Instruction Manual

for the

Aquaprobe AP-5000

Multiparameter Water Quality Probe

and associated

Aquameter, Utilities & Accessories

Aquameter Software Version 4.00 and Above

Document No. 10401-00906

Revision: A

Date: November 28, 2012

Aquaread Ltd

Kent Innovation Centre
Thanet Reach Business Park
Millennium Way
Broadstairs
Kent
CT10 2QQ
ENGLAND

Phone: +44 1843 609 692
www.aquaread.com

PROPRIETARY NOTICE

SOFTWARE LICENCE AGREEMENT

By using the Aquameter, its associated probes and PC based software (AquaLink), you agree to be bound by the terms and conditions of the following software licence agreement. Please read this agreement carefully.

Aquaread Ltd grants you a limited license to use the software embedded in the devices (the "Software") in binary executable form in the normal operation of the products. Title, ownership rights and intellectual property rights in and to the Software remain in Aquaread Ltd.

You acknowledge that the Software is the property of Aquaread Ltd and is protected under British copyright laws and international copyright treaties. You further acknowledge that the structure, organisation and code of the Software are valuable trade secrets of Aquaread Ltd.

You agree not to decompile, dissemble, modify, reverse assemble, reverse engineer or reduce to human readable form the Software or any part thereof or create any derivative works based on the Software.

RECYCLING

Any product bearing this symbol must be handed over to an applicable collection point for the recycling of electrical and electronic equipment. By ensuring this product is disposed of properly, you will prevent possible adverse consequences for the environment which could be caused by inappropriate waste handling.

Note: For return for recycling, please contact Aquaread Ltd for instructions on how to return end-of-life equipment, accessories, and all auxiliary items for proper disposal.

WARNING

Favourable indications made by this equipment **do not guarantee** water is safe for human or animal consumption. This equipment **can not** detect the presence of harmful bacteria or toxins. If in doubt, **ALWAYS TREAT SUSPECT WATER PRIOR TO CONSUMPTION.**

Limitations of Liability

Aquaread Ltd and its affiliates specifically disclaim liability for any and all direct, indirect, special, general, incidental, consequential, punitive or exemplary damages including, but not limited to, loss of profits or revenue or anticipated profits or revenue or expenses incurred arising out of the use or inability to use any Aquaread product, miscalibration, loss of data or product failure, even if Aquaread Ltd and/or its affiliates has been advised of the possibility of such damages or they are foreseeable or for claims by any third party. Notwithstanding the foregoing, in no event shall Aquaread Ltd and/or its affiliates aggregate liability arising under or in connection with Aquaread products, regardless of the number of events, occurrences, or claims giving rise to liability, be in excess of the price paid by the purchaser for the Aquaread product.

TRADEMARKS

Table of Contents

1. Introduction

This manual covers the setup, operation, calibration and maintenance of the Aquaprobe AP-5000, Aquameter V4.00+ Meter, AquaLink V4.00+ PC software and associated Aquaprobe accessories.

2. What's in the Box?

The Aquameter is supplied with the following:

- The Aquameter unit.
- Quick release lanyard.
- Set of 5 AA Alkaline batteries.
- USB Cable for downloading logged data to a PC.
- Cross-head screwdriver for fitting the batteries and Probe maintenance.
- Getting started card for quick reference.
- CD containing AquaLink software, USB drivers and this Instruction Manual.
- Warranty card.

The AP-5000 is supplied with the following:

- Protective Sleeve End Cap (pre fitted).
- 600mL of RapidCal Solution.
- Two part calibration / rinse cup.
- One mounting nut (pre-fitted).
- Getting started card for quick reference.

To complete your system, you will also need an AP-5000 Extension Cable, which should be purchased separately.

2.1. The Aquameter and the Environment

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.

2.2. The AP-5000 and the Environment

The AP-5000 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.

2.3. About the Probe Sleeve

The AP-5000 is constructed with an aluminium sleeve surrounding the delicate sensing electrodes. The Sleeve can be easily removed by unscrewing to allow cleaning of the individual electrodes, however, **the Probe sleeve forms an integral, working part of the Probe's measurement system, and MUST be fitted for correct operation.**

2.4. Protective Sleeve End Cap

Whilst the AP-5000 is fitted with an extremely rugged sleeve, damage may be caused to individual electrodes if sharp objects are allowed to enter the open end of the lower sleeve.

In order to avoid this, a protective Sleeve End Cap is provided and should always be fitted.

Both the Sleeve and protective Sleeve End Cap must be fitted during calibration or when using the AP-5000 with the optional Flow Through Cell (Flowcell).

Damage caused to electrodes when the Sleeve or Sleeve End Cap is not fitted, is not covered by your warranty.

2.5. About the Lanyard

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.

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 all 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** 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.

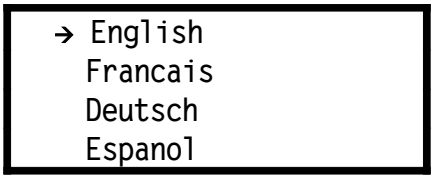
If you are used to operating a mobile phone or programming audio/visual equipment using a remote control, you should feel at home with the familiar up/down left/right arrow shaped navigation keys and central **OK** key.

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.

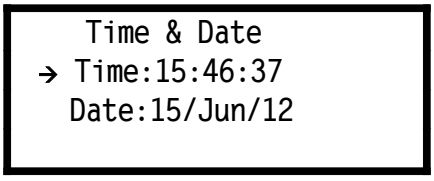
4.1. Initial Switch On, Language and Clock Setup

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.

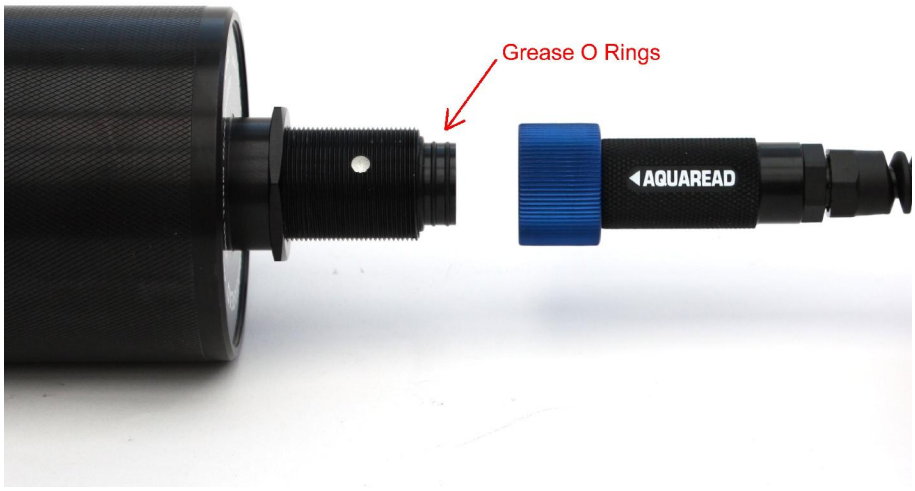
The next screen to be displayed is the Time & Date Setting Screen.



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. Connecting an AP-5000

The AP-5000 is designed to connect to the Aquameter using an AP-5000 Extension Cable. The AP-5000 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 supplied.



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-5000, align the coloured dot on the AP-5000 with the **◄AQUAREAD** logo on the plug body, then press the plug into the socket and tighten the retaining collar fully. Once the AP-5000 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-5000. 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-5000 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.

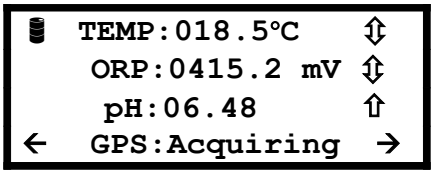
6. Taking Measurements

The AP-5000 includes a pH/ORP electrode, which is kept moist by a storage cap. Remove the storage cap by pulling the red lanyard marked ‘Remove Before Use / Replace After Use’ straight down. **Do not use a twisting motion to remove or replace the cap as this can unscrew the electrode from the Probe body.** Rinse any salty deposits from the pH/ORP electrode with fresh water.

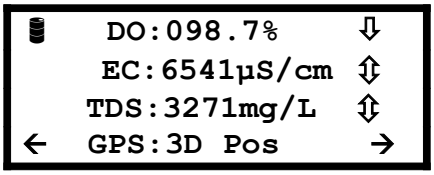
Fit the protective Sleeve End Cap into the end of the Probe sleeve. Switch the Aquameter on and immerse the AP-5000 in the sample water, making sure that the water level covers the minimum immersion depth groove halfway up the Probe sleeve.

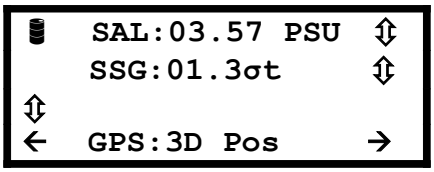
TIP: Occasional application of a smear of silicone grease or similar lubricant to the protective Sleeve End Cap thread will make fitting and removal of the Cap easier.

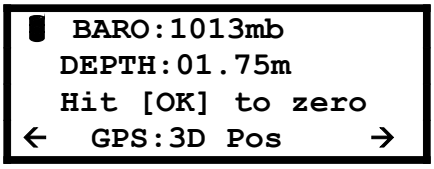
If the AP-5000 is connected correctly, the meter will read the Probe's serial number and model number, then will automatically configure itself to display only those readings the current AP-5000 is capable of taking. Initial Probe readings will be displayed on the meter's screen along with the current GPS status. The initial data screen for the GPS Aquameter in conjunction with the AP-5000 is shown below.

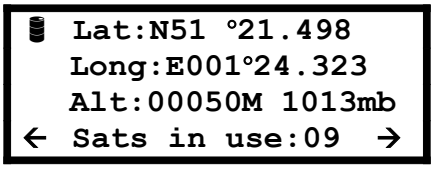


Left/right arrows at the bottom corners of the screen indicate further data screens are available. To access these screens, simply press either the left or right arrow keys. Any value that is out of range or unavailable will be displayed as dashes. The other four screens available with the standard AM-200/AP-5000 combination are shown below.









6.1. What Does It All Mean?

The screens above show the full default range of readings for the AM-200/AP-5000 combination. If you are using a different Meter/Probe combination, you may have fewer screens to choose from and the readings may appear in a different order to facilitate logical screen layouts. 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.

The table below explains the readings.

Prefix	Meaning	Units
TEMP	Probe Temperature	°C or °F*
pH	pH (Acidity/Alkalinity)	pH or pHmV*
ORP	Oxidation Reduction Potential	mV
GPS	GPS Status	See section 6.5
DO	Dissolved Oxygen	%Sat or mg/L*
EC	Electrical Conductivity	µS/cm or mS/cm†
TDS	Total Dissolved Solids	mg/L or g/l†
SAL	Salinity	PSU or ppt*
SSG	Sea Water Specific Gravity	σt
BARO	Barometric Pressure	mb or mmHg*
DEPTH	Depth above / below zero datum	Meters / Feet*
Lat	Latitude	Degrees & Mins
Long	Longitude	Degrees & Mins
Alt	Altitude above Sea Level	Meters or Feet*

Items in the Units column marked with an asterisk (*) can be selected as alternative units of measurement in the Settings Menu (see section 9). Items in the Units column marked with a dagger (†) are auto-ranging, i.e. when the values become too large to display, the units of measurement automatically re-scale.

The EC field can be replaced by its reciprocal value, RES (Resistivity), if selected in the Settings Menu. If selected, readings will be displayed in either Ω▪cm or KΩ▪cm, depending on the value. See section 9 for more details.

6.2. Trend Indication

To the right of each reading, (except position, BARO and Depth), 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%.

6.3. Global Stability Indication

In addition to the individual trend indications, there is a global stability indication, which is displayed when **all** readings are stable. This takes the form of a flashing double headed arrow which is displayed at the start of the third line of the display.

When taking a set of readings, gently stir the Probe, or raise and lower it in the sample (if there is no natural water flow) until the global stability icon appears. The initial display of the global stability icon will be accompanied by a double beep. When this occurs, all values are stable and ready for reading or saving.

6.4. Temperature Compensation

The electrochemical properties of all solutions change with the solution's temperature. In addition, the response of electrochemical 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.

In order to facilitate this, the AP-5000 automatically applies corrections for temperature wherever required.

During calibration of the pH and ISE electrodes, the variation in the calibration buffer solution due to temperature is automatically corrected for. The variation in response of the electrodes due to temperature is also automatically compensated for. During measurement, the variation in response of the electrodes due to temperature is automatically compensated for.

During calibration of the EC electrode, the variation in the calibration buffer solution due to temperature is automatically corrected for. During measurement of EC, the readings can be displayed without any temperature correction, corrected to 20°C, or corrected to 25°C. See section 9: for more details.

During calibration of the DO electrode, variations due to temperature and air pressure are automatically compensated for. During the measurement of DO, temperature, air pressure and salinity are automatically compensated for.

During calibration of the ORP electrode, the variation in the calibration buffer solution due to temperature is automatically corrected for. During measurement of ORP however, temperature corrections are not applied as the correction factors are system and chemical dependent and are not easily determined.

ORP potential measurements are mostly made to follow reactions rather than for their own sake. The completion of an ORP reaction is normally accompanied by a sharp change in the ORP millivolts reading. This change is usually much larger than the errors induced by temperature side effects.

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.

6.5. GPS Reception

The GPS version of 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.

7. Depth Measurement

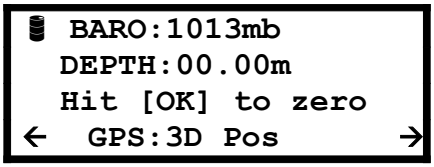
Depth is measured in the AP-5000 by a pressure sensor mounted inside the body of the probe. The datum on the probe for depth measurement is the top row of holes on the probe sleeve.

Depth is calculated by subtracting the barometric pressure being measured in the Aquameter from the water pressure being measured in the AP-5000. The pressure differential, once corrected for temperature and salinity (water density), is directly proportional to depth.

The depth measurement system uses the EC sensor to detect when the probe has been placed in water. All the time the probe is measuring an EC of zero, the depth will read zero. As soon as an EC value is detected, the meter will start to calculate depth. **For this reason, it is important to ensure the Probe is connected to the Meter and switched on prior to submerging the probe in water.**

7.1. Taking Depth Measurements

Connect the Probe to the Meter and switch on prior to submerging the probe in water. Select the Baro/Depth screen as illustrated below. The depth should be reading zero.



If the depth is not reading zero (this is possible if the probe is wet and a low EC reading is registering), press the OK key. You will be asked to confirm by pressing OK again.

Slowly lower the probe into the water. As soon as the depth value starts to register, you can lower the probe more quickly.

7.2. Differential Depth Measurement

If you want to measure changes in depth, it may be more convenient to zero the depth measurement once the probe has been submerged.

To do this, press the OK key whilst displaying depth, then confirm. The unit will now read positive or negative changes in depth from the current depth (zero datum).

If the values are positive, the water level has increased from the zero datum. If the values are negative, the water level has decreased.

Using the Automatic Data Logging feature detailed in the following section, it is possible to monitor water levels over a period of time for later recall.

8. Memory Mode

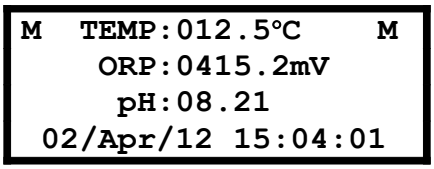
8.1. Manually Saving Readings

When you are happy that the readings are stable (see section 6.3: Global Stability Indication), 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.



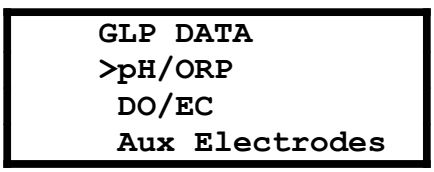
During Memory Recall, an 'M' is flashed in the top left and right corners of the screen alternatively with an up/down arrow and a left/right arrow. This is to indicate that the Meter is in Memory Recall mode and that other screens can be accessed using the arrow keys.

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. In addition to the date of the last successful EC calibration, the Calibration Standard value at which the EC was calibrated is also displayed (see section 14: Calibrating EC for further details).

To view the last successful calibration date for each 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.



