Instruction Manual

for the

Aquaprobe® Lite

Optical Water Quality Probe

and associated

Aquameter®, Utilities & Accessories

Aquameter® Software Version 6.00 and Above
AP-Lite Software Version 4.00 and Above

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TRADEMARKS

Table of Contents

1. Introduction

This manual covers the setup, operation, calibration and maintenance of the Aquaprobe® AP-Lite V4.00+, Aquameter® V6.00+ Meter, AquaLink V4.00+ PC software and associated Aquaprobe® accessories. If your Aquaprobe® or Aquameter® are running earlier software, the functionality may differ from that shown in this manual. In this case, contact Aquaread for an earlier version of this manual or return your equipment for software upgrade.

2. What's in the Box?

The AP-Lite is supplied with the following:

- Sleeve End Cap.
- One mounting nut (pre-fitted).
- Getting started card for quick reference.
- Pot of Silicone Grease

To complete your system, you will need an Aquameter® (AM-200) an Optical Electrode of your choice and an Aquaprobe® Extension Cable, which should be purchased separately.

2.1. About the Aquameter®

The Aquameter® is designed to be used outdoors and is rated to IP67, that is to say it is waterproof but it **is not** designed for submersion. In order to prevent accidental dunking or loss, a lanyard is supplied.

Please note that the socket on the Aquameter® is only waterproof when the associated plug is fitted. Without the plug fitted, water can enter the socket. Damage caused by water ingress through the socket is not covered by your warranty.

You may notice a small hole on the rear of the unit near the top. This is a waterproof vent for the internal barometric sensor. **Do not poke anything in this hole!** Doing so will cause major damage to the vent's waterproof membrane and invalidate your warranty.

The lanyard supplied with the Aquameter® may, at first, appear to be a little long. This is intentional. In order to keep the Meter out of the way whilst your hands are full, the lanyard has been made long enough to wear round your neck and over your shoulder so the Meter sits on your hip.

The extra length also allows the meter to be held in a comfortable position in front of you during normal use. In order to prevent you being dragged into the water in the event of the Probe cable becoming snagged, the lanyard includes a quick-release clip.

2.2. AP-Lite Minimum and Maximum Insertion Levels

The AP-Lite is designed to be fully submerged in water and is rated to IP68, that is to say, it is rated for continual immersion to a depth of 30 meters, and short term immersion to 100 meters.

Temperature is measured in the AP-Lite by a sensor located in the blue socket block. The recommended minimum level of insertion is therefore the blue line half way up the Probe.

The Probe will operate with just the lower row of holes in the Sleeve covered, but the temperature measurement response will be slower as the temperature of the liquid being measures will take a short time to conduct to the socket block via the Probe's Sleeve.

2.3. About the Probe Sleeve and End Cap

Please refer to the diagram and photograph below when reading the following important information.

All Aquaread® Optical Electrodes are incredibly sensitive. For example, the Turbidity electrode is capable of measuring between 0 and 3000NTU with an internal resolution of greater than 0.1NTU. This means that the electrode is able to detect changes in turbidity that are less than 0.003% of the full range! The other optical electrodes have a similar level of sensitivity.

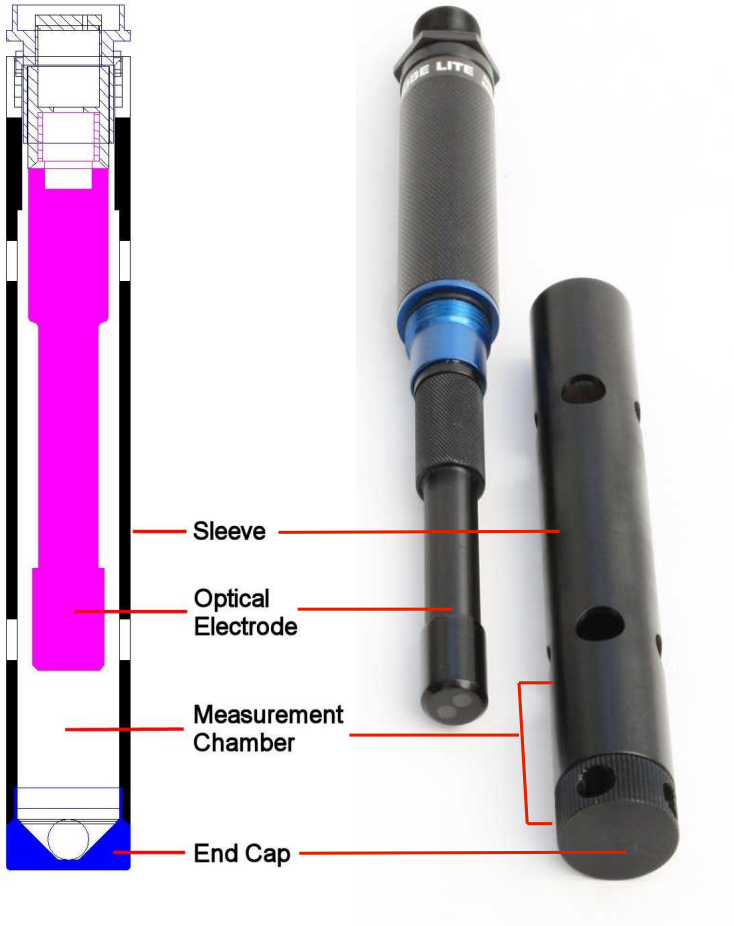
It follows, therefore, that in order to provide stable, repeatable readings, the environment in which the measurements are made must be completely stable and repeatable.

The AP-Lite is constructed with a matt black aluminium sleeve and end cap that enclose the sensing electrode and provide a closed, constant condition, non reflective measurement chamber.

This is essential for the correct calibration and operation of all types of optical electrodes.

In order to obtain consistent results, the measurement chamber created within the AP-Lite must remain physically constant during both calibration and measurement.

Both the Sleeve and Sleeve End Cap must be fitted during calibration and measurement including when using the AP-Lite with the optional Flow Through Cell (Flowcell).

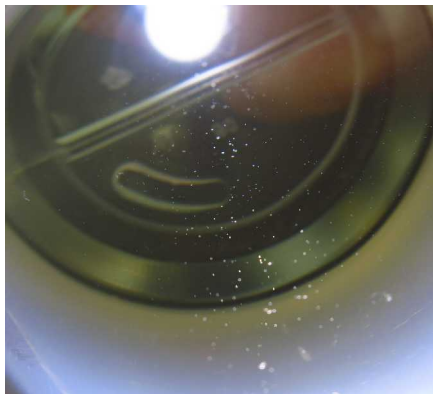


If the optical electrode is calibrated under one set of conditions then used to measure under another set of conditions, the readings will naturally be erroneous, especially at low concentrations.

A perfect example of this is calibrating with the end cap removed then measuring with the end cap fitted (or vice-versa). By changing the physical characteristics of the measurement chamber, you also change the calibration and response of the electrode.

Another particular problem when trying to measure very low concentrations is air in the form of both visible and microscopic bubbles. These act like tiny prisms and can refract and reflect both the excitation light and the return signal being measured.

The photograph to the right was taken in a calibration tube after fresh water was poured in. The bubbles are clearly visible in the light beam.



2.4. Top Tips for successful measurements using optical electrodes

- Always keep the measurement chamber and electrode lenses clean.
- Always fit the sleeve and end cap during both calibration and measurement.
- Always allow the readings to settle completely during both calibration and measurement.
- Always try to eliminate air bubbles by agitating the Probe after insertion both during calibration and measurement. On the AP-7000, activate the self-cleaning mechanism to clear bubbles.
- Always calibrate and zero the electrode as close to your sample temperature as possible. This is especially important with the Ref-Oil electrode.
- Always zero the electrode just prior to use in clean water (bottled still mineral water is ideal). This is also especially important with the Ref-Oil electrode.

2.5. About Fluorescent Measurement

All Optical Electrodes, with the exception of the Turbidity Electrode, employ fluorescent measurement techniques. Interference from microbiological species and compounds which fluoresce at similar wavelengths and differences in fluorescence caused by temperature, ambient light and turbidity can all cause inaccuracies.

Fluorescence measurement is ideal for researchers who are interested in detecting the presence or absence of a specific substance in reasonable concentrations and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations.

Fluorescence measurement techniques are not ideal for quantitative measurement and it is therefore impossible to specify an absolute accuracy.

In order to obtain accurate results, data obtained with a fluorescent electrode in the field must be post-calibrated with data from standard laboratory analysis of grab samples acquired during the study.

3. Battery Installation and Care

The Aquameter® requires five AA size batteries. To install the batteries, loosen the two screws on the centreline of the rear of the meter and remove the battery compartment lid. Following the battery polarity markings inside the battery compartment, insert five AA cells then replace the compartment lid and tighten the screws.

3.1. Choice of Battery Type

Alkaline or rechargeable batteries may be used, but never mix battery types in the meter. If you choose to use rechargeable batteries, we recommend *Energizer* 2500mAh (or greater) Nickel-Metal Hydride cells, which are widely available.

If the Meter is to be out of use for a long period, remove the batteries to prevent damage due to possible leakage.

3.2. Battery Life

A set of fresh alkaline cells will give over 20 hours use in the AM-200 GPS Aquameter®. A fully charged set of 2500mAh NiMH cells will give up to 40 hours use in the AM-200 GPS Aquameter®.

3.3. Battery Charging

During the charging process, batteries generate heat and vent gasses, and must never be charged inside a sealed unit. Because the Aquameter® is a sealed unit, we do not allow charging in-situ. Batteries must be removed and charged with a suitable battery charger outside the Meter. We recommend the use of one of the *Energizer* range of NiMH chargers.

3.4. Battery Condition Icon

On the main Aquameter® screens, a battery condition icon is displayed in the top left corner. The icon shows full when the batteries are fresh, and gradually empties as the batteries are used. When the batteries need replacing, the empty battery icon will flash on and off. If you ignore this, the Meter will automatically switch itself off when the battery voltage becomes too low for reliable operation.

When using rechargeable batteries, the battery icon will not show completely full, even with freshly charged cells. This is due to the fact that rechargeable batteries are only rated at 1.2V per cell compared to 1.5V per cell for alkaline batteries. This indication does not affect battery life. The icon will simply sit at the ¾ full mark for a longer period of time.

3.5. Battery Saver Functions

The Aquameter® is designed to switch off automatically if you do not touch any of the keys for 30 minutes. The only exception to this is if you have activated the Automatic Data Logging feature. In this case, the Meter will continue to operate until either the memory is full or the batteries go flat.

The display on the Aquameter® incorporates a white backlight to improve visibility in low-light conditions. As on a mobile phone, the backlight switches on each time a key is pressed, and stays on at full brightness for 15 seconds. After 15 seconds, the backlight will fade to half brightness. After a further 15 seconds the backlight will switch off.

During normal operation, if you want to activate the backlight without changing the Meter function, simply press the **ESC or OK** key.

4. Overview of the Operating System

The operating software in the Aquameter® has been designed for simple, intuitive use. Similarly, a great deal of development work has been put into simplifying and automating the calibration procedures in the Aquameter® in order to allow normal field operatives (as opposed to trained lab technicians) to achieve quick and accurate results.

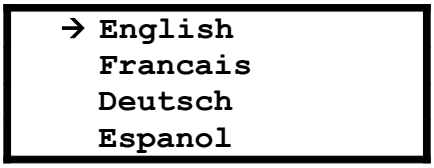
If you are used to operating a mobile phone or programming audio/visual equipment using a remote control, you should feel at home with the familiar up/down left/right arrow shaped navigation keys and central **OK** key.

The tree structure behind the **MENU** key should also be very familiar. Each item on the menu leads to a sub menu and then either onto further menus or final choices. Each branch of the menu system is navigated using the arrow keys. At each point, selections can be made by either pressing the **OK** key or the right arrow key.

To reverse along a branch of the menu system, use the **ESC** (escape) key or left arrow key. After a short time, you should be able to navigate around the entire menu system at speed using just the four arrow keys. If, at any time, you leave the Meter in one of the sub-menu screens, it will automatically back out to the main operating screen after 15 seconds.

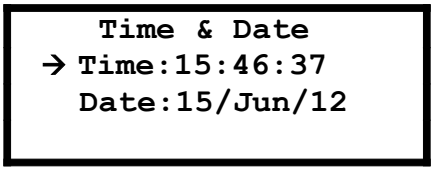
4.1. Initial Switch On, Language and Clock Setup

To switch the meter on or off, briefly press the red key. **Do not hold it down.** The meter contains a clock and is capable of operating in several different languages. When switching on for the first time, you must select an operating language and set the clock. The first screen you will see is the Language Selection Screen.



To select a language, move the cursor down the list using the down arrow key. To enter your selection, press the **OK** key or the right arrow key.

The next screen to be displayed is the Time & Date Setting Screen.



To set the time and date, use the arrow keys to move the cursor around the screen. Use the up and down arrow keys to adjust values. When the time and date are correct, press the **OK** key. Don't worry if you make a mistake first time round. You can easily get back to these screens later through the **MENU** key.

5. Fitting Electrodes

There are several different types of Optical Electrodes designed for use with the AP-Lite. The Aquameter® recognises the socket on the AP-Lite as Aux1 (axillary socket 1). Other models of Aquaprobe® have up to six Aux sockets.

Before the AP-Lite can be used, an Electrode must be fitted and correctly assigned. To fit an Electrode, first remove the sleeve from the AP-Lite by unscrewing at the blue split-line. Apply a small amount of silicone grease (supplied with the AP-Lite) to the threaded section and the O-ring of the AUX Electrode (see photograph). **ENSURE NO GREASE IS APPLIED TO THE GOLD CONTACTS**.

Using a clean cloth or tissue paper, polish the gold contacts ensuring they are completely clean. Carefully insert the electrode into the socket and tighten firmly **by hand** until the O-ring is completely compressed. **Do not over-tighten or use any tool (such as pliers).**

After fitting the Electrode, replace the Sleeve and ensure the Sleeve End Cap is fitted.

5.1. Socket Assignment

After installation, it is essential to connect the AP-Lite to an Aquameter® and assign the new electrode type to the AUX Socket. On the Aquameter®, press the MENU key, then select Setup & Install followed by Socket Assignment. When the Socket Assignment option has been selected, the following screen will be displayed.

```
 SOCKET ASSIGNMENTS
→1:EMPTY  | 4:N/A
 2:N/A    | 5:N/A
 3:N/A    | 6:N/A
```

Move the cursor to the right by pressing the right arrow key. When the cursor has moved to the right of the number 1, use the up and down arrow keys to select the appropriate electrode type. The table below show the available electrode options and the selection that should be made on this screen:

5.2. AP-Lite Optical Electrodes

Electrode Part No.	Function	Aquameter® Selection
2000-TURB	Turbidity	TURB
2000-CPHYLL	Chlorophyll	Cphl
2000-BGA-PC	Phycocyanin (Blue-Green Algae PC)	BGA-PC
2000-BGA-PE	Phycoerythrin (Blue-Green Algae PE)	BGA-PE
2000-RHOD	Rhodamine WT Dye	Rhod
2000-FSCEIN	Fluorescein Dye	Fcein
2000-REFOIL	Refined Oil	R-OIL
2000-CDOM	CDOM/FDOM	CDOM

When the desired electrode type is showing, move the cursor back to the left of the socket number then press OK to send the selection to the AP-Lite. The socket assignments are stored in the AP-Lite. If you press the ESC key whilst in this screen, any changes you have made will not be transferred to the AP-Lite.

