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User Manual

DW-HM-5000P

Multi-Function Portable Heavy Metal Analyzer

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Chapter 1 General Information

1.1 Introduction

Chongqing Drawell Instrument Company is a high-tech enterprise with independent intellectual properties, with its head office located on the scenic Yangcheng Lake of Kunshan, specializing in the development, manufacture and sales of analytical and testing instruments in Spectroscopy, Chromatography and MS fields. Our mission is to research, develop, manufacture and supply high-quality products and services. We are providing perfect solutions to electronics, electric appliances, jewelries, toys, food, construction material, metallurgy, minerals, plastic, petroleum, chemistry, medicine and other industries, with more advanced products and more satisfied services.

HM-5000P, Multi-Function Portable Heavy Metal Analyzer for water quality is the latest, second-generation and upgrade production of Drawell. It is based on Anodic Stripping Voltammetry method (ASV) and Colorimetry, which are separately recognized by the authority agency and National Standard. It sets the advantages of Anodic Stripping Voltammetry method (ASV) and Colorimetry, such as high sensitivity, wide detection range and fast, good anti-interference. In U.S. Anodic Stripping Voltammetry method (ASV) has been classified as standard testing method by the authority of EPA, such as EPA7063 and 7472 and others; The Colorimetry for heavy metal test is also has a number of national standards and wide application. HM-5000P can be used for environmental emergency detection, tap water testing, wastewater testing of electroplating and surface treatment industry and wastewater monitoring of food, pharmaceutical, hospital, etc.

1.2 Applications

HM-5000P is designed for field determination of heavy metals, and also can be used for water analysis in labs. It can detect multiple metals, such as Cu, Cd, Pb, Zn, Hg, As, etc.

1.3 Advantages

It combines the advantages of both methods, faster and more accurate than traditional method. The key features are:

High accuracy: up to 0.01ppb

Low detection limits: as low as 0.5~1ppb

Quick results: Only few minutes are required for measurement preparations, and the analysis takes just tens of seconds. The metals can be detected include Bi, Fe, I, Cd, Mn ,Cu, As, Ni, Sn, Hg, Pb, Cr, Zn, Co, Ti, and Sb

Good Anti-interference: Not affected by Na, K, NaO or other metals in the first and second group of periodic table.

Programmed methods supported: The analyzer can detect tens of metal ions among which ten applications are available from Drawell Instrument and more new applications are supported to be developed as needed. Colorimetry is used to test industrial wastewater with the complex composition.

Low Cost: low cost to run. Small amount of operations and fewer consumables are required. Part of consumables can be prepared yourself if condition permits.

Field Analysis: Full portable and can be powered by internal battery with outcomes displayed on the LCD screen.

Liquid Analysis: Simple and easy to operate. Extensively used for monitoring of drinking water, water sources, beverages and environmental water.

