PPM

GLUTARALDEMETER® 3

Glutaraldehyde Monitor

Operation Manual

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Foreword

The electrochemical fuel cell sensor as used in the PPM Glutaraldemeter®3 is formulated and manufactured to detect low concentrations of vapours emanating from glutaraldehyde solutions. This is achieved in this instrument by means of a 'snatch sampling' technique, whereby a small volume ($10cm^3$) of contaminated air is drawn into and across the sensor to produce a reading on the liquid crystal display.

The readings obtained and indicated on the display are therefore 'spot readings', indicating the level of contamination at that specific time and in that particular test area. Care should be exercised in relating these results to results obtained using other methods based on extended time and controlled air flow sampling, and which achieve determination of vapour level by use of laboratory chemical analysis.

CONTENTS

Introduction

The PPM Glutaraldemeter® 3, developed by PPM Ltd and designed by Snowdonia Business Innovation Centre, provides a compact, economical and easy-to-handle instrument capable of indicating levels of glutaraldehyde in air. It uses the same fuel cell as the MKI Glutaraldemeter® which was developed by Lion Laboratories plc.

Unlike other existing portable devices such as detection tubes and badges, the PPM Glutaraldemeter®3 uses a fuel cell detector and is capable of measuring many samples consecutively without the need for inconvenient ancillary equipment. The instrument is portable, battery operated and extremely simple to use, giving immediate, semi-quantitative readings of atmospheric glutaraldehyde displayed on a digital read-out.

The instrument is designed to measure the concentration of glutaraldehyde in snatch (discrete) samples of air and should be employed primarily as a screening device.

In common with most portable devices, the PPM Glutaraldemeter MK I was not totally specific, but the Glutaraldemeter®3 has a time to peak recording facility which allows greater selectivity as interfering substances such as alcohols take a shorter period of time to reach peak reading. Phenol and related compounds which are sometimes found in the same environment as glutaraldehyde can be removed using a disposable filter.

The PPM Glutaraldemeter®3 is totally safe to handle and use, presenting no electrical, mechanical or toxic hazard to the operator.

CHAPTER 1
INSTRUMENT DESCRIPTION

1.1 Initial Receipt of PPM Glutaraldemeter® 3 Kit

The Kit contains:-

1 PPM Glutaraldemeter® 3 instrument with battery installed
1 Calibration standard
1 Thermometer
1 Operation Manual
1 Certificate of calibration
1 Vial containing 10 phenol filters
1 PPM Pen

Immediately upon receipt, check that the Kit has been supplied complete.

The Kit will obviously be subjected to a great deal of movement during transit and the fuel cell detector in the instrument and the standards may be outside the recommended calibrating temperature range. Place the kit in a temperature-stable environment in the range 15 - 29 °C, away from direct sunlight and leave for 1 hour to allow both instrument and standard to equilibrate.

1.2 General Information

1. The GLUTARALDEMETER® 3 is temperature compensated to operate most accurately in the range 5 - 40 °C.

2. For calibration purpose store the instrument and standards in an ambient temperature in the range 15 - 29 °C for at least 1 hour.

3. Results obtained from the PPM Glutaraldemeter® are instantaneous spot readings; they are not necessarily representative of long term personal exposure. A series of readings taken at short intervals is preferable to infrequent tests.

