

Trace<sub>2</sub><sup>o</sup>

**ARSENOMETER  
HMAS100**

Portable Arsenic Analyser



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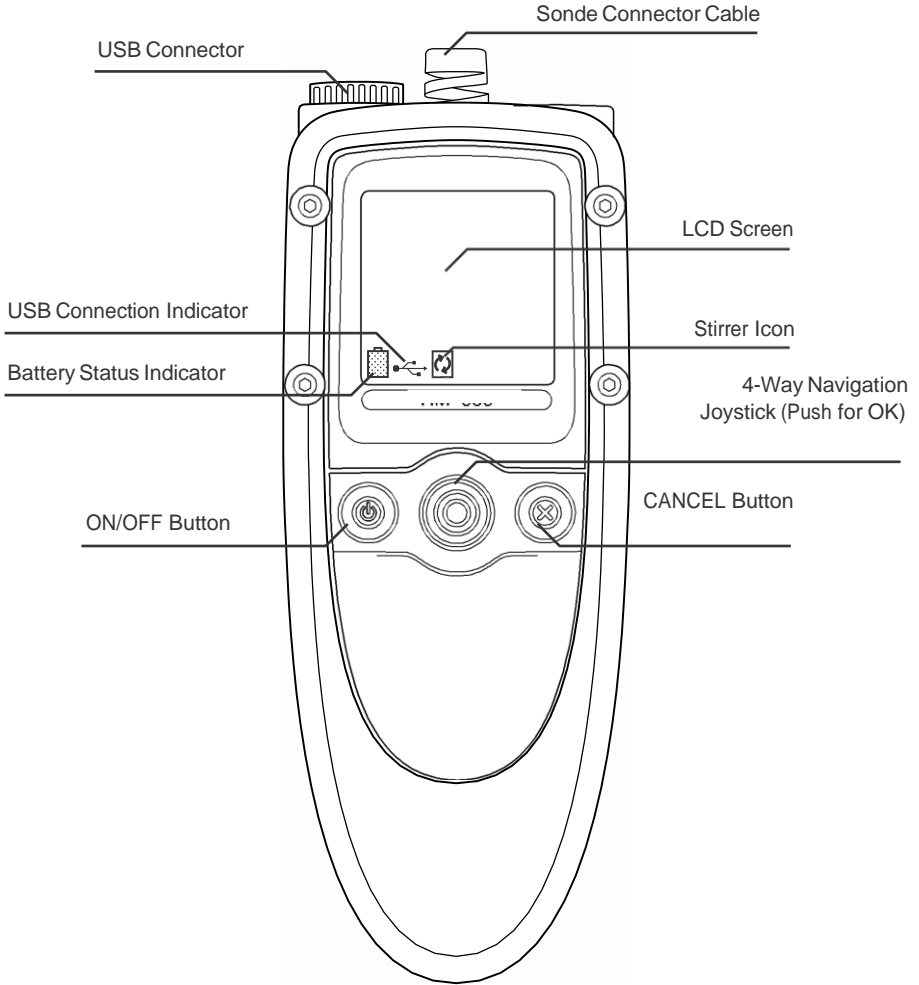
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## 1. INTRODUCTION

The Arsenometer HMAS100 kit is ideal for testing arsenic in natural water courses, for example lakes and rivers. The Arsenometer HMAS100 is a rugged field kit using a well established technique for the detection of heavy metals, Anodic Stripping Voltammetry.

The HMAS100 is very robust and has been designed to be virtually maintenance free. The instrument is sealed against water ingress and is housed in a waterproof Peli-case making it suitable for use at site for carrying out field screening analysis.

## 2.1 GETTING TO KNOW YOUR ARSENUMETER



### **USB Connector**

The USB connector can be used to charge the battery using the supplied car or mains charger, and also for download/upload and charging via a PC or laptop.

### **LCD Screen**

The LCD screen tells you what is happening as you go along. It will continually display the current date and time as well as other useful indicators such as battery and connection status. The screen is also backlit enabling use of the instrument under poor lighting conditions.

