Instruction Manual

for the

Aquaread® AS-Pro™

Multiparameter Water Quality Sonde

and associated

Utilities & Accessories

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IMPORTANT INFORMATION

Before using this equipment for the first time, it is **ABSOLUTELY ESSENTIAL** that the following steps are followed.

- Read this manual.
- Download and install the SondeLink PC application.
- Fit suitable batteries. These MUST be 3.6V Lithium (Li-SOCl2).
- Fit any optional electrodes required.
- Calibrate all electrodes.
- Setup a suitable logging regime.
- Fit the connector sealing cap.
- Switch the Sonde to Auto.

If any of these steps are missed, your AS-Pro will either not log any data or will log erroneous data.

WHEN USING AN EXTERNAL POWER SUPPLY, ONLY USE THE ACCESSORIES LISTED IN SECTION 13.8 External Power Supply. FAILING TO DO SO MAY CAUSE EARTH LOOPS OR IRREPAIRABLE DAMAGE TO YOUR PROBE AND WILL NOT BE COVERED BY YOUR WARRANTY.

Please read this manual carefully and fully prior to operating this equipment.

1. Introduction

This manual covers the setup, operation, calibration and maintenance of the Aquaread® AS-Pro™. In order to communicate with the AS-Pro™ you will need either a PC running Aquaread® SondeLink™ software, or a mobile device running the Aquaread® BlueLink® Mobile Device App.

This manual assumes you will be using Aquaread® SondeLink™ software. This software is available for download from: https://www.aquaread.com/downloads/software-downloads

2. Understanding the AS-Pro™ System

2.1. What's in the Box?

The AS-Pro™ is supplied with the following:

- Connector Sealing Cap
- Calibration Cap
- USB Cable
- 2 x Eye Bolts
- 2 x Carabiniers
- Suspension Cable
- 500mL of RapidCal Solution
- pH Storage Cap
- 25mL pH Storage Solution
- Pot of silicone grease
- Lint-free cleaning cloth

To complete your system, you will need two **3.6 Volt** Primary lithium-thionyl chloride (Li-$SOCl_2$) batteries, which should be purchased separately. The AS-Pro™ requires 2 x D size batteries. **The AS-Pro™ will not operate on 1.5V alkaline batteries.**

Prior to first use, the AS-Pro™ must be set up. To do this, the AS-Pro™ must have batteries fitted and must be connected to a PC running SondeLink™ software or a mobile device running the Aquaread® BlueLink® Mobile Device App.

2.2. Aquaread Aquameter® Compatibility

Whilst the AS-Pro™ is designed primarily to be calibrated and set up using SondeLink™ software via a USB cable or by using a mobile device running the Aquaread® BlueLink® Mobile Device App, the Sonde can also be calibrated and used for live dip-testing with an Aquaread® Aquameter®.

In order to make connection to an Aquameter®, an AS-Pro™® Extension cable is required. The Aquameter® will not communicate with the Sonde using the AS-Pro™ Vent/Data Cable, which is wired solely for USB communication. Also, when used with an Aquameter®, the AS-Pro™ must have its own batteries fitted as the Aquameter® will not supply power.

When connected to an Aquameter®, the AS-Pro™ will operate as an AS-Pro™. Whilst connected to an Aquameter®, the AS-Pro™ will not log any data. Setup of the AS-Pro's logging functions and logged data retrieval are not supported by the Aquameter®.

2.3. The AS-Pro™ and the Environment

The AS-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).

During deployment, the Sonde should be suspended by a suitable suspension cord attached to the Sonde's two eye-bolts. **The Sonde should NEVER be suspended by the hole in the connector sealing cap,** which is provided for tethering of the sealing cap only.

During deployment, the connector sealing cap or a cable must be fitted to the top connector. If the Sonde is deployed with the connector left open, the unit will fill with water and will be seriously damaged. This will not be covered by your warranty.

The AS-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 AS-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.

2.4. Vented Cable Option

The AS-Pro™ contains an internal barometric pressure sensor, which is vented through the top connector. This barometric pressure sensor is necessary for correction of both depth and percentage saturation of dissolved oxygen (DO %Sat), which both vary with barometric pressure. DO readings in mg/L are not affected by barometric pressure.

If accurate depth and %DO readings are required during a deployment lasting more than a few hours, during which the atmospheric pressure may change, the AS-Pro™ should be deployed on a vented cable, which will allow the pressure inside the Sonde to vary with the ambient air pressure, even when it is submerged.

If accurate depth and %DO readings are not important, the AS-Pro™ can be fully sealed using the connector sealing cap and deployed on a simple suspension cord.

2.5. About the Connector Sealing Cap

The internal barometric pressure sensor is vented through the top connector.

When using the BlueLink® Mobile Device App to calibrate the AS-Pro™ it is essential to remove the connector sealing cap.

This will allow the internal barometric pressure sensor to read accurate air pressure, which is essential for correct Dissolved Oxygen calibration.

In addition, it is advisable, when storing the AS-Pro™ with batteries fitted, to remove the connector sealing cap. This will allow the batteries to vent to the atmosphere in the event of a battery malfunction and will prevent a dangerous pressure build up inside the unit.

2.6. Anatomy of the AS-Pro™

The AS-Pro™ consists of four main parts: the Battery Compartment, Sonde 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 Sonde Body by unscrewing to allow cleaning of the individual electrodes. Likewise, the Measurement Chamber can be removed from the Sleeve to allow cleaning.

In order to fit and replace the batteries, the battery cover collar can be removed from the Sonde by unscrewing, then the battery cover can be pulled straight off the Sonde, revealing the battery compartment.

The Switch Ring allows the AS-Pro to be set to Auto or Bluetooth mode. In order to rotate the switch ring, pull it towards the bottom of the Sonde, rotate it to the desired position then release it ensuring it springs back into the locked position.

Directly below the Switch Ring there is a section of clear acrylic, which is illuminated by green, blue, yellow or red flashing LEDs to indicate the Sonde's status.

2.7. About Smart Electrodes

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

The AS-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.

Prior to using the AS-Pro™, any required optional electrodes should be fitted. See section Appendix 2. Fitting Electrodes for further information.

2.7.1. 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 AS-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.

2.8. About the Cleaning System

The AS-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.

The cleaning system can be activated from SondeLink™ or from the BlueLink® Mobile Device App, which is useful during calibration for removing air bubbles from the electrodes.

The cleaning interval can also be programmed using the above software. During deployment, whenever the Sonde cleans, an entry is made in the data log.

2.9. About 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 AS-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.

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 20ºC or 25ºC) although a variation of up to +/-10ºC makes very little difference in reality.

During pH measurement, temperature variation is automatically compensated for.

2.10. About the Calibration Vessel

The AS-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 to 325mL, dependent on the number of optional electrodes installed) calibration vessel. It is important to note that for accurate calibration of the EC and optical sensors, all EC rings must be covered and the calibration vessel should be **full to the top**.

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 Sonde's 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 Sonde will then be ready to use.

3. Battery Selection, Installation and Care

3.1. Choice of Battery Type

The AS-Pro™ requires two 3.6 Volt Primary lithium-thionyl chloride (Li-$SOCl_2$) **D size** batteries. **Batteries MUST always be fitted, even when using an external power supply.** See section 14.8. External Power Supply for details of the optional external supply.

Lithium-thionyl chloride (Li-$SOCl_2$) batteries are readily available on-line. **DO NOT USE standard 1.5V batteries.** The AS-Pro™ will not operate at all on 1.5V batteries.

When purchasing batteries for the AS-Pro™, which has a motorised cleaning system, always ensure the batteries you choose are capable of providing a **maximum continuous current of at least 500mA**. This information is available as part of the battery specification.

3.2. Installing the Batteries

During battery installation the switch ring on the AS-Pro™ must be set to the OFF position.

To install the batteries, grasp the knurled battery cover collar at the top of the Sonde, unscrew the collar and remove completely from the Sonde.

Next, twist and slide the carbon-fibre battery cover off the Sonde. This cover is sealed with four large O rings, so may take some effort to remove.

The battery compartment inside the AS-Pro™ will accept two batteries. Observing the polarity markings in the battery compartment, insert two batteries of the correct type.

Apply some silicone grease to the top and bottom O rings, then twist and slide the battery cover back on to the Sonde. Again, this may take some effort and is best done with the Sonde sitting vertically on a table.

Apply a little grease to the thread of the battery cover collar then replace the collar. Be sure to tighten the battery cover collar properly.

3.3. Battery Life

The life of the batteries is dependent upon the type of optional electrodes fitted, the logging rate, the event checking rate and the cleaning interval.

During setup of the Sonde using SondeLink software, the estimated battery life will be displayed and updated as you alter the logging, event and cleaning settings.

The following table represents the approximate battery life assuming optional optical electrodes are fitted and the cleaning rate is set to every four hours. If no optical electrodes are fitted, the battery life will be around 50% longer than shown below.

Logging / Event Interval	Expected Battery Lie
1 min	14 days
5 mins	71 days
10 mins	135 days
15 mins	193 days
30 mins	335 days
1 hour	531 days

3.4. Important note regarding battery life and Event Logging

If you set a long logging interval but a very short event checking interval, the battery life will be estimated on the event checking interval rate. Even though the Sonde will not log data every time an event is checked, it will take a reading and hence will use the same amount of battery power as a logged data point.

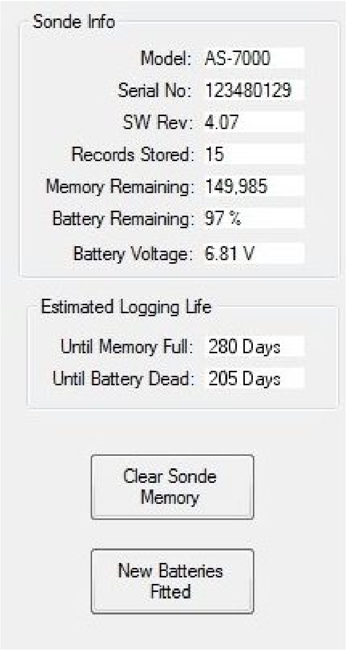
Always choose the longest logging / event checking interval that you can for your application in order to prolong the battery life. When setting the event logging rate, keep an eye on the estimated battery life figure.

3.5. Battery Condition Monitoring

Battery condition is continuously monitored by the AS-Pro™. When the switch ring is set to the AUTO position, if a low battery condition is detected, the red LED just below the switch ring will flash every two seconds. The batteries should be replaced as soon as possible if this indication is given.

If the batteries become too low to operate the unit reliably, the unit will stop logging data. Actual battery condition can be viewed any time by connecting the AS-Pro™ to a PC running SondeLink™ software and selecting the Data Logging Setup tab.

The Sonde Info panel (shown right) gives the actual battery capacity remaining and an estimate of the battery life remaining based on the current logging regime. It is advisable not to deploy the Sonde with less than 20% battery capacity available.


Sonde Info

Model: AS-7000
Serial No: 123480129
SW Rev: 4.07
Records Stored: 15
Memory Remaining: 149,985
Battery Remaining: 97 %
Battery Voltage: 6.81 V

Estimated Logging Life

Until Memory Full: 280 Days
Until Battery Dead: 205 Days

3.6. Resetting the Battery Condition Monitor

Whenever new batteries are fitted, it is essential to reset the battery condition monitor by clicking the 'New Batteries Fitted' button. This will reset the battery condition monitor to 100% and allow an accurate estimate of battery condition going forward.

DO NOT RESET THE BATTERY MONITOR UNLESS YOU HAVE FITTED NEW BATTERIES. This can lead to loss of data when the batteries unexpectedly run out.

3.7. Important note regarding storage

It is advisable, when storing the AS-Pro™ with batteries fitted, to remove the connector sealing cap. This will allow the batteries to vent to the atmosphere through the connector in the event of a battery malfunction and will prevent a dangerous pressure build up inside the unit.

4. Installing SondeLink™ Utility Software

Prior to first use, the AS-Pro™ must be set up. To do this, the Sonde must have any optional electrodes fitted (see section Appendix 2. Fitting Electrodes), it must have batteries fitted and it must be connected to a PC running SondeLink™ software.

The SondeLink PC Software is available for download using the following link:
http://www.aquaread.com/software-downloads

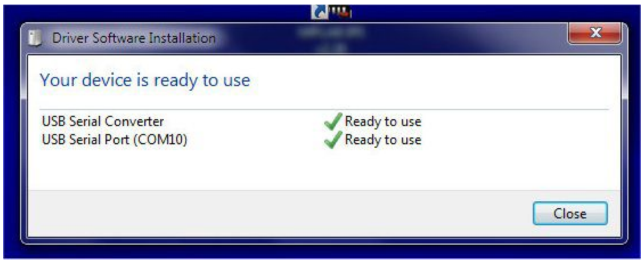
From the Aquaread® Downloads page, select 'SondeLink - AS-Pro™ Utility'. The software will be downloaded as a .ZIP file. Unzip the downloaded .ZIP file into a temporary directory.

4.1. Driver Installation

To communicate with the AS-Pro™, two software 'drivers' need to be installed. These are a '**USB Serial Converter**' driver and a '**USB Serial Port**' driver. Connect the AS-Pro™ USB cable to your PC. You do not need a Sonde connected at this point. 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.

After successful driver installation, the following message should be displayed.



Driver Software Installation

Your device is ready to use

USB Serial Converter ✓ Ready to use
USB Serial Port (COM10) ✓ Ready to use

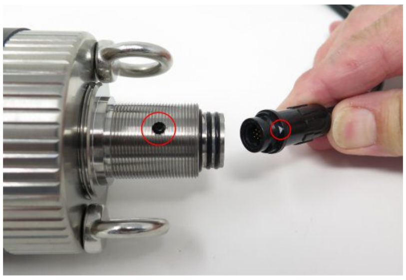
The USB Serial Port number (COM10 in the above example) may be different, but that is fine provided it shows 'Ready to use'. If the drivers do not install properly, refer to Section 24.. Appendix 5. Troubleshooting SondeLink™

4.2. Software Installation

Now you must install the SondeLink™ software application. To do this, browse the temporary directory into which you unzipped the download and click on '**setup.exe**'.

You will be given the usual Windows® security warnings. Allow the software to install. Once installed, SondeLink™ will run automatically. Thereafter, it can be found in you Programs List in the Aquaread folder.

4.3. Connecting an AS-Pro™



Set the Sonde's switch ring to the AUTO position. Connect the USB cable to your PC then align the small arrow on the end of the USB cable's round connector with the black dot on the Sonde's connector and plug it in.

The Sonde will detect the USB cable and enter USB mode. This is indicated by the green LED being continuously lit.