5.3. Initial Calibration

When a new electrode is fitted **it is essential to carry out a full two-point calibration prior to use**. Refer to the relevant section in this manual for detailed calibration instructions of your new Electrode type.

YOUR NEW ELECTRODE WILL NOT GIVE SENSIBLE READINGS UNTIL IT HAS BEEN FULLY CALIBRATED.

Please note: changing an AUX Socket assignment will clear all the calibration data for that socket.

6. Connecting the AP-Lite to an Aquameter®

The AP-Lite is designed to connect to the Aquameter® using an EX-2000 Aquaprobe® Extension Cable. The Aquaprobe® Extension Cable features high-pressure metal connectors, which incorporate several O-ring seals at the Probe end. Prior to first connection, the seals must be lubricated using the silicone grease provided.

Apply a generous smear of grease to the O-rings where indicated above. Be careful not to get any grease inside the connector near the gold contacts. A small smear of grease should also be applied to the thread on the Probe to allow easy tightening of the collar.

To connect the Extension Cable to the AP-Lite, align the white dot on the AP-Lite with the **◄AQUAREAD** logo on the plug body, then press the plug into the socket and tighten the retaining collar fully. **DO NOT TWIST THE CONNECTOR BODY WITH RESPECT TO THE PROBE**. Once the AP-Lite has been connected to the Extension Cable, the Aquameter® can be connected.

Always ensure the Aquameter® is switched off prior to connecting or disconnecting an AP-Lite. Align the **◄AQUAREAD** logo on the plug body with the red on/off switch on the Aquameter®, then press the plug into the socket and tighten the retaining collar.

Once the AP-Lite is connected to the Aquameter®, switch the Meter on by pressing the red on/off switch.

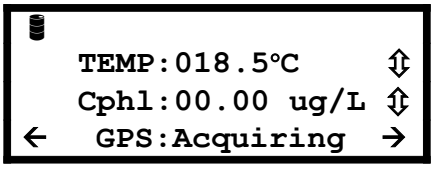
The Aquameter® should detect the Probe and automatically start displaying readings.

7. Taking Measurements

Prior to first use after fitting a new Electrode, it is essential to assign the new electrode type to the AUX Socket and to calibrate it. See section 5. Fitting Electrodes for full details.

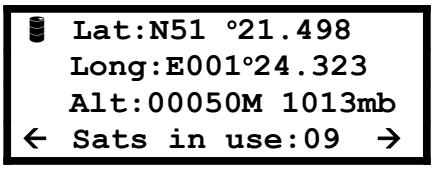
Ensure the Sleeve and Sleeve End Cap are fitted. Switch the Aquameter® on and immerse the AP-Lite in the sample water, making sure that the water level covers the bottom row of holes in the Probe sleeve and preferably comes up as far as the blue line on the Probe.

If the AP-Lite is connected correctly, the meter will read the Probe's serial number and model type. Initial Probe readings will then be displayed on the meter's screen along with the current GPS status. The initial data screen for the GPS Aquameter® in conjunction with the AP-Lite with a chlorophyll electrode fitted is shown below.



Left/right arrows at the bottom corners of the screen indicate another data screen is available. To access the GPS Status screen, simply press either the left or right arrow keys. Any value that is out of range or unavailable will be displayed as dashes.

The GPS Status screen is shown below.



If an asterisk (*) character is flashing just below the battery symbol, this indicates that Auto Data Logging is switched on. See Automatic Data Logging in section 8.

7.1. Trend Indication

To the right of each reading, a trend indication is given. This consists of either an upwards facing arrow (which indicates the numeric value of the reading is rising), a downwards facing arrow (which indicates the numeric value of the reading is falling) or a two-headed arrow, which indicates a stable reading. Readings are judged to be stable when the variation over a ten second period drops below 1%.

7.2. Temperature Measurement and Compensation

The fluorescent properties of all solutions change with the solution's temperature. In addition, the response of the measuring electrodes change with temperature. It is a fundamental, practical requirement in the field of water quality monitoring that test measurements taken at different temperatures can be compared.

During calibration of the optical electrodes, variations in the calibration solutions due to temperature are automatically compensated for. During the measurement, temperature is automatically compensated for.

Remember, temperature is measured in the AP-Lite by a sensor located in the blue socket block. The temperature of the liquid being measures is quickly conducted to the socket block by the Probe's Sleeve. The deeper the Probe Sleeve is submerged, the quicker the temperature will stabilise. See section 2.2 AP-Lite Minimum and Maximum Insertion Levels for more details.

7.3. GPS Reception

The Aquameter® (AM-200) contains a built-in GPS receiver and antenna. The antenna is situated at the top of the case, just behind the AQUAREAD Logo. For optimum signal reception, the antenna must be able to 'see' a reasonably large amount of the sky. **The GPS receiver will not work indoors or when shielded from the sky by any solid structure.**

After switch-on, the GPS receiver will automatically start to search for satellites. During this phase, the message **GPS:Acquiring** will be shown on the bottom line of all the screens. As soon as three satellites are acquired, two dimensional position (no altitude) will be calculated and the message **GPS:2D POS** will be shown on the bottom line of the screens.

Once a fourth satellite is acquired, altitude will be calculated and **GPS:3D POS** will be shown on the bottom line of the screens. With a good view of the sky, position should be calculated within ninety seconds of switch-on. To see your geographic position and the number of satellites in use, use the left or right arrow keys to scroll to the Position page.

If you switch the meter on indoors, then carry it outside after several minutes, there may be a considerable delay in acquiring satellites. In this case, switch the meter off, then back on again to reset the acquisition process.

8. Memory Mode

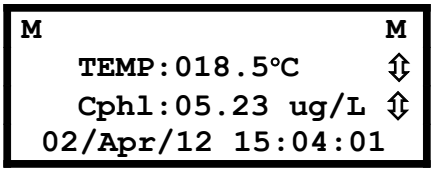
8.1. Manually Saving Readings

When you are happy that the readings are stable, press the **M+** key to snapshot the readings along with the time, date, GLP (calibration) data and position (GPS models only).

As each reading is saved, a numeric memory location 'Tag' will be briefly displayed which you can note down. This Tag can be used to identify readings at a later date, both on the Aquameter® and when using AquaLink software.

8.2. Recalling and Viewing Saved Readings

To recall your readings, press the **MR** key. On entering Memory Recall mode, the most recent Tag and set of readings are displayed first along with the date and time the readings were taken shown on the bottom line of the screen.



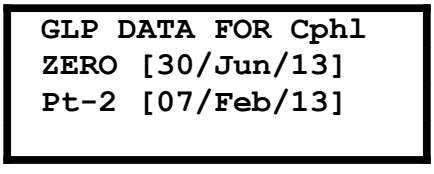
During Memory Recall, an 'M' is flashed in the top left and right corners of the screen alternatively with an up/down arrow and a left/right arrow. This is to indicate that the Meter is in Memory Recall mode and that other screens can be accessed using the arrow keys.

To see earlier readings, press the up arrow key. Just before each set of readings is displayed, the Tag will be briefly displayed. To view all the parameters within one set of readings, use the left/right arrow keys as described earlier. To exit Memory Recall mode, press the **ESC** key. If no key is pressed for 30 seconds, Memory Recall mode will be automatically cancelled.

8.3. Recalling GLP Data

Each time a set of readings is added to memory, the date of the last successful calibration of each electrode is also appended. This is called GLP (Good Laboratory Practice) Data.

To view the last successful calibration date for the electrode for any particular stored reading, enter Memory Recall mode, scroll to the reading you are interested in using the up/down keys, then press the **MENU** key. The screen below will be displayed.



This example shows that the electrode type fitted was Chlorophyll and the last successful calibration, **prior to the recorded reading being taken**, was June 30th for the Point 1 and February 7th for Point 2. If the date field is dashed (==/===/==), this means the electrode had not been calibrated at that point.

To exit this screen press the **ESC** key or the left arrow key.

8.4. Clearing the Memory

The memory within the Aquameter® is capable of storing over 1000 full sets of readings.

To clear the entire memory, switch the Meter off, hold down the **M+** key, then switch the Meter back on. A screen will be displayed asking you to confirm your request. Press OK to clear the memory or ESC to cancel and return to normal operation.

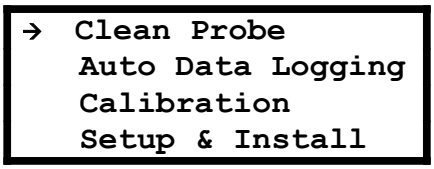
8.5. Automatic Data Logging

If you want to save readings on a regular basis, in order, say, to check water quality at a certain location over a period of time, you can set the Meter to record readings automatically.

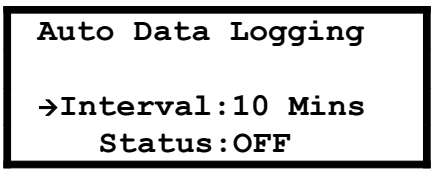
Readings can be logged for short periods with the Meter permanently displaying readings, or for much longer periods in a Low Power Mode, where the Meter switches itself off between readings in order to extent the battery life.

Please note: Low Power Logging Mode is only available on Meters running version 4.54 software and above.

To activate Automatic Logging, press the **MENU** key. The Main Menu screen will be displayed. Please note, the first item on the menu, 'Clean Probe', will only be active if an Aquaprobe® AP-7000 (which has an automatic cleaning system) is connected.



Select **Auto Data Logging** by pressing the down arrow key then the right arrow key or the **OK** key. The Auto Data Logging screen will be displayed.



Using the arrow keys to navigate, set the desired logging interval anywhere between 1 and 90 minutes.

To select permanent display logging mode, set the Status to **ON**. To select Low Power logging mode, set the Status to **LOW POWER**.

To activate the selected logging mode, press the **OK** key then revert back to the normal operation screen from the Main Menu by pressing the left arrow key.

To indicate that Auto Data Logging is switched on, an asterisk (*) character will flash on and off just below the battery symbol on all the main reading screens.

If permanent display logging mode was selected (Status set to **ON**), the Meter will record a full set of data automatically at the set rate until either the memory is full or the batteries go flat.

If Low Power Logging Mode was selected (Status set to **LOW POWER**), the Meter will switch itself off 30 seconds after your last key-press. Thereafter it will switch back on at the set rate, stay on for 30 seconds, log the data, then switch back off again. This will be repeated until either the memory is full or the batteries go flat.

If you press any key while the Meter is off between readings in low power mode, the Meter will switch back on. If no further key is pressed, the Meter will switch back off again after 30 seconds and resume Low Power Mode.

You can cancel Auto Data Logging at any time by going back into the screen above and setting the **Status** to **OFF**. Auto Data Logging will also be cancelled if you switch the Meter off manually.

8.6. Battery and Memory Duration in Low Power Logging Mode

Low Power Logging Mode is specifically designed for long term data logging. In order to estimate battery life and memory usage, the following table can be used.

The battery life figures quoted below are based on fresh, good quality alkaline batteries at a Meter temperature of 21°C or over. Colder Meter temperatures will drastically reduce the battery life. For example, at 5°C, the battery life will be approximately half that quoted.

Logging Rate	Battery Life (at 21°C)	Memory Duration
90 mins	38 Days	66 Days
60 mins	36 Days	44 Days
45 mins	34 Days	33 Days
30 mins	30 Days	22 Days
15 mins	20 Days	11 Days
5 mins	10 Days	3.6 Days
1 min	2 Days	17 Hours

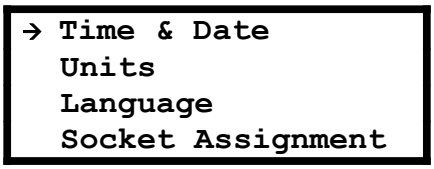
So, it can be seen that although the Meter has a maximum data capacity of 66 days, for logging rates above 45 minutes, fresh batteries would need to be fitted after approximately one month in order to make use of the Meter's full memory capacity.

Conversely, logging rates below 45 minutes will fill the Meter's memory on a single set of batteries (at 21°C or greater).

Useful Tip: If you want GPS data logged in association with your other data, ensure the Meter is positioned face up with a clear view of the sky.

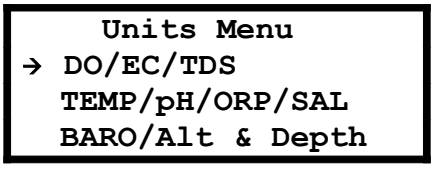
9. Setup & Install

To alter the way the Aquameter® displays readings, press the **MENU** key to get to the Main Menu, then choose **Setup & Install.** The Settings Menu will be displayed. Please note, many of the setup options do not apply to the AP-Lite and are only used when the Aquameter® is connected to other models of Aquaprobe®.



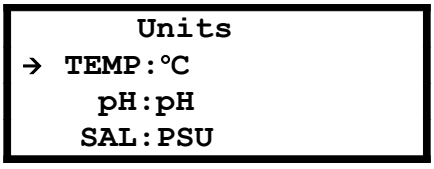
9.1. Setting Units of Measurement

From this screen choose **Units**. The Units Menu will be displayed. Remember, you can use just the arrow keys to navigate through the branches of the menus. You don't need to press **OK** or **ESC** at each level.



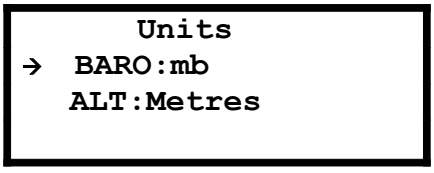
At the Units Menu, you have a choice of which units you want to adjust. Choose the first line if you want to adjust Dissolved Oxygen, Electrical Conductivity or TDS (not applicable to the AP-Lite). Choose line 2 if you want to adjust Temperature, pH, ORP or Salinity (Temperature only applicable to the AP-Lite). Finally, line 3 will give access to Barometric Pressure, Altitude and Depth settings (depth not applicable to the AP-Lite).

Selecting the second line of the Units Menu will display the following screen.



The only valid AP-Lite option on this screen allows you to change the temperature display between °C and °F.

Selecting the third line of the Units Menu will display the following screen.



The first line allows you to choose between displaying Barometric pressure in millibars (mb) or in mm of mercury (mmHg).

The second line allows you to choose between displaying altitude in metres (M) or feet (F).

10. About Calibration

Calibration is a very important part of successful water quality measurement and should be carried out regularly as detailed in the following section of this manual. A great deal of development work has been put into simplifying and automating the calibration procedures in the Aquameter® in order to allow normal field operatives (as opposed to trained lab technicians) to achieve quick and accurate results.

The AP-Lite is designed to be calibrated and operated **with the Probe Sleeve and Sleeve End Cap fitted.**

The Probe Sleeve and End Cap form an integral, working part of the Probe's measurement system, and MUST be fitted during calibration and measurement for correct operation.