### **ON/OFF Button**

The ON/OFF is used to turn the instrument on and off, there is also an optional ten minute auto shutdown feature should you leave the instrument unattended.

### **Navigation Joystick**

The joystick allows you to quickly and easily navigate your way through the menus and features of the Arsenometer. The joystick provides five controls; Up, Down, Left, Right and OK. To navigate up, down, left and right simply push the joystick in the required direction. To select an option or 'OK' a choice press the joystick in the centre.

### **Cancel Button**

Pressing the cancel button will return you to the previous menu or screen.

## On Screen Indicators

At the bottom of the screen these symbols will appear periodically to provide information about the instrument's status.



Battery fast charge indicator



Battery trickle charge indicator



Battery fault/overheat indicator



Battery Full



Battery  $\frac{3}{4}$  Full



Battery  $\frac{1}{2}$  Full



Battery  $\frac{1}{4}$  Full



Battery empty



Stirrer on indicator

## Components and care of components

Electrodes – your kit consists of 3 different types of electrodes:



Counter electrode – this electrode needs the least maintenance of all. A quick visual inspection to ensure the electrode has no physical damage.



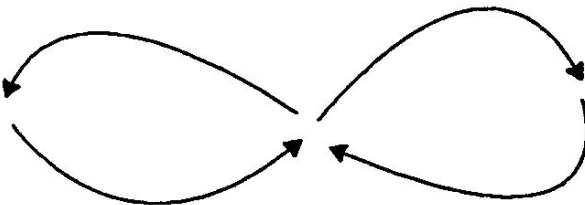
Reference Electrode – this electrode contains a liquid filled tube, the liquid can be replenished by using the Reference Electrode Fill Solution provided in the kit. Perform a visual inspection to ensure it has no physical damage and ensure there is enough liquid in the outer tube and that there are no bubbles in the inner tube. For best performance, the Reference Electrode tip should be kept wet. Please remove cap before use, and replace after use. Always place a few drops of deionised water in the cap before replacing it on the electrode.



Working Electrode – the electrode surface should be examined for cracks and imperfections that will affect analysis. The electrode should be regularly polished to remove contaminants and ensure a smooth mirror-like surface using the supplied glass platen, polishing cloth and polishing solution. Ensure that the protective rubber cap is replaced during storage of the electrode to prevent damage to the electrode surface. After polishing, Conditioning steps needs to be undertaken before analysis.

## Polishing technique

To polish the electrode, firstly make sure the glass platen and holder are clean and free of dust or dirt which may cause scratching. Place a clean cloth on the platen and dampen the cloth with the polishing solution provided. Hold the electrode perpendicular to the platen and use a smooth figure of eight motion as indicated.



Polish until the surface has a mirror finish and no scratches or imperfections are seen.

The instrument also consists of:

**Stirrer** – the stirrer will not operate all the time during the different stages of a run. The stirrer is crucial to the operation of the instrument and needs to be checked to ensure it is working properly. During a run, look through the translucent beaker or lightly touch the bottom of the SAB to determine that the stirrer is rotating when indicated on the handset. The stirrer has been designed to minimise turbulence thus ensuring increased repeatability.

**Sample Analysis Beaker (SAB)** – the SAB has a fixed volume so that when full and removed from the water course, excess sample will empty out of the holes levelling off at a constant volume.

**Handset** – the handset is waterproof and robust. A periodic visual inspection to ensure it is not damaged and that the screen is readable will suffice.

**Buffers** – the buffers are powders, which should be stored in a dark, cool, dry environment. If stored correctly, these have a shelf life of 3 years. Refer to individual sachets for expiry dates.



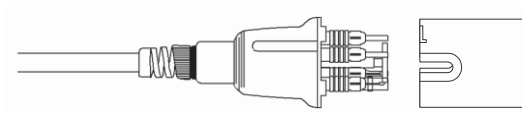
## Menu System

The Arsenometer is controlled via a system of on-screen menus. The structure of these menus is illustrated below to assist you in navigating them.

