



**Instruction Manual**

**for the**

**Aquaprobe<sup>®</sup> AP-Pro<sup>™</sup>**

**Multiparameter Water Quality Probe**

**and associated**

**Aquameter<sup>®</sup>, Utilities & Accessories**

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## 1. Introduction

This manual covers the setup, operation, calibration and maintenance of the Aquaread® AP-Pro™. In order to communicate with the AP-Pro™ you will need either an Aquaread® Aquameter® running software version 6.20+, an Aquaread® AP-PC Kit connected to a PC running AquaCal® software, or an Aquaread® BlueLink® unit and associated BlueLink® Mobile Device App. In addition, you will need an AP-Pro™ extension cable

This manual assumes you will be using an Aquaread® Aquameter®. Instructions for alternative methods of communication (AP-PC Kit and BlueLink®) are available for download from: <https://www.aquaread.com/downloads/brochures-and-manuals>.

## 2. What's in the Box?

The AP-Pro™ is supplied with the following:

- Calibration Cap
- Mounting Bracket and Nut
- 600mL of RapidCal Solution
- pH Storage Cap
- 25mL pH Storage Solution
- Pot of silicone grease
- Lint-free cleaning cloth

### 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-Pro™ and the Environment

The AP-Pro™ is designed to be fully submerged in fresh or salt water and is rated to IP68, that is to say, it is rated for continual immersion to a depth of 300 meters (1,000 feet).

The AP-Pro™ is manufactured predominantly from titanium and carbon fibre, but also contains components made from marine grade stainless-steel, POM, ABS and Nitrile rubber.

**Never clean the AP-Pro™ with solvents, alcohol or concentrated acid/alkaline based cleaning products such as Decon 90. These products can damage the plastic and rubber components. Damage caused by the use of aggressive cleaning agents or solvents is not covered by your warranty.**

### 2.3. About the AP-Pro™

The AP-Pro™ consists of three main parts: the Probe Body, Sleeve and Measurement Chamber. The Sleeve protects the delicate measurement electrodes whilst the Measurement Chamber provides a stable and repeatable environment in which the electrodes can operate.



The Sleeve, complete with Measurement Chamber can be easily removed from the Probe Body by unscrewing to allow cleaning of the individual electrodes. Likewise, the Measurement Chamber can be removed from the Sleeve to allow cleaning. See image below.





## 2.4. About Smart Electrodes

The AP-Pro™ features 'Smart Electrodes'. These electrodes are made predominantly from titanium and are resin filled for ultimate reliability.



The AP-Pro™ comes complete with a DO/EC/Temperature Smart Electrode, a pH/ORP Smart Electrode and a cleaning electrode as standard (centre three above).

In addition, four 'AUX' sockets are provided, into which any combination of PRO-ISE (shown above left) or PRO-OPTICAL (shown above right) electrodes can be fitted.

All smart electrodes include a memory chip, which stores information about the electrode, including date of manufacture, last calibration data (GLP) and factory (default) calibration data.

### 2.4.1. About Batch Calibration of Smart Electrodes

All AUX electrodes (with the exception of refined oil and tryptophan) can be 'batch calibrated' if required. That is to say, four electrodes of the same type can be fitted to the AP-Pro™ and calibrated one after the other in the same session and same solution.

See section [Appendix 2. Fitting Electrodes](#) for further information on Smart Electrodes.

## 2.5. About the Cleaning System

The AP-Pro™ features a motorised cleaning mechanism, which, when activated, wipes all the measurement electrodes. Any debris that is dislodged from the electrodes during cleaning falls into a gutter at the bottom of the Measurement Chamber and is washed out through the side holes.

This cleaning mechanism is designed for use during calibration and long-term deployment when the Probe is connected to an Aquaread® AquaTel® Telemetry unit or a third party telemetry device.

The cleaning system can be activated from the Aquameter®, BlueLink® unit or AquaCal PC software, which is useful during calibration for removing air bubbles from the electrodes. When connected to an Aquaread® AquaTel® Telemetry unit, the cleaning rate can be programmed remotely from a mobile device.

## 2.6. Calibration Vessel

The AP-Pro™ is provided with a calibration cap, which is designed to push onto the end of the Measurement Chamber, sealing off the ring of holes and thus forming a low volume (275mL) calibration vessel.

To create the calibration vessel, apply a very light smear of silicone grease (supplied) to the vertical face of the calibration cap, then press the Sleeve (with Measurement Chamber attached) into the calibration cap as detailed below.



The calibration vessel is now ready for use and should be used for all calibration operations.

When calibration is complete, simply pull the calibration cap off the end of the Measurement Chamber. The Probe will then be ready to use.

### 3. Aquameter 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

Good quality alkaline batteries must be used. Never use rechargeable batteries as they do not provide enough voltage to power the Aquaprobe's cleaning system.

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 up to 15 hours use in the AM-200 GPS Aquameter® when used in conjunction with the AP-Pro™. Please be aware however that alkaline battery capacities are extremely temperature dependant. The figures quoted throughout this manual for battery life assume a temperature of 21°C. Battery life can be significantly shorter (by up to 50%) at lower temperatures.

#### 3.3. 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.

#### 3.4. 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.

#### 3.5. Cable Length

AP-Pro™ extension cables in excess of 50m length include a Cable Booster circuit, which overcomes voltage drop in long cables.

The Aquameter® should not be used with AP-Pro™ extension cables longer than 50m as it can not supply sufficient current to drive the booster circuitry.

The Aquaread® AP-PC Kit and the Aquaread® BlueLink® unit both have a higher output capacity and can therefore be used with any length AP-Pro™ extension cable.

## 4. Overview of the Operating System

The operating firmware 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.

→ English	Italiano
Francais	Portugues
Deutsch	Malaysia
Espanol	Indonesia

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

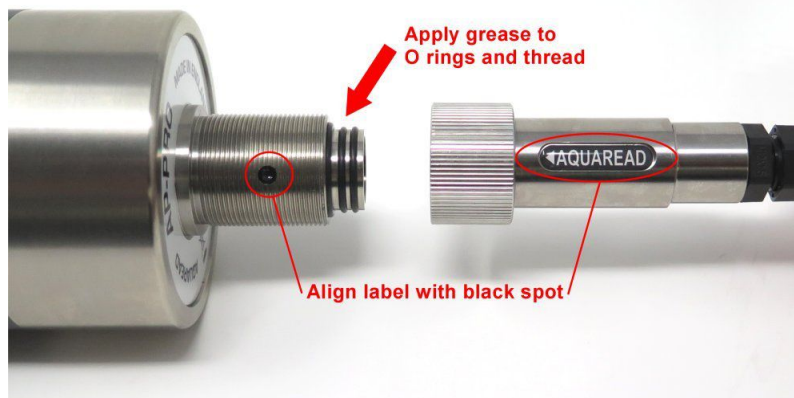
The next screen to be displayed is the Time & Date Setting Screen.

Time & Date
→ Time:15:46:37
Date:15/Jun/23

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-Pro™

The AP-Pro™ is designed to connect to the Aquameter® AP-PC Kit or the BlueLink® unit using an AP-Pro™ Extension Cable. The AP-Pro™ Extension Cable features high-pressure metal connectors, which incorporate several O-ring seals at the Probe end. Prior to first connection, the O-ring 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-Pro™, align the black dot on the AP-Pro™ with the **◀AQUAREAD** logo on the stainless steel plug body, then press the plug into the socket and tighten the retaining collar fully. Once the Probe has been connected to the Extension Cable, the Aquameter® can be connected.

Always ensure the Aquameter® is switched off prior to connecting or disconnecting a Probe. Align the **◀AQUAREAD** logo on the black aluminium 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-Pro™ is connected to the Aquameter®, switch the Meter on by pressing the red on/off switch. The Aquameter® should detect the Probe and start displaying readings.

### 5.1. AP-Pro™ Deployment (See also section 17.)

When you are ready to deploy the AP-Pro™, remove the mounting nut, fit the mounting bracket then replace and tighten the mounting nut.



During deployment, the AP-Pro™ **should not** be suspended by the Extension Cable. A non-conductive Mylar or Nylon cord should be attached to the mounting bracket and be used to support the weight of the AP-Pro™.

Deploying the AP-Pro™ on a conductive cable (such as stainless steel) is **not recommended** as this can lead to galvanic corrosion between dissimilar metals.

## 5.2. Deployment Orientation

The AP-Pro™ is designed to operate vertically, with the measurement chamber at the bottom and the socket at the top.

**This orientation is important to ensure proper operation of the cleaning system**, which collects debris in a gutter at the bottom of the measurement chamber, where it is washed away through the holes around the periphery.

If it is absolutely unavoidable, the AP-Pro™ may be deployed up to 80° off vertical, but installing it at any angle above the horizontal could result in air bubbles collecting in the glass bulb of the pH electrode, which will result in erroneous readings.

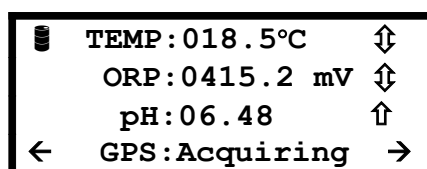
## 6. Taking Measurements

The AP-Pro™ includes a pH/ORP electrode, which is kept moist by a storage cap. Unscrew the Sleeve and remove the storage cap, which is attached to a red lanyard marked 'Remove Before Use / Replace After Use'. Refit the Sleeve and ensure the black Measurement Chamber is fitted.

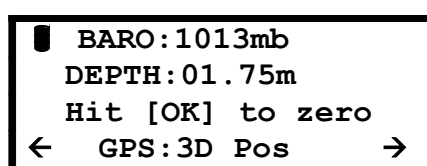
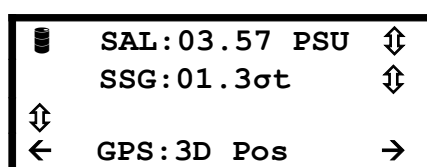
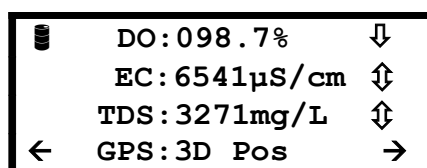
Switch the Aquameter® on and immerse the AP-Pro™ in the sample water, making sure that the water level comes at least half way up the vertical slots in the Probe sleeve.

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


If the AP-Pro™ 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-Pro™ 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-Pro™ 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-Pro™ combination are shown below.





 Lat:N51 °21.498 Long:E001°24.323 Alt:00050M 1013mb ← Sats in use:09 →
--

### 6.1. What Does It All Mean?

The screens above show the full default range of readings for the AM-200/AP-Pro™ combination. 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 8.5.

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 & mg/L
EC	Electrical Conductivity	µS/cm or mS/cm <sup>†</sup>
TDS	Total Dissolved Solids	mg/L or g/l <sup>†</sup>
SAL	Salinity	PSU or ppt*
SSG	Sea Water Specific Gravity	σ <sub>t</sub>
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-Pro™ automatically applies corrections for temperature wherever required.

During three point calibration of the ISE electrodes, the variation in response of the electrodes due to temperature is automatically calculated. 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 [9.1. Setting Units of Measurement](#))

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.

During calibration of the pH electrode, the small variation in the calibration buffer solutions due to temperature is not compensated for due to the differences in thermal coefficient between various buffer manufacturers. For this reason, the three pH points should be calibrated as close to the buffer manufacturer's specified temperature as possible (usually 20°C or 25°C) although a variation of up to +/-10°C makes very little difference in reality.

During pH measurement, temperature variation is automatically compensated for.

## 6.5. GPS Reception

The GPS version of the Aquameter® (AM-200) contains a built-in GPS/GLONAS receiver and antenna. The antenna is situated at the top of the case, just behind the SQUAREAD 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

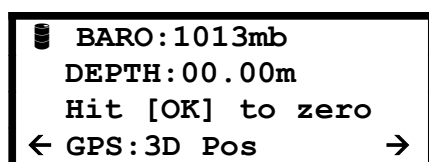
Depth is measured in the AP-Pro™ by a pressure sensor mounted inside the body of the Probe. The datum on the Probe for depth measurement is the top edge of the vertical slots cut into the Probe sleeve.

Depth is calculated by subtracting the barometric pressure being measured in the Aquameter® from the water pressure being measured in the AP-Pro™. 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.

### 7.3. Depth Calibration

The depth sensor is automatically re-zeroed each time the DO 100% point is calibrated in free air. The depth sensor is factory calibrated and no further calibration is required for the lifetime of the sensor.

## 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.

M	TEMP:012.5°C	M
	ORP:0415.2mV	
	pH:08.21	
	02/Apr/23 15:04:01	

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 [12.8. 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.

GLP DATA
>pH/REDOX(ORP)
DO/EC
Aux Electrodes

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/REDOX(ORP), the screen below would be displayed.

pH7.00	[31/Jan/23]
pH4.01	[07/Feb/23]
pH10.0	[07/Feb/23]
ORP	[09/Feb/23]

This tells you that the last successful calibration, **prior to the recorded reading being taken**, was January 31<sup>st</sup> for the pH 7.00 point, February 7<sup>th</sup> for the pH 4.01 & pH 10.0 point and February 9<sup>th</sup> for ORP. If the date field is dashed (==/==/==), this means the electrode has never been calibrated.

Pushing the left or right arrow keys will toggle this screen with the calibration report screen.

PH7	Offset: +01.2mV
PH4	Slope: 56.8mV/pH
PH10	Slope: 56.3mV/pH
ORP	Offset: -02.6mV

The calibration report screen displays the calibration report values from the last calibration.

To exit this screen press the **ESC** key.

#### 8.4. Clearing the Memory

The memory within the Aquameter® is capable of storing over 10,000 full sets of readings.

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

#### 8.5. Automatic Data Logging

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

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

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

To activate Automatic Logging, press the **MENU** key. The Main Menu screen will be displayed.

→	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 anywhere between 1 and 90 minutes.

To select permanent display logging mode, set the Status to **ON**. To select Low Power logging mode, set the Status to **LOW POWER**. To activate the selected logging mode, press the **OK** key then revert back to the normal operation screen from the Main Menu by pressing the left arrow key.

To indicate that Auto Data Logging is switched on, an asterisk (\*) character will flash on and off just below the battery symbol on all the main reading screens. If permanent display logging mode was selected (Status set to **ON**), the Meter will record a full set of data automatically at the set rate until either the memory is full or the batteries go flat.

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

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

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

## 8.6. Battery and Memory Duration in Low Power Logging Mode

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

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

Logging Rate	Battery Life (at 21°C)	Memory Duration*
90 mins	34 Days	625 Days
60 mins	30 Days	416 Days
45 mins	28 Days	312 Days
30 mins	24 Days	208 Days
15 mins	16 Days	104 Days
5 mins	7 Days	34 Days
1 min	40 Hours	6.9 Days

So, it can be seen that although the Meter has a maximum data capacity of 625 days, for logging rates above 15 minutes, fresh batteries would need to be fitted every three weeks or so in order to make use of the Meter's full memory capacity.

Conversely, a logging rate of 2 seconds will fill the Meter's memory on a single set of batteries (at 21°C or greater).

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

### 8.7. 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.

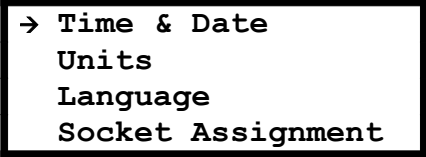
The advantage of this is that the readings will always appear in the current Meter configuration. For example, if you spent a day taking readings with the Meter set to read EC corrected to 25°C, then when you got back you really want to see EC corrected to 20°C or even raw EC, you can do this by simply changing the Meter settings (see section [9.1. Setting Units of Measurement](#)).

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

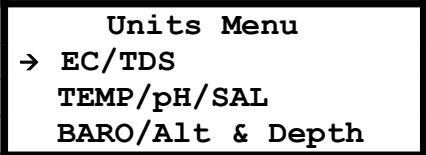
To alter the way the Aquameter® displays readings, press the **MENU** key to get to the Main Menu, then choose **Setup & Install**. The Settings Menu will be displayed. Please note, the 'Socket Assignment' option on this screen is only accessible when a Probe is connected.

A screenshot of the Settings Menu displayed on a device screen. The menu is enclosed in a black rectangular border. At the top, there is a right-pointing arrow followed by the text 'Time & Date'. Below this, the words 'Units', 'Language', and 'Socket Assignment' are listed vertically.

```
→ Time & Date
Units
Language
Socket Assignment
```

### 9.1. Setting Units of Measurement

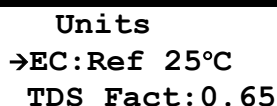
From this screen choose **Units**. The Units Menu will be displayed. Remember, you can use just the arrow keys to navigate through the branches of the menus. You don't need to press **OK** or **ESC** at each level.

