Palintest ChloroSense Kit

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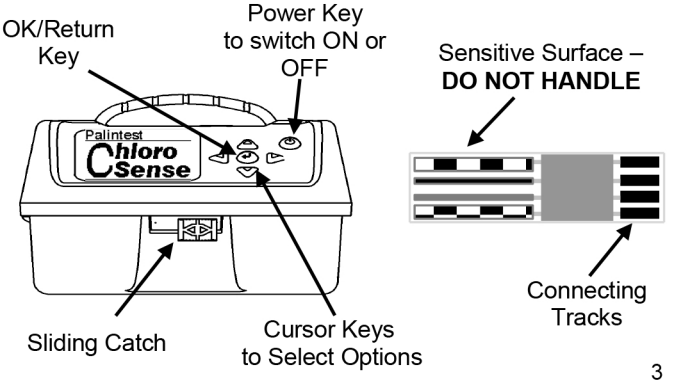
INTRODUCTION

The Palintest ChloroSense is a precision instrument used with unique pre-calibrated disposable sensors*. It offers a simple, rapid, reagent-free method of analysing water for chlorine, removing almost all sources of technique dependence.

The instrument is lightweight and portable for field or laboratory use. It is extremely simple to use, with a large, clear, backlit results display. In 'Analysis' mode, all settings are locked, and the display prompts guide the user through the test. Once linked to a PC through the USB interface, a stored log of up to 500 tests may be accessed, and the instrument option settings may be edited.

* patent applied for

Diagram of Instrument and Sensor



The sensor is designed for single use only. The surface of the sensor is highly sensitive. It should be handled by the edges or through the foil packaging only.

Kit Contents

ChloroSense Instrument
Sensor Pack (x100 Sensors)
Instructions
Sample Bottle
Sensor Carrying Box

INSTRUMENT OPERATION

The ChloroSense has three operating modes, the ANALYSIS mode, the SET-UP mode and the TEST mode.

The instrument automatically engages SET-UP mode when connected to a PC, and ANALYSIS mode when battery powered and not connected to a PC.

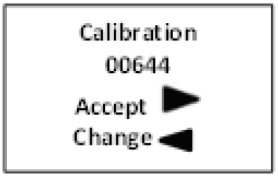
To access the TEST mode, see the calibration check standards instructions.

ANALYSIS Mode – for Testing Water Samples

Start-Up

1 Press and hold the power button ⏻ until the title screen is displayed.

Ensure the calibration code shown on screen matches with the number on the foil of the batch of sensors in use.



To accept the calibration, press the ▶ button.

To change the calibration, press the ◀ button.

(See Entry of New Calibration Code - Page 9).

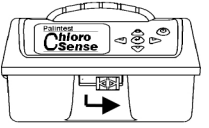
3 When the instrument passes all internal functional checks on start up, the screen displays the current batch code and prompts the user to insert a sensor.

```
00644
Insert Test
Sensor
```

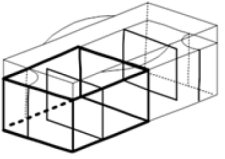
If start up fails, an error message is displayed.

Performing a Test (Analysis Mode)

1 Slide the front catch to the right, and open the instrument case fully.

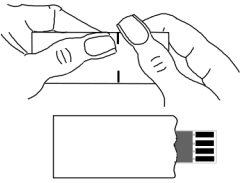


2 Remove the sample container. Rinse and then fill **one half** to the stepped line with the water sample.

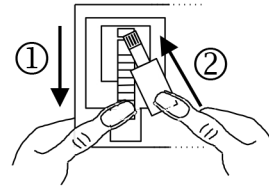


3 Replace the filled sample container in the instrument.

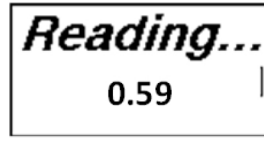
4 Tear open the foil along the pre-cut marks, in the manner shown. Holding the sensor through the foil pack, expose the connecting tracks.