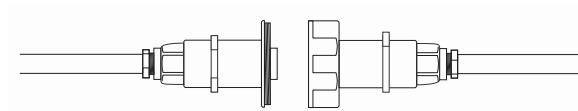
### Main Menu

Test Methods	→	Condition Electrode	Used to condition the working electrode with a Conditioning solution. When used as part of a test it is used to prime the electrode to increase sensitivity
	→	Analyse Sample	Used with Calibrate function. Calibration must be undertaken before analyse sample can be used
	→	Standard Addition	Used to analyse samples and calculate the unknown concentration by the addition of a known standard
	→	Calibrate	Used with analyse sample. Calibration must be performed before analyse sample is used
	→	Blank subtraction	Used to set or replace a baseline if contaminants are suspected in the buffer.
Data Log	→	View Log	Data Log viewing options
	→	Last Result	Displays latest result and graph
System	→	Backlight	Backlight control options
	→	Set date/time	Used to set the instrument date and time
	→	Language	Used to select the display language
	→	Charge	Battery charging options
	→	Auto switch off	Auto off select
	→	Program P/STAT	Program internal hardware (Not used in normal operation)

## The Sonde Assembly

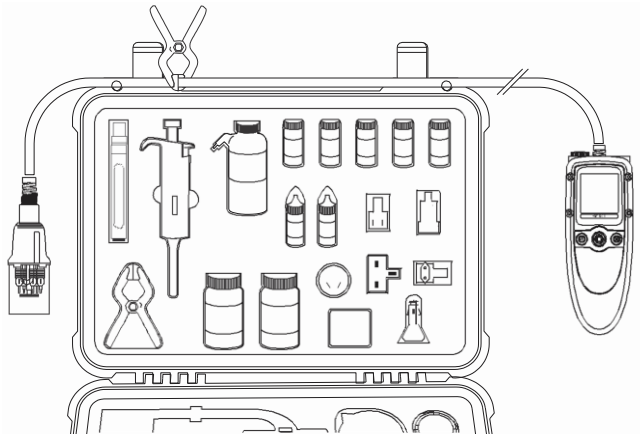


The sonde (electrodes x 3) SAB (Sample Analysis Beaker)



In-line waterproof cable connector

**Warning:** Sonde head is designed for submersion up to 1 metre in water. Lowering the head deeper than this may result in water ingress which will require sonde head replacement.

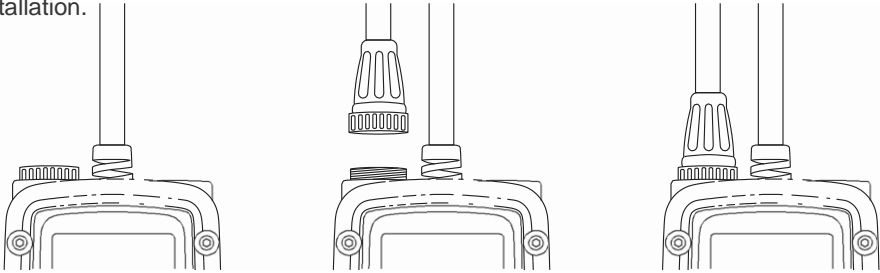


**Note:** The sonde cable may be fixed to the lid of the Arsenometer box, using the box closure tabs and the supplied cable clamp. Alternatively, the user may attach the cable to a suitable fixture at the sample site, eg. branch, rope, fence, barrier.

## 2.2. GETTING STARTED

### Charging the battery

When you first receive your Arsenometer it would be advisable to fully charge the battery. This can be done several ways using the USB lead and chargers provided with the kit. If a computer is used the software drivers will need to be installed to perform a fast charge. Refer to section on software installation.



Unscrew the blue cap

Insert mini USB lead

Tighten the screw cap

Connect to chosen charge system (Computer/ Mains/ 12V)

The Arsenometer is capable of charging at a fast rate taking approximately 7 hours to fully charge the battery, or a trickle charge rate which should be used for overnight top up charge if the instrument is only used once or twice a day.

From the system menu select Charge and you will be given three options:

100mA Trickle charge rate

500mA Fast charge rate

AUTO The instrument will automatically select the best charge rate.

