinsert batteries with correct polarity c) Replace batteries
Unstable readings	a) Insufficient electrolyte in probe b) Air bubbles trapped around the probe c) Dirty or damaged probe d) Probe not deep enough in sample e) External noise pickup or induction caused by nearby electric motor f) Broken probe	a) Fill probe with electrolyte &/or replace pre-assembled cap b) Stir or tap probe to remove bubbles c) Clean the probe and re-calibrate d) Make sure sample entirely covers the probe sensors e) Move or switch off interfering motor f) Replace probe
Slow response	a) Dirty/Oily probe b) Temperature is changing	a) Clean probe b) Allow temperature to stabilize
No response to key press	a) HOLD in use- indicated by flashing display b) Damaged pad c) Internal program error	a) Press HOLD/ENTER b) Return to manufacturer c) Reset by reinserting batteries

8. ERROR MESSAGES

LCD Display	Indicates	Cause	Solution
	Low battery	Need new batteries or battery connection is bad.	Clean battery contacts. Replace batteries, noting polarity.
“Err 1” in % Saturation Mode	% Saturation calibration error	Calibration is attempted when the factory calibrated absolute value is within 10.1% to 49.9%	Check the value of the calibration solution. If zero calibration is done, make sure the limit of 10% is not exceeded Recondition the probe
“Err. 1” in mg/L (ppm) Concentration Mode	Concentration calibration error	Calibration is attempted when the factory calibrated absolute value is below 2.00	Verify the solution is above 2.00 Verify the temperature and salinity settings Recondition the probe
“UR”/“OR” with blinking “A” annunciator in Temperature Mode	ATC probe error, Under Range, Over Range	ATC probe is disconnected or broken with the ATC feature activated. Temperature is out of range	Connect the ATC plug to the meter. Verify the temperature accuracy. Ensure probe is not broken or punctured.
“----”with blinking “A” annunciator in % Saturation and Concentration Mode	ATC probe error	ATC probe is disconnected or broken with the ATC feature activated. Temperature is out of range	Connect the ATC plug to the meter. Verify the temperature accuracy. Ensure probe is not broken or punctured.

9. FACTORY DEFAULT SETTINGS

MENU	DESCRIPTION	OPTIONS	DEFAULT
COF.1	Configuration Setup Menu		
A.ATC	Automatic Temperature Compensation	YES / NO	YES
b.DO	DO Concentration Units	mg/L or ppm	mg/L
CAL.2	Calibration Data	View only	— — — —
ELE.3	Electrode Data Menu		
FACT	Electrode Slope Factor	View only	1.000
OFS	Viewing the % Saturation offset adjustment.	View only	0.0%
HI.mV	View mV Value at 100% Saturation	View only	50 mV
LO.mV	View mV Value at 0% Saturation	View only	0 mV
AtO.4	Automatic Power Off	YES / NO	YES
rSt.5	Reset to Factory Default Menu		
A.CAL	Selection of Calibration Reset	NO / YES	NO
b.USR	Selection of User Reset	NO / YES	NO
OFS.6	% Saturation Offset Adjustment	+/- 10.0%	0.0%
DPr.7	Dissolved Oxygen Parameters Menu		
A.HG	Pressure Adjustment in mm Hg	500 – 1499	760
A.PA	Pressure Adjustment in kPa	66.6 - 199.9	101.3
b.SAL	Salinity Adjustment in ppt	0.0 - 50.0	0.0
	Manual Temperature Compensation	0.0 - 50.0 °C	25.0°C

