ATOMIC ABSORPTION MERCURY ANALYZER

AZA1344A

The AZA1344A Atomic Absorption Mercury Analyzer is a high-sensitivity laboratory instrument designed for the determination of mercury (Hg) in gas, liquid, and solid samples. The analyzer is based on the principle of cold-vapor atomic absorption spectrometry (CV-AAS), utilizing the characteristic mercury resonance wavelength of 253.7 nm.

The instrument is designed for stable, reliable and rapid mercury measurement in applications including environmental monitoring, industrial emissions, petrochemical laboratories, geological investigations, power plants, research laboratories and mining industries.

A constant-light optical system, stable absorption cell and automatic gas-path switching provide improved baseline stability and measurement repeatability. The instrument can operate without an external argon or nitrogen carrier-gas supply for routine operation, making it suitable for laboratories where carrier gas availability is limited.

The analyzer supports direct gas analysis, liquid mercury analysis and solid-sample pyrolysis, with optional gold-film amalgamation technology for enhanced mercury collection and measurement.

Key Features

- Cold-vapor atomic absorption measurement principle at 253.7 nm
- High sensitivity with excellent baseline stability
- Excellent short-term and long-term measurement stability
- Rapid mercury measurement with results available within seconds during continuous gas measurement
- Gas, liquid and solid sample analysis
- Two-point calibration and direct concentration reading
- Automatic switching between measurement and cleaning/zero-calibration gas paths
- Closed-loop gas path during measurement for stable analytical conditions
- Open-loop gas path during cleaning for efficient removal of residual mercury
- Constant-temperature absorption cell for improved measurement stability
- Built-in mercury lamp, photosensor, amplifier and digital display
- Optional gold-film amalgamation measurement mode
- Automatic zero calibration function
- PC connectivity for real-time data transfer and data storage
- No continuous argon or nitrogen carrier gas required for normal operation
- Adjustable gas flow, measurement time, cleaning time and amplifier gain
- Suitable for continuous mercury-vapour monitoring

Applications

The AZA1344A is suitable for:

- Environmental mercury monitoring
- Industrial exhaust and emission analysis
- Atmospheric mercury measurement
- Petrochemical industry
- Power plants
- Geological and mineral exploration
- Mining and metallurgical industries
- Research and development laboratories
- Environmental testing laboratories
- Mercury analysis in water and other liquid samples
- Mercury determination in soil, ore and other solid samples

Measurement Principle

The AZA1344A operates according to the atomic absorption principle. Mercury atoms absorb ultraviolet radiation at their characteristic resonance wavelength of 253.7 nm. The mercury vapour passes through the absorption cell, where the mercury atoms absorb part of the incident radiation. The transmitted optical signal is detected by the photosensor and converted into an electrical signal.

The relationship between absorbance and mercury concentration follows the Beer-Lambert law:

TECHNICAL SPECIFICATIONS

Parameter	Specification
Model	AZA1344A
Measurement Principle	Atomic Absorption Spectrometry / Cold-Vapor AAS
Mercury Wavelength	253.7 nm
Measurement Modes	Gas Analysis, Liquid Analysis, Solid Pyrolysis
Measuring Range	0.1–100 μg/m³
Detection Limit	0.03 μg/m³
Precision	CV ≤ 5%
Relative Standard Deviation	< 5%
Linear Correlation Coefficient	r > 0.997
Zero Drift	< 0.2 mV
Noise	< 0.08 mV

AZA LAB UNIVERSE

TECHNICAL SPECIFICATIONS

Parameter	Specification
Gas Flow Range	Typically 0.4–0.6 L/min
Recommended Warm-up Time	30 minutes
Mercury Lamp	Built-in
Absorption Cell	Constant-temperature type
Calibration	Two-point calibration / Standard curve
Gas Path	Automatic measurement / cleaning switching
PC Interface	Available
Carrier Gas	Not required for routine operation
Power Supply	AC 220 V, 50 Hz
Power Consumption	Approx. 50 W
Ambient Temperature	5–35°C
Ambient Humidity	< 90% RH

MANUAL

Installation

Unpacking

Please check the instrument and accessories according to packing list.And contact us if the instrument had damge or missing parts.

Instrument work environment that apply

1. Far from strong electromagnetic field and vibration source
2. Dust-proof, moisture-proof and anti-corrosion
3. Keep out of the sun
4. Room temperature :5~35°C
5. Ambient humidity less than 90%

Work conditions

Power Supply:

Voltage:AC 220±20V,

Frequency :50Hz,

Power consumption:50W

Assemble

Put the instrument on the worktable and assemble the following parts:

1. Assemble the gas path and driving power

First put two shelves of desiccant on the white plastic parts. The entrance of pipe hang in the air and exit connect to Carrier Gas on the panel of instrument. The pipe is used to filter the mercury in the air and then discharge the air into the instrument as the clean air .You can discharge argon or nitrogen into the the Carrier Gas to reduce the determination of mercury in the air. There is activated carbon in the pipe. The waste gas can be discharged into the air through Gas Outlet by the plastic pipe which inner diameter is 8mm.Or connect to the pipe which inner diameter is 4mm and then to a one-way valve which is connected to the entrance of the desiccant. Put Potassium Permanganate solution in the waste bottle which the height is less than 1/3 of the bottle. Connect the desiccant and the bottle by the pipe which inner diameter is 4mm. There is desiccant in the pipe on the front panel. The entrance is connected to sample to be measure. The exit is connected to the Mercury Vapour. It is used to dry the sample and get rid of the water vapour.