Using the up/down keys, select the electrode you are interested in, then press either the OK key or the right arrow key. If, for instance, you selected pH/ORP, the screen below would be displayed.

```
      GLP DATA
pH7.00 [31/Jan/12]
pH4.01 [07/Feb/12]
ORP    [09/Feb/12]
```

This tells you that the last successful calibration, **prior to the recorded reading being taken**, was January 31st for the pH 7.00 point, February 7th for the pH 4.01 point and February 9th for ORP. If the date field is dashed (==/===/==), this means the electrode was either not fitted or had never been calibrated.

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 automatically 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.

To do this, 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.

```
→ Clean Probe
  Auto Data Logging
  Calibration
  Setup & Install
```

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.

```
Auto Data Logging

→Interval:10 Mins
   Status:OFF
```

Using the arrow keys to navigate, set the desired logging interval, then set the **Status** to **ON**.

To leave this screen, reverse back to the Main Menu screen then the normal operation screen by pressing the left arrow key. The Meter will now record a full set of data automatically at the set rate until either the memory is full or the batteries go flat.

To remind you 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.

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.

8.6. Important Information About Memory Mode

When data is saved in the Meter, it is compressed in raw Probe format. In other words, the same way that it came up from the Probe. When you recall the data in Memory Recall mode, the data is decompressed, then processed for display.

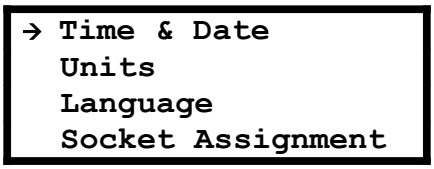
The advantage of this is that the readings will always appear in the current Meter configuration. For example, if you spent a day taking readings with the Meter set to read Dissolved Oxygen in %Saturation, then when you got back you really want to see Dissolved Oxygen displayed in mg/L, you can do this by simply changing the Meter settings (see section 9).

The stored data can be displayed any way you want on recall. You are not limited to viewing the data in the same way it was logged. This is a major advantage and allows you to actually store and recall far more parameters than can be displayed at any one time.

The same rules apply when data is output to a PC running AquaLink Software via the USB cable. The data that is output is always as per the Meter's current configuration. You can output the data as many times as you like in various Meter configurations.

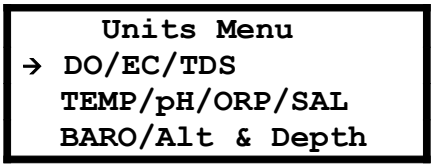
9. Setup & Install

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, the 'Socket Assignment' option on this screen is only accessible when an AP-5000 or AP-5000 Probe is connected.



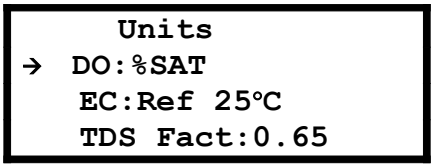
9.1. Setting Units of Measurement

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. Choose line 2 if you want to adjust Temperature, pH, ORP or Salinity. Finally, line 3 will give access to Barometric Pressure, Altitude and Depth settings.

Moving the cursor right onto the first line will display the following screen.

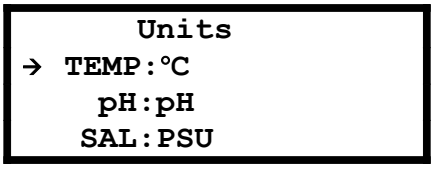


On this screen you can adjust the DO: setting between %Sat and mg/L. This will set the Meter to display Dissolved Oxygen as either % Saturation or in milligrams/Litre (which is the same as parts per million). Both readings are automatically corrected for atmospheric pressure, sample temperature and sample salinity.

The second option on this screen allows you to choose how the Meter displays Electrical Conductivity. There are four options. EC can be displayed as 'Absolute EC' without any temperature correction [ABS EC], as 'Specific EC' referenced to 20°C [Ref 20°C], as 'Specific EC' referenced to 25°C [Ref 25°C] or as a reciprocal of Absolute EC, which is Absolute Resistivity [ABS RES].

Finally, this screen allows you to set the factor that the Meter uses to calculate Total Dissolved Solids from Specific EC. This is the TDS Fact: (TDS = EC x TDS Fact) and can be set anywhere between 0.00 and 1.00. Default value is 0.65.

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



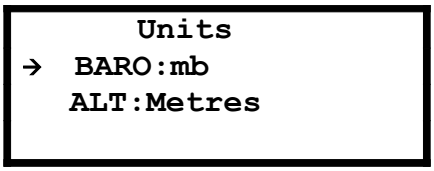
The first option on this screen allows you to change the temperature display between °C and °F.

The second option allows you to change the pH display between plain pH and pHmV. Plain pH displays normal, temperature compensated pH values in the range 0 - 14.

pHmV displays the actual voltage being generated by the pH electrode in +/- millivolts (mV) over a range of +/- 625mV. This is not temperature compensated.

The last option on this screen allows you to choose between displaying salinity in Practical Salinity Units (PSU), or parts per thousand (ppt), which is the same as grams per litre.

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 and depth in metres (M) or feet (F). Whatever units ALT is set to, DEPTH will follow. Altitude is displayed with respect to mean sea level.

Depth is displayed with respect to the depth zero datum, which can be the water surface or any point at which the depth has been zeroed. See section 7: Differential Depth Measurement for further details.

9.2. AUX Socket Assignment

The AP-5000 features four AUX (axillary) sockets into which additional electrodes may be fitted. Any of the AUX sockets can be fitted with either AP-5000 Optical electrodes or AP-5000 ISE (Ion Specific) electrodes.

When an electrode has been fitted to an AUX socket (see appendix 2 for fitting instructions), the socket must be assigned to the specific electrode type.

The Socket Assignment option is only available if the Aquameter is connected to an AP-5000. This is because the assignment data is held in the Aquaprobe, not in the Aquameter.

When the Socket Assignment option has been selected, the following screen will be displayed.

The numbers 1 – 6 represent the AUX socket numbers. Only sockets 1 -4 are available on the AP-5000 so the other two are shown as N/A. These additional sockets are available on the AP-7000 only.

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

Using the up and down arrow keys, select the AUX socket you wish to assign then move the cursor to the right by pressing the right arrow key. When the cursor has moved to the right of the AUX socket number, use the up and down arrow keys to select the appropriate electrode type.

The tables below show the available electrode options and the selection that should be made on this screen:

AP-5000 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	OIL

AP-5000 ISE Electrodes

Electrode Part No.	Function	Aquameter Selection
7000-AMM	Ammonium/Ammonia	NH4
7000-CHL	Chloride	Cl
7000-FLU	Fluoride	F
7000-NIT	Nitrate	NO3
7000-CAL	Calcium	Ca2

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-5000. The socket assignments are stored in the AP-5000.

If you press the ESC key whilst in this screen, any changes you have made will not be transferred to the AP-5000.

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

If you subsequently remove an electrode, be sure to set the socket assignment back to EMPTY.

10. RapidCal Calibration Method

10.1. About Calibration

Calibration is a very important part of successful water quality measurement and should be carried out regularly as detailed in each separate 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.

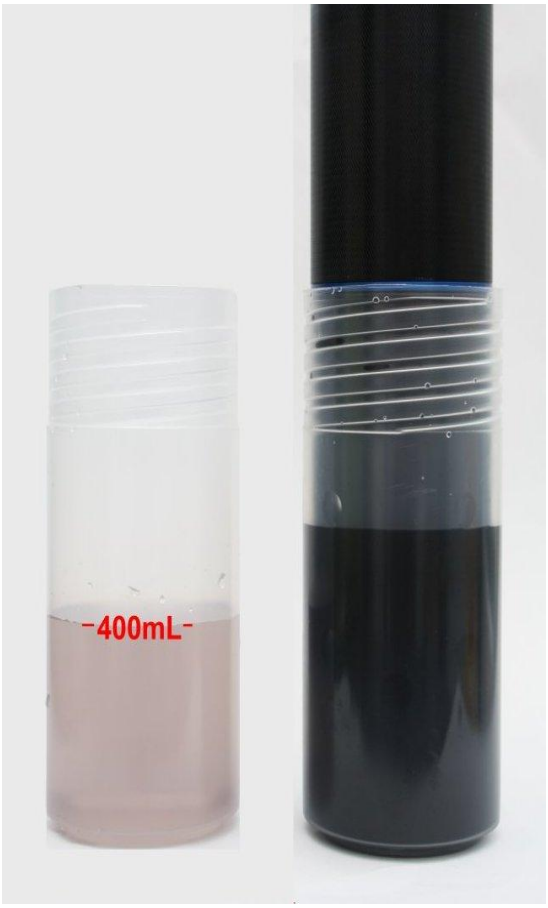
The AP-5000 is provided with a two part calibration cup. The probe is designed to be calibrated in these cups **with the Probe Sleeve and Sleeve End Cap fitted.**

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

10.2. Using RapidCal

RapidCal is an easy way to calibrate the AP-5000 in the field using just one calibration solution. RapidCal calibrates EC at 2570µS/cm, the pH7.00 point and all the optional Optical Electrodes Zero points simultaneously. Ideally, this procedure should be carried out at the beginning of each day the Probe is to be used. To use RapidCal:

1. Pour 400mL of RapidCal solution into one of the calibration cups provided as shown in the adjacent photograph.



2. Remove the storage cap from the pH electrode if fitted, wash the Probe in distilled water, then gently lower the Probe into the calibration cup.

3. Bang the probe against the bottom of the cup several times to dislodge any air bubbles.

4. Wait until all readings are **completely** stable. The longer you can leave the probe to achieve thermal equilibrium before proceeding, the better. A minimum of two minutes is recommended.

5. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF - 104ºF).

6. Press the **MENU** key then select **Calibration.** The following screen will be displayed.

```
   Calibration
→  RapidCal
   DO 100%
   Full Cal
```

7. Select **RapidCal.** The screen will change to:

```
PLEASE WAIT
Stabilising
   000%
```

The Meter will wait until all readings are stable, then it will send the RapidCal 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.

```
Calibrating
   100%
 Press [OK]
```

When calibration is complete, press **OK** then **ESC** to return to normal reading mode**.**

Now the DO 100% saturation point should be calibrated in damp air.

To Calibrate the 100% Saturation Point in Damp Air

1. After calibrating with RapidCaL, remove the Probe from the cup, wash in fresh water, then shake off ensuring there are no droplets adhering to the DO membrane.

2. Moisten a clean cloth or piece of tissue paper with fresh water and wrap it around the end of the probe ensuring all the holes are covered. Place the probe on a flat surface. Do not hold the probe, the heat from your hands will warm the probe up and interfere with calibration.

3. Wait until the temperature measurement is completely stable**. This is very important.**

4. Referring back to the screen shown in item 5 above, select **DO 100%.**

5. Wait while the Aquameter carries out the calibration procedure.

6. When the 'Calibrating 100%' screen (shown above) is displayed, press OK then ESC repeatedly to return to normal reading mode.

10.3. Calibration Error Messages

If the Aquameter detects a problem with either the AP-5000 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
REPLACE DO CAP	Full re-calibration required or Optical DO Cap needs replacing	See note below.
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 RapidCal
OUT OF CAL RANGE	Readings are outside calibration limits. Probe Sleeve is not fitted	Top up / replace the RapidCal. Ensure the Probe Sleeve is fitted
OUT OF TEMP RANGE	Temperature is outside 5°C – 40°C limit ISE differential calibration rules not met.	Warm / cool the RapidCal

If the 'REPLACE DO CAP' error occurs during Optical DO Zero calibration, this usually indicates that the DO Cap needs replacing. Perform a full DO calibration first at DO Zero then at 100% DO. If that does not cure the problem, replace the DO Cap (see Replacing the Optical DO Cap in section 14).

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 then try again.

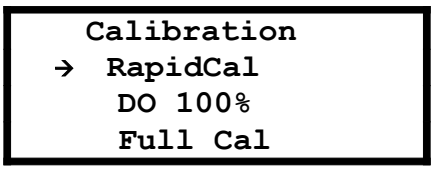
If the 'OUT OF CAL RANGE' error persists when calibrating EC, check you are using the correct EC Calibration Standard and that the sleeve is fitted.

If the 'OUT OF TEMP RANGE' error persists when carrying out a three point ISE calibration, check your solution temperatures are within the specified limits with respect to eachother.

Remember: **The Probe sleeve and End Cap form an integral, working part of the Probe's optical and EC measurement system, and MUST be fitted during calibration and measurement for correct operation. If you try to calibrate the Probe without the sleeve fitted, you may get an error message.**

10.4. 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 Probe to its factory defaults. To do this, first bring up the Calibration screen:



Select Full Cal. This will give you a choice of electrodes:

```
   Calibration
→  pH/ORP
   DO/EC
   Aux Electrodes
```

Move the cursor arrow to the electrode you want to reset, then press the **MR** key. If you select Aux Electrodes, you must press OK first to enter the Aux Electrode selection screen. Once in that screen, select the Aux electrode you want to reset then press **MR**.

A confirmation screen will be displayed.

```
Are you sure you
want to restore the
factory calibration
values?  [ESC]=NO
```

If you are sure, press the **OK** key. If you want to change your mind, press the **ESC** key. If you press OK, you will see a message that says CAL RESTORED.

Once factory calibration defaults have been restored, you **must** carry out a **full calibration** of the electrode in question.

10.5. Calibration Data Storage

The AP-5000 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.

10.6. 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.

No calibration report is generated when using RapidCal.

11. After Use

The AP-5000 should always be cleaned after every use.

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-5000 can be removed by unscrewing to allow cleaning of the individual electrodes. After every use, remove the protective Sleeve End Cap then unscrew the sleeve. With the Sleeve removed, the individual electrodes are very vulnerable, so please handle the Probe with extreme care. If you drop it, it's going to break!

Rinse the exposed electrodes, the inside of the Sleeve and the Sleeve End Cap with fresh, clean water. Shake the water from inside the Sleeve, then reattach. Dry the outside of the Probe using a soft cloth.

Remember to replace the pH/ORP storage cap after use. Failure to do so will damage the electrode. For more details, see Keeping the Electrodes Moist in section 13.

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.

Store the Probe without the protective Sleeve End Cap fitted in order to allow free air circulation around the individual electrodes.

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

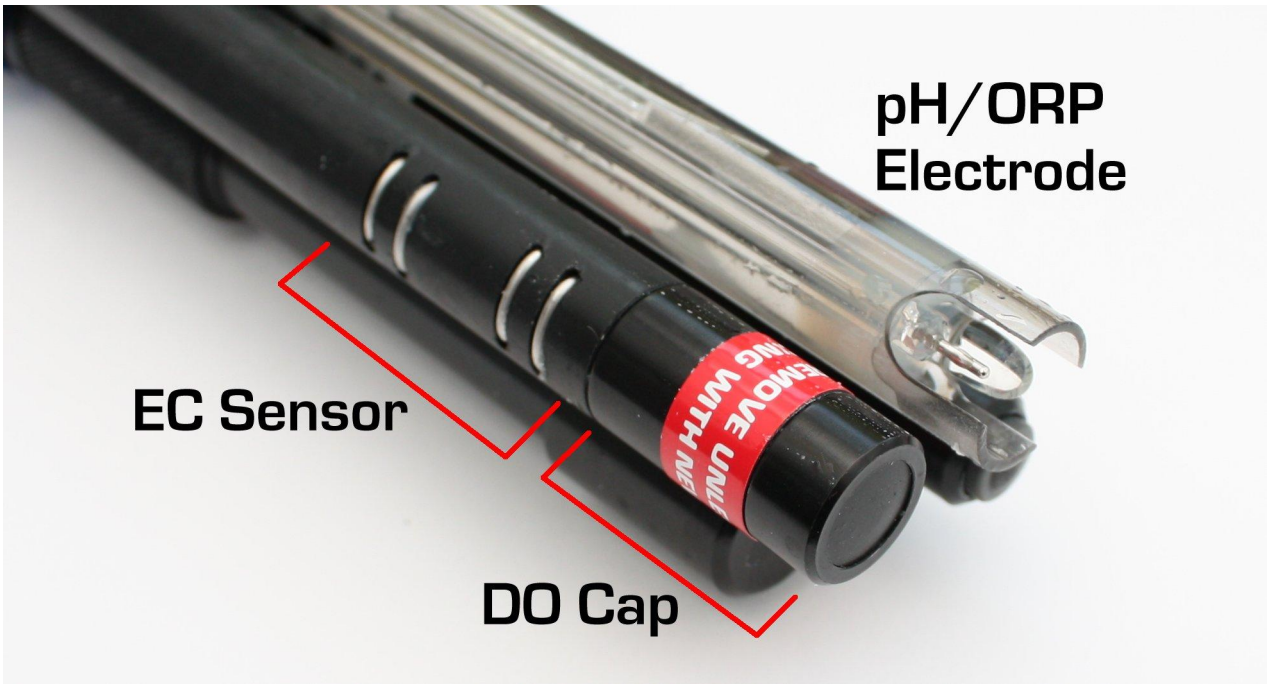
12. General Probe Maintenance

Other than regular cleaning and calibration, very little in the way of maintenance is needed.