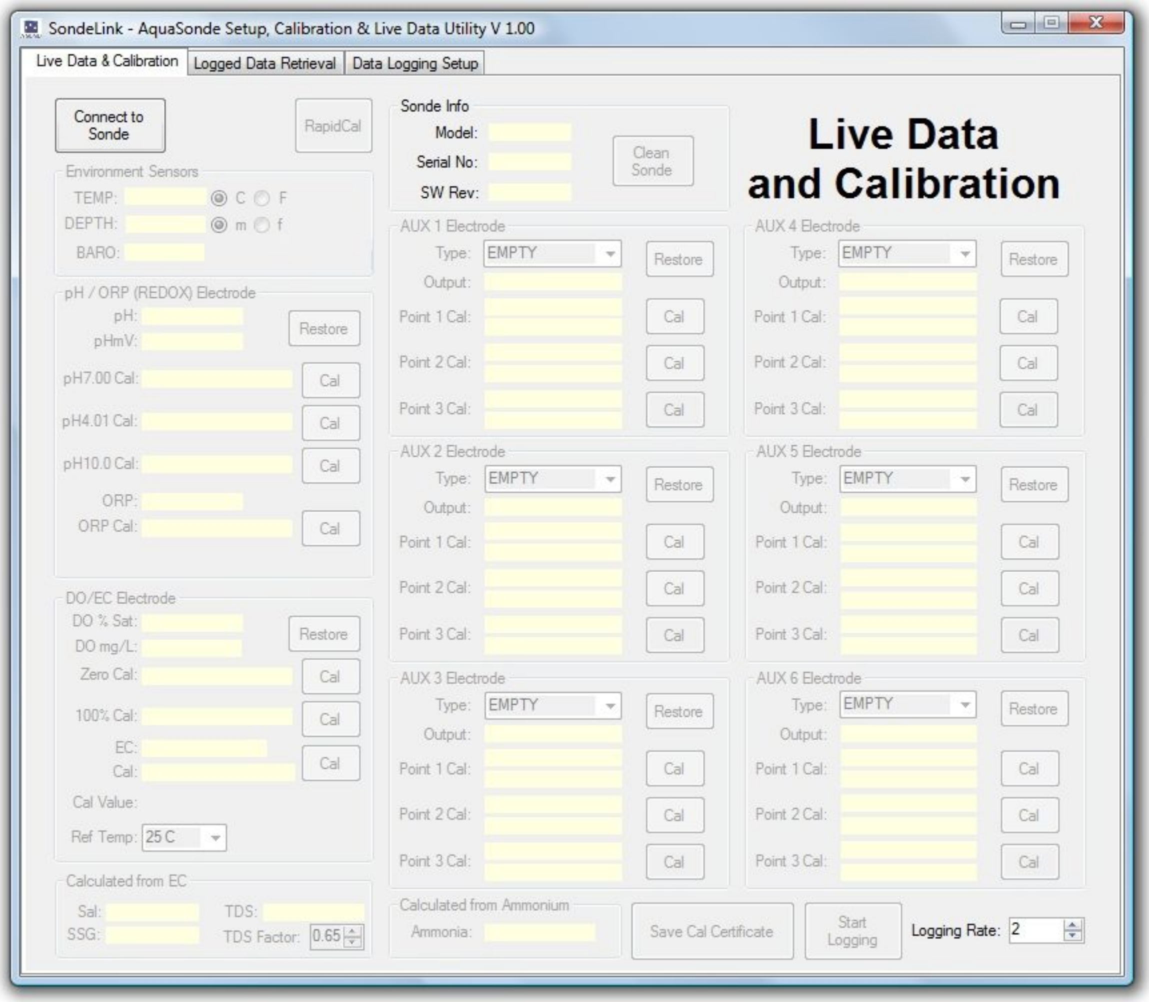
5. Taking Live Measurements & Calibrating Electrodes

The AS-Pro™ includes a pH/ORP electrode, which is kept moist by a storage cap. Remove the Sleeve then remove the storage cap by pulling it straight off. **Do not use a twisting motion to remove or replace the cap as this can unscrew the electrode from the Sonde body.** Rinse any salty deposits from the pH/ORP electrode with fresh water.

Re-fit the Sleeve and ensure the Measurement Chamber is fitted.

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

Connect the AS-Pro™ to the PC as described in section 4.3. Connecting an AS-Pro™ and start SondeLink™. The *Live Data and Calibration* tab will be displayed.



SondeLink - AquaSonde Setup, Calibration & Live Data Utility V 1.00

Live Data and Calibration

TEMP: ● C ○ F

DEPTH: ● m ○ f

AUX 1 Electrode Type: EMPTY

AUX 2 Electrode Type: EMPTY

AUX 3 Electrode Type: EMPTY

AUX 4 Electrode Type: EMPTY

AUX 5 Electrode Type: EMPTY

AUX 6 Electrode Type: EMPTY

Ref Temp: 25 C

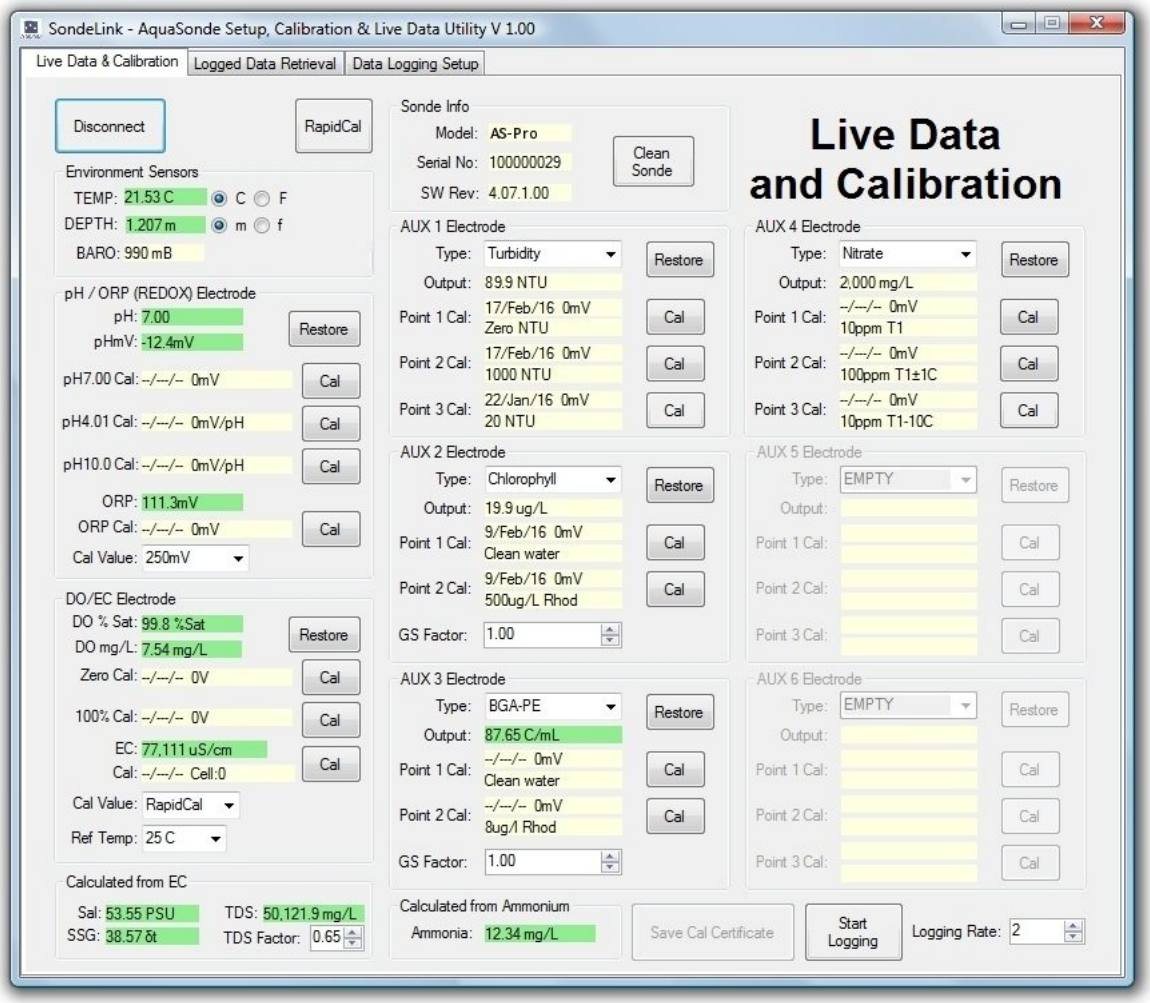
TDS Factor: 0.65

Logging Rate: 2

The switch ring on the AS-Pro™ should be set to the AUTO position **before the cable is inserted.** Once the cable is inserted and recognised, the green LED below the switch ring will illuminate solidly to indicate the Sonde is in USB mode.

Immerse the Sonde in the sample water, making sure that the water level comes at least half way up the slots in upper part of the Sleeve.

On the SondeLink™ software, select the *Live Data & Calibration* tab then click the *Connect to Sonde* button at the top left of the screen. If the AS-Pro™ is properly connected and the drivers are installed, SondeLink™ will start to read live data from the Sonde and update every two seconds.



Environment Sensors
TEMP: 21.53 C ● C ○ F
DEPTH: 1.207 m ● m ○ f
BARO: 990 mB

pH / ORP (REDOX) Electrode
pH: 7.00
pHmV: -12.4mV
pH7.00 Cal: --/---/-- 0mV
pH4.01 Cal: --/---/-- 0mV/pH
pH10.0 Cal: --/---/-- 0mV/pH
ORP: 111.3mV
ORP Cal: --/---/-- 0mV
Cal Value: 250mV

DO/EC Electrode
DO % Sat: 99.8 %Sat
DO mg/L: 7.54 mg/L
Zero Cal: --/---/-- 0V
100% Cal: --/---/-- 0V
EC: 77,111 uS/cm
Cal: --/---/-- Cell:0
Cal Value: RapidCal
Ref Temp: 25 C

Calculated from EC
Sal: 53.55 PSU
SSG: 38.57 δt
TDS: 50,121.9 mg/L
TDS Factor: 0.65

Sonde Info
Model: AS-Pro
Serial No: 100000029
SW Rev: 4.07.1.00

AUX 1 Electrode
Type: Turbidity
Output: 89.9 NTU
Point 1 Cal: 17/Feb/16 0mV Zero NTU
Point 2 Cal: 17/Feb/16 0mV 1000 NTU
Point 3 Cal: 22/Jan/16 0mV 20 NTU

AUX 2 Electrode
Type: Chlorophyll
Output: 19.9 ug/L
Point 1 Cal: 9/Feb/16 0mV Clean water
Point 2 Cal: 9/Feb/16 0mV 500ug/L Rhod
GS Factor: 1.00

AUX 3 Electrode
Type: BGA-PE
Output: 87.65 C/mL
Point 1 Cal: --/---/-- 0mV Clean water
Point 2 Cal: --/---/-- 0mV 8ug/l Rhod
GS Factor: 1.00

Calculated from Ammonium
Ammonia: 12.34 mg/L

AUX 4 Electrode
Type: Nitrate
Output: 2,000 mg/L
Point 1 Cal: --/---/-- 0mV 10ppm T1
Point 2 Cal: --/---/-- 0mV 100ppm T1±1C
Point 3 Cal: --/---/-- 0mV 10ppm T1-10C

AUX 5 Electrode
Type: EMPTY
Output:
Point 1 Cal:
Point 2 Cal:
Point 3 Cal:

AUX 6 Electrode
Type: EMPTY
Output:
Point 1 Cal:
Point 2 Cal:
Point 3 Cal:

Logging Rate: 2

5.1. Environment Sensors

This group box, located below the Connect button, displays the following:

Temperature is measured in the AS-Pro™ by a temperature sensor in the DO/EC electrode. By clicking on the adjacent controls, you can see temperature in Centigrade or Fahrenheit.

Water pressure is measured in the AS-Pro™ by a pressure sensor mounted inside the body of the Sonde that is in contact with the water.

Barometric pressure is measured in the AS-Pro™ by a pressure sensor mounted inside the body of the Sonde that is vented to the atmosphere through the main connector.

Depth is calculated by subtracting the barometric pressure from the water pressure. The pressure differential, once corrected for temperature and salinity (water density), is directly proportional to depth.

The datum on the Sonde for depth measurement is the top of the slots on the Sonde sleeve. Depth can be displayed in meters or feet.

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

If accurate depth readings are required during a deployment lasting more than a few hours, during which atmospheric pressure may change, the AS-Pro™ should be deployed on a vented cable, which will allow the pressure inside the AS-Pro™ to vary with the ambient air pressure, even when it is submerged.

If accurate depth readings are not important, the AS-Pro™ can be fully sealed using the connector sealing cap and deployed on a simple suspension cord. In this case, depth readings will vary with atmospheric pressure changes at a rate of roughly 1cm/mB.

5.2. Logging Live Data

At any time an AS-Pro™ is connected and running, you can save the readings to a log file on your PC. First select your desired logging interval then click on the 'Start Logging' button at the bottom right of the screen.

Logging Rate: 2

You will be asked for a file name, which will default to the Sonde's type and serial number. Once started, data will be logged at the selected interval. To stop data logging, click on the 'Stop Logging' button. If you start to calibrate the Sonde with the log running, the logging function will be automatically stopped.

The logged data is saved as a TAB delimited file, which can be opened in any spreadsheet application such as Microsoft® Excel®.

5.3. 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 AS-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 25ºC 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.

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.

5.4. Calibration Vessel

The AS-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 to 325mL, dependent on the number of optional electrodes installed) calibration vessel. It is important to note that for accurate calibration of the EC and optical sensors, all EC rings must be covered and the calibration vessel should be **full to the top**.

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 Sonde will then be ready to use.
The AS-Pro™ is designed to be calibrated **with the Wiper, Sonde Sleeve, Measurement Chamber and Calibration Cap fitted.**

The Wiper, Sonde Sleeve, end Measurement Chamber form an integral, working part of the Sonde's optical and EC measurement system, and MUST be fitted during calibration and measurement for correct operation.

5.5. 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 and EC calibration solutions) 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.

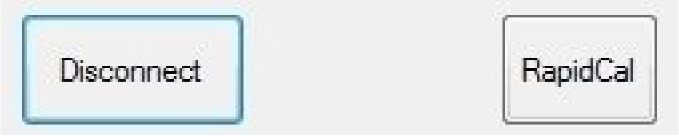
The caps MUST NOT be fitted when calibrating optical electrodes or serious calibration errors will occur due to reflections from the caps.

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

5.6. 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 Sonde 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 5.4. Calibration Vessel.
2. Pour RapidCal solution into the calibration vessel ensuring sufficient volume to fill the calibration cup completely, this will be between 275 and 325mL dependent in the number of optional electrodes fitted. **ENSURE LIQUID FILLS THE VESSEL UP TO THE TOP OF THE CALIBRATION CUP.**
3. Remove the storage cap from the pH electrode if fitted **Fit the red rubber caps to any ISE electrodes fitted.** Wash the Sonde in deionised water, then gently lower the Sonde into the calibration vessel and screw into place.
4. Activate the Sonde cleaning feature in order to remove any air bubbles that may be clinging to the electrodes. To do this click the Clean Sonde button.
5. Wait until all readings are **completely** stable. The longer you can leave the Sonde to achieve thermal equilibrium before proceeding, the better. A minimum of two minutes is recommended.
6. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF – 104ºF). The closer to 25ºC the better.
7. Now click the RapidCal button.



SondeLink will wait until all readings are stable, then it will send the RapidCal command to the Sonde, where the calibration takes place.

During stabilisation and calibration, progress is reported on screen with a progress bar.

When calibration is complete, a message box will be displayed. Click on the OK button return to normal reading mode**.** If a problem occurs during calibration, an error message will be displayed with details of the problem.

Important

If you have ISE electrodes fitted to your AS-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.

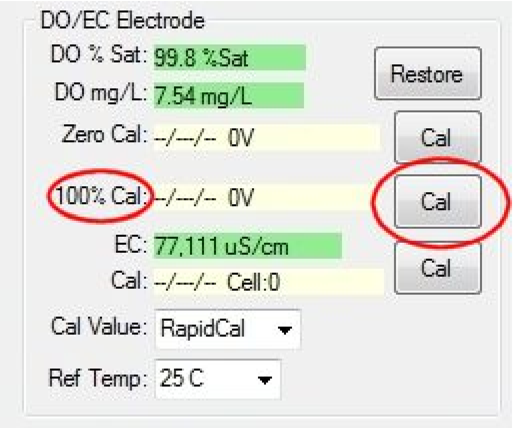
5.7. To Check / Calibrate the 100% Saturation Point in Damp Air

1. After calibrating with RapidCaL, remove the Sonde from the calibration vessel and wash both the Sonde and calibration vessel in fresh water. Shake off any water from the Sonde **ensuring there are no droplets adhering to the DO membrane**. If droplets remain gently pat dry with the lint free cloth provided. **Never use abrasive material or a rubbing action on the membrane as this can damage the membrane**.

