DW-210&200
User Manual

Please read operating manual before installation and operation.

Drawell International Technology Limited

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Safety 1

Read this section carefully before using our instrument to avoid person injure or instrument damage accidents occurring. If those accidents occur because of transgress of this manual, user should bear responsibility for them.

1. If person hasn't been specially trained, the instrument must not be operated.

2. Do not install or use this instrument when falling short of the conditions and requirements mentioned in this manual.

3. Do not use this instrument in non-AA analysis or test.

4. Do not install or repair this instrument, and don't replace the accessories or software of instrument without the authority of Chongqing Drawell Instrument Co., Ltd.

5. To avoid the computer virus attacking the computer and making the system broken down, do not travel on Internet or play games in the computer special used for analysis.

6. Requirements of gas source storage.

(1) It is strictly prohibited that the oxygen steel bottle and the acetylene steel bottle are put together! The acetylene steel bottle should be stored in a well-ventilated room without any fire source or hidden fire danger nearby!

(2) Steel bottles should be stored nearby the laboratory. The distance must be more than 10 meters. The gas pipes should be prevented from impact, squeeze, roast and chemical corrosion.

(3) All steel bottles should be placed firm and avoid falling down. The gas steel bottles should be placed vertically. Fire caution must be marked in the room stored the steel bottles. Fire extinguisher must be equipped.

7. Requirements of gas use.

(1) Acetylene is combustible and detonatable gas, so good ventilation must be provided when using the instrument. Draught apparatus must be installed above the instrument.

(2) Draught apparatus should run for ten minutes before starting the analysis and let the draught apparatus go on running for ten minutes after closing the instrument. Other device with flame or electric spark must not be used in instrument room.

(3) Check all valves and pipes if there is gas leakage before using the instrument. If so, stop using and replace new pipe or new valve.

(4) Be sure that the acetylene switch on the instrument is in "OFF" status before opening the main valve of acetylene steel bottle. Open or close the main valve of steel bottle with a special spanner. Do not knock it. The main valve can be turned 1~1.5 circles in maximum. Check the main valve with soap water regularly (three times a week). If the leakage exists, replace it in time. Operation procedures of the oxygen steel bottles are the same as the acetylene.

(5) After the analysis, firstly close the main valve on the acetylene steel bottle. When the acetylene in pipe is burned out, the instrument can be powered off. Then shut off the acetylene switch and air compressor. Avoid the acetylene left in the instrument.

(6) There is solvent, such as acetone in the acetylene steel bottle. If the exit pressure is less than 0.5MPa, it is required to replace a new steel bottle to avoid the solvent flow out. The acetylene pressure meter on the steel bottle should be checked regularly. Ensure the meter to show the correct output pressure value.

(7) If the humidity in the instrument room is more than 70%, the dehumidify apparatus should be started to make the humidity being less than 50%.

8. Check if the water seal is good enough before ignition! Otherwise flashback will be occurred.

9. The cathode metals of some hollow cathode lamps are harmful to human body or pollutant. When they are damaged or obsolete, handle with them according to laboratory standard methods, and do not throw them away randomly.

Safety 2

1. Characteristics of acetylene

(1). Physical and chemical characteristics

Appearance: achromatic and liquefied solution gas.

Flavor: pure and flavorless, but the acetylene has been sold on the market with some special garlic flavor.

Molecular weight: 26.04

Molecular formula: $C_2 H_2$

Boiling point: -75℃

Melting Point: -82.2℃

Flash Point: -18℃

Explosion bounds: low explosion limited: -2.55%, up explosion limited: -81%

Digestion temperature: --

Auto ignition temperature: 305℃,

Density of vapor (air=1, 20℃): 1atm: 0.906

Density of the liquid: (-82℃), 1atm, 0.621

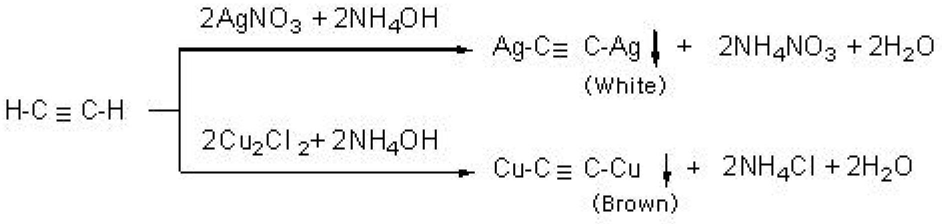
Pressure of the vapor: (21.1℃), 4.375Mpa

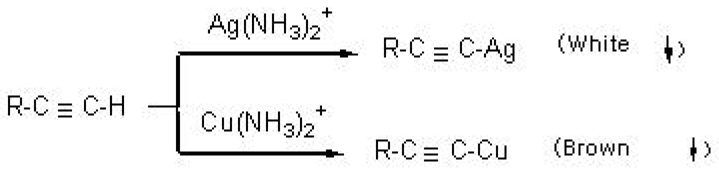
Specific volume: (20℃), 1atm....................$9.17\times10^{-4}m^3/g$.

Solubility in acetone: 15℃, 1atm, $20m^3/m^3$
15℃, 12atm, $240m^3/m^3$

(2). Generation of the acetylene

Hydrogen atom on the triple bond is weak acid. (PK_a=25), it can be replaced by metal element, and generate the acetylene.





The reaction generating acetylene Ag or Acetylene Cu is very sensitivity, and the phenomenon is sharp. So acetylene and end-base alkyne can be identified by these.

The dry acetylene Ag or Acetylene Cu blow up easily when they are heated or be shake and then create metal and carbon.

$$Ag\text{-}C\equiv C\text{-}Ag \longrightarrow 2Ag + 2C + 364KJ/mol$$

After finish the experiment, please add the hydrochloric acid immediately to decompose the acetylene series to avoid the dangerous.

(3). Chemical stability and reaction activity

Chemical stability: instability

Harm decomposed material: Hydrogen and carbon.

Conditions should be avoided: avoid explosion and whenever cylinders lay down. Using pressure can't exceed 15 Psing, the steel cylinder should avoid the temperature higher than 45℃, and avoid crash and fire source.

Materials should be avoided: oxide, halogen, and halide.

Toxicity: no toxicity but lead asphyxia.

Part effect: sensitization.

Slow toxicity or long-term toxicity: NPT, IARC, or OSHA Subpart Z hasn't been list within the carcinogen or incubation carcinogen materials.

2. Safety requirement for acetylene gas

Users should know and understand something about the configuration of cylinder and the characteristics of the acetylene. The following basic safety rules are described, such as: storage, operation and using guide of the acetylene cylinder.

1. Configuration and requirement of the steel cylinder.

(1). The empty cylinder with standard dimension is equipped with gas compressor devices including: safety reducer device, valve and protecting cap.

(2). Each cylinder is fulfilled with multi-hole filter material, including: diatomaceous earth, char, asbestos and cement. Acetylene cylinder is filled with packing material and dissolvent

(3). Acetone is fulfilled in the cylinder and all of the packing material. The acetone is solvent, it can dissolve the acetylene gas filled in the cylinder. Acetylene gas can be stored and used in the cylinder.

(4). According to the requirements, the working pressure should be 1.72Mpa while the temperature is 21℃, Originally, when the pressure is reached up to two or three times of the working pressure, make the fluid statics detect on the cylinder. The acetylene cylinder should be check and recognized timely. Cylinder body must be re-recognized within ten years from its production. And per ten years it should be recognized. The cylinder body and packing materials only can be recognized by the authorized organizations.

(5). The physical description of the cylinder.

Size	Cylinder Net weight（kg）	Gross Weight（kg）	Gas volume （m^3）
1	21.32	23.81	2.123
2	31.75	35.83	3.679
3	45.36	51.26	5.377
4	79.38	89.70	9.339
5	83.92	95.14	10.188

2. Storage, transportation and usage.

Storage:

(1). Place the cylinder in the site where is satisfied ventilation, safety, and protection against the shine and rain. Temperature of the storage area can't exceed 40℃, and there mustn't put combustible materials, Strictly prohibit the smoke and fireworks. Keep distance from stuffed area and urgent exits.

(2). The cylinder should be put firmly and upright with proper locked valve outlet cap and valve protection cap. Residual and full cylinder should be separately placed. Using the “First in first out” principle to avoid the exceeding the valid.

(3). Close the valve when it is unused. Far away from heat source, fire source or incompatible materials such as oxide more than 8 meters. Or set a 1.5m high fire wall. fire prevention speed of which should not less than half an hour.

(4). Grounded ventilation and electric devices without spark should be used to avoid fire.

(5). Termly check cylinders for breakage and leakage. Protect the cylinder bottom to avoid contacting damp floor.

(6). Make cautions on proper places. Treatment and storage should abide principles of inflammable and compress gas.

Transport:

(1). Forwarders should have been trained for the special dangerous materials principles.

(2). Special transport ways and cautions: Fixed and standing upright on the truck with well ventilation conditions. Cylinders mustn’t be transported in the back case of cars. Make sure that the valve cap and cylinder cap have been re-installed and locked well.

Usage:

(1). For cylinders, pull, push, roll or kick is prohibited. Cylinders should be transported by the special trammers. Strictly prohibit hanging cylinders with cap. Make sure cylinders are fixed while it is in using.

(2). Prohibit to operate cylinders rudely and unconcernedly to avoid cylinders and the packing materials damage.

(3). Using check-valve to avoid reverse flow enter the cylinder. Strictly prohibit fire. Cylinder body is prohibited heating.

(4). Leakage checks of pipelines and equipments must have been done before usage. Suds should been used to check pressure regulator, pipelines and connectors of cylinders. Leakage makes acetylene accumulate in a narrow space, and the concentration will reach, the low limit, 2.5% of inflammable range in air.

(5). Steel and wrought iron are recommended be of the acetylene duct materials. Pressed-steel, cast-steel, or cast iron device can be used, except pig-iron. Explosive acetylene series may generate if those materials used. Pure copper, pure silver or mercury are prohibited to contact directly with cylinders. Copper, 70-30 brass or aluminum bronze with damp acetylene will generate explosive acetylene series. Use weight but pressure to determine the acetylene quantity. Gross weight includes cylinder, packing materials, acetone, valve, saturated gas and safety plug, but except cylinder cap. Subtract real weight from gross weight, and then multiple 9.17×10^{-4}， then you can determine the gas quantity in m^3 unit.

(6). Please gently turn on the cylinder valve when it has been connected with the instrument. Stop immediately and inform vendor if there is any difficult. Prizing up the cylinder cap by screw driver or spanner is strictly prohibited, to avoid valve damage or gas leakage. Adjustable ringed chain spanner should be used to open the tighten cylinder cap. The cylinder valve can’t be turned more than 1.5 circles. In order to decrease quantity of the injection solvent to the minimum, users should know: In discontinuous using, injection quantity of the acetylene should not more than 1/10 of the cylinder volume; in continuous using, injection quantity of the acetylene should not more than 1/15 of the cylinder volume.

(7). Make sure to use full-filled cylinders. Mark clearly on empty and residual cylinders to defines their using status.

(8). When the cylinder is unused or empty, turn off the valve. Never use off the gas to avoid air entry and pressure release inside of the cylinder. Lock valve outlet cap by torsion spanner after completed the determination. After off duty or complete the daily determination turn off the cylinder cap, and release pressure inside of the pressure regulator and instrument. It is needed to equip the emergency devices to put out fire or deal with the gas leakage.

(9). Mark these statuses to caution manufactory: sharp or deep depressed, cut or any other mechanical damages. Prohibit any person to repair cylinders except its manufactory. Experienced person are allowed to deal with the waste cylinder.

(10). Safety glasses, safety shoes and normal gloves are recommended to use in cylinders operations.

3. Project Control:

Provide natural and explosion-proof ventilation conditions to keep the concentration less than the explosion limit.

4. Treatment of the waste gas.

(1). Unused and residual gas:

Return to vendor; never try to deal with them.

(2).Burn off the residual gas, inside the system if there are proper devices at the spot. Caution never to pollute the environment.

5. Harm level

Healthy 0

Flammability 4

Reactivity 3

Level: 0 least; 1 slight; 2 normal; 3 high; 4 terribly;

3. Safety requirement when using air-acetylene flame operation or analyzing samples such as copper, mercury and silver.

According to above description of the chemical and physical characteristics, copper, mercury and silver with acetylene will easily generate metal acetylene compound, which might decompose and explode under heat impact. So when air-acetylene flame operation is selected, in particularly, the above three elements as the base element of samples, abide the following rules is needed.

1. From outside connector of the instrument to acetylene source in the lab, all the connectors and pipelines mustn't use copper, silver, mercury or their alloy materials.
2. When complete determinations or the air-acetylene operation will not used the right day, turn off the cylinder valve under igniting state.
3. Before determination by air-acetylene flame operation, firstly unpack instrument cover, power on the ventilation device above the instrument for about 20 minutes to avoid explosion. The explosion caused by the storage gas can damage the instrument.
4. Termly check the pipelines, connectors and valves for leakage. Repair the leakage points timely. Especially for the storage instrument. Strictly check is needed for them is much needed.
5. Dilute samples as possible within the sensitivity range of the instrument while the copper, silver or mercury concentration is too high in the samples.
6. When determinate the high concentration samples of copper, silver or mercury, injection and

spry time should not too long. Spray de-ion water for 5~10 minutes after each sample's injection.

7. After completed all determinations, inject and spray de-ion water for 20 minutes.
8. Termly (once a week) check the spray burner system to eliminate the residual materials of high concentration samples solution。
9. If there is some slightly explosion sound or any other abnormal sound, extinguish the fire at once, then check every part of the spray burner system.
10. When the flame operation is selected, users should try one's best to avoid compress, crash or other pressure impact.

4. Treatment of the accident

1. For acetylene is flammable gas, special carefully when put out fire until all of the acetylene sources are cut off. It is very important to avoid gas accumulated in a short time because it can cause fire and explosion. The fusible metal plug on the top an d base of the cylinder can melt down at 100℃. In case the fusible metal plug release, the fire can spray about 4~6 meters away from the top and base of the cylinder.

(1). If the cylinder got fire and linked other cylinders, spray water to the other cylinders to get down their temperatures. It is very important to avoid their fusible metal plug being heated melt down.

(2). If all cylinders got fire, evaluate the area. Leave experienced person to take charge the spot. Turn off the valve if possible to cut the acetylene flow, and then put out the flaming materials. Burn off the residual gas if stopping the leakage was impossible. It is to avoid gas accumulate and the caused inflammable mixture gas burning.

Special harm when put out fire:

(3). Suitable fire-extinguish solvent

Chemical powder, carbon dioxide or water can be used. Water is prohibit use before turn off the cylinder.

(4) Special equipment needed for firemen:

Fire-proof dresses and must take official SCBA.

Materials generated by the burning: CO and CO_2.

2. Emergent treatment of abnormal leakage.

(1). Evacuate the area.

(2). Use suitable fire-proof equipment.

(3). Check concentration if it is higher than 2.5%, fire and explosion will occur immediately. If the concentration higher than 10% of the low explosion limit, people and carriage are prohibit enter.

(4). Eliminate all fire sources; use the maximum size of explosion-proof ventilation device. And cut sown leakage source if it is possible.

(5). Insulate the leaked container.

(6). Inform the vendor if cylinder leaked.

(7).Turn off the cylinder valve and release the pressure safely if the pipeline inside of the instrument. Blow the pipeline with inert gas before repairing.

Content

Chapter 1 Description

1.1 Applications

The atomic absorption spectrophotometer is an inorganic analysis instrument. It can be widely used in the quantitative analysis of the microelements and trace elements in the metallurgical, geologic, oil, chemical, medicine and health, industrial, farming and forestry, commodity inspection and environmental protection fields, etc.

It can determine more than 70 elements. Along with the instrument accessories increasing and the analytical technique developing, the Analytical fields are extended continually; the objects to be determined are from element to morphotype (valence and morphogenesis), and from non-metal anion and gas phase molecule all can be directly or indirect analyzed.

1.2 Main Features

1.2.1 Model DW-210 Atomic Absorption Spectrophotometer is currently the newest model, with highly automation.

1) Auto-sampling system is provided to the graphite furnace method. Its sampling range is 1 ~ 100μl. The smallest sampling volume is 1μl, with the perfect sampling accuracy and high repeatability precision. It can completely substitute the whole process of manual sampling, also with the functions of automatic dilution, matrix modifier, automatic curve, a big amount of cleaning, change-over each other of single-step sampling and continuous automatic sampling, etc, to make the graphite furnace analysis more accuracy, stable and reliable.

2) The gas piping control of the flame analytical method adopts a flow automatic controlling system, which can directly receive the control signal and automatically set the gas flow in every piping passage (acetylene and oxygen, not including the air piping) according to this signal. It makes the flow of the controlled gas much more accurate, better resetting, thus the process of repeated adjusting flow is simplified. In addition, the system also has the following functions: automatic ignition, abnormal flameout, alarm for fuel gas leakage, short of air pressure and bigger deviation of the controlled flow and various kinds of automatic safe protection devices, etc. Therefore, the automation degree and operation safety in the flame method can be greatly improved. Furthermore, a new type oxygen-enriched air-acetylene flame is adopted on DW-210 AAS instrument (patent has been approved by China). The flame temperature can be changed continuously from 2300°C to 2950°C. Compared with the nitrous oxide-acetylene flame, the gas source is easily to be obtained without polluting the environment. For analyzing the high temperature elements (such as: Ca, Sr, Ba, Eu, Yb, Mo, Ga and Sn, etc.), the oxygen-enriched air-acetylene flame is more outstanding than the air-acetylene flam and the nitrous oxide-acetylene flame.

3) Flame/flameless integrated atomizer is a new type atomizer system. Its functions are: auto-changeover for the analysis methods, auto-optimization orientation of graphite furnace and auto-setting for the flame height. The system simplifies the working intensity during exchanging with each other, and meanwhile the complex adjusting process is avoided.

4) Automatic seeking peak and wavelength scanning functions are provided. With respect to the background correction, besides the deuterium lamp background correction technology, it also adopts the self-absorption effects background correction technology (Called" S-H method "). Therefore the instrument has high capability of the background correction.

1.2.2 Specifications

Configuration	Background correction	Analytical method
Main unit; Air compressor; Photo-controlled graphite furnace and power supply; Auto-sampler of graphite furnace; atomizer; computer; printer	D_2 lamp background correction Self-absorption effect background correction	Air-acetylene flame Oxygen-enriched air-acetylene flame Graphite furnace analysis Flame emission analysis Hydride analysis

1.2.3 The data processing system of the common personal computers is used in the instrument. The absorbance, the standard deviation and the relative standard deviation are all displayed on CRT. It can also indicate and print the working curve and the instantaneous signal diagram. The instantaneous signal diagram overlapped can be also displayed for the convenience of observing the change of the instantaneous signal to provide the analyzers with more subjective information for optimizing the conditions.

1.2.4 Higher sensitivity. The characteristic concentration measured in the flame method is from mg/L to µg/L (characteristic concentration of Cu is not more than 0.04mg/L/1%). The characteristic energy determined by the graphite furnace method is in the range of 10^{-10}~ 10^{-12} (characteristic energy of Ge is not more than 1×10^{-12} g).

1.2.5 Photo-controlled graphite furnace system adopts FUZZY-P.I.D (ambiguity-Proportion-Integration-derivativation) technology, double working curves method, with quick temperature-rising and accurate temperature control. It has temperature self-calibration function, improve its adaptability to the environment. Temperature-control precision will not be affected by electric net wave and resistance change of graphite tube.

1.2.6 The instrument has high-performance HCL supplying system. High-performance HCL has following advantages: high spectral line intensity, low background. Its light intensity is 10 ~ 20 times larger than common hollow cathode lamp, which is convenient for improving the analytical performance.

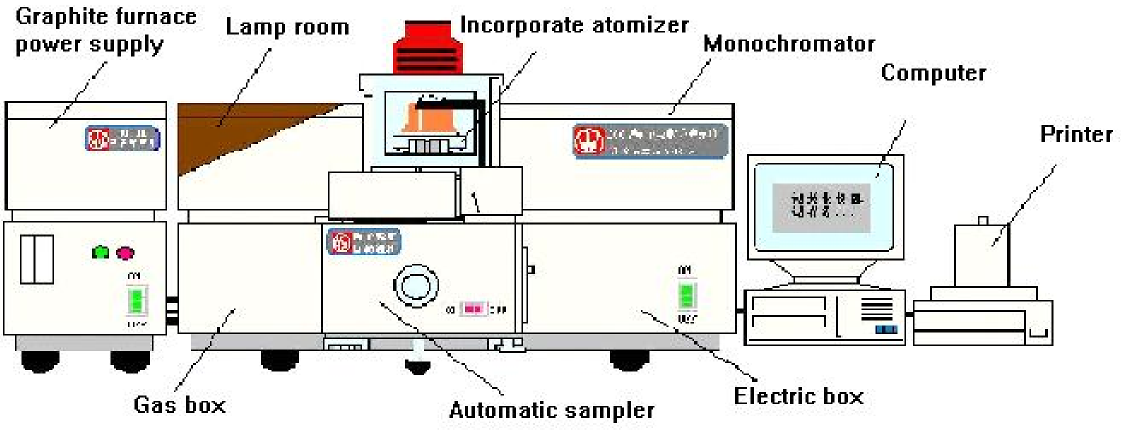


Fig. 1-1 Effect Diagram of WFX-200 Atomic Absorption Spectrometer

1.3 Instrument Structure

1.3.1 Main unit.

Main unit is composed of “Light source chamber”, “Sample housing”, “Monochrometer”, “Gas box”, and “Electronic box”.

Light source chamber: To install hollow cathode lamp and deuterium lamp. Six lamps can be ignited at the same time, they can be automatically exchanged. Two lamps of them with high performance are available for the use..

Sample housing: To install an atomizer. An integrated atomizer is provided, that is flame atomizer and flameless atomizer are integrated as one assembly. When changing analysis method, the flame atomizer/flameless atomizer will be automatically exchanged by pressing the keyboard of the computer. Turn the switch valve to change locking state of the graphite furnace.

Monochrometer : It is C-T type grating monochromator. It consists of optical system, sine mechanism wavelength scan system and slit system.

Gas pipeline box: It is a gas control system. It consists of three gas passages of air, acetylene and oxygen.

Electronic box: It is electronic control system.

1.3.2 Power supply of graphite furnace: It is power supply of atomizer of graphite furnace. The photoelectric temperature measurement and fuzzy temperature-control technology, etc are adopted.

1.3.3 Computer: It is data processing system of the instrument.

1.3.4 Printer: data output system.

1.4 Operating Principle

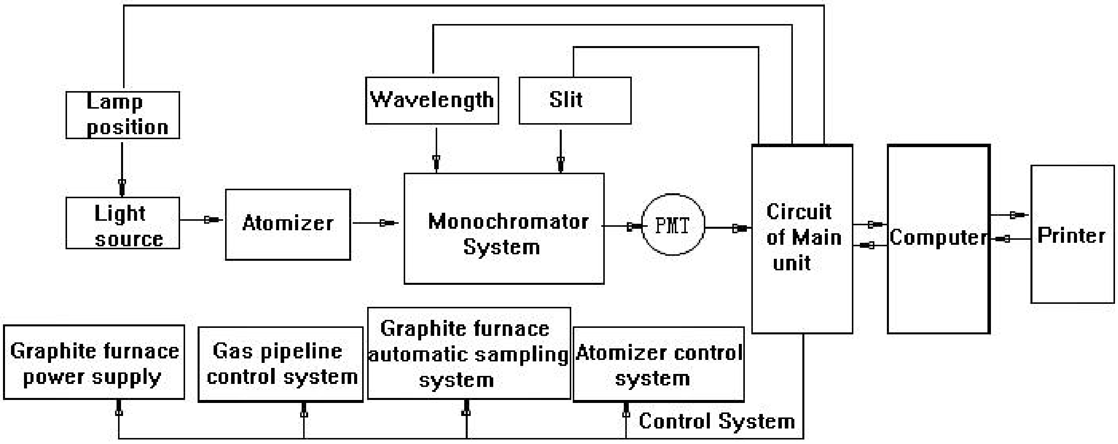


Fig. 1-2 Principle Diagram

The working principle of the instrument is described as follows:

The light source is used to emit the characteristic spectral radiation of the element to be determined, which will be absorbed by the ground-state atoms of the element to be determined in the sample vapor generated by the flame atomizer or, the graphite furnace atomizer. By measuring the absorbed quantity of the characteristic radiation, the content of the element to be determined will be calculated according to the function relation between the change of the light energy and the concentration of the element to be determined (Beer's law).