12.1. Identifying The Individual Electrodes

The photograph below shows the two standard electrodes, the Combi pH/ORP electrode and the DO/EC electrode.

The DO/EC electrode includes the Optical DO sensor the EC sensor and the temperature sensor. These electrodes will be referred to in the next two sections.



13. pH/ORP Electrode Calibration and Maintenance

13.1. Recognising the pH/ORP Electrode

The combined pH/ORP electrode is easy to recognise because it is the only electrode that is not black. This electrode has a clear, gel filled body.

13.2. Electrode Removal and Replacement

The pH/ORP electrode can be unscrewed from the Probe body by rotating it anti-clockwise. When replacing an electrode, apply a little silicone grease or similar lubricant to the thread and O ring, then screw fully in.

Gripping the knurled collar at the top of the electrode, tighten until the O ring is fully compressed.

Useful Tip: The red lanyard that is attached to the pH/ORP storage cap makes a very useful belt wrench for tightening and loosening the pH/ORP and AUX electrodes.

Slide the lanyard over the electrode and use it to grip the knurled body.

Never immerse an AP-5000 with the pH/ORP electrode removed. This will cause serious damage to the electrode socket. **This is not covered by your warranty.**

13.3. Keeping the Electrodes Moist

It is very important that the pH/ORP electrode is kept moist when not in use. This is achieved by always fitting the storage cap, which incorporates a sponge that should be soaked in a special storage solution.

The sponge within the storage cap should be moistened with a few drops of pH Electrode Storage Solution each time it is removed and replaced. If a pH/ORP electrode is inadvertently allowed to dry out, it must be re-hydrated by soaking in storage solution for at least one hour prior to use.

13.4. Calibrating pH

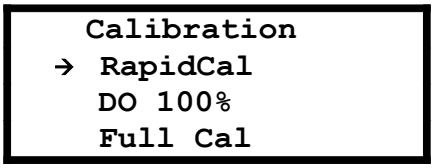
pH electrodes should be calibrated fully at least once a week to ensure optimum accuracy. Full calibration involves calibrating at pH 7.00 first, then at pH 4.01. Although the AP-5000 allows only two point pH calibration, the pH electrodes are extremely linear and once calibrated, will read accurately over the full range of 0 – 14.

Due to the way in which pH calibration works, **the Probe must be calibrated at pH7.00 before calibrating at pH 4.01**. Never calibrate at pH 4.01 before first calibrating at pH7.00.

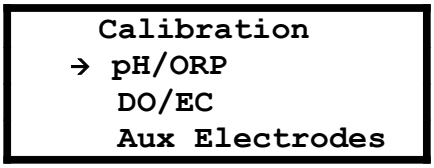
For best results, calibrate as close to 25°C as possible. The probe will compensate for temperature variation in the calibration buffer and pH electrode during calibration.

To calibrate the pH electrode follow these steps:

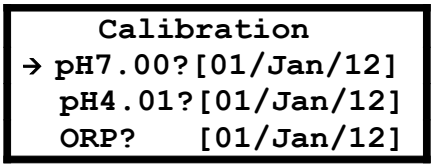
1. Pour 200mL of fresh pH 7.00 solution or RapidCal in a calibration cup, remove the storage cap from the pH electrode, wash the Probe in distilled water, then gently lower the Probe in all the way.
2. Bang the probe against the bottom of the cup several times to dislodge any air bubbles.
3. Wait until the temperature and pH measurements are completely stable.
4. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF – 104ºF).
5. Press the **MENU** key then select **Calibration.** The following screen will be displayed.



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

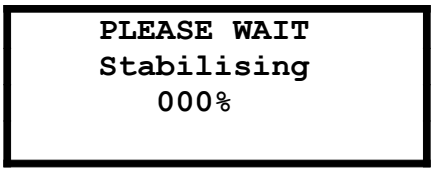


7. Select **pH/ORP**. The screen will change to:

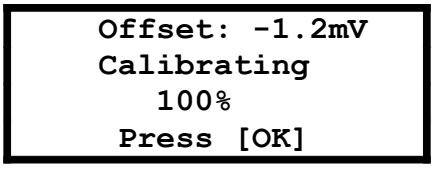


The dates shown to the right of the screen are the dates of the last successful calibration.

8. Select pH7.00. 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 top line displays the voltage offset from zero for the pH electrode in +/-millivolts (mV). If this offset goes beyond +/-25mV at 25°C, the pH electrode should be serviced.

This value is not stored in memory so should be noted down in a calibration record book for the Probe. When the offset voltage details have been noted down, press **OK** then **ESC** repeatedly to return to normal reading mode**.**

Remove the Probe from the calibration cup, rinse thoroughly in de-ionised water, shake off any excess and dry the outer sleeve with a soft cloth.

Now pour 200mL of fresh pH 4.01 solution into a clean calibration cup and gently lower the Probe in. Follow the procedure detailed above, but at step 7, select pH4.01. Wait while the Meter stabilises and calibrates. When the 'Calibrating 100%' screen is displayed, the calibration report will display the slope for the pH electrode in millivolts (mV) per pH unit. If this slope goes below 45mV/pH at 25°C, the pH electrode should be serviced. Press **OK** then press the **ESC** key repeatedly to get back to the main display.

Remove the Probe from the calibration cup, rinse thoroughly in fresh water, shake off any excess and dry the outer sleeve with a soft cloth. Dampen the sponge in the storage cap with storage solution and fit it to the pH/ORP electrode. pH calibration is now complete.

13.5. 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.

13.6. pH Electrode Efficiency

If the pH electrode becomes worn or clogged, its efficiency and response time can be reduced. The efficiency of the pH electrode is constantly monitored and in the event of the efficiency dropping below 85%, 'ERROR 01' will be flashed on the bottom line of the display. If this occurs, or if the pH reading response becomes slow, recondition the electrode as described below.

13.7. Servicing the pH Electrode

1. Remove the pH or combined pH/ORP electrode from the Probe body (see Electrode Removal and Replacement).
2. Rinse with methyl alcohol.
3. Replace the electrode.
4. Re-calibrate.

Never place the entire AP-5000 in methyl alcohol, as this will cause irreparable damage to the DO/EC electrode. Damaged caused in this way is not covered by the warranty.

If the methyl alcohol rinse does not restore the electrode, perform the following actions:

1. Remove the electrode from the body again.
2. Soak in 0.1M HCl for 5 minutes.
3. Rinse in de-ionised water.
4. Soak in 0.1M NaOH for 5 minutes.
5. Rinse in de-ionised water.
6. Soak in pH4.01 buffer for 10 minutes.

If the above procedure still does not restore performance, replace the electrode.

13.8. Calibrating ORP

ORP electrodes should be calibrated at least once a month to ensure optimum accuracy. Full calibration involves calibrating at a single point, (250mV at 25°C) using a 250mV ORP calibration standard such as **Reagecon RS250 Redox Standard,** or similar.

For best results, calibrate as close to 25°C as possible. The probe will automatically compensate for temperature variation in the calibration solution during calibration.

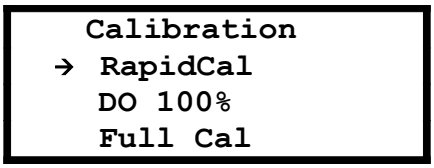
To calibrate the ORP electrode follow these steps:

1. Pour 200mL of fresh calibration solution into a calibration cup, remove the storage cap from the pH/ORP electrode, wash the Probe in distilled water, then gently lower the Probe in all the way.

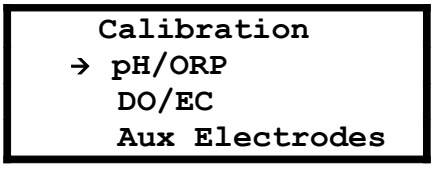
2. Bang the probe against the bottom of the cup several times to dislodge any air bubbles. Wait until the temperature and ORP measurements are completely stable.

3. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF - 104ºF).

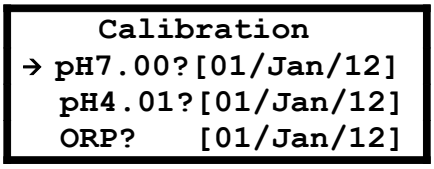
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.



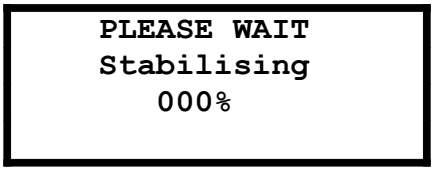
5. Select **Full Cal.** The screen will change to:



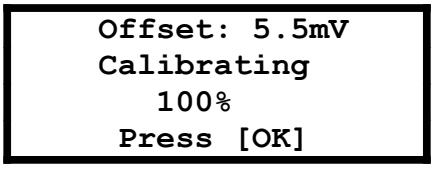
6. Select **pH/ORP**. The screen will change to:



7. Select ORP. 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 offset between the ORP electrode output and the value of the calibration solution at the calibration temperature in +/-millivolts (mV). During normal operation this offset will be subtracted from the ORP electrode output to give a corrected ORP display.

This value is not stored in memory so should be noted down in a calibration record book for the probe. When calibration is complete, press the **OK** key then the **ESC** key repeatedly to return to normal operating mode.

Remove the Probe from the calibration cup, rinse thoroughly in fresh water, shake off any excess and dry the outer sleeve with a soft cloth. Dampen the sponge in the storage cap with storage solution and fit it to the pH/ORP electrode. ORP calibration is now complete.

13.9. Converting ORP Readings to the Hydrogen Scale

Electrochemical measurements are ultimately referred to the so-called hydrogen scale, the convention for which is that the electrochemical potential of a hydrogen electrode in contact with hydrogen gas at one atmosphere partial pressure and a solution containing hydrogen ions at unit activity is zero at all temperatures.

The ORP reference electrode used in Aquaread combination electrodes is a 3MPK1 silver chloride type, and exhibits potentials on the hydrogen scale of:

Temperature	Potential
5°C	221 mV
10°C	217 mV
15°C	214 mV
20°C	210 mV
25°C	207 mV
30°C	203 mV
35°C	200 mV
40°C	196 mV

Thus, to refer an ORP potential value measured with the AP-5000 to the hydrogen scale, the appropriate value above should be added to the measured value.

14. DO/EC Electrode Calibration and Maintenance

14.1. Recognising the DO/EC Electrode

The DO/EC electrode is easy to recognise because it has a screw-on cap and four stainless-steel EC sensor contacts on the side (see photograph in section 12). Dissolved Oxygen (DO) is measured at the end of the electrode by the components behind the removable cap. Electrical Conductivity (EC) is measured on the side of the electrode by the four stainless steel contacts. The sleeve forms part of the EC cell. Temperature is also measured in this electrode.

14.2. DO Measurement Technique

The AP-5000 features an optical DO sensor. This sensor does not use a liquid electrolyte and has a black rubber gas-permeable membrane. See Appendix 1. The Tech Behind Aquaread's Optical DO Measurement System for further details.

14.3. Precautions During Use

EC measurement is not possible with the Probe's Sleeve removed as the Sleeve forms an integral part of the measurement system.

Never immerse the Probe without the DO Cap fitted. If the components at the end of the DO/EC electrode come into contact with the liquid being tested, serious damage can occur to the DO/EC electrode circuitry.

14.4. Calibrating the DO/EC Electrode

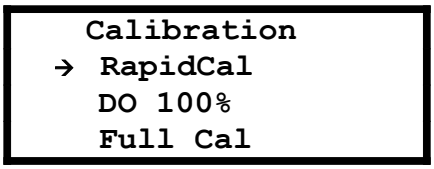
Calibration of the EC section of the electrode is normally carried out during RapidCal (see RapidCal Calibration Method). EC can be calibrated separately using different EC Calibration Standards, this is covered after the DO calibration section (Calibrating EC).

The DO section of the electrode should be calibrated at the Zero saturation point at least once a month. Before each day's use, the 100% saturation point should be checked in moist air and re-calibrated if necessary. For optimum accuracy, calibrate the DO100% point as near to your sample temperature as possible (within the calibration temperature limits of 5°C - 40°C).

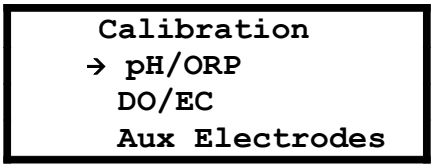
If you are going to calibrate both the Zero and 100% points at the same time, **ALWAYS calibrate the Zero point first**, then the 100% point.

14.5. Calibrating the DO Zero Point

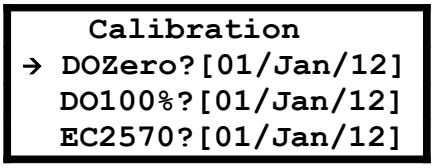
1. Pour 200mL of DO Zero calibration solution into a calibration up, remove the storage cap from the pH electrode if fitted, wash the Probe in distilled water, then gently lower the Probe in all the way. The Sleeve End Cap should not be fitted.
2. Bang the probe against the bottom of the cup several times to dislodge any air bubbles. Wait until the temperature and DO measurements are completely stable.
3. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).
4. Press the **MENU** key then select **Calibration. T**he following screen will be displayed.



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

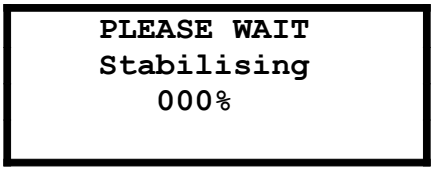


6. Select **DO/EC**. The screen will change to:

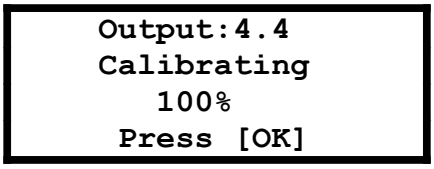


The dates shown to the right of the screen are the dates of the last successful calibration.

7. Select DOZero. 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 top line will display a value which represents the health of the luminophore. This value should be between 3.5 and 4.5 (at 25°C). If the value returned is less than 3.5, the Optical DO Cap should be replaced.

This value is not stored in memory so should be noted down in a calibration record book for the probe. When the Cell offset voltage details have been noted down, press **OK** then **ESC** repeatedly to return to normal reading mode**.**

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

Remove the Probe from the calibration cup, rinse thoroughly in fresh water, shake off any excess and dry the outer sleeve with a soft cloth.

14.6. Calibrating the DO 100% Saturation Point in Moist Air

1. Wash the probe thoroughly in fresh water, then shake off ensuring there are no droplets adhering to the DO membrane.
2. Moisten a clean cloth or piece of tissue paper with fresh water and wrap it around the open end of the probe ensuring all the holes are covered. Place the probe on a flat surface. Do not hold the probe, the heat from your hands will warm the probe up and interfere with calibration.
3. Switch the Aquameter on and wait until the temperature measurement is completely stable. **This is very important.**
4. Referring back to the screens shown in items 4 or 6 above (dependent on software version), select **DO100%**
5. Wait while the Aquameter carries out the calibration procedure.
6. When calibration is complete, the Calibration Report will be displayed.

The top line will display a value which represents the health of the luminophore. This value should be between 0.8 and 1.5 (at 25°C). If the value returned is less than 0.8, the Optical DO Cap should be replaced. These values are not stored in memory so should be noted down in a calibration record book for the probe.