2. Screw the Sonde back into the moist calibration vessel and sit it upright. Do not hold the Sonde, the heat from your hands will warm the Sonde 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, click the Cal button adjacent to the 100% Cal box.



DO/EC Electrode
DO % Sat: 99.8 %Sat
DO mg/L: 7.54 mg/L
Zero Cal: --/--/-- 0V
100% Cal: --/--/-- 0V
EC: 77,111 uS/cm
Cal: --/--/-- Cell:0
Cal Value: RapidCal
Ref Temp: 25 C

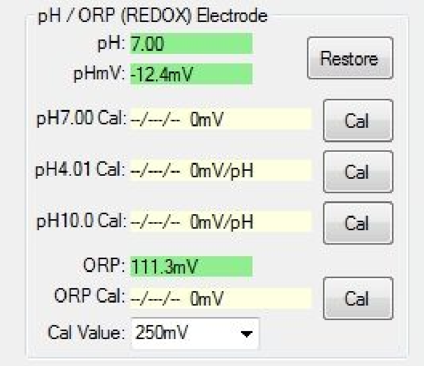
SondeLink will wait until all readings are stable, then it will send the calibration command to the Sonde, where the calibration takes place.

During stabilisation and calibration, progress is reported on screen with a progress bar.

When calibration is complete, a message box will be displayed. Click on the OK button return to normal reading mode. If a problem occurs during calibration, an error message will be displayed with details of the problem.

Finally, if you have any optical electrodes fitted, you should zero them now. To do this refer to section: 8. Optional Optical Electrodes Calibration and Maintenance

5.8. PH/ORP (REDOX) Electrode



pH: 7.00
pHmV: -12.4mV
pH7.00 Cal: --/--/-- 0mV
pH4.01 Cal: --/--/-- 0mV/pH
pH10.0 Cal: --/--/-- 0mV/pH
ORP: 111.3mV
ORP Cal: --/--/-- 0mV
Cal Value: 250mV

This group box displays the output from the combined pH/ORP (REDOX) electrode. pH is displayed in both pH units and mV. ORP (REDOX) is displayed in mV.

The '*Restore*' button restores the calibration of this electrode to factory defaults.

5.8.1. Keeping the pH Electrode 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.

5.8.2. Calibrating pH

pH electrodes should be calibrated fully at least once a week to ensure optimum accuracy. Full calibration involves calibrating at pH 7.00 first, then at pH 4.01 and/or pH 10.00. The AS-Pro™ allows for both two and three point pH calibration. Should you decide to carry out just a two point calibration, the Sonde 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.

5.8.3. Calibrating the First Point (pH 7.00)

Due to the way in which pH calibration works, **the Sonde 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. Pour RapidCal solution or pH7.00 calibration solution into the calibration vessel.

2. Remove the storage cap from the pH electrode if fitted **Fit the red rubber caps to any ISE electrodes fitted.** Wash the Sonde in deionised water, then gently lower the Sonde into the calibration vessel and screw into place.

3. Activate the Sonde cleaning feature in order to remove any air bubbles that may be clinging to the electrodes. To do this click the Clean Sonde button.

4. Wait until the temperature and pH measurements are completely stable (boxes are both green).

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

6. Click on the '*Cal'* button adjacent to the pH7.00 Cal box.

pH7.00 Cal: --/--/-- 0mV

When calibration is complete, the calibration date and the voltage offset from zero for the pH electrode in +/-millivolts (mV) will be written into the calibration box shown above. If this offset goes beyond +/-30mV at 25°C, the pH electrode should be serviced.

This value is stored in the Sonde's memory and will be displayed each time the Sonde is connected to SondeLink.

Remove the Sonde from the calibration vessel and wash both the Sonde and calibration vessel in deionised water. Dry all parts with the lint-free cloth provided.

5.8.4. 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 disconnecting the Sonde.**

If the Sonde is disconnected after calibrating just one additional point (pH 4.00 for example), the Sonde 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 fresh pH 4.01 or pH 10.00 solution into the clean calibration vessel and screw the Sonde in all the way. Follow the procedure detailed above, but at step 6, click the *Cal* button for either pH4.01 or pH10.0, dependent upon the solution you are using.

Wait while the Sonde stabilises and calibrates. When the '*Calibrating Complete*' box 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.

Remove the Sonde from the calibration vessel and wash both the Sonde and calibration vessel in deionised water. Dry all parts with the lint-free cloth provided.

5.8.5. Calibrating the Third Point

Without disconnecting the Sonde, pour fresh pH 4.01 or pH 10.00 solution into the calibration vessel and screw the Sonde in all the way. Follow the procedure detailed above, but at step 6, select either pH4.01 or pH10.0 dependent upon the solution you are using.
Wait while the Sonde stabilises and calibrates. When the '*Calibrating Complete*' box 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.

Remove the Sonde from the calibration vessel and wash both the Sonde and calibration vessel in fresh or deionised water. Dry all parts with the 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.

5.8.6. Servicing the pH Electrode

1. Remove the pH or combined pH/ORP electrode from the Sonde body.
2. Rinse the tip with methyl alcohol ensuring the connector is kept dry.
3. Replace the electrode.
4. Re-calibrate.

Never place the entire AS-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.

5.8.7. Calibrating ORP (REDOX)

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.

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 dependant 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.

To calibrate the ORP electrode follow these steps:

1. Pour fresh ORP calibration solution into the calibration vessel.

2. Remove the storage cap from the pH electrode if fitted. **Fit the red rubber caps to any ISE electrodes fitted.** Wash the Sonde in deionised water, pat dry, then gently lower the Sonde into the calibration vessel and screw into place.

3. Activate the Sonde cleaning feature in order to remove any air bubbles that may be clinging to the electrodes. To do this click the Clean Sonde button.

4. Wait until the temperature and pH measurements are completely stable (boxes are both green).

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

6. Select the correct calibration solution value (either 250mV or 229mV) for the solution you are using in the *Cal Value* drop-down box.

ORP: 111.3mV
ORP Cal: -/--/-- 0mV
Cal Value: 250mV

7. Click on the *Cal* button adjacent to the ORP Cal box.

When calibration is complete, the calibration date and the voltage offset for the ORP electrode in +/-millivolts (mV) will be written into the calibration box shown above. This value is stored in the Sonde's memory and will be displayed each time the Sonde is connected to SondeLink.

Remove the Sonde from the calibration vessel and wash both the Sonde and calibration vessel in fresh or deionised water. Dry all parts with the lint-free cloth provided.

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

6. DO/EC Electrode Calibration and Maintenance

6.1. 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.

6.2. DO Measurement Technique

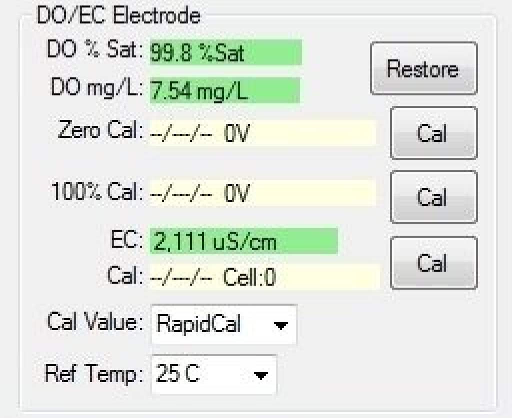
The AS-Pro™ features an optical DO sensor. This sensor does not use a liquid electrolyte and has a black rubber gas-permeable membrane.

6.3. Precautions During Use

EC measurement is not possible with the Sonde central wiper removed as the central wiper forms an integral part of the measurement system.

Never immerse the Sonde 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.

6.4. DO/EC Display



DO/EC Electrode
DO % Sat: 99.8 %Sat
DO mg/L: 7.54 mg/L
Zero Cal: --/--/-- 0V
100% Cal: --/--/-- 0V
EC: 2,111 uS/cm
Cal: --/--/-- Cell:0
Cal Value: RapidCal
Ref Temp: 25 C

This group box displays the outputs from the Dissolved Oxygen (DO) and the Electrical Conductivity (EC) electrode. DO is displayed in both %Saturation and mg/L. If the background of the DO %Saturation box is shaded red, this means the DO electrode requires calibration or service.

The AS-Pro™ outputs Electrical Conductivity (EC) in an absolute form. The EC value can be corrected to correspond to a reference temperature of either 20°C or 25°C. To choose the way in which EC is reported, simply click one of the three settings within the Ref Temp drop-down box.

The DO %Saturation value calculated by the Sonde is dependant upon barometric pressure. Barometric pressure is measured in the AS-Pro™ by a pressure sensor mounted inside the body of the Sonde that is vented to the atmosphere through the main connector.

If accurate DO %Saturation readings are required during a deployment lasting more than a few hours, during which atmospheric pressure may change, the AS-Pro™ should be deployed on a vented cable, which will allow the pressure inside the AS-Pro™ to vary with the ambient air pressure, even when it is submerged.

If accurate DO %Saturation readings are not important, the AS-Pro™ can be fully sealed using the Connector Sealing Cap and deployed on a simple suspension cord. In this case, DO %Saturation readings will vary with atmospheric pressure changes at a rate of roughly 0.5%/mB.

Atmospheric pressure does not affect the DO values calculated in mg/L.

6.5. Calibrating the DO/EC Electrode

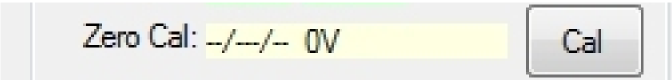
Calibration of the EC section of the electrode is normally carried out during RapidCal (see section 5.6. Using RapidCal). EC can be calibrated separately using different EC Calibration Standards, this is covered after the DO calibration section 6.9. Calibrating EC .

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.

6.6. Calibrating the DO Zero Point

1. Create the calibration vessel as described in section 5.4. Calibration Vessel.
2. Pour 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 Sonde in deionised water, then gently lower the Sonde into the calibration vessel and screw into place.
4. Activate the Sonde cleaning feature in order to remove any air bubbles that may be clinging to the electrodes. To do this click the Clean Sonde button.
5. Wait until the temperature and DO readings are **completely** stable. The longer you can leave the Sonde to achieve thermal equilibrium before proceeding, the better. A minimum of ten minutes is recommended.
6. Ensure the temperature of the solution is between 5°C and 40°C (41°F - 104°F).
7. Click the *Cal* button next to the DO Zero box.



Zero Cal: --/--/-- 0V

When calibration is complete, the calibration date and a voltage will be written into the calibration box shown above. The voltage value 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 Sonde's memory and will be displayed each time the Sonde is connected to SondeLink.

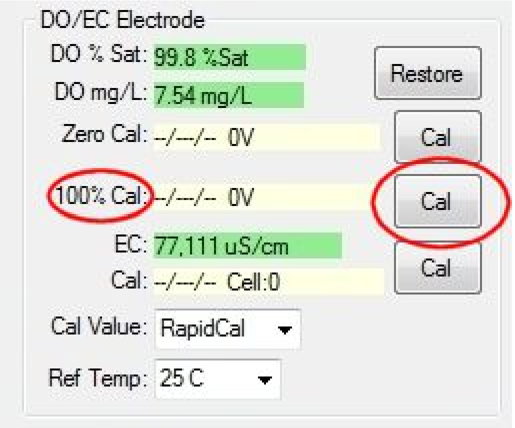
6.7. Calibrating the DO 100% Saturation Point in Moist Air

1. After calibrating the DO Zero point, remove the Sonde from the calibration vessel and wash both the Sonde and calibration vessel in fresh water. Shake off any water from the Sonde **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 Sonde back into the moist calibration vessel and sit it upright. Do not hold the Sonde, the heat from your hands will warm the Sonde 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, click the Cal button adjacent to the 100% Cal box.



DO/EC Electrode

DO % Sat: 99.8 %Sat

DO mg/L: 7.54 mg/L

Zero Cal: --/--/-- 0V

100% Cal: --/--/-- 0V

EC: 77,111 uS/cm

Cal: --/--/-- Cell:0

Cal Value: RapidCal

Ref Temp: 25 C

SondeLink will wait until all readings are stable, then it will send the calibration command to the Sonde, where the calibration takes place.

During stabilisation and calibration, progress is reported on screen with a progress bar.

When calibration is complete, the calibration date and a voltage will be written into the calibration box shown above. The voltage value 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.

6.8. 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 with your fingers 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 Sonde 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 Sonde 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.

6.9. 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

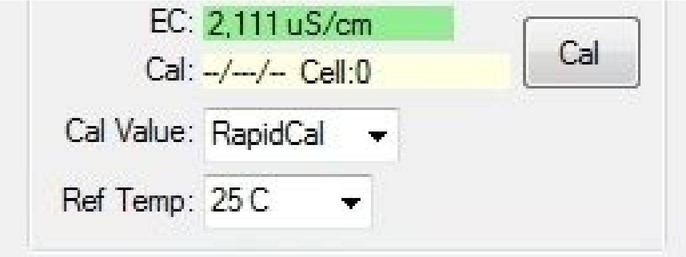
The calibration solution value you use to calibrate EC should always be chosen to be as near to the readings you expect to see in the field as possible. If you are not sure what values to expect, RapidCal is a good choice as this will give reasonably accurate readings across a wide range of EC values.

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.

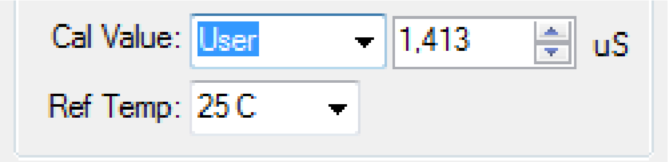
The Sonde's central wiper forms an integral, working part of the Sonde's EC measurement system, and MUST be fitted during calibration and measurement for correct operation. If you try to calibrate the Sonde without the wiper fitted, you will get erroneous results.

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

1. Create the calibration vessel as described in section 5.4. Calibration Vessel.
2. Pour EC calibration solution into the calibration vessel. **It is very important that all four gold EC rings are covered during this calibration and at least 1cm above the rings are submerged. Ensure the calibration cup is FULL to the top when the Sonde is screwed into place, depending on the number of optional electrodes installed the volume required will be between 275mL and 325mL.**
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 Sonde in deionised water, then gently lower the Sonde onto the calibration vessel and screw into place.
4. Activate the Sonde cleaning feature in order to remove any air bubbles that may be clinging to the electrodes. To do this click the Clean Sonde button.
5. Wait until the EC and temperature readings are **completely** stable. The longer you can leave the Sonde to achieve thermal equilibrium before proceeding, the better. A minimum of two minutes is recommended.
6. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF – 104ºF). Ideally, the solution should be as close to 25ºC as possible.


EC: 2,111 uS/cm
Cal: --/--/-- Cell:0
Cal Value: RapidCal
Ref Temp: 25 C

7. In the *Cal Value* drop-down box, select the calibration solution you are using. Your choices are 'RapidCal', 'SC-35' or 'User'. If you select 'User', a new box will appear into which you must enter the EC value of your calibration solution **AT 25ºC**. This information will be printed on the label of the EC calibration standard bottle.


Cal Value: User 1,413 uS
Ref Temp: 25 C

8. Click on the *Cal* button adjacent to the EC Cal box.

When calibration is complete, the calibration date and the EC electrode's cell constant will be written into the calibration box. This value is stored in the Sonde's memory and will be displayed each time the Sonde is connected to SondeLink.

Remove the Sonde from the calibration vessel and wash both the Sonde and calibration vessel in fresh water. Dry all parts with the lint-free cloth provided.

6.10. Errors During Calibration

At the beginning of the calibration routine, a sanity check is done. If the Sonde 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.

6.11. 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 Sonde Sleeve and re-calibrate.