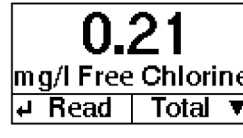
5 Press the blue lever to open the jaws of the sensor connector. Insert the exposed end of the sensor, connecting tracks uppermost, into the slot, and release the lever. The jaws will close to hold the sensor in place. Slide the foil pouch off to expose the sensor.



6 **Gently** close the instrument lid to immerse the sensor in the sample. The test starts automatically. The display indicates progress of the test. ***Do not disturb the instrument during the test.***



7 The Free Chlorine result will be displayed. Press the down arrow to scroll through Free Chlorine, Total Chlorine, Temperature, Date and Time and Sample Number. All results are automatically stored to the instrument log.



8 After completion of the test, open the instrument and press the blue lever to remove the used sensor.

Empty and rinse the sample container. ***Do not leave water within the instrument on completion of the test.***

9 Press ↵ key to carry out a new test.

If no key is pressed for five minutes, the instrument automatically switches off to save power.

10 To recall the last reading to the screen, press the ↵ key from the 'Insert Sensor' screen.

Getting the Best Results

1 Handle the sensors with care.

2 Place the instrument on a flat surface free from vibration.

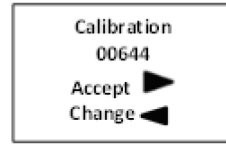
3 Do not disturb the instrument or sample during the test.

4 The sensor response compensates for sample temperature in the range 2 – 35° C (35 – 95° F). The precision of sensor response is enhanced at low temperature.

5 Store the sensors at a temperature of less than 20° C.

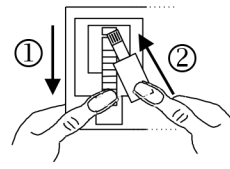
Entry of New Calibration Code

1 On start up, change the calibration using the ◀ button.

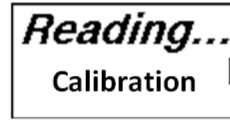


Slide the front catch to the right, and open the instrument case fully.

2 Press the blue lever, and insert the contacts of the calibration chip fully into the slot revealed. Release the blue lever.

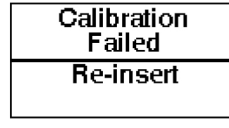


3 Close the instrument lid and view the display. Check the new code number displayed on screen matches the number on the sensor packaging. A test can now be performed.



4 If the calibration procedure was unsuccessful, an error message will be displayed.

Do not remove the calibration chip. Just open and close the lid again to repeat the calibration.



5 Remove the calibration chip.

Error Messages

The ChloroSense features an error detection system to guide the user. After correcting each error, press ↵ key to reset the instrument. Always use a fresh portion of sample if a sensor has been immersed in the water sample :-

Error	Action
Unable to read: Check sensor and contacts	1 Remove sensor, dry the contacts (see overleaf). 2 Remove calibration chip.
Unable to read: Sensor not responding	Press ↵ key and use Palintest check standards (CS 180).
Unable to read: Faulty Sensor	Remove and discard the sensor. Dry the contacts (see overleaf). Press ↵ key and start again with fresh sample and sensor.
Lid opened during test	Remove the sensor. Press ↵ key and start again with fresh sample and sensor.
Sample not level during test	Remove the sensor. Press ↵ key and start again with fresh sample and sensor.

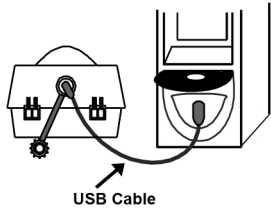
The instrument is fitted with integral electrical connectors for insertion of the sensors. If the contacts accidentally become wet, open the jaws with the blue lever and insert a dry tissue or Palintest Contact Drying Stick (CS 160). Wait a few seconds until it absorbs the water, then remove and insert the opposite end to check the contacts are dry. A dry 'Contact Drying Stick' may also be used to clean the contacts.

Adjusting Optional Settings and Data Handling (Set-Up Mode)

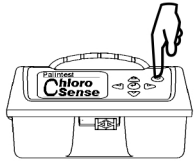
The ChloroSense is designed for simplicity of use in the field. The user selectable options are only accessed when linked to the PC. Once selections have been made, these are stored in memory, and applied to each reading. A group of instruments can be coordinated, and the settings cannot be changed accidentally, or without supervisor intervention.