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

14.7. Replacing the Optical DO Cap

The Optical DO Cap contains a lens, which is coated with an oxygen sensitive luminophore, which is in turn coated with a black rubber compound that provides optical isolation but is permeable to oxygen. Oxygen molecules pass through the rubber into the luminophore. **Never touch the black rubber end of the DO electrode as the oils in your skin can block the pores in the rubber coating and stop it from working correctly.**

The luminophore within the DO Cap will need replacing every few years, as it is a consumable item. Since the luminophore is an integral part of the DO Cap, the entire DO Cap is replaced. An Optical DO Cap can last up to ten years dependent upon the amount of use it gets. See Sensor Cap Life in Appendix 1 for further details.

Caution: The inside of the Optical DO Cap is very sensitive to light and can be ruined (bleached) if it is exposed to bright light for any length of time. Never remove the Optical DO Cap from the Probe unless you intend to replace it with a new one. When replacing an Optical DO Cap, do so under subdued light.

To replace the Optical DO Cap, follow these simple steps.

1. Remove the Probe sleeve.
2. Unscrew the Optical DO Cap from the end of the DO/EC electrode by rotating it anti-clockwise. Do not touch the exposed optical components.
3. Apply a light smear of silicone grease to the thread and O ring.
4. Remove the new Optical DO Cap from its light-proof bag and quickly screw it onto

the end of the DO/EC electrode. Ensure that the cap is screwed fully onto the electrode and that it is done up tight.

5. Carry out both Zero point and 100% point DO calibration as described earlier.

Please Note: It is essential when replacing the Optical DO Cap to calibrate the Zero point BEFORE calibrating the 100% point.

14.8. Calibrating EC

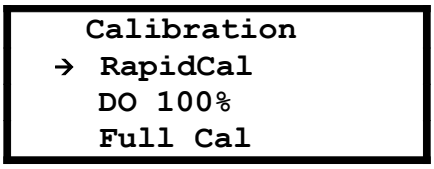
EC calibration is always carried out at a single point. There is a choice of three single points. These are: 1413µS/cm, 2570µS/cm (using Aquaread RapidCal solution) and 12,880µS/cm. These values have been chosen to allow accurate readings to be taken in a variety of water types.

For taking measurements in fresh surface or ground water, use Aquaread RapidCal solution. If this is not available, use a third party 1413µS/cm EC Calibration Standard. For taking readings in brackish or salt water, use a third party 12,880µS/cm (12.88mS/cm) EC Calibration Standard.

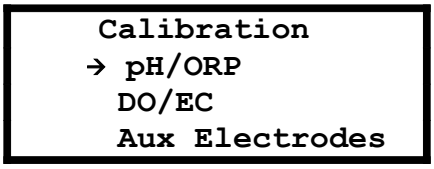
The Probe's Sleeve forms an integral, working part of the Probe's EC measurement system, and MUST be fitted during calibration and measurement for correct operation. If you try to calibrate the Probe without the Sleeve fitted, you will get erroneous results.

For best results, calibrate as close to 25ºC as possible. The probe will compensate for temperature variation in the Calibration Standard during calibration.

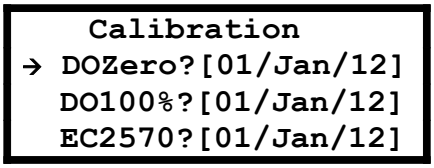
1. Pour 400mL of calibration solution into one of the calibration cups provided. Remove the storage cap from the pH electrode if fitted, wash the Probe in distilled water, then gently lower the Probe into the calibration cup.
2. **Ensure the liquid level is at least two thirds of the way up the calibration cup. Low liquid level will result in erroneous EC calibration**. Refer to the photograph in section 10 Using RapidCal.
3. Bang the probe against the bottom of the cup several times to dislodge any air bubbles. Wait until the temperature and EC measurements are completely stable.
4. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF - 104ºF).
5. Press the **MENU** key then select **Calibration.** The following screen will be displayed.



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

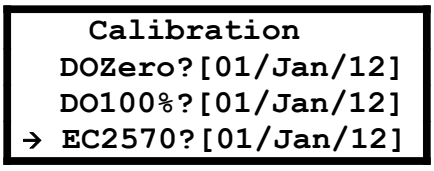


7. Select **DO/EC**. The screen will change to:



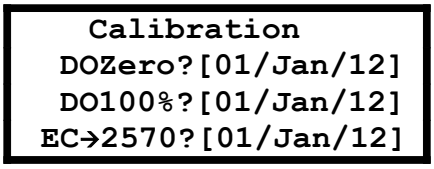
The dates shown to the right of the screen are the dates of the last successful calibration. The value shown on the bottom line next to 'EC' is the value the EC electrode was last calibrated to.

8. Move the pointer down to the bottom line using the down arrow key.



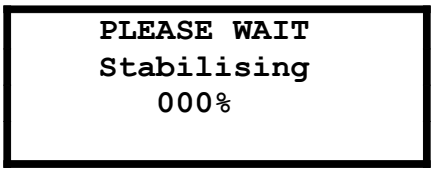
If the Calibration Standard value you are using is already displayed, press the **OK** key to start calibrating. Remember, if you are using RapidCal solution, the EC value on this line should be 2570.

If the value of the EC Calibration Standard you are using is not displayed, press the right arrow key. The bottom line will change to:

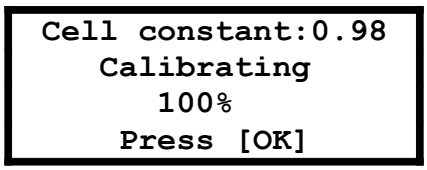


You can now use the up and down arrow keys to select one of three EC Calibration Standard values (1413, 2570 or 12880).

9. Once the correct Calibration Standard value is being displayed, press the **OK** key. The screen will change to:



10. 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 EC Cell Constant. This value is not stored in memory so should be noted down in a calibration record book for the probe.

When the cell constant details have been noted down, press **OK** then **ESC** repeatedly to return to normal reading mode**.**

Special Notes:

- If you have selected a Calibration Standard value other than 2570 (RapidCal), then you subsequently use the RapidCal calibration technique described in section 10, the Calibration Standard value will automatically be reset to 2570.
- The Calibration Standard value is stored in the Probe, **not** the Meter. If you use one Meter with several different Probes, you will have to set the Calibration Standard value for each probe individually during calibration.
- If you select a Calibration Standard value but do not press **OK**, the information will not be sent to the Probe and the change will not be registered.

14.9. Errors During Calibration

At the beginning of the calibration routine, a sanity check is done. If the probe detects that the Calibration Standard value set and the Calibration Standard being used differ, the 'OUT OF CAL RANGE' error will be reported. If any other problems occur during calibration, an error message will be displayed. Refer to Calibration Error Messages in section 10 for error message handling.

14.10. Cleaning the EC Contacts

On a regular basis, thoroughly clean the four stainless steel EC contacts situated on the side of the DO/EC electrode with a soft cloth or toothbrush and non-abrasive detergent. **Never use solvent or alcohol based products to clean the DO/EC electrode**. After cleaning, replace the Probe sleeve and re-calibrate.

15. Optional Optical Electrodes Calibration and Maintenance

15.1. 2000-TURB Turbidity Electrode

Turbidity can be measured by the AP-5000 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.

15.1.1. 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.

15.1.2. 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 bang the probe against the bottom of the cup several times to dislodge any air bubbles. In order to maintain a common reflective pattern between calibration and use, always calibrate and measure turbidity with the protective Sleeve End Cap fitted.

The lens system in the Turbidity Electrodes is designed to focus correctly in water. When the Probe is not submerged, the system will be out of focus and random readings will occur. This is normal.

15.1.3. Calibrating the Turbidity Electrodes

Turbidity calibration must be carried out with the protective Sleeve End Cap fitted.

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

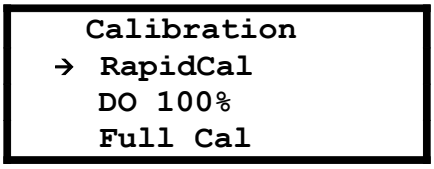
Calibration of the Turbidity electrode Zero NTU point is normally carried out during RapidCal (see RapidCal Calibration Method).

The Turbidity electrode should be calibrated at the Zero NTU point before each day's use, and at least once a month at 1000 NTU to ensure optimum accuracy. To avoid air bubbles in the calibration solutions, **never shake the bottles**.

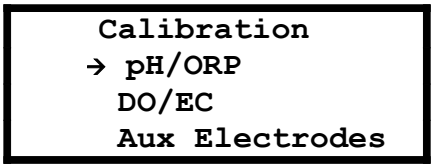
15.1.4. Turbidity Zero Point Calibration

To calibrate the Turbidity zero point, follow these steps:

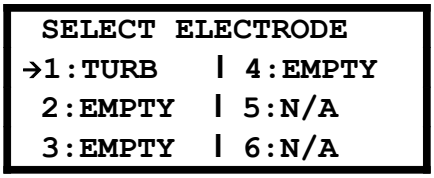
1. Pour 300mL of de-ionised water or fresh RapidCal solution into a clean calibration cup, remove the storage cap from the pH electrode if fitted, wash the Probe in distilled water, then gently lower the Probe in all the way. **The Sleeve End Cap must be fitted**. Bang the probe against the bottom of the cup several times to dislodge any air bubbles.
2. Wait until the temperature and turbidity readings are stable.
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.



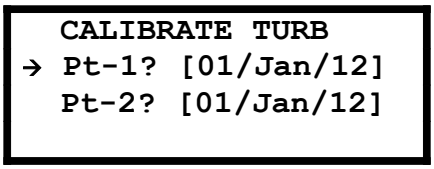
5. Select **Full Cal.** The screen will change to:



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



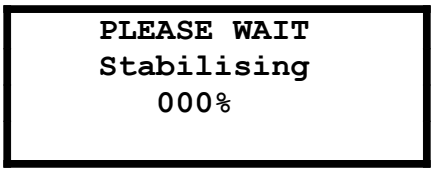
The TURB electrode should have been assigned to an AUX socket when it was fitted. Choose that socket. Press the OK or right arrow key to select TURB. The screen will change to:



Calibration point 1 (Pt-1) is the Zero NTU point. Calibration point 2 (Pt-2) is the 1000 NTU point.

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

7. Select Pt-1. 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 Receiver Electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe.

15.1.5. Calibrating the Turbidity 1000 NTU Point

Remove the Probe from the calibration cup, 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 **StablCal® Standard 1000 NTU Stabilised Formazin Turbidity Standard** solution (manufactured by the **HACH Company** and 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.

Pour 300mL of 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 Turbidity Receiver Electrode in millivolts (mV). Press the **OK** key to continue.

Turbidity calibration is now complete.

15.1.6. 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.

15.1.7. Lens and Sleeve Maintenance

On a monthly basis (or more regularly if heavy fouling occurs), the lenses on the Turbidity electrode should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Similarly, the inside of the Probe sleeve and protective sleeve cap should be kept clean and free from any deposits that may cause stray light reflections. **Never use an abrasive cleaner on the inside of the Probe sleeve as it has 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 after cleaning the sleeve or lenses.

15.1.8. 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.

15.2. 2000-BGA-PC Freshwater Blue-Green Algae (phycocyanin) Electrode

Freshwater Blue-Green Algae (BGA-PC) can be measured by the AP-5000 using the optional 2000-BGA-PC optical electrode.

15.2.1. Principle of Operation

The 2000-BGA-PC optical electrode is a submersible, fixed response fluorometer, which provides excitation at 595nm and detects any resultant fluorescence above 645nm.

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

15.2.2. 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 the fluorometer in the field should be post-calibrated with data from standard laboratory analysis of grab samples acquired during the study.**

15.2.3. 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 establish its slope.

Subsequently, a single point (Zero) calibration should be carried out daily. Calibration of the BGA-PC electrode Zero point is normally carried out during RapidCal (see RapidCal Calibration Method).

Full two-point calibration should be carried out every few months.

15.2.4. 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.

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

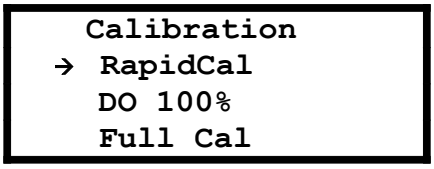
Be sure to handle chemicals with care and to read and comply with all health and safety advice.

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.

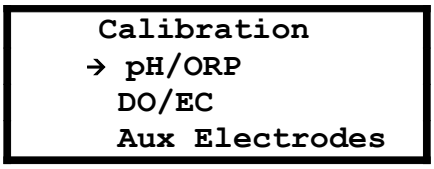
15.2.5. Zero Point Calibration

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 distilled water, then gently lower the Probe in all the way. **The Sleeve End Cap must be fitted**. Bang the probe against the bottom of the cup several times to dislodge any air bubbles.
2. 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.
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:BGA-PC | 4:EMPTY
 2:EMPTY  | 5:N/A
 3:EMPTY  | 6:N/A
```

The BGA-PC 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 BGA-PC. The screen will change to:

```
  CALIBRATE BGA-PC
→ Pt-1? [01/Jan/12]
  Pt-2? [01/Jan/12]
```

Calibration point 1 (Pt-1) is the Zero point. 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 Pt-1. 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.

```
   Offset: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.

15.2.6. 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 freshly mixed Rhodamine 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.

BGA-PB calibration is now complete.

15.2.7. 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.

15.2.8. Lens and Sleeve Maintenance

On a monthly basis (or more regularly if heavy fouling occurs), the sapphire lenses on the electrode should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Similarly, the inside of the Probe sleeve and protective 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 as it has 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 after cleaning the sleeve or lenses.

15.3. 2000-BGA-PE Freshwater Blue-Green Algae (phycoerythrin) Electrode

Salt-water Blue-Green Algae (BGA-PE) can be measured by the AP-5000 using the optional 2000-BGA-PE optical electrode.

15.3.1. Principle of Operation

The 2000-BGA-PE optical electrode is a submersible, fixed response fluorometer, which provides excitation at 540nm 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.

15.3.2. 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.**

15.3.3. 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 establish its slope.

Subsequently, a single point (Zero) calibration should be carried out daily. Calibration of the BGA-PE electrode Zero point is normally carried out during RapidCal (see RapidCal Calibration Method).

Full two-point calibration should be carried out every few months.

15.3.4. 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.

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

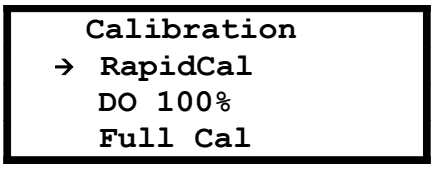
Be sure to handle chemicals with care and to read and comply with all health and safety advice.

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.

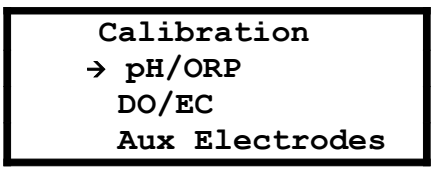
15.3.5. Zero Point Calibration

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 distilled water, then gently lower the Probe in all the way. **The Sleeve End Cap must be fitted**. Bang the probe against the bottom of the cup several times to dislodge any air bubbles.
2. 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.
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:BGA-PE | 4:EMPTY
 2:EMPTY  | 5:N/A
 3:EMPTY  | 6:N/A
```

The BGA-PE 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 BGA-PE. The screen will change to:

```
  CALIBRATE BGA-PE
→ Pt-1? [01/Jan/12]
  Pt-2? [01/Jan/12]
```

Calibration point 1 (Pt-1) is the Zero point. 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 Pt-1. 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.

```
    Offset: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.

15.3.6. 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 freshly mixed Rhodamine 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.

BGA-PB calibration is now complete.

15.3.7. 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.

15.3.8. Lens and Sleeve Maintenance

On a monthly basis (or more regularly if heavy fouling occurs), the sapphire lenses on the electrode should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Similarly, the inside of the Probe sleeve and protective 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 as it has 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 after cleaning the sleeve or lenses.

15.4. 2000-CPHYLL Chlorophyll Electrode

Chlorophyll can be measured by the AP-5000 using the optional 2000-CPHYLL optical electrode.

15.4.1. 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.

15.4.2. 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.**

15.4.3. 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 establish its slope.