To Select the charge rate follow these steps:

- From the main menu select System
- From the system menu select Charge
- Highlight required charge rate and press <OK>
- Press <cancel> to return to main menu

**Note:** The fast charge option is only available when the instrument is switched on. The instrument will also charge at a trickle rate if the instrument is connected for charging but not switched on

## Software Installation

Your Arsenometer is compatible with most computers with a USB socket, but first the USB drivers must be installed. The drivers are located on the Software CD ROM provided for all versions of Windows post Windows 95.

- Insert the CD ROM into the CD drive
- Connect the USB cable supplied to the Arsenometer instrument as described for battery charging. Connect the other end to an available USB port on your PC
- Windows will run the 'install new hardware wizard'
- When asked if Windows can connect to Windows update to search for software. Select 'No, not this time'
- Select 'Install from a list or specific location', navigate to CD Rom
- Windows should install the drivers
- Once complete the wizard will run again. Use the same settings as before
- Once Windows has installed the drivers, reboot the computer and your Arsenometer should be installed
- To verify correct installation select fast charge on the instrument and check that the fast charge icon (see page 7) is displayed on the Arsenometer's screen

## Setting the Date and Time

The Arsenometer contains a calendar and clock which is used to date stamp the results log. The clock may be set to UTC when you receive the instrument so may need re-setting. It will also need re-setting if the battery is disconnected. To set the clock follow these steps.

- From the main menu select **System**
- From the system menu select **Set date/time** and press **<OK>**
- Use the navigation key to alter the date and time
- Press **<OK>** when finished to save settings

## Backlight

Your Arsenometer is equipped with a backlight to aid viewing in poor lighting conditions. Selecting backlight from the system menu will present the following options.

ON	The backlight will be on at all times <sup>1</sup>
OFF	The backlight will be off at all times
AUTO	The backlight will switch on when a key is pressed or the screen refreshes. It will turn off after five seconds of inactivity.

<sup>1</sup> The battery life will be shortened in this mode.

To change the backlight settings follow the steps below.

- From the main menu select **System**
- From the system menu select **Backlight**
- Highlight required setting and press **<OK>**
- Press **<cancel>** to return to main menu

## Language Selection

The Arsenometer comes with English, French and Spanish languages pre-installed. To Change the language follow the steps below:

- From the main menu select the 3rd option **System**
- From the system menu select the 3rd option **Language**
- Highlight required language; **English, French, Spanish** and press **<OK>**
- Press **<cancel>** to return to main menu

## Auto switch off

The Arsenometer can be set to automatically switch off after ten minutes of inactivity. This is recommended to extend battery life. To change this setting select 'Auto Switch Off' from the System menu and then select On or Off.

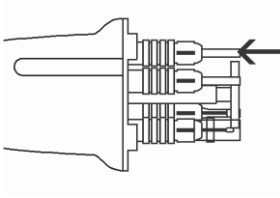
- From the main menu select **System**
- From the system menu select **Auto switch off**
- Highlight required setting and press **<OK>**
- Press **<cancel>** to return to main menu

## Electrodes

The Arsenometer is designed to be used out of the box. The electrodes are all pre-fitted.

### Setting up the Arsenometer

The Arsenometer comes with three electrodes. The electrodes are WE2 (Working Electrode 2), R (Reference) and C (Counter). The electrodes are connected to the Sonde as follows:

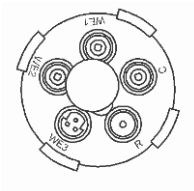


To fit the electrode simply align the arrow on the electrode with the arrow on the sonde head and push the electrode. A quiet double click should be heard. Gently pull on the top of the black holder of the electrode to ensure it is fully connected

To remove the electrodes pull back the connector shroud with the arrow on and the connector will pull off.

**When attaching or removing electrodes be careful to avoid touching the stirrer**

To correctly identify electrodes, the Sonde has the electrode letter reference stamped into it..

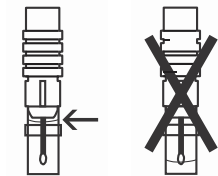


Electrode WE2 (3 pins) is to be fitted in position WE2.