The working principle of background correction device is described as follows:

Even though the technology of the self-absorption effective background-correction and deuterium background correction has utilized the different physic principle, for the correction background absorption device, the working principle is the same----to utilize double beam of Varity characteristic produced against the different absorption of atomic spectral line and molecular spectral line to deduct the background absorption signal so as to decrease the influence on the atomic absorption signal. Atomic spectral characteristic emitting line in the radiation light of hollow cathode lamp is absorbed by the atomic vaporization of the element to be determined in the sample, also absorbed by the coexistence matters vaporization, so the atomic absorption signal plus the background absorption signal are generated, that is AA + BG. When the continuous spectral radiation of the deuterium lamp is passing through the sample, it is absorbed by the coexistence matter in the sample to be determined to produce the background absorption signal. Meanwhile, a little amount of the atomic absorption signal also exists at the wavelength of the atomic characteristic spectral line, it is : AA' + BG'. The light signals which two beams are alternately passed through the sample will go through the detection system and data processing system of the instrument, and assume that the background absorption signal produced by two beam light signals are equal with each other (BG = BG'), therefore the net atomic absorption signal after the deduction with each other: AA + BG – (AA' + BG') = AA – AA'.

For more detailed operating principle of atomic absorption spectrum method, please refer to relevant spectroscopic books.

Operating procedures of the instrument are described as follows:

1) After connection of the instrument and the computer and powering on, the hollow cathode lamps selected are lit by the computer to control the main unit;
2) The radiation light of the hollow cathode lamp after pulse modulation is firstly passing through the atomizer and then is entered into the monochromator;
3) The monochromator will select the characteristic wavelength radiation of the element to be determined to enter the photomultiplier (PMT), to complete the conversion from the light signal to the electric signal and feedback to the computer.
4) The negative high voltage (gain value) of PMT is automatically adjusted by the computer, such adjust the light energy (AA) of the hollow cathode lamp to be 100%;
5) Use the flame method or the graphite furnace method to make the element to be determined in the sample formed to free atomic vaporization of the ground state, absorb the characteristic wavelength radiation of the element to be determined emitted from the lamp;
6) After passing through the photoelectric detection system, the change magnitude of the light signal is conversed to the change magnitude of the electric signal to feedback it to the computer;
7) The computer will calculate the absorbance value of the sample according to the signal change magnitude and use a group of given concentration sample to be corresponding to the absorbance value to fit the working curve;
8) Measure the absorbance value of the unknown concentration sample, and then calculate the sample concentration according to the working curve.

1.5 Main Technical data

1.5.1 Wavelength range and wavelength accuracy

Wavelength range: 190~900nm;

Wavelength accuracy: ≤± 0.25nm.

1.5.2 Resolution

It is able to resolve the wavelengths of 279.5nm and 279.8nm, energy value of wave valley between two spectral lines should be less than 40% of wavelength energy of 279.5nm.

1.5.3 Typical characteristic concentration of element (characteristic quantity), detection limit and precision

Characteristic concentration, detection limit and precision are measured by the flame method:

Element of Cu, measuring wavelength: 324.7nm.

Air-acetylene flame: Characteristic concentration: ≤0.04μg/ml/1%.

Detection limit: ≤0.007μg/L. Precision: ≤1%

Characteristic concentration of oxygen-enriched air-acetylene flame method.

Element of Ba, measuring wavelength: 553.6nm. oxygen-enriched air-acetylene flame:

Characteristic concentration: less than 0.22μg/ml/1%.

Characteristic quantity and precision determined by the graphite furnace method

Element of Cd, measuring wavelength: 228.8nm.

Characteristic quantity: $\leq 1\times10^{-12}$ g. Precision: ≤5%.

1.5.4 Baseline stability and Noise level

The zero drift of static baseline within 30 minutes is less than 0.005Abs. The zero drift of dynamic baseline within 10 minutes is less than 0.005Abs. Peak value of baseline noise peak is less than 0.001Abs.

1.5.5 Background correction ability

Deuterium lamp background correction method: when the background absorption value is near 1Abs, the background correction ability is more than 30 times;

Self-absorption background correction method: when the background absorption value is near 1.8Abs, the background correction ability is more than 30 times.

1.5.6 Calibration curve linearity

Measure the element of Cu with the flame method. The linear range of the calibration curve is more than 0.6Abs, the relative coefficient of the linearity is not less than 0.995.

1.6 Specification and Standard Configuration

Wavelength range: 190~900nm

Light source: hollow cathode lamp and deuterium lamp

Modulation mode: square-wave pulse

Modulation frequency: 400Hz (without background correction mode or deuterium lamp background correction mode)

100Hz (self-absorption background correction mode)

Photometric system: C-T type monochromator

Dispersion component: plane, diffraction grating

Ruled density: 1800 lines/mm

Blazed at wavelength: 250nm

Focal length: 277mm

Spectral bandwidth: 0.1, 0.2, 0.4 and 1.2nm

Wavelength adjustment mode: automatic peaking, spectral line scanning

Photometric type: single beam

Atomization system: flame method. 100mm single slot burner

Integrated atomizer

Hydride method: selectable hydride generator

Ignition mode : auto-ignition

Protection measures: safety protection and alarm for flame extinction;

Safety protection and alarm for ignition failure;

Safety protection and alarm for air pressure deficiency;

Safety protection and alarm for fuel gas leakage of gas pipeline box;

Safety protection and alarm for big error of control flow rate.

Data processing system: measuring mode: absorbance, concentration, content and emission intensity, etc.

Readout mode: instantaneous value, integral value, peak value and peak-area value, etc.

Indication mode: data, signal graph and fitting curve, etc.

Signal processing function: standard curve and standard addition method, 1~10 standard sample numbers for option, resetting slope and statistical average, etc.

Information save method: Available to save the operating conditions, analytical data table, analytical report and signal graph, etc.

Power requirements:	220V, 50Hz, 1500VA (including computer, display unit and printer)
Dimension:	107 (L) × 49 (W) × 58 (H)cm^3
Weight:	140kg

1.7 Base Safety Requirements of Instrument electronic Protection

When the instrument is working in normal case, it should comply with JB5517 requirements.

1.8 Transportation and Storage

During the transportation, rain, sun shinning and strong crash must be avoided. The packing boxed packed the instrument should be stored in the storage room and kept it well. The environment conditions while shipping and storage should be as follows:

1) Temperature range: -40℃~55℃

2) Relative humidity range: ≤95%

3) Height of incline drop:250mm.

Chapter 2 Operating Environment and Facility Requirements

2.1 Normal operating environment of instruments

2.1.1 Ambient temperature: +10°C~+35°C

2.1.2 Indoor relative humidity: <85%

2.1.3 Sea level elevation: 0~4000m

2.1.4 No strong magnetic field interference.

2.1.5 No vibration in the room

2.1.6 Clean and dry in the room without dust and corrosive gases.

2.1.7 No open flame, no electric heating and no devices which easily produce arc spark.

2.1.8 A qualified discharging rod should be mounted on the top of the outer wall of the laboratory, Its grounded point should be far away from working grounded wire.

2.2 Essential Conditions of Laboratory

Before the installation of the instrument, be sure the following conditions are satisfied with the requirements of the installation.

2.2.1 Requirements of power supply

1) Voltage, frequency and power of power supply
   a. Main unit: single phase AC 220V±22V, 50Hz, total power 1500VA, but 1000VA more or less is used the computer, display unit and printer. Self consumption power of the main unit is 500VA.
   b. Power supply of air compressor: single phase 220V±22V, 50Hz, 240W.
   c. Graphite furnace power supply: AC 220V, 50Hz, 4KW, instantaneous output power 6KW
   d. Auto-sampler of the graphite furnace: single phase AC 220V±22V, 50Hz, 60W.
2) Wiring mode
   a. Recommend that main unit, computer, printer and auto-sampler should be powered by regulating power supply. Wiring mode of distribution board in the laboratory and specifications of the plug-in are shown in Fig. 2-1.
   b. To provide power supply to the laboratory, great attention should be paid that the supply phase cables of big power devices and producing strong magnetic field devices must be separated from cables used for the instrument
3) Earth connection

   To insure the smooth working of the instruments and the safe operation, the ground wire of the instrument must be connected to one square-meter metal plate which is directly buried in the earth of 1.5M and the grounding should be humidity and no rock.

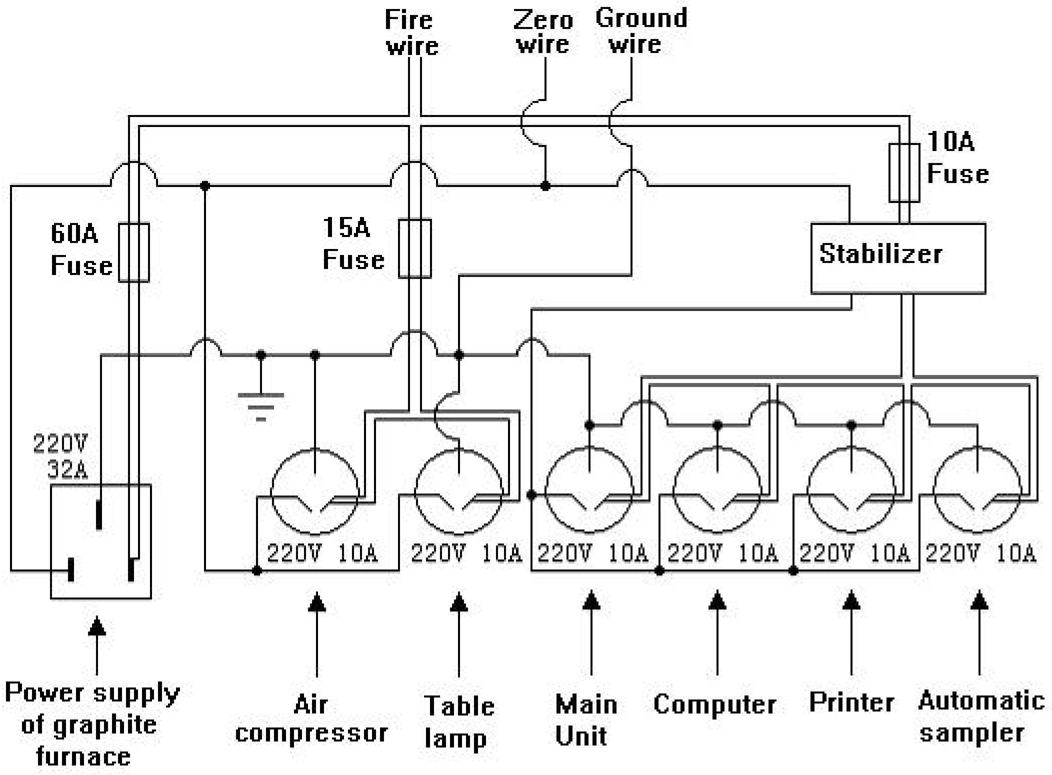


Figure 2-1 Schematic Diagram of Switchboard Electric and Socket Specification of Laboratory

2.2.2 Gas Source Requirements

1) Required gas

a. Compressed air: the outlet pressure of the air compressor is adjusted to 0.3MPa, which is used for the flame method.

b. Acetylene gas: when the steel cylinder is used to store the acetylene gas, it is necessary to be provided with the pressure-reducing regulator. The outlet pressure should not be less than 0.05MPa and not larger than 0.1MPa. The purity of the gas should be the analytical purity (>99.99%) used for the flame method.

c. Argon gas: The steel cylinder is used to store the argon gas. It is necessary to be provided with the oxygen gas pressure-reducing regulator or argon gas pressure-reducing regulator. The whole pressure range is 0~25MPa. The adjustment range of the outlet pressure is 0~0.4Mpa. The purity should be 99.99%. It is used for the graphite furnace method or the hydride method.

d. Oxygen gas: The steel cylinder is used to store the oxygen gas. It is necessary to be provided with the oxygen gas pressure-reducing regulator. The outlet pressure is 0.1MPa~0.12MPa used for the oxygen-enhanced air-acetylene flame method.

2) Storage Requirements

a. The acetylene steel cylinder should be stored independently in the room with good ventilation and be far away from the fire sources. But they should be stored in the place nearby the working zone. **It is prohibited to store the oxidation gas and the fuel gas sources in the same room.**

b. The argon cylinders and the air compressor can be stored in the laboratory.

c. All the steel cylinders must be put to be stable, firm and right up.

2.2.3 Requirements for the cooling water

The cooling water is used for the determination of the graphite furnace method.

a. It is permissible to use the tap water or the cooling cycling water systems with the flow rate over 1.9litre/minute.

b. At the water outlet of the water source, there should be provided with the pipe jointer which fit with the plastic pipe with ID ϕ8mm.

2.2.4 Ventilation Requirements

a. When using the atomic absorption spectrophotometer to analyze elements, many gaseous substances will be created. Therefore the laboratory must be equipped with ventilating facilities.

b. The ventilating port should be mounted above the atomizer of the instrument. For the dimensions and the installation of the ventilating facilities, please refer to Figure 2-2.

c. For the ventilation rate, put a piece of paper at the ventilating port, if it is sucked slightly, that shows it is OK. If the ventilation is too strong, it will affect the stability of the flame. If it is too weak, it cannot exhaust the gases well. The ventilation rate of the discharge fan should be 10~20m^3/minute, depending on the size, length and direction of the discharge pipe.

d. It is better that ventilating facilities are made of metal, while not plastic.

2.3 Other Requirements for the Laboratory

1) Work-bench

(1) The dimension of the work-bench is 300 (length)×110 (width) ×70 (height) cm^3.

(2) The work-bench should be firm, even and deformation free with load.

(3) The table surface should be even. It should be covered with anti-vibration and erosion-proof plastic plate or rubber plate.

(4) When putting the work-bench, it is better to leave some space around the work-bench to make easy connecting the gas pipes behind the instrument and easy maintaining the instrument.

2) This instrument is an integration precision instrument of optics, machinery and electrons. Therefore the operation environment should be clean and dust free. The room temperature should not have apparent fluctuation. The air conditioning equipment must be installed in the instrument room.

3) The atomic absorption spectrophotometer is a large precision instrument. To prevent the acid, alkaline or other erosive gases from etching the instrument, the atomic absorption laboratory must be set apart from the chemical laboratory.

4) For the laboratories using the graphite furnace to carry out the trace or super trace analyses, there are strict requirements on the indoor cleanness. The normal indoor air pressure is positive pressure and the air should be filtered. The floor and wall should be furnished with dust-proof materials to meet the requirements of the cleanness. Especially for Ca, K, Na, Mg, Si, Zn and other elements that are easy to be seriously contaminated by the environment, it is permissible

only to use the laboratory furnished with the inert plastic polytetrafluoroethylene. To obtain precise measuring result, be carefully to touch the containers of the reagent and make sure the environment is clean and sample to be determined without contamination

5) For avoiding virus to damage the computer system, strictly forbid to view Internet or play games on the specialized computer.

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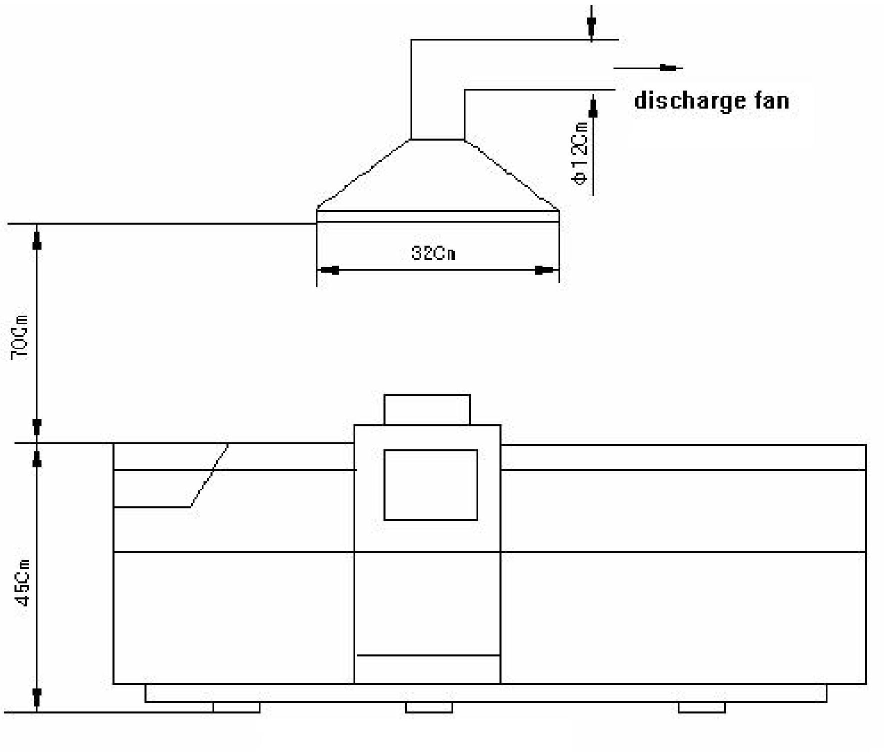


Figure 2-2 Schematic diagram of installing the discharge fan

Chapter 3 Installation

3.1 Commodity Inspection

After the instrument is received, it is necessary to immediately check and accept the goods according to the shipping documents and determine whether the name and quantity comply with the contract and the transport invoices or not. Moreover it is necessary to check whether the package of the instrument is in good condition and there is apparent damage after the transportation. If there is any damage, contact the commodity carrier or your local dealer.

3.2 Unpacking

3.2.1 After unpacking the instrument, take out the technical documents and check whether the spare parts are complete according to the packing list, at the same time check whether the instrument is damaged after the transportation. If there are any problems, immediately inform the local dealers.

3.2.2 Carefully read the instructions of the instrument and get familiar with the principle, structure and application of the instrument.

3.2.3 Prepare the operating conditions of the instrument and the essential conditions of the laboratory according to the requirements set forth in this instruction manual. Then carry out the installation of the instrument under the instructions of this chapter.

3.2.4 Check and accept the main performances of the instrument.

3.3 Installation

After having prepared all the essential conditions of the instrument in laboratory according to the requirements set forth in Chapter 2 of this instruction manual, open the packing boxes and check the instrument if it is in good condition. It is to carry out the installation and adjustment of the instrument according to the instruction of this chapter.

3.3.1 Necessary parts

3.3.1.1 Hollow cathode lamps: User should purchase hollow cathode lamps according to the analytical purpose in exception with the hollow cathode lamps equipped with the instrument.

3.3.1.2 Prepare several plastic barrels of 5~10-liter with caps to contain waste liquids and de-ionized water. Pay great attention to make the obverse marks on the barrels with different uses. Moreover it is better not to use the glass container to contain the waste liquids.

3.3.1.3 Printing paper: A4 duplicating paper.

3.3.1.4 Common tools: except the standard screwdrivers and the internal hex wrenches equipped with the instrument, the user should prepare several screwdrivers, monkey wrenches and vice clamps of different size.

3.3.2 Installation of Instrument

3.3.2.1 Take out the main unit, all the accessories and parts from the packing boxes and install them in the laboratory. From left to right, they are the power supply of graphite furnace, the main unit of instrument, the computers and the printer.

3.3.2.2 The main unit should be placed on the work-bench to make two support feet of auto-sampler opening to the work-bench's edge. (Refer to details of the operation manual of auto-sampler). Firstly make sure that the hold-down feet are firmly stand on the surface of the bench. If it is not so, adjust three rubber hold-down feet (totally six feet, there three feet are used to fix the feet) on the bottom of the main unit to make the instrument stable and firm.

3.3.3 Installation of main unit and connection of electric circuit.

The wiring of the internal electronic system of the main unit has been done before the delivery. If the instrument has not any abnormality, please don't anyway change or dismount the internal wirings. The following is the wiring of the main unit and the external electronics.

Behind the instrument, there are four sockets. From left to right, respectively they are:

3.3.3.1 Socket of connecting computer: marked with the letter "PC" or computer icon , with 9-hole D type socket. It is connected to the COM2 of the computer via the "PC communication" cable.

3.3.3.2 Socket of connecting to the power supply of the graphite furnace: marked with the letter "power supply of graphite furnace" of the icon of graphite furnace power supply , with 9-pin D type socket. It is connected to the "COM" socket of the power supply of graphite furnace via the communication cable equipped with the graphite furnace power supply (please pay attention to the mark on the cable connections).

3.3.3.3 Socket of connecting to auto-sampler of graphite furnace: marked with "auto-sampler" or the icon of auto-sampler , with 9-pin D type socket. It is connected to the "COM" interface of auto- sampler with automatic sampler cable (please pay attention to the mark on the cable connections).

3.3.3.4 The characters of "198~242V 50Hz" are marked on the socket of the power supply. It is the three-core power supply socket. It is connected to the socket of output of stable power supply via power supply cable of 1mm^2.

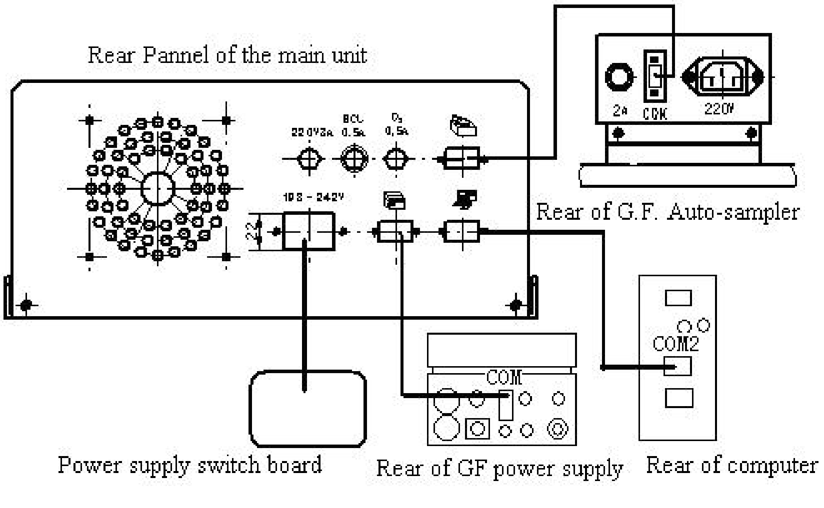


Fig 3-1 Connection between main unit and outer equipments

3.3.4 Connections of flame atomization system piping

3.3.4.1 Connection of gas piping

On the rear panel of the instrument, the gas piping box is at the right side with six connection nozzles. They are respectively the inlets ⊗ and outlets ⊙ of acetylene, oxygen and air. They are marked with letters or icons. The piping of the atomizer has been well connected before the delivery. It only requires the user to connect the gas sources to the gas piping box, gas piping box to the rear piping of the atomizer. (inlet of the atomizer).

1）There are three gas piping of flame atomization system including acetylene, oxygen and air. The connections are shown as follows:

A) Gas source outlet of acetylene gas → filter → inlet of acetylene gas, outlet of acetylene gas → acetylene gas inlet of the atomizer;

B) Air source outlet → air & water separator → air inlet, air outlet → air inlet of the atomizer;

C) Oxygen gas source outlet → filter → oxygen gas inlet, oxygen gas outlet → oxygen gas inlet of the atomizer.

Figure 3-2 shows the detailed connection method.