Chapter 2 Structures and Principles

2.1 Overview

Figure 1 HM-5000P and electrode detection devices

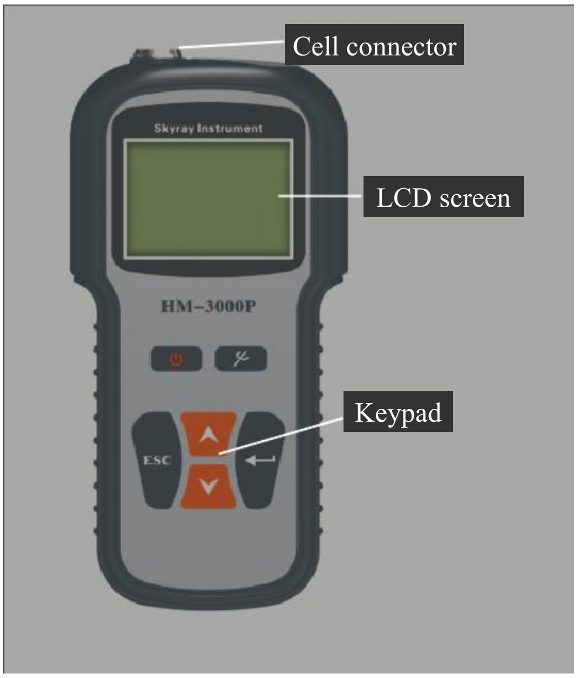


Figure 2 HM-5000P handheld Host

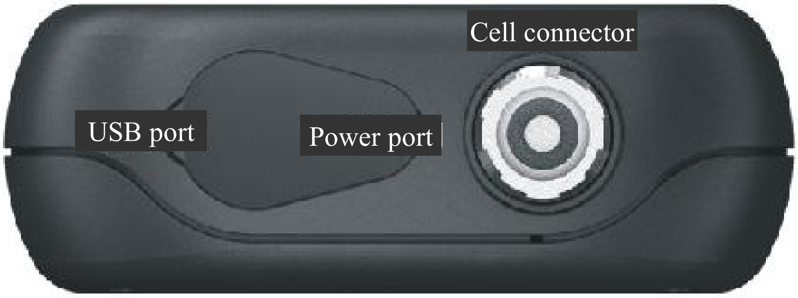


Figure 3 Top view of handheld Host

Figure 4 Electrode detection devices

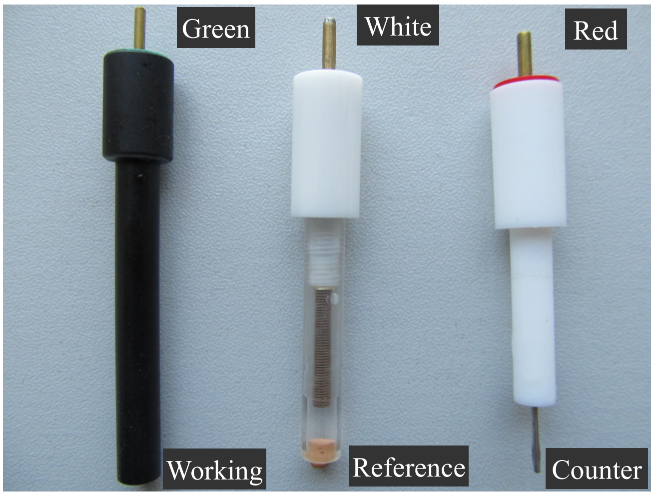


Figure 5 Electrodes

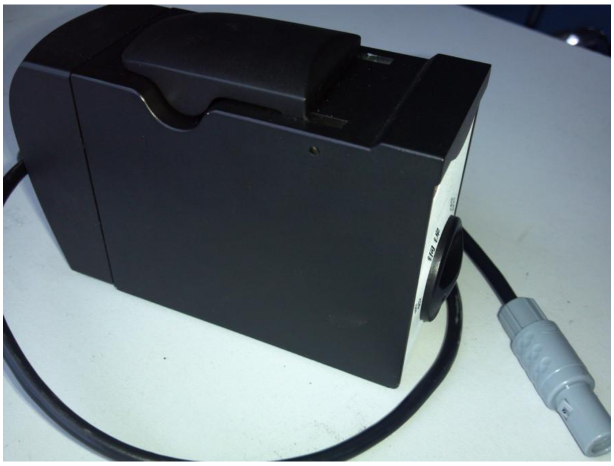


Figure 6 colorimetric device

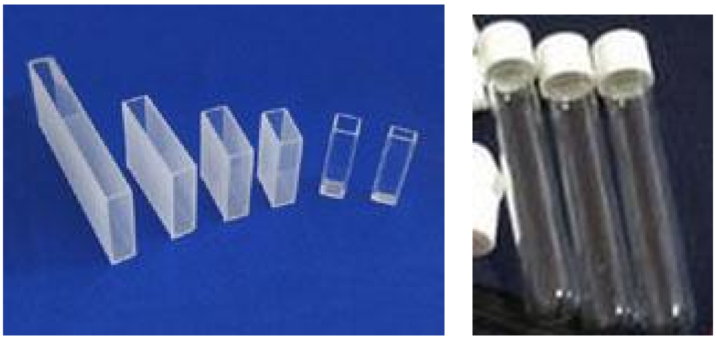


Figure 7 Cuvette/ colorimetric tubes

2.2 Working Principle

Colorimetry:

All kinds of metal ions and corresponding colorimetric reagent show chromogenic reaction in the appropriate circumstances, measuring the metal ions' absorbance in a LED light with specific wavelength, and the absorbance is proportional to the ion concentration. To calculate the concentration of unknown sample through measuring the absorbance of blank sample, standard sample and unknown sample.

Anodic Stripping Voltammetry method (ASV):

The principal used by the HM-5000P analyzer is Anodic Stripping Voltammetry (ASV), which is a simple procedure. A reducing potential is applied to the working electrode. When the electrode potential exceeds the ionization potential of the analyte metal ion in solution (Mn+), it is reduced to the metal which plates onto the working electrode surface as follows.

$$M^{n+} + ne^{-} \rightarrow M$$

The longer the potential is applied, the more metal is reduced and plated onto the electrode surface (also known as the "deposition" or "accumulation" step). When sufficient metal has been plated onto the working electrode, the metal is stripped (oxidized) off the electrode by increasing, at a certain rate, the potential applied to the working electrode. For a given electrolyte solution and electrode, each metal has a specific potential at which the oxidation reaction will occur.

$$M \rightarrow M^{n+} + ne^{-}$$

The electrons released by this process form a current, which is measured and may be plotted as a function of applied potential to give a "voltammogram". As the quantity of each metal is proportional to the peak height or area, the metal concentration can be calculated.

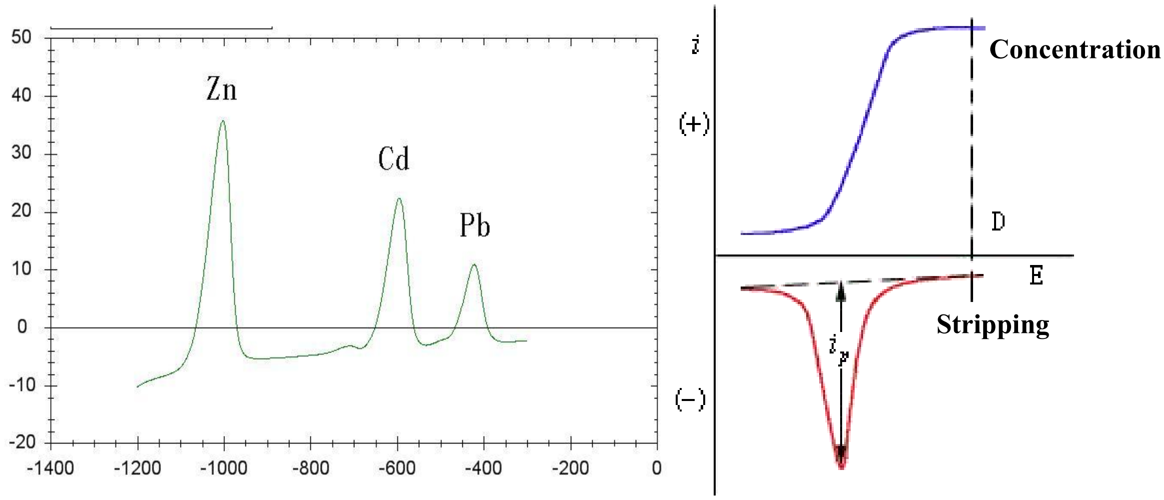


Figure 6 Voltammogram for Zn, Cd and Pb and schematic diagram

2.3 Components

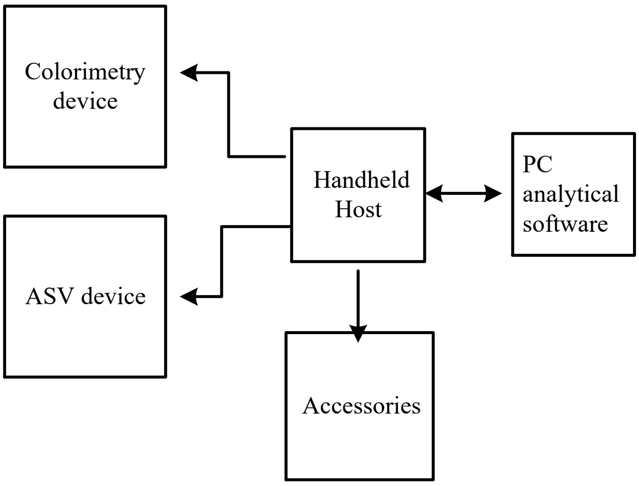


Figure 7 HM-5000P System Configuration

The analyzer consists of handheld Host, detection system, accessories and PC analytical software, the detection system includes Colorimetry device and ASV device. It employs handheld Host as the core unit, detection system, including cell assembly and cell stand, as the measurement site, and pipette, electrode cleaning kit, electrolyte, standard solution, plating solution as well as other devices as auxiliaries. What's more, linked to the computer running the analytical software via USB, the analyzer can achieve more advanced measurement, data management, spectra analysis and so on.