4. Avoid smoking in the environment to be analysed - tobacco smoke contains aldehyde.

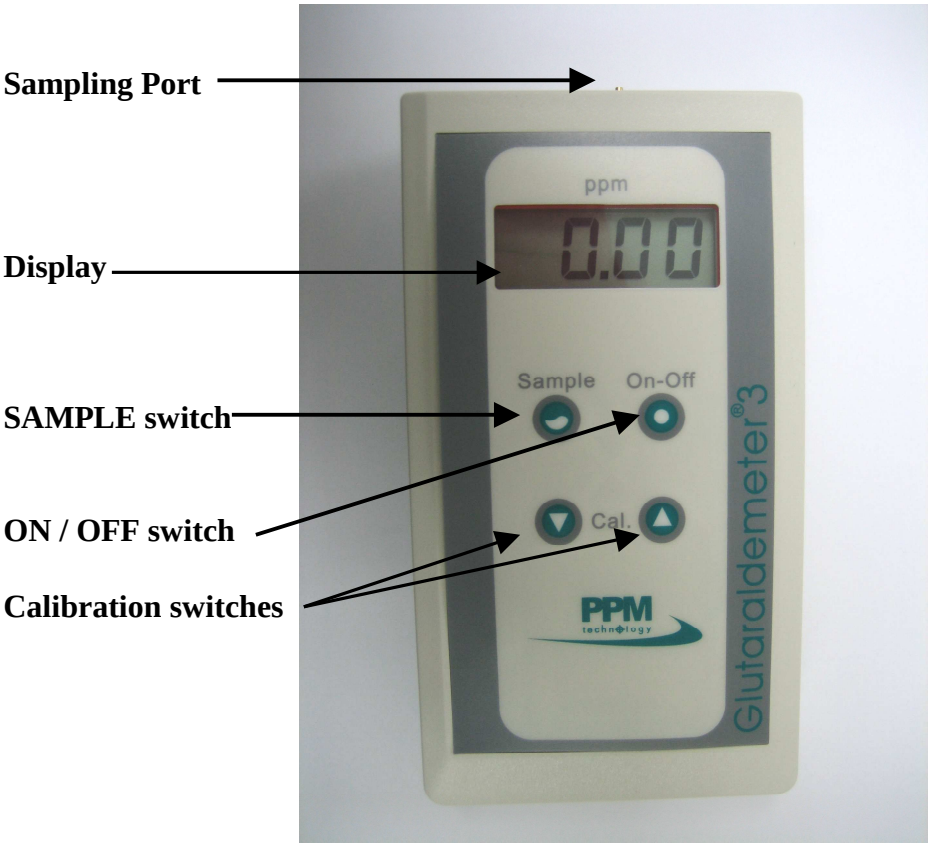
5. Care must be taken to ensure that fluid or dust is not taken into the instrument. This could permanently damage the fuel cell detector.

6. Normal physical shock encountered in the field should present no problem but if a severe shock is sustained, the operation and calibration of the instrument should be checked using the Glutaraldemeter calibration standard supplied.

7 Readings are given in parts per million (ppm) of glutaraldehyde in air.

8 Do not use chemicals to sterilise the instrument.

1.3 Description of Instrument



Display

This shows the glutaraldehyde concentration of the sample in increments of 0.01 ppm, from 0.03 to 4ppm. If “Bat” appears on the display then the battery needs replacing.

Glossary

"----"	*fuel cell recovering*
"0.00"	*fuel cell ready*
"run"	*sample being taken*
"CAL"	*calibration sample being taken*
"SEt"	*set calibration level*
"END"	*calibration completed successfully*
"BAt"	*battery low sign*
"SEt" followed by "CAL"	*must be calibrated before use*
"HEAt"	*temperature in °C*

'ON/OFF' Switch
The instrument switch itself off automatically after 5 minutes.

Calibration Switches
For calibration see Chapter 3.

Sampling Port
Provides the flow path for the air sample to be drawn into the fuel cell detector.

'SAMPLE' Button
Depress this button to activate the sampling pump.

Battery
This is located underneath a cover at the bottom rear of the instrument. It powers the amplifier and display systems and should have sufficient power for approximately 300 tests.

1.4 Interfering Substances

Phenol and Resorcinol
Trace quantities of phenolic substances in general give a reading on the PPM Glutaraldemeter®3. When measuring glutaraldehyde in situations where phenolic resins are used, the phenol filters should be used by fitting on to the sampling port of the instrument. These filters will minimise phenols even at concentrations in excess of 1,000 ppm without affecting the glutaraldehyde reading. These filters may be bought from PPM Technology Ltd.

Each filter should not no be used more than 5 times. Partially used filters should not be stored in the vial with unused filters.

Alcohols
Alcohols may also cause positive interference effects, e.g. when an air sample is taken above a glutaraldehyde solution, alcohols such as ethanol, butanol or propanol, if present, have the effect of decreasing the time to reach maximum reading ("time to peak").

1.5 Selectivity by means of time to peak

When the instrument is calibrated, the time to peak is recorded and permanently stored (until the next calibration). The time to peak of subsequent measurements of pure glutaraldehyde should not vary by more than + / - 20% providing the concentration exceeds 0.1 ppm. If the time to peak lies outside this range then interference has occurred from one or more contaminants.

To display the glutaraldehyde calibration standard 'time to peak', press ⩛CAL immediately after the instrument has been switched ON. Press the same button to read the 'time to peak' of the sample under investigation once the signal has risen to a maximum and compare with the calibration standard.