2) Between the gas piping of main unit and the nebulizer, the $\phi 6$ (OD)×1mm color nylon tube is used for the connection. The acetylene, oxygen and air in the internal gas piping box respectively correspond to the white, blue and yellow nylon tubes.

Caution: The oxygen piping to connect the main unit and atomizer must be connected although the oxygen-enriched method is not selected!!!

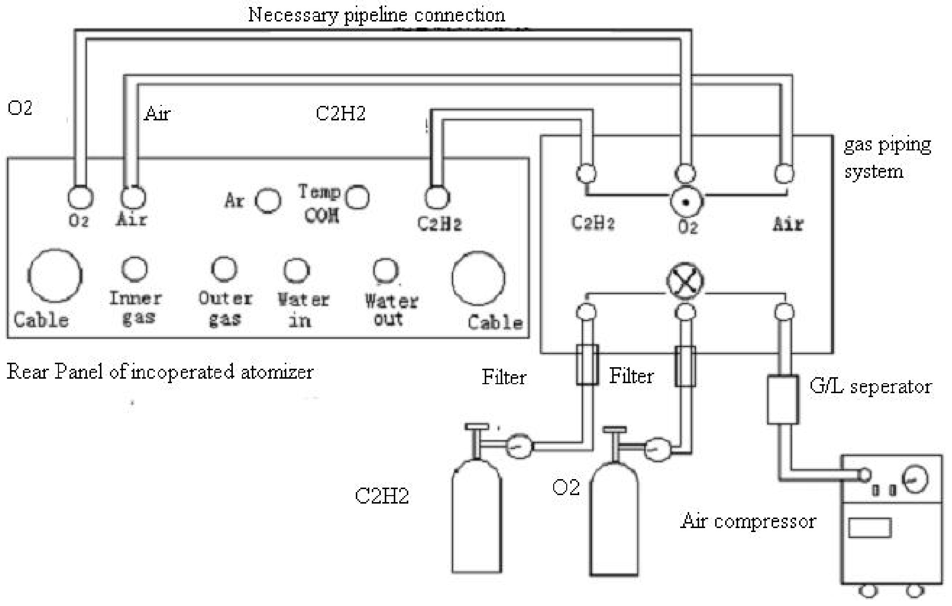


Fig.3-2 Gas pipeline connection schematic diagram of DW-210 flame atomization system

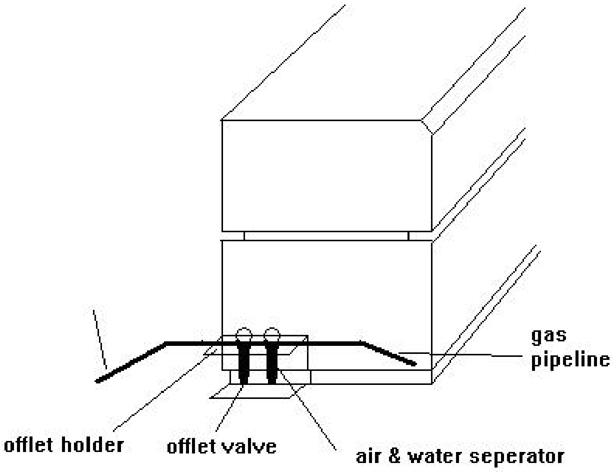


Fig 3-3 Connection schematic diagram of gas-water separator of DW-210 Instrument

3.3.4.2 Installation of gas-water separator

1) Take out the water support from the water bag and put it on the position shown on the main unit diagram of Fig.3.3.

2) Connect the gas-water separator equipped with the air compressor in series, and put it on the water support.

3) Connect the outlet pipe to the air inlet nozzle of the main unit; connect the inlet pipe to the outlet nozzle of the air compressor.

4) After starting the air compressor, user should notice: when water in the gas-water separator exceeds one third position, the water inside must be discharged.

5) Method of the discharging water: connect a container at the bottom of gas-water separator; loosen discharge water valve to let water out thoroughly and then screw it again.

3.3.4.3 Installation of air compressor

1) If equipped with the low noise air compressor, check whether the compressor has been filled with 18# refrigerating machine oil for the lubrication in advance.

2) Before connecting the air compressor to the gas piping system, check whether the air compressor operates normally. Firstly check if the compressor can be normally started after powering on. And then check whether the separation of the oil and water and the air filtration pressure reducer are in normal case. Check whether the third outlet pressure can normally be adjusted to the necessary value (normally adjust it to 0.3MPa). For the oil-free air compressor, it is not necessary to do the latter two procedures. But it is still necessary to, before connected to the gas piping, observe whether the air compressor can run normally after it is turned on.

3.3.4.4 Installation of acetylene gas source

1) Requirements of installing site

The acetylene gas source should be placed outside the laboratory, in a place with good ventilation. Moreover the qualified pipes must be used to conduct the gas into the laboratory. The location stored the acetylene gas source should be provided with warning symbol and the fire extinguishers.

Note 1: It is prohibited to keep any fire or hot and high temperature materials near the acetylene gas sources.

Note 2: The acetylene gas source shouldn’t be stored together with the oxidization gas source.

2) When using the acetylene steel cylinder, it is necessary to purchase and install the gas source regulator for the acetylene steel cylinder. Use the opening tools of the steel cylinder equipped along the pressure regulator to open or close the main valve of the steel cylinder.

The steel cylinders should be placed vertically, firmly and not easy to fall down.

3.3.4.5 Installation of the oxygen gas source

1) Normally the oxygen gas source is stored in steel cylinder. Replace a new steel cylinder when the total pressure is less than 0.5MPa in the steel cylinder. The pressure regulator must be equipped with the steel cylinders to be used. The outlet pressure of the regulator should be adjusted in the range of 0~0.25MPa. The piping for the oxygen gas should be kept clean to prevent the gas pipe being blocked.

2) The oxygen gas cylinder can never be stored together with the acetylene gas cylinder.

Notice: DW-210 spectrometer should be equipped with the oxygen gas source.

3.3.4.6 Connections of waste pipe (See figure 3-4)

In the nebulization system there is a waste liquid nozzle mounting at the front below position of atomization chamber. Connect one end of $\phi 8$(I.D)×1mm plastic tube to the waste liquid nozzle as the draining the waste liquid piping. Connect another end of plastic tube to the nozzle of water-seal bottle, finally fix the waste liquid bottle and add proper water into the waste liquid bottle to make water pipe keeping under the water surface and forming the water seal. Thus inside of the nebulizer can be isolated with the outer atmosphere. Connect the plastic tube to the lower nozzle of the water-seal bottle. Insert the bottom end of the waste liquid tube into a plastic vessel with 5 to 10 liter capacity, but it cannot be inserted into the waste liquid surface in the vessel. Don’t insert the waste liquid tube directly into the laboratory drain system so as to avoid the corrosive piping..

Note: When carrying out the flame method analysis, make sure that the water seal is in good condition to prevent the flashback explosion and fuel gas leakage!!!

3.3.4.7 Checking gas leakage

After connecting the gas piping of the flame atomization system, check the gas leakage with soap water at each joint, especially check if the explosion-proof on the rear bottom of the atomization chamber is in good condition. Otherwise it may result in the flashback when igniting the flame.

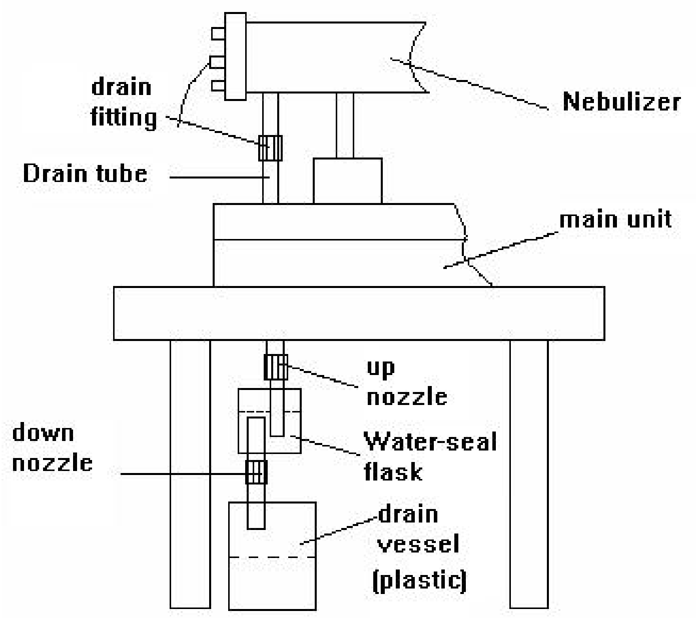


Figure 3-4 Waste liquid tube connections

3.3.5 Installation of automatic sampler

Refer to WF-10A auto-sampler operation guide in Chapter 7.

3.3.6 Installation of graphite furnace atomization system

Refer to DW-1E operation guide of photo-control graphite furnace.

3.3.7 Installation of hydride atomization system

The hydride generator and quartz tube furnace can be selected as the hydride atomization system in the instrument for the atomic absorption analysis of the hydride methods. The installation and operation methods are referred to the concerned operation manual

3.4 Acceptance

Before proceeding with the acceptance check, read the operation instructions carefully to get familiar with the functions of every control and the operations of the instrument. To avoid accidents or damages, it is required that instrument should be operated only by the qualified personnel.

The purpose of inspection and acceptance is to check whether the quality of instrument is degraded and caused not to meet the application requirements after the transportation and storage. If so, find out the causes to make it well timely.

3.4.1 Items of Acceptance

Main specifications are listed in Chapter 1 of this instruction manual.

3.4.2 Requirements of acceptance

3.4.2.1 The inspection and acceptance of the instrument should be in accord with the working environmental conditions described in Chapter 2. Otherwise the poor environmental conditions will cause the accidental failure of the instrument or result in unsatisfied determination.

3.4.2.2 The acceptance check of all the items or functions should be carried out according to the following conditions and methods.

3.4.3 Methods of Acceptance

3.4.3.1 Wavelength range and wavelength accuracy

1) Wavelength Range

Use Cu lamp to check the short-wave end with the spectral line of 205.5nm.

Conditions: Wide pulse lamp current: 3mA. Spectral bandwidth: 0.4nm.

Requirements: when the intensity of the spectral line makes the energy reaching up to 100, the high voltage of photomultiplier should not exceed 600V.

2) Wavelength accuracy

Use the lamp of Hg to check the following spectral lines: 253.7nm, 546.1nm and 871.6nm.

Method: Select the element lamp of Hg, on the instrumental condition page, select spectral bandwidth: 0.2nm, select Hg lamp location number, set the wide pulse current: 3Ma, respectively input the wavelength above mentioned. Click " auto-wavelength" on the instrumental control page. The wavelength will be displayed after calculating the peak value current located.

3) Resolution

Use Mn lamp to check the spectral lines of 279.5nm and 279.8nm.

Condition: wide pulse lamp current: 3mA; Spectral bandwidth: 0.2nm.

Requirement: Energy ratio of peak and valley can not exceed 40%. If it is OK, that shows it is qualified.

Method: Select the element of Mn, select the wavelength of 279.5nm on the instrumental condition page, click "Auto-wavelength" to complete peak-picking. And then click "Scan" to select the wavelength to be 279.0~280.5nm. Press "Wavelength scan" and use the mouse to find the first wave peak (the highest peak) and the closest wave valley and record each energy value of them. Each energy value refers to the section1.5.2.

4) Static baseline stability

Condition: use Cu lamp with the spectral line of 324.8nm to check it. The spectral bandwidth is 0.2nm; the wide pulse lamp current is 3mA; the damp constant is 2. After preheating the instrument and the lamp for 30minutes, find out the largest energy referring to the section 4.11.1 in Chapter 4. Click the icon at the right side on the measurement page, the window of the baseline stability is appeared as shown in Fig. 4-22. Select the time length of 30minutes. After zeroing, click "Start" key to start the measurement. The sampling accuracy can reach up the third digit after the decimal point (absorbance). When the energy is about 100, the drift determined will be directly compared to the section1.4.4 in chapter 1.

5) Determination of the characteristic concentration (characteristic quantity) and detection limit and precision

For determining the characteristic concentration (characteristic quantity), detection limit and precision, one kind of element is only required for the determination.

(1) Characteristic concentration (characteristic quantity) and detection limit and precision of Cu element with flame method

Conditions: Cu 324.8nm spectral line; spectral width is 0.4nm; damp constant is 2. Other parameters of instrument should be adjusted to the optimal working condition.

Determination of characteristic concentration and detection limit:

Standard solution of Cu: 1.0μg/ml; blank solution: 0.5% HNO_3 water solution.

Input 1.0 in the standard sample table of the software; the sample repeat times is 3. Select the blank solution. Repeat 20 times and select the concentration unit to be μg/ml or mg/L (firstly make the determination of the blank, then the standard sample).

After the determination, the characteristic concentration and the detection limit are automatically calculated.

Determination of precision:

Standard solution of Cu: 3.0μg/ml, blank solution: 0.5% HNO_3 water solution.

Input 3.0 in the standard sample table of the software. The repeat of sample is 11 times. Do not select the blank solution for the measurement. Select the concentration unit to be μg/ml or mg/L. After the determination, precision value will be calculated out automatically.

(2) Calibration of curve linearity

Condition: 324.8nm spectral line of Cu; spectral bandwidth: 0.4nm; damp constant: 2; The other instrument parameters should be adjusted to the optimal working condition.

Standard solution of Cu: 1.0, 3.0, 5.0μg/ml; medium: 0.5% HNO_3 water solution;

Blank solution: 0.5% HNO_3 water solution.

Input 1.0, 3.0, and 5.0μg/ml into the standard sample table on the software. Respectively determine the blank solution and 1.0, 3.0, 5.0μg/ml standard concentration solution of Cu and build up the calibration curve. The linearity relative coefficient should be more than 0.995.

(3) Characteristic concentration of Ba determined by Oxygen-enriched air acetylene flame method

Condition: Ba 553.6nm spectral line; the spectral width: 0.4nm; damp constant: 2. The other parameters of instrument should be adjusted to the optimal working condition.

Standard solution of Ba: 5.0μg/ml; blank solution: 0.4% KCl water solution.

Input 5.0 into the standard sample table of the software. The repeat times of sample is 3 times. Select the concentration unit to be μg/ml.

After the determination, the characteristic concentration and the detection limit are automatically calculated.

(4) Characteristic concentration (characteristic quantity) and precision with the determination of graphite furnace method

Condition: Cd 228.8nm spectral line; the spectral bandwidth: 0.2nm. Cd standard solution: 1.0μg/L; the sampling volume: 20μl.

Method: select proper atomization conditions. The drying temperature is 70~100°C; drying time is 20S; the ash temperature is 220°C; the ash time is 15S; the atomizing temperature is 2000~2200°C and the atomizing time is 4S.

Note: The conditions mentioned above are only for reference.

Input 1.0μg/L in the standard sample table of the software; repeat 7 times, select blank solution. Put 1.0μg/L standard solution with proper concentration into sample cup and put it on the appointed position of auto-sampler. Set the sampling volume to be 20μl. After the determination, the characteristic quantity and the precision value are automatically calculated.

(5) Checking lamp position

There have 6 lamp positions on DW-210 instrument. Check each lamp position after powering on. The operation procedures will refer to the relative sections described in the operation manual of the instrument.

Note:

1) The standard using solution should be prepared whenever it is used during the acceptance. If it is stored so long time, the concentration value will have big deviation.

2) To eliminate determination error caused by solutions, any kind of contamination should be avoided during the solution preparation.

3) The determination of characteristic concentration and detection limit has the great relations with the selection of analytical conditions and instrument parameters. No matter the lame method or the graphite furnace method, when the troubles appear on the characteristic concentration and detection limit, the analytical conditions of flame property, flame height, nebulizing condition, atomization condition and function parameters, etc. should be re-adjusted to ensure the accurate determination.

3.4.4 Processing of acceptance results

Make a note for the instrument parameters, checking methods, determination results and symptoms during the acceptance check. If any item cannot meet the specification, users can present the note to the manufacture (or local dealer) so as to find out the trouble reasons and get it repaired.

Chapter 4 Operation

The application software should be operated under Windows98 or XP environment. It will be better if the user get familiar with Windows98 or XP system first.

4.1 Software Setup

Connect the main unit of the spectrophotometer with the PC first. And then switch on the main unit and the computer respectively. If the auto-sampler is used, switch on if before entering into the software. Window 98 or XP system will be automatically entered after powering the computer. Double click shortcut mode “BRAIC” on the Window 98 or XP desktop to enter the main page of the software as shown in figure 4-1.

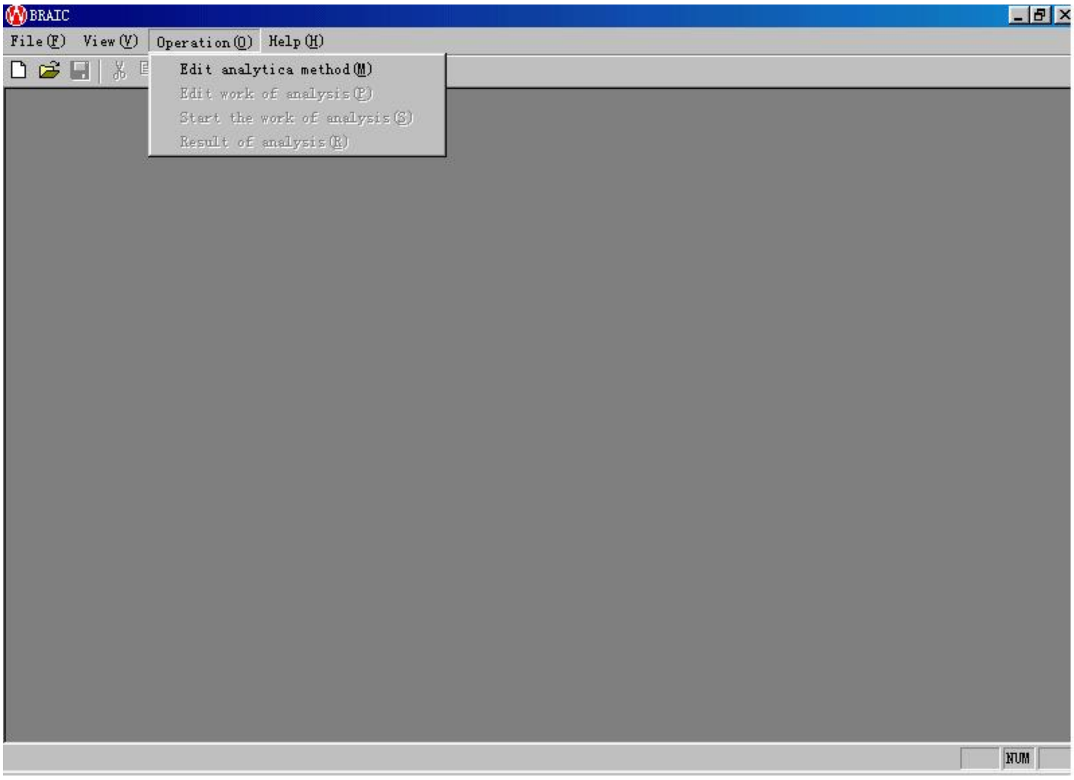
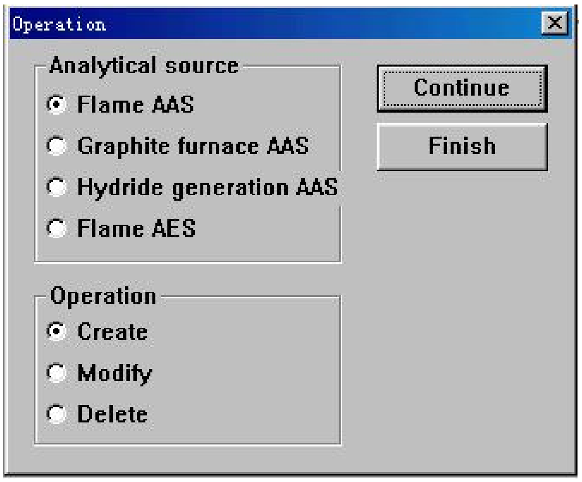


Fig. 4-1

4.2 Editing analytical method

Click “Operation (O)” to appear the menu as shown in Fig.4-1, then click “Edit Analytical Method (M)”, the menu shown in Fig. 4-2 will appear on the screen.



Operation

Analytical source
- ● Flame AAS
- ○ Graphite furnace AAS
- ○ Hydride generation AAS
- ○ Flame AES

Operation
- ● Create
- ○ Modify
- ○ Delete

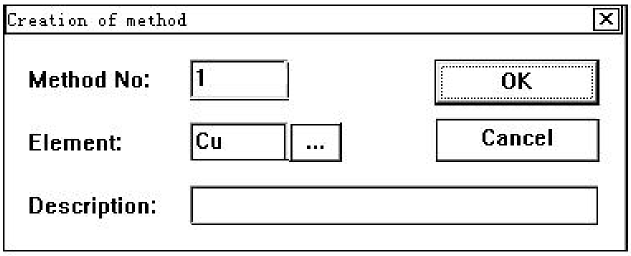
Fig. 4-2

(1) Analytical light source: There are four methods available for the selection: flame AAS, graphite furnace AAS, hydride generation AAS and flame atomic emission AAS.

(2) Operation: You can create a new analysis method and modify or delete the old one. Directly click the analytical method shown in Fig.4-2 for the selection according to the analytical requirement of users.

For example: If the flame atomic absorption analysis is selected by user, just click ○ at “Flame AAS” and “Create”, then click “Continue” button. “Creation of method” page as shown in Fig. 4-3 will be displayed.

Select the element to be analyzed: click “··· shown in Fig.4-3 to appear Periodic Table of the Elements as shown in Fig. 4-4



Creation of method

Method No: 1

Element: Cu

Description:

Fig. 4-3

Click the element to be determined on the table and then click [OK] to confirm and return to the Fig. 4-3.

“Method Number”: If several analytical methods are selected, the ““Method Number” will be automatically arranged. Then click [OK] to appear the page of Fig. 4-5.

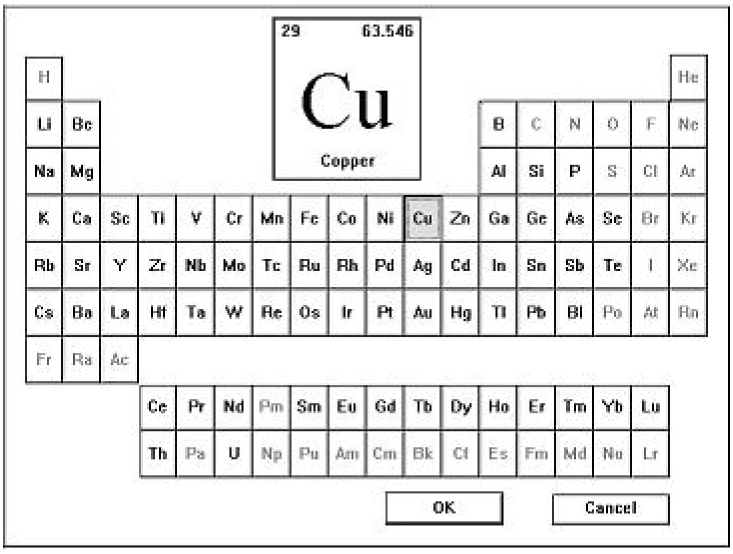
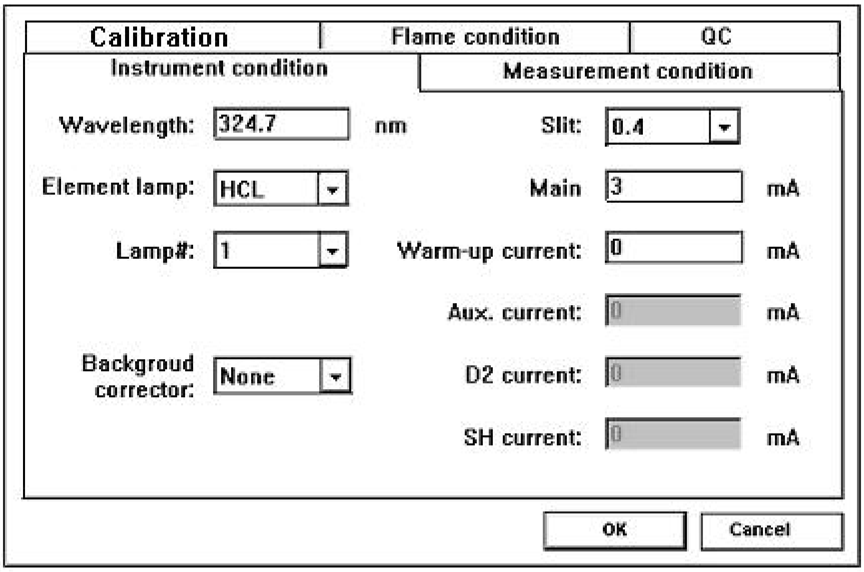


Fig. 4-4



Wavelength: 324.7 nm

Slit: 0.4

Element lamp: HCL

Main 3 mA

Lamp#: 1

Warm-up current: 0 mA

Aux. current: 0 mA

Backgroud corrector: None

D2 current: 0 mA

SH current: 0 mA

Fig. 4-5

4.3 Selection of analytical conditions

4.3.1 Selection of instrument condition

Refer to Fig.4-5, click “Instrument condition” in the page of Fig. 4-5.