A screenshot of the Units Menu displayed on a device screen. The menu is enclosed in a black rectangular border. At the top, the text 'Units Menu' is centered. Below it, there is a right-pointing arrow followed by 'EC/TDS'. Underneath that, 'TEMP/pH/SAL' and 'BARO/Alt & Depth' are listed vertically.

```
Units Menu
→ EC/TDS
TEMP/pH/SAL
BARO/Alt & Depth
```

At the Units Menu, you have a choice of which units you want to adjust. Choose the first line if you want to adjust Electrical Conductivity or TDS. Choose line 2 if you want to adjust Temperature, pH 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.

A screenshot of the Units screen displayed on a device screen. The screen is enclosed in a black rectangular border. At the top, the word 'Units' is centered. Below it, there is a right-pointing arrow followed by 'EC:Ref 25°C'. At the bottom, 'TDS Fact:0.65' is displayed.

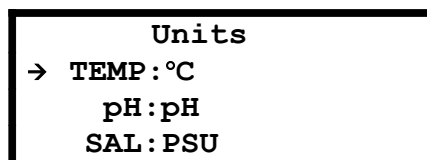
```
Units
→EC:Ref 25°C
TDS Fact:0.65
```

The first 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: ( $TDS = EC \times TDS \text{ Fact}$ ) 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.



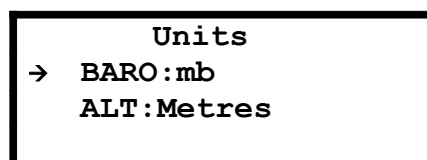
The first option on this screen allows you to change the temperature display between °C and °F.

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 [7.2. Differential Depth Measurement](#) for further details.

## 9.2. AUX Sockets

The AP-Pro™ features four AUX (axillary) sockets into which additional 'smart' electrodes may be fitted. Any of the AUX sockets can be fitted with either AP-Pro™ Optical electrodes or AP-Pro™ ISE (Ion Specific) electrodes. Only one of each electrode type should be fitted during normal operation.

When an electrode has been fitted to an AUX socket (see [Appendix 2. Fitting Electrodes](#) for fitting instructions), the electrode's identification and the latest calibration data stored on the electrode will be transferred to the AP-Pro™.

To view the installed electrode types, select the Socket Assignment option from the Setup & Install screen on the Aquameter®.

When the Socket Assignment option has been selected, the following screen will be displayed with the names of the installed electrodes shown.

The numbers 1 – 6 represent the AUX socket numbers. Only AUX 1 – 4 are available on the AP-Pro™.

SOCKET ASSIGNMENTS	
→1:TURB	4:CDOM
2:BGA-PC	5:EMPTY
3:CPHYLL	6:EMPTY

When connected to an AP-Pro™, this screen can be used for viewing the fitted electrode types only. Any changes to the socket assignments made on this screen will be ignored.

## 10. Calibration

### 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 AP-Pro™ in order to allow normal field operatives (as opposed to trained lab technicians) to achieve quick and accurate results.

As a general rule, pH and EC should be calibrated as close to 25°C as possible. Optical electrodes should be calibrated as close to their deployment temperature as possible. Please see the individual sections later on, which deal specifically with these electrodes.

### 10.2. Calibration Vessel

The AP-Pro™ is provided with a calibration cap, which is designed to push onto the end of the Measurement Chamber, sealing off the ring of holes and thus forming a low volume (275mL) calibration vessel.

To create the calibration vessel, apply a very light smear of silicone grease (supplied) to the vertical face of the calibration cap, then press the Sleeve (with Measurement Chamber attached) into the calibration cap as detailed below.



The calibration vessel is now ready for use and should be used for all calibration operations.

When calibration is complete, simply pull the calibration cap off the end of the Measurement Chamber. The Probe will then be ready to use.

The AP-Pro™ is designed to be calibrated **with the Wiper, Probe Sleeve, Measurement Chamber and Calibration Cap fitted.**

**The Wiper, Probe Sleeve, end Measurement Chamber 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.**

### 10.3. Special Notes Concerning ISE Electrodes

The high ionic concentration of pH calibration solutions (buffers), including RapidCal, can cause significant offsets in ISE electrodes.

These offsets are temporary, but best avoided because they can cause significant errors during both calibration and normal operation. For this reason all ISE electrodes are supplied with a red rubber sealing cap.



**The caps should be fitted to all ISE Electrodes during pH/ORP calibration, when using RapidCal or using buffers containing interfering ions (i.e. all other ISE calibration solutions other than the one for the specific ISE being calibrated)** in order to protect the ISE electrodes from the effects of the buffer solution or interfering ions. At all other times, the ISE electrodes should be left uncovered.

**The caps MUST NOT be fitted when calibrating optical electrodes or serious calibration errors will occur due to reflections from the caps.**

**There must be a functioning pH/ORP-EL fitted for ISE measurement to be valid. Please do not leave the Probe soaking in ISE calibration buffers for extended periods as the pH/ORP electrode will become depleted of ions leading to errors in ISE measurements.**

## 10.4. Using RapidCal

RapidCal calibrates EC at 2570µS/cm and the pH7.00 point simultaneously. Ideally, this procedure should be carried out at the beginning of each day the Probe is to be used. In addition, you should check the DO 100% calibration point and zero any optical electrodes you may have fitted. To use RapidCal:

1. Create the calibration vessel as described in section [10.2. Calibration Vessel](#).
2. Pour 275mL of RapidCal solution into the calibration vessel.
3. Remove the storage cap from the pH electrode if fitted **Fit the red rubber caps to any ISE electrodes fitted**. Wash the Probe in deionised water, then gently lower the Probe into the calibration vessel and screw into place.
4. Activate the Probe cleaning feature in order to remove any air bubbles that may be clinging to the electrodes. To do this, press the MENU key and select CLEAN PROBE.
5. 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.
6. Ensure the temperature of the solution is between 5°C and 40°C (41°F – 104°F). The closer to 25°C the better.
7. Press the **MENU** key then select **Calibration**. The following screen will be displayed.



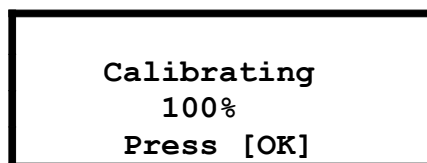
```
Calibration
→ RapidCal
  DO 100%
  Full Cal
```

8. 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.



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

### Important

If you have ISE electrodes fitted to your AP-Pro™, you must now remove the rubber sealing caps from all the ISE electrodes.

Now the DO 100% saturation point should be checked and if necessary, calibrated in damp air.

#### 10.4.1. To Check / Calibrate the 100% Saturation Point in Damp Air

1. After calibrating with RapidCaL, remove the Probe from the calibration vessel and wash both the Probe and calibration vessel in fresh water. Shake off any water from the Probe **ensuring there are no droplets adhering to the DO membrane**.
2. Screw the Probe back into the moist calibration vessel and sit it upright. Do not hold the probe, the heat from your hands will warm the Probe up and interfere with calibration.
3. Wait until the temperature and DO measurements are **completely stable. This is very important**. If the DO measurement is 100% +/- 1%, there is no need to recalibrate.
4. If recalibration is needed, refer back to the screen shown in item 7 above and 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.

Finally, if you have any optical electrodes fitted, you should zero them now. To do this:

1. Pour 275mL of fresh, clean water into the calibration vessel.
2. Gently lower the Probe onto the calibration vessel and screw into place.
3. Activate the Probe cleaning feature in order to remove any air bubbles that may be clinging to the electrodes. To do this, press the MENU key and select CLEAN PROBE.
4. Ensure the temperature of the solution is between 5°C and 40°C (41°F – 104°F).
5. Press the **MENU** key then select **Calibration**. The following screen will be displayed.

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

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

```
Calibration
→ pH/REDOX(ORP)
DO/EC
Aux Electrodes
```

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

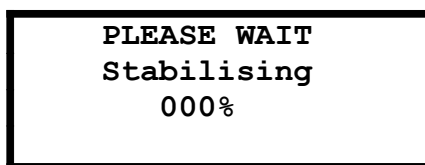
```
SELECT ELECTRODE
→1:BGA-PC | 4:CDOM
2:TURB | 5:EMPTY
3:CPHYLL | 6:EMPTY
```

The AUX electrodes fitted to each socket will be displayed. Move the arrow to the first socket with an optical electrode fitted then press the OK key to select that electrode. The screen will change to:

```
CALIBRATE BGA-PC
→ ZERO? [01/Jan/23]
Pt-2? [01/Jan/23]
GS Factor:01.00
```

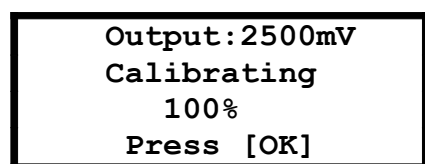
The dates shown to the right of each point are the dates of the last successful calibration.

8. Select ZERO. The screen will change to:



**PLEASE WAIT**  
**Stabilising**  
**000%**

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



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

The Calibration Report on the top line displays the voltage output from the electrode in millivolts (mV). This value is stored in the electrode's memory and can be recalled at any time. See section [10.8. Calibration Data Storage and Retrieval](#).

Press OK then ESC repeatedly to return to the screen shown in point 7 above.

Select the next optical electrode and repeat the zero point calibration.

Repeat this procedure until all optical electrodes fitted have been zeroed.



## 10.5. Calibration Error Messages

If the Aquameter® detects a problem with either the AP-Pro™ 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 (can be caused by low level / incorrect calibration solution). Or the Probe Sleeve is not fitted	Top up / check calibration solution is correct type. Ensure the Probe Sleeve is fitted
OUT OF TEMP RANGE	Temperature is outside 5°C – 40°C limit ISE differential calibration rules not met.	Warm / cool the RapidCal or ISE solution
CAL ZERO FIRST	You are trying to calibrate an upper calibration point on an optical electrode without first calibrating the zero point.	Calibrate the zero point first, then without switching the Aquameter off, calibrate the upper point.

If the '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 12.7.).

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 wiper is fitted.

If the 'OUT OF CAL RANGE' error persists when calibrating pH, check you are using the correct pH Calibration Standard for the calibration point selected.

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 each other.

Remember: **The Probe Sleeve, Wiper and Measurement Chamber form an integral, working part of the Probe's optical and EC measurement system, and MUST be fitted during calibration and measurement of these functions for correct operation.** If you try to calibrate any of the optical electrodes or the EC without the Wiper, Sleeve or Measurement Chamber fitted, you may get an error message.