6.12. Calibrating Temperature

The AS-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.

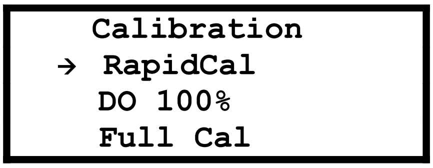
This offset can only, however, be applied using the AS-Pro Bluetooth App or an Aquameter® (connected via an **AS-Pro** extension cable). This function is not available in SondeLink™. The following description shows the calibration technique using an Aquameter®.

To calibrate the temperature sensor, set the Sonde's switch ring to Auto, remove the Measurement Chamber and Sleeve from the AS-Pro™ then set the Sonde 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 AS-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.

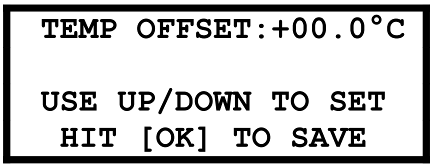
Once the Sonde is set up in the water bath, switch the Aquameter® on wait until the temperature reading has been **completely stable** for at least five minutes. Make a note of the temperature displayed on the Aquameter® and compare this to the actual temperature of the water bath as displayed by the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

7. Aquaprobe Averaging

In all Aquaread multiparameter Aquaprobes, readings are averaged prior to output to an Aquameter, BlackBox or other logging/telemetry device.

All Aquaprobes sample at a two second rate. Parameters that are inherently stable, such as temperature, dissolved oxygen, pH and electrical conductivity are subject to a running average of four readings. That is to say, the most recent four readings are added together and divided by four to give an averaged output value.

ISE electrodes require a little more time to stabilise so are subject to an eight reading running average.

Optical electrodes, such as chlorophyll, blue-green algae and CDOM are subject to a sixteen reading running average. This is not because the electrodes are slow to react (quite the opposite in fact), it is because the distribution of chlorophyll and algae in environmental water is never homogenous.

That is to say, if a sample of water is studied under a microscope, the chlorophyll or algae cells will be found scattered at random throughout the sample. In one area there may be no cells at all, whilst in another area there may be a concentration of cells.

When a reading is taken by an Aquaprobe using an optical electrode, that reading is a very fast snapshot of the cells in front of the electrode. The reading taken two seconds later will be looking at a different set of cells and may result in a higher or lower reading.
For this reason, a longer averaging period is required in order to provide a representative value for the entire body of water.

7.1. Long Term Deployment

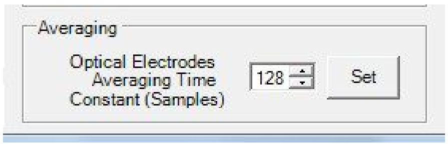
In addition to the sixteen reading running average, all Aquaprobes running software version 5.11 and above include a second smoothing algorithm for the optical electrodes, which takes into consideration historical readings in order to provide a smoother, spike free output over a longer period.

During long-term deployment, when connected to a BlackBox or AquaTel telemetry device, each time a reading is requested, the Aquaprobe will wake from sleep, take sixteen readings, then output the averaged values and return to sleep mode.

The number of samples (Averaging Time Constant) the long-term deployment algorithm takes into consideration is set by default to 128. So, if the reading rate of the controlling device is set to request readings every 15 minutes, and allows the Aquaprobe to enter sleep mode between readings, the readings that are output by the Aquaprobe will take into consideration the values collected over the past two hours (eight sets of 16 readings = 128 readings).

If the Aquaprobe is left powered continuously, the readings that are output by the Aquaprobe will take into consideration the values collected over the past four minutes (128 readings at 2 second intervals = 4.27 minutes).

The Averaging Time Constant can be adjusted between the values of 16 and 192 in increments of 16 using an AP-PC Kit and the AquaRead AquaCal software package (Version 2.07 and above) or by using the Aquaread Mobile App and a BlueLink Bluetooth adaptor.



Optical Electrodes Averaging Time Constant (Samples) 128

The image above shows the Averaging Time Constant setup control in AquaCal. After adjusting the time constant value, click the Set button to transfer the setting to the probe.

Please note: In order for the long term averaging to work properly, the Aquaprobe MUST be kept submerged between readings.

7.2. Dip Testing and Profiling

In order to allow a fast optical electrode response during dip testing or profiling, the long term averaging algorithm is reset (i.e. all historical data is deleted) each time the Aquaprobe is removed from the water (provided it is switched on).

The Aquaprobe detects that it has been removed from the water by monitoring the electrical conductivity value. If the EC drops to zero, the historical averaging data is deleted and the Aquaprobe reverts to using a normal sixteen value running average, as described earlier in this section.

If the Aquaprobe is subsequently left in the water, it will slowly start to build up historical data again over the number of readings prescribed by the Averaging Time Constant. If a consistently fast response is required, set the Averaging Time Constant to 16.

In all cases during dip testing or profiling, the Aquaprobe should be left to stabilise for a minimum of one minute before recording the readings.

8. Optional Optical Electrodes Calibration and Maintenance

The AS-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 Sonde sleeve, Measurement Chamber and wiper form an integral, working part of the Sonde'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 AS-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 Sonde sleeve, wiper and measurement chamber are fitted during calibration and operation of all types of optical electrodes. ENSURE THE CALIBRATION VESSEL IS FULL TO THE TOP (this ensures all EC rings are covered plus at least 1cm above the rings).

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.

8.1. 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 activating 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).

- Optical electrodes will only function with an EC reading present, see section 7.

8.2. 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 AS-Pro™).

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

8.3. 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.

8.4. TURB Turbidity Electrode

Turbidity can be measured by the AS-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 AS-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.

8.4.1. 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.

8.4.2. Precautions During Use

In common with all other submersion type Turbidity Sondes, 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 Sonde 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**.

8.4.3. Calibrating the Turbidity Electrode

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

8.4.4. 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.

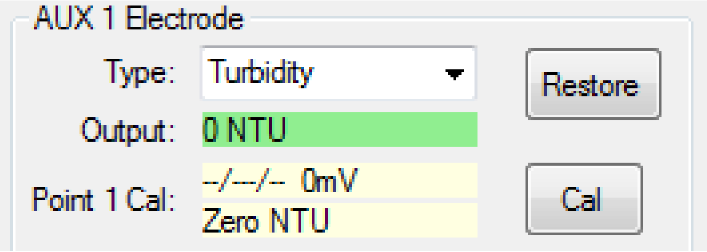
The Turbidity electrode should subsequently be Zeroed (calibrated at the Zero NTU point) before each day's use. A three point calibration should be carried out once a month to ensure optimum accuracy.

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.

8.4.5. 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 5.4. Calibration Vessel.
2. Pour clean water into the calibration vessel (bottled still mineral water is ideal).
3. Remove the storage cap from the pH electrode if fitted. Wash the Sonde in clean water, then gently lower the Sonde onto the calibration vessel and screw into place.
4. Activate the Sonde cleaning feature in order to remove any air bubbles that may be clinging to the electrode. To do this click the Clean Sonde button.
5. Wait until the temperature and turbidity readings are **completely** stable. The longer you can leave the Sonde to achieve thermal equilibrium before proceeding, the better. A minimum of two minutes is recommended.
6. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF - 104ºF).
7. Click on the *Cal* button adjacent to the Point 1 Cal box.



AUX 1 Electrode

Type: Turbidity

Output: 0 NTU

Point 1 Cal: --/--/-- 0mV Zero NTU

When calibration is complete, the calibration date and the voltage output from the electrode in millivolts (mV) will be written into the calibration box.

This value is stored in the Sonde's memory and will be displayed each time the Sonde is connected to SondeLink.

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

8.4.7. 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 Sonde.

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 the solution into the calibration vessel then screw the Sonde in all the way. Activate the Sonde 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 Sonde 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). Click the **OK** key to continue.

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

8.4.8. 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 Sonde 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.

8.5. 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.

8.5.1. 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).

8.5.2. 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.

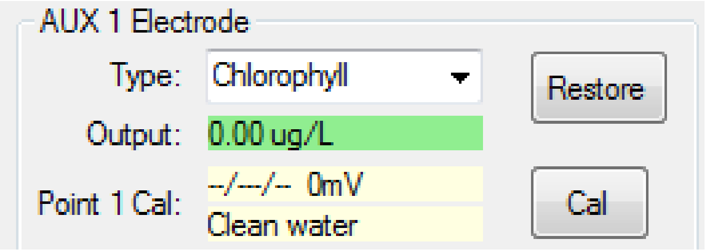
When a fluorescent electrode is first installed, **it should be calibrated at the Zero point** in order to correct for any small differences in the Measurement Chamber.

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.

8.5.3. Zero Point Calibration

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

1. Create the calibration vessel as described in section 5.4. Calibration Vessel.
2. Pour clean water into the calibration vessel (bottled still mineral water is ideal).
3. Remove the storage cap from the pH electrode if fitted. Wash the Sonde in clean water, then gently lower the Sonde onto the calibration vessel and screw into place.
4. Activate the Sonde cleaning feature in order to remove any air bubbles that may be clinging to the electrode. To do this click the Clean Sonde button.
5. Wait until the temperature and electrode readings are **completely** stable. The longer you can leave the Sonde to achieve thermal equilibrium before proceeding, the better. A minimum of two minutes is recommended.
6. Ensure the temperature of the solution is between 5ºC and 40ºC (41ºF – 104ºF).
7. Click on the *Cal* button adjacent to the Point 1 Cal box.


AUX 1 Electrode

Type: Chlorophyll

Output: 0.00 ug/L

Point 1 Cal: --/---/-- 0mV

Clean water

When Point 1 calibration is complete, the calibration date and the voltage output from the electrode in millivolts (mV) will be written into the calibration box.

This value is stored in the Sonde's memory and will be displayed each time the Sonde is connected to SondeLink.

8.5.4. Verifying the Zero Calibration

An accurate zero point calibration is essential to the correct operation of the fluorescent electrodes. 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 Sonde cleaning feature then allow the reading to settle. Check the reading is zero. If not, re-calibrate the zero point.

8.5.5. 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 AS-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 10. Calibration Solution Preparation

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

Gently pour the pre-prepared **Point 2** solution into the calibration vessel then screw the Sonde 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 click on the button for Point 2. 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.

8.5.6. 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 input it in the GS Factor box.

GS Factor: 1.25

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 SET button to send the Factor to the Sonde.

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.

If you subsequently re-calibrate Point 2 on the electrode, the GS factor will be reset to 1.00.

8.5.7. 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.

9. 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 Sonde'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.

9.1. 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 ISEs 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.

9.2. 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 11. 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 10ºC 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.

9.3. 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 Sonde and allow the temperature to stabilise quicker between the different solutions.

9.4. 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 and EC calibration solutions) in order to protect the ISE electrodes from the effects of the buffer solution or interfering ions. Ensure the red cap is pushed firmly onto the ISE to prevent the wiper from jamming. 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 Sonde soaking in ISE calibration buffers for extended periods as the pH/ORP electrode will become depleted of ions leading to errors in ISE measurements.

9.4.1. Three-point Calibration

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

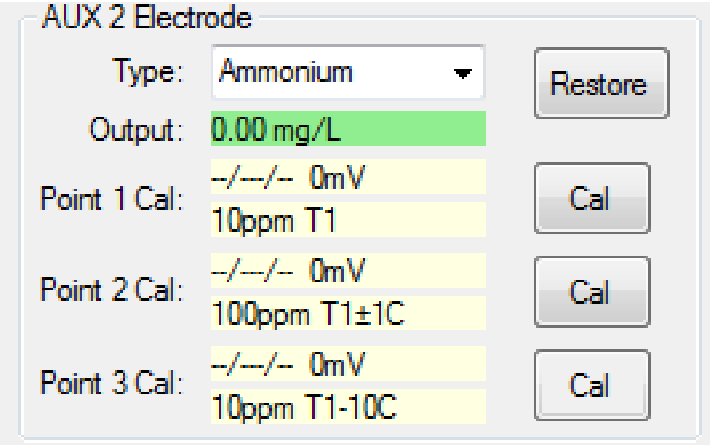
Point 1.

1. Remove the Sonde Sleeve. Remove the storage cap from the pH electrode, fit the red storage caps to any ISE electrodes not being calibrated, wash the Sonde in deionised water, dry the Sonde thoroughly using the lint-free cloth provided, then gently lower the Sonde in to the warm **Point 1** solution.

2. Switch on the Aquameter®, deploy the wiper to dislodge any microscopic air bubbles and allow to rest until the temperature and ISE readings are completely stable.

3. Ensure the temperature of the solution is between 20ºC and 40ºC (68ºF – 104ºF).

4. Click the '*Cal*' button adjacent to the Point 1 Cal box.



AUX 2 Electrode

Type: Ammonium

Output: 0.00 mg/L

Point 1 Cal: --/--/-- 0mV 10ppm T1

Point 2 Cal: --/--/-- 0mV 100ppm T1±1C

Point 3 Cal: --/--/-- 0mV 10ppm T1-10C

When Point 1 calibration is complete, the calibration date and the voltage output from the electrode in millivolts (mV) will be written into the calibration box.

This value is stored in the Sonde's memory and will be displayed each time the Sonde is connected to SondeLink.

Point 2

1. Remove the Sonde from the **Point 1** solution and wash thoroughly in deionised water. Dry the Sonde then gently lower it into to the warm **Point 2** solution.
2. Deploy the wiper to dislodge any microscopic air bubbles and allow to rest until the temperature and ISE readings are completely stable.
3. **Ensure the temperature of the solution is within 1ºC of the previous Point 1 calibration point.** If the solution is warmer or cooler than this, calibration will fail.
4. Referring to steps 2-4 above, click on the button for Point 2 Cal.

If the temperature of the Point 2 solution is more than 1ºC different from the Point 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 Sonde from the **Point 2** solution and wash thoroughly in deionised water. Dry the Sonde then gently lower it into to the **cool Point 3** solution.
2. Deploy the wiper to dislodge any microscopic air bubbles and allow to rest until the temperature and ISE readings are completely stable.
3. **Ensure the temperature of the solution is at least 10ºC cooler than the previous Point 2 calibration point.** If the solution is too warm, calibration will fail.
4. Referring to steps 2-4 above, click on the button for Point 3 Cal.

If the temperature of the cool **Point 3** solution is less than 10ºC cooler than the **Point 1** and **Point 2** calibration temperatures, an OUT OF TEMP RANGE calibration error will be reported. If this happens, adjust the temperature and try again.

9.4.2. Two-point Calibration

Two-point calibration should be carried out weekly. For this, Point 1 and Point 2 solutions are required. The two solutions can be at any temperature between 5ºC and 30ºC but they both must be the same temperature (within 1ºC).

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

During two-point calibration, the AS-Pro™ must remain connected to SondeLInk. If the AS-Pro™ is disconnected 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 Point 1 and 2 only.

9.4.3. Single-point Calibration

Single-point calibration should be carried out daily. For this, just Point 1 solution is required. The solution can be at any temperature between 5ºC and 30ºC .

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

10. Calibration Solution Preparation

10.1. 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 pure 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.

10.1.1. 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 pure 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 pure 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 AS-Pro™ directly after calibration should be approximately 70,000 cells/mL at 20ºC (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.

10.2. 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 pure 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.

10.2.1. 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 pure 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 pure 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 AS-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.

10.3. 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 pure 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.

10.3.1. 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 pure 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 pure 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 AS-Pro™ directly after calibration should be approximately 118 µg/L at 20ºC (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.

10.4. 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 pure 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.

10.4.1. 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 pure 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 pure 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.

10.5. 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 pure 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.

10.5.1. 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 pure 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 pure 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 pure 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.