Enter SET-UP Mode

1 To engage SET-UP mode, connect the instrument to a PC via the USB port using USB cable PT 747 or equivalent.



2 Press and hold the power on/off button.



3 Scroll through the menu of options using the △ ▽ keys, and press ↵ to select.

Selectable Options

Language

Press ↵ to show the available languages. Scroll △ ▽ to highlight the required language. Press ↵ to select and return to the options list.

Clear Log

Press ↵ to select. Use ◁ ▷ keys to highlight [**Yes**] or [**No**].

Press ↵ to perform the action and return to the options list.

Reset Sample

Press ↵ to select reset of sample number to 1. Use ◁ ▷ keys to highlight [Yes] or [No].

Press ↵ to perform the action and return to the options list.

Set Time

Press ↵ to edit the displayed time. Use △ ▽ keys to increment/decrement the highlighted number. Use the ◁ ▷ keys to move the highlight to different numbers.

Press ↵ to accept the new time and return to the options list.

Set Date

Press ↵ to edit the displayed date. Use the △ ▽ keys to increment/ decrement the highlighted number. Use the ◁ ▷ keys to move the highlight to different numbers.

Press ↵ to accept the new date and return to the options list.

Date Format

Press ↵ to select UK or US date format. Use the △ ▽ keys to highlight either DD/MM/YYYY or MM/DD/YYYY.

Press ↵ to select and return to options list.

Temperature Format

Press ↵ to select the temperature scale for logged results. Use the △ ▽ keys to highlight °C or °F.

Press ↵ to select and return to the options list.

Serial Number

Press ↵ to view the instrument serial number.

Press ↵ to return to the options list.

COMPUTER INTERFACE

The ChloroSense USB port, once connected to a PC, can be used to access data stored in the instrument log, or to up-grade the instrument software.

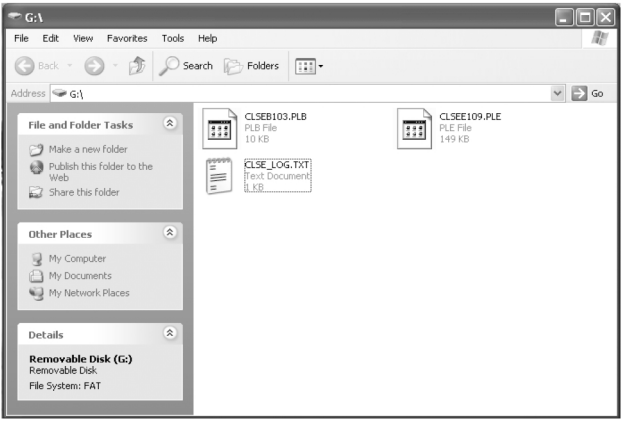
When the ChloroSense is connected to a PC, it behaves like a removable hard drive or USB memory stick.

Data Access

1 Connect the ChloroSense to a PC using the USB cable.

2 Press and hold the ⏻ key until the title screen appears then release.

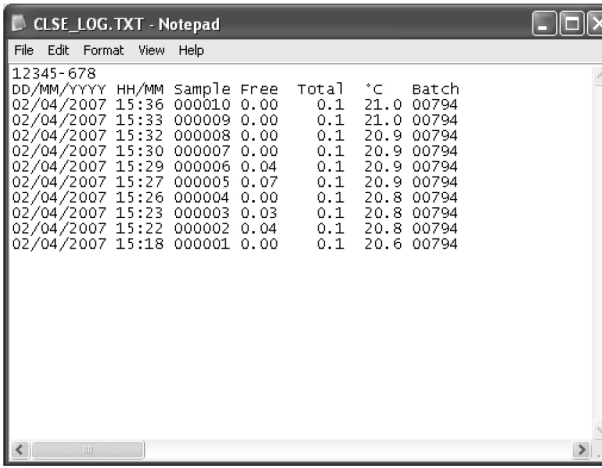
3 On the PC, open the hard drive window. Three files will be seen :-



4 Results are stored in the Log file, CLSE_LOG.TXT.

5 Copy the file to the PC to view and handle the data.

6 Open this file. Results appear as a text file. Each result appears on one line with spacing to allow easy opening in a spreadsheet program :-



7 To delete the results from the instrument memory, delete the log file on the hard drive window or from the instrument memory.