## 10.6. Resetting to Factory Calibration Defaults

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

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

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

```
Calibration
→ pH/REDOX (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 should carry out a **full calibration** of the electrode in question.

## 10.7. 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.

## 10.8. Calibration Data Storage and Retrieval

All AP-Pro™ Smart Electrodes contain their own memory. All calibration data, including the GLP data, is stored within the individual Smart Electrode's memory. When an AP-Pro™ is connected to a Meter, this data is transferred for display and logging.

This is a major advantage and allows Smart Electrodes to be switched between Probes without the need for full re-calibration.

In order to recall the calibration data for a certain electrode on the Meter, first select the calibration screen for that electrode. If, for instance, you selected pH/REDOX(ORP), the screen below would be displayed.

pH7.00	[31/Jan/23]
pH4.01	[07/Feb/23]
PH10.0	[07/Feb/23]
ORP	[09/Feb/23]

This tells you that the last successful calibration was January 31<sup>st</sup> for the pH 7.00 point, February 7<sup>th</sup> for the pH 4.01 & pH 10 points and February 9<sup>th</sup> for ORP.

Pushing the left or right arrow keys will toggle this screen with the calibration report screen.

PH7	Offset: +01.2mV
PH4	Slope: 56.8mV/pH
PH10	Slope: 56.3mV/pH
ORP	Offset: -02.6mV

The calibration report screen displays the calibration report values from the last calibration. If the calibration report values are zero, this means the electrode has factory default calibration values only and the associated date shown will represent the date of manufacture of the electrode.

To exit this screen press the **ESC** key.

## 11. pH/ORP Electrode Calibration and Maintenance

### 11.1. Recognising the pH/ORP Electrode

The combined pH/ORP electrode is easy to recognise because it is the only electrode that has slots in the body. The slots allow the gel filled body to be inspected.

### 11.2. Electrode Removal and Replacement

The pH/ORP electrode can be removed from the Probe body by rotating the knurled collar anti-clockwise then pulling the electrode straight out. When replacing an electrode, apply a little silicone grease or similar lubricant to the thread and O rings, then align the black tag on the electrode plug with the black dot next to the socket and push the electrode firmly in. Once the electrode is engaged with the socket, tighten the knurled collar hard down.

Detailed instructions for removal and fitting of electrodes are included in section [24. Appendix 2. Fitting Electrodes](#)

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

### 11.3. 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 (SS-25) 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.

### 11.4. Calibrating pH

pH electrodes should be calibrated regularly (exact time between calibrations is dependant upon conditions) to ensure optimum accuracy. Full calibration involves calibrating at pH 7.00 first, then at pH 4.01 and/or pH 10.00. The AP-Pro™ allows for both two and three point pH calibration. Should you decide to carry out just a two point calibration, the Probe will automatically calculate and save a calibration value for the un-calibrated third point in order to maintain the electrode's linearity over the full range of 0 – 14.

For best results, calibrate all three points as close to 25°C as possible.

#### 11.4.1. Special Notes Concerning ISE Electrodes during pH Calibration

The high ionic concentration of pH calibration solutions (buffers), including RapidCal, can cause significant offsets in ISE electrodes. These offsets are temporary, but best avoided because they can cause significant errors during both calibration and normal operation. For this reason all ISE electrodes are supplied with a red rubber sealing cap.



**The caps should be fitted to all ISE Electrodes during pH/ORP calibration, when using RapidCal or using buffers containing interfering ions (i.e. all other ISE calibration solutions other than the one for the specific ISE being calibrated)** in order to protect the ISE electrodes from the effects of the buffer solution or interfering ions. At all other times, the ISE electrodes should be left uncovered.

**The caps MUST NOT be fitted when calibrating optical electrodes or serious calibration errors will occur due to reflections from the caps.**

**There must be a functioning pH/ORP-EL fitted for ISE measurement to be valid. Please do not leave the Probe soaking in ISE calibration buffers for extended periods as the pH/ORP electrode will become depleted of ions leading to errors in ISE measurements.**

#### 11.4.2. Calibrating the First Point (pH 7.00)

Due to the way in which pH calibration works, **the Probe must be calibrated at pH7.00 before calibrating at pH 4.01 or pH 10.00. Never calibrate at pH 4.01 or pH 10.00 before first calibrating at pH7.00.**

To calibrate the pH electrode follow these steps:

1. Create the calibration vessel as described in section [10.2. Calibration Vessel](#).
2. Pour 275mL of RapidCal or pH7.00 solution into the calibration vessel.
3. Remove the storage cap from the pH electrode. **Fit the red rubber caps to any ISE electrodes fitted.** Wash the Probe in deionised water, then gently lower the Probe into the calibration vessel and screw into place.
4. Activate the Probe cleaning feature in order to remove any air bubbles that may be clinging to the electrodes. To do this, press the MENU key and select CLEAN PROBE.

5. 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.
6. Ensure the temperature of the solution is between 5°C and 40°C (41°F – 104°F). The closer to 25°C the better.
7. Press the **MENU** key then select **Calibration**. The following screen will be displayed.

Calibration  
→ RapidCal  
DO 100%  
Full Cal

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

Calibration  
→ pH/REDOX(ORP)  
DO/EC  
Aux Electrodes

9. Select **pH/REDOX(ORP)**. The screen will change to:

→pH 7.00?[01/Jan/23  
PH 4.01?[01/Jan/23]  
PH 10.0?[01/Jan/23]  
ORP+250?[01/Jan/23]

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

10. Select pH7.00. 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: -1.2mV  
Calibrating  
100%  
Press [OK]

The top line displays the voltage offset from zero for the pH electrode in +/-millivolts (mV). If this offset goes beyond +/-30mV at 25°C, the pH electrode should be serviced.

This value is stored in the electrode's memory and can be recalled at any time. See section [10.8. Calibration Data Storage and Retrieval](#). Press OK then ESC repeatedly to return to normal reading mode.

Remove the Probe from the calibration vessel, empty the calibration vessel, rinse both the Probe and calibration vessel thoroughly with de-ionised water, shake off any excess and dry the Probe and calibration vessel with the special lint-free cloth provided.

#### 11.4.3. Calibrating the Second Point

The pH electrode can now be calibrated at either pH 4.01 or pH 10.00. **If you intend to calibrate at both pH 4.01 and pH 10.00, both points must be calibrated in the same session, i.e. without turning the power off.**

If the power is removed after calibrating just one additional point (pH 4.00 for example), the Probe will automatically calculate and save a calibration value for the un-calibrated third point in order to maintain the electrode's linearity.

To calibrate the second point, pour 275ml of fresh pH 4.01 or pH 10.00 solution into the calibration vessel then lower the Probe onto the calibration vessel and screw into place. Follow the procedure detailed above, but at step 9, select either pH4.01 or pH10.0, dependent upon the solution you are using. 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 vessel, empty the calibration vessel, rinse both the Probe and calibration vessel thoroughly with de-ionised water, shake off any excess and dry the Probe and calibration vessel with the special lint-free cloth provided.

#### 11.4.4. Calibrating the Third Point

Without switching the Aquameter® off or disconnecting the Probe, pour 275mL of fresh pH 4.01 or pH 10.00 solution into the calibration vessel then lower the Probe onto the calibration vessel and screw into place.

Follow the procedure detailed above, but at step 9, select either pH4.01 or pH10.0, dependent upon the solution you are using. 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 vessel, empty the calibration vessel, rinse both the Probe and calibration vessel thoroughly with de-ionised water, shake off any excess and dry the Probe and calibration vessel with the special lint-free cloth provided.

Dampen the sponge in the storage cap with storage solution and fit it to the pH/ORP electrode. pH calibration is now complete.

### 11.5. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to [Calibration Error Messages](#) in section 10.5. for error message handling.

### 11.6. Servicing the pH Electrode

1. Remove the pH or combined pH/ORP electrode from the Probe body (see [11.2. Electrode Removal and Replacement](#)).
2. Rinse with methyl alcohol.
3. Replace the electrode.
4. Re-calibrate.

**Never place the entire AP-Pro™ 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.

### 11.7. Calibrating ORP

ORP electrodes should be calibrated at least once a month to ensure optimum accuracy. Full calibration involves calibrating at a single point, either +250mV (at 25°C) using a +250mV ORP calibration standard such as **Reagecon RS250 Redox Standard**, or +229mV (at 25°C) using a +229mV ORP calibration standard such as **Zobell Solution**.

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. Create the calibration vessel as described in section [10.2. Calibration Vessel](#).
2. Pour 275mL of ORP calibration solution into the calibration vessel.
3. Remove the storage cap from the pH/ORP electrode. **Fit the red rubber caps to any ISE electrodes fitted.** Wash the Probe in deionised water, then gently lower the Probe into the calibration vessel and screw into place.
4. Activate the Probe cleaning feature in order to remove any air bubbles that may be clinging to the electrodes. To do this, press the MENU key and select CLEAN PROBE.
5. 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.



6. Ensure the temperature of the solution is between 5°C and 40°C (41°F – 104°F). The closer to 25°C the better.

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

Calibration  
→ RapidCal  
DO 100%  
Full Cal

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

Calibration  
→ pH/REDOX (ORP)  
DO/EC  
Aux Electrodes

9. Select **pH/REDOX (ORP)**. The screen will change to:

→pH 7.00? [01/Jan/23]  
PH 4.01? [01/Jan/23]  
PH 10.0? [01/Jan/23]  
ORP+250? [01/Jan/23]

10. Move the arrow to the bottom line. If you are using 250mV calibration solution press the OK key to continue. If you are using 229mV calibration solution, move the cursor to the right, then use the up/down arrow keys to select +229. When the correct solution has been selected, press OK. 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: 5.5mV  
Calibrating  
100%  
Press [OK]

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 stored in the electrode's memory and can be recalled at any time. See section [10.8. Calibration Data Storage and Retrieval](#). Press OK then ESC repeatedly to return to normal reading mode.

Remove the Probe from the calibration vessel, empty the calibration vessel, rinse both the Probe and calibration vessel thoroughly with de-ionised water, shake off any excess and dry the Probe and calibration vessel with the special lint-free cloth provided.

Dampen the sponge in the storage cap with storage solution and fit it to the pH/ORP electrode. ORP calibration is now complete.

### 11.8. 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-Pro™ to the hydrogen scale, the appropriate value above should be added to the measured value.

## 12. DO/EC Electrode Calibration and Maintenance

### 12.1. Recognising the DO/EC Electrode

The DO/EC electrode is easy to recognise because it has a plastic central section incorporating four gold EC sensor contacts on the inside facing the rubber wiper. Dissolved Oxygen (DO) is measured at the end of the electrode by the components behind the removable cap. Temperature is measured in the plastic section of the electrode, where the temperature sensor is potted in epoxy resin. Electrical Conductivity (EC) is measured on the inside edge of the electrode by the four gold contacts. The wiper forms part of the EC cell.

### 12.2. DO Measurement Technique

The AP-Pro™ features an optical DO sensor. This sensor does not use a liquid electrolyte and has a black rubber gas-permeable membrane.

### 12.3. Precautions During Use

**EC measurement is not possible with the Probe central wiper removed as the central wiper 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.**

### 12.4. Calibrating the DO/EC Electrode

Calibration of the EC section of the electrode is normally carried out during RapidCal (see section [10.4. Using RapidCal](#)). EC can be calibrated separately using different EC Calibration Standards, this is covered after the DO calibration section [12.8. Calibrating EC](#).

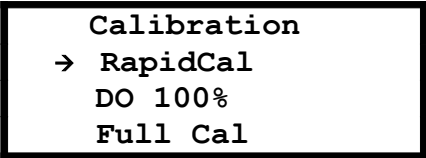
The DO section of the electrode should be calibrated at the Zero saturation point at least once every six months. Before each day's use, the 100% saturation point should be checked in moist air and re-calibrated if necessary. For optimum accuracy, calibrate the DO100% point as near to your sample temperature 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.

### 12.5. Calibrating the DO Zero Point

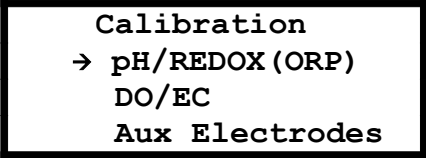
1. Create the calibration vessel as described in section [10.2. Calibration Vessel](#).
2. Pour 275mL of DO Zero calibration solution into the calibration vessel.
3. Remove the storage cap from the pH/ORP electrode. **Fit the red rubber caps to any ISE electrodes fitted.** Wash the Probe in deionised water, then gently lower the Probe into the calibration vessel and screw into place.

4. Activate the Probe cleaning feature in order to remove any air bubbles that may be clinging to the electrodes. To do this, press the MENU key and select CLEAN PROBE.
5. Wait until the temperature and DO readings are **completely** stable. The longer you can leave the Probe to achieve thermal equilibrium before proceeding, the better. A minimum of ten minutes is recommended.
6. Press the **MENU** key then select **Calibration**. The following screen will be displayed.



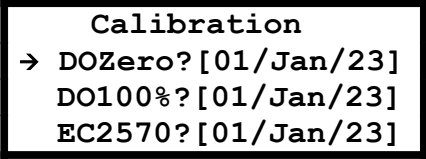
Calibration  
→ RapidCal  
DO 100%  
Full Cal

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



Calibration  
→ pH/REDOX (ORP)  
DO/EC  
Aux Electrodes

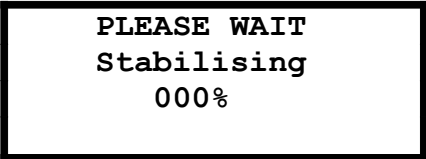
6. Select **DO/EC**. The screen will change to:



Calibration  
→ DOZero? [01/Jan/23]  
DO100%? [01/Jan/23]  
EC2570? [01/Jan/23]

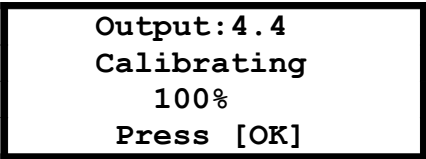
The dates shown to the right of the screen are the dates of the last successful calibration.

7. Select DOZero. The screen will change to:



PLEASE WAIT  
Stabilising  
000%

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



Output: 4.4  
Calibrating  
100%  
Press [OK]

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 stored in the electrode's memory and can be recalled at any time. See section [10.8. Calibration Data Storage and Retrieval](#). 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 [10.5](#). for error message handling.

## 12.6. Calibrating the DO 100% Saturation Point in Moist Air

1. After calibrating the DO Zero point, remove the calibration vessel from the Probe and wash both the Probe and calibration vessel in fresh water. Shake off any water from the Probe **ensuring there are no droplets adhering to the DO membrane**. If droplets remain, blot the membrane with the lint free cloth provided, do not wipe membrane with abrasive material.
2. Screw the Probe back into the moist calibration vessel and sit it upright. Do not hold the probe, the heat from your hands will warm the Probe up and interfere with calibration.
3. Wait until the temperature and DO measurements are both **completely stable. This is very important**. If the DO measurement is 100% +/- 1%, there is no need to recalibrate.
4. If recalibration is needed, refer back to the screen shown in item 6 above and select DO 100%.
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. This value is stored in the electrode's memory and can be recalled at any time. See section [10.8. Calibration Data Storage and Retrieval](#). 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 [10.5](#). for error message handling.

## 12.7. 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.

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 rings.
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.**

## 12.8. Calibrating EC

EC calibration is always carried out at a single point. There is a choice of two pre-set calibration standards or you can enter any calibration standard value between 100µS/cm and 99,999µS/cm manually.

The pre-set standards are: Aquaread® RapidCal (EC value 2570µS/cm) and Aquaread® SC-35 (35ppt sodium chloride solution), which is specifically for use when measuring EC and salinity in sea water. Both solutions are readily available from all Aquaread® dealers

The calibration solution value you use to calibrate EC should always be chosen to be as near to the readings you expect to see in the field as possible. If you are not sure what values to expect, RapidCal is a good choice as this will give reasonably accurate readings across a wide range of EC values.

SC-35 calibration solution is available from Aquaread® dealers or can be made by adding 35 grams of laboratory grade sodium chloride (99.9% pure) to a 1 Litre volumetric flask and topping it up with DEIONISED water (approx 965g of water) to make 1Litre.

**The Probe's central wiper 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 wiper fitted, you will get erroneous results.**

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

1. Create the calibration vessel as described in section [10.2. Calibration Vessel](#).
2. Pour 275mL of EC calibration solution into the calibration vessel. **It is very important that all four gold EC rings are covered during this calibration. Do not use less than 275mL of solution.**
3. Remove the storage cap from the pH electrode if fitted. **If you have ISE electrodes installed, the red protective caps should be fitted now.** Wash the Probe in deionised water, then gently lower the Probe onto the calibration vessel and screw into place.
4. Activate the Probe cleaning feature in order to remove any air bubbles that may be clinging to the electrodes. To do this, press the MENU key and select CLEAN PROBE.
5. Wait until the EC and temperature 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.
6. Ensure the temperature of the solution is between 5°C and 40°C (41°F – 104°F). Ideally, the solution should be as close to 25°C as possible.

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

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

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

```
Calibration
→ pH/REDOX (ORP)
DO/EC
Aux Electrodes
```

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

```
Calibration
→DO Zero?[01/Jan/23]
DO 100%?[01/Jan/23]
EC R-CAL?[01/Jan/23]
```

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.

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

```
Calibration
DO Zero?[01/Jan/23]
DO 100%?[01/Jan/23]
→EC R-CAL?
[01/Jan/23]
```

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 R-CAL.

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:

```
Calibration
DO Zero?[01/Jan/23]
DO 100%?[01/Jan/23]
EC→R-CAL?
[01/Jan/23]
```

You can now use the up and down arrow keys to select one of two pre-set EC Calibration Standard values (R-CAL or SC-35) or to input any calibration standard value between 100µS/cm and 99,999µS/cm. **The value you input should be the calibration solution's EC value at 25°C.**



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

PLEASE WAIT  
Stabilising  
000%

12. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

Cell constant:0.90  
Calibrating  
100%  
Press [OK]

The Calibration Report on the top line displays the EC Cell Constant. This value is stored in the electrode's memory and can be recalled at any time. See section [10.8. Calibration Data Storage and Retrieval](#). Press OK then ESC repeatedly to return to normal reading mode.

### Special Notes:

- If you have selected a Calibration Standard value other than R-CAL, then you subsequently use the RapidCal calibration technique described in section 10, the Calibration Standard value will automatically be reset to R-CAL.
- The Calibration Standard value is stored in the electrode, **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.

### 12.9. Verifying EC Calibration

Due to the fact that debris and air bubbles can adversely affect EC calibration, it is advisable to verify calibration has been properly achieved. To do this, follow item ten above with this procedure.

1. Activate the cleaning system.
2. Press the **ESC** key repeatedly to get back to the Main Menu.
3. Go into settings and make sure EC is set to read with reference to 25°C. If it's not, set it that way. See section [9.1. Setting Units of Measurement](#).
4. Go back to the main screen, wait until the temperature and EC readings are stable, then check that the EC is reading +/- 1% of the Calibration Standard value.
5. If the EC reading is outside the 1% limit, recalibrate, this time leaving more time for stabilisation.

If you can not successfully verify the EC calibration after several attempts, replace the Calibration Standard. If the problem persists, strip the Probe down as described below and thoroughly clean the EC contacts.

### 12.10. 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 10.5. for error message handling.

### 12.11. Cleaning the EC Contacts

On a regular basis, thoroughly clean the four gold EC contacts situated on the inside face 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 wiper and Probe Sleeve and re-calibrate.

### 12.12. Calibrating Temperature

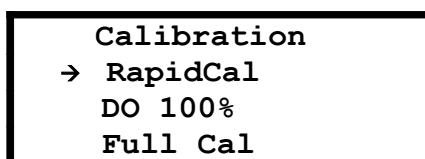
The AP-Pro's temperature sensor is built into the oval resin pocket located on the back of the DO/EC sensor. The temperature sensor is extremely linear and by default is set up to read within +/- 0.5°C of the true temperature, which is ample for most applications. If, however, your application requires a better absolute temperature accuracy, you can re-calibrate the temperature sensor to the nearest 0.1°C by applying a temperature offset.

To calibrate the temperature sensor, remove the Measurement Chamber and Sleeve from the AP-Pro™ then set the Probe up in a container of water with a known temperature. This would normally be a temperature controlled bath that is fitted with a calibrated thermometer and a circulation device.

The AP-Pro™ can be calibrated at any temperature you choose, and should be calibrated as close as possible to the typical temperatures that will be encountered during normal use.

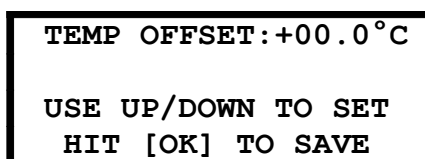
Once the Probe is set up in the water bath, switch the Aquameter® on wait until the temperature reading has been **completely stable** for at least five minutes. Make a note of the temperature displayed on the Aquameter® and compare this to the actual temperature of the water bath as displayed by the calibrated thermometer.

Now select the Calibration screen on the Aquameter®.



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

When this screen is being displayed, press the 'up arrow' key **eight times in quick succession**. This will cause the hidden Temperature Offset screen to be displayed.