10.6. 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 AS-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

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

10.6.1. Serial Dilution

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

One step process:
Weigh out 10.5mg of the recommended salt and add to 1L of pure 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 pure 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 pure water. Invert 10 times. This step results in a 1 in 100 dilution of the

1000ppm stock giving the 10ppm standard required for Pt-2 calibration.

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

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

10.7. 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 AS-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

11. ISE Electrode Calibration Solution Preparation

11.1. AMM Ammonium/Ammonia Electrode

Ammonium (NH4) and Ammonia (NH3) 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.

11.1.1. 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.

11.1.2. 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 NH4) at a concentration of 10ppm and one 400mL batch of Ammonium (as NH4) at a concentration of 100ppm.

The three calibration solutions should be freshly prepared by serial dilution from 1000ppm calibration standard 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).

11.1.3. 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 10ºC cooler.

In order to achieve this, one batch of the 10ppm solution should be put into a refrigerator and the other two solutions should be put into a water bath at 25ºC. Once all three solutions are at a stable temperature, calibration can begin.

11.2. NIT Nitrate Electrode

Nitrate (NO3) 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.

11.2.1. 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.

11.2.2. 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).

11.2.3. 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 10ºC cooler.

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

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

11.3. 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.

11.3.1. 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.

11.3.2. 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).

11.3.3. 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 10ºC cooler.

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

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

11.4. CAL Calcium Electrode

Calcium (Ca2) 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.

11.4.1. 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.

11.4.2. 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).

11.4.3. 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 10ºC cooler.

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

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

11.5. 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.

11.5.1. 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.

11.5.2. 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).

11.5.3. 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 10ºC cooler. In order to achieve this, one batch of the 0.5ppm solution should be put into a refrigerator and the other two solutions should be put into a water bath at 25ºC.

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

12. After Use

The AS-Pro™ should always be cleaned after every use.

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

The Sleeve on the AS-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 Sonde with extreme care. If the Sonde is dropped, irreversible damage may occur to the electrodes which will not be covered by your warranty.

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 Sonde 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 Sonde, small pieces of lint will be left behind, which will interfere with the optical electrodes that use fluorescent measurement techniques.

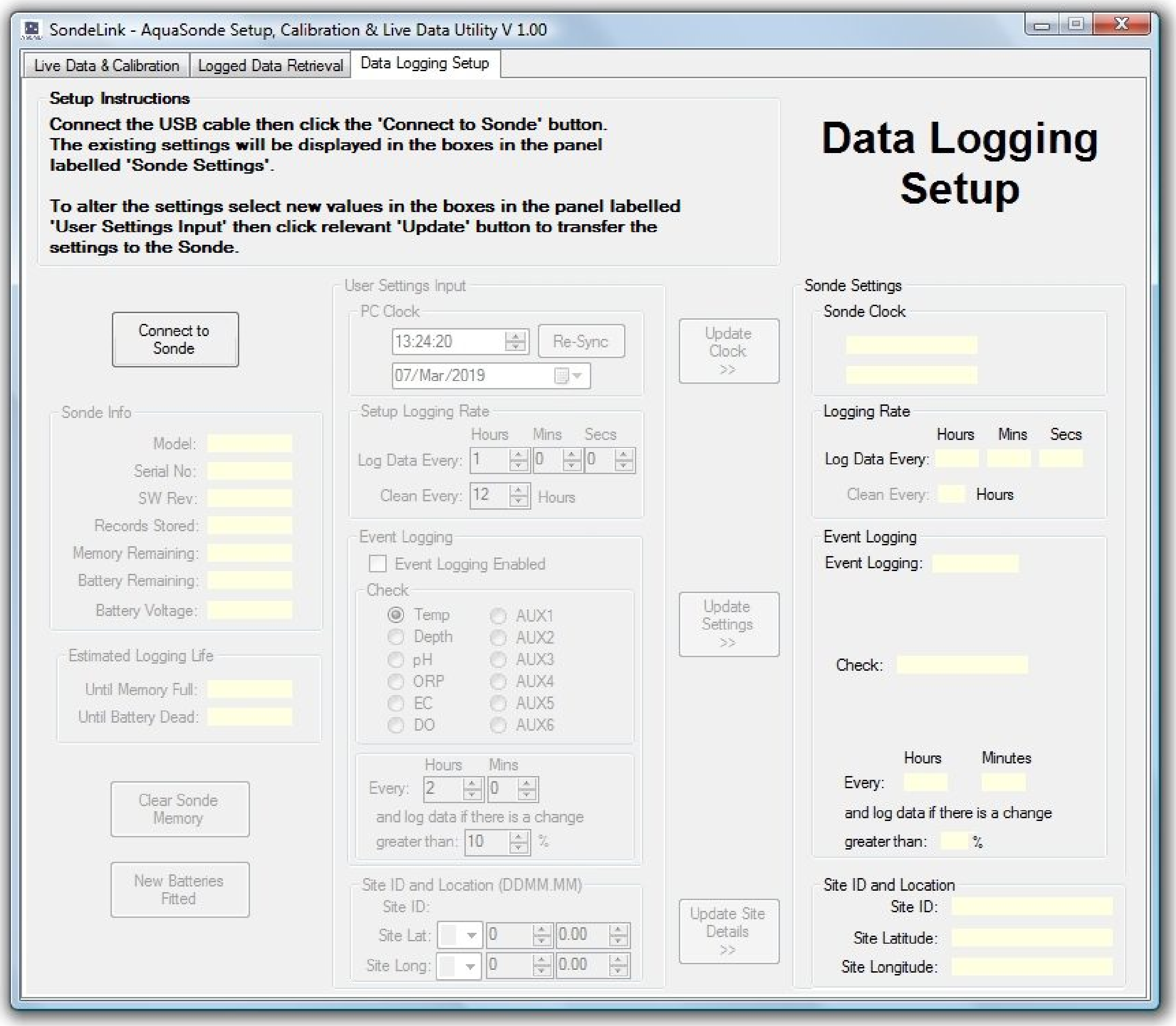
Remember to replace the pH/ORP storage cap after use. Failure to do so will damage the electrode.

Never clean the Sonde 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.

13. Data Logging Setup

Before the AS-Pro™ will log any data, a data logging regime must be set up. To do this, connect the Sonde to a PC running SondeLink and select the 'Data Logging Setup' tab. The following screen will appear.



Setup Instructions

Connect the USB cable then click the 'Connect to Sonde' button. The existing settings will be displayed in the boxes in the panel labelled 'Sonde Settings'.

To alter the settings select new values in the boxes in the panel labelled 'User Settings Input' then click relevant 'Update' button to transfer the settings to the Sonde.

User Settings Input

PC Clock: 13:24:20, 07/Mar/2019

Setup Logging Rate – Log Data Every: 1 Hours, 0 Mins, 0 Secs

Clean Every: 12 Hours

Event Logging: ☐ Event Logging Enabled

Check: ● Temp ○ Depth ○ pH ○ ORP ○ EC ○ DO ○ AUX1 ○ AUX2 ○ AUX3 ○ AUX4 ○ AUX5 ○ AUX6

Every: 2 Hours, 0 Mins and log data if there is a change greater than: 10 %

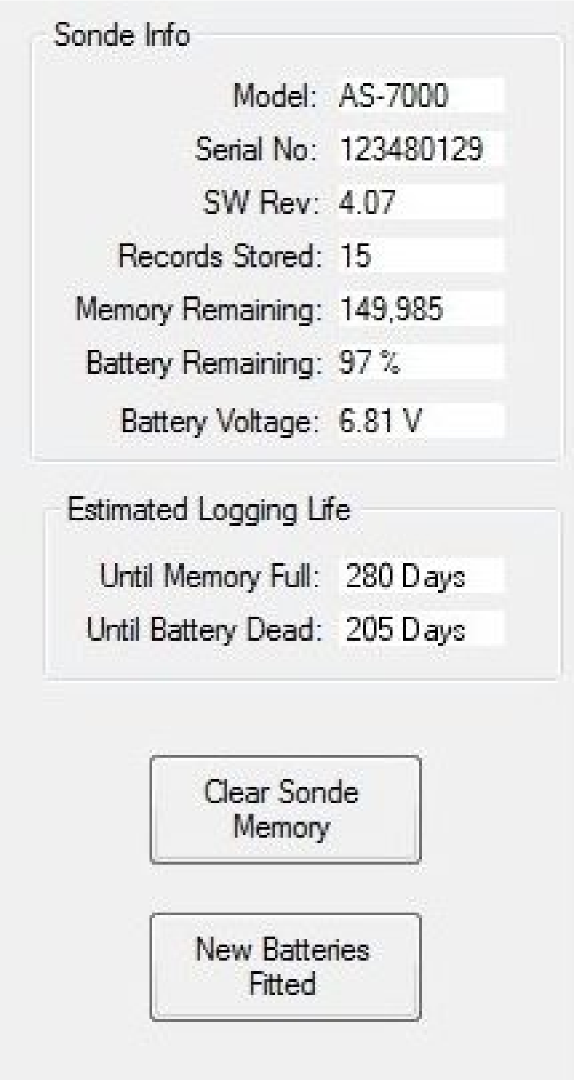
Site ID and Location (DDMM.MM) – Site Lat: 0, 0.00; Site Long: 0, 0.00

Click on the '*Connect to Sonde'* button. If the AS-Pro™ is properly connected and the drivers are installed, SondeLink will display the Sonde's status and current settings.

Sonde information including remaining battery and memory capacity along with an estimated battery and memory life based on the current logging regime will be displayed in the panel labelled 'Sonde Info'. The current settings will be displayed in the boxes in the panel labelled 'Sonde Settings'

To alter the settings, select new values in the panel labelled 'User Settings Input' then click the relevant 'Update' button to transfer the settings to the Sonde.

13.1. Sonde Info Panel



Sonde Info

Model: AS-7000
Serial No: 123480129
SW Rev: 4.07
Records Stored: 15
Memory Remaining: 149,985
Battery Remaining: 97 %
Battery Voltage: 6.81 V

Estimated Logging Life

Until Memory Full: 280 Days
Until Battery Dead: 205 Days

The Sonde Info panel contains data concerning the Sonde. This includes model, serial number, software revision, number of records currently stored, number of free records (or memory remaining), battery capacity remaining and the current battery voltage.

In addition, this panel shows the estimated time until the memory is full (in days) and the estimated time until the battery runs flat (in days). Both these values are dynamic and will change as you change the logging settings.

If you want to log data for a specific length of time, adjust the logging, event logging and cleaning rates until the required number of days is shown in the estimated life boxes.

Please be aware that the battery life estimate is just that: an *estimate*. The actual battery life will vary with temperature, quality of the battery and previous usage.

Always be sure to leave a little battery life in hand to ensure that no data is lost.

13.1.1. Clearing the Sonde's memory

To clear the Sonde's memory, simply click the 'Clear Sonde Memory' button. Please be aware, once the Sonde's memory has been cleared, the data can not be recovered. You can save the contents of the Sonde's memory to your PC using the 'Save as Raw Data' button on the 'Logged Data Retrieval' tab.

13.2. Resetting the Battery Condition Monitor

Whenever new batteries are fitted, it is essential to reset the battery condition monitor by clicking the 'New Batteries Fitted' button.

This will reset the battery condition monitor to 100% and allow an accurate estimate of battery condition going forward.

DO NOT RESET THE BATTERY MONITOR UNLESS YOU HAVE FITTED NEW BATTERIES! If you do this, the 'Battery Remaining' value will be calculated erroneously. This can lead to loss of data when the batteries unexpectedly run flat.

13.3. User Settings Input Panel

13.3.1. Clock Setup

The first item in this panel is the system clock. This will automatically sync with your PC clock to show current time and date.

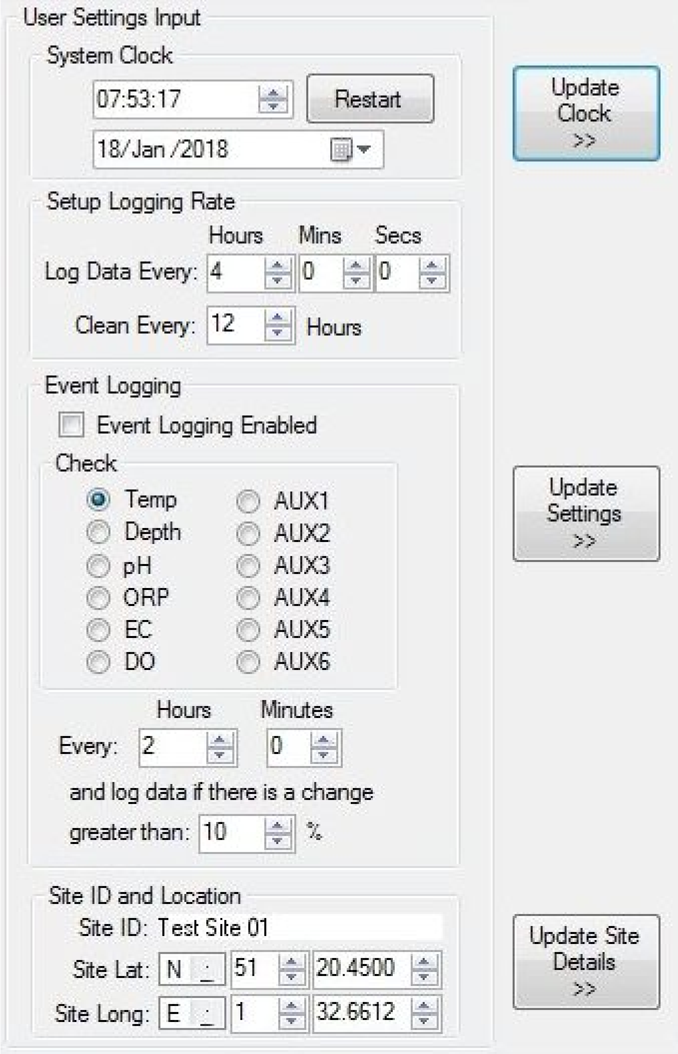
If you want to set a different time and date simply type in the new values. At this point, the time and date will stop syncing with the PC clock. If you want to re-sync with the PC clock, click the 'Restart' button.

To transfer the time and date to the Sonde, click the 'Update Clock' button.

13.3.2. Logging Rate Setup

The logging rate can be setup to any value between 2 seconds and 120 hours in steps of 2 seconds.

When setting up the logging rate, keep an eye on the estimated battery life figure. Obviously, if you want to log data for a month, there is no point in setting the logging rate to 2 seconds because the batteries are not going to last that long at that rate.



User Settings Input

System Clock

07:53:17

18/Jan /2018

Setup Logging Rate

Log Data Every: 4 Hours 0 Mins 0 Secs

Clean Every: 12 Hours

Event Logging

☐ Event Logging Enabled

Check

● Temp ○ AUX1
○ Depth ○ AUX2
○ pH ○ AUX3
○ ORP ○ AUX4
○ EC ○ AUX5
○ DO ○ AUX6

Every: 2 Hours 0 Minutes

and log data if there is a change greater than: 10 %

Site ID and Location

Site ID: Test Site 01

Site Lat: N 51 20.4500

Site Long: E 1 32.6612

It is always best to log at the slowest permissible rate for your application. This saves the batteries and reduces the amount of data you have to handle at the end of the project.

To transfer the Logging Rate settings to the Sonde, click the 'Update Settings' button.

13.3.3. Cleaning Rate Setup

The rate at which the self cleaning mechanism runs can be selected in increments of 1 hour.

In clean water, once every 24 hours is generally sufficient. In sea water, a cleaning rate of every six hours is advisable in order to discourage marine growth. In extremely polluted water a faster rate may be required.

Please bear in mind that the cleaning mechanism uses a considerable amount of battery power, so it should be set to the longest period possible for the application. When setting the cleaning rate, keep an eye on the estimated battery life figure.