Power connections

Connect the power supply socket of the instrument to voltage regulator output socket,and

shalled be grounded.

Notes: Voltage regulator and ground are not necessary.

3. Computer connection

Take the cable connect the computer and the instrument.

Notes: Shut down the power before the connection.

Measuring principle

The principle as shown in the Figure 1.

Measuring principle

According to the principle of atomic absorption, mercury atoms can absorb the resonance line which wavelength is 253.7nm.The optical signal after absorption flash into the photosensor to be changed into electrical signal. Show the result after amplified circuit.

The size of absorption and concentration of mercury atoms conforme to Beer's Law.

E=lg（1/T）=lg（I0/I）=KCL

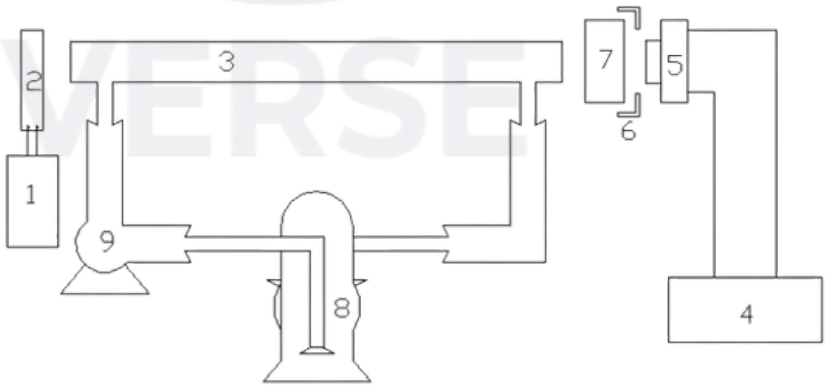
E---Absorbance I0---Incident intensity

I---Transmitted intensity K---Molar absorption coefficient

C---Concentration of mercury vapour L---Length of the light passes through

T---Transmittance

So we can ensure the concentration of mercury of the sample by measuring absorbance.



1.Power of mercury lamp

2.Mercury lamp

3.Absorption cell

4.Amplifier and digital display

5.Photosensor

6.Sealing cover

7.Color filter

8.Reduction bottle

9.Circulating pump

Gas system

There are two states: Measuring condition and zero calibration.

Measuring condition: In this state, conduit PB open and PA closed. Set the sampling flow. Then the samples get into conduit PB. Mercury vapour flow through absorption cell and we get the measurement. The flow can be changed, usually between 0.4 to 0.6 L/min. Zero calibration: In this state, conduit PB closed and PA open. Mercury atoms are absorbed when the air flow through activated carbon. The left clean air flow through conduit PA and we get a method blank.

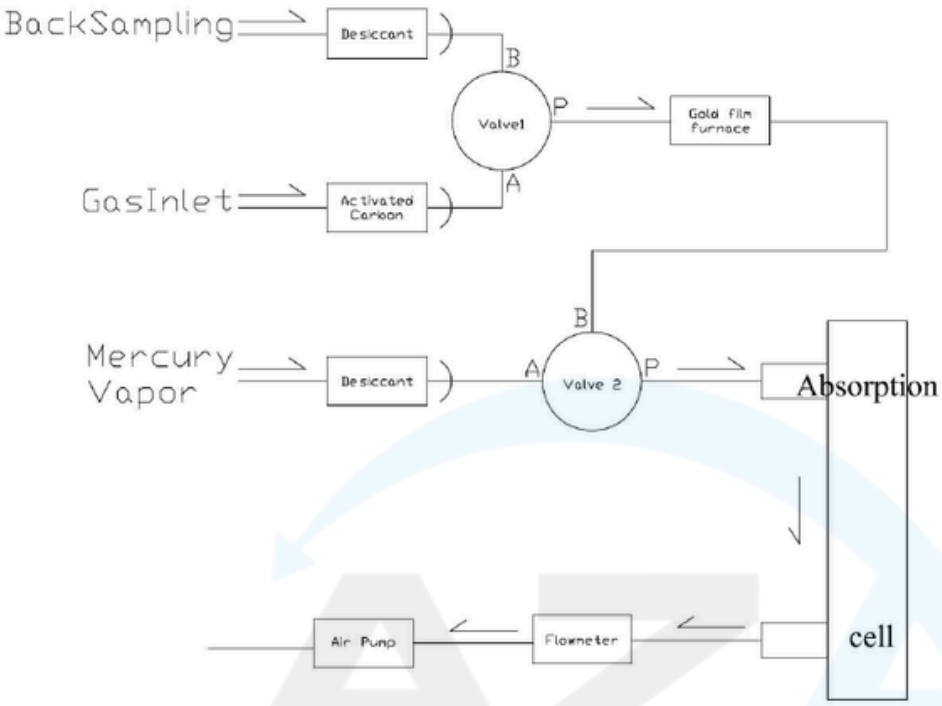
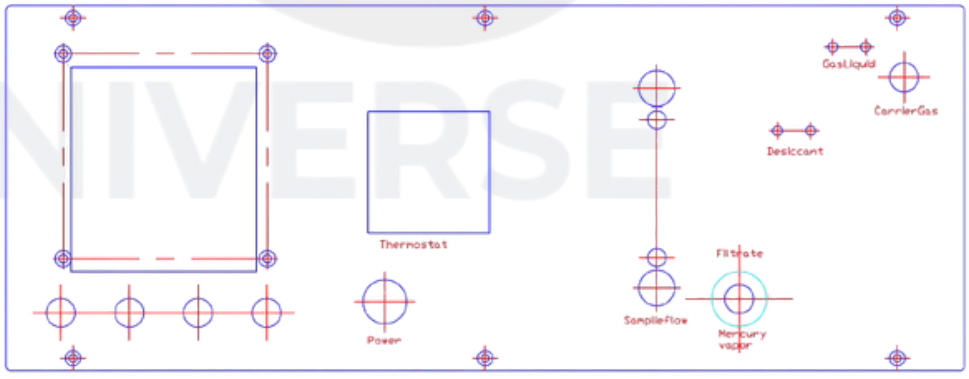