```
TEMP OFFSET: +00.0°C

USE UP/DOWN TO SET
HIT [OK] TO SAVE
```

Now, using the up and down arrow keys, set the temperature offset that is required to correct the temperature reading.

For example, if the water bath is set to 25.0°C and the Aquameter® is displaying 24.80°C, you should input an offset (or correction) of +00.2°C.

Alternatively, if the water bath is set to 25.0°C and the Aquameter® is displaying 25.30°C, you should input an offset (or correction) of -00.3°C.

When you have input the desired offset, hit the OK key. Now return to the temperature measurement screen. If the offset has been correctly input, the Aquameter® will now be reading the corrected temperature.

The temperature correction offset is stored in the DO/EC electrode and applied at all times going forward.

### 13. Optional Optical Electrodes Calibration and Maintenance

The AP-Pro™ is constructed with a titanium Sleeve and plastic Measurement Chamber surrounding the delicate sensing electrodes. The Sleeve and Measurement Chamber can be easily removed by unscrewing to allow cleaning of the individual electrodes, however, **The Probe sleeve, Measurement Chamber and wiper 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.**

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

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

For this reason, the AP-Pro™ includes a removable measurement chamber, which encloses the sensing electrodes and provides a constant, repeatable environment during both calibration and measurement.

**In order to obtain consistent results, the measurement chamber must remain physically constant during both calibration and measurement. It is therefore essential that Probe sleeve, wiper and measurement chamber are fitted during calibration and operation of all types of optical electrodes.**

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

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

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

#### 13.1. Top Tips for successful measurements using optical electrodes

- Always keep the measurement chamber and electrode lenses clean.
- Always fit the wiper, Sleeve and measurement chamber during both calibration and measurement.
- Always allow the readings to settle completely during both calibration and measurement.
- Always try to eliminate air bubbles by activate the self-cleaning mechanism.

- Always calibrate and zero the electrode as close to your sample temperature as possible.
- Always zero the optical electrodes directly after installation and just prior to use in clean water bottled still mineral water is ideal.

### 13.2. Optical Electrode Calibration Sequence

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

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

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

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

### 13.3. Fluorescent Electrode Grab Sample Correction Factor

A unique feature of the Aquaread® fluorescent type electrodes is the ability to include a correction factor based upon a grab sample.

If grab sample data is available, a Grab Sample Factor (GS Factor) can be input on the calibration screen of each fluorescent type electrode in order to improve accuracy the of future readings from that electrode.

See the individual fluorescent electrode calibration sections for more details of the unique GS Factor.

### 13.4. TURB Turbidity Electrode

Turbidity can be measured by the AP-Pro™ using the optional PRO-TURB optical electrode.

This electrode employs a Nephelometric technique in accordance with ISO 7027, which uses Formazin as a reference standard. The AP-Pro™ outputs 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.

#### 13.4.1. 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.

#### 13.4.2. 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 activate the Probe cleaning system after submersion to dislodge any air bubbles which may be clinging to the lenses. In order to maintain a common reflective pattern between calibration and use, **always calibrate and measure turbidity with the Measurement Chamber fitted.**

#### 13.4.3. Calibrating the Turbidity Electrode

**The Probe Sleeve, Measurement Chamber and Wiper all form an integral, working part of the Probe's turbidity measurement system, and MUST be fitted during calibration and measurement for correct operation.**

#### 13.4.4. Calibration Points

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

When a turbidity electrode is first installed, **it should be calibrated at the Zero point** in order to correct for any small differences in the Measurement Chamber.

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

**During full calibration, the Zero NTU point must always be calibrated first, followed by the 1000NTU point, both within the same calibration session (i.e. without turning the Aquameter® off).** The third calibration point (20NTU) is optional and can be used if enhanced accuracy is required at very low levels.

#### 13.4.5. Turbidity Zero Point Calibration

To calibrate the Turbidity zero point (zero the electrode), follow these steps:

1. Create the calibration vessel as described in section [10.2. Calibration Vessel](#).
2. Pour 275mL of clean water into the calibration vessel.
3. Remove the storage cap from the pH electrode if fitted. Wash the Probe in clean water, then gently lower the Probe onto the calibration vessel and screw into place.
4. Activate the Probe cleaning feature in order to remove any air bubbles that may be clinging to the electrode. To do this, press the MENU key and select CLEAN PROBE.
5. Wait until the temperature and turbidity 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.
6. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).
7. 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/REDOX (ORP)
  DO/EC
  Aux Electrodes
```

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

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

Select the TURB electrode. The screen will change to:

```
CALIBRATE TURB
→ ZERO? [01/Jan/23]
 1000? [01/Jan/23]
 20?   [01/Jan/23]
```

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

7. Select ZERO. The screen will change to:

```
PLEASE WAIT
Stabilising
 000%
```

The Meter will wait until the readings are stable, then it will send the calibration command to the Probe, where the calibration takes place.

During calibration, the Calibrating screen is displayed and the progress counter counts up. If the calibration is successful, the counter will reach 100% and the following screen will be displayed.

```
Output:1318mV
Calibrating
 100%
Press [OK]
```

The Calibration Report on the top line displays the voltage output from the Turbidity Electrode in millivolts (mV). This value is stored in the electrode's memory and can be recalled at any time. See section [10.8. Calibration Data Storage and Retrieval](#). Press OK then ESC repeatedly to return to normal reading mode.



### 13.4.6. Verifying the Zero Calibration

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

After calibrating the zero point, activate the Probe cleaning feature then allow the reading to settle. Check the turbidity reading is within +/- 1NTU of zero. If not, re-calibrate the zero point.

### 13.4.7. Calibrating the Turbidity 20 NTU & 1000 NTU Points

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

Remove and empty the Measurement Chamber and shake off any excess water from the Probe.

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

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

Gently pour 275mL of the solution into the calibration vessel then screw the Probe in all the way. Activate the Probe cleaning feature in order to remove any air bubbles that may be clinging to the electrodes.

Follow the procedure detailed above for Zero point calibration as far as step 6, then select either 20 or 1000, dependant upon the solution the electrode is in. Wait while the Meter stabilises and calibrates.

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

Rinse the calibration vessel and Probe thoroughly then repeat this procedure for the third point.

### 13.4.8. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to [Calibration Error Messages](#) in section 10.5. for error message handling.

### 13.4.9. Lens and Sleeve Maintenance

On a daily basis, the lenses on the electrode should be wiped over with the lint-free cloth provided. Similarly, the inside of the Probe Sleeve and Measurement Chamber should be kept clean and free from any deposits that may cause stray reflections.

**Never use an abrasive cleaner on the inside of the Measurement Chamber as it has a non-reflective coating which can be easily damaged.**

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

**13.4.10. Calibrating Fluorescent Types of Optical Electrode**

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

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

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

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

**13.4.11. Limitations of Use**

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

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

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

If grab sample data is available, a Grab Sample Factor (GS Factor) can be input on the calibration screen of each fluorescent type electrode in order to improve the accuracy of future readings.

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.
- Differences in the fluorescent response caused by temperature and life cycle.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity (BGA-PC and BGA-PE electrodes are particularly susceptible to interference from turbidity due to excitation/detection wavelengths).

### 13.4.12. Calibration Points

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

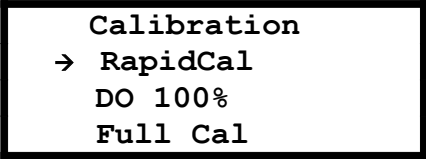
When a fluorescent electrode is first installed, **it should be calibrated at the Zero point** in order to correct for any small differences in the Measurement Chamber.

The electrode should subsequently be Zeroed (calibrated at Point 1 in clean water) before each day's use. A two point calibration should be carried out once a month to ensure optimum accuracy.

### 13.4.13. Zero Point Calibration

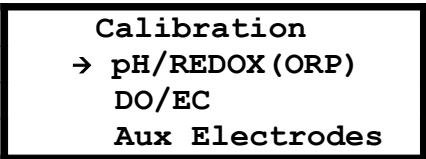
To calibrate the zero point (Point 1), follow these steps:

1. Create the calibration vessel as described in section [10.2. Calibration Vessel](#).
2. Pour 275mL of clean water into the calibration vessel.
3. Remove the storage cap from the pH electrode if fitted. Wash the Probe in clean water, then gently lower the Probe onto the calibration vessel and screw into place.
4. Activate the Probe cleaning feature in order to remove any air bubbles that may be clinging to the electrode. To do this, press the MENU key and select CLEAN PROBE.
5. Wait until the temperature and electrode 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.
6. Ensure the temperature of the solution is between 5°C and 40°C (41°F – 104°F).
7. 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/REDOX (ORP)
DO/EC
Aux Electrodes
```

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

```
SELECT ELECTRODE
→1: BGA-PC | 4: EMPTY
 2: EMPTY  | 5: EMPTY
 3: EMPTY  | 6: EMPTY
```

All installed AUX electrodes will be displayed in a list. Choose the electrode you want to calibrate. Press the OK or right arrow key to select. The screen will change to:

```
CALIBRATE XXXXX
→ ZERO? [01/Jan/23]
Pt-2? [01/Jan/23]
GS Factor: 01.00
```

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

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

7. Select ZERO. The screen will change to:

```
PLEASE WAIT
Stabilising
000%
```

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

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

The Calibration Report on the top line displays the voltage output from the electrode in millivolts (mV). This value is stored in the electrode's memory and can be recalled at any time. See section [10.8. Calibration Data Storage and Retrieval](#). Press OK then ESC repeatedly to return to normal reading mode.

#### 13.4.14. Calibrating the Second Point

When calibrating any fluorescent electrode, **the Zero point must be calibrated first within the same calibration session (i.e. without disconnecting the AP-Pro™).**

A Point 2 calibration standard must be prepared to suit each electrode being calibrated. Each electrode type has a specific requirement, which is detailed in section [15. Calibration Solution Preparation](#)

Once calibrated at Point 1 (the zero point), remove the Probe from the calibration vessel and dry all wetted parts thoroughly with the lint-free cloth provided.

Gently pour 275mL of the pre-prepared **Point 2** solution into the calibration vessel then screw the Probe in all the way. Activate the cleaning system in order to remove any air bubbles that may be clinging to the electrodes.

Follow the general procedure detailed above for Zero point calibration as far as step 6, then Point 2 and hit OK. Wait while the readings stabilise and the electrode calibrates.

The Calibration Report on the top line displays the voltage output from the electrode in millivolts (mV). This value is stored in the electrode's memory and can be recalled at any time. See section [10.8. Calibration Data Storage and Retrieval](#). Press OK then ESC repeatedly to return to normal reading mode.

#### 13.4.15. Errors During Calibration

If a problem occurs during calibration, an error message will be displayed. Refer to [Calibration Error Messages](#) in section [10.5](#) for error message handling.

#### 13.4.16. Calculating and Applying a Grab Sample Factor

The Grab Sample Factor (GS Factor) is a value that is used as a multiplier to correct the readings made by a fluorescent electrode based on known values derived from grab samples. The default GS factor is 1.00. So when the electrode's output is multiplied by a GS Factor of 1.00, the value is not affected.

If grab sample data is available for the location in which you plan to take measurements, you should calculate a GS Factor for the electrode and enter it on the bottom line of the relevant electrode's calibration screen.

<p>CALIBRATE XXXXX → ZERO? [01/Jan/23] Pt-2? [01/Jan/23] GS Factor:01.00</p>
--

To calculate a GS Factor, first take measurements using the fully calibrated electrode.

Next, compare the average of these values with the average values derived by laboratory analysis of grab samples from the same location. To do this, divide the average grab sample value by the average electrode value. This will give you a GS Factor.

For example, your calibrated electrode gives an average output of 100 at a given location. The analysis of grab samples from that location reveal an actual value of 125. So, 125 divided by 100 gives a GS Factor of 1.25. This value should now be input in the GS Factor box. Once the GS Factor value has been input, click the OK button to send the Factor to the electrode.

Now that this GS Factor has been applied to the electrode, all future measurements will be multiplied by 1.25 prior to being displayed. In this way, the electrode has been corrected for the local conditions.

**13.4.17. Lens and Sleeve Maintenance**

On a daily basis, the lenses on the electrode should be wiped over with the lint-free cloth provided.

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

**Never use an abrasive cleaner on the inside of the Measurement Chamber as it has been treated with a non-reflective coating which can be easily damaged.**

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

## 14. Calibrating ISE Electrodes

During calibration of the ISE electrodes, very special care must be taken to achieve the specified temperatures. In order to help reduce the Probe's thermal mass and thereby speed up temperature stabilisation, it is advisable to carry out ISE calibration with the Sleeve removed but with the wiper installed. In this condition, however, the individual electrodes are very vulnerable so care should be taken in order to avoid damage.

### 14.1. 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.

All ISE exhibit calibration drift over time (around 3% per week). Drift should not be a major problem where the electrodes can be frequently calibrated.

During long term deployment of ISEs, the user should obtain grab samples during the course of the deployment for analysis in the laboratory by chemical means and use the results to apply post calibration to the recorded results.

### 14.2. Calibration Points

All ISE electrodes have three calibration points. Three calibration standards must be prepared to suit each electrode being calibrated. Each electrode type has a specific requirement, which is detailed in section [16. ISE Electrode Calibration Solution Preparation](#).

When an ISE electrode is fully calibrated 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 10°C cooler.

When an ISE electrode is first installed, **it should, at least, be calibrated at Point 1** in order to correct for any small differences in the junction of pH electrode, which all ISE electrodes use as a reference.

Subsequently, a two-point or three-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.

### 14.3. Calibration Vessel

Calibration of the ISE electrodes can be done in any suitable calibration vessel, provided the level of the calibration solution covers the temperature sensor, which is located in the resin pocket in the plastic section of the DO/EC electrode.

The wiper should be fitted during calibration, but the sleeve is not necessary. Removal of the sleeve during ISE calibration will reduce the thermal mass of the Probe and allow the temperature to stabilise quicker between the different solutions.

#### 14.4. Special Notes Concerning ISE Electrodes

The high ionic concentration of pH calibration solutions (buffers), including RapidCal, can cause significant offsets in ISE electrodes.

These offsets are temporary, but best avoided because they can cause significant errors during both calibration and normal operation.

For this reason all ISE electrodes are supplied with a red rubber sealing cap.



**The caps should be fitted to all ISE Electrodes during pH/ORP calibration, when using RapidCal or using buffers containing interfering ions (i.e. all other ISE calibration solutions other than the one for the specific ISE being calibrated) in order to protect the ISE electrodes from the effects of the buffer solution or interfering ions. At all other times, the ISE electrodes should be left uncovered.**

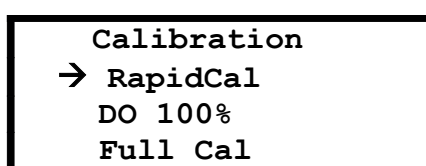
**There must be a functioning pH/ORP-EL fitted for ISE measurement to be valid. Please do not leave the Probe soaking in ISE calibration buffers for extended periods as the pH/ORP electrode will become depleted of ions leading to errors in ISE measurements.**

##### 14.4.1. Three-point Calibration

During three-point calibration, the AP-Pro™ 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. The AP-Pro's Sleeve can also be removed in order to reduce the Probe's thermal mass. To calibrate the ISE electrode follow these steps:

###### Point 1.

1. Remove the Probe Sleeve. Remove the storage cap from the pH electrode, fit the red storage caps to any ISE electrodes not being calibrated, wash the Probe in deionised water, dry the Probe thoroughly using the lint-free cloth provided, then gently lower the Probe in to the warm **Point 1** solution.
2. Switch on the Aquameter®, and allow to rest until the temperature and ISE readings are completely stable.
3. Ensure the temperature of the solution is between 20°C and 40°C (68°F - 104°F).
4. Press the **MENU** key then select **Calibration**. The following screen will be displayed.





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

Calibration  
→ pH/REDOX (ORP)  
DO/EC  
Aux Electrodes

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

SELECT ELECTRODE  
→ 1: TURB | 4: EMPTY  
2: NH4 | 5: EMPTY  
3: EMPTY | 6: EMPTY

All installed AUX electrodes will be displayed in a list. Choose the electrode you want to calibrate. Press the OK or right arrow key to select.

7. The screen will change to:

CALIBRATE XXXX  
→ Pt-1? [01/Jan/23]  
Pt-2? [01/Jan/23]  
Pt-3? [01/Jan/23]

Calibration point 1 (Pt-1). Using the example of Ammonium in this section, 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:

PLEASE WAIT  
Stabilising  
000%

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

Output: 348mV  
Calibrating  
100%  
Press [OK]

The Calibration Report on the top line displays the voltage output from the ISE electrode in millivolts (mV). This value is stored in the electrode's memory and can be recalled at any time. See section [10.8. Calibration Data Storage and Retrieval](#). Press OK then ESC repeatedly to return to normal reading mode.

### 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. Allow to rest until the temperature and ISE readings are completely stable.
3. **Ensure the temperature of the solution is within 1°C 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 1°C 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. Allow to rest until the temperature and ISE readings are completely stable.
3. **Ensure the temperature of the solution is at least 10°C 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 10°C 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.

#### 14.4.2. 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 5°C and 30°C but they both must be the same temperature (within 1°C).

If the temperature of the two solutions differ by more than 1°C, 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-Pro™ 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.

#### **14.4.3. 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 5°C and 30°C .

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

#### **14.4.4. Errors During Calibration**

If a problem occurs during calibration, an error message will be displayed. Refer to [Calibration Error Messages](#) in section 10.5. for error message handling.

## 15. Calibration Solution Preparation

### 15.1. BGA-PC Electrode 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.

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

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

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

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

#### 15.1.1. Serial Dilution

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

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

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

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

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

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

The value output by the AP-Pro™ directly after calibration should be approximately 70,000 cells/mL at 20°C (this value will vary with temperature).

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. BGA-PE Saltwater Blue-Green Algae (phycoerythrin) Electrode Calibration Solution Preparation

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

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

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

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

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

### 15.2.1. Serial Dilution

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

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

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

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

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

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

The value output by the AP-Pro™ directly after calibration should be approximately 200,000 cells/mL at 20°C (this value will vary with temperature).

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. CPHYLL Chlorophyll Electrode Calibration Solution Preparation

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

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

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

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

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

#### 15.3.1. Serial Dilution

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

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

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

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

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

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

The value output by the AP-Pro™ directly after calibration should be approximately 118 µg/L at 20°C (this value will vary with temperature).

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. RHOD Rhodamine Electrode Calibration Solution Preparation

Rhodamine WT is a fluorescent red dye that is commonly used in water flow studies.

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

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

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

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

### 15.4.1. Serial Dilution

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

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

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

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

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

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

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

### 15.5. FSCEIN Fluorescein Electrode Calibration Solution Preparation

Fluorescein is a fluorescent dye that is commonly used in water flow studies.

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

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

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

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

#### 15.5.1. Serial Dilution

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

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

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

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

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

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



## 15.6. REFOIL Refined Oil Electrode

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

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

In order to 'calibrate' the REFOIL electrode, a 10ppm calibration solution of 1-5, naphthalenedisulfonic acid disodium salt should be used. This solution contains naphthalene, an aromatic hydrocarbon, which has **similar** fluorescence characteristics to many Refined Oils. REFOIL pre mixed calibration solution can be purchased from your Aquaread Dealer (part number REFOIL-CAL), this solution is recommended if you do not have access to high precision scales or volumetric equipment.

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

Part number: 250899

Description: 1,5-Naphthalenedisulfonic acid disodium salt hydrate (95% pure)

Supplier: Sigma Aldrich

Contact: [www.sigma-aldrich.com](http://www.sigma-aldrich.com)

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

### 15.6.1. Serial Dilution

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

#### One step process:

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

#### Two step process:

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

**Step 2:** Transfer 10ml of the 1000ppm stock solution to a 1L volumetric flask and top up

with 1L of deionized water. Invert 10 times. This step results in a 1 in 100 dilution of the 1000ppm stock giving the 10ppm standard required for Pt-2 calibration.

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

**Important note:** When calibrating the Refined Oil sensor with naphthalenedisulfonic acid disodium salt, the readings given will be in  $\mu\text{g/L}$  (ppb) naphthalene. In order to display readings with respect to a specific type of refined oil, it is necessary to prepare a 10ppm solution of the target oil type and use that to calibrate the electrode in place of the naphthalene solution. Alternatively, apply a suitable Grab Sample Factor to correct the naphthalene readings for the target oil type.

### 15.7. CDOM/FDOM Chromophoric (Fluorescent) Dissolved Organic Matter Calibration Solution

Fluorescent) Dissolved Organic Matter can be measured using the optional CDOM optical electrode.

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

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

In order to 'calibrate' the CDOM electrode, a 100ppb solution of Quinine Sulphate in sulphuric acid can be used. However, since Quinine Sulphate is extremely expensive and sulphuric acid is dangerous to handle, it is highly recommended to purchase pre-made CDOM electrode calibration solution from your Aquaread Dealer. This is available in 500mL bottles.