Subsequently, a single point (Zero) calibration should be carried out daily. Calibration of the CPHYLL electrode Zero point is normally carried out during RapidCal (see RapidCal Calibration Method).

Full two-point calibration should be carried out every few months.

15.4.4. 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.

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

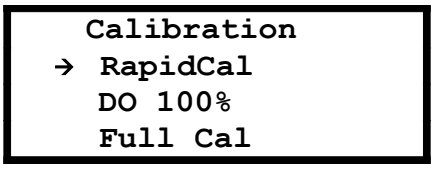
Be sure to handle chemicals with care and to read and comply with all health and safety advice.

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.

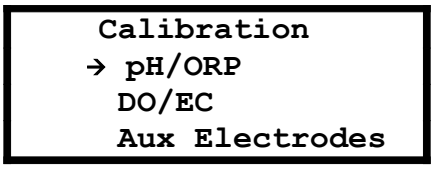
15.4.5. Zero Point Calibration

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 distilled water, then gently lower the Probe in all the way. **The Sleeve End Cap must be fitted**.Bang the probe against the bottom of the cup several times to dislodge any air bubbles.
2. 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.
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:Cphl    | 4:EMPTY
 2:EMPTY   | 5:N/A
 3:EMPTY   | 6:N/A
```

The Cphl 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 Cphl. The screen will change to:

```
  CALIBRATE Cphl
→ Pt-1? [01/Jan/12]
  Pt-2? [01/Jan/12]
```

Calibration point 1 (Pt-1) is the Zero point. 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 Pt-1. 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.

```
    Offset: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.

15.4.6. 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 freshly mixed Rhodamine 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.

BGA-PB calibration is now complete.

15.4.7. 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.

15.4.8. Lens and Sleeve Maintenance

On a monthly basis (or more regularly if heavy fouling occurs), the sapphire lenses on the electrode should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Similarly, the inside of the Probe sleeve and protective 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 as it has 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 after cleaning the sleeve or lenses.

15.5. 2000-RHOD Rhodamine Electrode

Rhodamine WT is a fluorescent red dye that is commonly used in water flow studies and can be measured by the AP-5000 using the optional 2000-RHOD optical electrode.

15.5.1. Principle of Operation

The 2000-RHOD optical electrode is a submersible, fixed response fluorometer, which provides excitation at 540nm and detects any resultant fluorescence above 570nm.

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

15.5.2. 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.

15.5.3. 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 establish its slope.

Subsequently, a single point (Zero) calibration should be carried out daily. Calibration of the RHOD electrode Zero point is normally carried out during RapidCal (see RapidCal Calibration Method).

Full two-point calibration should be carried out every few months.

15.5.4. Calibration Solution Preparation

In order to 'calibrate' (actually, set the relative sensitivity) of 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

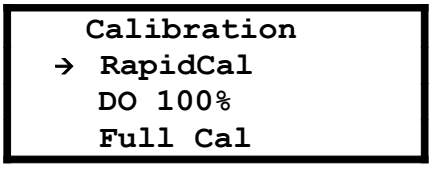
Be sure to handle chemicals with care and to read and comply with all health and safety advice.

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.

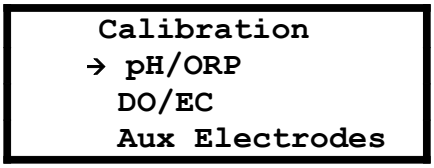
15.5.5. Zero Point Calibration

To calibrate the zero point, follow these steps:

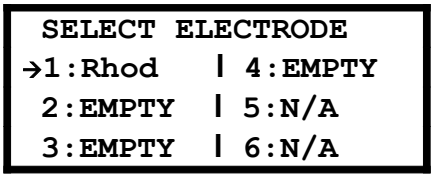
1. Pour 300mL of de-ionised water into a clean calibration cup, remove the storage cap from the pH electrode if fitted, wash the Probe in distilled water, then gently lower the Probe in all the way. **The Sleeve End Cap must be fitted**. Bang the probe against the bottom of the cup several times to dislodge any air bubbles.
2. 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.
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 Rhod 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 Rhod. The screen will change to:

```
  CALIBRATE Rhod
→ Pt-1? [01/Jan/12]
  Pt-2? [01/Jan/12]
```

Calibration point 1 (Pt-1) is the Zero point. 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 Pt-1. 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.

```
   Offset: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.

15.5.6. 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 freshly mixed Rhodamine 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.

BGA-PB calibration is now complete.

15.5.7. 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.

15.5.8. Lens and Sleeve Maintenance

On a monthly basis (or more regularly if heavy fouling occurs), the sapphire lenses on the electrode should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Similarly, the inside of the Probe sleeve and protective 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 as it has 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 after cleaning the sleeve or lenses.

15.6. 2000-FSCEIN Fluorescein Electrode

Fluorescein is a fluorescent dye that is commonly used in water flow studies and can be measured by the AP-5000 using the optional 2000-FSCEIN optical electrode.

15.6.1. Principle of Operation

The 2000-FSCEIN optical electrode is a submersible, fixed response fluorometer, which provides excitation at 485nm and detects any resultant fluorescence above 540nm.

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

15.6.2. 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.

15.6.3. 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 establish its slope.

Subsequently, a single point (Zero) calibration should be carried out daily. Calibration of the FSCEIN electrode Zero point is normally carried out during RapidCal (see RapidCal Calibration Method).

Full two-point calibration should be carried out every few months.

15.6.4. Calibration Solution Preparation

In order to 'calibrate' (actually, set the relative sensitivity) of the FSCEIN electrode, a 100µg/L calibration solution of Fluorescein Dye 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 Fluorescein Dye is recommended:

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

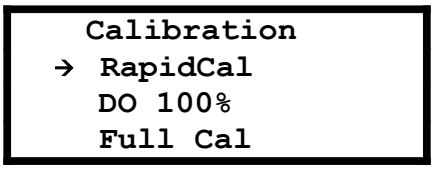
Be sure to handle chemicals with care and to read and comply with all health and safety advice.

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.

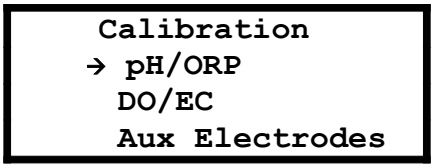
15.6.5. Zero Point Calibration

To calibrate the zero point, follow these steps:

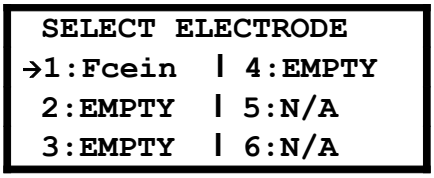
1. Pour 300mL of de-ionised water into a clean calibration cup, remove the storage cap from the pH electrode if fitted, wash the Probe in distilled water, then gently lower the Probe in all the way. **The Sleeve End Cap must be fitted**. Bang the probe against the bottom of the cup several times to dislodge any air bubbles.
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.
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 Fcein 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 Fcein. The screen will change to:

```
  CALIBRATE Fcein
→ Pt-1? [01/Jan/12]
  Pt-2? [01/Jan/12]
```

Calibration point 1 (Pt-1) is the Zero point. 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 Pt-1. 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.

```
   Offset: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.

15.6.6. 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 freshly mixed Fluorescein 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.

Fluorescein calibration is now complete.

15.6.7. 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.

15.6.8. Lens and Sleeve Maintenance

On a monthly basis (or more regularly if heavy fouling occurs), the sapphire lenses on the electrode should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Similarly, the inside of the Probe sleeve and protective 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 as it has 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 after cleaning the sleeve or lenses.

15.7. 2000-REFOIL Refined Oil Electrode

Refined fuels such as benzene, toluene, ethylbenzene, and xylenes (BTEX) can be measured by the AP-5000 using the optional 2000-REFOIL optical electrode.

15.7.1. Principle of Operation

The 2000-REFOIL optical electrode is a submersible, fixed response fluorometer, which provides excitation at 255nm and detects any resultant fluorescence between 320nm and 380nm.

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

15.7.2. 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.**

15.7.3. Calibrating the REFOIL Electrode

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

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

Subsequently, a single point (Zero) calibration should be carried out daily. Calibration of the REFOIL electrode Zero point is normally carried out during RapidCal (see RapidCal Calibration Method).

Full two-point calibration should be carried out every few months.

15.7.4. Calibration Solution Preparation

In order to 'calibrate' (actually, set the relative sensitivity) of 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.

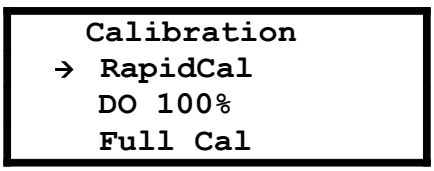
Be sure to handle chemicals with care and to read and comply with all health and safety advice.

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.

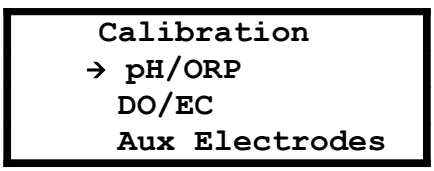
15.7.5. Zero Point Calibration

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 distilled water, then gently lower the Probe in all the way. **The Sleeve End Cap must be fitted**. Bang the probe against the bottom of the cup several times to dislodge any air bubbles.
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:N/A
 3:EMPTY   | 6:N/A
```

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
→ Pt-1? [01/Jan/12]
  Pt-2? [01/Jan/12]
```

Calibration point 1 (Pt-1) is the Zero point. 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 Pt-1. 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.

```
    Offset: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.

15.7.6. 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 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.

15.7.7. 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.

15.7.8. Lens and Sleeve Maintenance

On a monthly basis (or more regularly if heavy fouling occurs), the sapphire lenses on the electrode should be wiped over with a soft damp cloth and **non-abrasive** detergent.

Similarly, the inside of the Probe sleeve and protective 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 as it has 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 after cleaning the sleeve or lenses.

16. Optional ISE Electrodes Calibration and Maintenance

16.1. ISE Electrode Limitations

All ion selective electrodes suffer from interference from ions which are similar in nature to the target ion. For this reason, ISE Electrodes are not recommended for use in brackish or salt water due to the high level of interfering ions.

16.2. Calibration Points

All ISE electrodes have three calibration points. Careful calibration is essential in order to ensure consistent and reliable results.

When an ISE electrode is first installed, **it MUST be calibrated at three points** in order to establish the electrode's slope and thermal characteristics. Two of the calibration points must be at the same temperature whilst the third must be at least 10ºC cooler.

Subsequently, a two-point calibration should be carried out weekly and a single point calibration should be carried out daily. The ISE electrode should be replaced every 6-12 months.

16.3. 7000-AMM Ammonium/Ammonia Electrode

Ammonium (NH4) and Ammonia (NH3) can be measured by the AP-5000 using the optional 7000-AMM ISE electrode within a pH range of 5 – 8.

The Ammonium ISE electrode will suffer interference from Potassium, Sodium and Magnesium ions, which are similar in nature.

16.3.1. Ammonium Calibration Solution Preparation

When an Ammonium ISE electrode is first installed, it must be calibrated at three points. In order to achieve this, three batches of Ammonium calibration solution must be prepared.

The solutions required are two 200mL batches of Ammonium (as NH4) at a concentration of 10ppm and one 250mL batch of Ammonium (as NH4) at a concentration of 100ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard. The following Ammonium standard is recommended:

Part number: SS-702-1610
Description: 500mL Ammonium 1000ppm as NH4 ISE
Supplier: T E Laboratories Ltd, Ireland.
Contact: http://www.tellab.ie

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

Preparing the 100ppm solution

250mL of 100ppm solution is required. To prepare this, mix 25mL of 1000ppm calibration standard with 225mL of deionised water.

Dispense 200mL of the 100ppm solution into a calibration cup and retain 50mL for preparation of the 10ppm solution.

Preparing the 10ppm solution
A total of 400mL of 10ppm solution is required. To prepare this, mix 40mL of the 100ppm solution you have just prepared with 360mL of deionised water. Dispense the 10ppm solution into two calibration cups (200mL each).

Achieving the correct temperature
During three point calibration, the 100ppm solution and one batch of the 10ppm solution must be at exactly the same temperature. The second batch of 10ppm solution must be at least 10ºC cooler.

In order to achieve this, one batch of the 10ppm solution should be put into a refrigerator and the other two solutions should be put into a water bath at 25ºC.

Once all three solutions are at a stable temperature, calibration can begin.

16.3.2. Three-point Calibration

During three-point calibration, the AP-5000 and Aquameter must remain switched on. If the Aquameter is switched off between points, the calibration process will be aborted and must be re-started from point 1. To calibrate the ISE electrode follow these steps:

Point 1.

1. Remove the storage cap from the pH electrode, wash the Probe in distilled water, dry the probe thoroughly then gently lower the Probe in to the warm **10ppm** solution.
2. Switch the Aquameter on and wait until the temperature and NH4 readings are completely stable. A minimum of five minutes is recommended.
3. Ensure the temperature of the solution is between 20ºC and 40ºC (68ºF - 104ºF).
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.

```
   Calibration
 → RapidCal
   DO 100%
   Full Cal
```

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

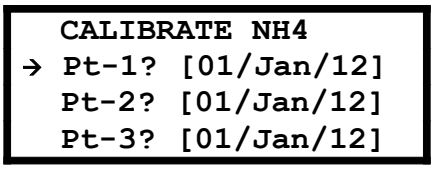
```
   Calibration
 → pH/ORP
   DO/EC
   Aux Electrodes
```

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