Chapter 3 Specifications and Performances

3.1 Standard Configurations

Items		Configurations
1	Glassy carbon electrode	made of glassy carbon, 5mm substrate, 3mm diameter, smooth surface without scratches, used for plating
2	Glassy carbon electrode (optional)	made of glassy carbon, 5mm substrate, 3mm diameter, smooth surface without scratches
3	Gold electrode	High-purity gold, 5mm substrate, 3mm diameter, smooth surface without scratches
4	Reference electrode	Ag/AgCl reference electrode
5	Auxiliary electrode	Pt counter electrode
6	Handheld Host	Monochrome LCD screen, 6 action buttons
7	Detection system	POM/ABS，spray and corrosion prevention processed surface
8	Analysis cups	disposable, 30mL, made of PP (polypropylene)
9	Electrode cleaning Kit	polishing pad + polishing liquid kit, 1 set
10	Micropipette	Range: 10-100μL
11	Micropipette	Range: 1000-5000μL
12	Power adapter	100~240V AC, 50/60Hz, Output DC 12V/1A
13	Car cigarette lighter adapter	DC12V/24V
14	Electroplating solution	Liquid mercury, liquid chrome (optional)
15	Standards	Metal standard solutions
16	Electrolyte buffer	Cu/Cd/Pb/Zn buffer, Hg buffer, As buffer and others
17	PC connecting cable	USB cable
18	Portable suitcase	anti-shock and waterproof lockable carry case
19	PC application software	1×CD-ROM
20	Colorimetric Reagent	Reagents used for colorimetric reaction
21	Colorimetric device	The surface Plastic-sprayed and anticorrosive processing, mechanical rotating to switch light source
22	Polarizing voltage range:	-2 V ~2V
23	Sweep rate range:	0.001V/s~0. 8V/s
24	Current range:	0.01μA～ 25000μA
25	Mass concentration range (Cd^{2+})	0. 1 μg/dm^3～40000μg/dm^3
26	Detection limit (Cd^{2+})	0. 05 μg/dm^3
27	Analyzer Load	Periodic use of device during working day
28	Accuracy(relative error)	Not more than 10%

3.2 Technical Data

No.	Item	Technical Data
1	Analysis elements	More than ten Metals: Bi, Fe, I, Cd, Mn ,Cu, As, Ni, Sn, Hg, Pb, Cr, Zn, Co, Ti, and Sb
2	Measurement range	**ASV :** Cu：0.1 ppb ～ 30 ppm；Cd：0.1 ppb ～ 40 ppm ； Pb：0.1 ppb ～ 45 ppm；Zn：0.1 ppb ～ 40 ppm； Hg：0.1 ppb ～ 6 ppm；As：1 ppb ～ 20 ppm； Tl：0.1 ppb ～ 40 ppm；Mn：1 ppb ～ 6 ppm； Cr：5 ppb ～ 20 ppm；Ni：5 ppb ～ 2 ppm； Fe：5 ppb ～ 2 ppm； Co：5 ppb ～ 2 ppm； Sb：5 ppb ～ 40 ppm；Bi:0.1 ppb ～ 45 ppm I: 5 ppb ～ 40 ppm； Sn: 5 ppb ～ 40 ppm **Colorimetry:** Cu：0.025 ppm ～ 5 ppm； Cr：0.025 ppm ～ 2.5 ppm； Ni：0.1 ppm ～ 5 ppm； Pb：0.05 ppm ～1.2 ppm； Zn ：0.1 ppm ～1.5ppm；
3	Indication error	≤±10%（standard）
4	Reproducibility	≤5%
5	Resolution	0.01ppb
6	Detection limits	0.05ppb
7	Calibration	Standard comparison
8	Fastest detection time	30 seconds and only few minutes for preparation
9	Communications	USB
10	Battery life after each charge	≥100 times of continual measurement
11	Storage	Support up to 2000 pieces of measurement data
12	Specific analytical Software	Linking the analyzer to a PC running the analytical software via USB enables the user to manage and analyze the data.
13	Weight	≤10kg
14	Measuring Cell	Three-electrode cell
15	Thanone	2 Thanone
16	Salt Bridge	Availability of salt Bridge

17	Cell volume	21mL

3.3 Electrical Data

Power Supply	● Power adapter：Input 100~240V AC 50/60Hz, Output 12V DC 1A ● 2500mAh li-ion battery ● Car Cigarette Lighter Adapter
Ambient	Temperature 5～45℃, Humidity 10%～90% RH
Atmospheric Pressure	86~106kPa

Chapter 4 Installation and Connection

4.1 Installation Requirements

(Multi-Function) portable heavy metal analyzer software is a Windows software application, which runs on a personal computer giving the instrument greater analysis capability for the accurate determination of metal ion types and concentrations. To use the whole HM-5000P system, a USB cable must be connected to the instrument and the computer before HM-5000P analyzer is switched on.

4.2 Unpacking

Standard Configuration:

No.	Item	Remarks
1	**Instrument**	
1.1	Handheld Host	1
1.2	HM-3000P analytical software (CD-ROM) （shared by HM-3000P and HM-5000P instrument）	1
2	**Accessories**	
2.1	Glassy carbon electrode ()	1
2.2	Gold electrode	1
2.3	Ag/AgCl reference electrode	1
2.4	Platinum counter electrode	1
2.5	Analytical cell assembly (complete with integral stirrer and connecting cable)	1suit
2.6	10~100 µL accurate pipette	1
2.7	1~5 mL accurate pipette	1
2.8	User manual	1
2.9	12V/24V car cigarette lighter adapter	1
2.10	Built-in 7.4V/2500mAh Lithium battery	1
2.11	12V/1W DC power adapter	1
2.12	USB cable (connect instrument with computer)	1
2.13	Carry case	1
2.14	Analytical cell stand	1 suit
2.15	Colorimetric tubes rack	1
2.16	Colorimetric tubes	5
2.17	Cuvettes	4
2.18	Bottle-washer	1
2.19	Rod box	1
3	**Consumables**	
3.1	Electrode clean suit (comprising polishing fluid and polishing cloth)	1 suit
3.2	Disposable analysis cups	1000

3.3	1~5mL pipet tips	300
3.4	10~100μL pipet tips	300
4	**Reagents of ASV**	
4.1	Zn standard solution	1 pack (5 bottles)
4.2	Cu ,Cd, Pb standard solution	1 pack (5 bottles)
4.3	Hg standard solution	1 pack (5 bottles)
4.4	Trivalent As standard solution	1 pack (5 bottles)
4.5	CCLZ electrolyte	6 bottles
4.6	Hg electrolyte	3 bottles
4.7	Total As electrolyte	3 bottles
4.8	As additives	1 pack (5 bottles)
4.9	Conditioning solution A	1 pack (5 bottles)
4.10	Conditioning solution B	1 pack (5 bottles)
4.11	Hg plating solution	1 pack (5 bottles)
4.12	Reference electrode soak solution	1 pack (5 bottles)
4.13	Zn additives	1 pack (5 bottles)
5	**Reagents of Colorimetry**	
5.1	Standard stock solution (Colorimetric)	1 pack (5 bottles)
5.2	Cr colorimetric reserve reagent 1	1 bottle
5.3	Cr colorimetric reserve reagent 2	1 bottle
5.4	Cu colorimetric reserve reagent 1	1 bottle
5.5	Cu colorimetric reserve reagent 2	1 bottle
5.6	Cu colorimetric reserve reagent 3	1 bottle
5.7	Cu colorimetric reserve reagent 4	1 bottle
5.8	Ni colorimetric reserve reagent 1	1 bottle
5.9	Ni colorimetric reserve reagent 2	1 bottle
5.10	Ni colorimetric reserve reagent 3	1 bottle
5.11	Portable Colorimetric reagent kit Cu 1	1 pack (5 bottles)
5.12	Portable Colorimetric reagent kit Cu 2	1 pack (5 bottles)
5.13	Portable Colorimetric reagent kit Cr	2 pack (5 bottles)
5.14	Portable Colorimetric reagent kit Ni	2 pack (5 bottles)
5.15	Pb colorimetric reserve reagent 1	1 bottle
5.16	Pb colorimetric reserve reagent 2	1 bottle
5.17	Pb colorimetric reserve reagent 3	1 bottle
5.18	Zn colorimetric reserve reagent 1	1 bottle
5.19	Zn colorimetric reserve reagent 2	1 bottle
5.20	Zn colorimetric reserve reagent 3	1 bottle
5.21	Portable Colorimetric reagent kit Pb	2 pack (5 bottles)
5.22	Portable Colorimetric reagent kit Zn	2 pack (5 bottles)