8 Note that for security of the audit trail, it is not possible to save files to the log file stored in the instrument.

Software Upgrade

When new software is made available by Palintest, the ChloroSense may be upgraded. Files will be available by e-mail or on the Palintest website.

1 Connect the ChloroSense to a PC using the USB cable.

2 Press and hold the  key until the title screen appears. Release the  key.

3 On the PC, open the hard drive window.

4 Drag and drop the software upgrade (PLE.) file onto the hard drive window.

5 The new software will be programmed into the ChloroSense. The instrument will re-start to run the new software.

6 When upgrading the PLE. file, the instrument should be turned off and then back on again in order for the new software to take effect.

7 Any logged data will be retained during this upgrade.

TECHNICAL INFORMATION

Operating Principle

The ChloroSense uses the electrochemical technique known as chronoamperometry. Chronoamperometry involves applying a fixed voltage to a working electrode and recording the resulting current-time dependence. The magnitude of the current is directly proportional to the concentration of chlorine in the test sample.

ChloroSense sensors have two working electrodes, one that measures free chlorine and one that measures total chlorine. The voltage has been selected so that free and total chlorine can be measured simultaneously.

Once the sensor is inserted, the analysis is fully automatic and operator independent. The ChloroSense precisely controls the sensor cycle, and captures and collates thousands of signal readings. The processor interprets these readings to identify free and total chlorine, and determines the exact concentration. The instrument display gives a direct reading of the test result in mg/l.

No user calibration is required, because each sensor batch is assigned a 60 digit calibration code during manufacture. This code is used to construct a calibration curve that exactly matches the sensor batch. A pre-programmed, plug-in calibration chip is provided with each pack of sensors to automatically enter the calibration code into the instrument.

System Performance Characteristics

	FREE CHLORINE	TOTAL CHLORINE	TEMPERATURE
Analysis Time	< 1 minute	< 1 minute	< 1 minute
Precision Range	0.02 – 10.0 mg/l	0.05 – 75 mg/l	0 – 100°C*
Resolution	0.01 up to 1.0 mg/l 0.1 mg/l thereafter	0.02 up to 1 mg/l 0.1 from 1 – 20 mg/l 1 mg/l thereafter	0.1°C
Precision @ 12°C	5% CV @ 1.00mg/l	5% CV @ 10mg/l	0.5°C
Indicative Range	N/A	75 – 100 mg/l	N/A
Sample Temperature	2 – 35°C	2 – 35°C	N/A

Limit of Detection

The method detection limit (MDL) for a test is important because it determines whether a measurement is different from zero. It can be difficult to determine and experts disagree about its definition.

It is recognised that the MDL is not fixed; it varies for each batch, instrument, analyst, sample type, etc. Therefore, a published MDL is a useful guide, but is only accurate in a specific set of circumstances.

Regulatory bodies have produced varying methods for determining the MDL and two are quoted here :-

1) UK Drinking Water Inspectorate (UK DWI) –

The UK DWI method defines the MDL as the concentration for which there is a high probability that the determinand has been detected. From the properties of the normal distribution and at the 95% confidence level the MDL is given by 4.66 x σ_w, where σ_w is the within batch standard deviation of single blank determinations (in concentration units).

A number of tests (n = 10) were carried out on a blank solution, the responses were recorded and the standard deviation of the responses was calculated. The MDL was then determined.

2) US Environmental Protection Agency (USEPA) –

The result obtained by this method give the calculated lowest average concentration in a standard water matrix that is different from zero with a 99% level of confidence. Specifically, it is the upper 99% confidence limit for zero concentration based on the calibration data used to prepare the pre-programmed calibration curve.