13.3.4. Event Logging Setup

This panel allows you to choose one parameter to check on a regular basis and forces the Sonde to log extra data if a preset change in the chosen parameter is detected.

Using this feature, memory can be saved by using a long logging interval (say several hours or more), but any rapid changes will be logged in full detail.

To activate event logging, first tick the 'Event Logging Enabled' tick box. Next select the parameter that you want to monitor for event logging.

Next, select the time interval at which the event should be checked. **This value must be more regular than the normal logging rate.**

Finally, set the trigger point for the event logging, in other words, the amount each value must change from the previously logged value in order to be logged.

So, for example, you could set the regular logging rate to 4 hours and set the depth to be monitored every 15 minutes, looking for a change of 10% during that 15 minute period.

The Sonde will subsequently take a measurement every 15 minutes, but will only log the data if the depth has changed by more than 10% from the previous logged value.

Important note regarding battery life and Event Logging: If you set a long logging interval but a very short event checking interval, the battery life will be estimated on the event checking interval rate. Even though the logger will not log data every time an event is checked, it will take a reading and hence will use the same amount of battery power as a logged data point. Always choose the longest logging / event checking interval that you can for your application in order to prolong the battery life. When setting the event logging rate, keep an eye on the estimated battery life figure.

To transfer the Event Logging settings to the Sonde, click the 'Update Settings' button.

13.3.5. Setting Site ID and Location

The Site ID and Location panel allows you to enter a site identifier of up to 16 characters and a latitude and longitude for the site. This data is output at the start of Text (.txt) and Spreadsheet (.csv) files saved from the 'Logged Data Retrieval' tab.

Filling in this panel is optional but can be very useful to help identify the origins of saved data files. To transfer the Site ID and Location settings to the Sonde, click the 'Update Site Details' button.

13.4. Checking and Activating the Logging Regime

After setting all the user parameters and transferring them to the Sonde, check that the Sonde has accepted the settings by comparing the 'Sonde Settings' panel to the 'User Settings Input' panel. They should be the same. Also check that the Sonde clock is correct.

The Sonde can now be disconnected by clicking the 'Disconnect Sonde' button. The USB cable should be removed then the switch ring should then be set to the OFF position.

When the Sonde is subsequently deployed, the logging regime will be automatically activated. See the next section for more details.

14. Deploying the AS-Pro™

14.1. Deployment in Open Water

If the Sonde is to be deployed in open water (i.e. a river, lake or the sea), a length of **plastic pipe** should first be firmly mounted, then the Sonde should be suspended within the pipe so it is always under water, but not on the bottom where it could become buried by silt. This will protect the Sonde from currents, wave action, and debris. Mounting the Sonde within a **metal pipe is NOT RECOMMENDED**.

14.2. Vented Cable Option

The AS-Pro™ contains an internal barometric pressure sensor. This barometric pressure sensor is necessary for correction of both depth and percentage saturation of dissolved oxygen (DO %Sat), which both vary with barometric pressure. DO readings in mg/L are not affected by barometric pressure.

If accurate depth and %DO readings are required during a deployment lasting more than a few hours, during which atmospheric pressure may change, the AS-Pro™ should be deployed on a vented cable, which will allow the pressure inside the AS-Pro™ to vary with the ambient air pressure, even when it is submerged.

If accurate depth and %DO readings are not important, the AS-Pro™ can be fully sealed using the AS-Pro™ Connector Sealing Cap and deployed on a simple suspension cord.

During deployment, the Sonde should be suspended by a suitable suspension cord attached to the Sonde's two eye -bolts. **The Sonde should NEVER be suspended by the hole in the Connector Sealing Cap,** which is provided for tethering of the sealing cap only.

During deployment, the connector sealing cap or a cable must be fitted to the top connector. If the Sonde is deployed with the connector left open, the unit will fill with water and will be seriously damaged. This will not be covered by your warranty.

14.3. Important Notes Regarding Long-Term Deployment

Whilst the AS-Pro™ features an effective electrode cleaning system, the Sonde 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 Sonde 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 Sonde 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, Sonde 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.

14.4. Deployment Orientation

The AS-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 AS-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.

14.5. Switch Ring and LED Indications

The AS-Pro™ should be activated just prior to deployment by rotating the switch ring to the AUTO position. This will activate the logging regime and continually monitor the battery condition, memory remaining, and the Sonde's general health giving indications on coloured LEDs, which can be seen just below the switch ring.

In the AUTO position, if an external device is attached via a cable, the Sonde will automatically detect the device and enter the correct mode.

Possible external devices are a PC connected by a USB cable, an Aquaread® Aquameter® connected by an AP-Pro™ or AS-Pro™ cable, an Aquaread® BlueLink® unit connected by an AS-Pro™ cable or an Aquaread® BlackBox™ connected by an AP-Pro™ or AS-Pro™ cable.

If the switch ring is set to the Bluetooth position, the AS-Pro™ will communicate directly with the Aquaread® BlueLink® Mobile App. This should only be used for calibration and setup, not during deployment. No cable or sealing cap should be attached when using the internal Bluetooth interface as this will prevent accurate barometric pressure readings.

The LEDs under the switch ring indicate the Sonde's status by a sequence of flashes. The table below describes the various indications.

14.5.1. LED Indications

Sequence	What it means	Action Required
Solid Green	The sonde is connected to an external device by cable.	Operate the Sonde from the external device.
Single Green flash	Normal operation. Data is being logged. Using internal batteries.	Deploy the Sonde.
Single Yellow flash	Normal operation. Data is being logged. Using external power.	Deploy the Sonde.
Single Red flash	The battery voltage is low or the batteries are dead.	Replace batteries and reset battery condition monitor.
Two Red flashes	Memory is full. Data is not being logged.	Upload the logged data to a PC and clear the Sonde's memory.
Three Red flashes	This indicates a technical problem with the Sonde that needs addressing. This can include the need for calibration or the need to correct the clock among other conditions.	Connect the Sonde to a PC and use SondeLink™ to investigate the issue.
Single Blue flash every 3 seconds	The Sonde is in Bluetooth Pairing mode looking for a compatible device.	Pair the Sonde with a suitable device.
Two Blue flashes every second	The Sonde is paired to a device and is ready for use.	Open Aquaread® BlueLink® App.

14.6. Suspension Eye-Bolts & Cable

During deployment, the Sonde should be suspended by a suitable suspension cord. **The Sonde should NEVER be suspended by the hole in the connector sealing cap,** which is provided for tethering of the sealing cap only.

The AS-Pro™ is supplied with two eye-bolts, a short suspension cable and two carabiniers. A small amount of grease should be applied to the threads on the eye-bolts, then they should be screwed into the threaded holes in the battery cover collar.

The two carabiniers and the short suspension cable should then be used to form a loop, onto which the main suspension cable can be clipped as shown in the adjacent photograph.

14.7. Deployment on a Vented Cable

The AS-Pro™ features a high-pressure metal connector, which incorporates several O-ring seals. Prior to first connection of a vented cable or connector sealing cap, the O-ring seals must be lubricated using the silicone grease supplied.

Apply a generous smear of grease to the O-rings. 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 Sonde to allow easy tightening of the collar.

To connect the Extension Cable to the AS-Pro™, align the black dot on the AS-Pro™ with the **◄AQUAREAD** logo on the stainless steel plug body, then press the plug into the socket and tighten the retaining collar fully.

14.7.1. Vent/Data Hub

When using a vented cable, a Vent/Data hub should be used in order to prevent moisture build-up in the cable and Sonde.

The free end of the AS-Pro™ vented cable must be attached to the Sonde socket on the Vent/Data Hub. A Desiccant Cartridge should be attached to the desiccant socket to keep the cable and Sonde dry. The socket at the top of the Vent/Data Hub should be sealed using the connector sealing cap. This arrangement is shown below.

The Vent/Data Hub should be mounted in a sheltered location ABOVE THE MAXIMUM WATER LEVEL. The Vent/Data Hub and desiccant bottle MUST NOT be submerged.

14.7.2. Connecting External Devices Whilst Deployed

If necessary, the AS-Pro™ can be connected to various external equipment after it has been deployed by making connections to the top connector of the Vent/Data Hub.

External devices include:

- A PC connected by a USB cable for live data readings, setup or data retrieval.
- A BlueLink® unit connected by an AS-Pro™ extension cable for live data readings, setup or data retrieval vis Bluetooth.
- An Aquameter® connected by a standard Aquaprobe® AP-6000 cable or an AS-Pro™ cable for live data readings.
- An Aquaread® BlackBox™ connected by a standard Aquaprobe® AP-6000 cable or an AS-Pro™ cable for live data readings.
- An Aquaread® AquaTel® Telemetry unit connected by a standard Aquaprobe® AP-6000 cable or an AS-Pro™ cable for live data readings.

With the switch ring set to the AUTO position, the AS-Pro™ will detect the type of equipment that is connected as soon as that equipment applies power to the cable. When an external device is detected, the AS-Pro™ will suspend the programmed logging regime and switch to the appropriate mode for the external device.

If a PC or BlueLink® unit is detected, the Sonde will enter USB mode and allow live data readings, setup or data retrieval. If an Aquameter® , BlackBox™ or AquaTel® Telemetry unit is detected, the AS-Pro™ will enter live data reading mode during which it will mimic the output of an AP-Pro™. Whilst an external device is applying power to the cable, the Sonde's internal logging regime will be suspended.

When using a USB cable, BlueLink® unit or Aquameter®, **the cable must be physically disconnected** in order for the Sonde to revert to the programmed internal logging regime.

When using a BlackBox™, the BlackBox™ should be wired in Auto-Sleep mode. When the BlackBox™ drops the power to the Sonde between readings, the Sonde will revert to the programmed internal logging regime.

14.8. External Power Supply

The AS-Pro™ can be powered by an external 12V supply in order to save the internal batteries. **Internal batteries should always be fitted**, but will only be used in the event of the external supply failing. **The external supply MUST NOT exceed 14V.**

For this, an AS-Pro™ Power Cable is required (part number: AS-PRO-POWER). The power cable should be plugged into the top socket of the Vent/Data Hub and connected to a suitable 12V DC supply capable of providing at least 500mA.

During sleep mode, the Sonde will draw around 1mA. When awake and taking readings, the Sonde will draw around 150mA. During cleaning, the Sonde will draw around 350mA. These values will vary depending upon the optional electrodes fitted.

When the Sonde is using the external supply, the LED will flash Yellow.

ONLY USE THE ACCESSORIES LISTED ABOVE WHEN CONNECTING TO AN EXTERNAL POWER SUPPLY. FAILING TO DO SO MAY CAUSE DAMAGE TO YOUR SONDE OR EARTH LOOPS AND WILL NOT BE COVERED BY YOUR WARRANTY.

14.9. Desiccant Cartridges

The desiccant used within the Aquaread® Desiccant Cartridges is a non-toxic, self-indicating synthetic amorphous silica designed to change colour as it absorbs moisture from orange to clear. Desiccant Cartridges are available in two sizes.

The choice of small (DC-50) or large (DC-100) Desiccant Cartridge is dependant upon the humidity at the deployment site and the expected maintenance frequency. If the deployment site is humid or the time between maintenance visits is expected to be long, the large (DC-100) Desiccant Cartridge is recommended.

The time taken for a fresh, dry Desiccant Cartridge to go from orange to clear (i.e. become fully saturated) is dependant upon site conditions. Regular maintenance checks should be made on the installation and the Desiccant Cartridge should be replaced or regenerated **before it is completely saturated (clear).**

14.9.1. Regenerating Desiccant

When the desiccant in a Desiccant Cartridge has absorbed all the moisture it can and has changed from orange to clear, it can be regenerated and reused by a simple drying process.

Spread the desiccant crystals evenly on a suitable baking sheet and bake in an oven between 100°C and 200°C for around an hour or until the colour has changed from clear back to deep orange. After being allowed to cool, the crystals can be replaced in the Desiccant Cartridge and reused.

14.10. Important Information Regarding Depth Measurement

The depth measurement system uses the EC sensor to detect when the Sonde has been placed in water. All the time the Sonde is measuring an EC of zero, the depth will read zero.

As soon as an EC value is detected, the Sonde will start to calculate depth. **For this reason, it is important to ensure the Switch Ring is set to the AUTO position prior to submerging the Sonde in water.**

14.11. Deployment Orientation

The AS-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 AS-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.

14.12. Normal Operation

Directly after the Switch Ring is set to the AUTO position, the AS-Pro™ will take readings at two-second intervals for a period of five minutes.

During this period, the LED below the Switch Ring should give a **single green flash** every two seconds. If the LED flashes red, refer to section 14.5.1.:LED Indications.

After four minutes have elapsed, the AS-Pro™ will carry out a clean cycle. After a further minute has elapsed, the Sonde will log its first lot of data, then enter a dormant state, waiting for the next programmed logging event. During the dormant state, the green LED will flash every 15 seconds.

It is important that you lower the Sonde into the water within four minutes of activating it, otherwise the initial clean, the first set of readings and all subsequent depth readings will be erroneous. It is also important to lower the Sonde into the water slowly.

When a logging event is imminent, the Sonde will leave its dormant state and take readings every two seconds for a period of forty seconds.

During this time, the green LED will flash every two seconds. At the end of the forty-second reading period, the readings will be logged and the Sonde will re-enter the dormant state.

14.13. Maintenance Once Deployed

The Sonde 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 Sonde is deployed in clean water, the only necessity should be regular single point calibration of the electrodes. This should be done every 4 – 6 weeks.

If the Sonde 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 and/or wiper should be replaced as soon as they show any signs of clogging or 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.

The measurement chamber is an integral part of the optical measurement system. If it is 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. 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 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.

14.14. Cleaning

The AS-Pro™ should be cleaned regularly.

It is advisable to clean the Sonde after use with the connector cap attached. This will prevent any water entering the Sonde's socket.

The Sleeve on the AS-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 Sonde 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 Sonde and the inside of the Measurement Chamber using the lint- free cloth provided.

Using the special lint-free cloth is important. If a normal cloth or paper towel is used to clean the Sonde, 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.

Never clean the Sonde 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.