Optional Configuration:

1	**Accessories**	
1.1	Notebook Computer	1
1.2	Portable bluetooth printer	1
1.3	Portable digestion device	1
1.4	Battery of portable digestion device	1
1.5	Digestion liquid	1 bottle
2	**Reagents of ASV**	
2.1	Cr Standard Solution	1 pack (5 bottles)
2.2	Tl Standard Solution	1 pack (5 bottles)
2.3	Mn Standard Solution	1 pack (5 bottles)
2.4	Ni Standard Solution	1 pack (5 bottles)
2.5	Fe Standard Solution	1 pack (5 bottles)
2.6	Co Standard Solution	1 pack (5 bottles)
2.7	Sb Standard Solution	1 pack (5 bottles)
2.8	Fe, Co, Ni electrolyte	3 bottles
2.9	Cr electrolyte	1 bottle
2.10	Mn electrolyte	1 bottle
2.11	Sb electrolyte	1 bottle
2.12	Tl electrolyte	1 bottle
2.13	Tl additives	1 pack (5 bottles)
2.14	Cr plating solution	1 pack (5 bottles)
2.15	Fe, Co, Ni additives	1 pack (5 bottles)
3	**Accessories**	
3.1	Glassy carbon electrode	1

4.3 Consumables

The chemicals and accessories required to prepare the sample for testing are application specific. Application notes describe the consumables required for the particular analysis to be carried out. All reagents are available from Drawell Instrument or can be obtained from reputable chemical suppliers.

At a minimum you will need:

1. A supply of disposable analytical cups to hold the prepared sample in during the analysis.
2. A supply of metal electrolytes.
3. Metal standards and electrode plating solutions.
4. Pipettes and tips for measuring out sample and electrolyte quantities. Accurate pipettes are recommended.
5. Containers to handle waste. A waste container to discard used samples is recommended for field use.

6. Electrode polishing kit and associated items.
7. At least 1L of ultra-pure water.
8. Reagent containers and the other items needed.
9. For the usage of colorimetric device, you will need: colorimetric tubes / cuvettes, colorimetric tubes rack (removable). Two of portable Colorimetric reagent kit of corresponding elements.

Other items that are useful, but not essential are:

1. Absorbent cloth or paper to mop up spilled solutions.
2. Filter paper to assist holding components without touching them.
3. Disposable gloves, safety glasses and protective clothing are recommended when handling toxic samples or irritating solutions.

4.4 Connections

Figure 8 Connection of HM-5000P with electrode device

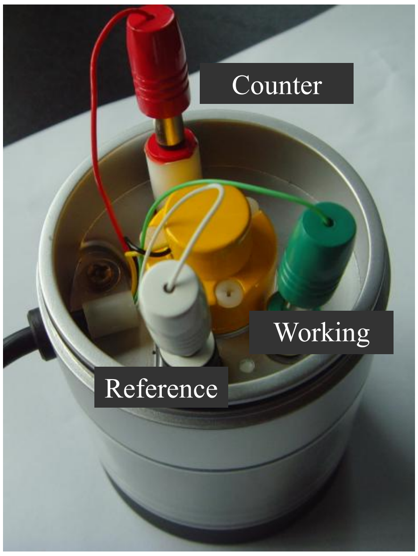


Figure 9 Electrodes connections

Connector Color Code:

Green - Working Electrode (Glassy Carbon or Gold)

White - Reference Electrode (Ag/AgCl)

Red - Counter Electrode (Pt)

4.5 Acceptance Inspection

If any of these items are missing or damaged, contact your distributor or sales representative immediately.

Chapter 5 Operations

5.1 Anodic Stripping Voltammetry method (ASV)

5.1.1 Preparations

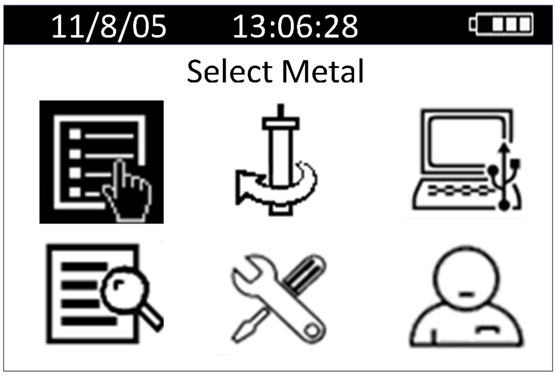
1. Reference Electrode: Soak the reference electrode by placing it into a clean analysis cup containing 3M KCl solution for at least 5 minutes. If the reference electrode will not be used for a long time, soak it for at least 1 hour, preferably overnight. Ensure the silver surface is an even dark brown to black color. Make sure that the reference filling solution is free of visible bubbles.
2. Working Electrode: For a gold electrode, the central area of the tip should be shiny gold, while for a glassy carbon electrode, it should be shiny black. The electrode tip surface should be free from blemishes, scratches or dust, otherwise it needs to be cleaned.

NOTE: Working electrode should be polished and rinsed before and after each test.

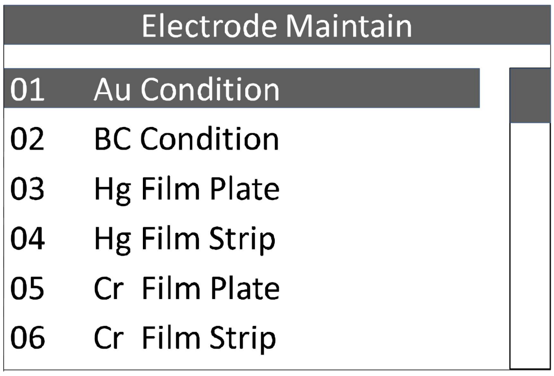
3. Insert the three electrodes into the corresponding colour identified holes and attach the correct connectors. Take care not to touch the electrode surfaces with fingers or allow any grease or oil to contact the electrode surface.
4. Place 5 clean analytical cups onto the analytical cell stand in order.
5. Fill the rinse container to the very top with ultra-pure water (about 20mL). Change the rinse water frequently. Pour about 20mL of plate or conditioning solution into the corresponding analysis cups. With a 5mL pipette, first add 10mL of the electrolyte separately to the blank, standard and sample analysis cups, then draw 10mL ultra-pure water to the blank cup, then add a certain amount of standard to the standard cup according to the sample requirement before adding ultra-pure water to 20mL final volume, and finally draw 10mL liquid sample to the sample analysis cup. If additives are involved, same amount is required for blank, standard and sample.