10.1. Precautions During Calibration

- Use a non-fluorescent container for calibration solutions. **Some plastics may fluoresce and interfere with calibration.**
- Use a reasonably deep container for calibration in order to ensure a fast temperature response. The calibration solution should preferably be up to the blue line on the Probe. See section 2.2 AP-Lite Minimum and Maximum Insertion Levels for more details.
- Avoid strong artificial lighting during calibration. The alternating nature of artificial lights (especially fluorescent tubes) can interfere with calibration.
- Avoid strong sunlight when calibrating the Refined Oil Electrode. The UV in the sunlight can interfere with calibration.
- **Always be sure that the Probe Sleeve and End Cap are fitted during calibration.**
-

10.2. Calibration Error Messages

If the Aquameter® detects a problem with either the AP-Lite or the calibration solution during the calibration procedure, an error will be indicated. The chart below shows the possible errors and how to correct them.

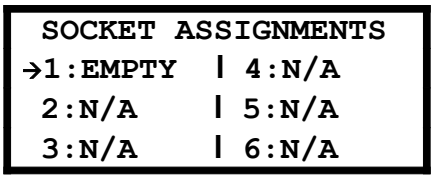
Error Message	Problem	Action
BATTERIES TOO LOW	Battery Voltage is too low for reliable calibration	Replace the batteries
NO PROBE RESPONSE	The Probe is not responding	Check connections / cycle power
READINGS UNSTABLE	Readings did not stabilise within the expected period	Top up / replace the calibration solution. Allow longer for stabilisation.
OUT OF CAL RANGE	Readings are outside calibration limits (can be caused by low level / incorrect calibration solution). Or the Probe Sleeve is not fitted	Top up / check calibration solution is correct type. Ensure the Probe Sleeve is fitted
OUT OF TEMP RANGE	Temperature is outside 5°C – 40°C limit	Warm / cool the calibration solution
CAL ZERO FIRST	You are trying to calibrate an upper calibration point on an optical electrode without first calibrating the zero point.	Calibrate the zero point first, then without switching the Aquameter off, calibrate the upper point.

If the corrective actions shown above for 'READINGS UNSTABLE' or 'OUT OF CAL RANGE' errors do not work, thoroughly clean the Probe and try again. If the 'OUT OF CAL RANGE' error persists, reset the calibration values to Factory Defaults (by deselecting the electrode type then re-selecting it) then try again.

Remember: **The Probe Sleeve and End Cap form an integral, working part of the Probe's measurement system, and MUST be fitted during calibration and measurement for correct operation.**

10.3. Resetting to Factory Calibration Defaults

In some cases, if there has been a serious calibration error, the easiest way to rectify the situation is to reset the Electrode to its factory defaults. To do this, first bring up the Socket Assignment screen:



Move the cursor arrow to the right and change the electrode type to EMPTY. Press OK.

Next, re-enter the Socket Assignments screen and re-select your electrode type. This will reset the calibration to default values.

Once factory calibration defaults have been restored, you **must** carry out a **full two-point calibration** of the Electrode.

10.4. Calibration Data Storage

The AP-Lite contains its own microprocessor and memory. All calibration data, including the GLP data, is stored within the Probe's memory. When a Probe is connected to a Meter, this data is transferred for display and logging.

This is a major advantage and allows you to use a variety of different Probes with a single Meter, without the need for re-calibration.

10.5. Calibration Reports

At the conclusion of each successful individual electrode calibration, a single line Calibration Report is displayed. This report contains the raw output of the electrode under calibration, uncorrected for temperature.

These values can be recorded and used to track the performance and ageing of the individual electrodes. Please note however, in order to maximise the value of this feature, all calibrations must be performed at the same temperature otherwise the recorded values will not be comparable over time.

11. Electrode Calibration and Maintenance

All Aquaread® Optical Electrodes are incredibly sensitive. For example, the Turbidity electrode is capable of measuring between 0 and 3000NTU with an internal resolution of greater than 0.1NTU. This means that the electrode is able to detect changes in turbidity that are less than 0.003% of the full range! The other optical electrodes have a similar level of sensitivity.

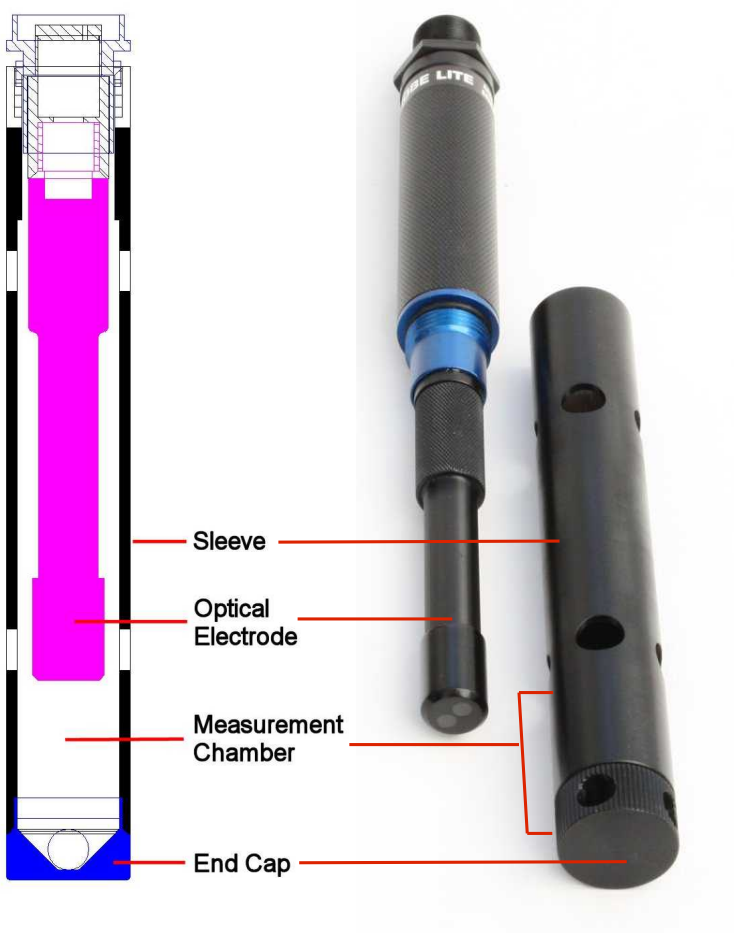
It follows, therefore, that in order to provide stable, repeatable readings, the environment in which the measurements are made must be completely stable and repeatable.

The AP-Lite is constructed with a matt black aluminium sleeve and end cap that enclose the sensing electrode and provide a closed, constant condition, non reflective measurement chamber.

This is essential for the correct calibration and operation of all types of optical electrodes.

In order to obtain consistent results, the measurement chamber created within the AP-Lite must remain physically constant during both calibration and measurement.

Both the Sleeve and Sleeve End Cap must be fitted during calibration and measurement including when using the AP-Lite with the optional Flow Through Cell (Flowcell).



If the optical electrode is calibrated under one set of conditions then used to measure under another set of conditions, the readings will naturally be erroneous, especially at low concentrations.

A perfect example of this is calibrating with the end cap removed then measuring with the end cap fitted (or vice-versa). By changing the physical characteristics of the measurement chamber, you also change the calibration and response of the electrode.

Another particular problem when trying to measure very low concentrations is air in the form of both visible and microscopic bubbles. These act like tiny prisms and can refract and reflect both the excitation light and the return signal being measured. The photograph to the right was taken in a calibration tube after fresh water was poured in. The bubbles are clearly visible in the light beam.

11.1. Top Tips for successful measurements using optical electrodes

- Always keep the measurement chamber and electrode lenses clean.
- Always fit the sleeve and end cap during both calibration and measurement.
- Always allow the readings to settle completely during both calibration and measurement.
- Always try to eliminate air bubbles by agitating the Probe after insertion both during calibration and measurement.
- Always calibrate and zero the electrode as close to your sample temperature as possible. This is especially important with the Ref-Oil electrode.
- Always zero the electrode just prior to use in clean water (bottled still mineral water is ideal). This is also especially important with the Ref-Oil electrode.

11.2. Electrode Calibration Sequence

Optical electrodes feature either two or three point calibration, dependent upon the type. In all cases however, the lower calibration points is ZERO.

When calibrating any optical electrode, **the Zero point must be calibrated first.**

If you are performing a two or three point calibration, all calibration points must be calibrated within the same calibration session (i.e. without turning the Aquameter® off or disconnecting the Aquaprobe).

If you attempt to calibrate an upper calibration point without first calibrating the ZERO point, a calibration error will occur.

11.3. 2000-TURB Turbidity Electrode

Turbidity can be measured by the AP-Lite using the optional 2000-TURB optical electrode.

This electrode employs a Nephelometric technique in accordance with ISO 7027, which uses Formazin as a reference standard. The Aquameter® displays turbidity in Nephelometric Turbidity Units (NTU) which are nominally equivalent to Formazin Turbidity Units (FTU).

Turbidity can be calibrated with either Formazin Turbidity Standards or Suspended Polymer Turbidity Standards, depending upon your preferred turbidity reference. **Be aware, these two standards will give very different results**. Factory calibration is carried out with a 1000 NTU Stabilised Formazin Turbidity Standard in accordance with ISO 7027.

11.3.1. About Turbidity

Turbidity is a measurement of the light scattering properties of solids suspended within a liquid and is therefore an **indirect** measurement of clarity. Turbidity is not a direct measurement of suspended solids, clarity or colour.

Particle size relative to the wavelength of the transmitted light, particle shape and refractive index modify the distribution of scattered light. Sample colour, (particularly dark colours) can also reduce a certain portion of the scattered light by varying degrees.

Combined, these effects result in wide variability in the distribution and intensity of light scattering from a turbid water sample. As a result, different combinations of particle shape, size, colour and refractive index can produce similar turbidity effects.

By contrast, changing only the incident light wavelength and detector distance can dramatically change the measured turbidity of a given sample. As a result, different model sensors from different manufacturers can measure different turbidity values for the same sample. This highlights the qualitative nature of turbidity measurements.

Integrated monitoring programs, where turbidity measurements from different locations are to be compared, **must** use a single model of sensor and maintain a strict QA and calibration program to accurately characterise, compare, and interpret observed turbidity values.

11.3.2. Precautions During Use

In common with all other submersion type Turbidity Probes, air bubbles and stray reflections can be a problem when trying to measure low turbidity values. In order to avoid air bubbles, keep the Turbidity electrode clean, and agitate the Probe after submersion to dislodge any air bubbles which may be clinging to the lenses. In order to maintain a common reflective pattern between calibration and use, **always calibrate and measure turbidity with the protective Sleeve End Cap fitted**.

11.3.3. Negative Turbidity Readings

When a Probe is deployed in clean/clear water and negative turbidity readings occur, the cause is usually an erroneous zero point calibration, caused either by contaminated calibration solution, aeration or changes in the measurement chamber between zeroing and deployment.

It follows that if the Probe has been zeroed in a solution that has a turbidity greater than true zero, subsequent measurements taken in a less turbid sample will be displayed as negative. If you experience negative turbidity readings, thoroughly clean the Probe then re-zero in completely clean water. Still, bottled mineral water is recommended for zeroing the electrode as it is cheap and readily available. **Never use sparkling or carbonated water.**

If you still experience negative turbidity readings and you are certain that your zero calibration solution is completely clear water, the problem is almost certainly aeration, i.e. air in the form of both visible and microscopic bubbles. These act like tiny prisms and can refract and reflect both the excitation light and the return signal being measured.

The photograph to the right was taken in a calibration bottle after fresh water was poured in. The bubbles are clearly visible in the light beam. This level of aeration will register the equivalent of around 5NTU as each bubble is seen as a solid particle.

If your zero calibration water is aerated, allow it to stand for a while until the air has all dispersed, then re-insert the Probe and re-calibrate. **Do not leave the Probe sitting in aerated water, the bubbles will simply cling to the inside surface of the Probe and make the problem worse.**

11.3.4. Calibrating the Turbidity Electrode

The Probe Sleeve and Sleeve End Cap form an integral, working part of the Probe's turbidity measurement system, and MUST be fitted during calibration and measurement for correct operation.

11.3.5. Calibration Points

Turbidity electrodes have three calibration points. Careful calibration is essential in order to ensure consistent and reliable results across the full measurement range.

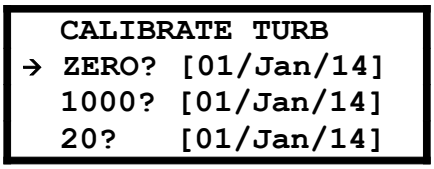
When a turbidity electrode is first installed, **it MUST be calibrated at three points** in order to establish the individual electrode's slope. **The Zero NTU point must always be calibrated first, followed by the other two points, all within the same calibration session (i.e. without turning the Aquameter® off).**

The Turbidity electrode should subsequently be Zeroed (calibrated at the Zero NTU point) before each day's use. A three point calibration should be carried out once a month to ensure optimum accuracy.

11.3.6. Turbidity Zero Point Calibration

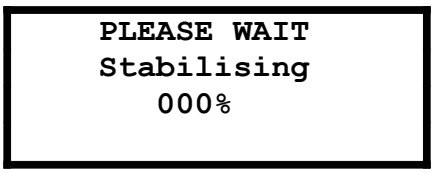
To calibrate the Turbidity zero point, follow these steps:

1. Fill a calibration bottle with clean water (bottled still mineral water is recommended), wash the Probe in clean water, then drop the Probe in all the way. **The Sleeve End Cap must be fitted**. Gently agitate the Probe several times in order to remove any air bubbles that may be clinging to the Turbidity electrode.
2. Switch the Aquameter® on and wait until the temperature and turbidity readings are stable. If the turbidity reading is very high, there are probably air bubbles adhering to the lenses. Agitate the Probe to remove.
3. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF - 104ºF).
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.



The dates shown to the right of each point are the dates of the last successful calibration.

5. Select ZERO. The screen will change to:



The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

The Calibration Report on the top line displays the voltage output from the Turbidity Electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

11.3.7. Verifying the Zero Calibration

An accurate zero point calibration is essential to the correct operation of the turbidity electrode. The zero point calibration can sometimes be erroneous due to small air bubbles or microscopic suspended solids in the calibration solution. For this reason, it is important to verify the zero point calibration before proceeding to calibrate the other points.

After calibrating the zero point, remove the Probe from the calibration bottle then reinsert, agitate and allow the reading to settle. Check the turbidity reading is within +/- 1NTU of zero. If not, re-calibrate the zero point.

11.3.8. Calibrating the Turbidity 20 NTU & 1000 NTU Points

When calibrating the 20 NTU and 1000 NTU points, **the Zero point must be calibrated first within the same calibration session (i.e. without turning the Aquameter® off)**.

Remove the Probe from the zero calibration bottle, rinse thoroughly in fresh water (if using RapidCal solution), shake off any excess and dry the outer sleeve with a soft cloth.

Gently invert, **do not shake,** a bottle of **20 NTU or 1000 NTU Stabilised Formazin Turbidity Standard** solution (available from most lab supply companies) several times to thoroughly mix.

Formazin Turbidity Standard is hazardous to your health. Be sure to handle with care and to read and comply with all health and safety advice.

Three-quarters fill a calibration bottle with the solution and drop the Probe in all the way. Again, agitate and swirl the Probe and bottle several times in order to remove any air bubbles that may be clinging to the Turbidity electrode.

Follow the procedure detailed above for Zero point calibration as far as step 4, then select either 20 or 1000, dependant upon the solution the probe is in. Wait while the Meter stabilises and calibrates.

After successful calibration, the ‘Calibrating 100%’ screen will be displayed along with the Calibration Report, which will show the voltage output from the Turbidity Receiver Electrode in millivolts (mV). Press the **OK** key to continue.