```
 SELECT ELECTRODE
→1:TURB   | 4:EMPTY
 2:NH4    | 5:N/A
 3:EMPTY  | 6:N/A
```

The Ammonium (NH4) electrode should have been assigned to an AUX socket when it was fitted. Move the pointer to NH4 then press the OK or right arrow key to select.

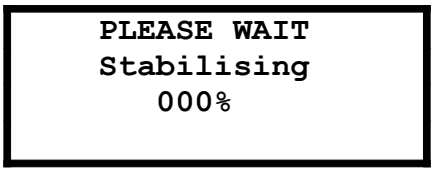
7.The screen will change to:



Calibration point 1 (Pt-1) is the warm 10ppm point. Calibration point 2 (Pt-2) is the warm 100ppm point. Calibration point 3 (Pt-3) is the cool 10ppm point.

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

8. Select Pt-1. 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 ISE electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe along with the temperature.

Point 2

1. Remove the probe from the 10ppm solution and wash thoroughly in deionised water. Dry the probe then gently lower it into to the warm **100ppm** solution.
2. Wait until the temperature and NH4 readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is within 1ºC of the previous 10ppm calibration point.** If the solution is warmer or cooler than this, calibration will fail.
4. Referring to steps 4-7 above, select Pt-2 and press OK.

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 as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the 100ppm solution is more than 1ºC different from the Pt-1 calibration temperature, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

Point 3

1. Remove the probe from the 100ppm solution and wash thoroughly in deionised water. Dry the probe then gently lower it into to the **cool 10ppm** solution.
2. Wait until the temperature and NH4 readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is at least 10ºC cooler than the previous 100ppm calibration point.** If the solution is too warm, calibration will fail.
4. Referring to steps 4-7 above, select Pt-3 and press OK.

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 as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the cool 10ppm solution is less than 10ºC cooler than the Pt-1 and Pt-2 calibration temperatures, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

16.3.3. Two-point Calibration

Two-point calibration should be carried out weekly. For this, 10ppm and 100ppm solutions are required. The two solutions can be at any temperature between 5ºC and 30ºC but they both must be the same temperature (within 1ºC).

If the temperature of the two solutions differ by more than 1ºC, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

During two-point calibration, the AP-5000 and Aquameter must remain switched on. If the Aquameter is switched off between points, the calibration process will be aborted and must be re-started from point 1.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 and 2 only.

16.3.4. Single-point Calibration

Single-point calibration should be carried out daily. For this, just 10ppm solution is required. The solution can be at any temperature between 5ºC and 30ºC .

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 only.

16.3.5. 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.

16.4. 7000-NIT Nitrate Electrode

Nitrate (NO3) can be measured by the AP-5000 using the optional 7000-CHL ISE electrode within a pH range of 3 – 10.

The Nitrate ISE electrode will suffer interference from Chloride, Bromide, Fluoride, Sulphate, Chlorate and Perchlorate ions, which are similar in nature.

16.4.1. Nitrate Calibration Solution Preparation

When an Nitrate ISE electrode is first installed, it must be calibrated at three points. In order to achieve this, three batches of Nitrate calibration solution must be prepared.

The solutions required are two 200mL batches of Nitrate at a concentration of 10ppm and one 250mL batch of Nitrate at a concentration of 100ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard. The following Nitrate standard is recommended:

Part number: SS-712-1610
Description: 500mL Nitrate 1000ppm ISE
Supplier: T E Laboratories Ltd, Ireland.
Contact: http://www.tellab.ie

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

Preparing the 100ppm solution

250mL of 100ppm solution is required. To prepare this, mix 25mL of 1000ppm calibration standard with 225mL of deionised water.

Dispense 200mL of the 100ppm solution into a calibration cup and retain 50mL for preparation of the 10ppm solution.

Preparing the 10ppm solution

A total of 400mL of 10ppm solution is required. To prepare this, mix 40mL of the 100ppm solution you have just prepared with 360mL of deionised water. Dispense the 10ppm solution into two calibration cups (200mL each).

Achieving the correct temperature

During three point calibration, the 100ppm solution and one batch of the 10ppm solution must be at exactly the same temperature. The second batch of 10ppm solution must be at least 10ºC cooler.

In order to achieve this, one batch of the 10ppm solution should be put into a refrigerator and the other two solutions should be put into a water bath at 25ºC.

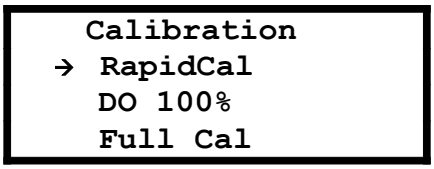
Once all three solutions are at a stable temperature, calibration can begin.

16.4.2. Three-point Calibration

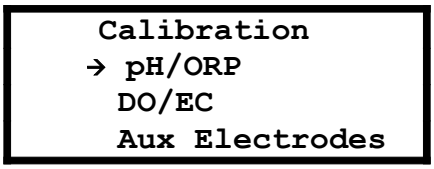
During three-point calibration, the AP-5000 and Aquameter must remain switched on. If the Aquameter is switched off between points, the calibration process will be aborted and must be re-started from point 1. To calibrate the ISE electrode follow these steps:

Point 1.

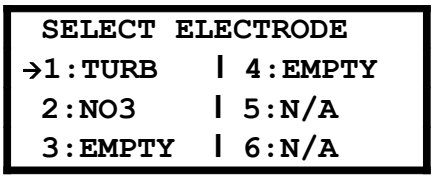
1. Remove the storage cap from the pH electrode, wash the Probe in distilled water, dry the probe thoroughly then gently lower the Probe in to the warm **10ppm** solution.
2. Switch the Aquameter on and wait until the temperature and NO3 readings are completely stable. A minimum of five minutes is recommended.
3. Ensure the temperature of the solution is between 20ºC and 40ºC (68ºF - 104ºF).
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.



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

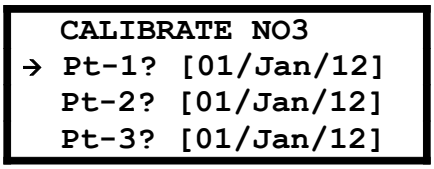


6. Select **Aux Electrodes**. The screen will change to:



The Nitrate (NO3) electrode should have been assigned to an AUX socket when it was fitted. Move the pointer to NO3 then press the OK or right arrow key to select.

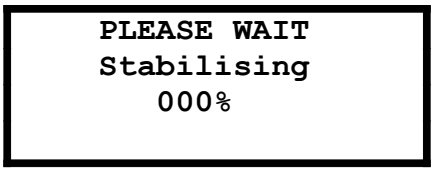
7.The screen will change to:



Calibration point 1 (Pt-1) is the warm 10ppm point. Calibration point 2 (Pt-2) is the warm 100ppm point. Calibration point 3 (Pt-3) is the cool 10ppm point.

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

8. Select Pt-1. 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 ISE electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe along with the temperature.

Point 2

1. Remove the probe from the 10ppm solution and wash thoroughly in deionised water. Dry the probe then gently lower it into to the warm **100ppm** solution.
2. Wait until the temperature and NO3 readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is within 1ºC of the previous 10ppm calibration point.** If the solution is warmer or cooler than this, calibration will fail.
4. Referring to steps 4-7 above, select Pt-2 and press OK.

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 as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the 100ppm solution is more than 1ºC different from the Pt-1 calibration temperature, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

Point 3

1. Remove the probe from the 100ppm solution and wash thoroughly in deionised water. Dry the probe then gently lower it into to the **cool 10ppm** solution.
2. Wait until the temperature and NO3 readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is at least 10ºC cooler than the previous 100ppm calibration point.** If the solution is too warm, calibration will fail.
4. Referring to steps 4-7 above, select Pt-3 and press OK.

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 as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the cool 10ppm solution is less than 10ºC cooler than the Pt-1 and Pt-2 calibration temperatures, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

16.4.3. Two-point Calibration

Two-point calibration should be carried out weekly. For this, 10ppm and 100ppm solutions are required. The two solutions can be at any temperature between 5ºC and 30ºC but they both must be the same temperature (within 1ºC).

If the temperature of the two solutions differ by more than 1ºC, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

During two-point calibration, the AP-5000 and Aquameter must remain switched on. If the Aquameter is switched off between points, the calibration process will be aborted and must be re-started from point 1.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 and 2 only.

16.4.4. Single-point Calibration

Single-point calibration should be carried out daily. For this, just 10ppm solution is required. The solution can be at any temperature between 5ºC and 30ºC .

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 only.

16.4.5. 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.

16.5. 7000-CHL Chloride Electrode

Chloride (Cl) can be measured by the AP-5000 using the optional 7000-CHL ISE electrode within a pH range of 2 – 11.

The Chloride ISE electrode will suffer nterference from Bromide, Iodide, Cyanide and Sulphide ions, which are similar in nature.

16.5.1. Chloride Calibration Solution Preparation

When an Chloride ISE electrode is first installed, it must be calibrated at three points. In order to achieve this, three batches of Chloride calibration solution must be prepared.

The solutions required are two 200mL batches of Chloride at a concentration of 10ppm and one 250mL batch of Chloride at a concentration of 100ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard. The following Chloride standard is recommended:

Part number: SS-706-1610
Description: 500mL Chloride 1000ppm ISE
Supplier: T E Laboratories Ltd, Ireland.
Contact: http://www.tellab.ie

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

Preparing the 100ppm solution

250mL of 100ppm solution is required. To prepare this, mix 25mL of 1000ppm calibration standard with 225mL of deionised water.

Dispense 200mL of the 100ppm solution into a calibration cup and retain 50mL for preparation of the 10ppm solution.

Preparing the 10ppm solution

A total of 400mL of 10ppm solution is required. To prepare this, mix 40mL of the 100ppm solution you have just prepared with 360mL of deionised water. Dispense the 10ppm solution into two calibration cups (200mL each).

Achieving the correct temperature

During three point calibration, the 100ppm solution and one batch of the 10ppm solution must be at exactly the same temperature. The second batch of 10ppm solution must be at least 10ºC cooler.

In order to achieve this, one batch of the 10ppm solution should be put into a refrigerator and the other two solutions should be put into a water bath at 25ºC.

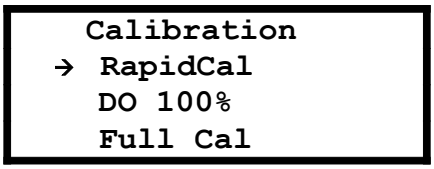
Once all three solutions are at a stable temperature, calibration can begin.

16.5.2. Three-point Calibration

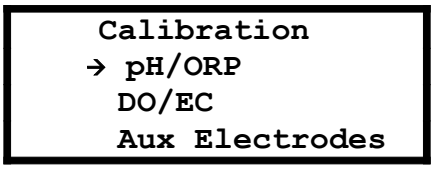
During three-point calibration, the AP-5000 and Aquameter must remain switched on. If the Aquameter is switched off between points, the calibration process will be aborted and must be re-started from point 1. To calibrate the ISE electrode follow these steps:

Point 1.

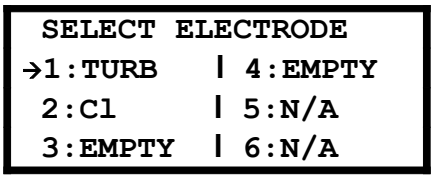
1. Remove the storage cap from the pH electrode, wash the Probe in distilled water, dry the probe thoroughly then gently lower the Probe in to the warm **10ppm** solution.
2. Switch the Aquameter on and wait until the temperature and Cl readings are completely stable. A minimum of five minutes is recommended.
3. Ensure the temperature of the solution is between 20ºC and 40ºC (68ºF - 104ºF).
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.



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

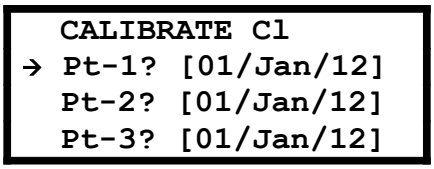


6. Select **Aux Electrodes**. The screen will change to:



The Chloride (Cl) electrode should have been assigned to an AUX socket when it was fitted. Move the pointer to Cl then press the OK or right arrow key to select.

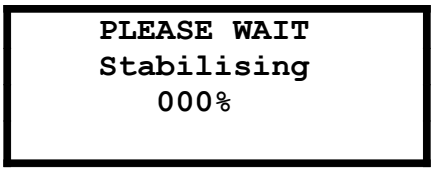
7.The screen will change to:



Calibration point 1 (Pt-1) is the warm 10ppm point. Calibration point 2 (Pt-2) is the warm 100ppm point. Calibration point 3 (Pt-3) is the cool 10ppm point.

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

8. Select Pt-1. 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 ISE electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe along with the temperature.

Point 2

1. Remove the probe from the 10ppm solution and wash thoroughly in deionised water. Dry the probe then gently lower it into to the warm **100ppm** solution.
2. Wait until the temperature and Cl readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is within 1ºC of the previous 10ppm calibration point.** If the solution is warmer or cooler than this, calibration will fail.
4. Referring to steps 4-7 above, select Pt-2 and press OK.

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 as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the 100ppm solution is more than 1ºC different from the Pt-1 calibration temperature, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

Point 3

1. Remove the probe from the 100ppm solution and wash thoroughly in deionised water. Dry the probe then gently lower it into to the **cool 10ppm** solution.
2. Wait until the temperature and Cl readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is at least 10ºC cooler than the previous 100ppm calibration point.** If the solution is too warm, calibration will fail.
4. Referring to steps 4-7 above, select Pt-3 and press OK.

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 as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the cool 10ppm solution is less than 10ºC cooler than the Pt-1 and Pt-2 calibration temperatures, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

16.5.3. Two-point Calibration

Two-point calibration should be carried out weekly. For this, 10ppm and 100ppm solutions are required. The two solutions can be at any temperature between 5ºC and 30ºC but they both must be the same temperature (within 1ºC).

If the temperature of the two solutions differ by more than 1ºC, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

During two-point calibration, the AP-5000 and Aquameter must remain switched on. If the Aquameter is switched off between points, the calibration process will be aborted and must be re-started from point 1.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 and 2 only.

16.5.4. Single-point Calibration

Single-point calibration should be carried out daily. For this, just 10ppm solution is required. The solution can be at any temperature between 5ºC and 30ºC .

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 only.

16.5.5. 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.

16.6. 7000-CAL Calcium Electrode

Calcium (Ca2) can be measured by the AP-5000 using the optional 7000-CHL ISE electrode within a pH range of 4 – 9.

The Calcium ISE electrode will suffer interference from Magnesium, Barium, Lead, Zinc and Sodium ions, which are similar in nature.

16.6.1. Calcium Calibration Solution Preparation

When an Calcium ISE electrode is first installed, it must be calibrated at three points. In order to achieve this, three batches of Calcium calibration solution must be prepared.

The solutions required are two 200mL batches of Calcium at a concentration of 10ppm and one 250mL batch of Calcium at a concentration of 100ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard. The following Calcium standard is recommended:

Part number: SS-705-1610
Description: 500mL Calcium 1000ppm ISE
Supplier: T E Laboratories Ltd, Ireland.
Contact: http://www.tellab.ie

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

Preparing the 100ppm solution

250mL of 100ppm solution is required. To prepare this, mix 25mL of 1000ppm calibration standard with 225mL of deionised water.

Dispense 200mL of the 100ppm solution into a calibration cup and retain 50mL for preparation of the 10ppm solution.

Preparing the 10ppm solution

A total of 400mL of 10ppm solution is required. To prepare this, mix 40mL of the 100ppm solution you have just prepared with 360mL of deionised water. Dispense the 10ppm solution into two calibration cups (200mL each).

Achieving the correct temperature

During three point calibration, the 100ppm solution and one batch of the 10ppm solution must be at exactly the same temperature. The second batch of 10ppm solution must be at least 10ºC cooler.

In order to achieve this, one batch of the 10ppm solution should be put into a refrigerator and the other two solutions should be put into a water bath at 25ºC.

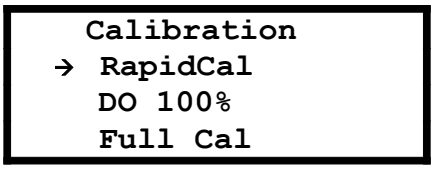
Once all three solutions are at a stable temperature, calibration can begin.

16.6.2. Three-point Calibration

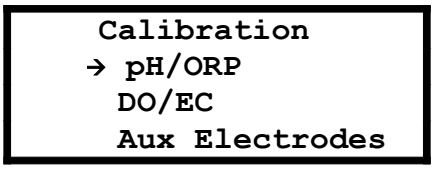
During three-point calibration, the AP-5000 and Aquameter must remain switched on. If the Aquameter is switched off between points, the calibration process will be aborted and must be re-started from point 1. To calibrate the ISE electrode follow these steps:

Point 1.

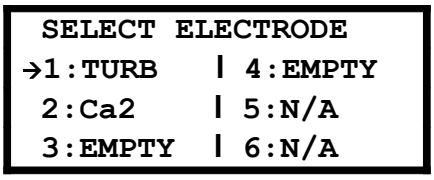
1. Remove the storage cap from the pH electrode, wash the Probe in distilled water, dry the probe thoroughly then gently lower the Probe in to the warm **10ppm** solution.
2. Switch the Aquameter on and wait until the temperature and Ca2 readings are completely stable. A minimum of five minutes is recommended.
3. Ensure the temperature of the solution is between 20ºC and 40ºC (68ºF - 104ºF).
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.



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

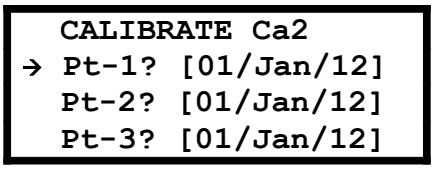


6. Select **Aux Electrodes**. The screen will change to:



The Calcium (Ca2) electrode should have been assigned to an AUX socket when it was fitted. Move the pointer to Ca2 then press the OK or right arrow key to select.

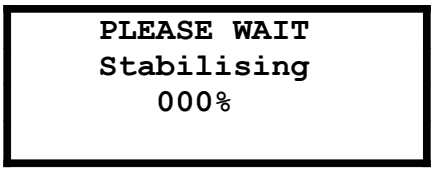
7.The screen will change to:



Calibration point 1 (Pt-1) is the warm 10ppm point. Calibration point 2 (Pt-2) is the warm 100ppm point. Calibration point 3 (Pt-3) is the cool 10ppm point.

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

8. Select Pt-1. 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 ISE electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe along with the temperature.

Point 2

1. Remove the probe from the 10ppm solution and wash thoroughly in deionised water. Dry the probe then gently lower it into to the warm **100ppm** solution.
2. Wait until the temperature and Ca2 readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is within 1ºC of the previous 10ppm calibration point.** If the solution is warmer or cooler than this, calibration will fail.
4. Referring to steps 4-7 above, select Pt-2 and press OK.

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 as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the 100ppm solution is more than 1ºC different from the Pt-1 calibration temperature, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

Point 3

1. Remove the probe from the 100ppm solution and wash thoroughly in deionised water. Dry the probe then gently lower it into to the **cool 10ppm** solution.
2. Wait until the temperature and Ca2 readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is at least 10ºC cooler than the previous 100ppm calibration point.** If the solution is too warm, calibration will fail.
4. Referring to steps 4-7 above, select Pt-3 and press OK.

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 as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the cool 10ppm solution is less than 10ºC cooler than the Pt-1 and Pt-2 calibration temperatures, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

16.6.3. Two-point Calibration

Two-point calibration should be carried out weekly. For this, 10ppm and 100ppm solutions are required. The two solutions can be at any temperature between 5ºC and 30ºC but they both must be the same temperature (within 1ºC).

If the temperature of the two solutions differ by more than 1ºC, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

During two-point calibration, the AP-5000 and Aquameter must remain switched on. If the Aquameter is switched off between points, the calibration process will be aborted and must be re-started from point 1.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 and 2 only.

16.6.4. Single-point Calibration

Single-point calibration should be carried out daily. For this, just 10ppm solution is required. The solution can be at any temperature between 5ºC and 30ºC .

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 only.

16.6.5. 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.

16.7. 7000-FLU Fluoride Electrode

Fluoride (F) can be measured by the AP-5000 using the optional 7000-CHL ISE electrode within a pH range of 4 – 8.

The Fluoride ISE electrode will suffer interference from hydroxide (OH-) ions, which are similar in nature.

16.7.1. Fluoride Calibration Solution Preparation

When an Fluoride ISE electrode is first installed, it must be calibrated at three points. In order to achieve this, three batches of Fluoride calibration solution must be prepared.

The solutions required are two 200mL batches of Fluoride at a concentration of 0.5ppm and one 250mL batch of Fluoride at a concentration of 5ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard. The following Fluoride standard is recommended:

Part number: SS-709-1610
Description: 500mL Fluoride 1000ppm ISE
Supplier: T E Laboratories Ltd, Ireland.
Contact: http://www.tellab.ie

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

Preparing the 5ppm solution

250mL of 5ppm solution is required.

To prepare this, first make an intermediate dilution of 50ppm. To do this, mix 6mL of 1000ppm calibration standard with 114mL of deionised water. This will produce 120mL of 50ppm solution.

Next mix 25mL of the 50ppm solution with 225mL of deionised water. This will produce 250mL of 5ppm solution.

Dispense 200mL of the 5ppm solution into a calibration cup and retain the rest for preparation of the 0.5ppm solution.

Preparing the 0.5ppm solution

A total of 400mL of 0.5ppm solution is required. To prepare this, mix 40mL of the 5ppm solution you have just prepared with 360mL of deionised water. Dispense the 0.5ppm solution into two calibration cups (200mL each).

Achieving the correct temperature

During three point calibration, the 5ppm solution and one batch of the 0.5ppm solution must be at exactly the same temperature. The second batch of 0.5ppm solution must be at least 10ºC cooler.

In order to achieve this, one batch of the 0.5ppm solution should be put into a refrigerator and the other two solutions should be put into a water bath at 25ºC.

Once all three solutions are at a stable temperature, calibration can begin.

16.7.2. Three-point Calibration

During three-point calibration, the AP-5000 and Aquameter must remain switched on. If the Aquameter is switched off between points, the calibration process will be aborted and must be re-started from point 1. To calibrate the ISE electrode follow these steps:

Point 1.

1. Remove the storage cap from the pH electrode, wash the Probe in distilled water, dry the probe thoroughly then gently lower the Probe in to the warm **0.5ppm** solution.
2. Switch the Aquameter on and wait until the temperature and F readings are completely stable. A minimum of five minutes is recommended.
3. Ensure the temperature of the solution is between 20ºC and 40ºC (68ºF - 104ºF).
4. Press the **MENU** key then select **Calibration.** The following screen will be displayed.