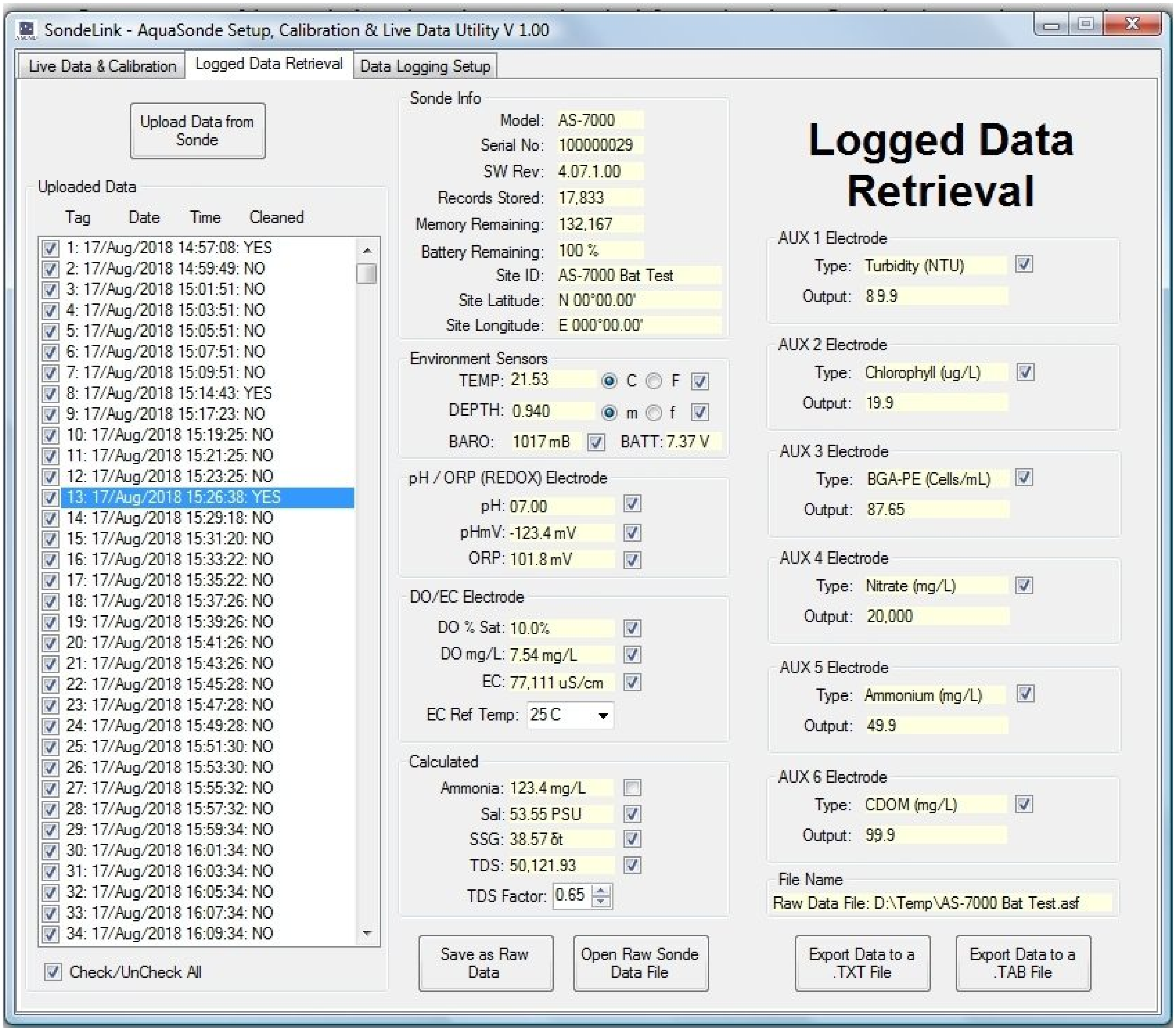
TIP: Occasional application of a smear of silicone grease (provided) to the connector O-rings and thread and the Sleeve thread will make fitting and removal of these parts easier.

15. Logged Data Retrieval

After the AS-Pro™ has been deployed for a period and has logged data, the data can be retrieved by re-connecting the Sonde to a PC running SondeLink.

15.1. Uploading Logged Data

Select the Logged Data Retrieval tab, then click on the '*Upload Data From Sonde*' button.



Uploaded Data

Tag Date Time Cleaned

- ☑ 1: 17/Aug/2018 14:57:08: YES
- ☑ 2: 17/Aug/2018 14:59:49: NO
- ☑ 3: 17/Aug/2018 15:01:51: NO
- ☑ 4: 17/Aug/2018 15:03:51: NO
- ☑ 5: 17/Aug/2018 15:05:51: NO
- ☑ 6: 17/Aug/2018 15:07:51: NO
- ☑ 7: 17/Aug/2018 15:09:51: NO
- ☑ 8: 17/Aug/2018 15:14:43: YES
- ☑ 9: 17/Aug/2018 15:17:23: NO
- ☑ 10: 17/Aug/2018 15:19:25: NO
- ☑ 11: 17/Aug/2018 15:21:25: NO
- ☑ 12: 17/Aug/2018 15:23:25: NO
- ☑ 13: 17/Aug/2018 15:26:38: YES
- ☑ 14: 17/Aug/2018 15:29:18: NO
- ☑ 15: 17/Aug/2018 15:31:20: NO
- ☑ 16: 17/Aug/2018 15:33:22: NO
- ☑ 17: 17/Aug/2018 15:35:22: NO
- ☑ 18: 17/Aug/2018 15:37:26: NO
- ☑ 19: 17/Aug/2018 15:39:26: NO
- ☑ 20: 17/Aug/2018 15:41:26: NO
- ☑ 21: 17/Aug/2018 15:43:26: NO
- ☑ 22: 17/Aug/2018 15:45:28: NO
- ☑ 23: 17/Aug/2018 15:47:28: NO
- ☑ 24: 17/Aug/2018 15:49:28: NO
- ☑ 25: 17/Aug/2018 15:51:30: NO
- ☑ 26: 17/Aug/2018 15:53:30: NO
- ☑ 27: 17/Aug/2018 15:55:32: NO
- ☑ 28: 17/Aug/2018 15:57:32: NO
- ☑ 29: 17/Aug/2018 15:59:34: NO
- ☑ 30: 17/Aug/2018 16:01:34: NO
- ☑ 31: 17/Aug/2018 16:03:34: NO
- ☑ 32: 17/Aug/2018 16:05:34: NO
- ☑ 33: 17/Aug/2018 16:07:34: NO
- ☑ 34: 17/Aug/2018 16:09:34: NO

☑ Check/UnCheck All

Sonde Info

Model: AS-7000
Serial No: 100000029
SW Rev: 4.07.1.00
Records Stored: 17,833
Memory Remaining: 132,167
Battery Remaining: 100 %
Site ID: AS-7000 Bat Test
Site Latitude: N 00°00.00'
Site Longitude: E 000°00.00'

Environment Sensors

TEMP: 21.53 ● C ○ F ☑
DEPTH: 0.940 ● m ○ f ☑
BARO: 1017 mB ☑ BATT: 7.37 V

pH / ORP (REDOX) Electrode

pH: 07.00 ☑
pHmV: -123.4 mV ☑
ORP: 101.8 mV ☑

DO/EC Electrode

DO % Sat: 10.0% ☑
DO mg/L: 7.54 mg/L ☑
EC: 77,111 uS/cm ☑
EC Ref Temp: 25 C

Calculated

Ammonia: 123.4 mg/L ☐
Sal: 53.55 PSU ☑
SSG: 38.57 δt ☑
TDS: 50,121.93 ☑
TDS Factor: 0.65

AUX 1 Electrode

Type: Turbidity (NTU) ☑
Output: 89.9

AUX 2 Electrode

Type: Chlorophyll (ug/L) ☑
Output: 19.9

AUX 3 Electrode

Type: BGA-PE (Cells/mL) ☑
Output: 87.65

AUX 4 Electrode

Type: Nitrate (mg/L) ☑
Output: 20,000

AUX 5 Electrode

Type: Ammonium (mg/L) ☑
Output: 49.9

AUX 6 Electrode

Type: CDOM (mg/L) ☑
Output: 99.9

File Name

Raw Data File: D:\Temp\AS-7000 Bat Test.asf

Once upload is complete, the record number (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. The '*Cleaned*' column will indicated if a cleaning cycle occurred prior to logging a particular data set.

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 either blanks or dashes. To move up and down the Tag/date/time column, use either your mouse or the cursor up/down keys.

The panel at the top of the screen labelled '*Sonde Info*' gives important information concerning the current status of the AS-Pro™.

Included in this is the Sonde's model type, serial number and software revision. Below that is a box showing the number of records stored and the memory remaining.

Next there are boxes showing battery capacity remaining and current battery voltage. Finally the Sonde's Site ID and position are displayed.

The AS-Pro™ outputs temperature in °C and depth in metres. To change these units of measurement, click the buttons adjacent to the readings. Adjacent to the barometric pressure reading box, the battery voltage at the time the data was logged is displayed.

The AS-Pro™ outputs Electrical Conductivity (EC) in an absolute form. The EC value can be displayed as an ABS value or can be corrected to correspond to a reference temperature of either 20°C or 25°C. To choose the way in which EC is reported, simply click one of the three settings within the Ref Temp drop-down box below the EC reading.

Total Dissolved Solids (TDS) is a value calculated by applying a TDS factor to the EC value. This factor is set at 0.65 by default but can be adjusted to suite your application.

15.2. Saving Logged Data

Once a set of logged data has been uploaded from the AS-Pro™, it can be saved on your PC as a Raw Data file. These files use a proprietary format and are saved with a .asf (aqua Sonde file) extension.

To save the uploaded data, click the ‘Save as Raw Data’ button. The site ID (if set) or Sonde serial number will be set as a file name, but you can replace this with a name of your choosing. The file name you choose will automatically be given the .asf extension.

Useful Tip: Once you have saved the logged data, it is a good idea to clear the AS-Pro™'s memory so next time you log data, you don’t get both your old data and new data uploaded to your PC. See section 13.1.1. Clearing the Sonde's memory .

15.3. Retrieving Stored Data Files

Once a Raw Data file has been saved using the above technique, it can be easily retrieved by clicking on the ‘Open Raw Sonde Data File’ button. When a raw data file is opened, it will appear exactly as uploaded data and the file name will be displayed in the 'File Name' box at the bottom right of the screen.

15.4. Exporting Data

SondeLink can export data with two different file extensions. 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 below 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.

15.4.1. Exporting Logged Data for use as a Text File

To export a .txt file, click on the ‘Export Data to a .TXT File’ button. You will be asked to specify a file name. A .txt extension will automatically be added. The file will be output in TAB delimited format. This means that each data field is separated by a Tab, and each data record appears on a new line. These files can be opened with any text editor or word processor application.

15.4.2. Exporting Logged Data for Import into a Spreadsheet

To export a file that can easily be opened in a spreadsheet application such as Microsoft® Excel®, click on the ‘Export Data to a .TAB File’ button. You will be asked to specify a file name. A .tab extension will automatically be added. These 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.

When opening a .tab file created by SondeLink 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’.

15.5. Clearing the Sonde’s Memory

Once the data has been uploaded from the AS-Pro™ and saved, the Sonde’s memory may be cleared by clicking on the *'Clear Sonde Memory*' button, which is located on the '*Data Logging Setup*' tab. See section 13.1.1. Clearing the Sonde's memory .

16. Limited Warranty

All Aquaread® Sondes, 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 Sonde sockets, and damage caused by leaking batteries are not covered.

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

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

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

16.1. 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 Sonde with concentrated acid or alkaline based cleaning products such as Decon 90. These products can strip the anodised finish from the Sonde and damage some of the plastic components.

16.2. 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: _____________________________

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.

17. TROUBLESHOOTING

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

Problem	**Cause / Remedy**
The SondeLink software can not find the Sonde.	✓ The USB drivers may not be properly installed. Reinstall the USB drivers carefully following the instructions. ✓ There may be a problem with the USB socket on the PC, try an alternative socket.
Dissolved Oxygen readings are inaccurate or unstable.	✓ The DO electrode may need calibrating. Recalibrate. ✓ The DO membrane may be dirty. Clean the DO membrane. ✓ Calibration may have been carried out at an extreme temperature. Recalibrate at a temperature as close to the sample temperature as possible.
pH and/or ORP readings are slow, inaccurate or unstable or calibration is impossible.	✓ The electrodes may need re-calibrating. Recalibrate. ✓ The electrodes may need cleaning. Clean as described in the relevant section of this manual. ✓ The electrodes may have been allowed to dry out. Re-hydrate as described in the relevant section of this manual. ✓ The electrodes may be damaged. Replace the electrodes. ✓ The electrode may be loose allowing water to enter the electrode socket. Remove the electrode, blow out the socket with compressed air then leave the sonde and electrode in a warm place for at least 48 hours to dry out.
EC readings are inaccurate or unstable. Calibration of EC fails.	✓ Have you got the Sonde wiper fitted? EC will not work without the Sonde wiper fitted. ✓ The Sonde may not be inserted deep enough into the sample being measured. Ensure the sample level reaches the bottom of the slots in the Sonde's sleeve. ✓ Trapped air bubbles may be causing problems. Activate the cleaning system to dislodge them. ✓ The EC electrode may need recalibrating. Recalibrate. ✓ The EC electrode may be dirty. Clean the EC electrode then recalibrate.
Optical electrode readings are inaccurate or unstable.	✓ Have you got the Sonde sleeve and measurement chamber fitted? Optical electrodes will not work without the sonde sleeve and measurement chamber fitted. ✓ Trapped air bubbles may be causing interference. Activate the cleaning system to dislodge them. ✓ The sample being measured may contain air bubbles. Under these conditions, optical electrode measurements can not be taken. ✓ The Sonde may not be inserted deep enough into the sample being measured. Ensure the sample level reaches the bottom of the slots in the Sonde's sleeve. ✓ The electrodes may need recalibrating. Recalibrate. ✓ The lenses on the electrode may be dirty. Clean the lenses then recalibrate.
'0' Values for optical electrodes when a value is expected (i.e probe is not in clean water)	✓ Not sufficient sample liquid to cover all EC rings. If the EC rings are not ALL covered and an EC reading is not available the Optical electrodes will read 0. Increase the volume of liquid to cover ALL EC rings.

18. DECLARATIONS OF CONFORMITY

18.1. UKCA DECLARATION

UK
CA

AQUAREAD
water monitoring instruments

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 Compatibility Regulations 2016

Radio Equipment Regulations 2017

Approved by

Craig Harrison

Aquaread Limited
Bridge House
Northdown Industrial Park
Broadstairs
Kent
CT10 3JP

Date Jan 1st 2023

18.2. CE DECLARATION

CE

AQUAREAD
water monitoring instruments

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 Compatibility (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

19. Appendix 1. The AS-Pro™ Automatic Cleaning System

The AS-Pro™ features a motorised cleaning mechanism. This cleaning mechanism is designed for use during calibration and long term deployment.

The cleaning cycle can be activated from the SondeLink™ software in live data mode, which is useful during calibration for removing air bubbles from the electrodes. The cleaning mechanism can also be programmed to activate at a regular interval during long term deployments. See section 13.3.3. Cleaning Rate Setup.

To activate the cleaning mechanism from SondeLink, click the 'Clean Sonde' button.

Sonde Info
Model: AS-7000
Serial No: 100000029
SW Rev: 4.07.1.00

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-Sonde 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 AS-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 Sonde'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 Sonde 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.

19.1. 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 Sonde 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.

Slide rubber wiper out of slot. Lubricate slot when re-fitting.

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.

19.2. 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 Sonde 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 Sonde body.

Push firmly home then tighten the collar so that the electrode is pulled all of the way into the socket

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.

19.3. 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.

20. Appendix 2. Fitting Electrodes

The AS-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 AS-Pro™: Optical Electrodes and ISE Electrodes. These can be fitted to any of the four AUX sockets marked AUX1 – AUX4.

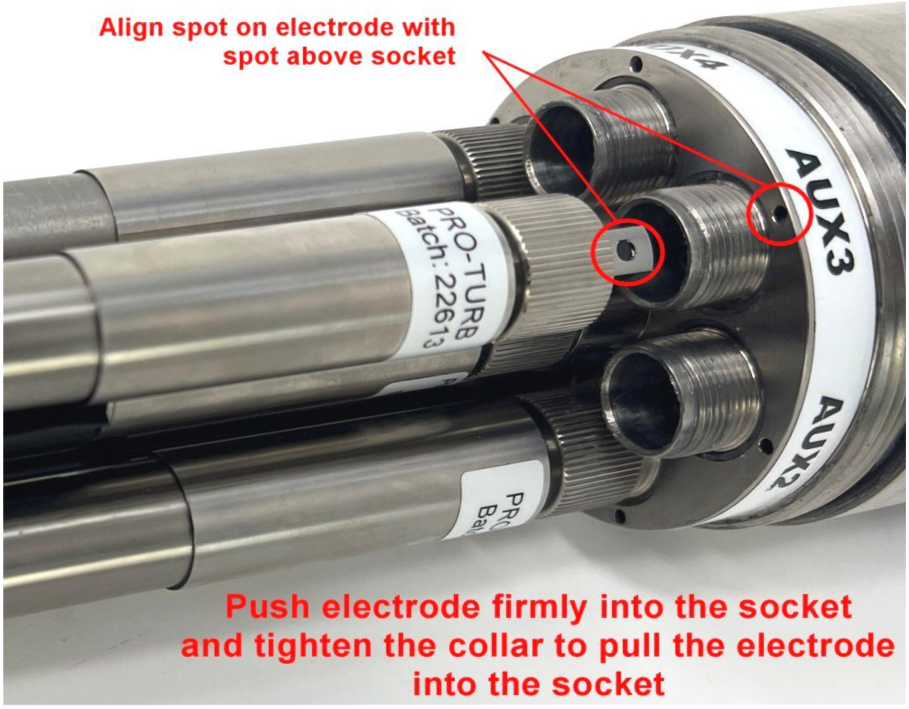
PH/ORP electrodes may only be fitted to the socket labelled pH/ORP. The pH/ORP electrode will not work if fitted to an AUX socket. Similarly, AUX electrodes must not be fitted to the pH/ORP socket.