CHAPTER 2

OPERATING INSTRUCTIONS

2.1 Use of the Instrument

1 Press **ON / OFF** button and then release.

2 On switching the instrument on the display shows ' - - - '. When the instrument is ready to use ‘0.00’ will be displayed.

3 Press **'SAMPLE'** button, and release.

4 The display shows “run”, followed by the sound of the pump sampling 10ml of air.

5 The display rises to the maximum value which is then held on the display until the instrument is switched off by operator or automatically after 5 min.

6 Switch the instrument **‘OFF’**.

Before taking the next sample it is advisable to leave the instrument switched off for a short period until the fuel cell clears and the display shows “0.00” permanently. The higher the reading obtained the longer it takes for the fuel cell to clear.

If no glutaraldehyde is present, proceed with the next analysis.

2.2 Sampling Frequency Capabilities

The fuel cell takes a short while to remove the glutaraldehyde from one sample and so return its output to zero, before it can be ready for the next analysis. The higher the previous reading the longer the recovery time and so the greater the delay between samples. If there was no glutaraldehyde in the previous sample, the fuel cell sensor will be ready to sample again and the display will show '0.00'

Last Reading ppm	**Typical waiting time between samples**
0.00	No waiting required
0.05	30 seconds
0.10	1 minute
0.15	1.5 minutes
0.20	2.0 minutes
0.30	up to 3 minutes

2.3 Temperature Reading

1. While pressing '**SAMPLE'** button down continuously, click briefly on the **'ON OFF'** button. Release '**SAMPLE'** button.
2. Instrument will display 'HEAt' followed by temperature (e.g. 21.5) alternating with "°C".

Accurate room temperature can only obtained if the temperature inside the instrument is allowed to equilibrate with room temperature for one hour.

2.4 Data Storage

This instrument can recall the last ten readings.

Retrieval of data

1. While pressing **'SAMPLE'** button down continuously, click briefly on the **'ON OFF'** button. Release **'SAMPLE'** button.
2. Instrument will display 'HEAt' followed by ---- (Since no temperature sensor is attached).
3. Whilst instrument is in this mode press both "**CAL**" buttons at the same time and release. The display will show "dAtA" followed by "run 0 " alternating with peak reading of last sample.
4. To read the last but one peak reading, press the "**CAL**" and release.
5. To cycle through the last ten readings press "**CAL**" and do not release. Switch instrument off.

Clearing memory

1. To clear the readings hold down both "**CAL**" buttons while the display runs through "CLr 3", "CLr 2" and "CLr 1"
2. The memory is now cleared of all data.

CHAPTER 3
CALIBRATION CHECKING

3.1 General Information

The sensitivity of the fuel cell sensor decreases very gradually with time. This means it is necessary to check the accuracy of the instrument on a regular basis, so as to determine when **calibration adjustment** is required.

Requirements for calibration checks in the field will depend to some extent on usage, but a check on a daily basis over the first month of a particular application will give an indication as to the frequency of future calibration requirements.

PLEASE READ THIS CHAPTER THOROUGHLY BEFORE ATTEMPTING TO CHECK OR ADJUST THE CALIBRATION OF THE INSTRUMENT. ANY ADJUSTMENT OF THE CALIBRATION CONTROL MUST BE CARRIED OUT IN STRICT COMPLIANCE WITH THESE INSTRUCTIONS.

3.2 The PPM Glutaraldemeter Standard (PPMGS)

Each standard has a capacity for 100 samples or a life of 6 months, and it must not be used after the expiry date.

Calibration adjustment and checking of the instrument must be carried out using the **PPMGS.** This standard consists of a glass tube containing a special absorbent material impregnated with glutaraldehyde. The standard should be stored in a cool place, away from direct heat and sunlight.

In use, the **PPM Glutaraldemeter** is used to draw a sample of this known glutaraldehyde vapour from the PPMGS, directly into the instrument.

3.3 Calibration Check Procedure

PLACE THE INSTRUMENT, THERMOMETER AND CALIBRATION STANDARD IN A ROOM WHERE THE TEMPERATURE IS CONSTANT FOR AT LEAST ONE HOUR BEFORE SAMPLING.

Ensure that the instrument is clear of glutaraldehyde vapour from a previous sample. The instrument should have been left off to accelerate discharge of the fuel cell. This is confirmed by a constant display reading of '0.00' a few seconds after switching on.