Rinse the probe thoroughly then repeat this procedure for the third point.

11.3.9. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to Calibration Error Messages in section 10 for error message handling.

11.3.10. Lens and Sleeve Maintenance

On a daily basis, the lenses on the electrode should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray reflections.

Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged. The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

11.3.11. Turbidity References

The summary on turbidity at the beginning of this section is based on information from the following sources.

- National Field Manual For the Collection of Water-Quality Data, Turbidity section 6.7, Revised by Chauncey w. Anderson, USGS, 2004.
- Environmental Instrumentation and Analysis Handbook, Randy D. Down and Jay H. Lehr, Chapter 24 Turbidity Monitoring, John Downing, John Wiley & Sons, Inc. 2005
- Turbidity Science, Michael J. Sadar, Hach Company 1998.
- Guidelines and Standard Procedures for continuous Water-Quality Monitors: Site Selection, Field Operation, Calibration, Record Computation and Reporting, Richard J. Wagner et al., USGS Reston VA Meeting, 2000.

11.4. 2000-BGA-PC Freshwater Blue-Green Algae (phycocyanin) Electrode

Freshwater Blue-Green Algae (BGA-PC) can be measured by the AP-Lite using the optional 2000-BGA-PC optical electrode. The BGA-PC has a minimum detection level of 200

11.4.1. Principle of Operation

The 2000-BGA-PC optical electrode is a submersible, fixed response fluorometer, which provides excitation at 590nm and detects any resultant fluorescence above 655nm.

The electrode induces the phycocyanin to fluoresce, then measures the longer wavelength light which is emitted as a result of the fluorescence process.

11.4.2. Limitations of Use

Determination of BGA-PC in the field using fluorescence measurement techniques will never be as accurate as measurements made in a lab using either cell counting or analysis of molecular phycocyanin after its extraction from cells.

Factors adversely affecting accuracy include:

- Interference from other microbiological species and compounds, which fluoresce at similar wavelengths.
- Differences in the fluorescent response between various species of BGA.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity.

Fluorescence measurement techniques are ideal for researchers who are interested in detecting the presence or absence of a specific substance and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations.

Fluorescence measurement techniques are not ideal for quantitative measurement. **In order to obtain more accurate results, data obtained with a fluorometer in the field should be post-calibrated with data from standard laboratory analysis of grab samples acquired during the study.**

11.4.3. Calibrating the BGA-PC Electrode

The BGA-PC electrode has two calibration points. Careful calibration is essential in order to ensure consistent and reliable results.

When a BGA-PC electrode is first installed, **it MUST be calibrated at both points** in order to set the electrode's relative sensitivity and establish its slope.

Subsequently, a single point (Zero) calibration should be carried out at the beginning of each day's use, as close to the measurement temperature as possible. Full two-point calibration should be carried out every few months.

11.4.4. Calibration Solution Preparation

In order to 'calibrate' (actually, set the relative sensitivity) of the BGA-PC electrode, a 100µg/L calibration solution of fluorescent dye known as Rhodamine WT should be used. This is exactly the same calibration solution that is recommended for calibration of the RHOD electrode.

Please note: there is no direct correlation between Rhodamine concentration and the number of BGA-PC cells/mL. Rhodamine is used as a convenient dye for setting the sensitivity of the sensor. The subsequent display of BGA-PC in terms of cells/mL is a generalisation based on research and experience. The only way to obtain a true value in terms of cells/mL is to correlate the values from the Probe to quantitative data that has been obtained by laboratory analysis of grab samples. See previous 'Limitations of Use' section.

The 100µg/L calibration solution should be freshly prepared by serial dilution from 200g/L standard using deionised water. The following Rhodamine WT standard is recommended:

Part number: 70301027
Description: Rhodamine WT Liquid
Supplier: Keystone Europe Ltd.
Contact: http://www.dyes.com

Be sure to handle chemicals with care and to read and comply with all health and safety advice.

11.4.5. Serial Dilution

The recommended Rhodamine solution is supplied as a 20% or 200g/L solution, dilution of the stock solution should be carried out as follows.

200g/L stock → 100µg/L is recommended to be done as a two step dilution procedure.

Step 1: weigh out 0.5g of 200g/L stock solution in a weigh boat and add this to 1L of deionized water in a volumetric flask, use some of the water from the 1L flask to rinse the weigh boat so no stock Rhodamine remains on the boat. Put a lid on the 1L flask and invert 10 times.

This step results in a 1 in 2000 dilution of the stock. At this point the 1L flask will contain a 100mg/L solution.

Step 2: Transfer 1ml of the 100mg/L solution to a 1L volumetric flask and top up to 1L with deionized water. Put a lid on the 1L flask and invert 10 times.

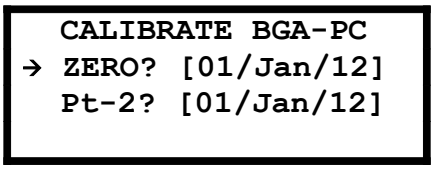
This step results in a 1 in 1000 dilution of the solution from step 1. The concentration of this solution is 100µg/L. This solution can now be used as Pt-2 calibration of the BGA-PC sensor.

The dilute solution can be stored in a dark bottle in a refrigerator for up to five days. After that time it must be discarded.

11.4.6. Zero Point Calibration

To calibrate the zero point, follow these steps:

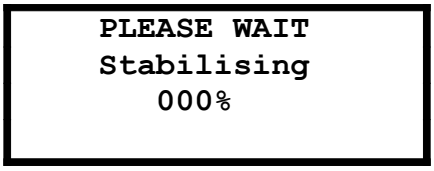
1. Fill a calibration bottle with mineral water, wash the Probe in mineral water, then drop the Probe in all the way. **The Sleeve End Cap must be fitted**. Gently agitate the Probe several times in order to remove any air bubbles that may be clinging to the electrode.
2. Switch the Aquameter® on and wait until the temperature and BGA-PC readings are stable. If the BGA-PC reading is very high, there are probably air bubbles adhering to the lenses. Agitate the Probe to remove.
3. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF - 104ºF).
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.



Calibration point 2 (Pt-2) is the upper calibration point.

The dates shown to the right of each point are the dates of the last successful calibration.

7. Select ZERO. The screen will change to:



The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

The Calibration Report on the top line displays the voltage output from the electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

11.4.7. Calibrating Point 2

Remove the Probe from the calibration bottle, shake off any excess water then dry the outer sleeve with a soft cloth.

Fill a calibration bottle with freshly mixed Rhodamine calibration solution and drop the Probe in all the way. Again, agitate the Probe several times in order to remove any air bubbles that may be clinging to the electrode.

Follow the procedure detailed above for Zero point calibration as far as step 4, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the 'Calibrating 100%' screen will be displayed along with the Calibration Report, which will show the voltage output from the electrode in millivolts (mV). Press the **OK** key to continue. The reading on the Aquameter® directly after calibration should be approximately 70,000 cells/mL at 20ºC (this value will vary with temperature).

Calibration is now complete.

11.4.8. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to Calibration Error Messages in section 10 for error message handling.

11.4.9. Lens and Sleeve Maintenance

On a daily basis, the lenses on the electrode should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray fluorescence.

Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged. The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

11.5. 2000-BGA-PE Saltwater Blue-Green Algae (phycoerythrin) Electrode

Salt-water Blue-Green Algae (BGA-PE) can be measured by the AP-Lite using the optional 2000-BGA-PE optical electrode.

11.5.1. Principle of Operation

The 2000-BGA-PE optical electrode is a submersible, fixed response fluorometer, which provides excitation at 520nm and detects any resultant fluorescence above 575nm.

The electrode induces the phycoerythrin to fluoresce, then measures the longer wavelength light which is emitted as a result of the fluorescence process.

11.5.2. Limitations of Use

Determination of BGA-PE in the field using fluorescence measurement techniques will never be as accurate as measurements made in a lab using either cell counting or analysis of molecular phycoerythrin after its extraction from cells.

Factors adversely affecting accuracy include:

- Interference from other microbiological species and compounds, which fluoresce at similar wavelengths.
- Differences in the fluorescent response between various species of BGA.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity.

Fluorescence measurement techniques are ideal for researchers who are interested in detecting the presence or absence of a specific substance and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations.

Fluorescence measurement techniques are not ideal for quantitative measurement. **In order to obtain more accurate results, data obtained with the fluorometer in the field should be post-calibrated with data from standard laboratory analysis of grab samples acquired during the study.**

11.5.3. Calibrating the BGA-PE Electrode

The BGA-PE electrode has two calibration points. Careful calibration is essential in order to ensure consistent and reliable results.

When a BGA-PE electrode is first installed, **it MUST be calibrated at both points** in order to set the electrode's relative sensitivity and establish its slope.

Subsequently, a single point (Zero) calibration should be carried out at the beginning of each day's use, as close to the measurement temperature as possible. Full two-point calibration should be carried out every few months.

11.5.4. Calibration Solution Preparation

In order to 'calibrate' (actually, set the relative sensitivity) of the BGA-PE electrode, an 8µg/L calibration solution of fluorescent dye known as Rhodamine WT should be used.

Please note: there is no direct correlation between Rhodamine concentration and the number of BGA-PE cells/mL. Rhodamine is used as a convenient dye for setting the sensitivity of the sensor. The subsequent display of BGA-PE in terms of cells/mL is a generalisation based on research and experience. The only way to obtain a true value in terms of cells/mL is to correlate the values from the Probe to quantitative data that has been obtained by laboratory analysis of grab samples. See previous 'Limitations of Use' section.

The 8µg/L calibration solution should be freshly prepared by serial dilution from 200g/L standard using deionised water. The following Rhodamine WT standard is recommended:

Part number: 70301027
Description: Rhodamine WT Liquid
Supplier: Keystone Europe Ltd.
Contact: http://www.dyes.com

Be sure to handle chemicals with care and to read and comply with all health and safety advice.

11.5.5. Serial Dilution

The recommended Rhodamine solution is supplied as a 20% or 200g/L solution, dilution of the stock solution should be carried out as follows.

200g/L stock → 8µg/L is recommended to be done as a two step dilution procedure.

Step 1: weigh out 0.5g of 200g/L stock solution in a weigh boat and add this to 1L of deionized water in a volumetric flask, use some of the water from the 1L flask to rinse the weigh boat so no stock Rhodamine remains on the boat. Put a lid on the 1L flask and invert 10 times.

This step results in a 1 in 2000 dilution of the stock, at this point the 1L flask will contain a 100mg/L solution.

Step 2: Transfer 80µl of the 100mg/L solution to a 1L volumetric flask and top up to 1L with deionized water. Put a lid on the 1L flask and invert 10 times.

This step results in a 1 in 12500 dilution of the solution from step 1. The concentration of this solution is 8µg/L. This solution can now be used as Pt-2 calibration of the BGA-PE sensor.

The dilute solution can be stored in a dark bottle in a refrigerator for up to five days. After that time it must be discarded.

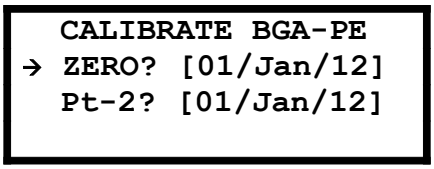
11.5.6. Zero Point Calibration

To calibrate the zero point, follow these steps:

1. Fill a calibration bottle with mineral water, wash the Probe in mineral water, then drop the Probe in all the way. **The Sleeve End Cap must be fitted**.

Gently agitate the Probe several times in order to remove any air bubbles that may be clinging to the electrode.

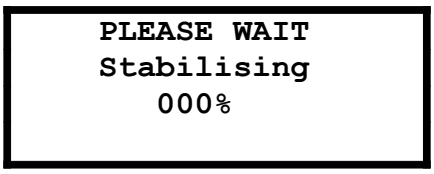
2. Switch the Aquameter® on and wait until the temperature and BGA-PE readings are stable. If the BGA-PE reading is very high, there are probably air bubbles adhering to the lenses. Agitate the Probe to remove.
3. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF - 104ºF).
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.



Calibration point 2 (Pt-2) is the upper calibration point.

The dates shown to the right of each point are the dates of the last successful calibration.

7. Select ZERO. The screen will change to:



The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

The Calibration Report on the top line displays the voltage output from the electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

11.5.7. Calibrating Point 2

Remove the Probe from the calibration bottle, shake off any excess water then dry the outer sleeve with a soft cloth.

Fill a calibration bottle with freshly mixed Rhodamine calibration solution and drop the Probe in all the way. Again, agitate the Probe several times in order to remove any air bubbles that may be clinging to the electrode.

Follow the procedure detailed above for Zero point calibration as far as step 4, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the 'Calibrating 100%' screen will be displayed along with the Calibration Report, which will show the voltage output from the electrode in millivolts (mV). Press the **OK** key to continue. The reading on the Aquameter® directly after calibration should be approximately 200,000 cells/mL at 20ºC (this value will vary with temperature).

Calibration is now complete.

11.5.8. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to Calibration Error Messages in section 10 for error message handling.

11.5.9. Lens and Sleeve Maintenance

On a daily basis, the lenses on the electrode should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray fluorescence..

Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged. The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

11.6. 2000-CPHYLL Chlorophyll Electrode

Chlorophyll can be measured by the AP-Lite using the optional 2000-CPHYLL optical electrode.

11.6.1. Principle of Operation

The 2000-CPHYLL optical electrode is a submersible, fixed response fluorometer, which provides excitation at 470nm and detects any resultant fluorescence above 630nm.

The electrode induces the chlorophyll to fluoresce, then measures the longer wavelength light which is emitted as a result of the fluorescence process.

11.6.2. Limitations of Use

Determination of chlorophyll in the field using fluorescence measurement techniques will never be as accurate as measurements made in a lab using either cell counting or analysis of molecular chlorophyll after its extraction from cells.

Factors adversely affecting accuracy include:

- Interference from other microbiological species and compounds, which fluoresce at similar wavelengths.
- Differences in the fluorescent response between various species of phytoplankton.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity.

Fluorescence measurement techniques are ideal for researchers who are interested in detecting the presence or absence of a specific substance and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations.

Fluorescence measurement techniques are not ideal for quantitative measurement. **In order to obtain more accurate results, data obtained with the fluorometer in the field should be post-calibrated with data from standard laboratory analysis of grab samples acquired during the study.**

11.6.3. Calibrating the CPHYLL Electrode

The CPHYLL electrode has two calibration points. Careful calibration is essential in order to ensure consistent and reliable results.

When a CPHYLL electrode is first installed, **it MUST be calibrated at both points** in order to set the electrode's relative sensitivity and establish its slope.

Subsequently, a single point (Zero) calibration should be carried out at the beginning of each day's use, as close to the measurement temperature as possible. Full two-point calibration should be carried out every few months.

11.6.4. Calibration Solution Preparation

In order to 'calibrate' (actually, set the relative sensitivity) of the CPHYLL electrode, a 500µg/L calibration solution of fluorescent dye known as Rhodamine WT should be used.

Please note: there is no direct correlation between Rhodamine concentration and the concentration of chlorophyll. Rhodamine is used as a convenient dye for setting the sensitivity of the sensor. The subsequent display of chlorophyll in terms of µg/L is a generalisation based on research and experience. The only way to obtain a true value in terms of µg/L is to correlate the values from the Probe to quantitative data that has been obtained by laboratory analysis of grab samples. See previous 'Limitations of Use' section.