10. SPECIFICATIONS

% Saturation Mode	
Range	0.00 – 200.0 %
Resolution	0.1 %
Relative accuracy	± 1.5% of Full Scale
mg/L (ppm) Concentration Mode	
Range	0.00 – 20.00 mg/L or ppm
Resolution	0.01 mg/L; 0.01 ppm
Relative accuracy	± 1.5% of Full Scale
Temperature	
Range	-5.0 – 105.0 °C (meter only)*
Resolution	0.1 °C
Relative accuracy	± 0.5 °C
	*Probe measures 0.0 – 50.0 °C
Salinity Correction	
Range	0.0 – 50.0 ppt
Resolution	0.1 ppt
Method	Automatic correction after manual input
Barometric Pressure Correction (mm Hg)	
Range	500 to 1499 mm Hg or 66.6 to 199.9 kPa
Resolution	1 mm Hg or 0.1 kPa
Method	Automatic correction after manual input
Automatic Temperature Compensation	0.0 to 50.0°C
Manual Temperature Compensation	0.0 to 50.0°C
Probe (DO/ Temp)	Galvanic / Thermistor
Probe Diameter	Body 12 mm, Cap 16 mm
Response Time	60 seconds to achieve 95% of the reading
% Saturation Calibration Points	100% in saturated air or air-saturated water. 0% in zero oxygen solution
% Saturation Calibration Limits	Factory calibrated absolute value of 10.0% and below for 0% point & 50% to 200% for 100% point.
Concentration Calibration Window	±40% from the factory default measurement value. Minimum reading allowed is 2.00 mg/L (ppm).
Temperature Calibration Window	±5°C from factory default measurement

Offset Adjustments (% Saturation)	±10.0 of reading in Saturation mode
HOLD function	Yes
Auto-Off function	Selectable Auto Off function. (20 minutes after last press)
Display	Custom Single 4 Digit LCD
Inputs	BNC for DO & 2.5 mm Phono for temperature
Operating Range	0 to 50 °C
Power Requirements	4 AAA-sized batteries (included)
Battery Life	> 700 hours (Alkaline Batteries)
Dimensions	Meter: 15.7 x 8.5 x 4.2 cm / 255 g Probe: 115 mm x 12 mm (Dia), 3-ft cable Membrane housing: 16 mm (Dia)

11. REPLACEMENT PARTS AND ACCESSORIES

Description	Code
DO 6 PLUS Dissolved Oxygen Meter and Probe	5-0107-01
DO 6 PLUS Probe w/3 ft. cable	5-0129
Replacement Caps (2) with pre-installed membrane and 10 mL electrolyte	5-0137

12. DISSOLVED OXYGEN THEORY

Dissolved Oxygen (DO) refers to the volume of oxygen that is contained in water. There are two main sources of dissolved oxygen in water; atmosphere and photosynthesis. Waves and tumbling water mix air into the water where oxygen readily dissolves until saturation occurs. Oxygen is also produced by aquatic plants and algae during photosynthesis.

The amount of dissolved oxygen that can be held by water depends on 3 factors:

1) TEMPERATURE:

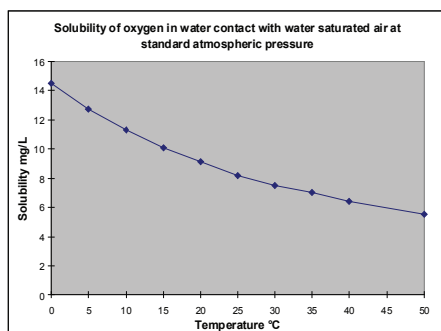
DO increases with decreasing temperature.
(Colder water holds more oxygen.)

2) SALINITY:

DO increases with decreasing salinity.
(Freshwater holds more oxygen than saltwater.)

3) ATMOSPHERIC PRESSURE:

DO decreases with decreasing atmospheric pressure.
(The amount of DO absorbed in water decreases as altitude increases.)



Measurement Units

One unit of measure of DO in water is parts per million (ppm) which is the number of oxygen molecules (O_2) per million total molecules in a sample. Calculating the % Saturation is another way to analyze DO levels. % Saturation is the measured DO level divided by the greatest amount of oxygen that the water could hold under various temperature and atmospheric pressure conditions multiplied by 100.

What Is Being Measured?

DO probes respond to the partial pressure of oxygen in liquid or gas being measured. The probes measure the “pressure” of the oxygen rather than the concentration. All of the oxygen entering the probe is consumed at the cathode where it is electrochemically reduced to hydroxyl ions producing an electrical current within the probe:



Since all of the oxygen entering the probe is chemically consumed, the partial pressure of oxygen in the electrolyte is zero. Therefore, a partial pressure gradient exists across the membrane and the rate at which oxygen enters the probe is a function of the partial pressure of oxygen in the gas or in liquid being measured.