```
   Calibration
 → RapidCal
   DO 100%
   Full Cal
```

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

```
   Calibration
 → pH/ORP
   DO/EC
   Aux Electrodes
```

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

```
 SELECT ELECTRODE
→1:TURB   | 4:EMPTY
 2:F      | 5:N/A
 3:EMPTY  | 6:N/A
```

The Fluoride (F) electrode should have been assigned to an AUX socket when it was fitted. Move the pointer to F then press the OK or right arrow key to select.

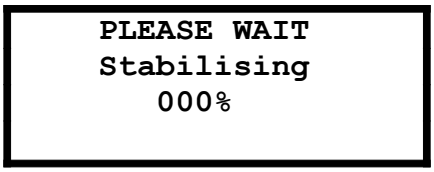
7.The screen will change to:

```
  CALIBRATE F
→ Pt-1? [01/Jan/12]
  Pt-2? [01/Jan/12]
  Pt-3? [01/Jan/12]
```

Calibration point 1 (Pt-1) is the warm 0.5ppm point. Calibration point 2 (Pt-2) is the warm 5ppm point. Calibration point 3 (Pt-3) is the cool 0.5ppm point.

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

8. Select Pt-1. 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 ISE electrode in millivolts (mV). This value is not stored in memory so should be noted down in a calibration record book for the probe along with the temperature.

Point 2

1. Remove the probe from the 0.5ppm solution and wash thoroughly in deionised water. Dry the probe then gently lower it into to the warm **5ppm** solution.
2. Wait until the temperature and F readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is within 1ºC of the previous 0.5ppm calibration point.** If the solution is warmer or cooler than this, calibration will fail.
4. Referring to steps 4-7 above, select Pt-2 and press OK.

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 as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the 5ppm solution is more than 1ºC different from the Pt-1 calibration temperature, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

Point 3

1. Remove the probe from the 5ppm solution and wash thoroughly in deionised water. Dry the probe then gently lower it into to the **cool 0.5ppm** solution.
2. Wait until the temperature and F readings are completely stable. A minimum of five minutes is recommended.
3. **Ensure the temperature of the solution is at least 10ºC cooler than the previous 5ppm calibration point.** If the solution is too warm, calibration will fail.
4. Referring to steps 4-7 above, select Pt-3 and press OK.

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 as shown above. If the calibration is successful, the counter will reach 100% and the calibration report screen will be displayed.

If the temperature of the cool 0.5ppm solution is less than 10ºC cooler than the Pt-1 and Pt-2 calibration temperatures, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

16.7.3. Two-point Calibration

Two-point calibration should be carried out weekly. For this, 0.5ppm and 5ppm solutions are required. The two solutions can be at any temperature between 5ºC and 30ºC but they both must be the same temperature (within 1ºC).

If the temperature of the two solutions differ by more than 1ºC, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

During two-point calibration, the AP-5000 and Aquameter must remain switched on. If the Aquameter is switched off between points, the calibration process will be aborted and must be re-started from point 1.

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 and 2 only.

16.7.4. Single-point Calibration

Single-point calibration should be carried out daily. For this, just 0.5ppm solution is required. The solution can be at any temperature between 5ºC and 30ºC .

To calibrate the ISE electrode follow the steps outlined above under three-point calibration for points 1 only.

16.7.5. 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.

17. 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.

17.1. Software Installation

These instructions describe installation on a PC running Windows® Vista®. Other versions of Windows® may vary slightly.

IMPORTANT: Install the software BEFORE plugging your Aquameter into your PC.

Place the AquaLink CD in your PC's CD drive. Browse your CD drive 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. **Leave the CD in your drive.** To communicate with the Aquameter, two further software 'drivers' need to be installed.

17.2. Driver Installation

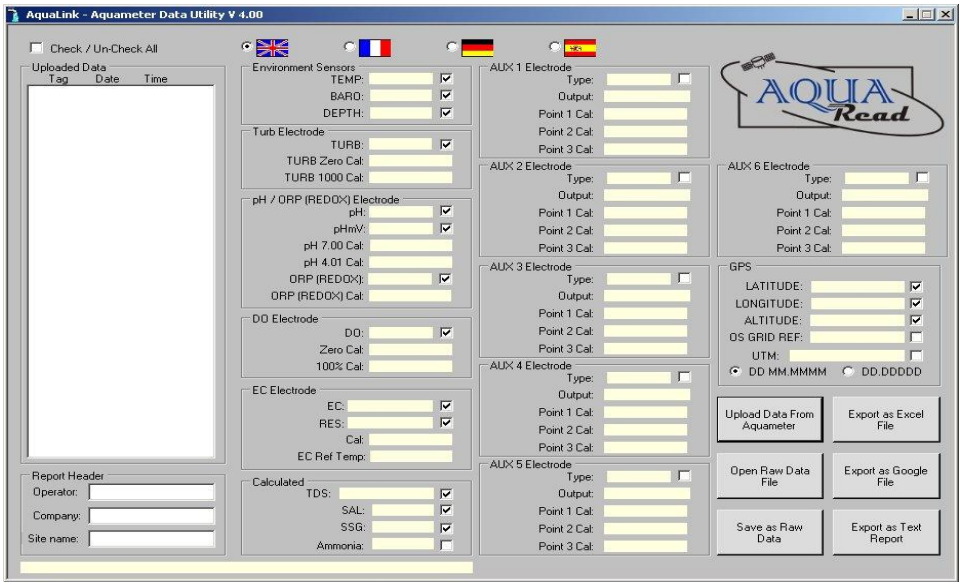
Ensure your Aquameter has batteries installed but is switched off. Connect the Aquameter to your PC using the USB cable supplied. The Aquameter will switch itself on automatically and display 'USB CONNECTED' on its screen as you plug into your PC.

The 'Found New Hardware' wizard on your PC will automatically activate. Select the recommended option: '**Locate and install driver software**'. If given the option, **do not** allow Windows® to search the Internet for drivers. The next screen will ask you to '**Insert the disk that came with your Aquameter**'. The CD should still be in your drive. Click on the '**Next**' button. Wait while the first driver is installed.

The next screen will ask you to '**Insert the disk that came with your USB Serial Port**'. The CD should still be in your drive. Click on the '**Next**' button. Wait while the second driver is installed. When this has completed, AquaLink is ready to use. The CD can now be removed and is not required for subsequent operation.

17.3. Running AquaLink

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

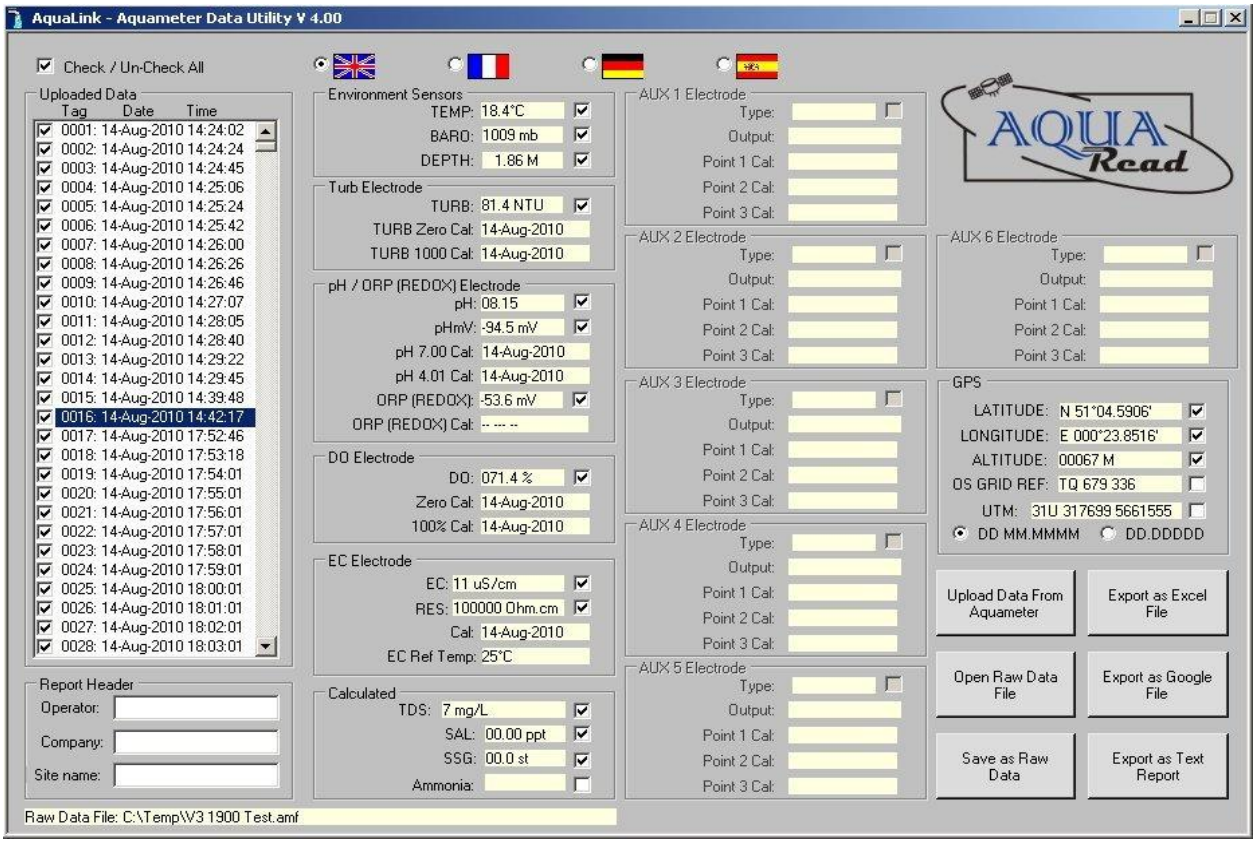


Select your preferred operating language by clicking on one of the national flags.

17.4. 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 individual data boxes, which are grouped by electrode function. 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.

Remember, the Aquameter stores all logged data in a raw Probe format, so can be made to output logged data in several different forms, dependent upon the Meter's current settings. See Important Information About Memory Mode in section 8 for more information.

17.5. 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.

17.6. 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.

17.7. 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.

17.8. 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.

17.9. 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.

17.10. 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.

A typical report cover page follows.

17.11. Typical Text Report Cover Page

AquaLink REPORT

File name:	C:\Test\3 day test 024690136.txt
Operator name:	G.E.M.
Company name:	Aquaread Ltd
Site name:	Test Site 4
Start date and time:	24-Jul-2009 10:09:33
Start position:	Lat: N 51°21.4989' Lon: E 001°24.3232' OSGB: TR 370 677
End date and time:	27-Jul-2009 13:01:00
End position:	Lat: N 51°21.4988' Lon: E 001°24.3233' OSGB: TR 370 677

Total number of readings: 877

Highest readings

Temp:	19.8C	Tag: 0648	Date: 26-Jul-2009	Time: 15:51:00
Baro:	1020mb	Tag: 0315	Date: 25-Jul-2009	Time: 12:19:00
Turb:	05.8 NTU	Tag: 0560	Date: 26-Jul-2009	Time: 08:46:00
pH:	7.63	Tag: 0565	Date: 26-Jul-2009	Time: 09:09:00
pHmV:	-36.3mV	Tag: 0009	Date: 24-Jul-2009	Time: 10:49:01
ORP:	365.7mV	Tag: 0320	Date: 25-Jul-2009	Time: 12:44:00
DO:	79.4% Sat	Tag: 0742	Date: 27-Jul-2009	Time: 01:46:00
EC:	810uS/cm	Tag: 0588	Date: 26-Jul-2009	Time: 10:51:00
RES:	1,445 Ω•cm	Tag: 0285	Date: 25-Jul-2009	Time: 09:49:00
TDS:	526mg/L	Tag: 0588	Date: 26-Jul-2009	Time: 10:51:00
SAL:	0.40ppt	Tag: 0001	Date: 24-Jul-2009	Time: 10:09:33
SSG:	0.0st	Tag: 0001	Date: 24-Jul-2009	Time: 10:09:33

Lowest readings

Temp:	17.9C	Tag: 0254	Date: 25-Jul-2009	Time: 07:14:01
Baro:	1005mb	Tag: 0838	Date: 27-Jul-2009	Time: 09:46:00
Turb:	04.1 NTU	Tag: 0830	Date: 27-Jul-2009	Time: 09:06:00
pH:	7.55	Tag: 0003	Date: 24-Jul-2009	Time: 10:19:01
pHmV:	-40.8mV	Tag: 0556	Date: 26-Jul-2009	Time: 08:24:00
ORP:	354.4mV	Tag: 0820	Date: 27-Jul-2009	Time: 08:16:00
DO:	30.1% Sat	Tag: 0427	Date: 25-Jul-2009	Time: 21:39:00
EC:	782uS/cm	Tag: 0149	Date: 24-Jul-2009	Time: 22:29:01
RES:	1,358 Ω•cm	Tag: 0651	Date: 26-Jul-2009	Time: 18:11:13
TDS:	508mg/L	Tag: 0145	Date: 24-Jul-2009	Time: 22:09:01
SAL:	0.39ppt	Tag: 0017	Date: 24-Jul-2009	Time: 11:29:01
SSG:	0.0st	Tag: 0001	Date: 24-Jul-2009	Time: 10:09:33

	Variance	Average values
Temp:	1.9C	18.81C
Baro:	15mb	1013mb
Turb:	1.7 NTU	4.87 NTU
pH:	0.08	7.60
pHmV:	4.5mV	-39.09mV
ORP:	11.3mV	358.45mV
DO:	49.3% Sat	59.10% Sat
EC:	28uS/cm	792.2uS/cm
Res:	87 Ω•cm	1,415.4 Ω•cm
TDS:	18mg/l	514.4mg/l
SAL:	0.01ppt	0.391ppt
SSG:	0.0st	0.00st

Calibration (GLP) data

Turb Zero:	24-Jul-2009	Turb 1000:	23-Jul-2009
pH 7.00:	24-Jul-2009	pH 4.01:	23-Jul-2009
DO Zero:	23-Jul-2009	DO 100%:	24-Jul-2009
EC:	24-Jul-2009	ORP:	23-Jul-2009

Blocks of individual readings, laid out in chronological order, follow this cover page. The readings picked out on the cover page can be cross-referenced to the blocks of individual readings using the Tag numbers.

17.12. 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'.

17.13. 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 either Google™ Maps or Google™ Earth, where the data is overlaid on maps or satellite images respectively.

Google™ Maps has a maximum import limit of 200 data records per file. If you intend to view your data in Google™ Maps, you must select 200 or less records for export in each file. If you select more than 200 records, Google™ Maps will truncate your file as it is loaded. If you have selected more than 200 data records for export, AquaLink will warn you of this limitation.

Google™ Earth does not suffer from the same limitation, so you can export a full set of records in your file.

17.14. Importing Files into Google™ Maps

To view your files in Google™ Maps, you will need to log on to the Google™ website, select the Maps tag then create a Google™ Account. This is free of charge at present. Once you are signed in, follow these steps:

1. Click on '**My Maps**'.
2. Click on the '**Create New Map**' button.
3. Click on '**Import**'.
4. An Import KML box will appear. Click on '**Browse**'.
5. Browse for the file you exported from AquaLink, and select it.
6. Back in the Import KML box, click the '**Upload from file**' button.
7. Once the file has been imported, click on '**Done**'

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

17.15. 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, follow these steps:

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

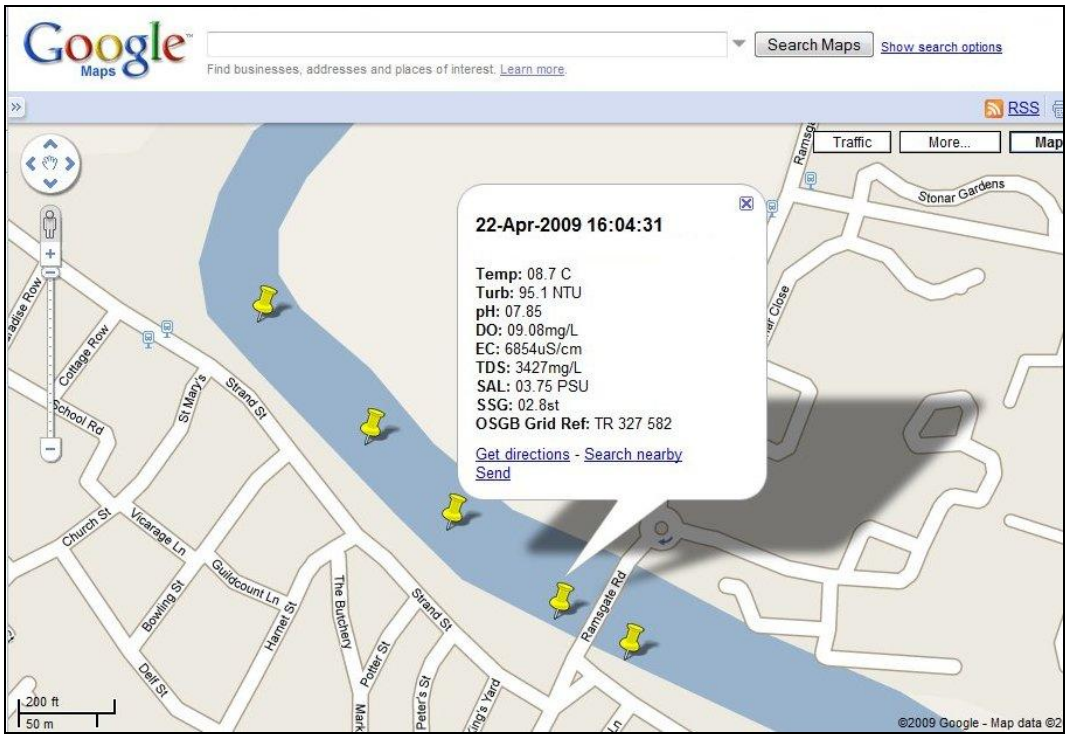