The 500µg/L calibration solution should be freshly prepared by serial dilution from 200g/L standard using deionised water. The following Rhodamine WT standard is recommended:

Part number: 70301027
Description: Rhodamine WT Liquid
Supplier: Keystone Europe Ltd.
Contact: http://www.dyes.com

Be sure to handle chemicals with care and to read and comply with all health and safety advice.

11.6.5. Serial Dilution

The recommended Rhodamine solution is supplied as a 20% or 200g/L solution, dilution of the stock solution should be carried out as follows.

200g/L stock → 500µg/L is recommended to be done as a two step dilution procedure.

Step 1: weigh out 0.5g of 200g/L stock solution in a weigh boat and add this to 1L of deionized water in a volumetric flask, use some of the water from the 1L flask to rinse the weigh boat so no stock Rhodamine remains on the boat. Put a lid on the 1L flask and invert 10 times.

This step results in a 1 in 2000 dilution of the stock, at this point the 1L flask will contain a 100mg/L solution.

Step 2: Transfer 5ml of the 100mg/L solution to a 1L volumetric flask and top up to 1L with deionized water. Put a lid on the 1L flask and invert 10 times.

This step results in a 1 in 200 dilution of the solution from step 1. The concentration of this solution is 500µg/L. This solution can now be used as Pt-2 calibration of the CPHYLL sensor.

The dilute solution can be stored in a dark bottle in a refrigerator for up to five days. After that time it must be discarded.

11.6.6. Zero Point Calibration

To calibrate the zero point, follow these steps:

1. Fill a calibration bottle with mineral water, wash the Probe in mineral water, then drop the Probe in all the way. **The Sleeve End Cap must be fitted**. Gently agitate the Probe several times in order to remove any air bubbles that may be clinging to the electrode.

2. Switch the Aquameter® on and wait until the temperature and Cphl readings are stable. If the Cphl reading is very high, there are probably air bubbles adhering to the lenses. Agitate the Probe to remove.

3. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF - 104ºF).
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.

```
  CALIBRATE Cphl
→ ZERO? [01/Jan/12]
  Pt-2? [01/Jan/12]
```

Calibration point 2 (Pt-2) is the upper calibration point.

The dates shown to the right of each point are the dates of the last successful calibration.

7. Select ZERO. The screen will change to:

```
   PLEASE WAIT
   Stabilising
      000%
```

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

```
   Output:2500mV
   Calibrating
      100%
    Press [OK]
```

The Calibration Report on the top line displays the voltage output from the electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

11.6.7. Calibrating Point 2

Remove the Probe from the calibration bottle, shake off any excess water then dry the outer sleeve with a soft cloth.

Fill a calibration bottle with freshly mixed Rhodamine calibration solution and drop the Probe in all the way. Again, agitate the Probe several times in order to remove any air bubbles that may be clinging to the electrode.

Follow the procedure detailed above for Zero point calibration as far as step 4, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the ‘Calibrating 100%’ screen will be displayed along with the Calibration Report, which will show the voltage output from the electrode in millivolts (mV).

Press the **OK** key to continue. The reading on the Aquameter® directly after calibration should be approximately 118 µg/L at 20ºC (this value will vary with temperature).

Calibration is now complete.

11.6.8. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to Calibration Error Messages in section 10 for error message handling.

11.6.9. Lens and Sleeve Maintenance

On a daily basis, the lenses on the electrode should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray fluorescence.

Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged. The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

11.7. 2000-RHOD Rhodamine WT Electrode

Rhodamine WT is a fluorescent red dye that is commonly used in water flow studies and can be measured by the AP-Lite using the optional 2000-RHOD optical electrode.

11.7.1. Principle of Operation

The 2000-RHOD optical electrode is a submersible, fixed response fluorometer, which provides excitation at 520nm and detects any resultant fluorescence above 575nm.

The electrode induces the Rhodamine to fluoresce, then measures the longer wavelength light which is emitted as a result of the fluorescence process.

11.7.2. Limitations of Use

Measurement of Rhodamine in the field using fluorescence measurement techniques can be adversely affected by:

- Interference from microbiological species and compounds, which fluoresce at similar wavelengths.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity.

The normal affects of temperature on the fluorescent response of Rhodamine is automatically compensated for by the electrode.

11.7.3. Calibrating the RHOD Electrode

The RHOD electrode has two calibration points. Careful calibration is essential in order to ensure consistent and reliable results.

When a RHOD electrode is first installed, **it MUST be calibrated at both points** in order to set the electrode's relative sensitivity and establish its slope.

Subsequently, a single point (Zero) calibration should be carried out at the beginning of each day's use, as close to the measurement temperature as possible. Full two-point calibration should be carried out every few months.

11.7.4. Calibration Solution Preparation

In order to 'calibrate' the RHOD electrode, a 100µg/L calibration solution of Rhodamine WT should be used. This is exactly the same calibration solution that is recommended for calibration of the BGA-PC electrode.

The 100µg/L calibration solution should be freshly prepared by serial dilution from 200g/L standard using deionised water. The following Rhodamine WT standard is recommended:

Part number: 70301027
Description: Rhodamine WT Liquid
Supplier: Keystone Europe Ltd.
Contact: http://www.dyes.com

Be sure to handle chemicals with care and to read and comply with all health and safety advice.

11.7.5. Serial Dilution

The recommended Rhodamine solution is supplied as a 20% or 200g/L solution, dilution of the stock solution should be carried out as follows.

200g/L stock → 100µg/L is recommended to be done as a two step dilution procedure.

Step 1; weigh out 0.5g of 200g/L stock solution in a weigh boat and add this to 1L of deionized water in a volumetric flask, use some of the water from the 1L flask to rinse the weigh boat so no stock Rhodamine remains on the boat. Put a lid on the 1L flask and invert 10 times.

This step results in a 1 in 2000 dilution of the stock, at this point the 1L flask will contain a 100mg/L solution.

Step 2; Transfer 1ml of the 100mg/L solution to a 1L volumetric flask and top up to 1L with deionized water. Put a lid on the 1L flask and invert 10 times.

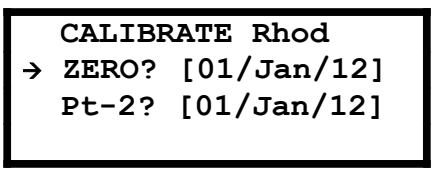
This step results in a 1 in 1000 dilution of the solution from step 1. The concentration of this solution is 100µg/L. This solution can now be used as Pt-2 calibration of the RHOD sensor.

The dilute solution can be stored in a dark bottle in a refrigerator for up to five days. After that time it must be discarded.

11.7.6. Zero Point Calibration

To calibrate the zero point, follow these steps:

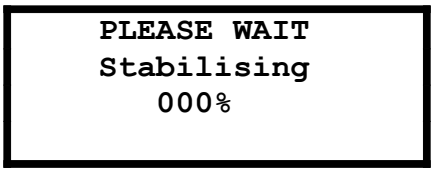
1. Fill a calibration bottle with mineral water, wash the Probe in mineral water, then drop the Probe in all the way. **The Sleeve End Cap must be fitted**. Gently agitate the Probe several times in order to remove any air bubbles that may be clinging to the electrode.
2. Switch the Aquameter® on and wait until the temperature and Rhod readings are stable. If the Rhod reading is very high, there are probably air bubbles adhering to the lenses. Agitate the Probe to remove.
3. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF - 104ºF).
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.



Calibration point 2 (Pt-2) is the upper calibration point.

The dates shown to the right of each point are the dates of the last successful calibration.

7. Select ZERO. The screen will change to:



The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

The Calibration Report on the top line displays the voltage output from the electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

11.7.7. Calibrating Point 2

Remove the Probe from the calibration bottle, shake off any excess water then dry the outer sleeve with a soft cloth.

Fill a calibration bottle with freshly mixed Rhodamine calibration solution and drop the Probe in all the way. Again, agitate the Probe several times in order to remove any air bubbles that may be clinging to the electrode.

Follow the procedure detailed above for Zero point calibration as far as step 4, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the ‘Calibrating 100%’ screen will be displayed along with the Calibration Report, which will show the voltage output from the electrode in millivolts (mV). Press the **OK** key to continue.

Calibration is now complete.

11.7.8. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to Calibration Error Messages in section 10 for error message handling.

11.7.9. Lens and Sleeve Maintenance

On a daily basis, the lenses on the electrode should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray fluorescence.

Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged. The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

11.8. 2000-FSCEIN Fluorescein WT Electrode

Fluorescein is a fluorescent dye that is commonly used in water flow studies and can be measured by the AP-Lite using the optional 2000-FSCEIN optical electrode.

11.8.1. Principle of Operation

The 2000-FSCEIN optical electrode is a submersible, fixed response fluorometer, which provides excitation at 470nm and detects any resultant fluorescence above 550nm.

The electrode induces the Fluorescein to fluoresce, then measures the longer wavelength light which is emitted as a result of the fluorescence process.

11.8.2. Limitations of Use

Measurement of Fluorescein in the field using fluorescence measurement techniques can be adversely affected by:

- Interference from microbiological species and compounds, which fluoresce at similar wavelengths.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity.

The normal affects of temperature on the fluorescent response of Fluorescein is automatically compensated for by the electrode.

11.8.3. Calibrating the FSCEIN Electrode

The FSCEIN electrode has two calibration points. Careful calibration is essential in order to ensure consistent and reliable results.

When a FSCEIN electrode is first installed, **it MUST be calibrated at both points** in order to set the electrode's relative sensitivity and establish its slope.

Subsequently, a single point (Zero) calibration should be carried out at the beginning of each day's use, as close to the measurement temperature as possible. Full two-point calibration should be carried out every few months.

11.8.4. Calibration Solution Preparation

In order to 'calibrate' the FSCEIN electrode, a 100µg/L calibration solution of Fluorescein Dye should be used.

The 100µg/L calibration solution should be freshly prepared by serial dilution from 200g/L standard using deionised water. The following Fluorescein Dye is recommended:

Part number: 801 073 81
Description: Keyacid Fluorescein 019187
Supplier: Keystone Europe Ltd.
Contact: http://www.dyes.com

Be sure to handle chemicals with care and to read and comply with all health and safety advice.

11.8.5. Serial Dilution

A three step dilution process should be used as outlined below.

Step 1; Weigh out 0.5g Fluorescein dye powder and add to 1L deionized water in a volumetric flask. Invert 10 times or until all powder is dissolved. This gives a stock solution of 500mg/L.

Step 2; Transfer 10ml of the 500mg/L stock solution into a 1L volumetric flask and top the flask up to 1L with deionized water. Invert to mix.

This step results in a 1 in 100 dilution of the 500mg/L stock resulting in a 5mg/L stock.

Step 3; Transfer 20ml of the 5mg/L stock from step 2 into a 1L volumetric flask. Top up to 1L with deionized water. Invert to mix.

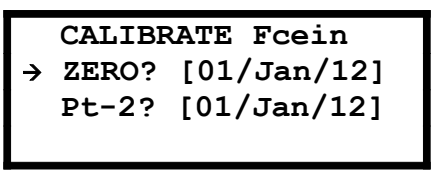
This step results in a 1 in 50 dilution and gives you the 100µg/L FSCEIN calibration standard required for Pt-2.

The dilute solution can be stored in a dark bottle in a refrigerator for up to five days. After that time it must be discarded.

11.8.6. Zero Point Calibration

To calibrate the zero point, follow these steps:

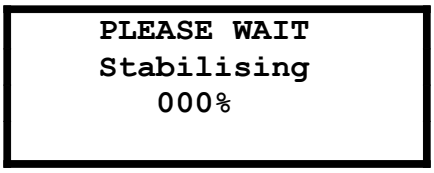
1. Fill a calibration bottle with mineral water, wash the Probe in mineral water, then drop the Probe in all the way. **The Sleeve End Cap must be fitted**. Gently agitate the Probe several times in order to remove any air bubbles that may be clinging to the electrode.
2. Switch the Aquameter® on and wait until the temperature and Fcein readings are stable. If the Fcein reading is very high, there are probably air bubbles adhering to the lenses. Agitate the Probe to remove.
3. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF - 104ºF).
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.



Calibration point 2 (Pt-2) is the upper calibration point.

The dates shown to the right of each point are the dates of the last successful calibration.

7. Select ZERO. The screen will change to:



The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

The Calibration Report on the top line displays the voltage output from the electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

11.8.7. Calibrating Point 2

Remove the Probe from the calibration bottle, shake off any excess water then dry the outer sleeve with a soft cloth.

Fill a calibration bottle with freshly mixed Fluorescein calibration solution and drop the Probe in all the way. Again, agitate the Probe several times in order to remove any air bubbles that may be clinging to the electrode.

Follow the procedure detailed above for Zero point calibration as far as step 4, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the ‘Calibrating 100%’ screen will be displayed along with the Calibration Report, which will show the voltage output from the electrode in millivolts (mV). Press the **OK** key to continue.

Calibration is now complete.

11.8.8. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to Calibration Error Messages in section 10 for error message handling.

11.8.9. Lens and Sleeve Maintenance

On a daily basis, the lenses on the electrode should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray fluorescence.

Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged. The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

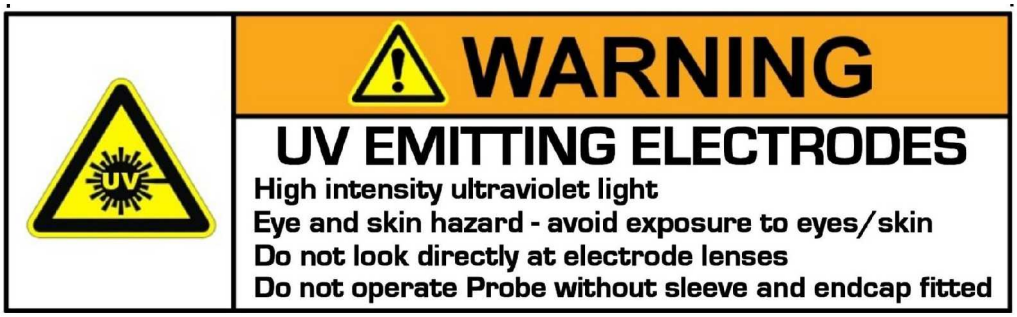
11.9. 2000-REFOIL Refined Oil Electrode

Refined fuels such as benzene, toluene, ethylbenzene, and xylenes (BTEX) can be measured by the AP-Lite using the optional 2000-REFOIL optical electrode.

11.9.1. Principle of Operation

The 2000-REFOIL optical electrode is a submersible, fixed response fluorometer, which provides excitation at 285nm (deep UV) and detects any resultant fluorescence between 330nm and 370nm.

The electrode induces the aromatic hydrocarbons within the refined oil to fluoresce, then measures the longer wavelength light which is emitted as a result of the fluorescence process.



- ➔ **During operation, the Refined Oil Electrode emits high intensity ultraviolet (UV) light, which is harmful to skin and eyes and may cause cancer. Avoid exposure to UV light when the Electrode is in operational.**
- ➔ **Precautions must be taken to avoid looking directly at the Electrode without the use of UV light protective glasses.**
- ➔ **Do not look directly at the lenses on the front face of the Electrode when it is operational.**
- ➔ **Ensure the warning label supplied with the Electrode is attached to the Aquaprobe®.**

11.9.2. Limitations of Use

Determination of refined oil in the field using fluorescence measurement techniques will never be as accurate as measurements made in a lab using either Gas or Liquid Chromatography.