The USEPA method of determining the MDL is based on replicate tests at a concentration 1 to 5 times the estimated detection limit. The MDL is calculated from the standard deviation of a number of replicate tests multiplied by the appropriate student's 't' value for a 99% confidence interval, if n = 7 tests, the 't' value would be 3.14.

The Palintest Research Laboratory have tested the instrument with both methods and have found that :-

DWI Method:

MDL (Free) = 0.05 mg/l
MDL (Total) = 0.05 mg/l

USEPA Method:

MDL (Free) = 0.04 mg/l
MDL (Total) = 0.05 mg/l

Ref 1: Manual on Analytical Quality Control for the Water Industry. R V Cheeseman & A L Wilson (January 1978).

Ref 2: The Code of Federal Regulations (40 CFR, Part 136, Appendix B).

GENERAL INFORMATION

Technical Specification – Instrument

Instrument Type	Fixed voltage potentiostat
Display	Backlit, graphical LCD (42 x 22 mm), with five language options and direct-reading of results in mg/l
User Selectable Options	Set time and date, date format, display language, reset sample number and temperature units
Data Logging	Stores 500 previous readings and offers prompts when 20 left
Interface	Waterproof USB connection to PC
Power	4 x 1.5v 'AA' alkaline batteries. Battery power saving system with auto switch-off after 5 minutes. Powered via USB port when connected to computer
Size	Instrument only 170 x 126 x 116 mm
Weight	975g

Technical Specification – Sensors

Sensor Type	Disposable, single-use, chrono amperemetric sensor
Calibration	Pre-calibrated during manufacture
Packaging	Individually packed in sealed foil
Storage Life	Two years
Storage Temp	2° C – 20° C (35° F – 68° F)

Calibration Check Standards

Traditional surrogate check standards based on permanganate or iodate are not suitable for use on the ChloroSense.

Real chlorine standards may be produced from calcium hypochlorite.

Certified electronic standards may be obtained from Palintest Ltd in the Chlorine Check Standards Kit (CS 180).

Power Supply

The ChloroSense is designed to operate on alkaline batteries. The instrument features an automatic battery condition check as part of the analysis cycle. If the batteries require replacement a 'Low Battery' warning message appears. The message can be cleared by pressing ↵ .

The instrument continues to function correctly for several tests, but the batteries should be replaced as soon as possible. When the power supplied by the batteries is insufficient to carry out a test, the instrument displays the warning message continually and will not carry out a test.

The battery compartment, in the base of the instrument, is secured by four screws. To replace the batteries, remove the cover, pull out the battery pack and remove the old batteries. Replace all four batteries at once with fresh batteries, observing the correct polarity as marked in the battery holder.

Insert the battery pack in the base of the instrument, replace the battery compartment cover. Tighten the screws in diagonal pairs to ensure waterproof fit.

Use 4 x 1.5v 'AA' alkaline cells (type MN1500, LR6, E91 and AM3 or equivalent).

To avoid corrosion damage through leakage, remove batteries from the instrument if it is to be stored or left unused for a long period of time.

CARE AND MAINTENANCE

The ChloroSense is designed to give long and trouble-free operation. The instrument is suitable for both laboratory and field use.

On no account should solvents or abrasive materials be used to clean the instrument.

Guarantee

The Palintest ChloroSense is guaranteed for a period of two years from the date of purchase, excluding accidental damage or damage caused by unauthorised repair or misuse. Should repair be necessary, contact our Technical Services Department quoting the serial number shown on the instrument label. This guarantee does not affect statutory rights.

REORDERING INFORMATION

Part Number	Description
CS 100	ChloroSense Instrument with Pack of 100 Sensors and Calibration Chip
CS 110	Pack of 100 Replacement ChloroSense Sensors with Calibration Chip
CS 150	Pack of 500 Replacement ChloroSense Sensors with Calibration Chip
CS 160	Pack of 20 Contact Drying Sticks
PT 747	USB Data Cable
CS 180	Chlorine Check Standards Kit
PT 677	Screwdriver (for Battery Compartment)
PT 540	Sample Vessel