1 Place the standard with the thermometer on a work surface. Handle the calibration standard as little as possible holding it by the yellow plastic end caps. Remove **both** end plugs

2 Place the instrument on the work surface and insert the nozzle into the sampling end of the standard (indicated by the black arrow).

3 Press the "**ON**" button then release.

PPM Glutaraldemeter calibration standard

4 Press the "**SAMPLE**" key and wait until the pump stops before detaching the instrument from the calibration standard. Replace both end plugs.

5 Observe the maximum reading displayed (approximately 60 seconds).

6 Note the reading obtained and note the temperature.

7 Refer to the Temperature / Calibration table and if the reading is within +/- 10% of the stated reading on the table then no calibration is required.

Leave the instrument for approx. 3 minutes before commencing another atmospheric analysis or calibration adjustment.

CHAPTER 4
Calibration Adjustment

The instrument should require only minimal adjustment every few weeks or even months.

PLEASE READ THIS SECTION THOROUGHLY BEFORE ATTEMPTING TO ADJUST CALIBRATION. IT IS STRONGLY RECOMMENDED THAT USERS SHOULD FAMILIARISE THEMSELVES WITH THE INSTRUMENT COMPLETELY BEFORE ATTEMPTING TO ADJUST THE CALIBRATION CONTROL.

4.1 Calibration Adjustment Procedure

Place the instrument and the calibration standard in a room where the temperature is constant for at least one hour before calibrating.

1 Read the temperature using the thermometer supplied, and from the lookup table on the calibration tube determine the required reading.
Example: *Temperature 21° C*
Reading of 1.47 ppm

2 Remove plugs from both ends of the calibration standard tube.

3 Place instrument on firm surface e.g. bench/table.

4 Press the ON button and release.

5. Insert the instrument nozzle into the sampling end of calibration standard, (sampling end indicated by black arrow).

6 Depress both **‘⩛CAL⩓’** buttons at the same time and release.

7. The display will show **‘CAL’** followed by the sound of the pump sampling 10 ml from tube.

8 Remove calibration tube and replace yellow end plugs.

9 The display shows the instrument reading rising, and then showing an arbitrary number of “1.75” alternating with “SEt”.

10 Calibrate to the required value by pressing the **‘⩛ CAL’** (down) **or ‘CAL⩓‘** (up) buttons.

11 **To end calibration the ‘SAMPLE’ button must be pressed.** The display will then show “CAL” and “END” .

12 The instrument switches itself off automatically and is now calibrated.

If the instrument has been calibrated on a low sample or clean air and it will not show '0.00' on the display it can be reset. Resetting the instrument will erase calibration and any data held in its memory. To reset press and hold down both ‘**⩛CAL⩓**‘switches and whilst holding these down press the **‘ON OFF’** switch and release all. 'rSEt' will be shown on the display. Switch instrument off. The instrument has now been reset and has default settings in its calibration.

CHAPTER 5
ROUTINE FIELD SERVICE CHECKS

5.1 Battery Replacement

If, when the instrument is switched on "BAt" appears on the display then the battery is low in voltage and should be replaced before further use of the instrument.

Means flat battery

Replacement batteries are 9 volt dry cell (PP3, MN1604, 6LR61); alkaline type is recommended. Access to the battery is obtained by unscrewing the two battery compartment screws located at the bottom rear of the instrument. When replacing the battery be sure to separate the contacts carefully and to ensure that the replacement battery is securely connected before returning to its compartment inside the instrument.

The user must not attempt to open the instrument other than to gain access to the battery. Any evidence of tampering with the instrument will automatically make the guarantee void.

5.2 Cleaning

1. In order to prevent soiling or damage to the instrument, the **PPM Glutaraldemeter®3** should be stored in its protective carrying case at all times when not in use.

2. If, due to liquid splashing or any dust deposit, it is necessary to clean the exterior surface of the instrument, this should be carried out very carefully and gently, using a soft dry (or lightly dampened) cloth. Under no circumstances should any solvents be used.

CHAPTER 6
TECHNICAL INFORMATION

6.1 Principle of Operation

When air is drawn into the fuel cell, by means of the aspirating sampling system, a small voltage is generated in direct proportion to the glutaraldehyde vapour concentration. time. When the fuel cell reaches the end of its life, it is replaced, the whole unit being returned to the distributor for fuel cell replacement.