Wavelength: After selecting the element in the periodic table of the elements, the wavelength of the main sensitive line of the element will be selected automatically. Users can change it to the wavelength of the secondary sensitive line according to their need. It will be input by user self.

Element lamp: Two types of hollow cathode lamps can be selected, the ordinary hollow cathode lamp (HCL) and the high performance hollow cathode lamp (HPHCL).

Note: High performance HCL (HPHCL) can only be installed on the lamp turret of No.5 and No.6. The Common HCL lamps and be installed on the lamp turret of No.5 and No.6.

Lamp position: There six lamp positions can be available for the selection when clicking tri-angle mark. Be sure to select the element lamp position in accord with the element just selected from the Periodic Table of the Elements. Otherwise the wavelength accuracy can not be guaranteed.

Background Corrector: D_2 lamp and S-H background correction can be selected.

Slit, Main (lamp current): Selected the slit width and enter the lamp current value according to the analytical requirement of different element.

Warm-up lamp current: Input the lamp current for preheating to prepare the next analysis.

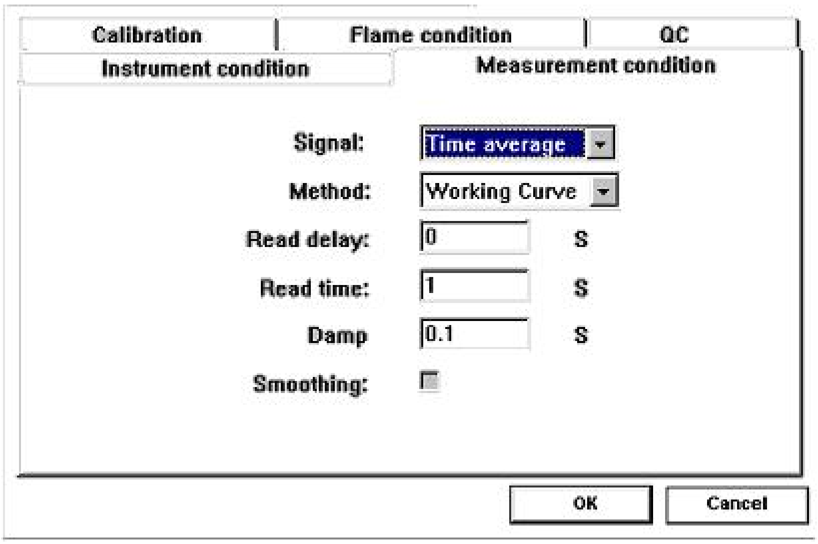
Aux. lamp current: The AUX. lamp current means the lamp current being input is HPHCL's lamp current. Input it only it is selected for increasing the sensitivity of the analytical element.

D_2 lamp current: Input the D_2 lamp current value only when D_2 lamp is used as the background corrector.

SH current: Input the SH current value only when SH is used as the background corrector.

4.3.2 Selection of measurement condition

Click on "Measurement condition" in the Page of Fig 4-5. The measurement condition page will be shown as Fig. 4-6.



Signal: Time average
Method: Working Curve
Read delay: 0 S
Read time: 1 S
Damp 0.1 S
Smoothing: ☐

Fig. 4-6

Signal: Includes time average (for flame AAS), Peak height and Peak area (for graphite furnace and hydride method AAS).

Method: Standard calibration method and standard addition method can be selected.

Read delay: It is used for the graphite furnace analysis. It shows the time interval from the start to appearing peak.

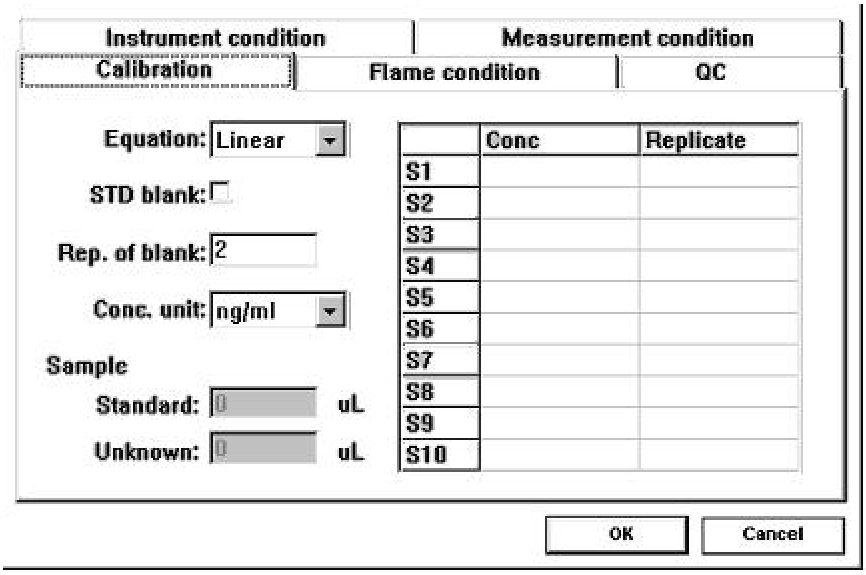
Read time: It is used for the flame and hydride analysis. It shows the speed of collecting sample.

Damp constant: It is used to decrease the noise level. It is generally selected to be 2 seconds.

Smoothing: It is used for graphite furnace AA analysis. "√" shows that it is selected. The peak shape of the graphite furnace is changed to be smooth and good look.

4.3.3 Setting-up standard working curve

Click on “Working curve” in the Page of Fig.4-5 to show the working curve setup page as shown in Fig.4-7



Equation: Linear

STD blank: ☐

Rep. of blank: 2

Conc. unit: ng/ml

Sample

Standard: 0 uL

Unknown: 0 uL

	Conc	Replicate
S1		
S2		
S3		
S4		
S5		
S6		
S7		
S8		
S9		
S10		

Fig. 4-7

Equation: Linear equation and quadratic equation can be selected.

Concentration unit: µg/ml or ng/ml

Sampling volume (for graphite furnace method): Normally select 20µl for the standard sample and unknown sample. It can be also selected according to the practice application condition.

Conc.: Up to 10 standard sample points with different concentrations can be inputted in sequence.

Rep. of blank and **Rep.**: Show the standard blank point and standard sample point to repeat the measurement times during the measurement. The mean value obtained will participate the curve fitting.

There are two selections for the standard blank:

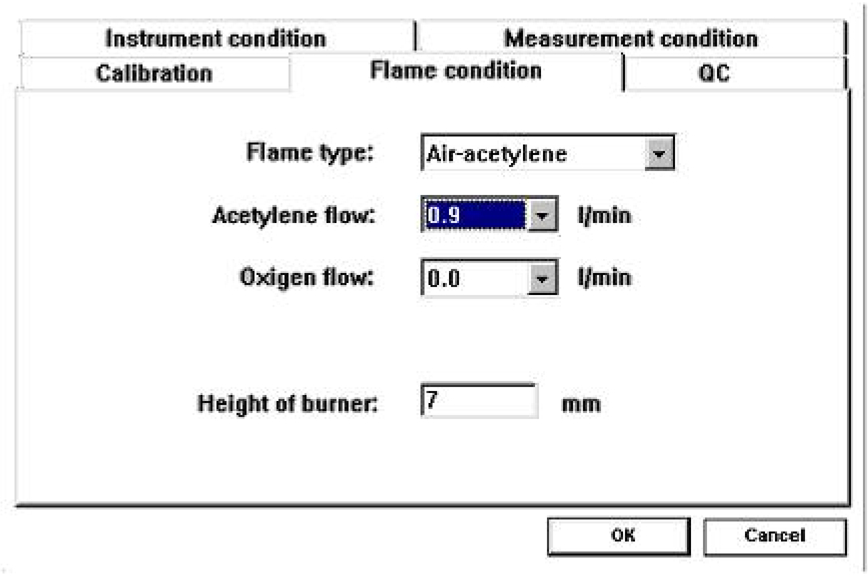
(1) Pass through the zero point by compulsion. Click the block frame nearby the standard blank point to be (√). Figure 4-7 shows that measure the standard blank point by per time to deduct the standard blank.

(2) Don’t select the block frame nearby the standard blank while S1 is used as the standard zero point (acting as the standard blank). And then input the standard sample points in sequence. For example: The standard sample points are : 1µg/ml, 3µg/ml, 5µg/ml, so the input method is as follows: respectively click S1 to input “0”, S2 to input “1”, S3 to input “3” and S4 to input “5”.

NOTE: **Input must be made on the page. If it is unnecessary to input the concentration value, (√) must be made at the standard blank.**

4.3.4 Setting of flame conditions

Click “Flame condition” in Fig. 4-7 to display the flame condition page as shown in Fig. 4-8.



Flame type: Air-acetylene

Acetylene flow: 0.9 l/min

Oxigen flow: 0.0 l/min

Height of burner: 7 mm

Fig. 4-8

Flame type: Click triangle mark to select the flame type. There are two flame types: Air-Acetylene flame and Air-Acetylene-Oxygen flame.

Acetylene flow, Air flow, Oxygen flow and Height of burner can be inputted according to the different requirement for different element analysis. The distance of the burning slot sheet of the integrated atomizer to the center of the optical path is in the range of 0-20mm. The burner head will be stopped at the height position Beijing set before entering the measurement page.

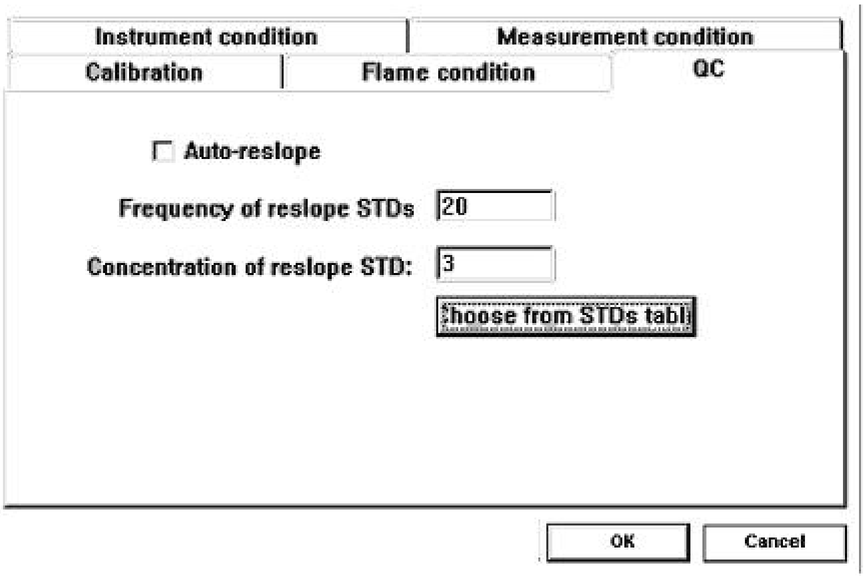
4.3.5 Quality control (re-slope)

Click “QC” in the page of Fig. 4-8 to display “QC”(quality control) page as shown in Fig. 4-9.

Auto re-slope: If auto-re-slope is required, click the block frame before the auto-re-slope to show (√) in the frame. That shows the re-slope can be automatically inserted in the setting sample table.

STD interval of re-slope: If the auto-re-slope is selected and the interval of the re-slope is determined, so the re-slope function will be automatically inserted into the program according to the interval being set in the sample table.

STD concentration of re-slope: User self can input the concentration value of the re-slope or input it from the selection of the standard sample table. Click the “Choose from STDs table” to display the page of Fig. 4-10, and select one point in selectable standard points. Click “OK” to return to the page of Fig. 4-9.

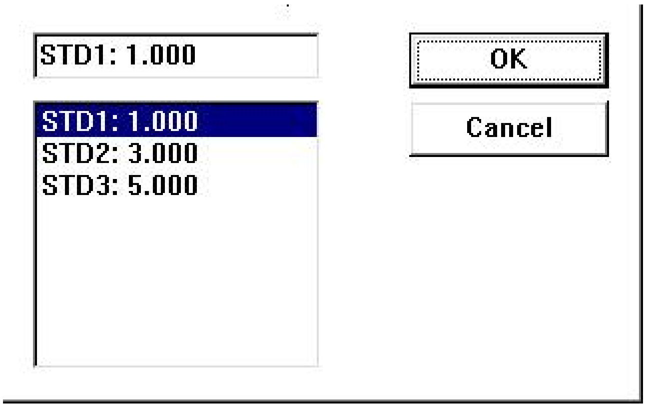


☐ Auto-reslope

Frequency of reslope STDs 20

Concentration of reslope STD: 3

Fig. 4-9



STD1: 1.000

STD1: 1.000
STD2: 3.000
STD3: 5.000

Fig.4-10

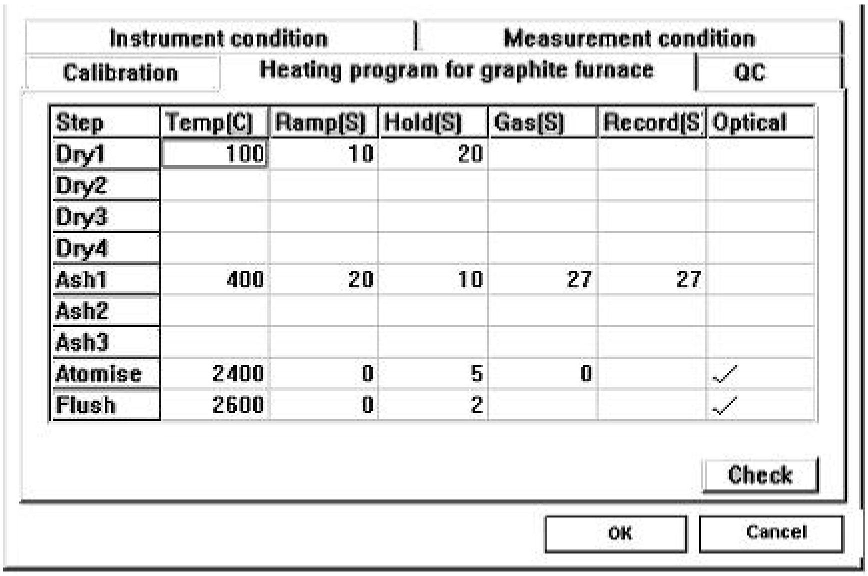
After all the above conditions are set, click [OK] to return to the page of Fig.4-2 and click [Finish] to complete the method edition.

4.4 Selection of graphite furnace conditions

Refer to Fig 4-2, select “Graphite furnace AA” and “Create” to set parameters for graphite furnace AA analysis. Refer to the previous procedures described in Section 4.2 and 4.3 for the instrument condition, measurement condition and working curve parameter settings. The only difference is to set the graphite furnace condition instead of the flame conditions.

Setting of graphite furnace conditions:

Click “Heating program for graphite furnace” in Fig 4-5 to display Fig. 4-11.



Step	Temp(C)	Ramp(S)	Hold(S)	Gas(S)	Record(S	Optical
Dry1	100	10	20			
Dry2						
Dry3						
Dry4						
Ash1	400	20	10	27	27	
Ash2						
Ash3						
Atomise	2400	0	5	0		✓
Flush	2600	0	2			✓

Fig. 4-11

The heating program for graphite furnace is composed of three steps: Drying, Ash and Atomization, the corresponding temperature, ramp and holding time differ from the different elements. Please refer to the Guidebook for Graphite Furnace AA Analysis. To input the parameters, double click the corresponding box to make it changing into the blue color, and then input the value via the keyboard.

Photo-control: There are two methods for the graphite furnace, such as photo-control and non-photo-control. If the non-photo-control is selected, it means this step is set to rising the temperature with the voltage working mode. When clicking the mouth key to make the photo-control column to be changed into "√", that means this step is set to rising temperature with the photo-control mode.

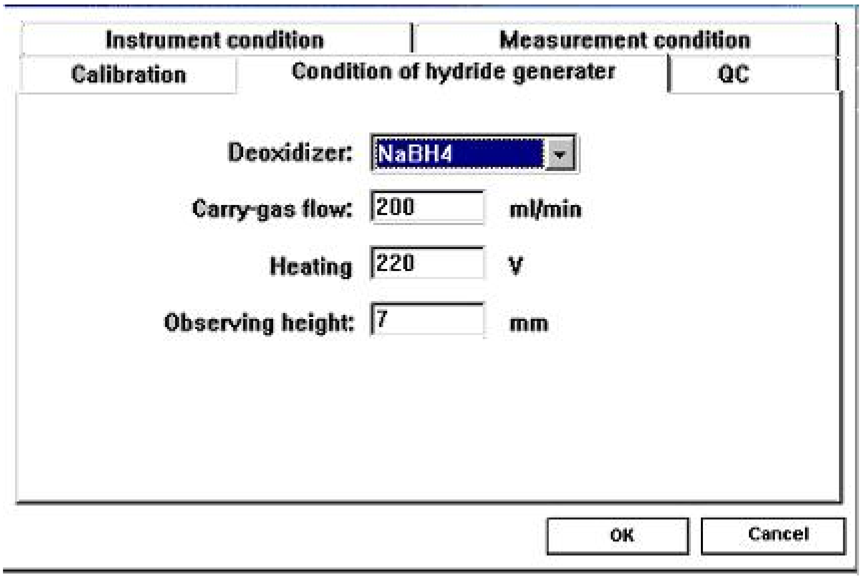
Main gas (Gas (s)): If the value is not set in the main gas column, it shows the carrier gas is introduced in this step. If the value is set in this column, it shows the carrier gas will be shut down in this step.

Record: It shows that the baseline retrieving zero and sample collecting signals are sent to the main unit in the last three seconds at the ash stage or before three seconds at the atomization step.

After finishing all the parameter setting, click [check], then [OK] to return to Fig. 4-2, and click [Finish] to complete the editing analytical method.

4.5 Measurement conditions of hydride generator

Select the "Hydride generation AAS" method in Fig. 4-2. Refer to the previous procedures described in Section 4.2 and 4.3 for the settings of the instrument condition, measurement condition and working curve parameter. The only difference is to set the conditions of the hydride generator instead of the flame conditions.



Deoxidizer: NaBH4

Carry-gas flow: 200 ml/min

Heating 220 V

Observing height: 7 mm

Fig. 4-12

Click “Condition of hydride generator” on Fig.4-5 to display the page of Fig 4-12.

Deoxidizer: Select $NaBH_4$ and KBH_4 at “Deoxidizer bar.

Carry-gas flow, **heating voltage**, **Observing height**: These parameters can be inputted according to the analytical condition of each elements. The analysis operations are the same as the flame method.

4.6 Settings of flame emission analytical conditions

The parameter setting procedures for the flame emission analysis are the same as the flame absorption method, as described in the section 4.2 and 4.3.

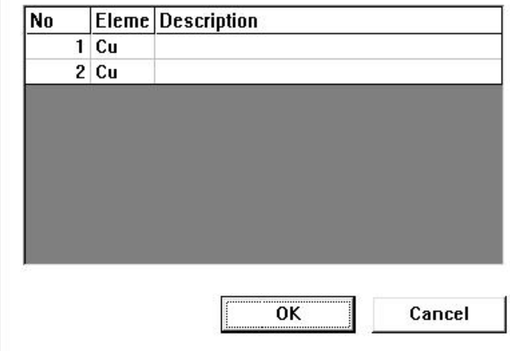
4.7 Modification of the conditions

Follow the procedures below to modify the existed conditions:

a. Click “Operation” in Fig.4-1 and then click “Edit analytical Method” .

b. Select “Modify” in Fig. 4-2, and then click “Continue” to display the page of Fig. 4-13.

c. If modifying any of the parameters, double click it to turn the item to be blue color. Then click “OK” to turn back to Fig. 4-5. Refer to the section 4.3 in this manual for modifying the conditions as “Instrument condition”, “Measurement condition”, etc.



No	Eleme	Description
1	Cu	
2	Cu	

Fig. 4-13

4.8 Deleting the conditions

Follow the procedures below to delete the existed conditions:

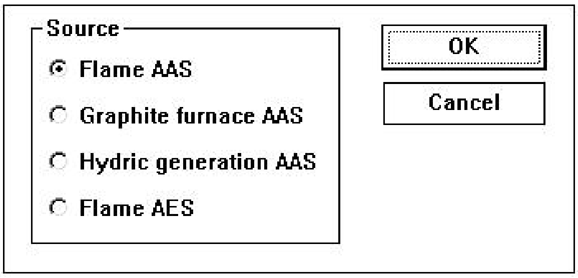
a. Click "Operation" in Fig 4-1and the click "Edit analytical Method".

b. Choose "Delete" in Fig 4-2, and then click "Continue" to display the page of Fig. 4-13.

c. If requiring for deleting any of the methods, double click it to turn the item to be blue color. Then click "OK" to delete the method selected. After so, it return to the page of Fig. 4-2.

4.9 Selecting analytical method

After setting up and modifying the conditions, click "Finish" in the page of Fig. 4-2 to display the page of Fig. 4-1. Click "File" and then click "New" column to display the page to Fig. 4-14 as shown below. Click the edited analytical method such as "Flame AAS" and then click "OK". The page as shown in Fig. 4-15 will appear.