Figure 2 Air path

OPERATING METHOD

INSTRUMENT PANEL



NSTRUMENT PANEL FIGURE 3.

Explanation:

1. Quit:Quit current menu.
2. Arrow up: Move the current menu up one line.
3. Arrow down:Move the current menu down one line.
4. Measure: Instrument begins to measure after press the button.
5. Sample flow: Show the flow of the gas.
6. Mercury Vapour: The entrance of gas measurement and liquid measurement.

Notes:The function of four buttons correspond to the last line of the screen.It changes with the condition of the instrument.The function of the buttons also change.

Instrument panel Figure 3.

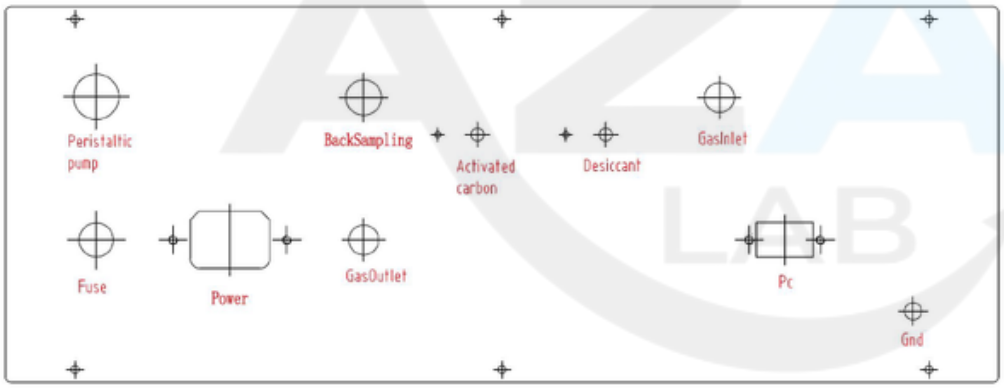
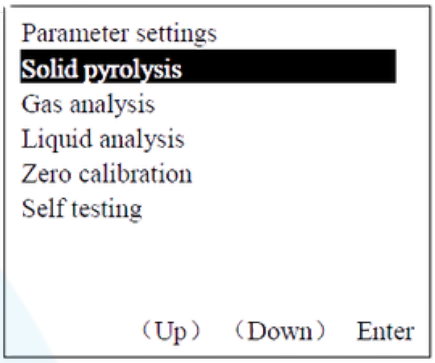


Figure 4 Back panel

Explanation:

1. Gas Inlet: Entrance of the clean air, also can be argon or nitrogen.
2. BackSampling: Entrance of sampling of mercury by amalgamation on gold alloy.
3. GasOutlet:Discharge the waste gas into atmosphere after measurement.
4. ActivatedCarbon:Absorb the mercury in the waste gas by activated carbon.
5. Desiccant:Dry the air by desiccant.
6. Power:AC 200V,50/60Hz.
7. Pc:Transport the data to Pc.
8. Ground.



5 Instrument main menu

4.2 Use of steps

1. Rreparations

Check the air path.

2. Power on.
3. Set parameters according to your requirement.
4. Preheat the instrument 30 minutes. The instrument will be stable after power on 30 mintues. So adjust negative high voltage and zero again after preheat.

Set conditions of measure

We must set the conditions seriously because they have influence on sensitivity, stability and life of the instrument.