You will now be able to view your data overlaid on Google™ Earth Satellite images. Each data point is represented by a yellow pushpin, and all the data points are listed in a column on the left of the screen. To view the data associated with each pin, either click on the pin or click on the data point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

Typical Google™ Maps and Google™ Earth images follow.

17.16. Google™ Examples

The following two images show the same logged data displayed first in Google™ Maps, then in Google™ Earth.



The data displayed on Google™ Maps is useful, but for real detail, Google™ Earth is the answer.

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.

18. 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. You must return your warranty card within 30 days of purchase to activate your warranty.

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.**

18.1. 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.

18.2. Decontamination Certificate

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

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: _____

19. TROUBLESHOOTING

This section details some of the common difficulties you may encounter when using the Aquameter, Aquaprobes 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.
ERROR 01 appears on the Aquameter screen.	✓ This indicates that the pH electrode has dropped below 85% efficiency. Try cleaning the pH electrode and re-calibrating as described in the relevant section of this manual. If that does not cure the problem, replace the electrode.
ERROR 02 appears on the Aquameter screen.	✓ This indicates that the Optical DO electrode needs calibrating or the cap needs replacing. Perform a full DO calibration, first at DO Zero then at 100% DO. If that does not cure the problem, replace the Optical DO Cap
COMMS ERROR appears on the Aquameter screen.	✓ This indicates that the Aquaprobe has stopped responding to requests for data from the Aquameter. Check the Aquaprobe plug is fully inserted. Cycle the power to reset the Aquaprobe.
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.
Dissolved Oxygen readings are inaccurate or unstable.	✓ The DO electrode may need calibrating. Recalibrate. ✓ The DO membrane may be dirty. Clean the DO membrane. ✓ Calibration may have been carried out at an extreme temperature. Recalibrate at a temperature as close to the sample temperature as possible.

Troubleshooting Continued …

Problem	Cause / Remedy
pH and/or ORP readings are slow, inaccurate or unstable or calibration is impossible.	✓ The electrodes may need re-calibrating. Recalibrate. ✓ The electrodes may need cleaning. Clean as described in the relevant section of this manual. ✓ The electrodes may have been allowed to dry out. Re-hydrate as described in the relevant section of this manual. ✓ The electrodes may be damaged. Replace the electrodes. ✓ The electrode may be loose allowing water to enter the electrode socket. Remove the electrode, blow out the socket with compressed air then leave the probe and electrode in a warm place for at least 48 hours to dry out.
EC readings are inaccurate or unstable. OUT OF CAL RANGE error shows during calibration of EC.	✓ Have you got the Probe Sleeve fitted? EC will not work without the Probe Sleeve fitted. ✓ The Aquaprobe may not be inserted deep enough into the sample being measured. Ensure the sample level reaches the minimum depth line on the outside of the Aquaprobe. ✓ Trapped air bubbles may be causing problems. Tap and swish the Aquaprobe to dislodge them. ✓ The Probe Sleeve may be loose. The Probe Sleeve must be absolutely rigid with respect to the Probe Body for correct EC operation. If you can move the Probe Sleeve to and fro whilst holding the Probe Body, tighten then recalibrate. ✓ The EC electrode may need recalibrating. Recalibrate. ✓ The EC electrode may be dirty. Clean the EC electrode then recalibrate.
Turbidity readings are inaccurate or unstable.	✓ Have you got the Probe Sleeve and end cap fitted? Turbidity will not work 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 turbidity measurements can not be taken. ✓ The Aquaprobe may not be inserted deep enough into the sample being measured. Ensure the sample level reaches the minimum depth line on the outside of the Aquaprobe. ✓ 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 Turbidity electrodes may need recalibrating. Recalibrate. ✓ The lenses on the turbidity electrodes may be dirty. Clean the lenses then recalibrate.

20. 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.

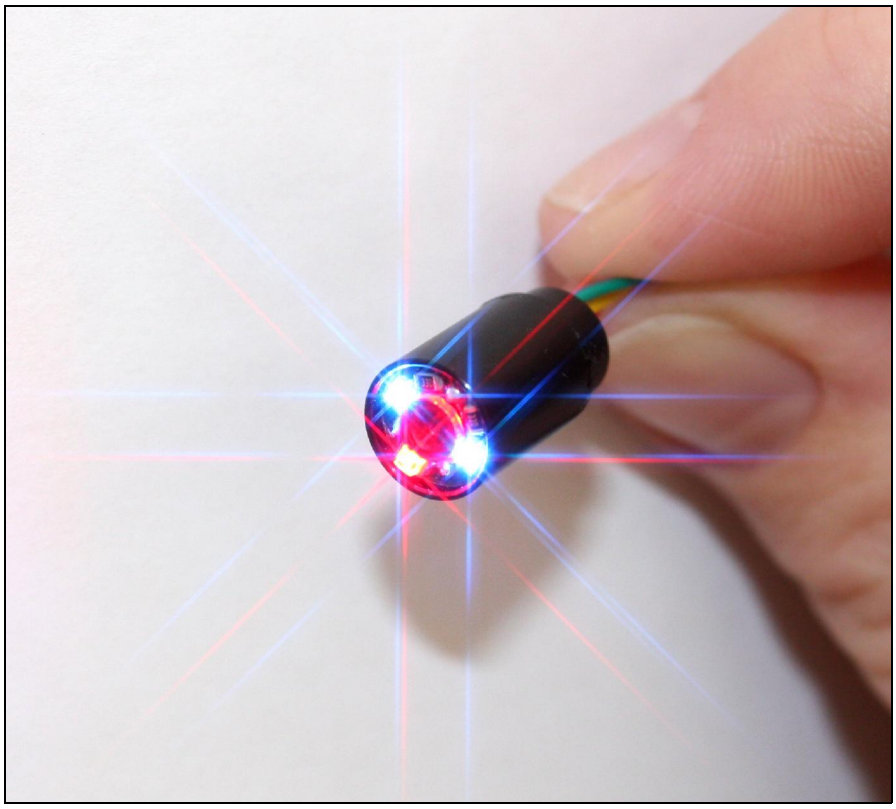
21. Appendix 1. The Tech Behind Aquaread's Optical DO Measurement System

21.1. Principle of Operation

The Aquaread™ AquaPlus™ Optical DO measurement system works on the principle of Dynamic Luminescence Quenching. A gas-permeable chemical known as a luminophore is excited with short bursts of blue light, which causes molecules in the luminophore to emit red photons. The presence of oxygen in contact with the luminophore causes the emission of the red photons to be quenched or delayed. By measuring the delay of the returned red photons with respect to the blue excitation, it is possible to determine the level of dissolved oxygen present.

Whilst this sounds very simple in principle, the optical system and the high-speed electronics required to obtain good accuracy are extremely complex. Calling on many years' experience designing military Night Vision Goggle (NVG) compatible optics, Aquaread engineers have produced an amazingly small and elegant solution.

Housed in a resin filled, marine grade aluminium body that measures just 8mm (0.3") diameter by 13mm (0.5") long, the fully waterproof AquaPlus Sensor Module contains blue excitation and red reference LEDs, optical filters, a photon detector, temperature sensor, driver circuitry and high gain amplification circuitry.



The nano-engineered AquaPlus™ Sensor Module

The incredibly small size of the Sensor Module allows it to fit comfortably into the end of a standard 12mm diameter DO electrode in place of a traditional Clark Cell. The addition of a replaceable cap containing a lens coated with the luminophore material completes the DO section of the electrode.

21.2. Sensor Cap Life

All optical dissolved oxygen sensors work on the same principle, and all must have the sensor cap containing the luminophore replaced periodically due to a phenomenon known as photo bleaching.

When a sensor cap is new, the luminophore will return a large number of red photons when excited. As time goes on, a bleaching effect takes place and the number of red photons returned reduces to a point where they are no longer detectable.

The amount of photo bleaching that the luminophore suffers is in direct proportion to the amount of time it is excited by the sensor's blue light source. It therefore follows that the faster a reading can be taken, the less time the luminophore needs to be excited and the longer it will last.

The high-speed circuitry within the AquaPlus™ module requires just eleven milliseconds to take a reading! This incredibly fast reading time increases the useful life of the luminophore considerably.

Another technique used to prolong the life of the luminophore in the AquaPlus™ module is variable excitation brightness. When the luminophore is new, the brightness of the excitation is reduced to a minimum in order to prevent unnecessary photo bleaching. As the output from the luminophore gradually reduces, the brightness of the excitation is increased in order to squeeze the maximum possible life from the sensor cap.

The combination of low duty cycle and variable excitation brightness can stretch the useful life of a sensor cap as far as several years.

22. Appendix 2. Fitting AUX Electrodes

There are two types of AUX Electrodes designed for use with the AP-5000: Optical Electrodes and ISE Electrodes. These and can be fitted to any of the AUX sockets. The four AUX sockets on the AP-5000 should be populated in numeric order starting with AUX1. If you are fitting a mix of Optical and ISE Electrodes, fit the Optical Electrodes first.

Installing AUX Electrodes

First, remove the blanking plug from the AUX socket that you want to use on the AP-5000. To remove the blanking plug and subsequently tighten the AUX Electrode, use the red lanyard that is attached to the pH/ORP storage cap as a belt wrench as shown below.

Apply a small amount of silicone grease (supplied with the AP-5000) 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 AUX socket and tighten firmly until the O-ring is completely compressed.

Apply a small amount of silicone grease (supplied with the AP-5000) 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 AUX socket and tighten firmly until the O-ring is completely compressed.

22.1. Socket Assignment and Calibration

After installation, it is essential to connect the AP-5000 to an Aquameter and assign the new electrode types to the relevant AUX Sockets. 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:EMPTY
 2:EMPTY  | 5:N/A
 3:EMPTY  | 6:N/A
```

Using the up and down arrow keys, select the AUX socket you wish to assign then move the cursor to the right by pressing the right arrow key. When the cursor has moved to the right of the AUX socket number, use the up and down arrow keys to select the appropriate electrode type. The tables below show the available electrode options and the selection that should be made on this screen:

AP-5000 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	OIL

AP-5000 ISE Electrodes

Electrode Part No.	Function	Aquameter Selection
7000-AMM	Ammonium/Ammonia	NH4
7000-CHL	Chloride	Cl
7000-FLU	Fluoride	F
7000-NIT	Nitrate	NO3
7000-CAL	Calcium	Ca2

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-5000. The socket assignments are stored in the AP-5000. If you press the ESC key whilst in this screen, any changes you have made will not be transferred to the AP-5000.

Finally, refer to the relevant section of this manual and carry out a full two-point (optical) or three-point (ISE) calibration of the new electrode.

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.

Keep the blanking plug in a safe place. If you subsequently remove an electrode, be sure to replace the blanking plug and set the socket assignment back to EMPTY.