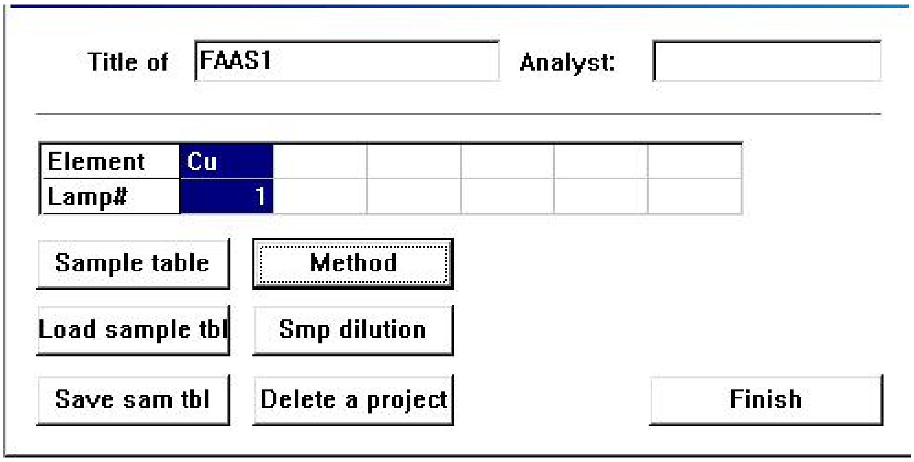


Source
● Flame AAS
○ Graphite furnace AAS
○ Hydric generation AAS
○ Flame AES

Fig. 4-14

4.10 Designing Analytical Task

4.10.1 Selecting the method



Title of: FAAS1
Analyst:

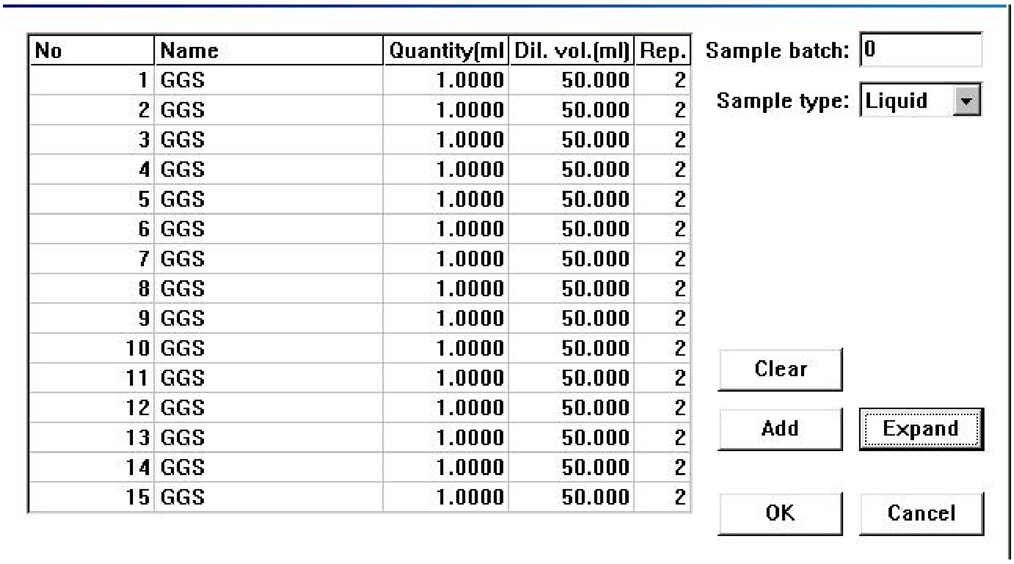
Element	Cu					
Lamp#	1					

Fig. 4-15

Click the first block beside "Element" and "Lamp#" to show the blue color before the selecting method. Then click "Method" to appear the edited method page as shown in Fig. 4-13. Click the element to be determined and make it being blue color, and then click "OK". Fig. 4-15 will be returned again, the moment, the first block is selected. To select more elements, click the second block and do the same as above. Up to six elements can be selected.

4.10.2 Sample table

Click “Sample table” in the page of Fig. 4-15 to display Fig. 4-16.



No	Name	Quantity(ml	Dil. vol.(ml)	Rep.
1	GGS	1.0000	50.000	2
2	GGS	1.0000	50.000	2
3	GGS	1.0000	50.000	2
4	GGS	1.0000	50.000	2
5	GGS	1.0000	50.000	2
6	GGS	1.0000	50.000	2
7	GGS	1.0000	50.000	2
8	GGS	1.0000	50.000	2
9	GGS	1.0000	50.000	2
10	GGS	1.0000	50.000	2
11	GGS	1.0000	50.000	2
12	GGS	1.0000	50.000	2
13	GGS	1.0000	50.000	2
14	GGS	1.0000	50.000	2
15	GGS	1.0000	50.000	2

Sample batch: 0

Sample type: Liquid

Fig. 4-16

“No”: It is used for user to input the Numbers. of unknown samples in sequence;

“**Name**”: It is used to input the names of the unknown samples;

“**Quantity (ml)**” and “**Dil. Vol. (ml)**”: If taking the sample to be 1ml and the diluted volume is 50ml, the dilution times will be 50X.

If the name, the quantity and the dilution volume of the sample will be the same for all the unknown samples, the following procedure could be taken for fast input: (Suppose there will be 15 unknown samples to be inputted.)

a. Click “No” column and input “1”, “2”, “,” and “15”.
b. Click “Name” and input “GGS” at the sample name column.
c. Input “1” and “50” at “Quantity ml” and “Dil. Vol. (ml)” respectively.
d. Click “Expand” in Fig. 4-16 to list all the samples according to their Numbers.

“**Add**”: Click “Addition” to continue to edit sample information after the edited samples; if the “Name”, “Quantity” and “Dil. Vol.” are not the same with the above samples, click “Add” to input the corresponding number. name, quantity and diluted volume of the sample..

“**Clear**”: used to delete all the items in the sample table.

“**Sample Batch**”: to input the batch no. of the samples to be analyzed.

“**Sample Type**”: to input the type of the samples according to the type before processing the samples, For example: the sample before process is sold, it should input” solid” otherwise it should input” liquid”.

After all the items are inputted, click “OK”.

4.10.3 Saving sample table

If the sample table needs to be saved for later use, click “Save sample tbl” in Fig. 4-15 and input the file name to be saved and click “Save” for the further use.

4.10.4 Loading sample table

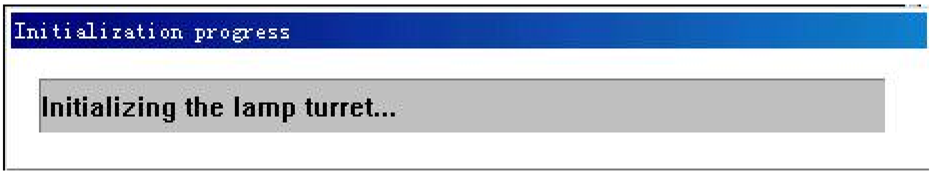
To load the sample table for viewing and editing, click “Load sample tbl” in Fig. 4-15 and find the file name and click “Open”.

4.10.5 Diluting samples

Click “Smp Dilution” to modify the diluting multiplier of any sample in the sample table.

4.10.6 Deleting a project

Refer to Fig.4-15, if modification or deletion is required, click the relative block beside “Element” and “Lamp#” to be blue color, then click “Delete a project” to delete method required immediately. If a new analytical method is required, the selection method must be made again. After completing all analytical parameters, click “Finish” to show Fig. 4-17. The initialization progress starts as following Fig.

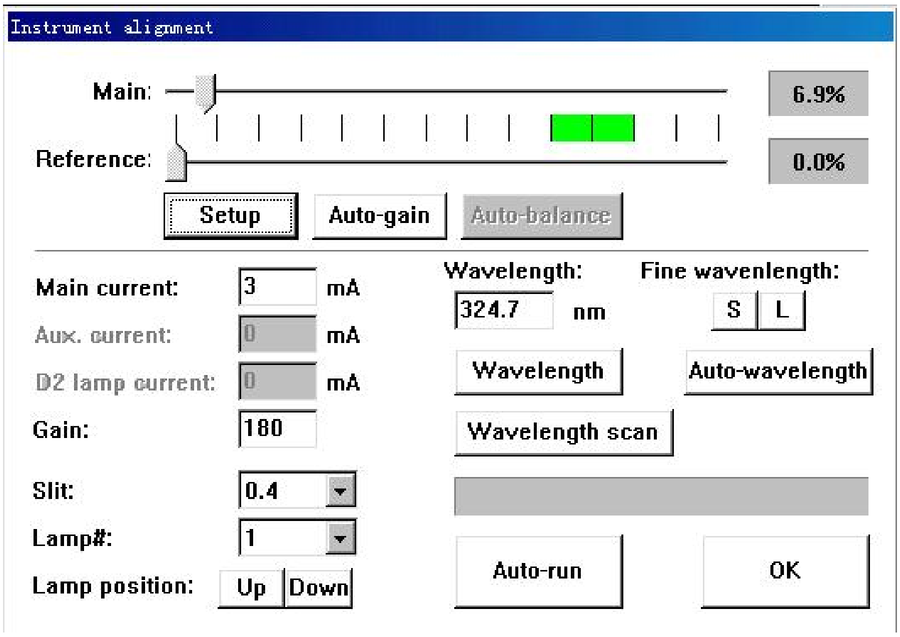


Initialization progress

Initializing the lamp turret...

Fig. 4-17

4.10.7 Instrument alignment



Instrument alignment

Main: 6.9%

Reference: 0.0%

Main current: 3 mA

Aux. current: 0 mA

D2 lamp current: 0 mA

Gain: 180

Slit: 0.4

Lamp#: 1

Wavelength: 324.7 nm

Fig. 4-18

Main beam (**Main**): it is used to adjust the energy of high-voltage of the photo-multiplier to 100%. If the energy exceeds or cannot reach 100%, click “Auto-gain” to balance it.

Reference beam **(Reference):** used for self-absorption method and deuterium lamp method.

Setup: used to send all the parameters as main current, aux. current, negative high voltage, etc. to the main unit of the spectrophotometer.

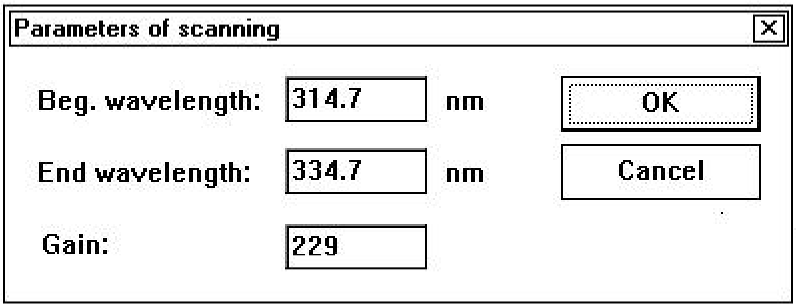
Auto-balance: Used to adjust the current of the reference beam to balance the energy of the main beam and the reference beam.

Auto-gain: Used to adjust the gain value (negative high voltage) to make the energy of the main beam up to 100%.

Auto-wavelength: click "Auto-wavelength" button. At this time the instrument will start to seek the peak position of the corresponding wavelength and optimal lamp position. The energy of the main beam would be adjusted automatically to 100% to match with the negative high voltage. When finishing peak scan, the wavelength error will be displayed automatically.

"**Wavelength Setting**": Click "wavelength" icon. The instrument will start to seek for the optimal wavelength position. Click "S" and "L" in "Fine wavelength" and "Up" and "Dn" in "Lamp position" for fine adjustment of the wavelength and the lamp position. If the gain value is too high or too low, you may modify the gain (negative high voltage) and click "Setup" or click "Auto-gain" to balance the energy.

"**Wavelength scan**": Used to seek the correct position of the wavelength. Scan the spectral line energy distribution in the wavelength range pointed as shown in Fig. 4-19. Click "OK" to enter the wavelength scanning.


Parameters of scanning

Beg. wavelength: 314.7 nm

End wavelength: 334.7 nm

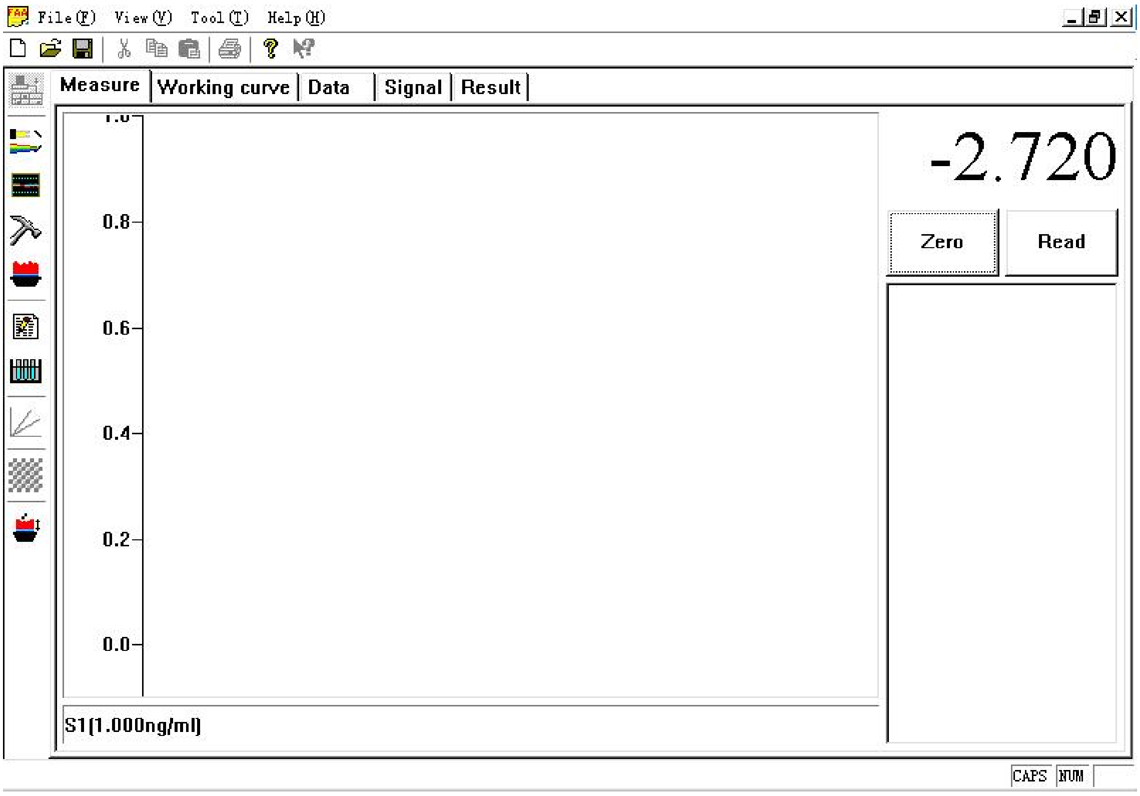
Gain: 229

Fig. 4-19

4.11 Software operation of flame analysis

4.11.1 Introduction of main interface of flame method

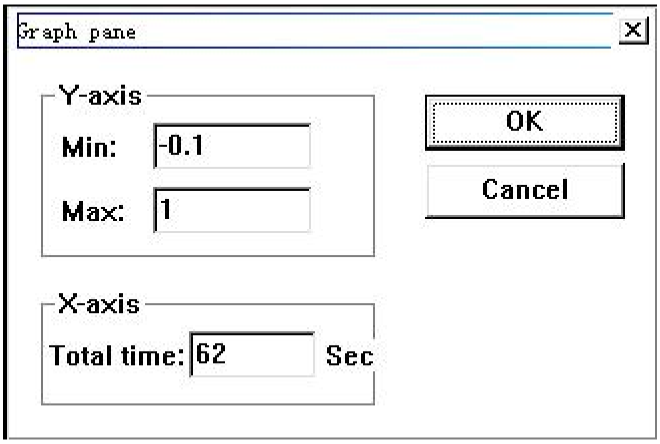
After every parameter in Instrument Alignment page is set well as shown in Fig. 4-18, click "Finsh" to enter into measuring page of flame analysis as shown in Fig. 4-21. Double click the black part in the page to modify the length of axes (X: Time; Y: Absorbance), referring to Fig. 4-22.



-2.720

S1(1.000ng/ml)

Fig. 4-21



Y-axis

Min: -0.1

Max: 1

X-axis

Total time: 62 Sec

Fig. 4-22

The following explains the meaning of the icons shown:

On-line: When the icon turns gray, the spectrophotometer is online. Otherwise the computer will remind you that there is no any response from the instrument. Check if switching on the instrument. If it is not so, switch on it and click “Retry”, so the troubleshooting is disappeared.

Instrument Alignment: Click it to display the page of Fig. 4-18 to perform proper alignment.

Baseline stability: Click this icon to check the baseline stability. When all the parameters of instrument wavelength, energy (100%), gain (negative high voltage) etc are adjusted in normal case on the page of Fig. 4-18, click this icon to show Fig. 4-22.

Click "Zero" icon, then again click "Start" icon to test the baseline stability of the instrument. When the test is finished, click "Print" to print out the result.

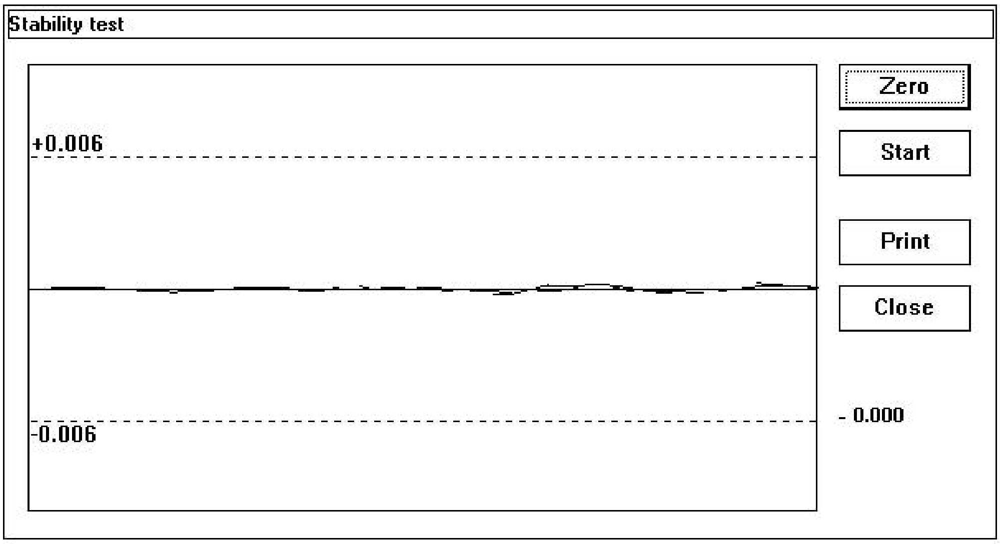
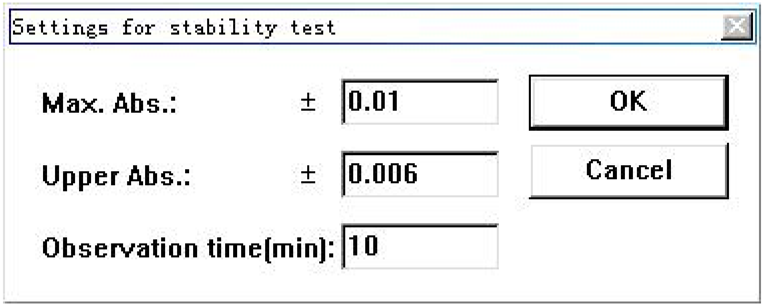


Fig. 4-23



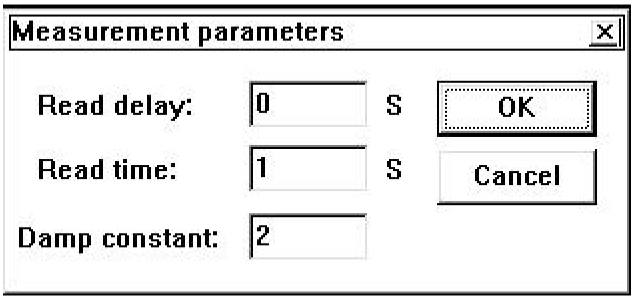
Max. Abs.: ± 0.01

Upper Abs.: ± 0.006

Observation time(min): 10

Fig. 4-24

Measurement parameters: Click the icon to set or modify parameters as "Read delay", "Read time", "Damp constant" etc., as shown in Fig. 4-25.



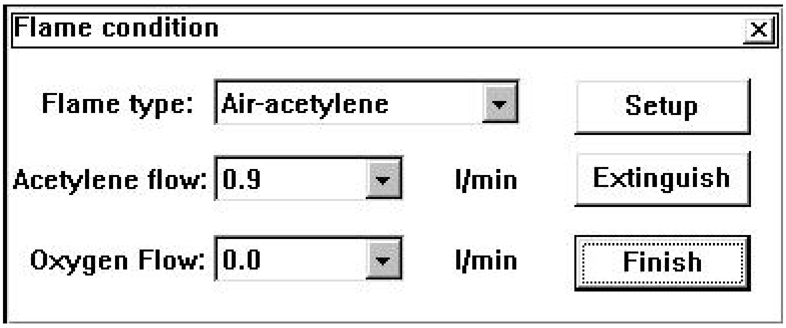
Read delay: 0 S

Read time: 1 S

Damp constant: 2

Fig. 4-25

Flame AA method: Click this icon to set the flame type, acetylene flow, oxygen flow (only when air-acetylene-oxygen is selected, the parameter can be set.), flameout. Refer to Fig.4-26. After setting the flow parameters, click "Setup" and the ignition will be automatically run. Click "Ok" automatically back to Fig. 4-21.

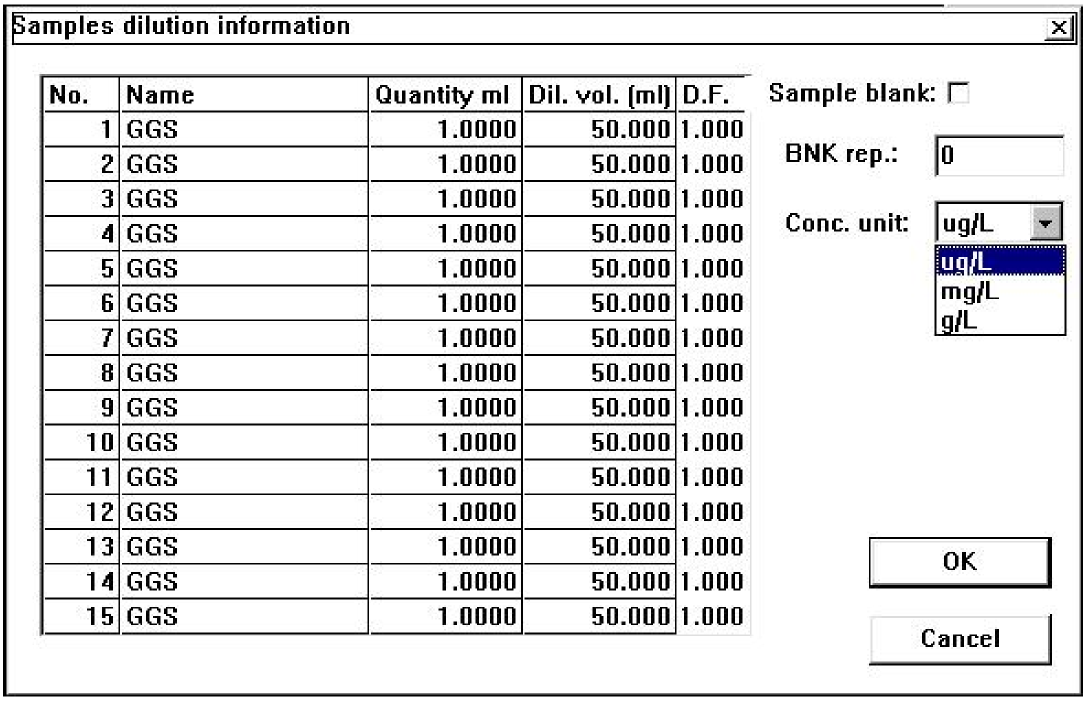


Flame type: Air-acetylene

Acetylene flow: 0.9 l/min

Oxygen Flow: 0.0 l/min

Fig. 4-26



No.	Name	Quantity ml	Dil. vol. (ml)	D.F.
1	GGS	1.0000	50.000	1.000
2	GGS	1.0000	50.000	1.000
3	GGS	1.0000	50.000	1.000
4	GGS	1.0000	50.000	1.000
5	GGS	1.0000	50.000	1.000
6	GGS	1.0000	50.000	1.000
7	GGS	1.0000	50.000	1.000
8	GGS	1.0000	50.000	1.000
9	GGS	1.0000	50.000	1.000
10	GGS	1.0000	50.000	1.000
11	GGS	1.0000	50.000	1.000
12	GGS	1.0000	50.000	1.000
13	GGS	1.0000	50.000	1.000
14	GGS	1.0000	50.000	1.000
15	GGS	1.0000	50.000	1.000

Sample blank: ☐

BNK rep.: 0

Conc. unit: ug/L

Fig. 4-27

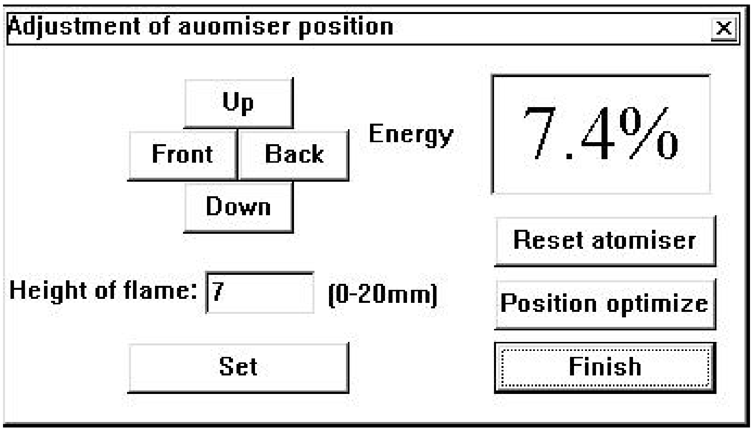
Task information: Click it to input the name of task and the name of the analyst.