**Do not mix up the electrodes.**

### Reference Electrode

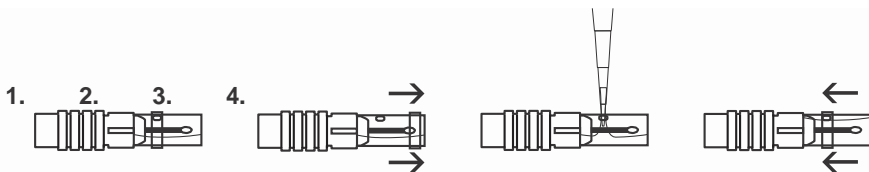
The Reference Electrode cap needs to be removed prior to analysis and replaced when the electrode is going to be stored. It is best practice not to let the tip of the Reference Electrode dry out.



The Reference Electrode must contain Reference Electrode fill solution to operate. Ensure the Reference Electrode is held vertically with the connector upwards and determine that there is enough solution in the Reference Electrode.

Fill  
solution  
level at  
max

Fill  
solution  
level too  
low



The outer tube needs to be at least 1/3rd full. To top up the Reference Electrode fill solution, slide the band down from the hole and use the pipette to drop enough solution into the Reference Electrode to fill it up. Once topped up, replace the band to prevent the electrode fill solution escaping. **Only use the supplied Reference Electrode fill solution.**

### Stirrer

The stirrer is used to ensure the sample is uniform and needs to operate during the analysis. To test for the operation of the stirrer, choose a Conditioning step that is under an elemental analysis section and run without the SAB attached. To achieve this from the Main menu, choose: Test methods => As (for example) => Condition electrode. The stirrer should rotate.

If the stirrer fails to rotate, turn the sonde head upside down, add a few drops of the **Stirrer Oil (do not use any other oil)** down the stirrer shaft at the base near the sonde head (near where it enters the sonde) and rotate gently to ensure the lubricant coats the bottom of the shaft .



## **2.3. OPERATING PROCEDURE**

### **2.3.1. METHODS**

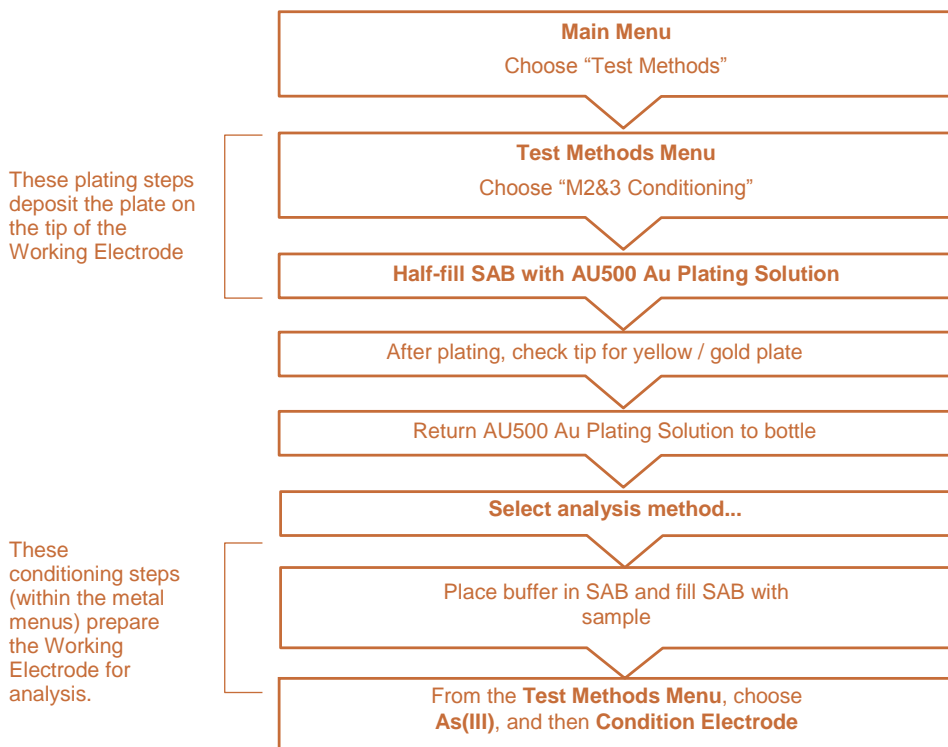
The Arsenometer operating procedure consists of two main steps – plating (conditioning) and analysis. The plating step forms a plate on the surface of the working electrode which can be seen as a yellow/gold layer on the tip of the Working Electrode. The quality of this plate is essential to achieving reliable results.