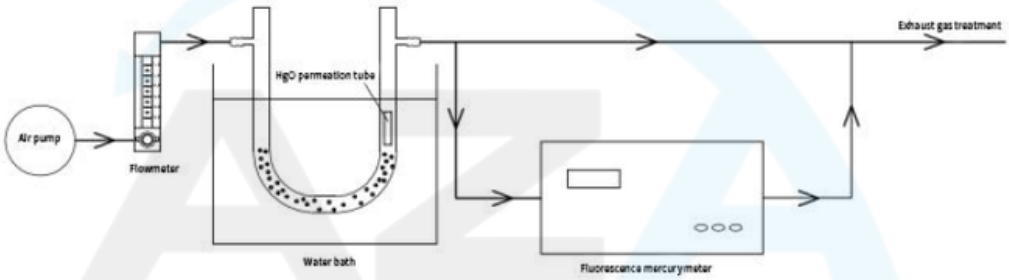
Setting of amplifier:Amplifier can change between 1 to 8.Amplifier 1 is lowest and amplifier 8 is highest.

Usually the energy value should between 200 to 1500. We can increase amplifier and high voltage to make the energy value at about 3000 if you need higher sensitivity. But don't make it over 3800.It will be unstable if it over 3800.

Process of measure

1. In the selecting menu:There are " Parameter settings"、"Solid pyrolysis"、"Gas analysis"、"Liquid analysis"、"Zero calibration"、"Self testing"to choose from. Use the middle two keys as the up and down keys to select the menu. After selecting, press the "Enter" function key to confirm.

2. Draw standard curve.(It must be done everyday and calibration point should be inserted when the test time is longer)



6 Mercury standard gas calibration

Standard mercury gas calibration

Connect air pump to U-tube, put calibrated mercury permeation tube in the other side of U-tube. Extract the air into the instrument and the flow is decided by the flowmeter as Figure 6.Then put the U-tube into the water bath and begin heating. Measure the temperature with the precision of 0.1 degrees Celsius and then get the permeability of mercury permeation tube.U-tube and syringe must be keep in the same temperature

Notes: Mercury in sample should be close to mercury in concentrations of saturated mercury vapour. It can increase the accuracy.

3. Choose“Parameter settings

”Menu，first enter the menu of time settings.The time of measurement changes by pressing up arrow. Keep pressing the up arrow key, the set time will continue to switch, switch to the time you need to determine. Then select “Set” and you will enter the flow setting state. Keep pressing the up arrow key, the set flow will be changed continuously, and it will be determined after switching to the required flow rate (Note: After setting the flow rate on the display, you must adjust the flow rate of the injection flow meter to the same as the one just set. Due to changes in the environment, the flow rate of the gas also changes. See the Appendix for specific correction methods. Once the time and flow are set, the injection volume of the gas can be determined. Then select “Flow” and the cleaning time setting status will be entered. Keep pressing the up arrow key, the cleaning time will be changed continuously, and it will be determined after switching to the cleaning time you need. Then select “Clear” and you will enter the zoom position setting state.

There are eight files in the zoom position, of which the first file has the lowest magnification and the eighth has the highest magnification.

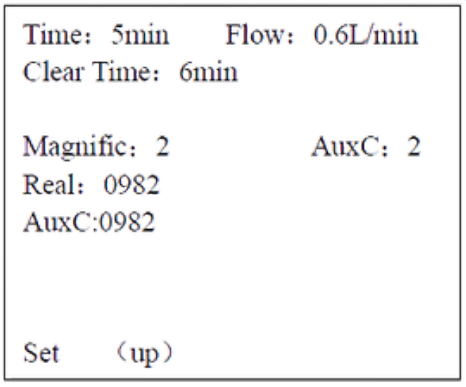


Figure 7 Parameter setting interface display

Then select “Gain”, at this time, it will enter the auxiliary gear setting state of the auxiliary channel (the auxiliary channel is the new function of the machine, which is used to refer to the brightness of the lamp. The ideal condition is 7000-8000, the instrument works normally. Because the delivery time Very nervous, so it is too late to completely modify the manual, please forgive me. If you are in the explanation section, please don't understand, please send your email address to sales@greencalm.com, we will send one after the translation is completed. The Chinese and English versions of the instructions are given to you). There are eight files in the zoom position, of which the first file has the lowest magnification and the eighth has the highest magnification. Keep pressing the up arrow key, the set zoom position will change continuously, and switch to the zoom position you need to determine. Then select "AuxC", this time will exit the setting state of each parameter and return to the main menu.

Typical Operating Conditions

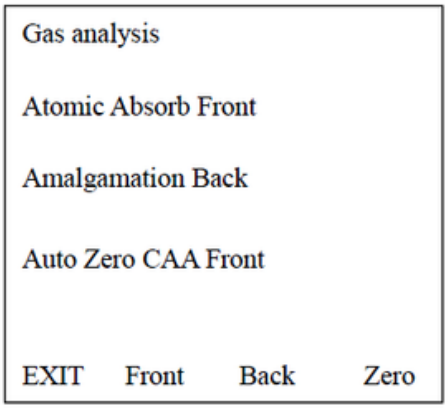
Parameter	Typical Setting
Gas Flow	0.4–0.6 L/min
Typical Setting	0.6 L/min
Warm-up	30 min
Measurement Time	User selectable
Cleaning Time	User selectable
Amplifier/Gain	1–8 levels
Solid Pyrolysis	200–800°C

There are three types of measurements: gas analysis, liquid analysis, and solid pyrolysis measurements.

a. Gas analysis

Select the “Gas analysis” menu to enter the gas measurement state. Gas measurement is divided into atomic absorption advance sample measurement, gold film atomic absorption post injection measurement and self-calibration zero atom absorption forward sample measurement.