20.1. Installing pH/ORP and AUX Electrodes

The pH/ORP electrode comes pre-fitted to the AS-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 AS-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 Sonde body and push the electrode firmly home.



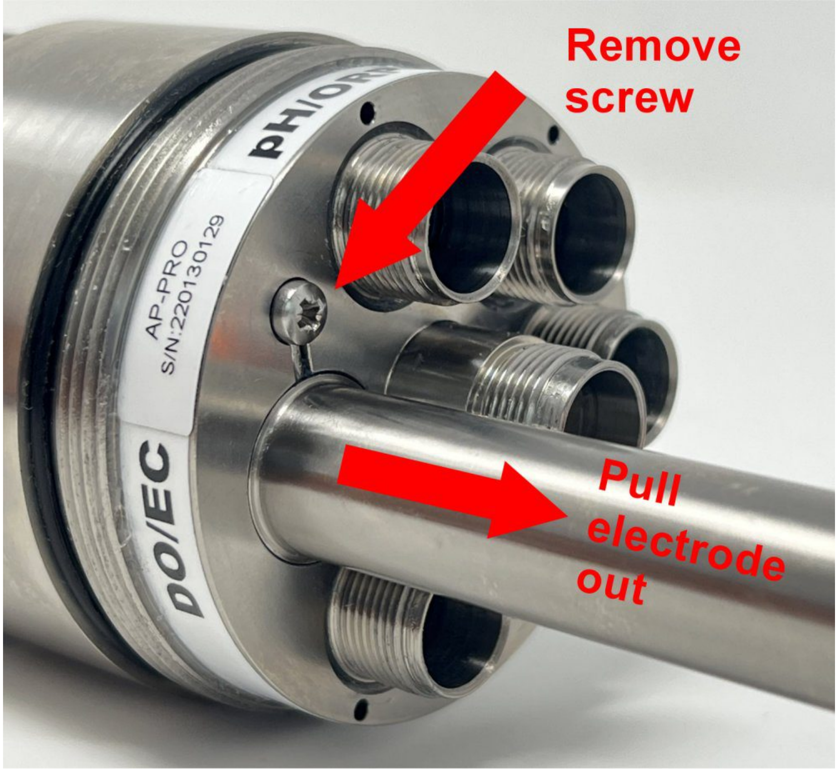
Tighten the knurled collar until the electrode is pulled all the way into the socket.

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

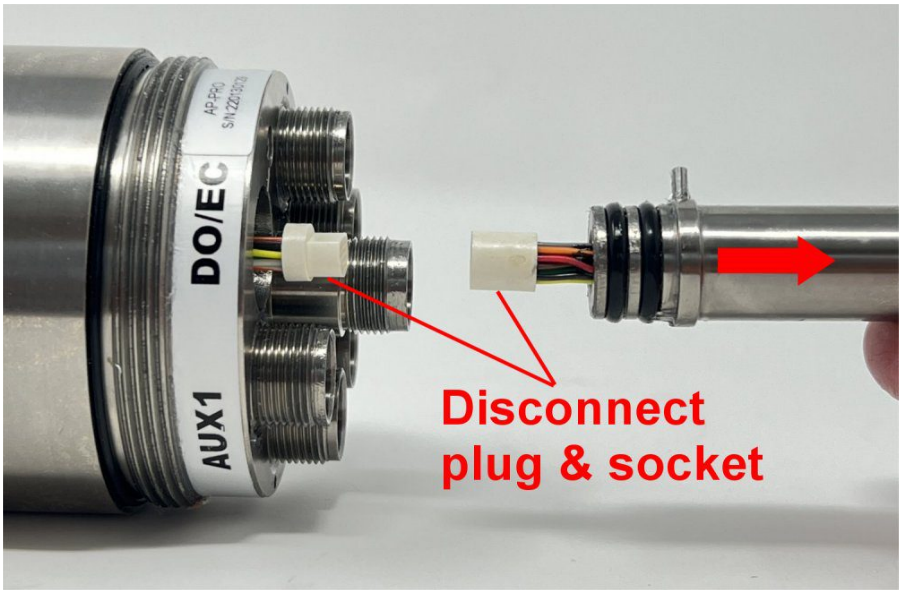
20.2. Replacing the DO/EC/Temperature Electrode

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

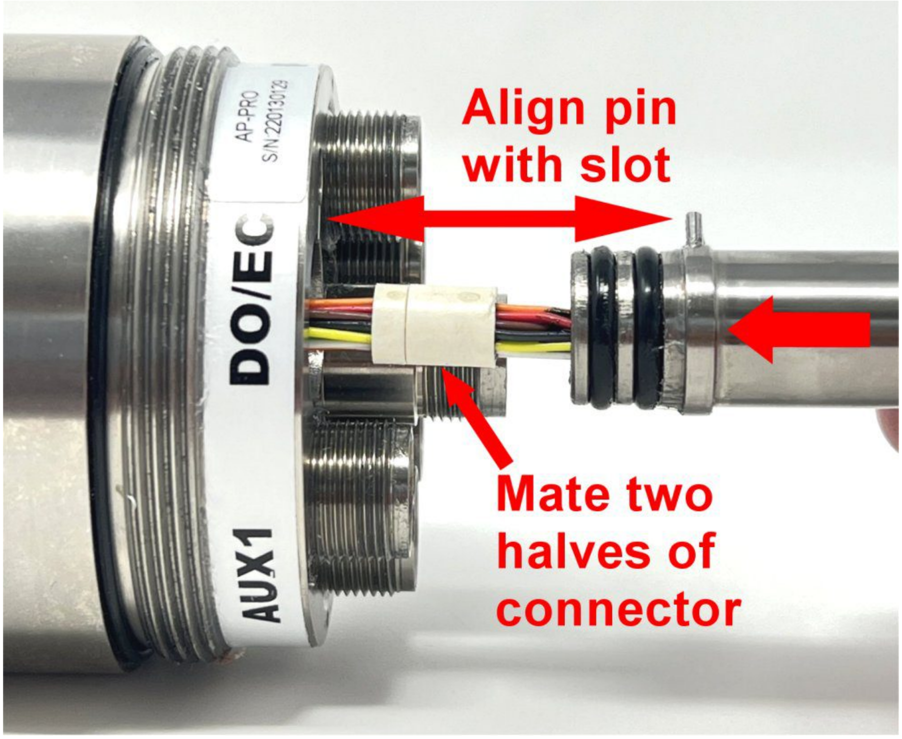
To remove the electrode, first remove the locking screw and pull the electrode straight out of the AS-Pro™ as shown below.



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 AS-Pro™ body, then press firmly home. Finally, replace the screw to lock the electrode in place.

20.3. 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 AS-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.

21. Appendix 3. Sonde & Standard Electrodes Specification

Protection Class	AS-Pro & All Electrodes: IP68 (Permanent Immersion)
AS-Pro Dimensions	650mm long x 70mm diameter
AS-Pro Weight	2,500g (excluding optional electrodes and batteries)
AS-Pro Power Supply	2 x 3.6 Volt Lithium D size batteries or external 12V, 500mA supply

Optical Dissolved Oxygen	Range	0 – 500.0% / 0 – 50.00 mg/L
	Resolution	0.1% / 0.01mg/L
	Accuracy	0 - 200%: ± 1% of reading. 200% - 500%: ± 10%
Conductivity (EC)	Range	0 – 200 mS/cm (0 - 200,000 μS/cm)
	Resolution	3 Auto-range scales: 0 – 9999 μS/cm, 10.00 – 99.99 mS/cm, 100.0 – 200.0mS/cm
	Accuracy	± 1% of reading or ± 1μS/cm if greater **(see note 2)**
TDS*	Range	0 – 100,000 mg/L (ppm)
	Resolution	2 Auto-range scales: 0 – 9999mg/L, 10.00 – 100.00g/L
	Accuracy	± 1% of reading or ± 1mg/L if greater **(see note 2)**
Resistivity*	Range	5 Ω•cm – 1 MΩ•cm
	Resolution	2 Auto-range scales: 5 – 9999 Ω•cm, 10.0 – 1000.0 KΩ•cm
	Accuracy	± 1% of reading or ± 1 Ω•cm if greater **(see note 2)**
Salinity*	Range	0 – 70 PSU / 0 – 70.00 ppt (g/Kg)
	Resolution	0.01 PSU / 0.01 ppt
	Accuracy	± 1% of reading or ± 0.1 unit if greater **(see note 2)**
Seawater Specific Gravity*	Range	0 – 50 σ_t
	Resolution	0.1 σ_t
	Accuracy	± 1.0 σ_t
pH	Range	0 – 14 pH / ± 625mV **(see note 3)**
	Resolution	0.01 pH / ± 0.1mV
	Accuracy	± 0.1 pH / ± 5mV
ORP	Range	± 2000mV **(see note 3)**
	Resolution	0.1mV
	Accuracy	± 5mV
Depth	Range	± 0 – 300m
	Resolution	1cm
	Accuracy	± 0.2% FS
Temperature	Range	-5˚C – +70˚C
	Resolution	0.01˚ C/F
	Accuracy	± 0.1˚ C

*** Readings calculated from EC and temperature electrode values**

Aquaread® Ltd reserves the right to change specifications without notice. Please refer to Aquaread website for current specifications.

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 100μS/cm and 99,999μS/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 100μS/cm. Special low EC pH electrodes are available to special order.

22. Appendix 4. Optical Electrodes Detailed Specification and FAQs

22.1. 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.

22.2. 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 Sonde is lowered to. Naturally, the Sonde 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.

22.3. 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.

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

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

Aquaread® Ltd reserves the right to change specifications without notice. Please refer to Aquaread website for current specifications.

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. MLD (Minimum Level of Detection) is the minimum value the electrode is physically capable of measuring.
3. 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.

22.5. 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 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 the proximity of their excitation and detection wavelengths).

23. Appendix 4. ISE Electrodes Detailed Specification

Ammonium / Ammonia†	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(1)	1.0 ppm
	Interfering Ions(2)	Potassium, Sodium and Magnesium
	pH Range(3)	5 - 8
Chloride	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(1)	2.0 ppm
	Interfering Ions(2)	Bromide, Iodide, Cyanide and Sulphide
	pH Range(3)	2 - 11
Fluoride	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(1)	0.05 ppm
	Interfering Ions(2)	Hydroxide (OH-)
	pH Range(3)	4 - 8
Nitrate	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(1)	0.5 ppm
	Interfering Ions(2)	Chloride, Bromide, Fluoride, Sulphate, Chlorate and Perchlorate
	pH Range(3)	3 - 10
Calcium	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(1)	0.05 ppm
	Interfering Ions(2)	Magnesium, Barium, Lead, Zinc and Sodium
	pH Range(3)	4 - 9

† Ammonia readings are calculated from Ammonium, pH and temperature electrode values.

Aquaread® Ltd reserves the right to change specifications without notice. Please refer to Aquaread website for current specifications.

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

3. 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.

4. 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 AS-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.

5. 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.

6. Accuracy in the field is dependent upon full three-point calibration and minimal time between calibration and use.

7. In order to achieve accurate longer term readings with ISE electrodes, the Sonde 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.

23.1. 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.

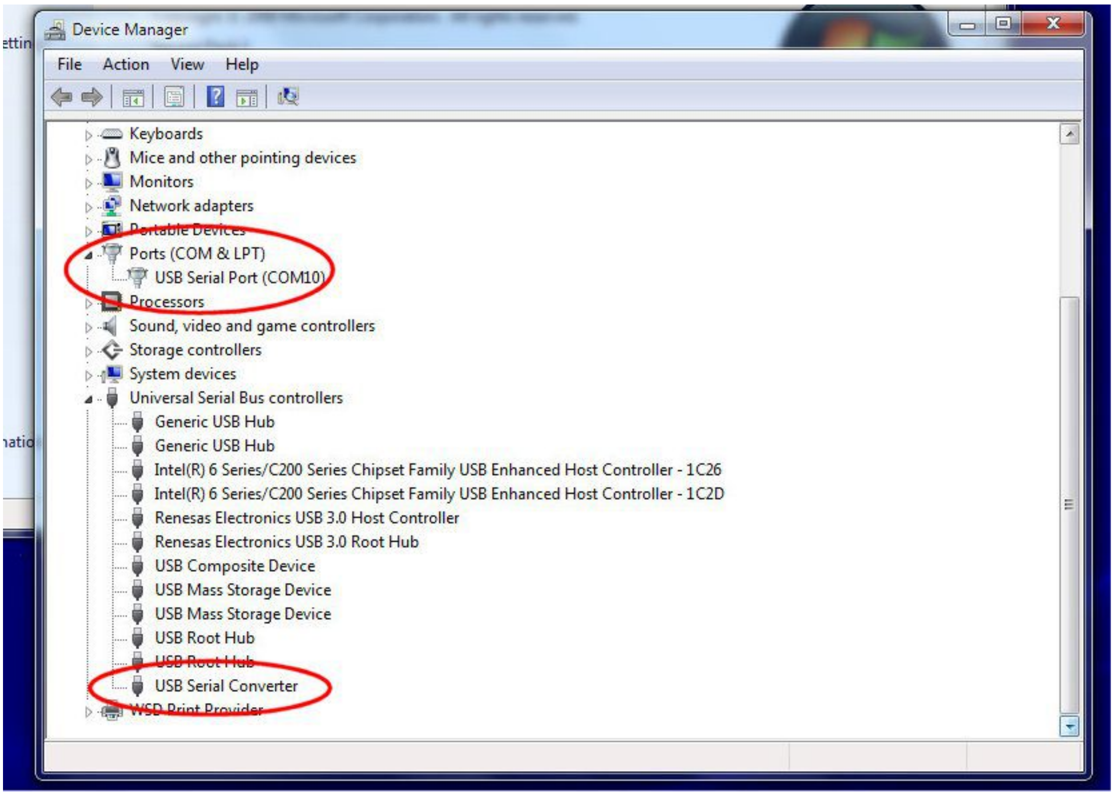
The caps should be fitted to all ISE Electrodes during pH/ORP calibration, when using RapidCal or using buffers containing interfering ions (i.e. all other ISE calibration solutions other than the one for the specific ISE being calibrated and EC calibration solutions) in order to protect the ISE electrodes 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 Sonde soaking in ISE calibration buffers for extended periods as the pH/ORP electrode will become depleted of ions leading to errors in ISE measurements.

24. Appendix 5. Troubleshooting SondeLink™

If the SondeLink™ software can not find the AS-Pro™, or if Windows® reports a problem installing the drivers, go to your Windows® Device Manager. The following two components should be present:



The USB Serial Port number (COM10 in the above example) may be different, but that is fine

If one or other of these components are not installed or are showing an error, re-install the drivers forcing Windows® to search your temporary directory for the drivers you downloaded from the Aquaread® website.

If more than one USB Serial Port is showing, determine which one is associated with the AS-Pro™ (by unplugging it then re-connecting it), then temporarily disable all other USB serial ports as they may be causing interference with communications to the AS-Pro™.