### 2.3.2. PLATING

The plating step takes a few minutes.

There are two preliminary steps required for any analysis with the Arsenometer. The plating step uses the AU500 Au Plating Solution and forms a plate on the working electrode, covering the black tip with a yellow/ gold colour. The conditioning of the electrode occurs when the element of interest is selected in the Test Methods menu and then choosing condition electrode which is at the top of the list when the element is selected. The conditioning step should be carried out in sample water, and undertakes a run which sensitises the Working Electrode.

**Example:** Overview of As (III) procedure to first plate then sensitise the electrode:



Refer to Application notes for Operating Procedures particular to each parameter.

It is necessary to perform the plating and then condition before a session or if the sensitivity of the analysis decreases. If a lot of samples are to be analysed then a plate in the morning and one in the afternoon at the beginning of the session is recommended.

If in doubt, remove the old plate by wiping the surface, polish the tip of the Working Electrode to a mirror smooth finish (with the polishing kit provided) then rinse with wash bottle and perform a new plating.

### 2.3.3. ANALYSIS

Before using the Arsenometer to perform a test ensure that the working electrode has been successfully plated and conditioned first.

There are now two ways to analyse a sample, either via the Standard Addition method or by an in-field calibration of the instrument.

1. The normal method of analysis for the Arsenometer is for the user to add a known amount of standard to the solution giving a known peak height, the **Standard Addition** method. The instrument then determines the value for the unknown sample previously analysed.
2. The in-field calibration method establishes a calibration curve first before analysing a number of samples rapidly. The Arsenometer firstly needs to establish the calibration curve using the Calibrate option in the menu of each metal of interest. Once this has been successfully completed an **Analyse Sample** can be undertaken  
(Note: using **Analyse Sample** without establishing a new calibration curve, the previous calibration will be used which may not be correct for the current analysis).

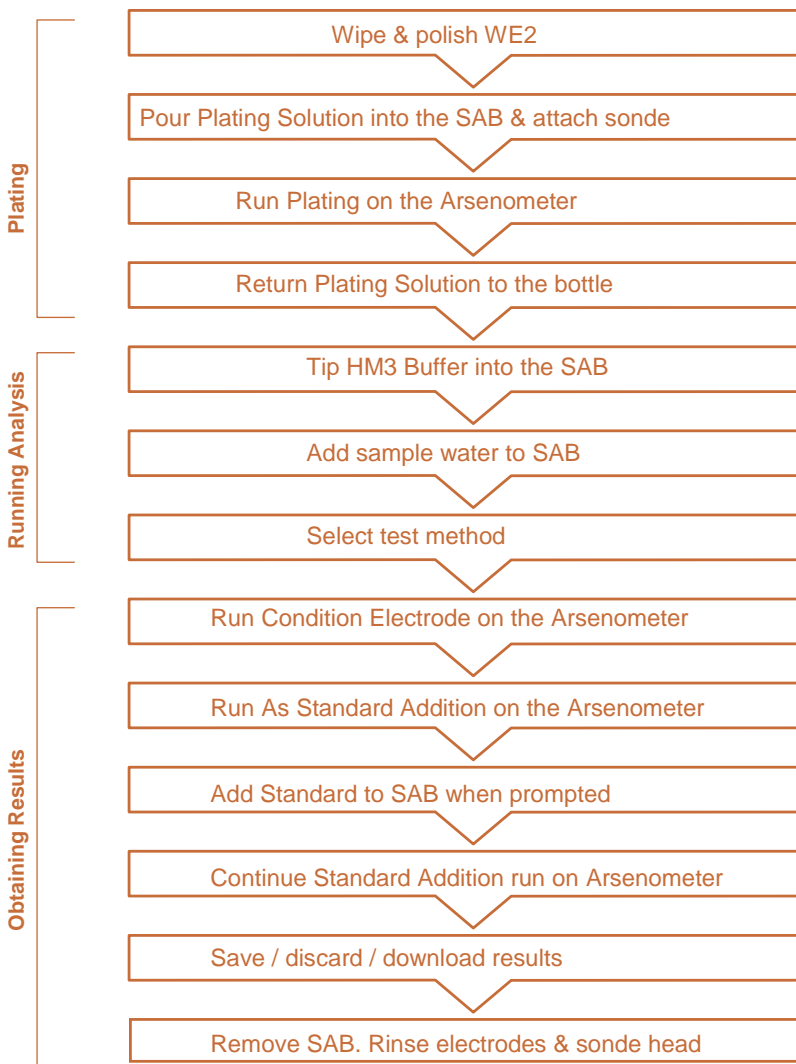
The calibration needs to be established just prior to analysis and also after a new plate has been applied to the tip of the working electrode. Many factors affect the calibration curve and the greater the time the analysis occurs after the calibration curve was established the greater the chance that there will be a decrease in accuracy. This is due to a number of factors including variability with the plate over time and even the components of the solution changing. It is important when calibrating the instrument that it is calibrated on a similar type of water to that being analysed, i.e. if a river sample from a particular river is being analysed then the Arsenometer needs to be calibrated using that river water, if a new river is to be analysed then recalibrate using a new river sample from the new location.