Select the “Front” button to enter the atomic absorption advance sample measurement state, as shown in Figure 9. When the “Measu(measure)” button is pressed, the current peak value and real-time value are displayed during measurement. Press the “Pause” button to stop the measurement process. Generally, it can be cleaned 2~3 times for the next measurement. When the data fluctuates by more than 5% during the test, the instrument needs to be recalibrated. After exiting the measurement state, press the “Zero” button, the instrument enters the zero calibration state and begins to re-determine the zero point of the instrument.

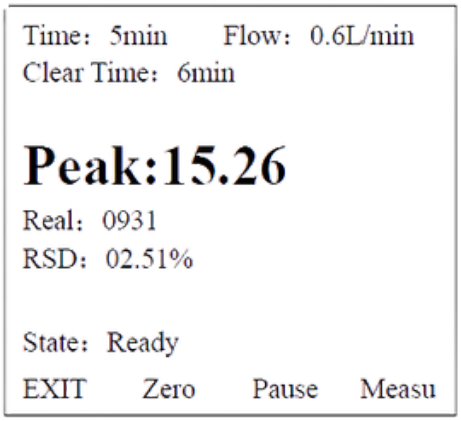


8 Gas measurement interface display

Select the “Zero” button to enter the self-calibration zero atom absorption advance sample measurement state. When the “Measure” button is pressed, the instrument will automatically perform zero calibration.

When measuring, the current peak value and real-time value will be displayed. Press the “Measu(measure)” button to stop the measurement process. Generally, it will be cleaned 2~3 times for the next measurement.

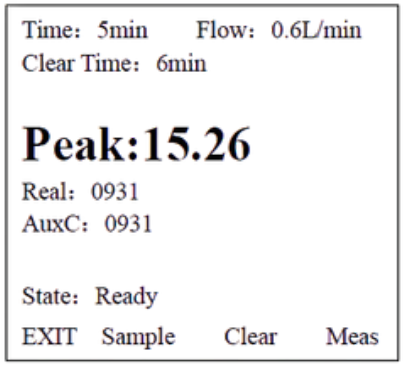
When the data fluctuates by more than 5% during the test, the instrument needs to be recalibrated. In order to maintain the stability of the instrument data, the instrument will automatically perform zero calibration every 10 minutes.



9 Atomic absorption advance measurement interface display

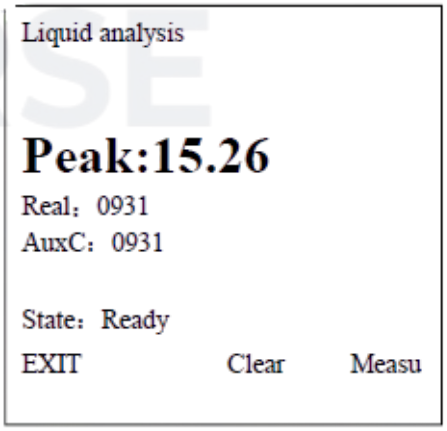
Select “Back” button to enter the measurement state of gold film atomic absorption, the interface is shown in Figure 10. The first line shows the time value and flow value set just now, the second line shows the cleaning time value just set, the three lines of large characters show the peak value during measurement, the four lines show the transient value during cleaning, and the five lines indicate that the instrument is located. status. In the process of measuring the gold film furnace, the gas to be tested is introduced into the air inlet of the rear panel of the instrument, and the mercury gas inlet of the front panel is not used. When the sampling function key is pressed, the status bar displays the word “Sampling” and disappears after sampling.

Press the measurement button again to measure, the status bar displays “measuring”, the real-time column displays the measured peak value at the end of the measurement, and the setting data and measurement results will be input to the PC for participation in the calculation. Press the “Clear” button to clean the measurement. Generally, it can be cleaned 2~3 times for the next measurement. You can also choose to enter the "Gold Film Furnace Continuous Measurement" menu. The instrument enters the automatic cycle measurement state. A cycle is: sampling -> measurement > cleaning. For continuous measurement, the display shows a similar value to a single measurement, and the gas to be tested still enters the air inlet of the instrument's rear panel.



10 Gold film atomic absorption after injection measurement interface display

The first line shows the time and flow, the second line shows the cleaning time, the three lines show the peak value, the four lines show the transient value, and the five lines show the instrument status in real time.