Factors adversely affecting accuracy include:

- Interference from other compounds (such as flour and some bacterial spores which fluoresce at similar wavelengths.
- Differences in the fluorescent response between various types of oil.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity.

Fluorescence measurement techniques are ideal for researchers who are interested in detecting the presence or absence of a specific substance and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations.

Fluorescence measurement techniques are not ideal for quantitative measurement. **In order to obtain more accurate results, data obtained with the fluorometer in the field should be post-calibrated with data from standard laboratory analysis of grab samples acquired during the study.**

11.9.3. Special Precautions When Using the REFOIL Electrode

- Always observe the safety advice printed above.
- Do not deploy the REFOIL electrode in water temperatures above 30ºC.

11.9.4. Calibrating the REFOIL Electrode

The REFOIL electrode has two calibration points. Careful calibration is essential in order to ensure consistent and reliable results. **It is important to calibrate this electrode as close to operational temperature as possible.**

When a REFOIL electrode is first installed, **it MUST be calibrated at both points** in order to set the electrode's relative sensitivity and establish its slope.

Subsequently, zero point calibration should be carried out before each use and full two-point calibration should be carried out every few months.

11.9.5. Calibration Solution Preparation

In order to 'calibrate' the REFOIL electrode, a 10ppm calibration solution of 1-5, naphthalenedisulfonic acid disodium salt should be used. This solution contains naphthalene, an aromatic hydrocarbon, which has **similar** fluorescence characteristics to many Refined Oils.

The 10ppm calibration solution should be freshly prepared by serial dilution from pure 1-5, naphthalenedisulfonic acid disodium salt. The following Naphthalene salt is recommended:

Part number: 250899
Description: 1,5-Naphthalenedisulfonic acid disodium salt hydrate (95% pure)
Supplier: Sigma Aldrich
Contact: www.sigma-aldrich.com

Be sure to handle chemicals with care and to read and comply with all health and safety advice.

11.9.6. Serial Dilution

10ppm Napthalene salt can be prepared either as a one or two step process dependent upon the accuracy of the scales used.

One step process:

Weigh out 10.5mg of the recommended salt and add to 1L of deionized water in a volumetric flask. Invert or mix until all salt has dissolved. This gives the Pt-2 10ppm stock solution required for calibration.

Two step process:
Step 1: Weigh out 1.05g of the recommended salt and add to 1L deionized water in a volumetric flask. Invert or mix until all salt has dissolved. This gives a 1000ppm stock solution.

Step 2: Transfer 10ml of the 1000ppm stock solution to a 1L volumetric flask and top up with 1L of deionized water. Invert 10 times. This step results in a 1 in 100 dilution of the 1000ppm stock giving the 10ppm standard required for Pt-2 calibration.

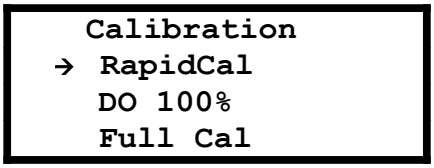
The dilute solution can be stored in a dark bottle in a refrigerator for up to five days. After that time it must be discarded.

Important note: When calibrating the Refined Oil sensor with naphthalenedisulfonic acid disodium salt, the readings given will be in µg/L (ppb) naphthalene. In order to display readings with respect to a specific type of refined oil, it is necessary to prepare a 10ppm solution of the target oil type and use that to calibrate the electrode in place of the naphthalene solution.

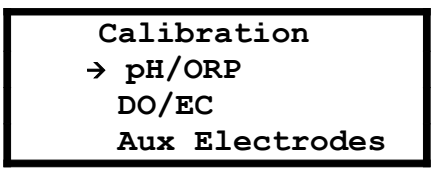
11.9.7. Zero Point Calibration

To calibrate the zero point, follow these steps:

1. Pour 300mL of de-ionised water into a clean calibration cup, remove the storage cap from the pH electrode if fitted, wash the Probe in mineral water, then gently lower the Probe in all the way. **The Sleeve End Cap must be fitted**. Activate the probe cleaning feature in order to remove any air bubbles that may be clinging to the electrode.
2. Switch the Aquameter® on and wait until the temperature and Oil readings are stable. If the Oil reading is very high, there are probably air bubbles adhering to the lenses.
3. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF - 104ºF).
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.



5. Select **Full Cal.** The screen will change to:



6. Select **Aux Electrodes**. The screen will change to:

```
 SELECT ELECTRODE
→1:Oil    | 4:EMPTY
 2:EMPTY  | 5:EMPTY
 3:EMPTY  | 6:EMPTY
```

The Oil electrode should have been assigned to an AUX socket when it was fitted. Choose that socket. Press the OK or right arrow key to select Oil. The screen will change to:

```
  CALIBRATE Oil
→ ZERO? [01/Jan/12]
  Pt-2? [01/Jan/12]
```

Calibration point 2 (Pt-2) is the upper calibration point.

The dates shown to the right of each point are the dates of the last successful calibration.

7. Select ZERO. The screen will change to:

```
   PLEASE WAIT
   Stabilising
      000%
```

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

```
   Output:2500mV
   Calibrating
      100%
    Press [OK]
```

The Calibration Report on the top line displays the voltage output from the electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

11.9.8. Calibrating Point 2

Remove the Probe from the calibration cup, shake off any excess water then dry the outer sleeve with a soft cloth.

Pour 300mL of freshly mixed 1-5, naphthalenedisulfonic acid disodium salt calibration solution into a clean calibration cup then gently lower the Probe in all the way.

Follow the procedure detailed above for Zero point calibration as far as step 6, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the 'Calibrating 100%' screen will be displayed along with the Calibration Report, which will show the voltage output from the electrode in millivolts (mV). Press the **OK** key to continue.

Refined oil calibration is now complete.

11.9.9. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to Calibration Error Messages in section 10 for error message handling.

11.9.10. Lens and Sleeve Maintenance

On a daily basis, the lenses on the electrode should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray fluorescence.

Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged. The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

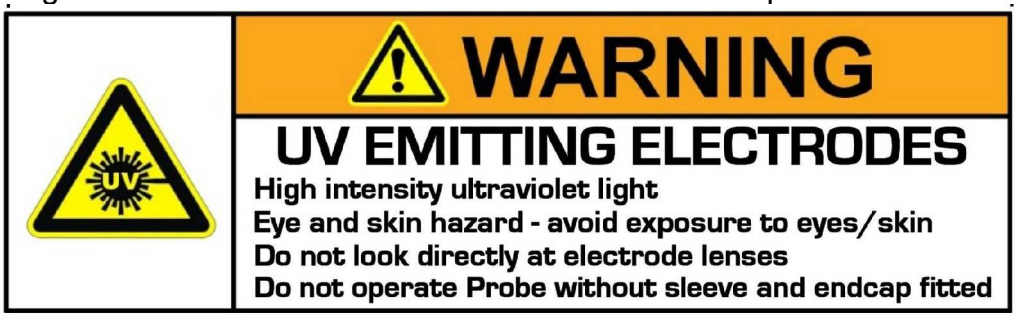
11.10. 2000-CDOM/FDOM Chromophoric (Fluorescent) Dissolved Organic Matter

Fluorescent) Dissolved Organic Matter can be measured by the AP-Lite using the optional 2000-CDOM optical electrode.

11.10.1. Principle of Operation

The 2000-CDOM optical electrode is a submersible, fixed response fluorometer, which provides excitation at 365nm (UV) and detects any resultant fluorescence between 450nm and 520nm.

The electrode induces the dissolved organic matter to fluoresce, then measures the longer wavelength light which is emitted as a result of the fluorescence process.



- ➔ **During operation, the CDOM Electrode emits high intensity ultraviolet (UV) light, which is harmful to skin and eyes and may cause cancer. Avoid exposure to UV light when the Electrode is in operational.**
- ➔ **Precautions must be taken to avoid looking directly at the Electrode without the use of UV light protective glasses.**
- ➔ **Do not look directly at the lenses on the front face of the Electrode when it is operational.**
- ➔ **Ensure the warning label supplied with the Electrode is attached to the Aquaprobe®.**

11.10.2. Limitations of Use

Determination of CDOM in the field using fluorescence measurement techniques will never be as accurate as measurements made in a lab using traditional techniques.

Factors adversely affecting accuracy include:

- Interference from compounds which fluoresce at similar wavelengths.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity.

Fluorescence measurement techniques are ideal for researchers who are interested in detecting the presence or absence of a specific substance and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations.

Fluorescence measurement techniques are not ideal for quantitative measurement. **In order to obtain more accurate results, data obtained with the fluorometer in the field should be post-calibrated with data from standard laboratory analysis of grab samples acquired during the study.**

11.10.3. Calibrating the CDOM Electrode

The CDOM electrode has two calibration points, zero and 100ppb (100µg/L). Careful calibration is essential in order to ensure consistent and reliable results. **It is important to calibrate this electrode as close to operational temperature as possible.**

When a CDOM electrode is first installed, **it MUST be calibrated at both points** in order to set the electrode's relative sensitivity and establish its slope.

Subsequently, zero point calibration should be carried out before each use and full two-point calibration should be carried out every few months.

11.10.4. Calibration Solutions

Scientists have not developed a standard way to report CDOM values. Results are therefore expressed in relative units based on calibration to a standard fluorescing compound, usually quinine.

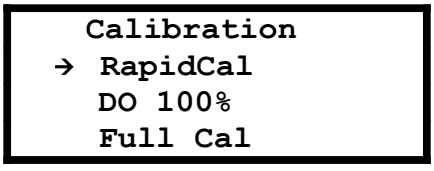
In order to 'calibrate' the CDOM electrode, a 100ppb solution of Quinine Sulphate in sulphuric acid can be used. However, since Quinine Sulphate is extremely expensive and sulphuric acid is dangerous to handle, Aquaread Ltd has formulated an equivalent, non toxic standard for use during CDOM electrode calibration. This is available in 600mL bottles.

Part number: CDOM-CAL-600
Supplier: Aquaread Ltd
Contact: http://www.aquaread.co.uk

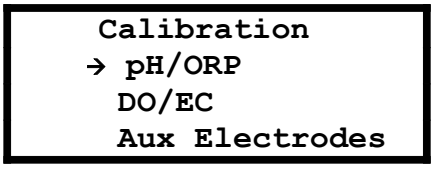
11.10.5. Zero Point Calibration

To calibrate the zero point, follow these steps:

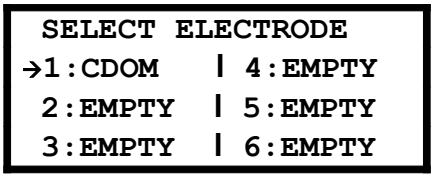
1. Pour 300mL of de-ionised water into a clean calibration cup, remove the storage cap from the pH electrode if fitted, wash the Probe in mineral water, then gently lower the Probe in all the way. **The Sleeve End Cap must be fitted**. Activate the probe cleaning feature in order to remove any air bubbles that may be clinging to the electrode.
2. Switch the Aquameter® on and wait until the temperature and CDOM readings are stable. If the CDOM reading is very high, there are probably air bubbles adhering to the lenses.
3. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF - 104ºF).
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.



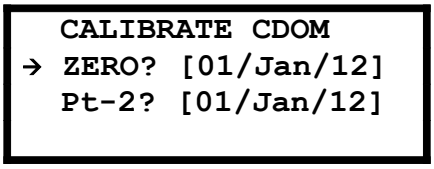
5. Select **Full Cal.** The screen will change to:



6. Select **Aux Electrodes**. The screen will change to:



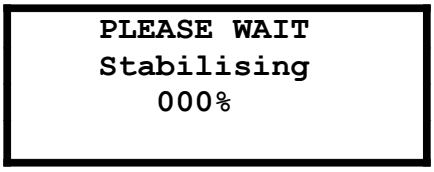
The CDOM electrode should have been assigned to an AUX socket when it was fitted. Choose that socket. Press the OK or right arrow key to select CDOM. The screen will change to:



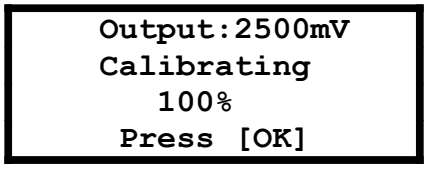
Calibration point 2 (Pt-2) is the upper calibration point.

The dates shown to the right of each point are the dates of the last successful calibration.

7. Select ZERO. The screen will change to:



The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place. During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.



The Calibration Report on the top line displays the voltage output from the electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

11.10.6. Calibrating Point 2

Remove the Probe from the calibration cup, shake off any excess water then dry the outer sleeve with a soft cloth.

Pour 300mL of fresh CDOM-CAL calibration solution into a clean calibration cup then gently lower the Probe in all the way.

Follow the procedure detailed above for Zero point calibration as far as step 6, then select Pt-2. Wait while the Meter stabilises and calibrates.

After successful calibration, the 'Calibrating 100%' screen will be displayed along with the Calibration Report, which will show the voltage output from the electrode in millivolts (mV). Press the **OK** key to continue.

CDOM calibration is now complete.

11.10.7. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to Calibration Error Messages in section 10 for error message handling.

11.10.8. Lens and Sleeve Maintenance

On a daily basis, the lenses on the electrode should be wiped over with a soft damp cloth.

Similarly, the inside of the Probe Sleeve and Sleeve Cap should be kept clean and free from any deposits that may cause stray fluorescence.

Never use an abrasive cleaner on the inside of the Probe sleeve or cap as they have been treated with a non-reflective coating which can be easily damaged. The inside of the sleeve should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Always re-calibrate the zero point after cleaning the sleeve or lenses.

12. After Use

The AP-Lite should always be cleaned after every use. A build-up of dirt on the inside of the Sleeve and End Cap will cause erroneous and unstable readings.

It is advisable to clean the Probe after use with the cable attached. This will prevent any water entering the Probe's socket and will allow any deposits to be removed from the connector collar and shell.

The Sleeve on the AP-Lite can be removed by unscrewing to allow cleaning of the electrode.

After every use, remove the Sleeve End Cap then unscrew the Sleeve.

Rinse the exposed electrode, the inside of the Sleeve and the Sleeve End Cap with fresh, clean water.

Dry the Electrode and polish the lenses using a soft cloth.

Shake the water from inside the Sleeve and Sleeve End Cap, then reattach.

Dry the outside of the Probe using a soft cloth.

TIP: Occasional application of a smear of silicone grease to the connector O-rings and thread, Sleeve thread, the Sleeve End Cap thread will make fitting and removal of these parts easier.

Never clean the Probe with solvents, alcohol or concentrated acid/alkaline based cleaning products such as Decon 90. These products can strip the anodised finish from the Probe and damage the plastic and rubber components. Damage caused by the use of aggressive cleaning agents or solvents is not covered by your warranty.

13. AquaLink PC Software

AquaLink is a utility program designed to run under Microsoft® Windows® XP®, Vista® or 7 on a stand-alone PC with a minimum screen resolution of 1024 x 768, a CD drive and an available USB 2.0 socket.