Part number: CDOM-CAL-600  
Supplier: Aquaread Ltd  
Contact: <http://www.aquaread.com>

## 16. ISE Electrode Calibration Solution Preparation

### 16.1. AMM Ammonium/Ammonia Electrode

Ammonium (NH<sub>4</sub>) and Ammonia (NH<sub>3</sub>) can be measured using the optional 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.

#### 16.1.1. Pre-Prepared Calibration Solutions

Pre-prepared calibration solutions are available from your Aquaread dealer. Order codes AMM-CAL-10 and AMM-CAL-100. **These are recommended.** If you wish to formulate your own solutions, please follow the procedure detailed below.

#### 16.1.2. 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 400mL batches of Ammonium (as NH<sub>4</sub>) at a concentration of 10ppm and one 400mL batch of Ammonium (as NH<sub>4</sub>) at a concentration of 100ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard if Aquaread pre-diluted solutions have not been purchased. The 1000ppm solution is available from Aquaread Dealers (part number AMM-CAL) but it is highly recommended to purchase the pre-diluted solutions if you are not equipped to use high accuracy volumetric liquid handling techniques or have access to high quality grade Deionised water.

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

#### Preparing the 100ppm solution

500mL of 100ppm solution is required. To prepare this, mix 50mL of 1000ppm calibration standard with 450mL of deionised water.

Dispense 400mL of the 100ppm solution into a calibration cup and retain 100mL for preparation of the 10ppm solution.

#### Preparing the 10ppm solution

A total of 800mL of 10ppm solution is required. To prepare this, mix 80mL of the 100ppm solution you have just prepared with 720mL of deionised water. Dispense the 10ppm solution into two calibration cups (400mL each).

#### 16.1.3. 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 10°C 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 25°C. Once all three solutions are at a stable temperature, calibration can begin.

## 16.2. NIT Nitrate Electrode

Nitrate (NO<sub>3</sub>) can be measured using the optional NIT 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.

### 16.2.1. Pre-Prepared Calibration Solutions

Pre-prepared calibration solutions are available from your Aquaread dealer. Order codes NIT-CAL-10 and NIT-CAL-100. **These are recommended.** If you wish to formulate your own solutions, please follow the procedure detailed below.

### 16.2.2. Nitrate Calibration Solution Preparation

When a 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 400mL batches of Nitrate at a concentration of 10ppm and one 500mL batch of Nitrate at a concentration of 100ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard if Aquaread pre-diluted solutions have not been purchased. The 1000ppm solution is available from Aquaread Dealers (part number NIT-CAL) but it is highly recommended to purchase the pre-diluted solutions if you are not equipped to use high accuracy volumetric liquid handling techniques or have access to high quality grade Deionised water.

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

#### Preparing the 100ppm solution

500mL of 100ppm solution is required. To prepare this, mix 50mL of 1000ppm calibration standard with 450mL of deionised water.

Dispense 400mL of the 100ppm solution into a calibration cup and retain 100mL for preparation of the 10ppm solution.

#### Preparing the 10ppm solution

A total of 800mL of 10ppm solution is required. To prepare this, mix 80mL of the 100ppm solution you have just prepared with 720mL of deionised water. Dispense the 10ppm solution into two calibration cups (400mL each).

### 16.2.3. 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 10°C 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 25°C.

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

### 16.3. CHL Chloride Electrode

Chloride (Cl) can be measured using the optional CHL ISE electrode within a pH range of 2 – 11. The Chloride ISE electrode will suffer interference from Bromide, Iodide, Cyanide and Sulphide ions, which are similar in nature.

#### 16.3.1. Pre-Prepared Calibration Solutions

Pre-prepared calibration solutions are available from your Aquaread dealer. Order codes CHL-CAL-10 and CHL-CAL-100. **These are recommended.** If you wish to formulate your own solutions, please follow the procedure detailed below.

#### 16.3.2. Chloride Calibration Solution Preparation

When a 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 400mL batches of Chloride at a concentration of 10ppm and one 500mL batch of Chloride at a concentration of 100ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard if Aquaread pre-diluted solutions have not been purchased. The 1000ppm solution is available from Aquaread Dealers (part number CHL-CAL) but it is highly recommended to purchase the pre-diluted solutions if you are not equipped to use high accuracy volumetric liquid handling techniques or have access to high quality grade Deionised water.

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

#### Preparing the 100ppm solution

500mL of 100ppm solution is required. To prepare this, mix 50mL of 1000ppm calibration standard with 450mL of deionised water.

Dispense 400mL of the 100ppm solution into a calibration cup and retain 100mL for preparation of the 10ppm solution.

#### Preparing the 10ppm solution

A total of 800mL of 10ppm solution is required. To prepare this, mix 80mL of the 100ppm solution you have just prepared with 720mL of deionised water. Dispense the 10ppm solution into two calibration cups (400mL each).

#### 16.3.3. 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 10°C 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 25°C.

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

## 16.4. CAL Calcium Electrode

Calcium (Ca<sup>2+</sup>) can be measured using the optional CAL 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.

### 16.4.1. Pre-Prepared Calibration Solutions

Pre-prepared calibration solutions are available from your Aquaread dealer. Order codes CAL-CAL-10 and CAL-CAL-100. **These are recommended.** If you wish to formulate your own solutions, please follow the procedure detailed below.

### 16.4.2. Calcium Calibration Solution Preparation

When a 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 400mL batches of Calcium at a concentration of 10ppm and one 500mL batch of Calcium at a concentration of 100ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard if Aquaread pre-diluted solutions have not been purchased. The 1000ppm solution is available from Aquaread Dealers (part number CAL-CAL) but it is highly recommended to purchase the pre-diluted solutions if you are not equipped to use high accuracy volumetric liquid handling techniques or have access to high quality grade Deionised water.

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

#### Preparing the 100ppm solution

500mL of 100ppm solution is required. To prepare this, mix 50mL of 1000ppm calibration standard with 450mL of deionised water.

Dispense 400mL of the 100ppm solution into a calibration cup and retain 100mL for preparation of the 10ppm solution.

#### Preparing the 10ppm solution

A total of 800mL of 10ppm solution is required. To prepare this, mix 80mL of the 100ppm solution you have just prepared with 720mL of deionised water. Dispense the 10ppm solution into two calibration cups (400mL each).

### 16.4.3. 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 10°C 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 25°C.

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

## 16.5. FLU Fluoride Electrode

Fluoride (F) can be measured using the optional FLU 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.

### 16.5.1. Pre-Prepared Calibration Solutions

Pre-prepared calibration solutions are available from your Aquaread dealer. Order codes FLU-CAL-0.5 and FLU-CAL-5. **These are recommended.** If you wish to formulate your own solutions, please follow the procedure detailed below.

### 16.5.2. Fluoride Calibration Solution Preparation

When a 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 400mL batches of Fluoride at a concentration of 0.5ppm and one 500mL batch of Fluoride at a concentration of 5ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard if Aquaread pre-diluted solutions have not been purchased. The 1000ppm solution is available from Aquaread Dealers (part number FLU-CAL) but it is highly recommended to purchase the pre-diluted solutions if you are not equipped to use high accuracy volumetric liquid handling techniques or have access to high quality grade Deionised water.

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

#### Preparing the 5ppm solution

500mL 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 50mL of the 50ppm solution with 450mL of deionised water. This will produce 500mL of 5ppm solution.

Dispense 400mL 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 800mL of 0.5ppm solution is required. To prepare this, mix 80mL of the 5ppm solution you have just prepared with 720mL of deionised water. Dispense the 0.5ppm solution into two calibration cups (400mL each).

### 16.5.3. 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 10°C 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 25°C.

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



## 17. Important Notes Regarding Long-Term Deployment

Whilst the AP-Pro™ features an effective electrode cleaning system, the Probe should not be deployed and left for extended periods without regular checking, calibration and maintenance.

The time period between maintenance visits depends heavily upon the deployment conditions. For example, if the Probe is deployed in clean water, the only necessity should be regular single point calibration of the electrodes. This should be done every 6 – 8 weeks.

If the Probe is deployed in water that is polluted, silt-laden or heavily affected by algal growth, maintenance visits should be much more frequent.

It is very important to keep the cleaning brush and EC wiper in good condition. The brush should be replaced as soon as it shows any signs of clogging or deterioration. The EC wiper should be replaced if it shows any signs of deterioration.

Likewise, it is very important to keep the inside of the Measurement Chamber clean and free from any build up of algae or silt. Please be careful when cleaning the inside of the Measurement Chamber as it has a matt black coating. Do not use abrasives or solvents.

The Wiper, Probe Sleeve and Measurement Chamber all form an integral part of the measurement system. If they are allowed to become excessively dirty, the accuracy of your readings will be affected.

It is strongly recommended that after initial deployment, maintenance visits are made on a weekly basis in order to assess the rate of fouling. After several weeks, it should be possible to establish the optimum time interval for routine maintenance at any given site.

All ion selective electrodes (ISE) exhibit calibration drift over time (around 3% per week). Drift should not be a major problem where the electrodes can be frequently calibrated.

During long term deployment of ion selective electrodes, the user should obtain grab samples during the course of the deployment for analysis in the laboratory by chemical means and use the results to apply post calibration to the recorded results.

### 17.1. Deployment Orientation

The AP-Pro™ is designed to operate vertically, with the measurement chamber at the bottom and the socket at the top.

**This orientation is important to ensure proper operation of the cleaning system,** which collects debris in a gutter at the bottom of the measurement chamber, where it is washed away through the holes around the periphery.

If it is absolutely unavoidable, the AP-Pro™ may be deployed up to 80° off vertical, but installing it at any angle above the horizontal could result in air bubbles collecting in the glass bulb of the pH electrode, which will result in erroneous readings.

## 18. After Use

The AP-Pro™ 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-Pro™ can be removed by unscrewing to allow cleaning of the individual electrodes. After every use, remove the Sleeve then unscrew the Measurement Chamber.

**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 Measurement Chamber with fresh, clean water. Shake the water from inside the Sleeve, then reattach. Dry the outside of the Probe and the inside of the Measurement Chamber using the Aquaread lint-free cloth provided.

Using the special lint-free cloth is important. If a normal cloth or paper towel is used to clean the Probe, small pieces of lint will be left behind, which will interfere with the optical electrodes that use fluorescent measurement techniques.

**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 11.3..

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

**TIP:** Occasional application of a smear of silicone grease (provided) to the connector O-rings and thread and the Sleeve thread will make fitting and removal of these parts easier.

## 19. AquaLink™ PC Software

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

### 19.1. Downloading AquaLink™ PC Software from the Aquaread® website

The AquaLink™ PC Software is available for download using the following link:  
<https://www.aquaread.com/downloads/software-downloads>

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

### 19.2. Software Installation

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

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

### 19.3. Driver Installation

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

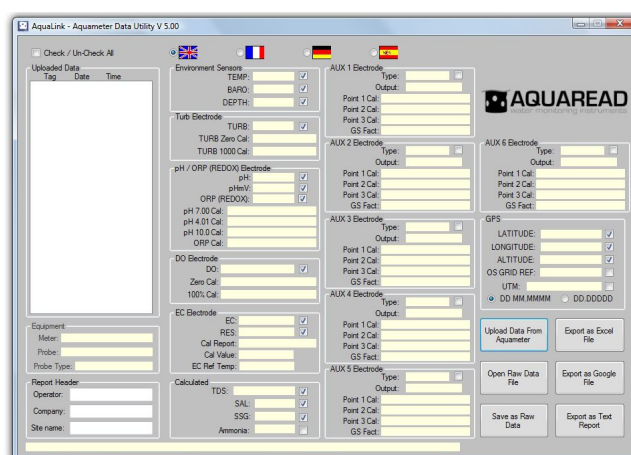
Different versions of Windows® react to plugging USB devices in differently. Earlier versions will give you the option to '**locate and install driver software**'. If this happens, direct Windows® to your temporary directory containing the unzipped download.

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

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

### 19.4. Running AquaLink™

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



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

## 19.5. Uploading Data From Your Aquameter®

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

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

**AquaLink - Aquameter Data Utility V 5.00**

☒ Check / ☐ Un-Check All

Uploaded Data

Tag	Date	Time
<input checked="" type="checkbox"/> 0275	06-Mar-2017	17:20:07
<input checked="" type="checkbox"/> 0276	06-Mar-2017	17:20:09
<input checked="" type="checkbox"/> 0277	06-Mar-2017	17:20:11
<input checked="" type="checkbox"/> 0278	06-Mar-2017	17:20:13
<input checked="" type="checkbox"/> 0279	06-Mar-2017	17:20:15
<input checked="" type="checkbox"/> 0280	06-Mar-2017	17:20:17
<input checked="" type="checkbox"/> 0281	06-Mar-2017	17:20:19
<input checked="" type="checkbox"/> 0282	06-Mar-2017	17:20:21
<input checked="" type="checkbox"/> 0283	06-Mar-2017	17:20:23
<input checked="" type="checkbox"/> 0284	06-Mar-2017	17:20:25
<input checked="" type="checkbox"/> 0285	06-Mar-2017	17:20:27
<input checked="" type="checkbox"/> 0286	06-Mar-2017	17:20:29
<input checked="" type="checkbox"/> 0287	06-Mar-2017	17:20:31
<input checked="" type="checkbox"/> 0288	06-Mar-2017	17:20:33
<input checked="" type="checkbox"/> 0289	06-Mar-2017	17:20:35
<input checked="" type="checkbox"/> 0290	06-Mar-2017	17:20:37
<input checked="" type="checkbox"/> 0291	06-Mar-2017	17:20:39
<input checked="" type="checkbox"/> 0292	06-Mar-2017	17:20:41
<input checked="" type="checkbox"/> 0293	06-Mar-2017	17:20:43
<input checked="" type="checkbox"/> 0294	06-Mar-2017	17:20:45
<input checked="" type="checkbox"/> 0295	06-Mar-2017	17:20:47
<input checked="" type="checkbox"/> 0296	06-Mar-2017	17:20:49
<input checked="" type="checkbox"/> 0297	06-Mar-2017	17:20:51

Environment Sensors

TEMP: 17.90°C ☒

BARO: 1005 mb ☒

DEPTH: 0.01 m ☒

Turb Electrode

TURB:

TURB Zero Cal:

TURB 1000 Cal:

pH / ORP (REDOX) Electrode

pH: 06.89 ☒

pHmV: -14.2 mV ☒

ORP (REDOX): 261.9 mV ☒

pH 7.00 Cal: 06-Mar-2017 -20.8 mV

pH 4.01 Cal:

pH 10.0 Cal:

ORP Cal: 06-Mar-2017 3.9 mV

DO Electrode

DO: 031.5% / 02.95 mg/L ☒

Zero Cal:

100% Cal:

EC Electrode

EC: 340 uS/cm ☒

RES: 3401 Ohm.cm.cbr: ☒

Cal Report: 06-Mar-2017 C = 5.2

Cal Value: 400 uS/cm

EC Ref Temp: 25°C

Calculated

TDS: 221 mg/L ☒

SAL: 00.11 PSU ☒

SSG: 00.0 st ☒

Ammonia: 0.02 mg/L ☒

AUX 1 Electrode

Type: Ammonium ☒

Output: 8.82 mg/L

Point 1 Cal: 06-Mar-2017 -1250 mV

Point 2 Cal:

Point 3 Cal:

GS Fact:

AUX 2 Electrode

Type: BGA-PC ☒

Output: 0 Cells/mL

Point 1 Cal: 06-Mar-2017 1223 mV

Point 2 Cal:

Point 3 Cal:

GS Fact: x1

AUX 3 Electrode

Type: Chlorophyll ☒

Output: 67.88 ug/L

Point 1 Cal: 06-Mar-2017 2428 mV

Point 2 Cal: 06-Mar-2017 2617 mV

Point 3 Cal:

GS Fact: x0.72

AUX 4 Electrode

Type: Turbidity ☒

Output: 0.0 NTU

Point 1 Cal: 06-Mar-2017 1223 mV

Point 2 Cal:

Point 3 Cal:

GS Fact:

AUX 5 Electrode

Type: Nitrate ☒

Output: 0.25 mg/L

Point 1 Cal: 06-Mar-2017 -788 mV

Point 2 Cal:

Point 3 Cal:

GS Fact:

AUX 6 Electrode

Type: Refined Oil ☒

Output: 2.525.4 ug/L