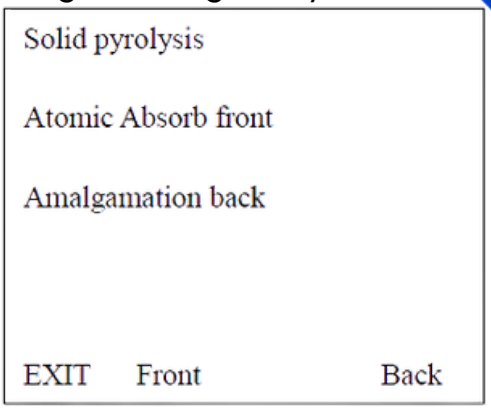
11 Liquid measurement interface display

The six lines have the “Exit” function key,
which can be pressed to exit the measurement state during cleaning. Every time it is measured, its data is entered into the PC.

b. Liquid analysis（Purchase）

Select the “Liquid analysis” menu to enter the liquid measurement state, as shown in Figure 11.

Connect the air outlet of the reaction bottle to the air inlet of the instrument's front panel. When measuring, first add 5mL sample and 1mL stannous chloride to the reaction bottle, then press the “Measu(measure)” button to measure. After the measurement is finished, the data will be displayed directly. Every time it is measured, its data is entered into the PC. When the data fluctuates by more than 5% during the test, it is necessary to return to the gas measurement state to zero the instrument.

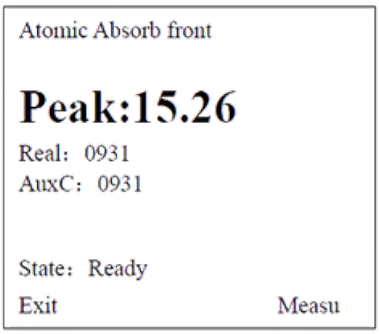


12 Solid pyrolysis measurement interface display

c. Solid pyrolysis（Purchase）

Soil, ore, first crush it to 80 mesh, pyrolysis mercury use soil 10mg-500mg, first weigh 200mg soil (quantity is related to mercury content); put into the quartz boat, push the heat with iron wire The furnace is defired; the pyrolysis furnace pyrolyzes the mercury sample according to the set pyrolysis temperature (200-800 °C); the organic matter in the soil is adsorbed in the filter; the filter is mainly strong alkali (NaOH) chemical adsorption acid anhydride gas Sodium peroxide (Na2O2) can chemically adsorb all reducing gases. The released mercury is sent to the host for analysis.

Temperature control, using the PID control principle, is heated at a high speed away from the target temperature, and is heated slowly when approaching the target temperature, that is, the differential integration method controls the heating, and the temperature is stabilized at the target value.

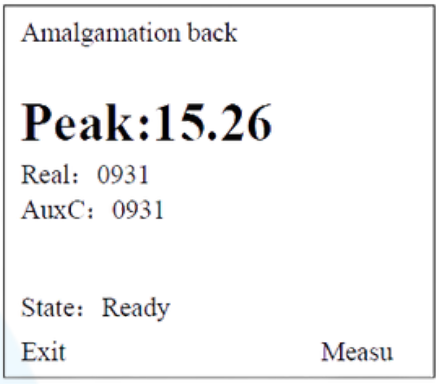


13 Pyrolysis atomic absorption front-end measurement interface display

Connect the power cord to the AC220V wall socket and turn on the pyrolysis furnace switch. The pyrolysis furnace is energized and starts working. The solid in the quartz boat is heated in the furnace, and the outlet of the furnace is provided with a filter membrane, and the pyrolyzed gas flows out through the filter membrane. When measuring, it is necessary to add an adsorbent to the two absorption tubes of the rear panel of the pyrolysis furnace for absorbing impurities which are not required after pyrolysis. The air outlet of the drying tube also has a filter for absorbing impurities. The final pyrolyzed gas can be connected to the host for measurement.

Select the “Solid pyrolysis” menu to enter the solid pyrolysis measurement state. The solid pyrolysis measurement is divided into a pyrolysis atomic absorption forward sample measurement and a pyrolysis gold film method post injection measurement. Select the “Front” button to enter the measurement state of the pyrolysis atom absorption sample. The interface is shown in Figure 13. Connect the mercury gas outlet of the pyrolysis furnace to the inlet of the instrument's front panel. When measuring, first place the quartz boat with the sample into the pyrolysis furnace, and then press the “Measu (measure)” button.

The instrument first cleans the internal piping with air and heats the sample in the quartz boat to the same temperature as the furnace. The gas generated by the combustion of the pyrolysis furnace is then taken in for measurement, and the data is directly displayed after the measurement is completed. Every time it is measured, its data is entered into the PC. Select “Back” button to enter the pyrolysis gold film method and then measure the state of the sample. The interface is shown in Figure 14. This method is similar to continuous measurement of a gold film furnace in gas measurement. Connect the mercury gas outlet of the pyrolysis furnace to the inlet of the instrument's rear panel. When measuring, first place the quartz boat with the sample into the pyrolysis furnace, and then press the “Measure” button. A cycle is: sampling -> measurement -> cleaning. The instrument first inhales the gas generated by the combustion of the pyrolysis furnace, and the mercury in the gas is adsorbed in the gold furnace built in the main engine. After the sampling is completed, the built-in gold furnace begins to heat up, the mercury in the furnace begins to desorb with the gold therein, and then the mercury is brought into the absorption tube by the outside clean air for measurement. After the measurement is completed, the outside air enters the furnace to cool the furnace.4.5 Management after measure



14 Post-injection measurement interface display after pyrolysis gold film method

.Stop flowing mercury vapour into the instrument, press the" clean" button to clean the air path by blowing several times .It can remove the residual mercury.