13.1. Downloading AquaLink™ PC Software from the Aquaread® website

The AquaLink™ PC Software is available for download using the following link: http://www.aquaread.co.uk/downloads.php

From the Aquaread® Downloads page, select 'AquaLink-Aquameter Utility'. The software will be downloaded as a .ZIP file.

13.2. Software Installation

Unzip the downloaded .ZIP file into a temporary directory . Browse the temporary directory and click on '**setup.exe**'. You will be given the usual Windows® security warnings. Allow the software to install. Once installed, AquaLink™ will run automatically.

To communicate with the Aquameter, two further software 'drivers' need to be installed. These are the '**Aquameter**' driver and a '**USB Serial Port**' driver.

13.3. Driver Installation

Connect the Aquameter to your PC using the USB cable provided. The 'Found New Hardware' wizard on your PC should activate automatically.

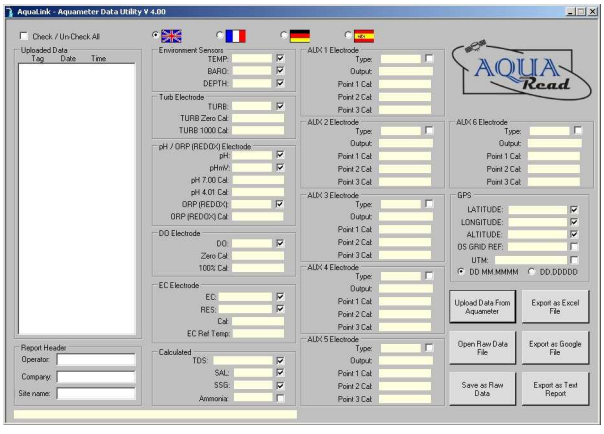
Different versions of Windows® react to plugging USB devices in differently. Earlier versions will give you the option to '**locate and install driver software**'. If this happens, direct Windows® to your temporary directory containing the unzipped download.

If your version of Windows® tries to search the Internet or 'Windows Update' for the drivers, stop the search and direct Windows® to your temporary directory.

If Windows® reports a problem installing the drivers, go to your Windows® Device Manager, locate the 'Aquameter' device and update the driver forcing Windows® to search your temporary directory for the driver. Repeat this process for the USB Serial Port.

13.4. Running AquaLink

Select AquaLink from your Programs menu. After an introductory splash-screen has been displayed, the following screen will appear:

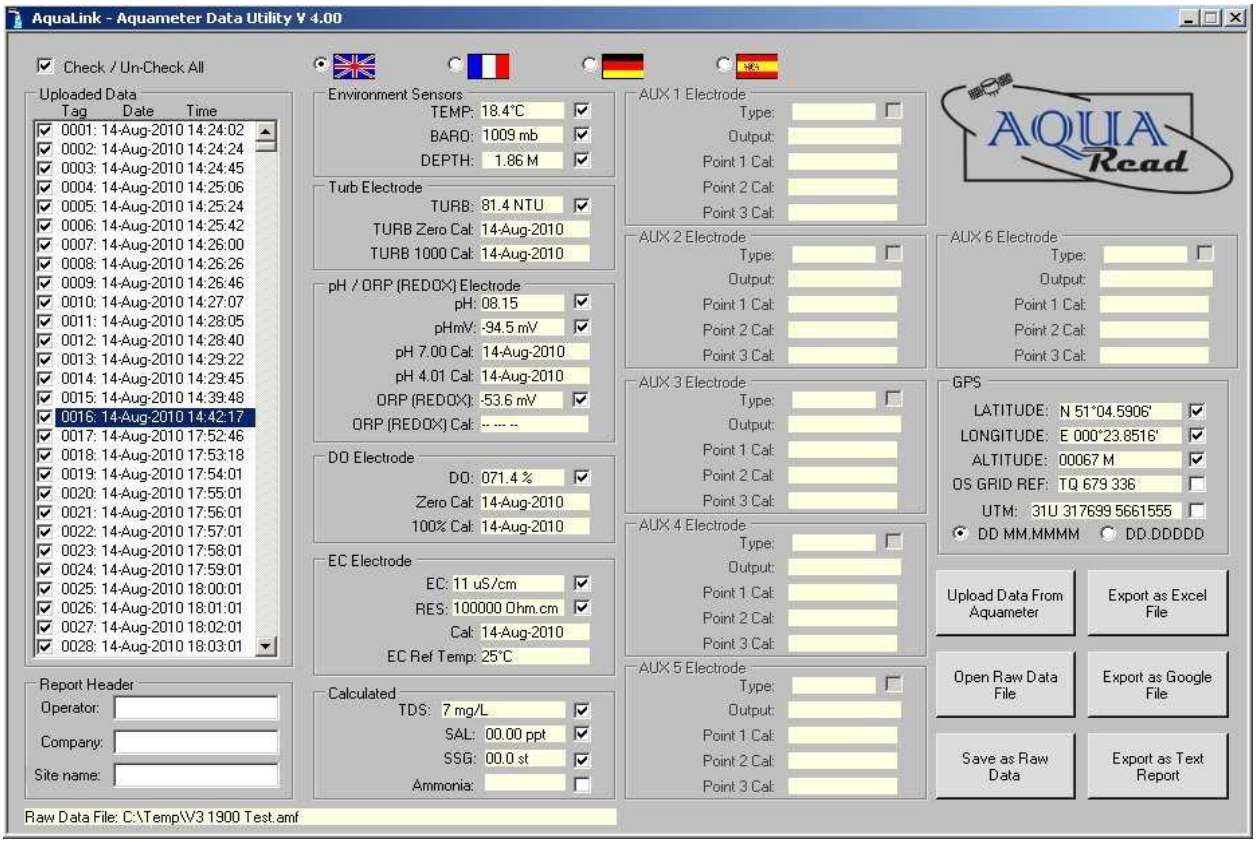


Select your preferred operating language by clicking on one of the national flags.

13.5. Uploading Data From Your Aquameter®

Ensure your Aquameter® has batteries installed but is switched off. Connect the Aquameter® to your PC using the USB cable supplied. The Aquameter® should switch itself on automatically and display 'USB CONNECTED' on its screen.

Click the '**Upload Data From Aquameter®'** button. AquaLink will search for the Aquameter® then upload all the available logged data from the Meter to your PC. A progress bar and file counter will be displayed during this process. Once upload is complete, the memory Tag, date and time for all the logged data that has been uploaded will be displayed in the **Uploaded Data** column on the left of the screen.



To view any of the logged data records, simply click on the desired Tag, date and time label as shown above. The data for the highlighted label will be displayed in the data boxes labelled **Environment Sensors and AUX 1 Electrode**. Any data that is unavailable or out of range will be displayed as dashes. To move up and down the Tag/date/time column, use either your mouse or the cursor up/down keys.

13.6. Displaying GPS Co-ordinates

On the right of the screen, the position at which the data was logged is displayed in the GPS boxes (when logged using an AM-200 GPS Aquameter® only). Latitude and longitude can be displayed as Degrees and decimal Minutes (DD MM.MMMM) or as decimal Degrees (DD.DDDDD). Select one format or the other by clicking one of the two options at the bottom of the GPS box. Positional accuracy of lat/lon co-ordinates is +/- 10 meters with a 3D Position fix.

GPS position is also displayed as an Ordnance Survey Great Britain (OSGB) grid reference, (if the position falls within the United Kingdom) and UTM (Universal Transverse Mercator) co-ordinates.

Positional accuracy of OSGB co-ordinates is +/- 1 digit (i.e. +/- 100 metres). Positional accuracy of UTM co-ordinates is +/- 10 metres with a 3D Position fix.

13.7. On Screen Help

Help has been provided in this software in the form of 'Tool Tips'. If you want to know what a control button does or what a data box displays, simply move your mouse pointer over the item in question. A multi-lingual Tool Tip will appear after a few seconds to give you more information.

13.8. Saving Logged Data

Once a set of logged data has been uploaded from the Aquameter®, it can be saved on your PC as a Raw Data file. These files use a proprietary Aquaread® format and are saved with a .amf (**a**qua**m**eter **f**ile) extension.

To save the uploaded data, click the '**Save as Raw Data**' button. You will be asked for a file name in the normal Windows® format. The file name you choose will automatically be given the .amf extension.

Useful Tip: Once you have saved the logged data, it is a good idea to clear the Aquameter®'s memory so next time you log data, you don't get both your old data and new data uploaded to your PC. See Clearing the Memory in section 8.

13.9. Retrieving Logged Data

Once a Raw Data file has been saved using the above technique, it can be easily retrieved by clicking on the '**Open Raw Data**' button. When a raw data file is opened, it will appear exactly as uploaded data and the file name will be displayed in the box below the Report Header box.

13.10. Exporting Data

AquaLink can export data in three different formats. Before exporting data, the actual data to be exported must be selected.

First, select which data records you want to export by checking the relevant check-boxes in the Uploaded Data column. You can check or un-check all data records simultaneously by checking or un-checking the 'Check / Un-Check All' box above the Uploaded Data column.

Next, select which individual data classes you want to export by checking or un-checking the check-boxes next to each individual data box. You are now ready to export your data.

13.11. Exporting Text Reports

To export a text report, first fill in the boxes in the group marked **Report Header** on the left of the screen. This information will be used at the beginning of your report. Next, click on the '**Export as Text Report**' button. You will be asked to specify a file name. A .txt extension will automatically be added.

A report will be generated that consists of a cover page giving the start and end date, time and position, the total number of readings, an analysis of the highest and lowest readings, the variance between the highest and lowest readings, the average readings and the GLP data. Each block of individual readings, laid out in chronological order, follows this page.

This report can be imported into any text editor or word processor package.

Useful Tip: Of the two text editors supplied with Windows®, Microsoft® WordPad is the preferred text editor for viewing AquaLink Text Reports as this handles text file formatting better than Microsoft® Notepad.

13.12. Exporting Excel® Files

To export an Excel® file, click on the '**Export as Excel File**' button. You will be asked to specify a file name. A .xls extension will automatically be added. Excel® files are exported in a Tab delimited text format. This means that each data field is separated by a Tab, and each data record appears on a new line.

Excel® files are saved with a .xls extension and can be opened directly in Microsoft® Excel®. When opening a .xls file created by AquaLink for the first time, Excel® may automatically run a 'Text Import Wizard'. Follow the three simple steps to import the file. Save the file afterwards as a 'Microsoft Excel Workbook'.

13.13. Exporting Google™ Files

To export a Google™ file, click on the '**Export as Google File**' button. You will be asked to specify a file name. A .kml extension will automatically be added. **Please note: only data logged with a valid GPS position can be exported to Google™ files.**

Google™ files are exported in Google's proprietary Keyhole Markup Language with a .kml extension, and can be directly imported into Google™ Earth, where the data is overlaid on satellite images.

13.14. Importing Files into Google™ Earth

To view your files in Google™ Earth, you will need to log on to the Google™ website and install the Google™ Earth application on your computer. This is free of charge at present.

Once you have downloaded Google™ Earth and have it running, either double click on your .KML file or follow these steps:

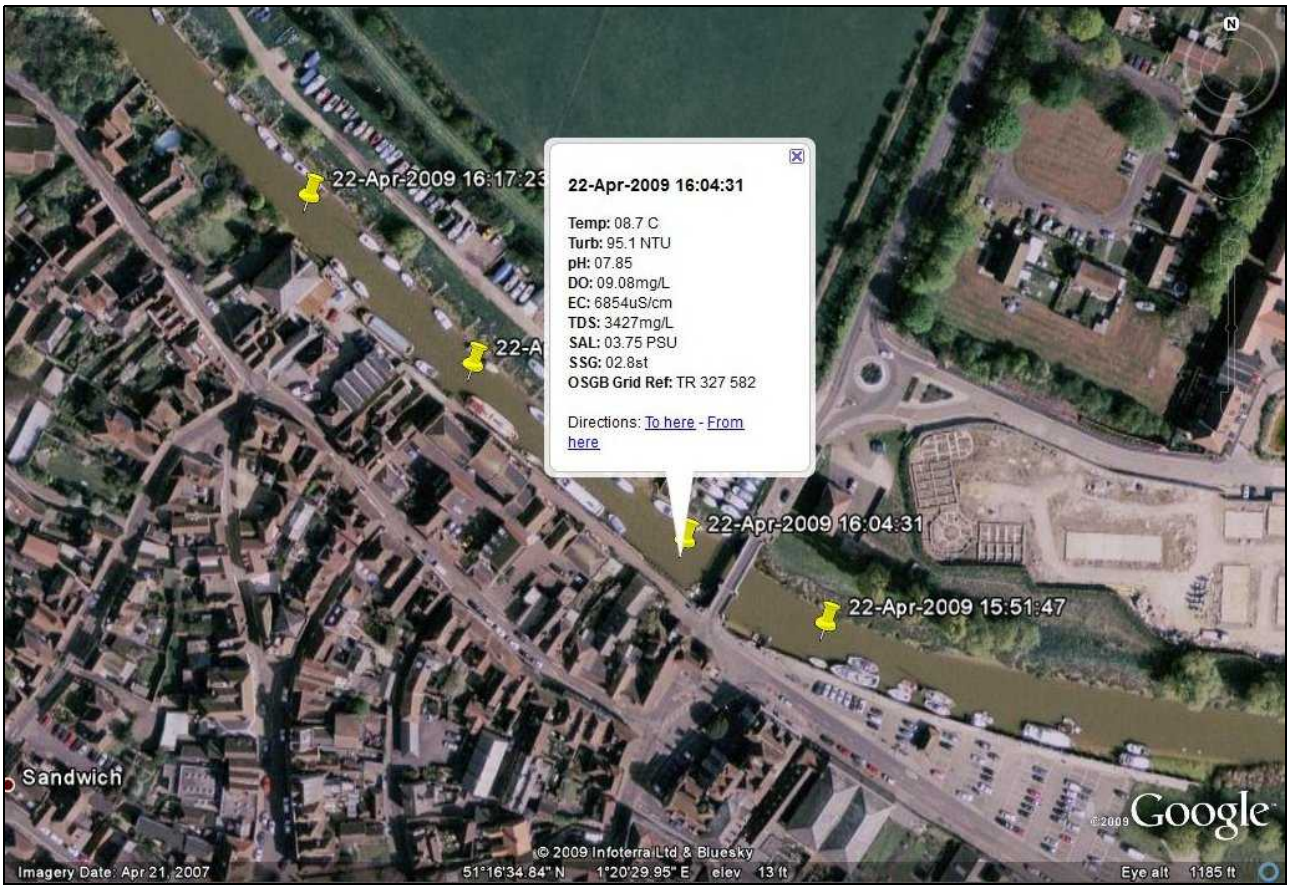
1. Click on '**File**'.
2. Select '**Open**' from the list.
3. Browse for the .KML file you exported from AquaLink, and select it.

You will now be able to view your data overlaid on Google™ Earth Satellite images. Each data point is represented by a yellow pushpin, and all the data points are listed in a column on the left of the screen. To view the data associated with each pin, either click on the pin or click on the data point in the list.

Please note: Although you have downloaded the Google™ Earth application and are running it from your PC, you still need to be connected to the Internet in order for the application to access satellite images.

A typical Google™ Earth image follows.

13.15. Google™ Example



Zooming in on the satellite photos in Google™ Earth is a great way to spot potential sources of pollution. If one of the readings you have taken shows an abnormality, the chances are that you will be able to spot the possible source of the problem (a riverside factory for example) directly on the satellite photo.