Modify the sample dilution table: In this table, the "sample blank", "blank repeat time" and "concentration unit" etc can be selected. The re-dilution can be made for any of samples on the original basis. For example: in fig. 4-16, take 1ml sample and dilute it to 50 times, if the concentration of one unknown sample is found to be larger during the measuring procedure, the dilution is needed again. Take 1ml sample from the first dilution solution of 50ml to dilute it to be 10ml, thus the second dilution should be 10 times. Input the multiple into dilution times column in fig. 4-27. The total dilution multiple should be 50×10=500 times.

Re-slope: Click it at any time during sample determination to insert re-slope point. Refer to Section 4.3.5 and Fig. 4-10 for details.

Changing Method: If several analytical methods are selected in analytical task design, click this icon to change it to the next method after the first method is finished.

Position adjustment of Flame Atomizer: in detecting process, adjust the atomizer up, down, front and back positions and carry out setup of flame height and operation of the atomizer. Refer to Fig. 4-28.


Adjustment of auomiser position

Energy 7.4%

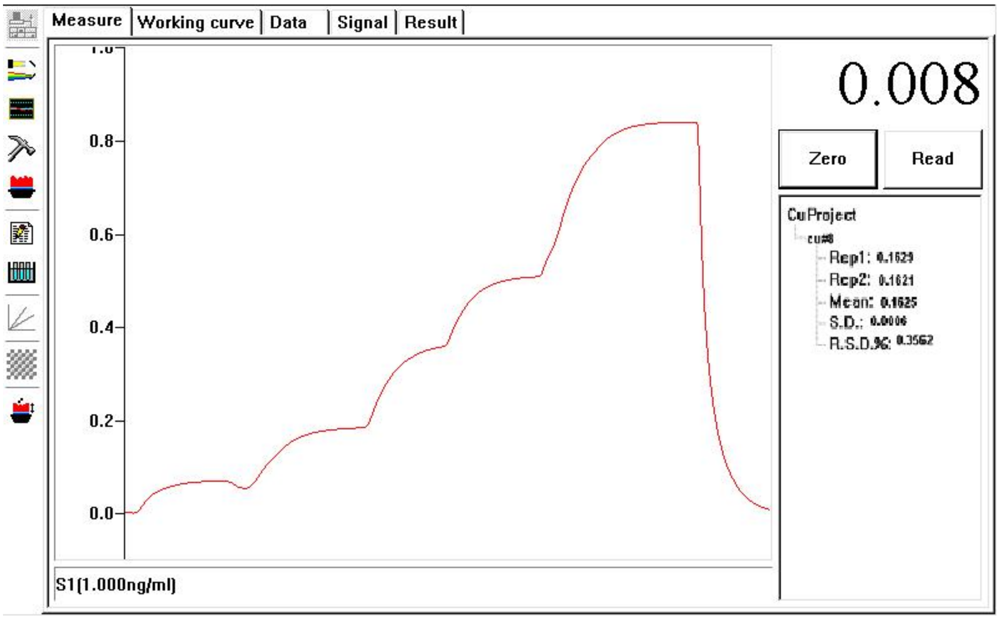
Height of flame: 7 (0-20mm)

Fig. 4-28

4.11.2 Setting up standard curve and determining unknown samples with flame method

Take Copper (Cu) standards 1μg/ml, 3μg/ml and 5μg/ml as an example. The operation procedures are as follows:

1) Turn on air and C_2H_2 to ignite the flame.
2) Put the aspirating capillary into the distilled water after the flame is stable, then click “Zero” key to adjust the zero.
3) Put the aspirating capillary into the standard blank: 1μg/ml, 3μg/ml and 5μg/ml standard solutions in sequence and click “Read” key by each time as shown in Fig. 4-29. If the absorbance value is too big to exceed the Y coordinate during reading out, double click the page of Fig. 4-21 to display Fig. 4-22. Use the mouse to select and input the corresponding modified values and the coordinate times.


0.008

CuProject
cu#8
Rep1: 0.1629
Rep2: 0.1621
Mean: 0.1625
S.D.: 0.0006
R.S.D.%: 0.3562

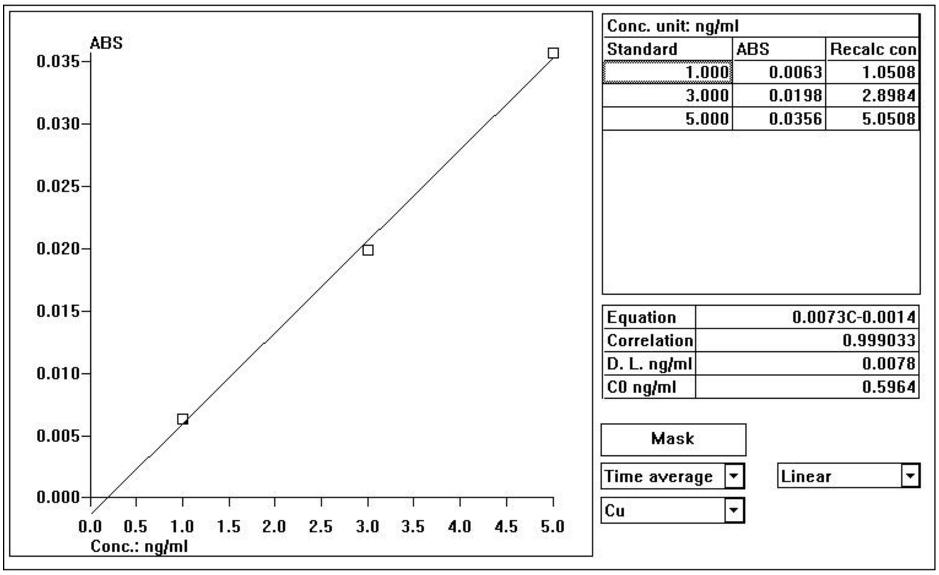
S1(1.000ng/ml)

Fig. 4-29

4) To view the established standard curve, click “Working curve” in Fig. 4-21 and display Fig.

4-30.

5) In Fig. 4-30, “Mask” key is used to mask one of the standard points to increase the relative coefficient. The concrete method to do it is: select some of standard point witch influence the curve fitting, then click “Mask” key. If retrieving the original curve, click “Mask” key again.



Conc. unit: ng/ml

Standard	ABS	Recalc con
1.000	0.0063	1.0508
3.000	0.0198	2.8984
5.000	0.0356	5.0508

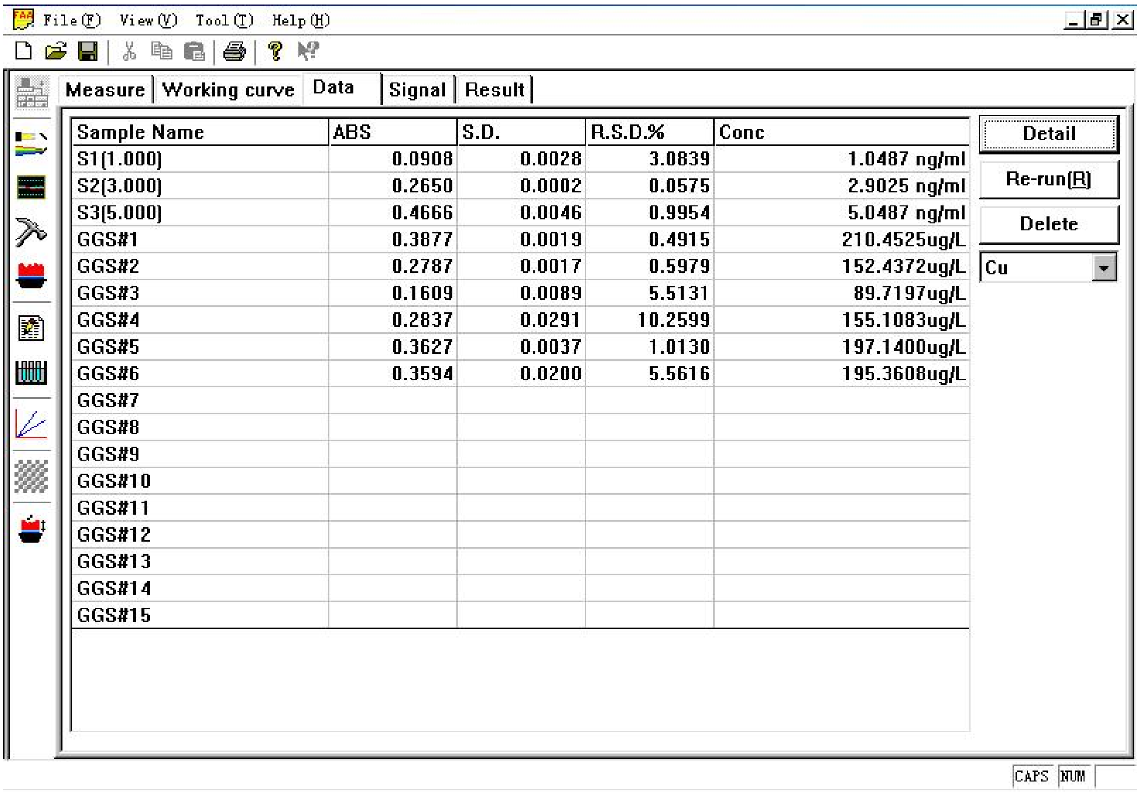
Equation	0.0073C-0.0014
Correlation	0.999033
D. L. ng/ml	0.0078
C0 ng/ml	0.5964

Time average
Linear
Cu

Fig. 4-30

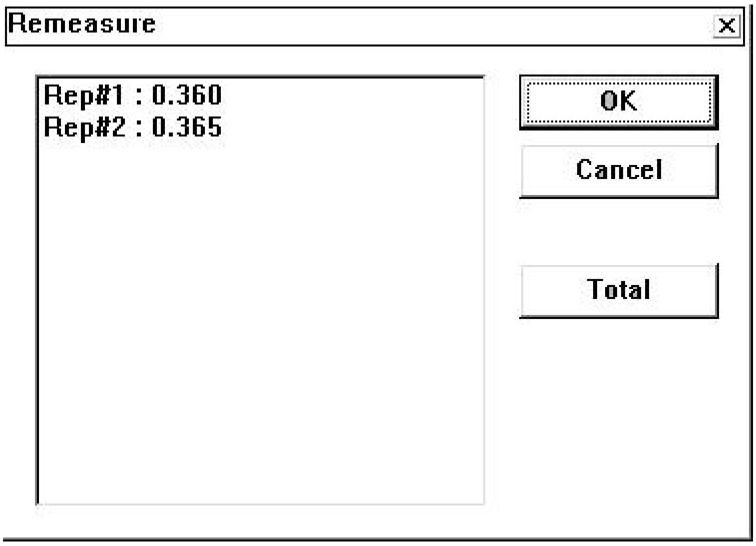
6) To measure the unknown sample continuously, click back to the measurement page to make the determination continuously.

7) To modify the data of a standard point or the unknown sample point, click “Data” in the measurement page to display Fig. 4-31. Select the standard point or unknown sample to be modified, firstly click the item to making it being the blue color, then click “Rerun” key (Fig. 4-32) to select the abnormal point to make it again. And the return to the measurement page to measure the data continuously.



Sample Name	ABS	S.D.	R.S.D.%	Conc
S1(1.000)	0.0908	0.0028	3.0839	1.0487 ng/ml
S2(3.000)	0.2650	0.0002	0.0575	2.9025 ng/ml
S3(5.000)	0.4666	0.0046	0.9954	5.0487 ng/ml
GGS#1	0.3877	0.0019	0.4915	210.4525ug/L
GGS#2	0.2787	0.0017	0.5979	152.4372ug/L
GGS#3	0.1609	0.0089	5.5131	89.7197ug/L
GGS#4	0.2837	0.0291	10.2599	155.1083ug/L
GGS#5	0.3627	0.0037	1.0130	197.1400ug/L
GGS#6	0.3594	0.0200	5.5616	195.3608ug/L
GGS#7				
GGS#8				
GGS#9				
GGS#10				
GGS#11				
GGS#12				
GGS#13				
GGS#14				
GGS#15				

Fig. 4-31

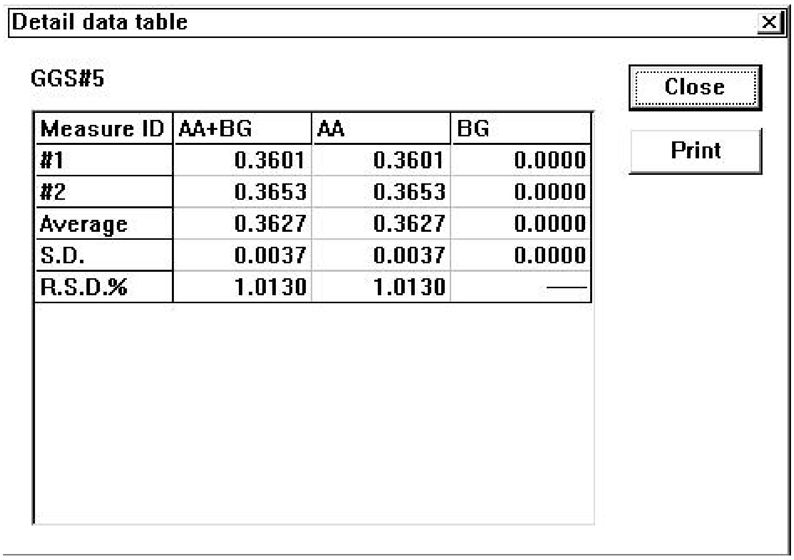


Rep#1 : 0.360
Rep#2 : 0.365

Fig. 4-32

8) In Fig. 4-31, if click “Delete” key, all the data including the standard point and unknown sample point will be deleted.

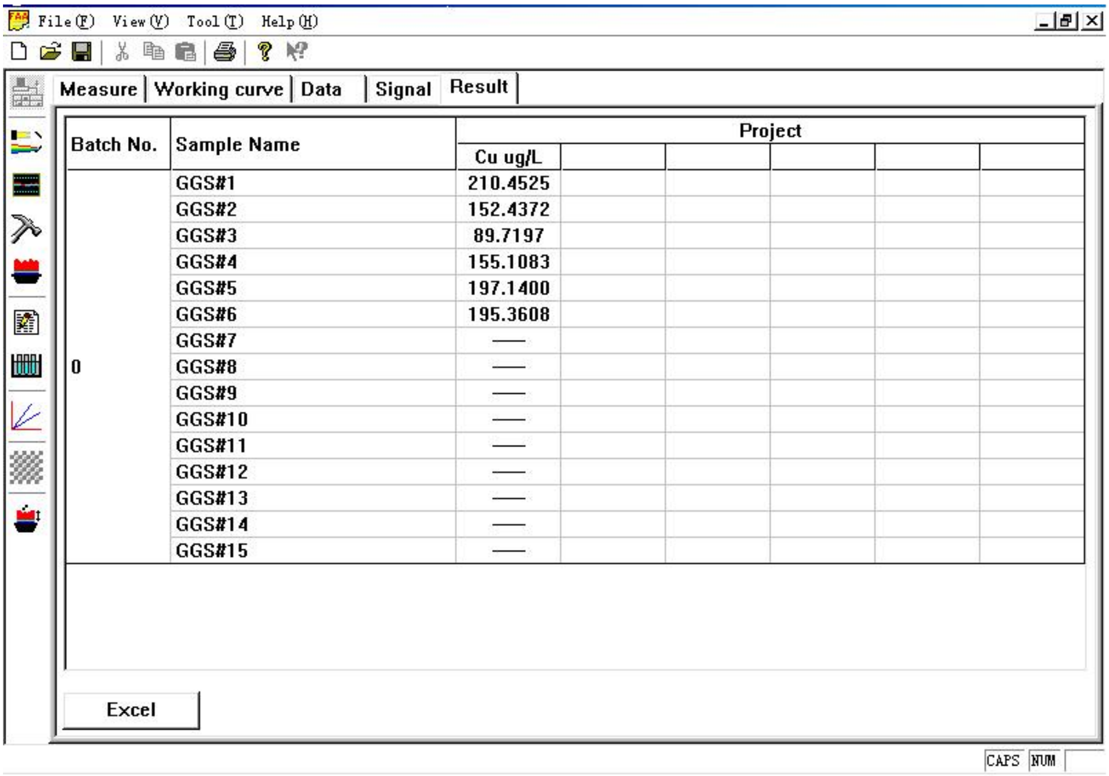
9) “Detail” key is used to display the detailed measurement value for each standard point and each unknown point, and calculate the mean value and R.S.D, etc. The data can be printed out as shown in Fig. 4-33.



GGS#5

Measure ID	AA+BG	AA	BG
#1	0.3601	0.3601	0.0000
#2	0.3653	0.3653	0.0000
Average	0.3627	0.3627	0.0000
S.D.	0.0037	0.0037	0.0000
R.S.D.%	1.0130	1.0130	——

Fig. 4-33



Batch No.	Sample Name	Project					
		Cu ug/L					
0	GGS#1	210.4525					
	GGS#2	152.4372					
	GGS#3	89.7197					
	GGS#4	155.1083					
	GGS#5	197.1400					
	GGS#6	195.3608					
	GGS#7	——					
	GGS#8	——					
	GGS#9	——					
	GGS#10	——					
	GGS#11	——					
	GGS#12	——					
	GGS#13	——					
	GGS#14	——					
	GGS#15	——					

Fig. 4-34

10) Click “result” in the page of Fig. 4-31 to show Fig. 4-34, that shows the final result of the unknown sample. if the result format required by the user is not in accord with the format supplied by the software, click “Excel” key at the lower left corner to edit it.

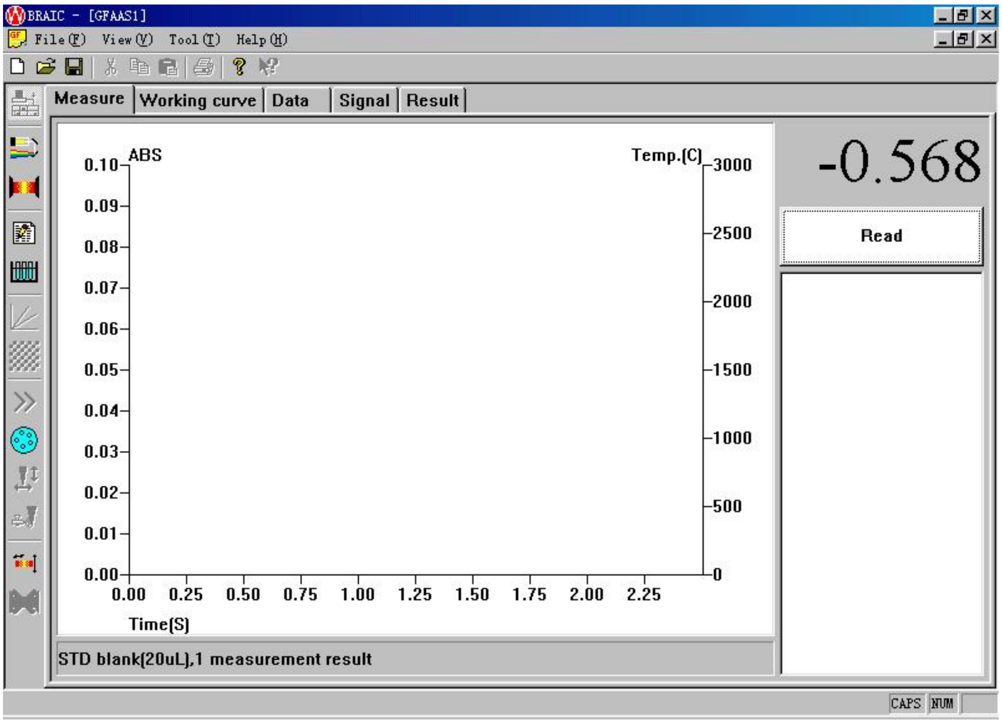
Note: the edited format can not cover the old one; furthermore Office software should been installed in the operation system.

4.12 Software Operation of Graphite Furnace Analysis

As automatic sampling function is added in the graphite furnace method, before carrying out the analysis, firstly adjust the sampling position of WF-10A auto-sampler according to the descriptions in the chapter 7.

4.12.1 Introduction of main page for graphite furnace measurement:

The different point of graphite furnace method & flame method in the software is the “Control Function Key” in the measurement Page (shown in Fig. 4-35).



-0.568

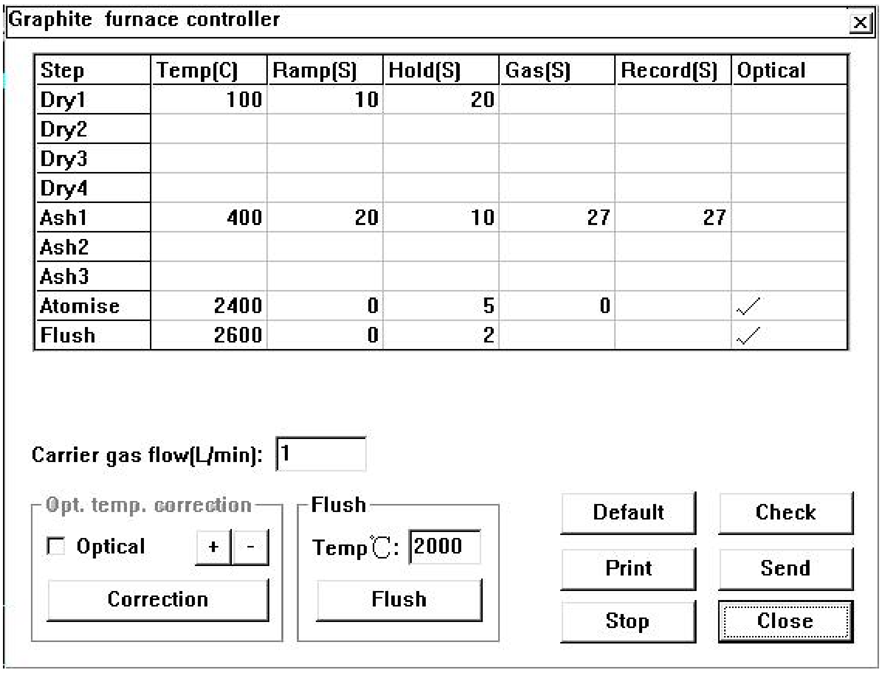
STD blank(20uL),1 measurement result

Fig. 4-35

On-line: The operations are the same as the flame method

Instrument Controller: Functions are the same as the flame method

Graphite Furnace Controller: 1) as shown in Fig. 4-36, in this page, user can modify or reset the temperature-rising program of the graphite furnace (refer to the section 4.4). After finishing the operation, click “Send”. 2) Heat or flush the graphite tube to eliminate sundries interference; 3) if the temperature-rising curve of the graphite furnace power supply is not valid any more, click “Default” to recall the default curves in the power supply. “Opt. temp. correction” is for calibrating temperature-control precision. Click “Correction” key and then the graphite furnace will raise temperature automatically according to the default value. If within 6 ~ 10 seconds, the graphite furnace stops raising temperature automatically, that shows the calibrating temperature is valid; if the time reaches up to 15 seconds, the raising temperature is not valid. If it is so, after starting the rising temperature, continuously click “+” key for several times to satisfy the condition of automatically stopping the rising temperature within 6-10S. If the rising temperature is less than 6seconds, continuously click “-“key for several times after starting the rising temperature program in order to satisfy with the condition of automatically stopping the rising temperature.