2. Shut up the air pump, shut up the flowmeter of carrier gas and valve of argon when the pressure drops to zero.

Data processing

Volume V is converted by the volume of air flowing through quartz tube at 20° C and 101.325kPa.Unit is m^3

$$V=V_1\times\frac{293.15}{273.15+t}\times\frac{P}{101.325}$$

V_1——Product of sample injection time and flow,m^3

t——Temperature of sampling gas(room temperature),° C

P——Atmospheric pressure of sample,kPa

Determination of mercury in the air at 20° C and 101.325kPa as ρ_{Hg} is calculated by the following formula.Unit is $\mu g/m^3$

$$\rho_{Hg}=\frac{h_s\times m}{h_c\times V}$$

h_s——Peak heights of sample, scale label

h_c——Average peak heights of standard substance, scale label

m——-Mercury in the standard substance,μg

V——Calculation of the formula.m^3

Maintenance

5.1 Simple debugging and maintenance

1. Handle with care because there are glassware in the instrument.

2. The instrument should avoid vibration.

3. Considering the adsorption of mercury for glassware, watch out the new glassware for the first time.

4. It will lead to error if there are beads in the gas path.

5. Cleanout of the reaction bulb(include the accessories)

a. Pour a beaker of 5% liquor sodium hydroxide into the reaction bulb. Press the “clean” button several times(3-5).Drain the solution after foaming and repeat several times.

b. Clean the reaction bulb if it will be lain idle long time.

Notes:Don’t remove the absorption cell at will.

5.2 Warranty

We give a period of one year (from date of shipment) of the warranty. Warranty is limited to repair or replace the materials due to manufacturing or process defects caused by faulty parts, or deterioration of components within the warranty period, then pledged to give free repair until replacement. But because of user’s improper or inappropriate care malfunctions, repairing small additional fees for the cost of fees.

Notes

1. Shut down the power if the instrument make a noise or the buttons are not working. It should be repaired if it's still not properly after restarting.
2. Arrange from low to high of mercury at single measurement. After high mercury measurement, gas path must be cleaned by fresh air and shut down the access of sample.
3. Shut down the power when repairing.
4. The flow should be kept stable in case having influence on sensitivity and stability.
5. Don't press any buttons during the measurement in case of abnormality.
6. Standard solution: must be prepared when using.

Causes of instrument failure and troubleshooting

Equipment in use during a variety of reasons there may be certain failure, its causes and troubleshooting can be found in "Common Faults and exclusion list"

Common Faults and Exclusion List

Failure Phenomenon	Common Causes	Troubleshooting
Baseline drift	Bad earth	Check grounding
No signal	1. The mercury lamp does not work 2. The photoelectric signal had short circuit 3. The gas path had been blocked	1. Check the mercury lamp and power 2. Check circuit 3. Check the gas path
Low sensitivity	1. The absorption cell is dirty 2. The place of light is wrong 3. The amplifier has failure	1. Clean the absorption cell 2. Reposition the place of light 3. Check the amplifier
Unstable	1. Flat tire 2. The power is not stable 3. Bad earth 4. The amplifier is not stable 5. The temperature changes too much 6. The time for warm-up is too short 7. The absorption cell is dirty 8. The gas path is dirty	1. Check the gas path 2. Add a voltage stabilizer 3. Check grounding 4. Check the amplifier 5. Measure at a different time or use air conditioner 6. Warm-up for longer 7. Clean the absorption cell 8. Clean the air path

Reagents and Containers

All the reagents should be analytically pure, that mercury content should be as low as possible. Use pure water and deionized water is best. Various types of water have been described in GB/T 6682.

a. Argon and nitrogen: purity is not less than 99.99%.

b. Mercury: purity is not less than 99.99%.

c. Pharmacal Solution 50mL, drill two holes on the rubber which are inserted with glass pipe or stainless steel pipe. It's the container of the saturated mercury vapor.

d. Syringe: 1 mL.

e. Pipe: It's made of stainless steel. O.D. 1.4 mm, I.D. 2.0 mm. It's used for correcting instrument.

f. Pressure gauge: range from 0 to 10 MPa, index value is 0.1 MPa.

g. Mercury standard solution: Weigh 0.1354 gram mercury chloride and dissolve by fixative. Then dilute to 1000 mL. There are 100 micrograms mercury per mL. It can be diluted by nitric acid potassium dichromate solution to use. Must be prepared when using.

h. Nitric acid potassium dichromate solution (fixative): Weigh 0.05 grams potassium dichromate and dissolve in deionized water, add 5 mL of nitric acid and then diluted to 100 mL by deionized water.

i. 10% stannous chloride solution: Weigh 10 grams stannous chloride and put it in a beaker. Add 10 mL concentrated hydrochloric acid and heating until the solution becomes transparent. Diluted to 100 mL by deionized water after cooling (purging nitrogen to filter mercury if necessary).