5.1.2 Electrode Maintenance

1. Place the analysis cup containing maintenance solution on its cup holder. A plate solution can be reused for about 5 times.
2. Place the electrode holder in the analysis cup and make sure three electrodes are all immersed in the solution.
3. Press **ON** to turn on HM-5000P analyzer and the main interface will appear after the instrument model name. There are six menus in all. You can navigate the screen by pressing the button △▽. Clicking ↵ opens its submenu.

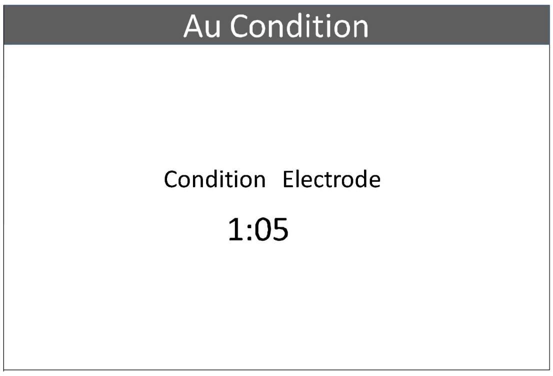


4. Click △▽ to select an menu for plating and then click ⏎ to choose an appropriate option.



Glassy carbon electrode - can be plated after conditioning in solution A.

Gold electrode - must be conditioned in solution B after polishing and before measurement.



Condition Electrode

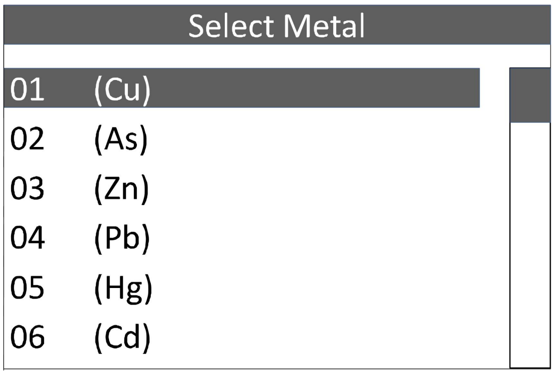
1:05

5. Press ESC to exit Electrode Maitain and return to the main interface. Place the electrode holder in a rinse cup filled with ultra-pure water. Press ⚡ to let the stirrer start running. The cleaning stops after 5 seconds.

5.1.3 Measurement

5.1.3.1 Analyte and range selection

1. After working electrode plating or conditioning, click Select Metal in the main menu. Press △▽ to locate the metal to be analyzed and then click⏎. Several measurement ranges will be given for your choice.



10ppb

50ppb

200ppb ...

NOTE: Every range has its best detection range in which the results are more accurate, as shown below.

10ppb: (4 ~ 40ppb)

50ppb: (10 ~ 150ppb)

200ppb: (50 ~ 500ppb)

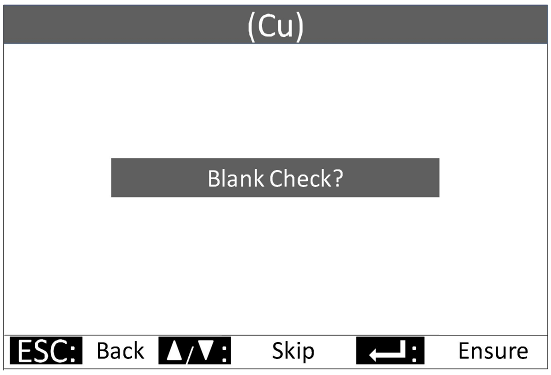
1ppm: (400ppb ~ 4ppm)

10ppm: (2 ~ 20ppm And above)

2. Place the electrode holder in a rinse cup filled with ultra-pure water. Press to let the stirrer start running. The cleaning stops after 5 seconds.

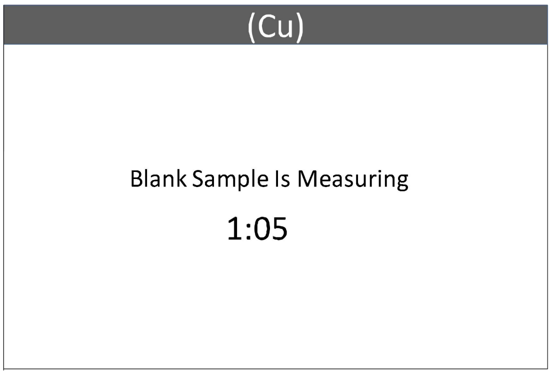
5.1.3.2 Run Blank

1. After analyte and range selection, the message 'Blank Check?' will prompt you. Click Ensure, Skip or Back according to your needs.



Blank Check?

2. Place the analysis cup containing blank sample prepared before on the holder, put the electrodes in the cup, and then click ⏎ to start blank measurement.



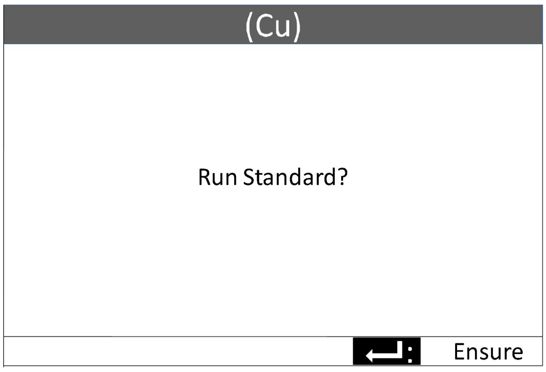
Blank Sample Is Measuring

1:05

NOTE: After measurement, it will display the curve of blank sample, which is in normal a kind of oblique and smooth curve, it is various for different sample.

5.1.3.3 Run Standard

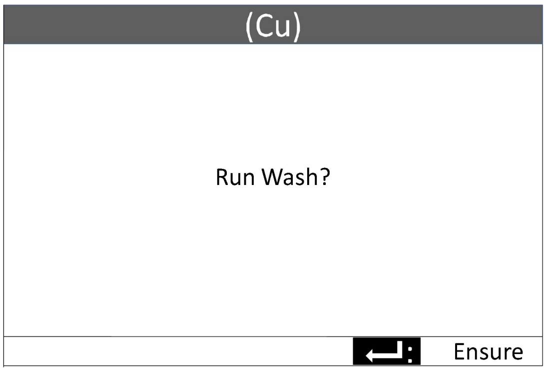
1. After blank sample measurement, press ⏎ and the screen will show 'Run Standard?'. Place the analysis cup containing the prepared standard solution on the cup holder and the electrodes into the analysis cup according to the prompt.



Run Standard?