When a probe is placed in air saturated water, the current it produces will not be affected by the temperature or salinity of the water. The DO concentration in the water, however, will vary with temperature and salinity. Because it is convenient to report DO concentration in mg/L or ppm, it is necessary to make an adjustment for the temperature and salinity of the water to obtain corrected readings in these units.

When DO is reported in terms of partial pressure or % Saturation, then a temperature and/or salinity compensation for oxygen solubility is not necessary. Most probes are temperature compensated—i.e. they convert the “partial pressure measurement” to mg/L of DO at the given water temperature, salinity, and barometric pressure.

Air Calibration

Understanding the principle of air calibration is easy, once it is understood that the probe is responding to partial pressure. When the probe is in air, it is measuring the partial pressure of oxygen in air. If water is air saturated, then the partial pressure of oxygen in the water will be the same as it is in the air. Therefore, all that must be known is the temperature of the air in which the probe is placed. By consulting solubility tables for oxygen at the specific barometric pressure and salinity of the water being measured, the corresponding concentration (mg/L or ppm) can be found for air saturated water at the air calibration temperature, and the meter can be set accordingly. Because most meters are temperature compensated, they will give correct readings in mg/L even though the actual water temperature may be different than the air calibration temperature. Note: The closer the air calibration temperature is to the water temperature, the more accurate the calibration.

Applications

Oxygen is essential for fish, invertebrate, plant, and aerobic bacteria respiration. DO levels below 3 ppm are stressful to most aquatic organisms. Levels below 2 or 1 ppm will not support fish. Fish growth and activity usually require 5 to 6 ppm of DO, an important consideration for the aquaculture industry.

Low DO indicates a demand on the oxygen of the system. Natural organic materials, such as leaves, accumulate in the stream and create an oxygen demand as they decompose. Organic materials from human activities also create an oxygen demand in the system. Micro-organisms consume oxygen as they decompose sewage, urban and agricultural run-off, and discharge from food-processing plants, meat-packing plants and dairies. There is an optimum DO level for this process and if the DO level falls too low, the micro-organisms die and the decomposition ceases. If the DO level is too high, more power is used than necessary for aeration and the process becomes costly.

In boiler water applications, the presence of oxygen in the water will increase corrosion and contribute to boiler scale that inhibits heat transfer. In such instances it is critical to keep the DO concentration to a minimum.

Some pollutants such as acid mine drainage produce direct chemical demands on oxygen in the water. DO is consumed in the oxidation-reduction reactions of introduced chemical compounds such as nitrate (NO_3^{1-}) and ammonia (NH_4^{1+}), sulfate (SO_4^{2-}), and sulfite (SO_3^{2-}) and ferrous (Fe^{2+}) and ferric (Fe^{3+}) ions.

These are important consideration for water and wastewater treatment industry.

13. WARRANTY

LaMotte Company warrants this instrument to be free of defects in parts and workmanship for 3 years from the date of shipment and the probe to be free of defects in parts and workmanship for 6 months from the date of shipment. If it should become necessary to return the instrument for service during or beyond the warranty period, contact our Technical Service Department at 1-800-344-3100 or tech@lamotte.com for a return authorization number or visit www.lamotte.com for troubleshooting help. The sender is responsible for shipping charges, freight, insurance and proper packaging to prevent damage in transit. This warranty does not apply to defects resulting from action of the user such as misuse, improper wiring, operation outside of specification, improper maintenance or repair, or unauthorized modification. LaMotte Company

specifically disclaims any implied warranties or merchantability or fitness for a specific purpose and will not be liable for any direct, indirect, incidental or consequential damages. LaMotte Company's total liability is limited to repair or replacement of the product. The warranty set forth above is inclusive and no other warranty, whether written or oral, is expressed or implied.

14. REPAIRS

Should it be necessary to return the meter for repair or servicing, pack the meter carefully in a suitable container with adequate packing material. A return authorization number must be obtained from LaMotte Company by calling 800-344-3100 (US only) or 410-778-3100, faxing 410-778-6394, or emailing tech@lamotte.com. Often a problem can be resolved over the phone or by email. If a return of the meter is necessary, attach a letter with the return authorization number, meter serial number, a brief description of problem and contact information including phone and FAX numbers to the shipping carton. This information will enable the service department to make the required.



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