14. Limited Warranty

All Aquaread® Meters are guaranteed for three years, Probes, Flow-Through Cells and individual electrodes are guaranteed for one year from date of purchase against defects in workmanship and materials when used for their intended purpose and maintained according to instructions.

This warranty is limited to repair or replacement free of charge. Accidental damage, misuse, tampering, lack of prescribed maintenance, water ingress through unprotected Meter and Probe sockets, and damage caused by leaking batteries are not covered.

If service is required, contact our Service Department directly by email in the first instance (service@aquaread.com). Report the model number, date of purchase, serial number and problem. You will be given a Returns Authorisation number by our Service Department. You should then return the equipment, thoroughly cleaned, properly packaged, carriage paid, to the address you are given. If the equipment is within warranty, any necessary repairs will be carried out and your equipment will be returned free of charge.

If the repair is not covered by the warranty, you will be given an estimate for the costs of repair and return carriage. Upon receipt of payment, your equipment will be repaired and returned.

Please note: The majority of perceived problems can be rectified by careful study of this instruction manual, use of the TROUBLESHOOTING section below, or with a little help from our engineers over the phone**. Always contact our Service Department prior to returning any equipment.**

14.1. Cleaning Prior To Return

In order to protect the health and safety of our employees, any equipment returned for service must be thoroughly cleaned and decontaminated prior to despatch, and must be accompanied by a completed copy of the Decontamination Certificate printed below. Any equipment returned for service without a satisfactory Decontamination Certificate, or any equipment deemed by our engineers to be contaminated, will be quarantined pending receipt of a properly completed Decontamination Certificate.

Never clean the Probe with concentrated acid or alkaline based cleaning products such as Decon 90. These products can strip the anodised finish from the Probe and damage some of the plastic components.

14.2. Decontamination Certificate

Please print this certificate, complete all sections, and enclose it with any returned equipment.

Any equipment returned for service without a satisfactory Decontamination Certificate, or any equipment deemed by our engineers to be contaminated, will be quarantined or returned untouched pending receipt of a properly completed Decontamination Certificate.

Decontamination Certificate

Company Name: _____

Address:

_____

_____

_____

_____

Postal code: _____

Country: _____

Phone: _____ email: _____

Product: _____ Serial No.: _____

Contaminant (if known): _____

Decontamination Procedure:_____

_____

Certified by (print name) : _____ Title:_____

Date: _____

Signature: _____

15. TROUBLESHOOTING

This section details some of the common difficulties you may encounter when using the Aquameter®, AP-Lite and AquaLink software. Try all the suggested remedies. If your problem is still unresolved, contact our Service Department (service@aquaread.com).

Problem	Cause / Remedy
The Aquameter® will not turn on when the on/off key is pressed.	✓ Batteries are probably dead or incorrectly fitted. Check you have fresh batteries fitted and that they are inserted the correct way round.
The Aquameter® turns on but turns off again almost immediately.	✓ Batteries are probably nearly dead or incorrectly fitted. Check you have fresh batteries fitted and that they are inserted the correct way round.
The Aquameter® can not find the Aquaprobe®.	✓ Probably a poor connection. Switch the Aquameter® off, disconnect the Aquaprobe®, ensure there is no debris or moisture in the plugs and sockets, then re-connect ensuring they are fully inserted and that the screw collars are fully tightened.
The GPS Aquameter® will not show a position fix.	✓ The Aquameter® probably does not have a good enough view of the available satellites. Ensure there are no obstructions between the Aquameter® and the open sky. Remember, GPS **does not** work indoors.
The AquaLink software can not find the Aquameter®.	✓ The USB drivers may not be properly installed. Reinstall the USB drivers carefully following the instructions. ✓ There may be a problem with the USB socket on the PC, try an alternative socket.
The 'USB CONNECTED' message does not appear on the Aquameter® when it is connected to a PC.	✓ The batteries in the Aquameter® may be dead or incorrectly fitted. Check you have fresh batteries fitted and that they are inserted the correct way round. The USB cable **does not** power the Aquameter®. ✓ There may be a problem with the USB socket on the PC, try an alternative socket.
Turbidity readings are negative in clear water.	✓ Erroneous zero point calibration caused either by contaminated calibration solution or changes in the measurement chamber between zeroing and deployment. Thoroughly clean the Probe then re-zero in completely clean/clear water.
Readings are inaccurate or unstable.	✓ Have you got the Probe Sleeve and end cap fitted? The probe will not work properly without the Probe Sleeve and end cap fitted. ✓ Trapped air bubbles may be causing interference. Tap and swish the Aquaprobe® to dislodge them. ✓ The sample being measured may contain air bubbles. Under these conditions, optical measurements can not be taken. ✓ The Aquaprobe® may not be inserted deep enough into the sample being measured. Ensure the sample level covers the lower row of holes on the Probe Sleeve. ✓ The Probe Sleeve may be loose. The Probe Sleeve must be absolutely rigid with respect to the Probe Body for correct turbidity operation. If you can move the Probe Sleeve to and fro whilst holding the Probe Body, tighten then recalibrate. ✓ The Electrode may need recalibrating. Recalibrate. ✓ The lenses on the Electrodes may be dirty. Clean the lenses then recalibrate.
Battery electrolyte leakage detected in the battery compartment.	✓ Remove and discard the batteries immediately. Thoroughly clean the battery compartment and terminals. If the battery terminals are corroded, contact our Service Department for return instructions.

16. DECLARATION OF CONFORMITY

Aquaread® Ltd declares that the equipment described herein is in compliance with the essential requirements and other relevant provisions of Directives 2004/108/EC and 1999/5/EC.

17. Appendix 1. Flow Through Cell

17.1. Introduction

The AP-Lite is designed to be used with the AP-2000 Flow Through Cell (Flowcell) via an adapter collar.

The Flowcell allows sample water to flow through the AP-Lite, passing over the Electrode. This eliminates air contact with pumped samples from groundwater boreholes allowing truly representative measurements to be obtained.

Made from marine grade aluminium and 6mm wall thickness acrylic, the Flowcell is ruggedly constructed for hard use in the field. The base flange includes four holes to allow the unit to be pegged down if necessary.

17.2. Adapter Collar Installation

Flowcell Adapter Collar

1. Remove the sleeve from the AP-Lite.
2. Screw the Adaptor Collar onto the AP-Lite as shown below.

3. Re-fit the Sleeve as shown below. Be sure to also fit the Sleeve End Cap.

4. Carry out a full calibration with the Adaptor fitted.

Re-calibration at this point is extremely important because by fitting the Adaptor Collar, you have altered the dimensions of the measurement chamber and hence the calibration.

17.3. Spigot Installation

The Aquaread® Flowcell is supplied with two pairs of spigots, one pair to fit 6mm (1/4”) ID tube and one pair to fit 10mm (3/8”) ID tube.

The spigots have a tapered thread so should be screwed into the inlet and outlet holes of the Flowcell until they are tight. At this point, they should seal due to the taper. If a spigot will not seal properly, remove it then re-insert with some PTFE plumber’s tape wrapped around the thread.

17.4. AP-Lite Installation

The Adapter Collar, Probe Sleeve and Sleeve End Cap must be fitted to the AP-Lite.

Loosen the screw collar located at the top of the Flowcell and slide the AP-Lite in all the way, ensuring the Adapter Collar is properly seated in the rubber seal. Tighten the Flowcell's screw collar to clamp the Adapter Collar in place.

17.5. Operation

Connect the Flowcell to a pumping device so that sample water enters at the bottom and exits at the top. Adjust the flow rate so that there is no visible turbulence or cavitation within the Flowcell. Connect an Aquameter® and monitor the readings. If the readings are jumpy or erratic, reduce the flow rate. The ideal flow rate is around 30 litres/hour (8 US gallons/hour), although the Aquaprobe® is capable of operating at flow rates as low as 15 litres/hour (4 US gallons/hour). Flow rates above 60 litres/hour (16 US gallons/hour) are not recommended.

17.6. Caution

The maximum operating pressure of the Flowcell is 300mb (4.4 PSI). Select your pumping device accordingly. If necessary, use a three-way bypass valve so that this limit is not exceeded.

17.7. Cleaning

After use, rinse the Flowcell thoroughly with fresh water. To remove stubborn deposits, scrub the inside of the Flowcell with a bottlebrush and non-abrasive detergent, then rinse thoroughly.

Never clean the Flowcell with concentrated acid or alkaline based cleaning products such as Decon 90. These products can strip the anodised finish from the Flowcell and damage the plastic components.

17.8. Flowcell Troubleshooting

Problem	Cause / Remedy
Readings are abnormally high.	Air bubbles adhering to the Electrode lenses. Agitate Flowcell to dislodge. Aeration of sample water. Check all joints for air leaks. Reduce flow rate to avoid cavitation.
Sample water is leaking from around the top of the screw collar.	Screw collar is not tight enough. Tighten up. Operating pressure is too high. Reduce pressure / flow rate.
Probe is forced up out of the Flowcell during use.	Operating pressure is much too high. Reduce pressure / flow rate.

18. Appendix 2. Standard Electrodes Detailed Specification and FAQs

18.1. What are the excitation and detection wavelengths?

Each Aquaread® Optical Electrode (with the exception of Turbidity) is effectively a stand-alone, fixed frequency fluorometer, specially tuned to excite and detect fluorescence of selected substances in water.

The Turbidity electrode is not a fluorometer. This electrode employs a Nephelometric measurement technique in accordance with ISO 7027.

The following table shows the excitation peak wavelengths and detection ranges for each electrode.

Electrode	Excitation Peak Wavelength	Detection Range
Chlorophyll	470nm	>630nm
Blue-Green Algae Phycocyanin (BGA-PC)	590nm	>655nm
Blue-Green Algae Phycoerythrin (BGA-PE)	520nm	>575nm
Fluorescein Dye	470nm	>550nm
Rhodamine WT	520nm	>575nm
Refined Oil	285nm	330nm – 370nm
CDOM	365nm	450nm - 520nm
Turbidity	850nm	850nm

Each fluorometer electrode (with the exception of the Refined Oil Electrode) emits short pulses of high energy light at the excitation wavelength and responds to fluorescence in the detection range. The deep UV excitation of the Refined Oil Electrode operates on a 15 second on / 15 second off duty cycle.

18.2. How does the Refined Oil sensor work?

The Refined Oil sensor detects volatile organic compounds (VOCs) that are found in petroleum derivatives. These include benzene, toluene, ethylbenzene, and xylenes (BTEX).

The sensor is a fixed frequency *in situ* fluorometer that uses deep UV wavelengths (285nm) to excite the VOCs. An emission filter is then used to detect any fluorescence generated by the VOCs between 330 and 370nm.

The electrode measures the VOCs immediately in front of the sensor face so will measure at whatever depth the probe is lowered to. Naturally, the probe will only detect compounds that are actually mixed/dissolved in the water, not those floating on the surface.

The Refined Oil electrode is ideal for customers who are interested in detecting the presence or absence of VOC's and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations.

The electrode is not intended for absolute, quantitative measurements. This can only really be done using Gas or Liquid Chromatography in a laboratory.

18.3. I can see algae in the water but my sensor is giving low readings. Why?

Aquaread® Chlorophyll and Blue-Green Algae sensors are not designed to measure floating macroscopic (visible to the naked eye) algae or plant material.

The sensors measure the fluorescence from the microscopic phytoplankton suspended within the body of the water below the surface. Carpets of floating algae are often seen on environmental water that has low subsurface phytoplankton concentrations. In these circumstances, the fluorescent algae sensors will return low readings.

18.4. What is the Range and Resolution of the Optical Electrodes?

Turbidity	Range	0 – 3000 NTU
	Resolution	2 Auto-range scales: 0.0 - 99.9 NTU, 100 - 3000 NTU
	Accuracy	± 5% of auto-ranged scale
	MLD(1)	0.0 NTU
	MLR(2)	5.0 NTU
Chlorophyll	Range	0 – 500.0 µg/L (ppb)
	Resolution	2 Auto-range scales: 0.00 - 99.99 µg/L, 100.0 - 500.0 µg/L
	Repeatability	± 5% of reading
	MLD(1)	0.1µg/L
	MLR(2)	5 µg/L
Phycocyanin (BGA-PC) **(Freshwater Blue -Green Algae)**	Range	0 – 300,000 cells/mL
	Resolution	1 cell/mL
	Repeatability	± 10% of reading
	MLD(1)	200 cells/mL
Phycoerythrin (BGA-PE) **(Marine Blue-Green Algae)**	Range	0 – 200,000 cells/mL
	Resolution	1 cell/mL
	Repeatability	± 10% of reading
	MLD(1)	400 cells/mL
Rhodamine WT Dye	Range	0 – 500 µg/L (ppb)
	Resolution	2 Auto-range scales: 0.00 - 99.99 µg/L, 100.0 - 500.0 µg/L
	Repeatability	± 5% of reading
	MLD(1)	0.1 µg/L
	MLR(2)	5 µg/L
Fluorescein Dye	Range	0 – 500 µg/L (ppb)
	Resolution	2 Auto-range scales: 0.00 - 99.99 µg/L, 100.0 - 500.0 µg/L
	Repeatability	± 5% of reading
	MLD(1)	0.1 µg/L
	MLR(2)	5 µg/L
Refined Oil	Range	0 – 10,000 µg/L (ppb) (Napthalene)
	Resolution	0.1 µg/L
	Repeatability	± 10% of reading
	MLD(1)	10 µg/L (Napthalene)
CDOM/FDOM	Range	0 – 20,000 µg/L (ppb) (Quinine Sulphate)
	Resolution	2 Auto-range scales: 0.0 – 9,999.9 µg/L, 10,000 – 20,000 µg/L
	Repeatability	± 10% of reading
	MLD(1)	10 µg/L (Quinine Sulphate)

Aquaread® Ltd reserves the right to change specifications without notice

Notes:

1. MLD (Minimmum Level of Detection) is the minimum value the electrode is physically capable of measuring.

2. MLR (Minimum Level of Repeatability) is the value below which optical electrode readings become generally unreliable and unrepeatable (unless taken under ideal conditions) due to interfering factors such as refraction from visible air bubbles and microscopic aeration.

18.5. What is the Accuracy of the Optical Electrodes?

The accuracy figures quoted throughout this document represent the equipment's capability at the calibration points at 25°C. These figures do not take into account errors introduced by variations in the accuracy of calibration solutions and errors beyond the control of the manufacturer that may be introduced by environmental conditions in the field.

Accuracy in the field is also dependent upon **full calibration** and minimal time between calibration and use.

All Optical Electrodes, with the exception of the Turbidity Electrode, employ fluorescent measurement techniques. Interference from microbiological species and compounds which fluoresce at similar wavelengths and differences in fluorescence caused by temperature, ambient light and turbidity can all cause inaccuracies.

Fluorescence measurement is ideal for researchers who are interested in detecting the presence or absence of a specific substance in reasonable concentrations and measuring relative fluorescence changes that can be used as an indication of increasing or decreasing concentrations. Fluorescence measurement techniques are not ideal for quantitative measurement and it is therefore impossible to specify an absolute accuracy.

In order to obtain accurate results, data obtained with a fluorescent electrode in the field must be post-calibrated with data from standard laboratory analysis of grab samples acquired during the study.

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