Point 1 Cal: 06-Mar-2017 2285 mV

Point 2 Cal: 06-Mar-2017 2359 mV

Point 3 Cal:

GS Fact: x0.05

GPS

LATITUDE: N 50°04.5906' ☒

LONGITUDE: E 000°23.8516' ☒

ALTITUDE: 00017 m ☒

OS GRID REF: TQ 679 336 ☐

UTM: 31U 317699 5661555 ☐

☒ DD MM.MMMM ☐ DD.DDDDD

Upload Data From Aquameter

Export as Excel File

Open Raw Data File

Export as Google File

Save as Raw Data

Export as Text Report

Raw Data File: Not Saved

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 8.7 for more information.

## 19.6. Displaying GPS Co-ordinates

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

GPS position is also displayed as an Ordnance Survey Great Britain (OSGB) grid reference, (if the position falls within the United Kingdom) and UTM (Universal Transverse Mercator) co-ordinates. Positional accuracy of OSGB co-ordinates is +/- 1 digit (i.e. +/- 100 metres). Positional accuracy of UTM co-ordinates is +/- 10 metres with a 3D Position fix.

## 19.7. On Screen Help

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

## 19.8. Saving Logged Data

Once a set of logged data has been uploaded from the Aquameter®, it can be saved on your PC as a Raw Data file. These files use a proprietary Aquaread® format and are saved with a .amf (aquameter file) 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 8.4..

## 19.9. Retrieving Logged Data

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

## 19.10. Exporting Data

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

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

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

### 19.11. Exporting Text Reports

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

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

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

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

A typical report cover page follows.

## 19.12. Typical Text Report Cover Page

<b>AquaLink REPORT</b>			
-----			
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			
-----			
<b>Highest readings</b>			
-----			
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
-----			
<b>Lowest readings</b>			
-----			
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
-----			
	<b>Variance</b>	<b>Average values</b>	
-----			
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	
-----			
<b>Calibration (GLP) data</b>			
-----			
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.

### 19.13. 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'.

### 19.14. Exporting Google™ Files

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

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

### 19.15. 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, either double click on your .KML file or follow these steps:

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

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

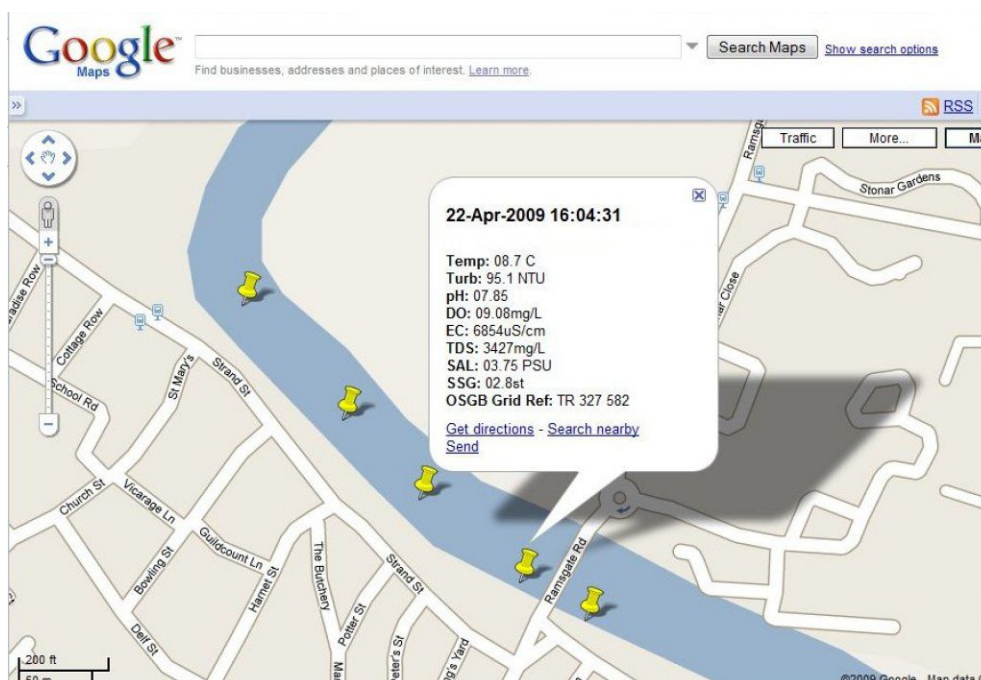
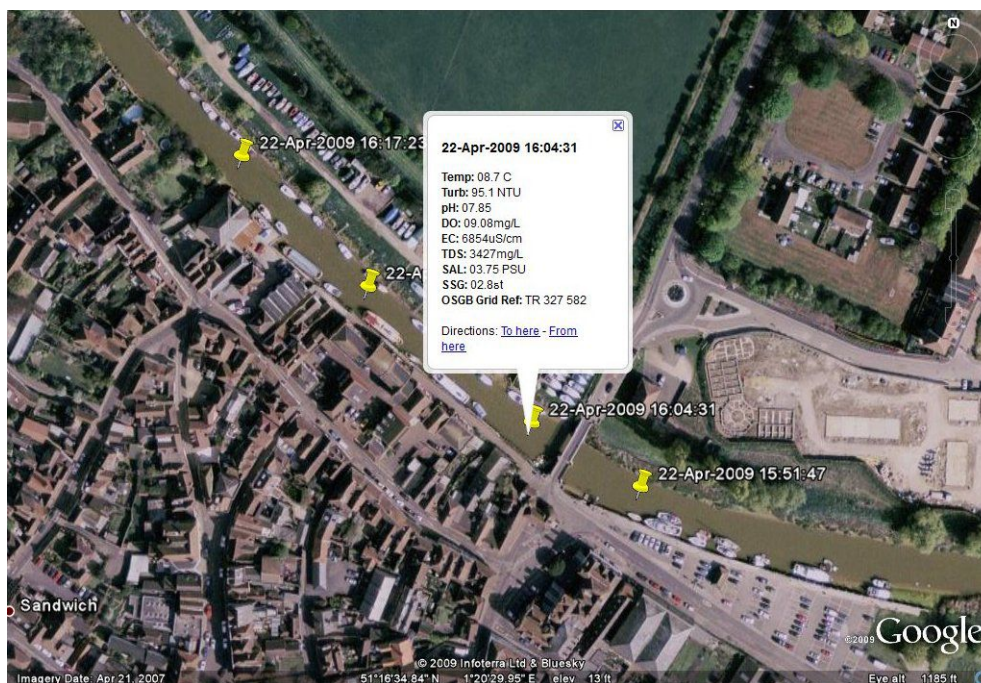
Please note: Although you have downloaded the Google™ Earth application and are running it from your PC, you still need to be connected to the Internet in order for the application to access satellite images.

A typical Google™ Earth image follows.



## 19.16. Google™ Examples

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.



## 20. Limited Warranty

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

Cables and connectors are guaranteed for two years from date of purchase against defects in workmanship and materials. This guarantee does not cover mechanical damage of any kind, including connector damage caused by misalignment or the application of excessive torque.

Consumables, such as pH/ORP electrodes, ISE electrodes, wiper brushes, DO caps and all chemicals are covered by an out-of-the-box warranty only. That is to say, if they are faulty when delivered, they will be replaced. Thereafter, there is no 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](mailto: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.**

### 20.1. 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.**

## 20.2. 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(s): _____
Serial Number(s): _____
Contaminant (if known): _____ _____
Decontamination Procedure: _____ _____
Certified by (print name) : _____
Title: _____
Date: _____
Signature: _____
<b>Please note, returns without an acceptable decontamination procedure being performed prior to sending will be returned to you for decontamination or a cleaning fee will be charged if the contaminant is not hazardous to health.</b>

## 21. TROUBLESHOOTING

This section details some of the common difficulties you may encounter when using the Aquameter®, AP-Pro™ and AquaLink™ software. Try all the suggested remedies. If your problem is still unresolved, contact our Service Department ([service@aquaread.com](mailto: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 AP-Pro™.	✓ Probably a poor connection. Switch the Aquameter® off, disconnect the AP-Pro™, 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 Aquameter® displays a 'Wiper Jammed' or 'Feedback Fault' message during the cleaning cycle.	<ul style="list-style-type: none"> <li>✓ Something (possibly the pH storage cap if it has been left on) is jamming the wiper. Clear the obstruction.</li> <li>✓ Batteries are possibly too low to supply the voltage and current required by the cleaning mechanism. Insert fresh, good quality alkaline batteries and try again.</li> </ul>
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 <b>does not</b> work indoors.
The AquaLink™ software can not find the Aquameter®.	<ul style="list-style-type: none"> <li>✓ The USB drivers may not be properly installed. Reinstall the USB drivers carefully following the instructions.</li> <li>✓ There may be a problem with the USB socket on the PC, try an alternative socket.</li> </ul>
The 'USB CONNECTED' message does not appear on the Aquameter® when it is connected to a PC.	<ul style="list-style-type: none"> <li>✓ 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 <b>does not</b> power the Aquameter®.</li> <li>✓ There may be a problem with the USB socket on the PC, try an alternative socket.</li> </ul>
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.
CAL DO ZERO 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 AP-Pro™ has stopped responding to requests for data from the Aquameter®. Check the AP-Pro™ plug is fully inserted. Cycle the power to reset the AP-Pro™.
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.	<ul style="list-style-type: none"> <li>✓ The DO electrode may need calibrating. Recalibrate.</li> <li>✓ The DO membrane may be dirty. Clean the DO membrane.</li> <li>✓ Calibration may have been carried out at an extreme temperature. Recalibrate at a temperature as close to the sample temperature as possible.</li> </ul>

## Troubleshooting Continued ...

Problem	Cause / Remedy
pH and/or ORP readings are slow, inaccurate or unstable or calibration is impossible.	<ul style="list-style-type: none"> <li>✓ The electrodes may need re-calibrating. Recalibrate.</li> <li>✓ The electrodes may need cleaning. Clean as described in the relevant section of this manual.</li> <li>✓ The electrodes may have been allowed to dry out. Re-hydrate as described in the relevant section of this manual.</li> <li>✓ The electrodes may be damaged. Replace the electrodes.</li> </ul>
EC readings are inaccurate or unstable.  OUT OF CAL RANGE error shows during calibration of EC.	<ul style="list-style-type: none"> <li>✓ Have you got the Wiper fitted? EC will not work without the Wiper fitted.</li> <li>✓ The electrodes may not be inserted deep enough into the sample being measured. Ensure the sample level reaches the middle of the slots on the Sleeve</li> <li>✓ Trapped air bubbles may be causing problems. Use the cleaning system to dislodge them.</li> <li>✓ The EC electrode may need recalibrating. Recalibrate.</li> <li>✓ The EC electrode may be dirty. Clean the EC electrode then recalibrate.</li> </ul>
Turbidity readings are inaccurate or unstable.	<ul style="list-style-type: none"> <li>✓ Have you got the Probe Sleeve and measurement chamber fitted? Turbidity will not work without the Probe Sleeve and the measurement chamber fitted.</li> <li>✓ Trapped air bubbles may be causing interference. Operate the cleaning system on the AP-Pro™ to dislodge them.</li> <li>✓ The sample being measured may contain air bubbles. Under these conditions, optical turbidity measurements can not be taken.</li> <li>✓ The electrodes may not be inserted deep enough into the sample being measured. Ensure the sample level reaches the middle of the slots on the Sleeve</li> <li>✓ 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.</li> <li>✓ The Turbidity electrodes may need recalibrating. Recalibrate.</li> <li>✓ The lenses on the turbidity electrodes may be dirty. Clean the lenses then recalibrate.</li> </ul>

## 22. DECLARATIONS OF CONFORMITY

### 22.1. UKCA DECLARATION



### Declaration of conformity

Aquaread Aquameter, Aquaprobe, Aquasonde, AquaTel, BlueLink and LevelLine water monitoring products are in compliance with essential requirements and other relevant provisions of Directives

Electromagnetic Compatibility Regulations 2016

Radio Equipment Regulations 2017

Approved by

A handwritten signature in black ink, appearing to read 'CH', followed by a horizontal line.

Craig Harrison

**Aquaread Limited**

Bridge House  
Northdown Industrial Park  
Broadstairs  
Kent  
CT10 3JP

Date Jan 1st 2023



## 22.2. CE DECLARATION



### Declaration of conformity

Aquaread Aquameter, Aquaprobe, Aquasonde, AquaTel, BlueLink and LeveLine water monitoring products are in compliance with essential requirements and other relevant provisions of Directives

Electromagnetic Comptibility (EMC) Legislation  
2014/30/EU

Radio Equipment Directive (RED)  
2014/53/EU

Approved by

Craig Harrison

**Aquaread Limited**

Bridge House  
Northdown Industrial Park  
Broadstairs  
Kent  
CT10 3JP

Date Jan 1st 2023

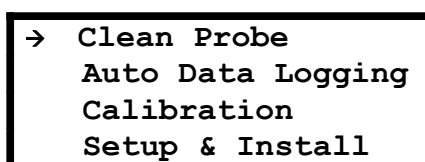
## 23. Appendix 1. The AP-Pro™ Automatic Cleaning System

The AP-Pro™ features a motorised cleaning mechanism. This cleaning mechanism is designed for use during calibration and long-term deployment when the Probe is connected to an AquaTel® Telemetry unit or a third party telemetry device capable of supplying the required voltage (6V-12V) and current (300mA).

The cleaning cycle can be activated from the Aquameter®, which is useful during calibration for removing air bubbles from the electrodes. When connected to an AquaTel®, the cleaning rate can be programmed remotely from a mobile device.

When connected to a third party telemetry device via an Aquaread® BlackBox, the BlackBox can be set to clean at various intervals. Please see the BlackBox manual for further details.

To activate the cleaning mechanism from the Aquameter®, press the **MENU** key. The Main Menu screen will be displayed. Select the first item on the menu, 'Clean Probe'.



When activated, the centrally mounted wiper will rotate once in each direction, cleaning all the electrodes before returning to its park position.

The wiper includes a clutch mechanism, which will disengage if the wiper jams. In this case the motor will continue to run for a few seconds, then a 'Wiper Jammed' or 'Feedback Fault' message will be displayed. Similarly, if there is not enough power available from the meter due to low battery voltage, or if the meter-probe cable is excessively long (which causes a voltage drop), a 'Wiper Jammed' or 'Feedback Fault' message may be displayed.

If the wiper jams and the clutch disengages, the cause of the jam should be rectified then the wiper should be rotated manually until the clutch re-engages with a sharp click. If power is removed then re-applied to the AP-Pro™, the motor will make one rotation after a few seconds in an attempt to re-engage the clutch automatically. This will also occur if the wiper is removed.

**The wiper forms an integral, working part of the Probe's EC and optical electrode measurement system, and MUST be fitted during calibration and measurement for correct operation. If you try to calibrate or use the Probe without the wiper fitted, you will get erroneous results. Also, the cleaning motor will run repeatedly in an attempt to put the wiper in the park position.**

### 23.1. Wiper Removal and Replacement

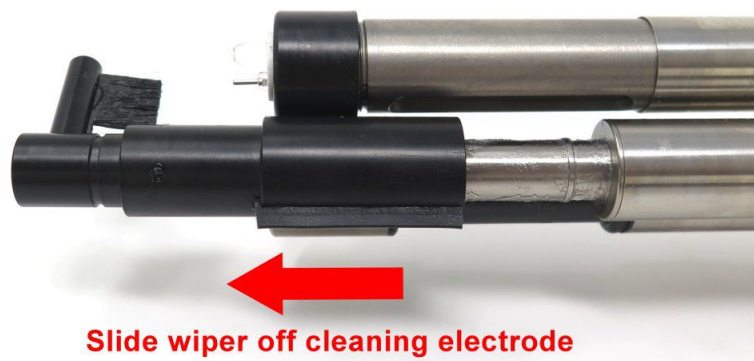
Occasional cleaning or replacement of the wiper brush and/or rubber EC wiper may be required due to wear or fouling. This is a simple job. In the following photos, all optional electrodes have been removed for clarity. You do not need to remove the electrodes in order to remove the brush holder.



First remove the Probe Sleeve then pull the stainless-steel spring clip out of the central shaft.



Next, slide the brush holder off the central shaft.



Next, slide the wiper arm out of the brush holder.



Next, slide the top brush out of the wiper arm.



Finally, if replacement is necessary, slide the rubber EC wiper from the brush holder.



Re-assembly is simply the reverse of this process. When re-assembly is complete, ensure the spring clip is correctly and securely fitted in the orientation shown below.



**Tips:**

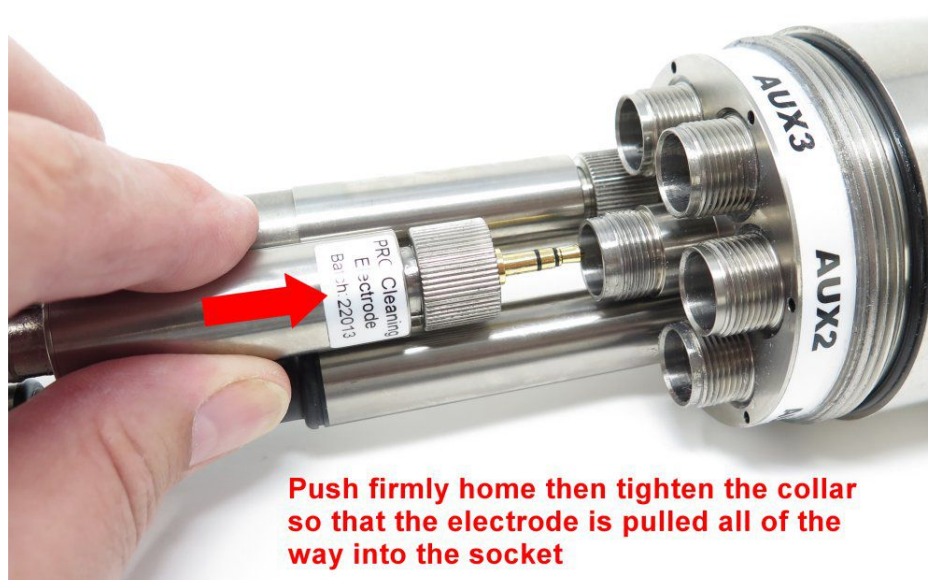
- Ensure the top brush is re-fitted the right way round and pushed all the way into the wiper arm. Refer to the photographs above if in doubt.
- When re-fitting the rubber EC wiper, lubricate the slot first with a little water, start the wiper in the slot then pull it all the way in.
- Before sliding the brush holder back onto the central shaft, rub a small amount of silicone grease onto the shaft.
- When the brush holder has been re-fitted and the spring clip is in place, rotate the wiper manually until you feel the drive clutch engage.
- Activate the cleaning system after re-assembly to ensure correct operation.

**23.2. Cleaning Electrode Removal and Replacement**

In the unlikely event of a fault or mechanical damage to the cleaning electrode, it can be easily replaced.

First, remove the Probe sleeve, then the wiper (as detailed above), then all of the AUX electrodes .

Next, unscrew the knurled collar at the base of the cleaning electrode and pull the electrode out of the Probe body.



To fit the new cleaning electrode, simply reverse this procedure ensuring the gold contacts on the plug are clean. No special alignment is necessary.

**Ensure the knurled collar is tightened hard down.** This is essential as it ensures the mechanical rigidity of the entire cleaning mechanism and it ensures the connection is water tight.

**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 knurled collars on the electrodes.



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

### 23.3. Wiper Mechanism Spare Parts

The following spare parts for the wiper system are available from your dealer.

Part Number	Description
Pro-Wiper	Replacement PRO series wiper assembly (made up of PRO-CLEANING-ELECTRODE , PRO-BRUSH-HOLDER and Spring Clip)
Pro-Cleaning-Electrode	Replacement PRO series Cleaning Electrode (requires PRO-BRUSH-HOLDER)
Pro- Brush Holder	Replacement PRO series cleaning brush holder assembly, includes 1 brush, 1 rubber EC wiper and 1 Spring Clip (requires PRO-CLEANING-ELECTRODE).
Pro-Brush	5 disposable brush / EC wiper pairs for the PRO series.

## 24. Appendix 2. Fitting Electrodes

The AP-Pro™ is supplied with three electrodes as standard. These are: DO/EC/Temperature, pH/ORP and the cleaning electrode.

There are two types of optional AUX Electrodes designed for use with the AP-Pro™: Optical Electrodes and ISE Electrodes. These can be fitted to any of the four AUX sockets marked AUX1 – AUX4.

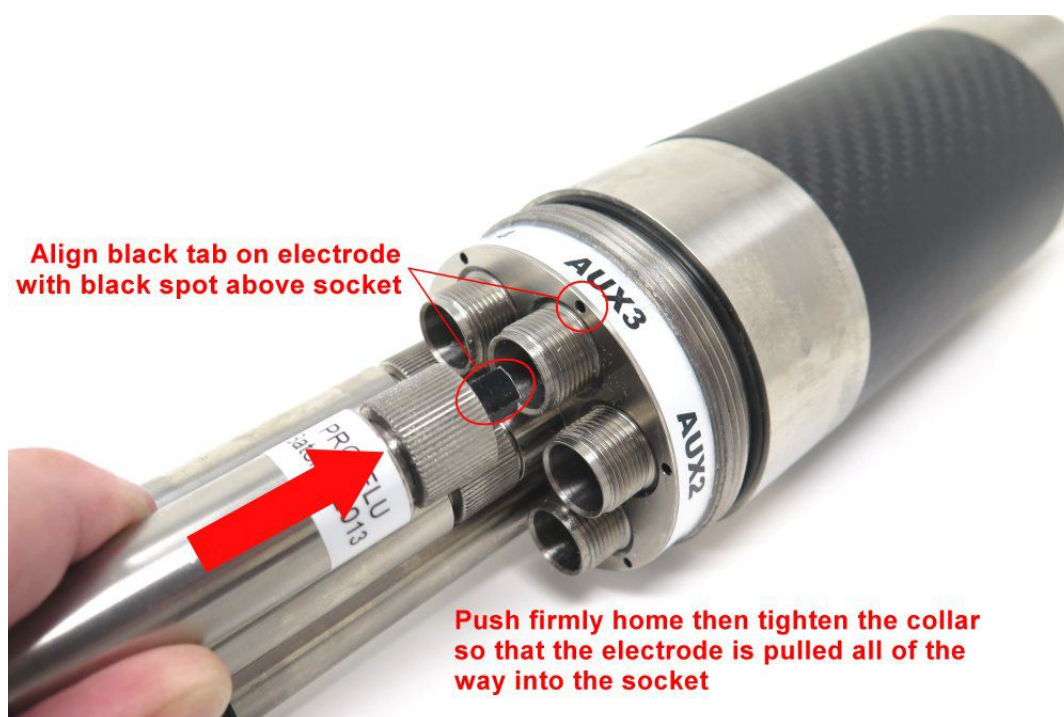
**PH/ORP electrodes may only be fitted to the socket labelled pH/ORP. The pH/ORP electrode will not work if fitted to an AUX socket.** Similarly, AUX electrodes must not be fitted to the pH/ORP socket.

### 24.1. Installing pH/ORP and AUX Electrodes

The pH/ORP electrode comes pre-fitted to the AP-Pro™. In the event that this electrode needs replacing, follow the instructions below for AUX electrodes.

To fit an optional AUX electrode, first remove the plastic blanking plug from the AUX socket that you want to use on the AP-Pro™. 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 on the previous page. Apply a small amount of silicone grease (supplied) to the threaded section of the socket and the O rings.

Align the black tab on the electrode with the black spot on the Probe body and push the electrode firmly home.



Tighten the knurled collar until the electrode is pulled all the way into the socket.

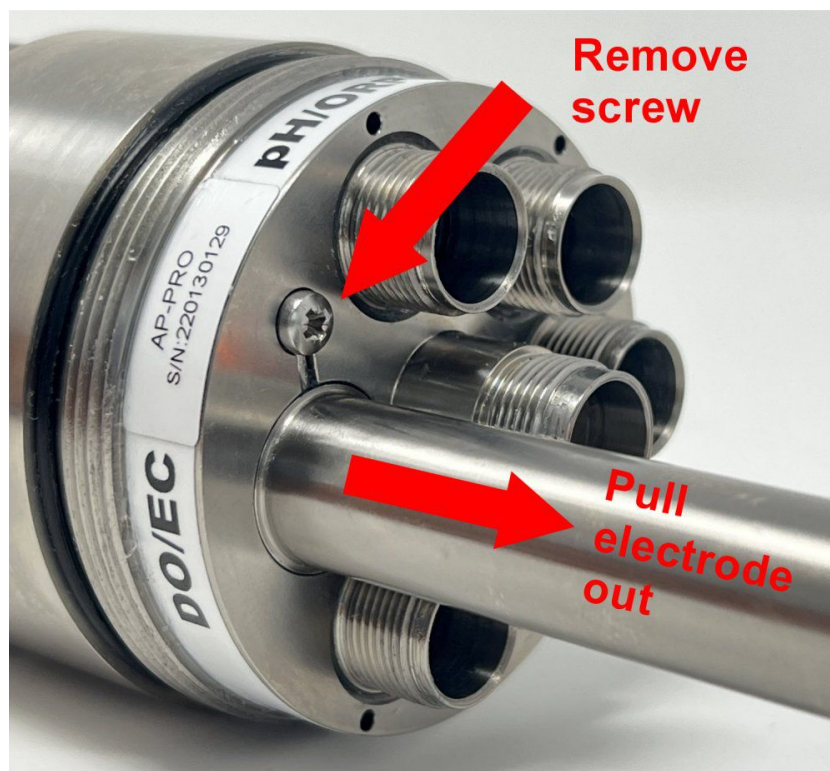
Keep the plastic blanking plug in a safe place. If you subsequently remove an electrode, be sure to replace the blanking plug.



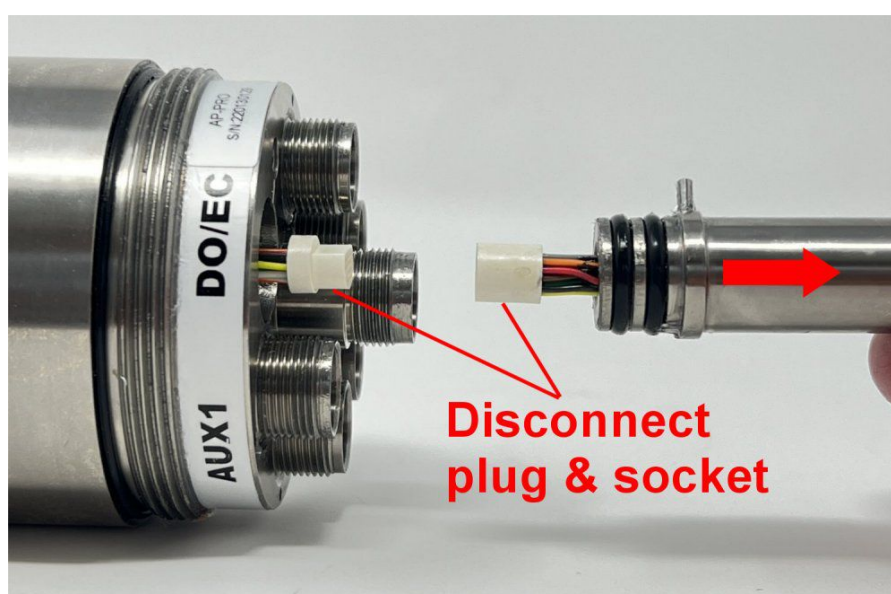
## 24.2. Replacing the DO/EC/Temperature Electrode

The DO/EC/Temperature electrode comes pre-fitted to the AP-Pro™. In the event that this electrode needs replacing, follow the instructions below.

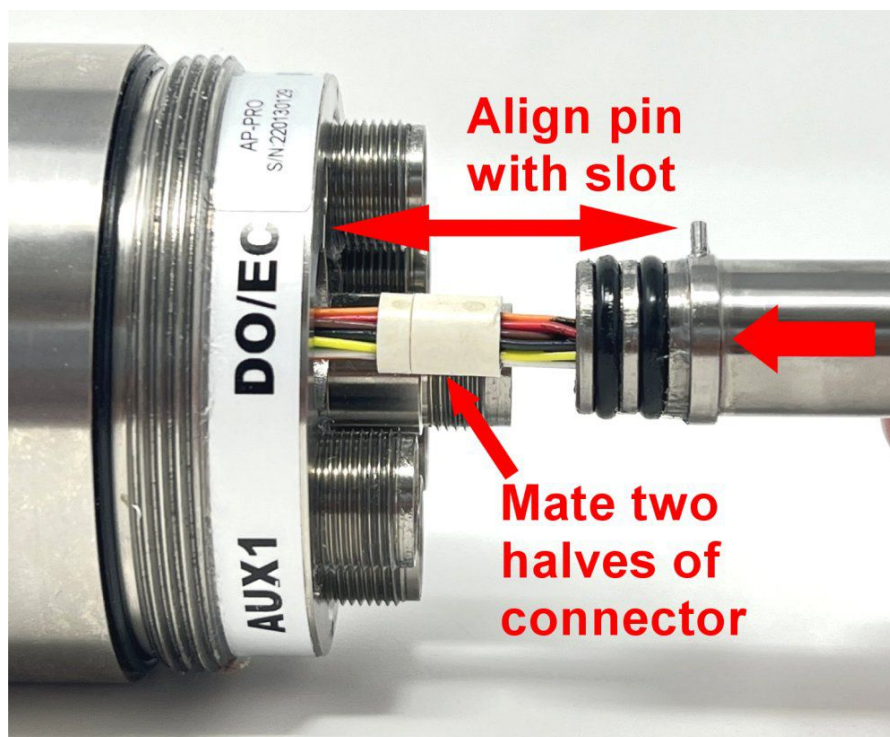
To remove the electrode, first remove the locking screw and pull the electrode straight out of the AP-Pro™ as shown below.