2. Click ⏎ to start the standard analysis by running some programs during which there will be a countdown timer. After analysis, place the electrodes into the rinse cup according to the prompt

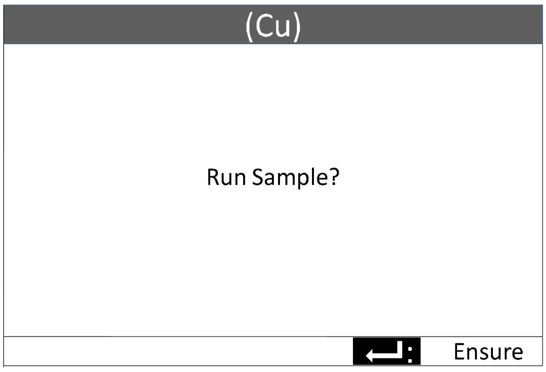
message 'Run Wash?'. Click ↵ to start cleaning and it stops automatically in 5 seconds.



Run Wash?

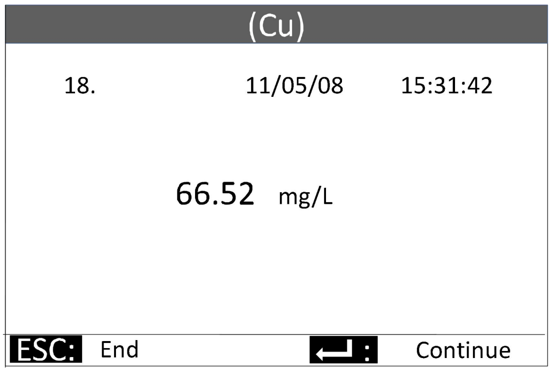
5.1.3.4 Run Sample

1. After standard analysis and electrodes cleaning, the message 'Run Sample?' will be prompted.



Run Sample?

2. Place the analysis cup on the holder and electrodes into the cup. Click ↵ to start sample analysis by running some programs during which there will be a countdown timer. After analysis, the results will be shown in μg/L or mg/L.



18. 11/05/08 15:31:42

66.52 mg/L

3. There will be End and Continue buttons on the screen after analysis. If you want to continue, place the electrodes assembly in the rinse cup and then click ↵ to start cleaning. After that, place the electrodes back in the sample analysis cup. If you click ESC, it will return to the main interface. Then you can choose a way to maintain the electrodes.

NOTE: Generally, about 10 times of sample analysis can be carried out after each standard calibration. For Hg, As, Mn and Cr, the number is 3 to 5 times before re-calibration is required. If the standard is overused, the repeatability will become poor. The plate solution can be used approximately 5 to 8 times before a new solution is required. Each metal film should last between 10 and 50 complete analysis, depending on the sample complexity.

NOTE: Refer to the application methods in the CD for detailed operating process of metal measurements, as well as reagent dealing methods and usage amount.

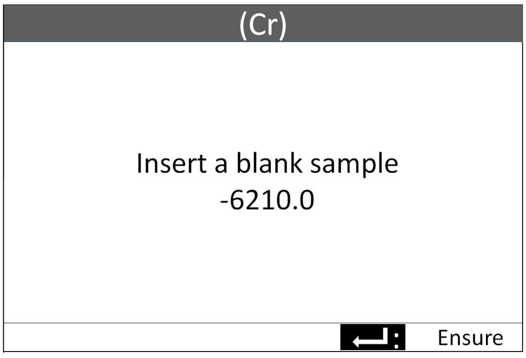
5.2 Colorimetry

5.2.1 Preliminary Preparation (with test Cr^{6+}, for example)

Ready hardware: Connect the handheld Host with Colorimetry module, and install the tubes rack, then put colorimetric tubes into the rack in sequence, prepared the corresponding elemental kit.

1. Power on the instrument, adjust Colorimetry devices switch to the Cr^{6+} position (For measurement of total Cr, only need to add digestion steps).

2. Enter “Metal choice" and “Colorimetry” menu in sequence, select Cr^{6+} to enter “Insert a blank sample" interface, as shown below. Keep in this interface, at the same time, the lamp is turned on and preheating.



Insert a blank sample
-6210.0

Reagent preparation:

Element	Unknown sample/ Standard solution/ Distilled water(mL)	Reagent 1 (mL)	Reagent 2 (mL)	Reagent 3 (mL)	Reagent 4 (mL)
Cu	4	0.5	1	1	0.5
Ni	2.5	1	1.5	1.5	
Cr/Cr^{6+}	2.5	2.5	2.5		
Pb	5	0.5	0.5	0.5	
Zn	2.5	1	1.5	1.5	

Table 1 Additive dose (Colour reagents are marked in red)

1. Put 2.5mL pure water into the 1st cuvette, 2.5mL Cr6+ to the 2nd cuvette and 2.5mL unknown sample to the 3rd cuvette separately by using the 5ml pipettor.

2. Take out Cr6 + portable reagent kit, adding 2.5mL Cr6 + reagent 1st to the three cuvettes, shake it well, and again add 2.5mL reagent 2nd, shake it well, then wait for five minutes.

5.2.2 Additional preparation

1. When the reagent of portable kit is used up, you should take the reserve reagent as supplement. Reserve reagents should be refrigerated.
2. If the concentration of unknown sample is too high, it should be diluted.
3. If the composition of unknown sample is turbid and complex, it should be filtered, digested and turbidity compensation before measurement.

Digestion: Add 0.5mL digestion solution into blank sample, standard sample and unknown sample separately, put them into digestion device and heating for 12 minutes, then waiting for cooling.(Note: To ensure uniform condition, the blank sample and standard samples must be added the same amount of digestion solution with unknown sample and be heating at the same time.)

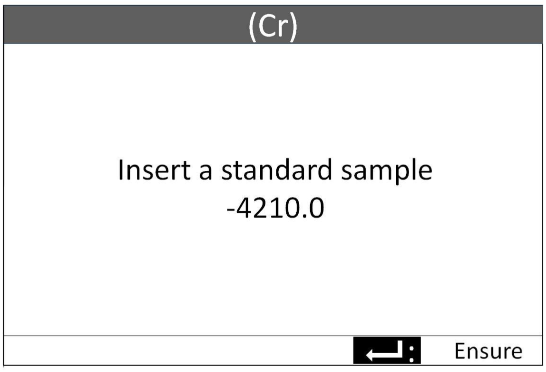
Turbidity compensation: replaced normal blank sample with turbidity blank sample. (Cu, Ni, Cr can be used).

Blank Sample	Preparation method	Service conditions	Restrict conditions
Normal blank sample	**Distilled water** with all of the reagent	/	/
Turbidity blank sample	**Unknown sample** with other reagents（except colour reagent）	Unknown sample is turbid and complex, such as wastewater of electroplating	The colour of colour reagent is deep (such as Pb, Zn）

5.2.3 Run Test

1. On the above interface, put the blank sample colorimetric tube into colorimetric device, observing the fluctuation of measuring results, when the fluctuation is tend to stable (only single digit of the value is changing), click [Ensure].