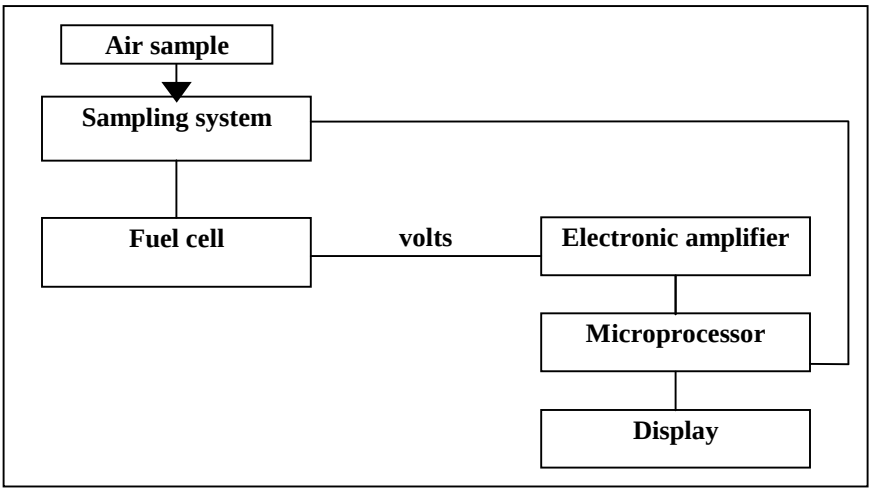
The electrical signal from the fuel cell sensor is amplified and converted precisely for processing by the internal computer circuitry. Glutaraldehyde concentration is displayed in parts per million . Fuel cell recovery is indicated by the display reading '- - - -'. It is possible to access the 'time to peak' value both for the sample under test and the most recent calibration.

The power source for the instrument is a 9 volt battery which will provide at least 300 separate test measurement. To preserve battery life, the instrument will switch itself OFF automatically. When the battery discharges to a point where replacement is necessary, the display flashes 'BAt'. If the instrument is powered OFF, the fuel cell is short- circuited in order to hasten the recovery from previous test and boost its life span.

The PPM Glutaraldemeter® 3 uses an electrochemical fuel cell, comprising two metal electrodes and a suitable electrolyte which detects and measures the concentration of glutaraldehyde vapour in the air samples. When air is drawn into this fuel cell by means of the sampling system, a small voltage is generated, which is directly proportional in magnitude to the glutaraldehyde vapour concentration. The electronic circuitry consists of a precision amplifier under microprocessor control. Data is acquired, formatted

and presented on the LCD display. The low power design maximises the battery life. Reliability and quality are ensured by use of modern surface mount production technology. This voltage is fed to an electronic amplifier and displayed on a digital meter (liquid crystal) calibrated directly in glutaraldehyde vapour concentration units.

All the electronic systems are based on modern, integrated circuitry and are robust and reliable.



The instrument is simple to operate and may be used as often as required, provided that a suitable delay is allowed between successive tests.

This time delay allows the fuel cell to clear itself of glutaraldehyde from the first sample and so prevents the possibility of additive readings. If no glutaraldehyde is present in the first sample then the instrument may be used again immediately, since the fuel cell voltage is already at zero.

If instrument shows '0.00' then it is ready for use.

6.2 Glutaraldehyde Vapour Concentration Units

The instrument is designed and calibrated to read glutaraldehyde concentration in units of 'parts per million' (ppm). 1.0 ppm is defined as one unit volume of glutaraldehyde vapour in one million unit volumes of air, i.e. 1 microlitre of glutaraldehyde in 1 litre of air.