Step	Temp(C)	Ramp(S)	Hold(S)	Gas(S)	Record(S)	Optical
Dry1	100	10	20			
Dry2						
Dry3						
Dry4						
Ash1	400	20	10	27	27	
Ash2						
Ash3						
Atomise	2400	0	5	0		✓
Flush	2600	0	2			✓

Carrier gas flow(L/min): 1

☐ Optical

Temp℃: 2000

Fig. 4-36

Task Information: operations are the same as the flame method.

Modify the sample dilution table: operations are the same as the flame method.

Reslope: operations are the same as the flame method.

Changing method: when carrying out the analysis of multi-elements, if the current analysis is finished, it will automatically changeover to the next item.

Note: before running the next analysis, the pre-heating time if the instrument can be selected, after pre-heating, the settings of the automatic wavelength scan, etc. will be automatically entered. If the last analysis is in full automatic state, the auto-sampler will start automatically and carry out automatic sampling analysis of the current item.

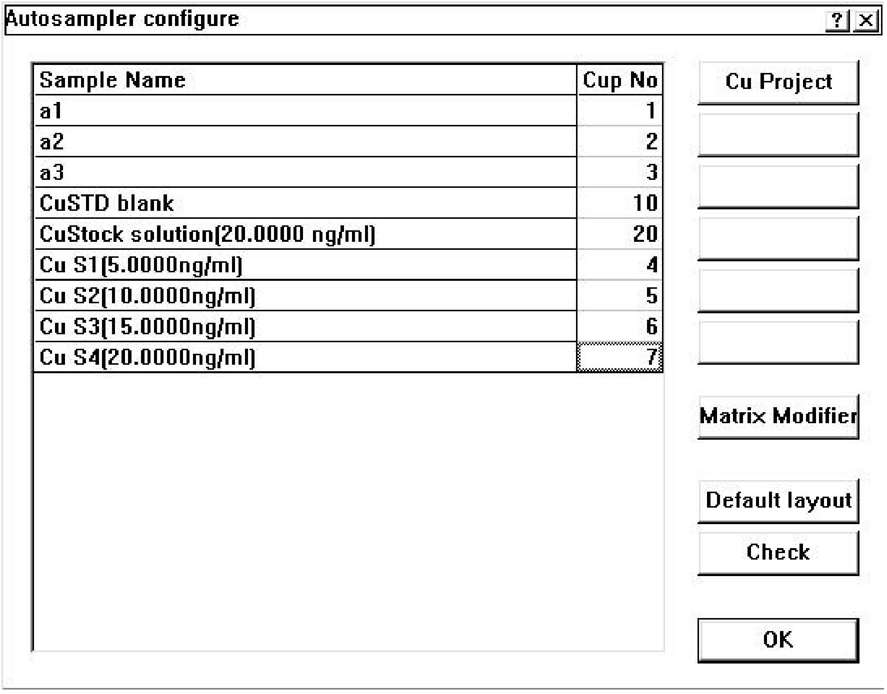
Un-auto/Auto/Manual (cycling): control the sampling model of the graphite furnace auto-sampler: Un-auto model (default model): sampling in single step, click “Read” key. For smpling. Auto mode: run automatically and continuously according to the edited standard points of working curves and the corresponding cup numbers, also sample series and their corresponding cup numbers, until all standard points and the sample are analyzed.. Manual mode: the auto-sampler does not work, the manual sampling mode is adopted.

Auto-sampler configuration: it is for setting the standard solutions and the solutions in the cup numbers of the auto-sampler. After editing the cup numbers, click “Check” key; if there has something wrong with it, clewing to reedit it. “Matrix Modifier” is for eliminating the matrix interference in the samples.

Setup working curves:

Method 1: as shown in Fig. 4-37, use a standard concentration, according to different sampling volume to setup the standard curves. For instance: Cu stock solution concentration is 20ng/ml, the working curves are separately 5ng/ml, 10ng/ml, 15ng/ml and 20ng/ml. In the “Auto-sampler configure” page, click “Cu Project”; input 20ng/ml in the sample using information page, click “Ok”. Input number “20” (random) in the sample cup No. table in Cu stock solution column, input “10” (random) for the standard blank cup, for others S1… S4, cup No. can be also set randomly; Instrument will suck up the samples with the different volume automatically and generate S1, …, S4 standard absorbance value. The cup No of sample to be measured can be only inputted from No.1 …in sequence.

Note: The highest sampling volume of standard curves should be divided by 20ul, that is, 5ul. (5ng/ml) and 10ul (10ng/ml) ……



Sample Name	Cup No
a1	1
a2	2
a3	3
CuSTD blank	10
CuStock solution(20.0000 ng/ml)	20
Cu S1(5.0000ng/ml)	4
Cu S2(10.0000ng/ml)	5
Cu S3(15.0000ng/ml)	6
Cu S4(20.0000ng/ml)	7

Fig. 4-37

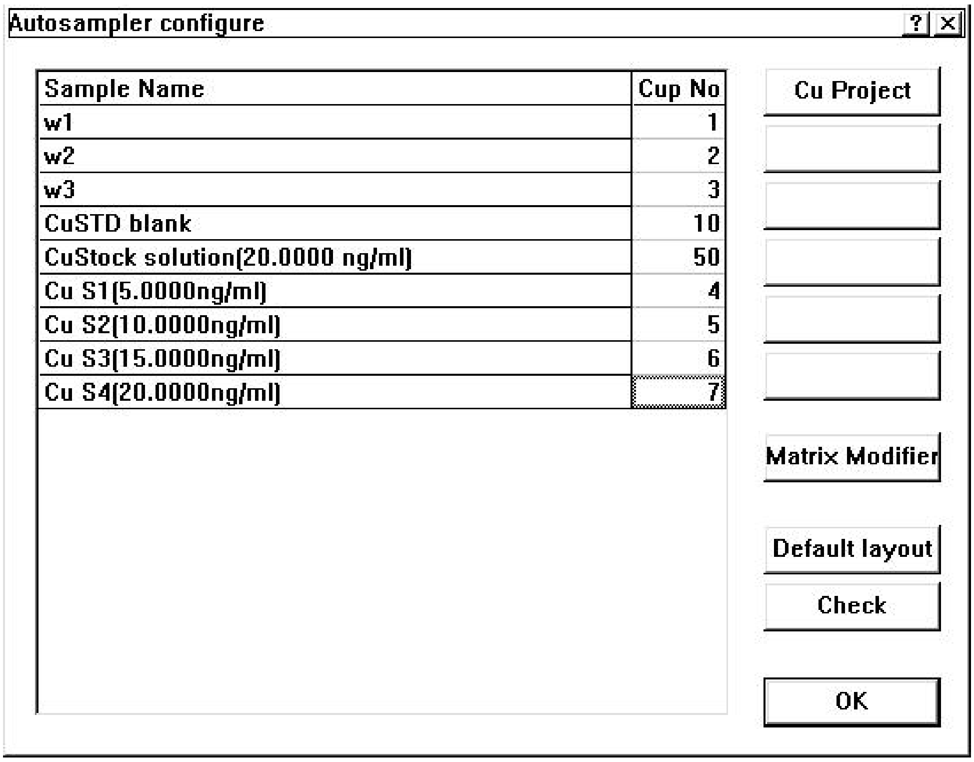
Method 2: as shown in Fig. 4-38, prepare Cu standard solution of series concentrations, sequentially suck up the sample solution with the same sampling volume and setup the working curves. That is: Input the standard blank solution into cup No. 10, S1, …, S4, input cup No. 4, …., 7 in order.

Therefore, it is not necessary to set Cu stock solution, only set a far terminal cup No. 50, move out away the working curve and the cup number of samples.

Note: In above two method, when inputting the cup No. of samples to be analyzed, it must start from the cup No.1 and the other cup numbers can be set at random.

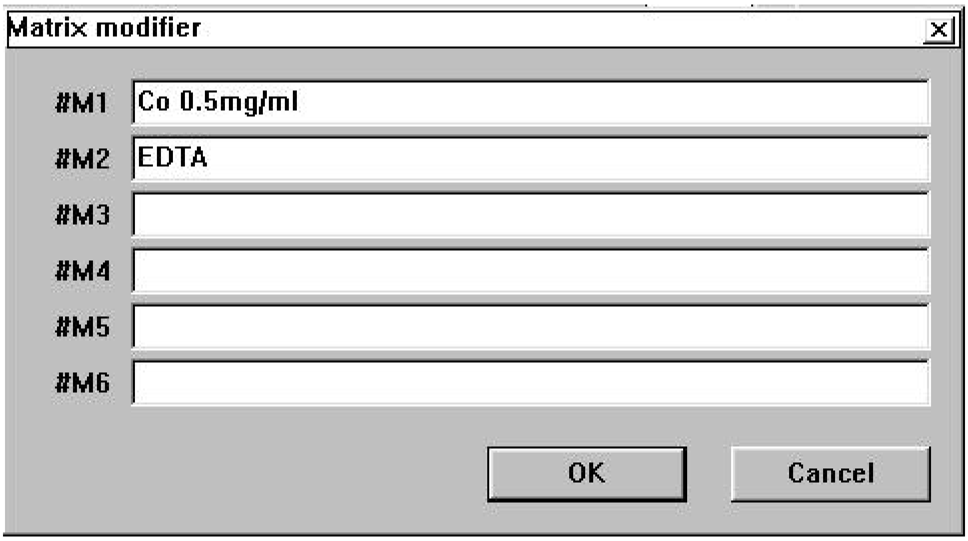
Setting of matrix modifier: in the page of :auto-sampler configuration” as shown in Fig. 4-38, click “Matrix Modifier”, show #1, …, #5 columns as shown in Fig. 4-39. According to the analytical requirement of the graphite furnace method, input the type of matrix modifier. Click

“Ok” after completing the edition. Click “Cu Project” to show usage circumstance of project sample. In Fig. 4-40, click the selected right side textbox from 1 to 5 and input the corresponding volume of matrix modifier. Click “Ok”.



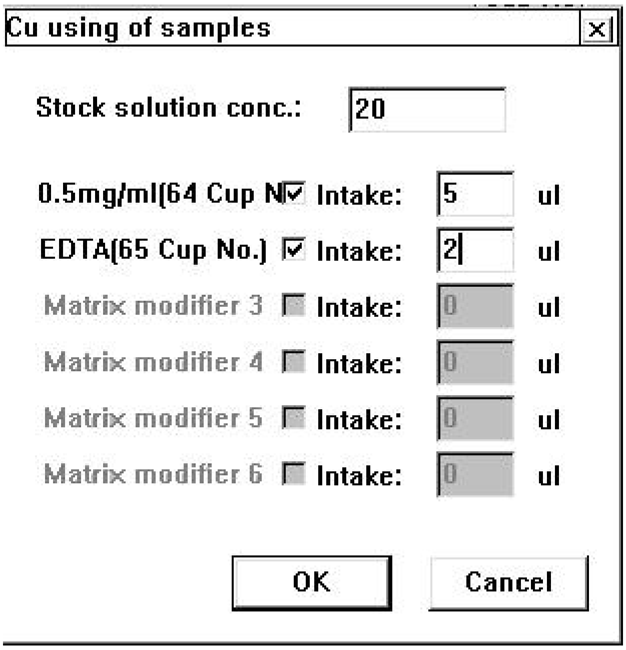
Sample Name	Cup No
w1	1
w2	2
w3	3
CuSTD blank	10
CuStock solution(20.0000 ng/ml)	50
Cu S1(5.0000ng/ml)	4
Cu S2(10.0000ng/ml)	5
Cu S3(15.0000ng/ml)	6
Cu S4(20.0000ng/ml)	7

Fig. 4-38



#M1 Co 0.5mg/ml
#M2 EDTA
#M3
#M4
#M5
#M6

Fig. 4-39


Cu using of samples

Stock solution conc.: 20

0.5mg/ml(64 Cup N ☑ Intake: 5 ul

EDTA(65 Cup No.) ☑ Intake: 2 ul

Matrix modifier 3 ☐ Intake: 0 ul

Matrix modifier 4 ☐ Intake: 0 ul

Matrix modifier 5 ☐ Intake: 0 ul

Matrix modifier 6 ☐ Intake: 0 ul

Fig. 4-40

Adjustment of auto-sampler: Click this button as shown in Fig.4-41, the following operations can be carried out: the position adjustment of the sampling pin relative to the graphite tube, the height adjustment of the sampling pin relative to the sample cup, “Cut tube” operation of the sampling tube. Details refer to the chapter 7.

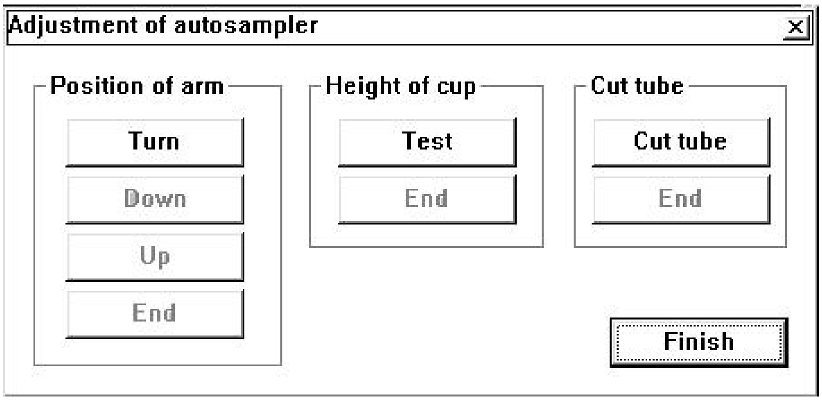


Fig. 4-41

Purge: click this icon, purge the sampling pin head of the auto-sampler.

Position adjustment of Graphite Tube: click this icon as shown in Fig.4-28, adjust the position of the graphite furnace up, down, front, and back. The position of the graphite furnace in the optical path can be optimized automatically. The operating method is the same as the flame method.

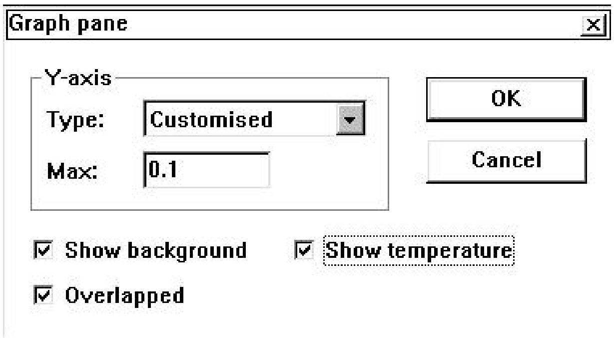
Stop Graphite Furnace: when it is required, the current temperature-rising program of the graphite furnace can be stopped.

Note: The icon is valid only after starting the program of the graphite furnace,.

4.12.2 Draw standard curve and determining unknown samples with graphite furnace

method

1) Connect the water and gas pipes and the instrument and the auto-sampler all are in normal case, select auto-sampling state, then click “Read” key in Fig.4-35, the auto-sampler will automatically inject the standard blank, series standard points and the sample ti be determined into the graphite tube in sequence.
2) If the displayed ABS value exceeds the Y coordinate maximum value, double click the black part on Fig. 4-35 to show the window Fig. 4-42. If selecting “Customized”, input the corresponding Y-Axis value at “maximum”. If “Auto” is selected, the Y coordinate value on the measuring page will be adjusted automatically according to the absorbance value (AA or BG).
3) Display the background: If selecting “√ “, that shows to display BG value of D_2 lamp background correction during the measurement. In addition, BG curve and temperature curve can be also printed out on the signal graphic page.
4) Display the temperature: Select “√ “ to display the temperature curve during the measurement.
5) Overlap: The standard sample, peak shape of the unknown sample and temperature curve will be all overlapped.



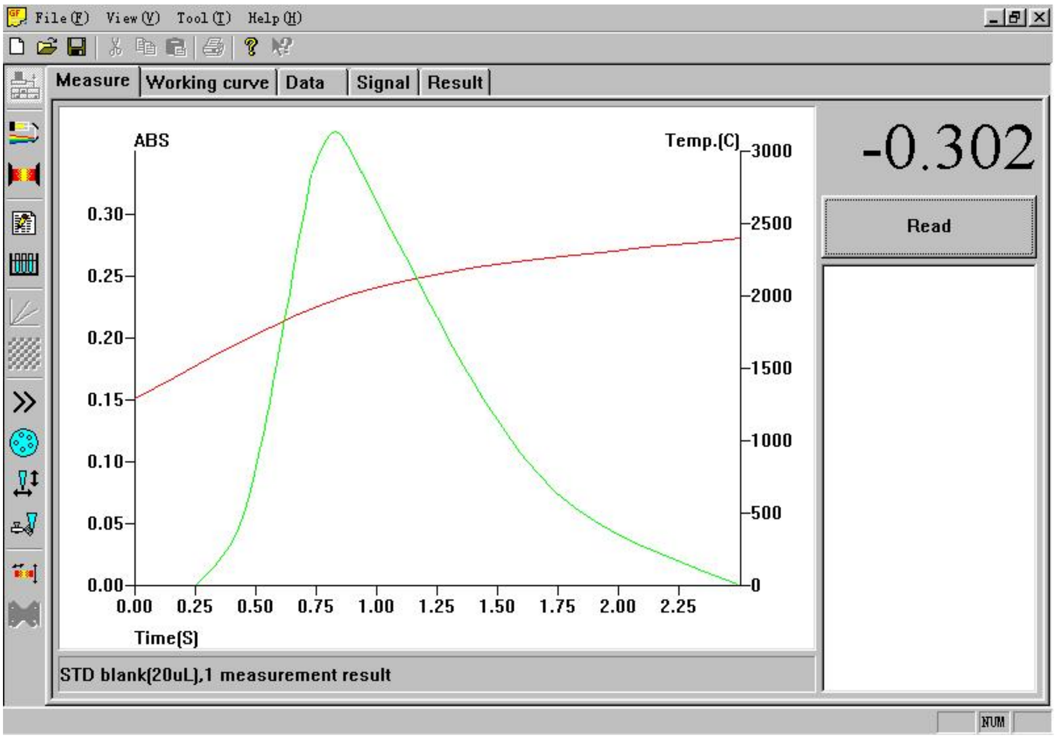
Type: Customised

Max: 0.1

☑ Show background ☑ Show temperature

☑ Overlapped

Fig. 4-42



-0.302

STD blank(20uL),1 measurement result

Fig. 4-43

Signal graph: to display the signal graphs of all the samples. “Time average” displayed for the flame mode is a straight line while the graphite furnace mode displayed is sampling peak shape as show in Fig. 4-43. The absorbance value and temperature curve are selected in Figure and all overlapped in one page and printed out for the future use.

Other operations of the graphite furnace analysis are the same as the flame method.

Note: Due to the limitation of the lifetime of the graphite tube, the replacement of the graphite tube will be often made. The procedures of the replacement are described as follows:

1) Under the un-heating condition, loosen the locked hand-heel and the tightened hand-wheel of the auto-sampler, and rotate them to non-work positions.

2) Set the cylinder knob located at the right side of the integrated atomizer to be “loosening position”, then make the baffle plate of the right side backwards to the leveling position; use hand to pinch the graphite cavity on the right side to a proper position, and take out the aged graphite tube.

3) Put a new graphite tube, push the graphite cavity on the right side and the baffle plate back to the original positions. Adjust the sampling hole of the graphite tube well with a special device, and set the cylinder knob to “pressed position”. The graphite cone will clamp the graphite tube automatically under the function of the cylinder. At last take out the special device used for the replacement.

Note: burn the new tube for 3 or 4 times under the temperature of 2600℃ before using it for cleaning the dust on its surface.

4.13 Standard addition method

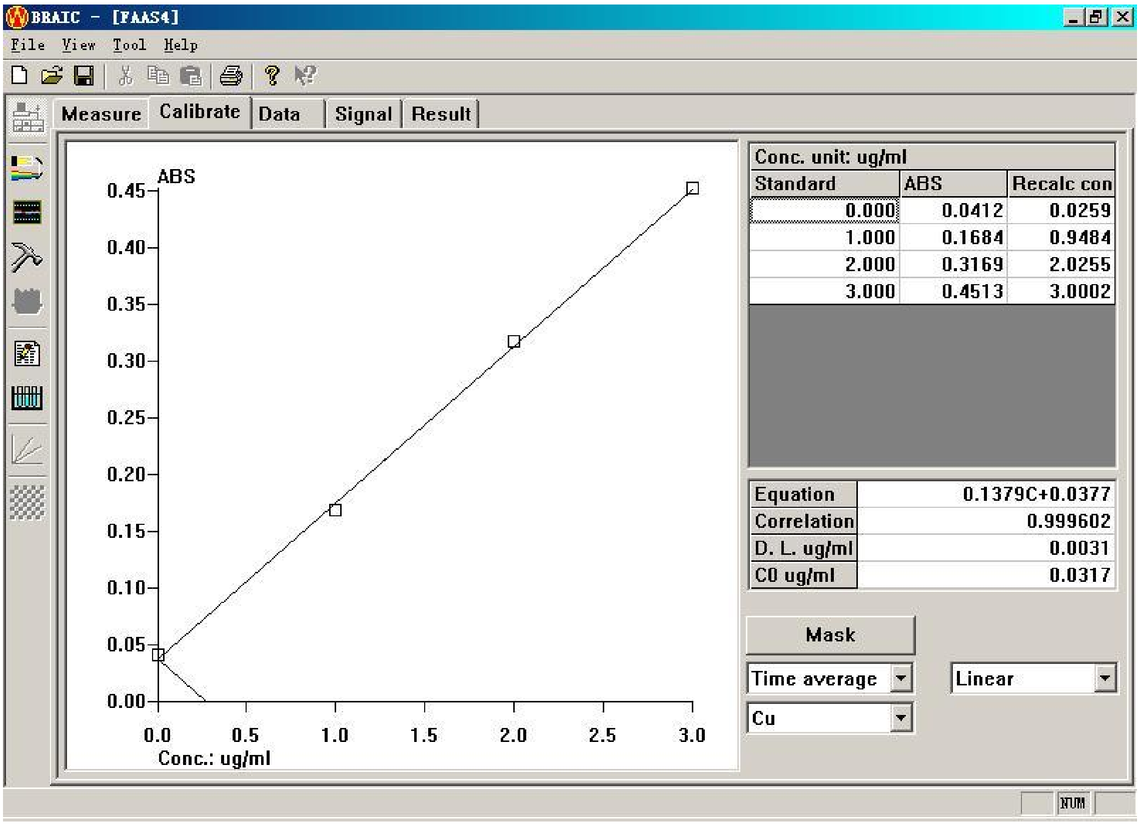
When the co-existence substance in the sample is more complex, or high content of the matrix, big varying, it’s difficult to prepare the approaching standards. On this occasion, the standard addition method should be used.

Divide the sample into four equal parts. Add different amount of the standard solution into the second, third and forth parts and dilute them to the same volume for the measurement.

Refer to Fig. 4-3 for the condition setting. Select “STD Addition” in the “Measurement Condition” page as shown in Fig.4-6. In Fig. 4-7, input “0” for S1, and the different standard solution for S2, S3 and S4. The quantity of the co-existence substance in this group are quite same, therefore, the measured standard curve will be a straight line without passing through the original point as shown in Fig. 4-44. The concentration of the sample to be determined is shown in Fig 4-45.