The **Blank Subtraction** method is used for creating a new baseline for the instrument for the analysis. It is to be used only when a suspected contaminant is present in the buffers being used. Performing this will replace the previous blank.

After each analysis the sonde head and the electrodes are to be washed thoroughly. This is in order to minimise carry-over and to clean off all traces of the previous analysis. This can be achieved by using the demineralised water or by washing the sonde head (without the SAB) in the sample water.

### 2.3.4. STANDARD ADDITION ANALYSES - OVERVIEW

Performing a Standard Addition method analysis consists of Plating, running Analysis and obtaining a result. The following main steps will assist you in understanding how to perform a Standard Addition based test. More extensive information on performing analyses can be found in the application notes.



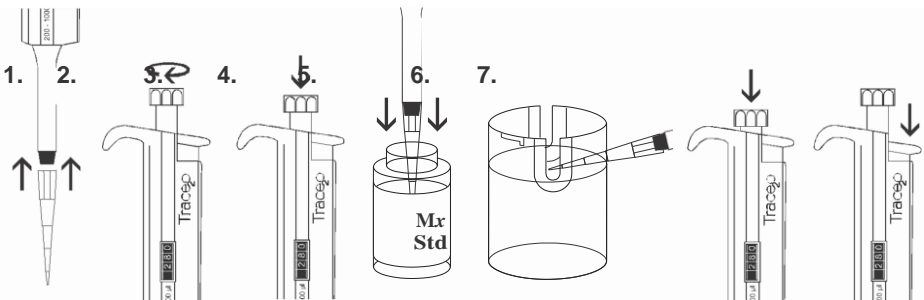
### 2.3.5. ADDING A STANDARD ADDITION

When prompted a 20ppb Standard Addition needs to be added to the SAB. This is achieved by using the pipette (which is set to 280 $\mu$ l). The 20ppb default setting can be changed by pushing the joystick left and right. Each 140 $\mu$ l increase on the pipette is equivalent to 10ppb.

On the handheld when prompted to add 20ppb of a particular element(s) then the highlighted value of 20ppb can be altered by pushing the joystick to the left and to the right. If the user wants to measure higher levels then a higher value closer to the concentration level will be required. The accuracy will increase the closer the Standard Addition is to the actual concentration. For example, an unknown sample is expected to be around 15ppb then a 20ppb standard in this case is sufficient. If the user expects the analysis to be 100ppb then, for example, a 120ppb standard would be suitable.