Replacement of Wearing Parts

Reaction bulb: Reaction bulb is one of fragile articles. You can buy from us if it's damaged.

Washing Containers

Every glassware should be soaked in 1:1 nitric acid solution and then rinsed. Furthermore, put the glassware in the solution which includes 0.1% $KMnO_4$ and 2% H_2SO_4. Then heating for 30 minutes. If there is MnO_2 remaining, you can wash it by low concentration of oxalic acid.

Calibration of Flow Counter

Flowmeter

Gas calibrating state:

- Pressure: P_n = 760 mmHg
- Temperature: T_n = (20 ± 2.73)°K
  - Density of medium measured:ρAir = 1.205 kg/m³
  - ρH_2 = 0.084 kg/m³

Liquid Calibrating State

$\rho O_2 = 1.331\ kg/m^3$

$\rho N_2 = 1.165\ kg/m^3$

Liquid calibrating state:

Temperature:

$T_n = (20 + 273)\ K$

Density:

$\rho H_2O = 998.23\ kg/m^3$

Technical Parameter of Flowmeter

The technical parameter of the flowmeter must be stable during calibration. If there is a difference from the parameter above, we can use the following formula to correct:

(1) Formula when the density of medium is changed:

$Qs = QN \times \surd [((\rho F - \rho S) \times \rho N) / ((\rho F - \rho N) \times \rho S)]$

(2) Formula when the pressure and temperature are changed:

$Qs = QN \times \surd [(PN \times TS) / (PS \times TN)]$

In the Formula Above:

QN is flow at calibrating.

Qs is flow after corrected.

ρN is density of medium at calibrating.

ρS is density of medium after changed.

ρF is density of rotator from flowmeter at calibrating.

PS is absolute pressure of the gas measured.

PN is absolute pressure of gas at calibrating.

TN is absolute temperature of gas at calibrating.

TS is absolute temperature of liquid at calibrating.

PS: density of medium:

- Stainless steel (1Cr18Ni9Ti): 7900 kg/m³
- Duralumin: 2750 kg/m³
- Agate: 2600 kg/m³
- Bakelite: 2200 kg/m³

Calibration of Flow Counter

Material	**Grade / Purity**
Mercury standard solution	—
Concentrated sulfuric acid	GR
Concentrated hydrochloric acid	GR
Concentrated nitric acid	GR
Potassium dichromate	SP or PT
Stannous chloride	GR or AR
Potassium permanganate	GR
Sodium hydroxide	GR
Sodium peroxide	GR

Argon (nitrogen): purity ≥99.99%

(pure nitrogen, high purity nitrogen, pure argon, high purity argon)

Pressure gauge:

Main gauge (0–25 MPa), sub gauge (0–0.4 MPa)

Glassware

Volumetric flask

Capacity	Quantity
100 mL	10
1000 mL	1–2

Pipette

Capacity	Quantity
1 mL	5
2 mL	10
5 mL	5
10 mL	5

Beaker

Capacity	Quantity
50 mL	5
100–250 mL	2
1000 mL	1

Notes

1. The purity above are minimum requirements.
2. The gauge outfit of pressure gauge had better buy as the parameter above or buy from our U.S. or damage the solenoid valve.
3. The amount of glassware is given to customers for reference while selecting and purchasing.

Concentrations of Saturated Mercury Vapour at Different Temperatures

TEMP °C	Concn. ng/mL	TEMP °C	Concn. ng/mL	TEMP °C	Concn. ng/mL	TEMP °C	Concn. ng/mL
1	2.4	11	6.1	21	14.43	31	31.8
1.5	—	11.5	6.4	21.5	15	31.5	33
2	2.64	12	6.6	22	15.7	32	34.3
2.5	—	12.5	7	22.5	16.3	32.5	35.6
3	2.9	13	7.26	23	17	33	37
3.5	—	13.5	7.6	23.5	17.6	33.5	38.5
4	3.18	14	7.92	24	18.4	34	40
4.5	—	14.5	8.3	24.5	19.1	34.5	41.6
5	3.5	15	8.36	25	19.9	35	43.2

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Concentrations of Saturated Mercury Vapour at Different Temperatures

TEMP °C	Concn. ng/mL	TEMP °C	Concn. ng/mL	TEMP °C	Concn. ng/mL	TEMP °C	Concn. ng/mL
5.5	—	15.5	9.1	25.5	20.5	35.5	45
6	3.86	16	9.4	26	21.5	36	46.6
6.5	—	16.5	9.9	26.5	22.1	36.5	48.3
7	4.24	17	10.24	27	23.2	37	50.2
7.5	—	17.5	10.7	27.5	24.1	37.5	52
8	4.64	18	11.2	28	25.1	38	54
8.5		18.5	11.7	28.5	26	38.5	55.9
9	5	19	12.2	29	27.2	39	58.2
9.5		19.5	12.8	29.5	28.2	39.5	60
10	5.57	20	13.28	30	29.5	40	62.6
10.5	5.9	20.5	13.9	30.5	30.6	40.5	-

Mercury permeation tube

Mercury permeation tube can be used as sample to make standard curve. It has better performance.