Next, disconnect the multi-way plug and socket.



To fit the new electrode, ensure the O rings are well coated with silicone grease, then re-connect the plug and socket.



Once the plug and socket are connected, align the pin on the electrode with the slot in the AP-Pro™ body, then press firmly home. Finally, replace the screw to lock the electrode in place.

### 24.3. Calibration After Electrode Fitting / Replacement

Unless you have specifically ordered and paid for a full calibration service, all Smart Electrodes leave the factory with just 'base line' calibration data. **When a new electrode is fitted, it should be fully calibrated at all points.**

If you are fitting an electrode that has been fully calibrated on another AP-Pro™ or has been factory calibrated, as an absolute minimum you should zero any optical AUX electrodes in order to compensate for variations in the measurement chamber. See [Zero Point Calibration](#) .

Likewise, you should carry out at least a single point calibration on any ISE AUX electrodes to compensate for variations in the junction in the pH electrode, which is used as a reference for all ISE electrodes. See [Single-point Calibration](#) .

If replacing a pH/ORP electrode, a pH7.00 calibration should be carried out as a minimum. See [Calibrating the First Point \(pH 7.00\)](#).

Finally, if replacing the DO/EC/Temperature electrode, a single point calibration at 100% DO Saturation should be carried out. See [Calibrating the DO 100% Saturation Point in Moist Air](#).

## 25. Appendix 3. Probe & Standard Electrodes Specification

<b>Protection Class</b>	AP-Pro & All Electrodes: IP68 (Permanent Immersion)
<b>AP-Pro Dimensions</b>	415mm long x 70mm diameter
<b>AP-Pro Weight</b>	1,900g (excluding optional electrodes)
<b>AP-Pro Power</b>	9V – 12V, 300mA (max during cleaning) Supplied by connected device

<b>Optical Dissolved Oxygen</b>	Range	0 – 500.0% / 0 – 50.00 mg/L
	Resolution	0.1% / 0.01mg/L
	Accuracy	0 - 200%: $\pm 1\%$ of reading. 200% - 500%: $\pm 10\%$
<b>Conductivity (EC)</b>	Range	0 – 200 mS/cm (0 - 200,000 $\mu$ S/cm)
	Resolution	3 Auto-range scales: 0 – 9999 $\mu$ S/cm, 10.00 – 99.99 mS/cm, 100.0 – 200.0mS/cm
	Accuracy	$\pm 1\%$ of reading or $\pm 1\mu$ S/cm if greater ( <b>see note 2</b> )
<b>TDS*</b>	Range	0 – 100,000 mg/L (ppm)
	Resolution	2 Auto-range scales: 0 – 9999mg/L, 10.00 – 100.00g/L
	Accuracy	$\pm 1\%$ of reading or $\pm 1$ mg/L if greater ( <b>see note 2</b> )
<b>Resistivity*</b>	Range	5 $\Omega$ •cm – 1 M $\Omega$ •cm
	Resolution	2 Auto-range scales: 5 – 9999 $\Omega$ •cm, 10.0 – 1000.0 K $\Omega$ •cm
	Accuracy	$\pm 1\%$ of reading or $\pm 1 \Omega$ •cm if greater ( <b>see note 2</b> )
<b>Salinity*</b>	Range	0 – 70 PSU / 0 – 70.00 ppt (g/Kg)
	Resolution	0.01 PSU / 0.01 ppt
	Accuracy	$\pm 1\%$ of reading or $\pm 0.1$ unit if greater ( <b>see note 2</b> )
<b>Seawater Specific Gravity*</b>	Range	0 – 50 $\sigma_t$
	Resolution	0.1 $\sigma_t$
	Accuracy	$\pm 1.0 \sigma_t$
<b>pH</b>	Range	0 – 14 pH / $\pm 625$ mV ( <b>see note 3</b> )
	Resolution	0.01 pH / $\pm 0.1$ mV
	Accuracy	$\pm 0.1$ pH / $\pm 5$ mV
<b>ORP</b>	Range	$\pm 2000$ mV ( <b>see note 3</b> )
	Resolution	0.1mV
	Accuracy	$\pm 5$ mV
<b>Depth</b>	Range	$\pm 0$ – 300m
	Resolution	1cm
	Accuracy	$\pm 0.2\%$ FS
<b>Temperature</b>	Range	-5°C – +70°C
	Resolution	0.01° C/F
	Accuracy	$\pm 0.1^\circ$ C

\* Readings calculated from EC and temperature electrode values  
 Aquaread® Ltd reserves the right to change specifications without notice

### Notes:

1. The accuracy figures quoted throughout this document represent the equipment's capability at the calibration points at 25°C. These figures do not take into account errors introduced by variations in the accuracy of calibration solutions and errors beyond the control of the manufacturer that may be introduced by environmental conditions in the field. Accuracy in the field is also dependent upon **full calibration** and minimal time between calibration and use.
2. The EC electrode can be calibrated at any point between 100 $\mu$ S/cm and 99,999 $\mu$ S/cm. The quoted accuracy of the electrode, and therefore all derived readings, relies upon the readings being within a reasonable range of the calibration point.
3. The measurement of pH and ORP relies upon the ability of the electrode to pass a minute electrical current through the water under test. For this reason, when using the standard pH/ORP electrode, the water under test must have a minimum EC (electrical conductivity) of 100 $\mu$ S/cm. Special low EC pH electrodes are available to special order.



## 26. Appendix 4. Optical Electrodes Detailed Specification and FAQs

### 26.1. What are the excitation and detection wavelengths?

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

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

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

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

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

### 26.2. How does the Refined Oil sensor work?

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

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

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

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

The electrode is not intended for absolute, quantitative measurements. This can only really be done using Gas or Liquid Chromatography in a laboratory although if grab sample data is available, a Grab Sample Factor (GS Factor) can be input on the calibration screen in order to improve the accuracy of future readings.

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

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

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

### 26.4. What is the Range and Resolution of the Optical Electrodes?

<b>Turbidity</b>	Range	0 – 3000 NTU
	Resolution	2 Auto-range scales: 0.0 - 99.9 NTU, 100 - 3000 NTU
	Accuracy	± 5% of auto-ranged scale
	MLD <sup>(1)</sup>	0.0 NTU
	MLR <sup>(2)</sup>	5.0 NTU
<b>Chlorophyll</b>	Range	0 – 500.0 µg/L (ppb)
	Resolution	2 Auto-range scales: 0.00 - 99.99 µg/L, 100.0 - 500.0 µg/L
	Repeatability	± 5% of reading
	MLD <sup>(1)</sup>	0.1 µg/L
	MLR <sup>(2)</sup>	5 µg/L
<b>Phycocyanin (BGA-PC)</b> (Freshwater Blue-Green Algae)	Range	0 – 300,000 cells/mL
	Resolution	1 cell/mL
	Repeatability	± 10% of reading
	MLD <sup>(1)</sup>	200 cells/mL
<b>Phycoerythrin (BGA-PE)</b> (Marine Blue-Green Algae)	Range	0 – 200,000 cells/mL
	Resolution	1 cell/mL
	Repeatability	± 10% of reading
	MLD <sup>(1)</sup>	400 cells/mL
<b>Rhodamine WT Dye</b>	Range	0 – 500 µg/L (ppb)
	Resolution	2 Auto-range scales: 0.00 - 99.99 µg/L, 100.0 - 500.0 µg/L
	Repeatability	± 5% of reading
	MLD <sup>(1)</sup>	0.1 µg/L
	MLR <sup>(2)</sup>	5 µg/L
<b>Fluorescein Dye</b>	Range	0 – 500 µg/L (ppb)
	Resolution	2 Auto-range scales: 0.00 - 99.99 µg/L, 100.0 - 500.0 µg/L
	Repeatability	± 5% of reading
	MLD <sup>(1)</sup>	0.1 µg/L
	MLR <sup>(2)</sup>	5 µg/L
<b>Refined Oil</b>	Range	0 – 10,000 µg/L (ppb) (Napthalene)
	Resolution	0.1 µg/L
	Repeatability	± 10% of reading
	MLD <sup>(1)</sup>	10 µg/L (Napthalene)
<b>CDOM/FDOM</b>	Range	0.0 – 2,000.0 µg/L (ppb) (Quinine Sulphate)
	Resolution	0.1 µg/L
	Repeatability	± 10% of reading
	MLD <sup>(1)</sup>	10 µg/L (Quinine Sulphate)

Aquaread® Ltd reserves the right to change specifications without notice

#### Notes:

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

## 26.5. What is the Accuracy of the Optical Electrodes?

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

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

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

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

If grab sample data is available, a Grab Sample Factor (GS Factor) can be input on the calibration screen of each fluorescent type electrode in order to improve the accuracy of future readings.

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.
- Differences in the fluorescent response caused by temperature.
- Differences in the fluorescent response caused by ambient light.
- Interference caused by turbidity (BGA-PC and BGA-PE electrodes are particularly susceptible to interference from turbidity due to the proximity of their excitation and detection wavelengths).

## 27. Appendix 4. ISE Electrodes Detailed Specification

<b>Ammonium / Ammonia<sup>†</sup></b>	Range	0 – 9,000mg/L (ppm)
	Resolution	2 Auto-range scales: 0.00 - 99.99 mg/L, 100.0 – 8,999.9 mg/L
	Accuracy	± 10% of reading or 2ppm (whichever is greater)
	MLD <sup>(1)</sup>	1.0 ppm
	Interfering Ions <sup>(2)</sup>	Potassium, Sodium and Magnesium
	pH Range <sup>(3)</sup>	5 - 8
<b>Chloride</b>	Range	0 – 20,000mg/L (ppm)
	Resolution	2 Auto-range scales: 0.00 - 99.99 mg/L, 100.0 – 19,999.9 mg/L
	Accuracy	± 10% of reading or 2ppm (whichever is greater)
	MLD <sup>(1)</sup>	2.0 ppm
	Interfering Ions <sup>(2)</sup>	Bromide, Iodide, Cyanide and Sulphide
	pH Range <sup>(3)</sup>	2 - 11
<b>Fluoride</b>	Range	0 – 1,000mg/L (ppm)
	Resolution	2 Auto-range scales: 0.00 - 99.99 mg/L, 100.0 – 999.9 mg/L
	Accuracy	± 10% of reading or 2ppm (whichever is greater)
	MLD <sup>(1)</sup>	0.05 ppm
	Interfering Ions <sup>(2)</sup>	Hydroxide (OH-)
	pH Range <sup>(3)</sup>	4 - 8
<b>Nitrate</b>	Range	0 – 30,000mg/L (ppm)
	Resolution	2 Auto-range scales: 0.00 - 99.99 mg/L, 100.0 – 29,999.9 mg/L
	Accuracy	± 10% of reading or 2ppm (whichever is greater)
	MLD <sup>(1)</sup>	0.5 ppm
	Interfering Ions <sup>(2)</sup>	Chloride, Bromide, Fluoride, Sulphate, Chlorate and Perchlorate
	pH Range <sup>(3)</sup>	3 - 10
<b>Calcium</b>	Range	0 – 2,000mg/L (ppm)
	Resolution	2 Auto-range scales: 0.00 - 99.99 mg/L, 100.0 – 1,999.9 mg/L
	Accuracy	± 10% of reading or 2ppm (whichever is greater)
	MLD <sup>(1)</sup>	0.05 ppm
	Interfering Ions <sup>(2)</sup>	Magnesium, Barium, Lead, Zinc and Sodium
	pH Range <sup>(3)</sup>	4 - 9

<sup>†</sup> Ammonia readings are calculated from Ammonium, pH and temperature electrode values.

Aquaread® Ltd reserves the right to change specifications without notice

### Notes:

1. MLD (Minimum Level of Detection) is the minimum value the electrode is physically capable of measuring.
2. Each ion selective electrode is prone to interference from ions that are similar in nature to the target ion. The main interfering ions for each electrode type are listed here. If the water under test contains interfering ions, the electrode will produce erroneous readings. **Ion Selective Electrodes are not recommended for use in brackish or salt water** due to the high level of interfering ions.
3. Each ion selective electrode will only operate within a specific pH and EC range. The pH limits vary and are listed against each electrode. All ion selective electrodes work in conjunction with the pH electrode during measurement. For this reason, the selected AP-Pro™ must have a working pH or pH/ORP electrode fitted and the conductivity (EC) of the water under test must be greater than 50µS/cm.
4. All ion selective electrodes exhibit calibration drift over time. Drift should not be a major problem where the electrodes can be frequently calibrated. However, if the electrodes are to be used in long-term deployment studies, drift is almost certain to occur.

During long-term deployment of ion selective electrodes, the user should obtain grab samples during the course of the deployment for analysis in the laboratory by chemical means and use the results to apply post calibration to the recorded results.

5. Accuracy in the field is dependent upon full three-point calibration and minimal time between calibration and use.
6. In order to achieve accurate longer term readings with ISE electrodes, the Probe needs to be either placed in flowing water, or needs to be stirred or raised and lowered continuously to ensure a minimum flow rate of 0.3m/s over the electrode. **If there is no water flow across the ISE electrode, the ions in the immediate area of the electrode will be depleted over time and the reading will start to fall.** During calibration this is not as important as the ISE is only left in the calibration solution for a short period of time, however, it is recommended that if you intend to test for longer periods with the stirring/raising and lowering technique in the field this should be matched during calibration for ultimate accuracy.

### 27.1. Special Notes Concerning ISE Electrodes and pH Buffer Solutions

The high ionic concentration of pH calibration solutions (buffers), including RapidCal, can cause significant offsets in ISE electrodes.

These offsets are temporary, but best avoided because they can cause significant errors during both calibration and normal operation.

For this reason all ISE electrodes are supplied with a red rubber sealing cap.



**The caps should be fitted to all ISE Electrodes during pH/ORP calibration, when using RapidCal or using buffers containing interfering ions (i.e. all other ISE calibration solutions other than the one for the specific ISE being calibrated)** in order to protect the ISE electrodes from the effects of the buffer solution or interfering ions. At all other times, the ISE electrodes should be left uncovered.

**The caps MUST NOT be fitted when calibrating optical electrodes or serious calibration errors will occur due to reflections from the caps.**

**There must be a functioning pH/ORP-EL fitted for ISE measurement to be valid. Please do not leave the Probe soaking in ISE calibration buffers for extended periods as the pH/ORP electrode will become depleted of ions leading to errors in ISE measurements.**

## **28. Appendix 5. Flow Through Cell (Flowcell)**

### **28.1. Introduction**

The Aquaread® AP-7000 Flow Through Cell (Flowcell), once fitted with an AP-Pro™ adaptor ring, can be used with the AP-Pro™ in conjunction with most third party pumping device.

The Flowcell allows sample water to flow over all the AP-Pro's individual electrodes simultaneously. This eliminates air contact with pumped samples from groundwater boreholes allowing truly representative measurements to be obtained. Made from marine grade aluminium, the Flowcell is ruggedly constructed for hard use in the field. The base flange includes four holes to allow the unit to be pegged down if necessary.

### **28.2. Spigot Installation**

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

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

### **28.3. AP-Pro™ Preparation Prior to Use**

In order to fit the AP-Pro™ into the Flowcell, it is necessary to first fit the AP-Pro™ Flowcell Adapter Ring onto the AP-Pro™.

First remove the sleeve from the AP-Pro™. Next, slide the Adapter Ring onto the main body of the AP-Pro™. The body of the AP-Pro™ with its O ring should fit snugly into the recess in top of the Adapter Ring. Do not refit the AP-Pro™ Sleeve.

### **28.4. AP-Pro™ Installation into the Flowcell**

Grease the threaded section and O ring of the Adapter Ring and screw the AP-Pro™ into the Flowcell. Do not over tighten. Hand tight is fine.

### **28.5. Zeroing Optical Electrodes**

If you have any optical electrodes fitted to the AP-Pro™, prior to inserting the Probe into the Flowcell, block the inlet (bottom) spigot and fill the Flowcell with clean, still mineral water. Leave the top spigot open.

Now screw the AP-Pro™ fully in allowing the excess water to escape through the top spigot. Connect an Aquameter® or similar device, operate the cleaning mechanism, then zero each optical electrode in turn.

### **28.6. Operation**

Connect the Flowcell to a pumping device so that sample water enters at the bottom and exits at the top. Adjust the flow rate so that there is no visible turbulence or cavitation within the pipework. Connect an Aquameter® or similar device and monitor the readings. If the readings are jumpy or erratic, reduce the flow rate.

The ideal flow rate is around 30 litres/hour (8 US gallons/hour), although the AP-Pro™ is capable of operating at flow rates as low as 15 litres/hour (4 US gallons/hour). Flow rates above 60 litres/hour (16 US gallons/hour) are not recommended.

## 28.7. Caution

The maximum recommended operating pressure of the Flowcell is 500mb (7.25 PSI). Select your pumping device accordingly. If necessary, use a three-way bypass valve so that this limit is not exceeded. Tip: use the depth measurement feature of the AP-Pro™ to measure the operating pressure. At 500mb, the AP-Pro™ will show a depth of approximately 5 meters.

## 28.8. Cleaning

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

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

## 28.9. Flowcell Troubleshooting

Problem	Cause / Remedy
DO readings are abnormally high or are fluctuating wildly.	<ul style="list-style-type: none"><li>• Aeration of sample water. Check all joints for air leaks. Reduce flow rate to avoid cavitation.</li></ul>
Turbidity or other optical electrode readings are abnormally high or are fluctuating wildly.	<ul style="list-style-type: none"><li>• Air bubbles adhering to the Turbidity Electrode lenses. Agitate Flowcell to dislodge.</li><li>• Aeration of sample water. Check all joints for air leaks. Reduce flow rate to avoid cavitation.</li><li>• Optical electrode not zeroed in the Flowcell. Fill the Flowcell with clean water and Zero the optical electrode.</li></ul>