#### How to use a pipette

1. Place a clean pipette tip on the pipette
2. Select the volume required by twisting the dial at the top of the pipette
3. Hold the pipette with the thumb uppermost and press the button down gently to the first stop on the top plunger
4. Place the pipette tip in the standard bottle just underneath the top of the liquid and slowly release the plunger
5. Move the pipette to the SAB and locate the pipette tip through the hole in the SAB
6. Push the plunger all the way down to the second stop and hold then slowly withdraw the pipette tip from the SAB
7. To release the pipette tip after use, push the white button at the side of the pipette



### Altering deposition times

The standard default deposition time of 60 seconds is suitable for all analysis down to 5ppb for most elements, 10ppb for arsenic. To increase accuracy for the lower levels an increased deposition time is recommended. If the user expects the analysis to be higher then a shorter deposition time should be used. This can be adjusted when prompted to choose a deposition time at the beginning of the test methods.

30, 60 or 120 seconds can be selected by moving the joystick to the right and to the left on this screen and then pushing the centre of the joystick to accept it.

Deposition time Concentration range	
30 seconds	50ppb to 500ppb
60 seconds	10ppb to 50ppb
120 seconds	<10ppb

Suggested ranges for choosing deposition times

The instrument has been designed to have a maximum reading of 500ppb. Should the user wish to measure higher than this they will need to dilute the sample. For example, if the user wishes to measure 600ppb dilute the sample by half and then multiply the result by 2.

Always dilute with water that will not contribute to the heavy metals being tested. Deionised water is ideal.

### Blank subtraction

Blank subtraction is recommended to be used for all of the analyses and is the default setting. It is particularly important for the analysis of Hg and As.



## 2.4. TROUBLESHOOTING

Whilst your Arsenometer is designed to be very reliable, problems may occur throughout its working life. The following tables are intended to help you diagnose and resolve these problems simply and quickly. Should you not be able to resolve the problem please contact your supplier and they will be able to assist you.

When troubleshooting your Arsenometer the following steps should be undertaken in this order:

1. Reference Electrode – does the Reference Electrode contain the right level of electrode fill solution? Is it damaged at all? Are there air bubbles in the inner tube?
2. Stirrer – does the stirrer rotate? Does it mix the powder reagents when operating?  
To check this run the stirrer according to the instructions on page 16
3. Working Electrode – is the Working Electrode plated correctly?  
Is WE2 yellow in colour?
4. Solutions – have the solutions been contaminated? Have the correct buffers been added in the correct order? Has the right amount of standard been added?

The Arsenometer will try and help you with determining the problems. See below.

Displayed Error	Probable Cause
> L.O.D	The metal concentration is above the maximum limit of 500ppb. Dilution should be used.
< L.O.D	The metal concentration is below the minimum limit of detection for the method being used.
Addition error	The increase in metal response was not sufficient enough to determine the addition
Calibration error	The addition was not added or the metals have not been detected

## 2.5. INTERFERENCE EFFECTS

The Arsenometer has been designed to test very low levels of metals in water and as such is very sensitive. Due to the interaction of other metals and organics in the water source, interferences can occur as with any system of this type.

The Arsenometer is designed to function in water sources that might be suitable for drinking. The buffers chosen mean that in many instances interferences are unlikely to occur.

## 2.6. SPECIFICATIONS

### Arsenometer HMAS100 Handheld Unit

Input Power: 4.5–5.5 V DC, 250mA.

Power Connector Type: mini USB Type B (Bulgin micro series).

### Li-Ion Internal Battery

Output voltage: 3.3V Output current: 2200mAh

	Parameter	Lower Limit <sup>†</sup>	Upper Limit <sup>*</sup>
Arsenic (III)	As (III)	5	500
Total Arsenic	As (III+V)	10	500

<sup>\*</sup>Upper limit fixed. If the user requires values higher than this then a dilution will be needed (see page 23)

<sup>†</sup>Lower limits achievable using the Handset at 60 seconds deposition.  
Increased accuracy can be achieved by setting the deposition time to 120 seconds

Variability at 20ppb ± 5% with Metaware software, ± 7.5% with handheld

Accuracy dependent on sample matrix and type

## NOTES



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