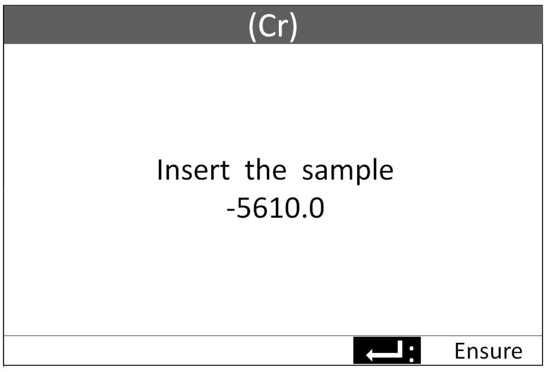
2. Take out the blank sample colorimetric tube, and put into standard sample colorimetric tube, observing the fluctuation of measuring results, when the fluctuation is tend to stable, click [Ensure]. As shown below:



(Cr)

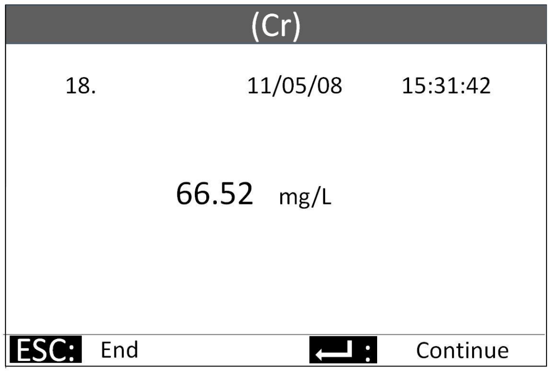
Insert a standard sample
-4210.0

3. Take out the standard sample colorimetric tube, and put into the unknown sample colorimetric tube, observing the fluctuation of measuring results, when the fluctuation is tend to stable, click [Ensure]. If need continue measuring, click↵. As shown below:



(Cr)

Insert the sample
-5610.0



(Cr)

18. 11/05/08 15:31:42

66.52 mg/L

Note 1: The measuring reagents are named in accordance with the order of the added sequence for reagent

1, reagent 2, reagent 3....

Note 2: After each measurement, there may have the history records of blank sample and standard sample, you can skip the measurement of them by pressing "up" or "down" button and to measure unknown sample directly.

Note 3: If within the measuring range, the result is less than 1ppm, you will need to remove blank sample, standard sample and unknown sample from colorimetric tubes to the cuvettes, re-calibration and re-measurement, the measuring results of cuvette shall prevail. If the result is greater than 1ppm, the former operation can be omitted, and the measuring results of colorimetric tubes shall prevail.

Chapter 6 Care and Maintenance

6.1 Electrode Maintenance

For best results, the electrode should be looked after before and after each test. Never allow oil or grease to get onto the electrode surfaces, the interior of the analysis cup or onto the stirrer. At the end of each measurement, it is recommended that the electrodes are removed from the electrode holder, polished and rinsed with ultra-pure water before replacing the protective end caps on all electrodes. When storing the HM-5000P for more than 1 month, it is necessary to soak the reference electrode in the reference immersion solution for more than 1 hour, preferably overnight.

NOTE: A electrode should be dedicated to certain groups of metals. A mercury film electrode should be used for Cu, Cd, Pb, Zn, Tl, Mn, Sb, gold electrode for As and Hg, bare glassy carbon electrode for Cr and chrome electrode for Ni, Fe and Co.

6.1.1 Working Electrode

The condition of the working electrode surface is very important for achieving good results. Do not touch it with fingers or other objects or rub it with dirty, hard or anti-static tissues.

A. Glassy Carbon Electrode

1. Rinse the electrode with ultra-purity water.
2. Wipe the electrode tip (the shiny black area) very gently on a clean white cloth or filter paper for approximately 20 seconds.
3. Rinse the electrode tip with ultra-purity water.
4. Polish the electrode clockwise on a metallographic sandpaper vertically. Shake the polish solution and add a few drops onto the polishing pad or cloth. Place the shiny black electrode tip vertically onto the area the polish solution was just added and using a circular motion (e.g. clockwise) to polish the electrode tip for at least 60 seconds.
5. Dip the tip in the conditioning solution A for minutes and then rinse again with ultra-purity water.
6. Check the surface of the electrode tip center. It should be shiny and free from visible blemishes.

NOTE: Some ordinary tissues are coated with organics such as anti-static coating. These coatings can stick to the electrode surface causing it to stop working correctly. They can usually be removed with the NaOH solution. The body of this electrode is made from PTFE, which is highly resistant to most chemicals. Concentrated oxidizing acids, however, should not be used with this electrode.

B. Gold Electrode

1. Rinse the electrode with ultra-purity water.
2. Wipe the electrode tip (the shiny gold area) very gently on a clean filter paper.
3. Rinse the electrode tip with ultra-purity water.
4. Shake the polish solution and add a few drops onto the polishing pad. Place the gold electrode tip vertically onto the area the polish solution was just added and using a circular motion (e.g. clockwise) to polish the electrode tip for at least 60 seconds.
5. Dip the tip in the conditioning solution B for minutes and then rinse again with ultra-purity water.
6. Check the surface of the electrode tip center. It should be shiny and free from visible blemishes.

6.1.2 Reference Electrode (Ag/AgCl)

The reference electrode tip is coated with a porous material which allows an electrical connection to be made between the electrode and the solution in the sample cup. The connection will not work if the porous material is dry out. This may cause damage to the working electrode. For that reason, place the reference electrode in the reference immersion solution for at least one hour.

6.1.3 Counter Electrode (Platinum)

This electrode requires no maintenance except for rising with ultra-purity water before and after each use.

6.2 Cell Assembly Maintenance

6.2.1 Electrode Holder

The electrode holder body is made from a durable plastic. After each analysis, check the electrode connectors are dry and free from dirt. Wipe away any liquid left on the electrode holder. Make sure that sample oe electrolyte has not been allowed to enter the stirrer motor.

Caution: Avoid allowing drops of liquid to run into the electrode holder body. Do not turn the electrode holder upside down after the analysis cup removed. Otherwise the liquid can get past the shaft seal and cause damage to the motor.

6.2.2 Stirrer Motor

The stirrer may not work correctly if sample or electrolyte has been allowed to enter the stirrer motor.

Caution: Do not leave the electrode holder in sample oe electrolyte overnight. Always remove the electrode holder from the analysis cups after use.

If this occurs, remove the screws holding the stirrer motor in place and pull the motor free of the electrode holder. Carefully hold the motor shaft firmly using pliers and gently rotate the motor body around the shaft until it rotates freely. Wipe off any excess oil and reassemble the motor into the electrode body, ensuring the holding screws tightened.

Push the stirrer back onto the motor shaft, connect the electrode holder to the analyzer and click Ψ to check the stirrer turns. If the stirrer does not turn, the motor may need replacing.

6.3 Periodic Checks

Followings are items require periodic checks.