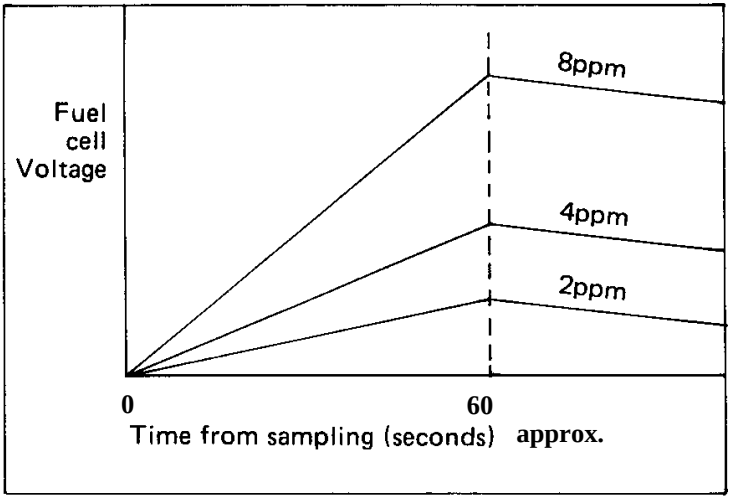
6.3 The Sampling System

To determine glutaraldehyde level in the air, the operator holds the unit with the sampling port in the atmosphere to be analysed and depresses SAMPLE switch. This activates the pump, which draws in 10 ml of air through the sampling port and over one of the electrodes.

6.4 The Fuel Cell Detector

Immediately, the air sample is introduced into the fuel cell, any glutaraldehyde present is oxidised on a platinum electrode and a potential is developed which is a measure of the glutaraldehyde concentration of the sample. The higher the glutaraldehyde concentration, the higher the voltage. The time taken by the cell to charge this maximum voltage is generally around 60 seconds, so it is essential to allow at least this period of time for the reading to develop on the display after the sample has been taken. The time taken for the fuel cell to reach its maximum voltage is independent of the glutaraldehyde concentration of the sample.

The maximum voltage attained by the fuel cell is held on the display until the instrument is switched off or until the instrument switches itself off.



Since the fuel cell sensitivity will vary slightly with time, the calibration should be checked regularly. The fuel cell is guaranteed for 1 year.

6.5 Technical Specification Summary

Sensor
Electrochemical fuel cell. Guaranteed for 1 year under normal working conditions.

Calibration
Glutaraldehyde-absorbent standard (sealed unit)

Display
3 Digit LCD

Sampling rate
Dependent on previous reading (0 - 10 minutes)

Sample volume:
$10cm^3$

Detection range:
0.03- 4 ppm

Precision:
10% at critical 0.20 ppm

Response time:
Approximately 60 seconds from sampling glutaraldehyde

Battery life:
300 field tests (approx). PP3size alkaline battery

Weight:
Instrument 280g
Complete kit 750g

Dimensions:

Instrument

150 x 80 x 34mm

Carrying case

266 x 230 x 50mm

Kit contents:

1 instrument including battery
1 calibration standard
1 handbook
1 thermometer
1 vial containing 10 phenol filters
1 pen
1 certificate of calibration

Accessories:

Calibration standards
Phenol filters

6.6 External validation.

Extract from summary of independent Validation by Inveresk Research International LTD Scotland.

The Glutaraldemeter was found to be light, compact and easy to use. Individual measurements using the meter were undertaken in less than one minute, and at a level of 0.1 ppm glutaraldehyde (determined using the amended MBTH method)mean readings of 0.11, 0.10 and 0.12 glutaraldehyde were obtained from 3 individual meters showing good agreement with the chemically measured concentration.

Meter readings, Glutaraldehyde stream concentration determined at 0.100 ppm by MBTH method.

Meter	1	2	3	4	5	6	Mean	Coeff. of var
01	0.11	0.12	0.11	0.10	0.11	0.12	0.11	6.7
05	0.10	0.1	0.1	0.11	0.12	0.12	0.11	9.1
09	0.12	0.13	0.12	0.12	0.12	0.13	0.12	4.2

Calibration Standards: Calibration performance

Meter	1	2	3	4	5	Mean	Coeff. of var.
01	0.54	0.51	0.48	0.51	0.45	0.5	6.9
05	0.59	0.57	0.54	0.60	0.52	0.56	6.0
09	0.56	0.54	0.50	0.60	0.55	0.55	6.6

CHAPTER 7
SOME DO'S AND DON'TS

- Never calibrate or check calibration using an expired Calibration Standard.

- Never expose the instrument to a heat source.

Before use, check that when switched **'ON'** a display is registered in the display window. This should normally indicate: -

a) '0.00' ready to use
b) '- - -' fuel cell recovering
c) 'BAt' low voltage indication.

- Do not allow fluids of any type to enter or contact the sampling probe.

- Remove batteries during long periods of unuse.

- When it is necessary to replace the battery, ensure that the instrument is switched **'OFF'**.

- Ensure that the **PPM Glutaraldemeter standard and instrument** are kept at ambient temperature for at least 60 minutes before carrying out calibration and/or adjustment check procedures.

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