Item	**Maintenance Frequency**
Working / Reference Electrode	before and after each analysis
Stirrer Motor	before and after each analysis

6.4 Instructions

1) The chemicals for analysis should be stored at room temperature and kept out of light. Tighten the cap when the chemical is not in use.
2) Removing the cover or other parts when the instrument is on may got someone hurt. Do disconnect all the power supplies before any modifications, replacement or services. Inspect insulation regularly to prevent current leakage.
3) Avoid severe vibrations during use, storage and transportation in case of damaging the inside.

Chapter 7 Troubleshooting

If an obviously incorrect result is seen after analyzing a sample or standard solution when running the HM-5000P analyzer as a standalone unit, follow the suggestions below. Besides, analyzing the same solution with HM-5000P software will get graphics and may help to determine the cause.

7.1 No Peak or Abnormal Peak

If sample solutions that are known to contain significant analyte concentrations shows no results or abnormal peaks but standard solutions show normal peaks or results when run as a sample, the sample solution may contain organics or others that are complexing the analyte metal ions. These samples need to be treated before analysis.

If fresh standard solutions show no peak or abnormal peaks, one of the following is probably the cause.

a. Incorrect electrolyte solution. Some elements require a specific electrolyte solution for analysis.

b. Poor connections. Check that all connectors between the electrode holder and HM-5000P Host unit are firm and correct. Also check the electrode connectors are firmly attached on the correct electrode.

c. Poor working electrode surface condition. Polish the electrode surface. Carry out the appropriate conditioning or plating for the required analyte.

d. Dirty analysis cup, electrodes or stirrer. A new clean analysis cup must be used for each sample or standard. Residual organics in the cup or on the electrodes or stirrer may complex certain metal ions affecting the measurement result. A NaOH solution can often remove this residue.

e. Faulty stirrer motor. Sensitivity is greatly dependent on efficient stirring during the accumulation step. Pree the button ψ to check stirrer operation. If it is not operating correctly, the stirrer may need to be replaced or serviced.

NOTE: Standard solutions will have a very limited lifespan if not correctly acidified and stored at high temperatures. For this reason, fresh standards should be prepared each day using the 20 ppm stock standard (already acidified). In order to minimize interference, thoroughly rinse the analytical cell top with ultra-purity water and use new analysis cups. Change the rinse water frequently when highly concentrated samples are analyzed.

7.2 Peak Visible But Not Detected

If a peak is visible with the HM-5000P program, but is not being measured by the instrument, then the peak has probably fallen outside the element detection window. This can occur for four different reasons. Check the applications manual for the expected position for the analyte metal.

a. Incorrect electrolyte solution. Check the application note to ensure the electrolyte used is correct for the analyte. Incorrect electrolyte may affect the peak potential and peak current.

b. Poor reference electrode (Ag/AgCl) condition. If the reference electrode is not in good condition, e.g., incorrect inside electrolyte or damaged porous material on the tip, peak potential may drift and the curve may have large fluctuations (signal noise). If standard solutions show peak drift or large fluctuations, the reference electrode probably needs maintenance or replacement.

NOTE: HM-5000P can be used to modify existing internal menus and parameter configurations or create new analytes and configurations.

Chapter 8 Service Statement

Limited warranty:

If the product or their authentic spare parts (hereafter referred to as “the product”) are turned out to have defects in material or workmanship, Chongqing Drawell Instrument Co., Ltd. (hereafter referred to as Drawell) will provide warranty services as long as they meet the following terms:

1. The products or their internal parts are under 12-month warranty since the date of purchase.

2. Limited warranty extends only to original customers (hereafter referred to as “customer”) who purchased products from Drawell and does not cover used products owners and end users who obtain the products through other legal or illegal methods.

3. Limited warranty only applies to customers in countries or regions listed in this manual. It is only valid in countries or regions where Drawell intends to sell its products.

4. During limited warranty period, Drawell or its authorized service network may adopt new or remade parts to repair or replace any defective products or parts according to Drawell’s choice, and then return operational products back to customers. Customers won’t be charged for parts used in repair or replacement and the service. All replaced parts, circuit boards or devices will be recycled by Drawell. The enclosure and the decorative parts approved of by customers during purchase are not included in warranty terms.

5. The repaired products are still under the remaining warranty period.

6. Customers are asked to provide purchase receipts or other purchase proof (information of date and place) as required by Drawell or its authorized service centers.

7. Customers shall cover fees occurred in transportation, shipment and treatment when the products are sent to and returned from Drawell or its authorized service centers.

8. Customers aren’t entitled to enjoy limited warranty in the following cases:

8.1 The products have suffered: abnormal use, improper storage, exposure to humid environment, exposure to environment of too high temperature or too low temperature, unauthorized change, unauthorized connection, unauthorized repairing (including but not limited to use of unauthorized spare parts), misuse, negligence, abuse, accidents, modification, improper installation, food or liquid splash, faulty operation or other conducts exceeding reasonable controls of Drawell, such as lack of wear-off parts (such as membrane), breakage and damage of power cable, unless it is directly caused by material or workmanship deficiency and normal wear of the product.

8.2 Drawell has not received any notice of fault or failure from customers during limited warranty period.

8.3 Serial number of the product or date codes of accessories are removed， damaged or altered.

8.4 The product is not provided by Drawell, which is not compatible with Drawell and it is connected with irrelevant accessories or used together.

9. If faults occur in limited warranty period, customers shall take the following steps:

9.1 Customer shall return the product to where customer purchased it for repairing or replacement.

9.2 If it is not convenient to return the product, customer shall contact local Drawell office or authorized service center to get the address of nearest authorized service center.

9.3 Customer shall deliver the product to the authorized service center and fees for dismantling the product from the equipment are not included in the limited warranty terms.

9.4 Customer will receive bills of all parts and manual work which aren’t included in limited warranty terms. And customer shall pay for reinstalling the product.

9.5 If the product is returned to Drawell after warranty period, Drawell will adopt general service policy and charge customer for related fees.

10. Any implicit warranty terms about commerciality or applicability for certain special purpose or use are limited to above warranty period. Otherwise, the warranty discussed above is the only compensation for purchaser, and it substitutes for all other explicit or implicit warranty. Drawell will not take legal responsibility for occasional or subsequent damage or anticipated loss in interest or profit, work interruption or data loss or damage caused by using or inability to use the product.

11. The interests provided in limited warranty terms are supplements to all the other rights and compensations regulated in laws of the countries or regions.

12. Drawell neither takes nor authorizes its authorized service center or individual or entity to take any responsibilities or obligations unspecified in the limited warranty terms.

13. All warranty information, product functions and specifications are subject to the change without notice.

Appendix

Glossary of Terms

ASV	Anodic stripping voltammetry
M	Mole. The standard unit of an amount of a substance. A 1 Mole (1M) solution of a compound has 1 mole of compound per litre of solution.
µL	micro litres (10^{-6} litre)
mL	mili litres (10^{-3} litre)
ppb	parts per billion
ppm	parts per million
CD-ROM	Compact Disk, read-only memory
DC	direct current
AC	alternating current
LCD	liquid crystal display
Mb	mega byte
PC	personal computer
WE	Working Electrode. The electrode at which the analyte is reduced and re-oxidised for voltammetric analysis.