The standard addition method can eliminate the matrix interference and obtain more accurate results. But it cannot eliminate the interference caused by the background absorption.

The working curve (including working conditions of instrument), data table, signal graphs, final results, flame conditions and graphite furnace conditions all can be printed out on the concerned page.

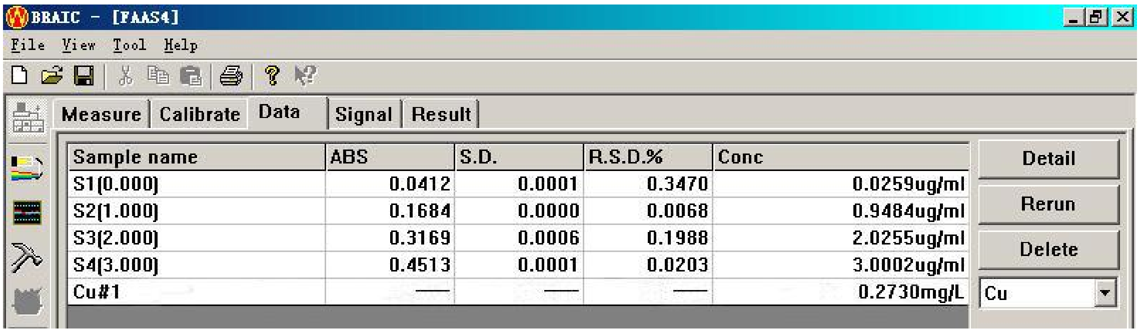


Conc. unit: ug/ml

Standard	ABS	Recalc con
0.000	0.0412	0.0259
1.000	0.1684	0.9484
2.000	0.3169	2.0255
3.000	0.4513	3.0002

Equation	0.1379C+0.0377
Correlation	0.999602
D. L. ug/ml	0.0031
C0 ug/ml	0.0317

Fig. 4-44



Sample name	ABS	S.D.	R.S.D.%	Conc
S1(0.000)	0.0412	0.0001	0.3470	0.0259ug/ml
S2(1.000)	0.1684	0.0000	0.0068	0.9484ug/ml
S3(2.000)	0.3169	0.0006	0.1988	2.0255ug/ml
S4(3.000)	0.4513	0.0001	0.0203	3.0002ug/ml
Cu#1	——	——	——	0.2730mg/L

Fig. 4-45

4.14 Software operation of flame emission method and hydride method.

Refer to the flame method.

4.15 Other operations in software

Click “Help (H)”in Fig 4-1 to display sub menu in Fig. 4.46.

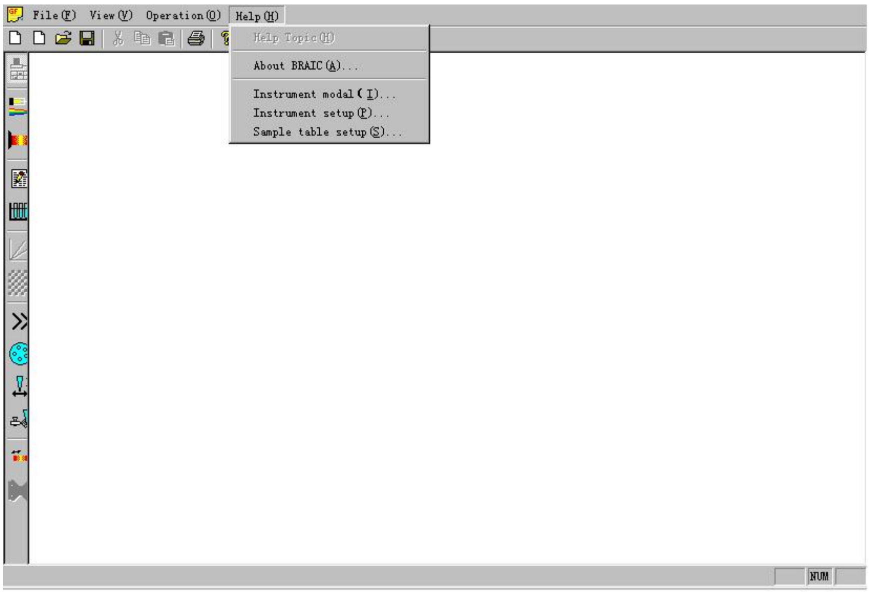
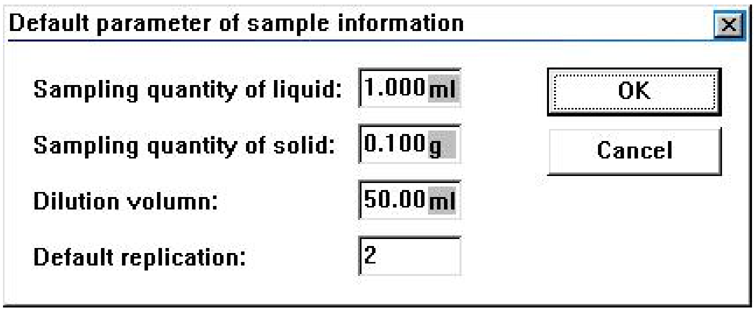


Fig. 4-46

Instrument setting (I): It is only used for the manufacturer, not for users.

Parameter setting (P): Modify the wavelength parameters of the instrument, the details refer to Chapter 6.

Sample parameter setting(S): Modify the default parameters for each item of the sample, referring to Fig. 4-47.



Sampling quantity of liquid: 1.000 ml

Sampling quantity of solid: 0.100 g

Dilution volumn: 50.00 ml

Default replication: 2

Fig. 4-47

4.16 Operation flow chart of software

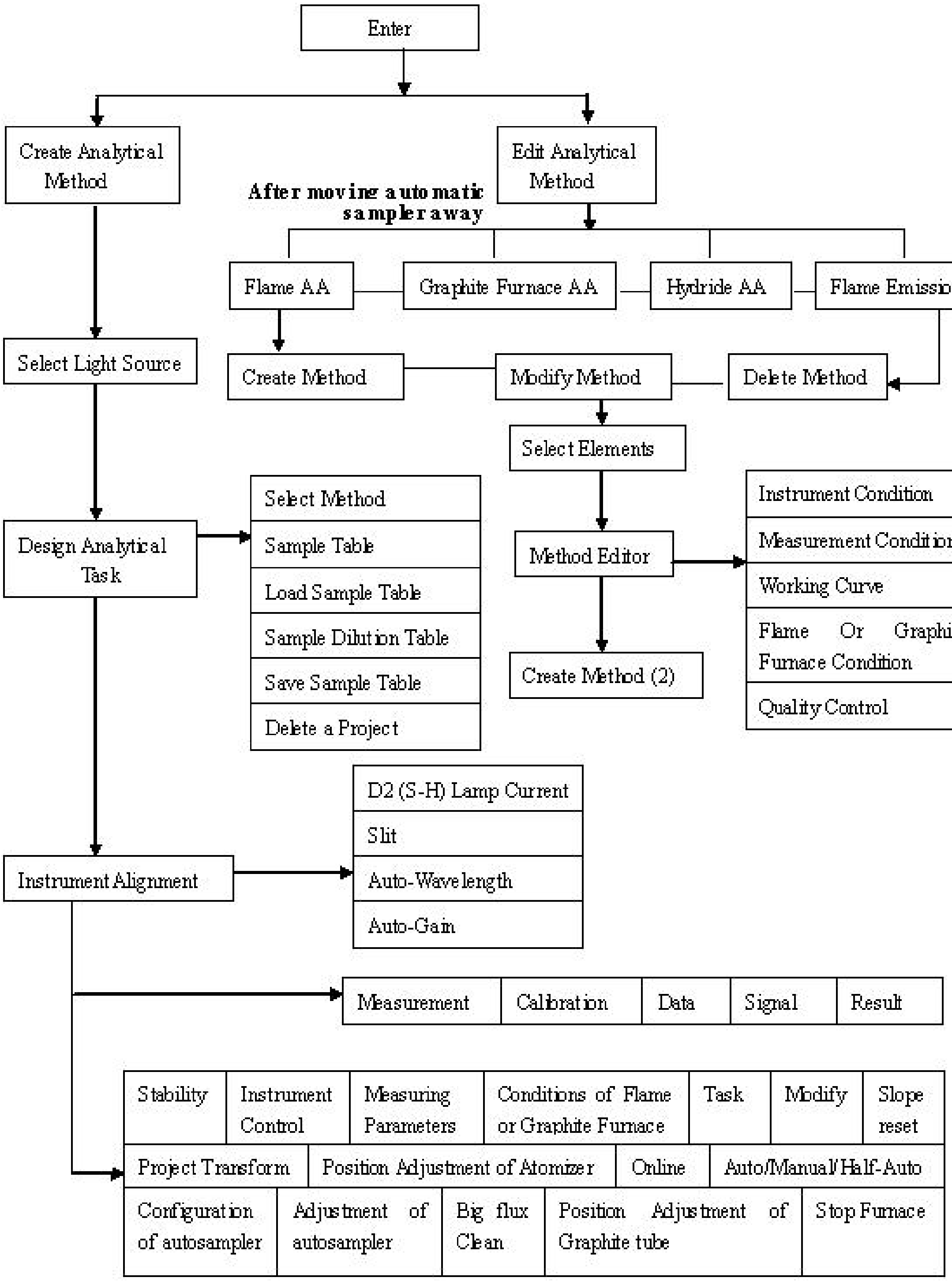


Fig. 4-48

Chapter 5 Oxygen-enriched air-acetylene flame

5.1 Introduction of Oxygen-enriched air-acetylene flame

The oxygen-enriched air-acetylene flame is a new kind of high temperature flame used for the atomic absorption spectroscopic method. It advantages are: environmental protection, economic, easy to operate and widely adaptation.

There are two kinds of commonly used flame atomic absorption spectrum method: one is the air-acetylene flame atomic absorption spectrum method. In this method, the flame temperature is 2300°C. It is only applicable for the elements with low melting point and boiling point (<2000K) and the oxide dissociation energy less than 5eV, such as: the alkaline metals, Cu Sub-group, Zn Sub-group and Mn, Fe, Co, Ni, Pb, etc. For the elements with medium melting point and boiling point and the oxide dissociation energy approaching 5ev, such as alkaline earth metals, Cr, Mo, Ga, Ge and Sn, etc., although they can use this method, the atomization efficiency is low due to low flame temperature and it will cause the serous solute interference (chemical interference). For the elements with high melting point and boiling point and the oxide dissociation energy higher than 6eV, such as the rare earth elements, Ti subgroup, V subgroup, Wu, B, Al and Si, it can hardly measure them. Therefore its application is limited.

Another kind is the nitrous oxide-acetylene flame. In this method, the flame temperature can reach up to 2950°C. It is a high temperature flame, 650°C higher than the temperature of the air-acetylene flame. Therefore it has higher atomization efficiency for the elements, such as: the alkaline metals, Cr and Mo. Furthermore the chemical interference is avoided. It can also be applicable for the elements with high melting point and boiling point and high oxide dissociation energy to extend the measuring elements to be about 70 kinds. But this flame still has some disadvantages. For example, the large quantity of toxic gas (commonly called as laughing gas, used in the medical as the narcosis gas) is used for this flame. When burning, it will produce CN. The consumption of this gas is very large and the cost is so high. Additionally, this flame temperature cannot be adjusted. So it is unable to achieve the best atomization efficiency for some elements. It also has stronger CN molecular emission and absorption so as to affect the measuring sensibility of some elements.

The low temperature of the air-acetylene flame is caused by the low oxygen content in the air. But the nitrous oxide can produce the oxygen of high rate when it is dissociated at high temperature with releasing the heat energy up to 2950K. So it is helpful for the atomization of most elements and elimination of the chemical interference.

Early in 1965, Mr.Amos and other people had tested the air-acetylene flame and the nitrogen-oxygen-acetylene flame. The temperature could be reached up to 3200°C. When using the total consumption (eddy flow) burner, the flame was in fierce turbulence. When using the pre-mixing burner, it was easy to cause the flashback due the unreasonable design of the burner at that time. For above reasons, it was not used in common. Mr. Kirkbright had studied to use the three-slot burner and oxygen-shielded air-acetylene flame to prevent the flashback. But the temperature of this flame can only reach up to 2600K, the flame has turbulence and the noise is so big. Therefore its performance is far worse than the nitrous oxide-acetylene flame.

The key to improve the sensitivity of the flame atomic absorption spectrum method and to reduce the chemical interference is to increase the flame temperature, but the increase of the flame temperature depends on the increase of the oxygen content in the fuel gas and the control and adjustment of the flow rate of all the gas components should be made freely.

The oxygen-enriched air-acetylene flame used in the atomic absorption method is a new kind of patent technology and method (patent No. 92101560.7). Its principle is to add pure oxygen gas into the air to make it becoming the rich oxygen air. Then mix it with the acetylene gas. The flow meter, is used precisely to control the flow rate of all the gases. The optimal flame status can be selected for different analytical element so as to achieve the optimal atomization efficiency. It is a new kind of high temperature flame for the atomic absorption method, easy to operate, low cost, no harmful for healthy and high sensitivity. It can be used in all fields of the measurement of the trace elements.

Because the flame temperature can be adjusted by controlling the flow rate of acetylene and oxygen, it is applicable for the measurement of different elements. For some elements with low melting point and boiling point, it is able to directly adopt the air-acetylene flame without adding the oxygen gas. For the elements, such as: Ca, Sr, Ba, Eu, Yb, Mo, Ga and Sn, the sensitivity of the oxygen enriched air-acetylene flame is much better than the air-acetylene flame and nitrous oxide-acetylene flame. For some elements with high melting point and boiling point, its sensitivity is approaching to the nitrous oxide flame.

Because the combustion speed of the high temperature flame is slower in fuel-rich condition, it is not easy to cause the flashback and is very safe. But its combustion speed is fast in fuel-poor condition and it is easy to cause the carbon-accumulation in the slot. Therefore, when the oxygen enriched air-acetylene flame is used alike the nitrous oxide-acetylene flame method, the determination is normally made under the fuel-rich or gentle fuel-rich flame condition (reducing flame).

5.2 Operation of oxygen-enriched air-acetylene flame

When the oxygen-enriched air-acetylene flame is used, the operation and analytical analysis are the same as the flame atomic absorption. It is very important to master how to adjust mixing ratio of Acetylene and oxygen (refer to conditions listed in < Flame Atomic Absorption Analysis Manual of Oxygen-Enriched Air-Acetylene flame>).

Note: First, increase the acetylene flow, and then increase oxygen flow. Following are procedures :

5.2.1 Correctly connect the piping of air, acetylene and oxygen according to the installation requirements of the instrument.

5.2.2 Switch on the main unit and communicate it with the computer. Select the flame atomic absorption.

5.2.3 Turn on the air compressor to adjust the output pressure to be more than 0.3MPa. Turn on the switch of the acetylene steel cylinder to adjust the pressure to be 0.15MPa more or less. Turn on the switch of oxygen steel cylinder to adjust the pressure to be about 0.15MPa.

5.2.4 Run the software, set the acetylene and oxygen flows, press “set” key, ignite Air-Acetylene flame automatically. Increase the acetylene flow step by step, at the same time the oxygen flow will increase slowly. During the process, color of flame becomes the fuel rich flame of yellow feather shape until the flame state is getting stable. The acetylene and oxygen flows will not be increased any more. The determination will be made under such conditions.

5.2.5 The operations are the same as the air-acetylene flame method.

5.2.6 During the measurement, if the sensitivity is lower, open the flow setting page. Modify the oxygen flow directly in the supplied range without modifying the acetylene, until satisfying the analysis demand; if the oxygen flow quantity stipulated in the software could not satisfy the prospective effect, select higher flow listed in the acetylene table. Select the proper flow in the corresponding oxygen listing.

Note: when adjusting the oxygen flow, observe the flame state at any times, keep the height of the yellow flame part strictly higher than 20mm to ensure the flame in gentle fuel rich flame state.

5.2.7 Switching on the instrument: first, open the flow setting page, press “flame out/Reset” key, the main unit will automatically decrease the oxygen flow slowly, and then decrease the acetylene flow, repeat this operation for several times and at last the flame goes out.

5.2.8 After the flame goes out, close the air compressor.

1) User can refer to the above operation procedures for making the analysis.

2) When the operations are correct, the flashback will not be happened.

3) When there has wrong operation, the protection device mounted on the instrument will be able to avoid the accident happening.

4) In the emergency, it is permissible to cut off the power supply directly to extinguish the flame.

Chapter 6 Maintenance and Service

During the operation, user should master the basic knowledge of AAS, maintenance and adjustment of the instrument in order to sufficiently use the performances of the instrument and prolong its lifetime. This chapter makes further introduction of structure and principle, and also explains the possible troubles and their processing methods briefly. It is helpful for users to operate the instrument well.

6.1 Attention points of maintenance

When the troubles occur during operating the instrument, please diagnose the abnormal phenomena and make correct process according to the instruction in this chapter. If user could not solve the problems, please submit the diagnose reports to your local dealer.

Carefully read "Operation manual of DW-210 Atomic Absorption Spectrophotometer" before the operation.

This chapter gives some necessary notices when maintaining or operating the instrument. However, some important things should still be emphasized here before the maintenance of the instrument. **Caution:** some parts on the instrument can not be retrieved after disassembling. So please notify the user can never disassembly such parts on the instrument.

The followings should also be noticed when making the maintenance:

6.1.1 Do disconnect the power cables before disassemble any parts of the instrument or opening the cover of the instrument..

6.1.2 Cut off the water source and the gas sources of the atomization system before the maintenance. Close the main valves of all gas cylinders, especially the main valve of the acetylene cylinder.

6.1.3 Do not leave bolts or gaskets and so on inside of the instrument during disassembling or retrieving. If it is so, must take them out.

6.1.4 Do not touch the surface of optical parts by any of matters. When adjusting inside of the monochromator, do not set the gain value of PMT if the monochromator is uncovered.

6.1.5 Do not damage the circuit of printed circuit panel when making the maintenance.

6.2 Replacements and adjustments of components and parts

Some parts of AAS are consumables or damageable, so they need replacement after using a period of time. For example, D_2 lamp, hollow cathode lamp, graphite tube, graphite cone and filter are all consumable parts while nebulizer and burner are damageable parts. These components and parts may be corrupted and broken after a long-term use. Even some parts are not consumables or damageable, they will also be rusted after servicing for a long time, such as: optical components, electric parts, etc. Anyhow, the damaged parts must be replaced. To ensure good performance of the instrument, some parts should be adjusted after the replacement.

6.2.1 Replacement and adjustment of hollow cathode lamp

Hollow cathode lamp is main light source of the instrument. Its working life is generally 5000 mA/hour. The hollow cathode lamps with different elements have the different using lifetime. At the same time, its lifetime also depends on the working current. The replacement of hollow cathode lamp is very simple. The method is:

Pull out the lamp from the lamp socket after moving it to working position and plug a new hollow cathode lamp into the pin, and then place it into the lamp holder. The instrument has six lamp holders and they can be inserted simultaneously and randomly.

The light spot of hollow cathode lamp is generally auto-adjusted in peak picking process. If the deviation is very large, adjust it as follows:

(1) Place the hollow cathode lamp into the No.1 lamp position and set the lamp current to be 5mA. A red light spot will be found on the right wall of spray chamber.

(2) There are four bolts on the No. 6 lamp position. Keep the middle two immobile, and unscrew the outer two. Turn the lamp holder and adjust the light spot in the center of the lens and then screw the two bolts down.

6.2.2 Replacement and adjustment of D_2 lamp

1) The minimum lifetime of D_2 lamp is generally 500 hours. It should be replaced when its lifetime is over. Great attention should be taken to the outer size and its working parameters strictly to be the same as the original one.

(1) Anode Current:	300mA
(2) Tube voltage Drop:	70VDC
(3) Filament Voltage:	10VAC
(4) Filament current:	0.5A
(5) Starting Voltage:	more than 200VDC

2) The D_2 lamp used in the instrument has four leading wires. The red one is anode lead-in. The two black wires are the filament leads-in and the yellow one is auxiliary electrode lead-in. They must be connected correctly. Do not touch the window of D_2 lamp by hand.

3) Align the window of D_2 lamp exactly to the semi-transmission-semi-reflection lens when installing the D_2 lamp.

4) The light spot of D_2 lamp is very small, so carefully adjust the light spot position after the replacement. If the light spot position is not right, it will affect output energy of D_2 lamp and influence the light spot of the hollow cathode lamp overlapping with it. The background correction can also be affected.

5) Adjusting method:

(1) Power on D_2 lamp and set the current to be about 60mA. Adjust the slit (band pass) to be 0.4nm. Set the lamp current to be 3mA and then Power on Cd lamp.

(2) Place a piece of paper in the middle of spray chamber and only observe the light spots of D_2 lamp and hollow cathode lamp of Cd. Adjust the top of D_2 lamp holder and side of screw to make the two light spots overlapped.

(3) After peak auto-seeking, adjust the energy of D_2 lamp and make the BG energy maximum. Up till now, the replacement of D_2 lamp is over.

6) Adjust the light spot position of D_2 lamp after igniting it. **Be careful that the D_2 lamp is very hot!**

6.2.3 Replacement of nebulizer

Nebulizer is the key part of the atomization system. Analytical sensitivity and detection limit greatly depend on the working status of the nebulizer. It is only one channel for sample to enter into the atomization system, so capillary tube, nozzle and impact bead are all directly corroded by sample solution. Wash these parts with the de-ionized water after every analysis. If the instrument works in abnormal state, check if the nebulizer should be replaced or washed.

Replacing method:

(1) Unscrew the four screws at the front of the nebulizer and take off the small elbow.

(2) Take off the nozzle from the nebulizer slightly.

(3) Hold the metal holder on the back of the nebulizer with hand and take it off slowly. If it needs washing, dip its glass part into the acid solution.

(4) After cleaning it, install the washed or a new nebulizer according to the above steps from item 3 to item 1.

Note: (1) When installing the nozzle, ensure that the elbow connecting impact bead points to downward. Otherwise, the stability of instrument will be affected.

(2) When screwing the four screws at the front of the nebulizer, do not forget O-ring on the front cover. The four screws should be screwed equably, avoiding the gas leakage and the flashback.

6.3 Daily maintenance of instrument

6.3.1 Light source

1) Hollow cathode lamp

(1) Carefully install or detach the hollow cathode lamps to avoid breaking it down. Keep the window passed the light clean. If oil stain or fingerprint dirties the window, the light energy emitted from cathode will be decreased, especially for the short wave. To clean oil stain, wipe the window with absorbent cotton dipped with alcohol-ether mixture (ratio 1:3). Hold the lamp holder with hand (metal part) when taking the lamp up or down.

(2) Hollow cathode lamp cannot be placed for a long time without using. If it is stored so long time, it may not be ignited or used normally because of gas leakage, gas absorption or release etc. So power on those rarely used hollow cathode lamps for 2~3 hours every 3~4 months. It is very important for the user to know it and avoid the lamps obsolescence. Recommended that the hollow cathode lamps would be purchased whenever they are used.

(3) If the hollow cathode lamp is broken, the cathode substance will be exposed. And some element materials are harmful to human body, so they should be processed according to standard

laboratory method.

2) D_2 lamp

(1) If frequently powering on and off the Deuterium lamp, it will shorten the lifetime of D_2 lamp.

(2) Do not touch the window passed the light with fingers. After the replacement, clean the window with absorbent cotton dipped with alcohol-ether mixture, and then power on the D_2 lamp again.

6.3.2 Optical System

1) Never touch the lenses in the lamp chamber, the lens exposed in the spray chamber and the top of photosensitive probe with figures, keep them as cleaning as possible.

2) The aluminized half-reflection lens in the lamp chamber can not never be touched with fingers or wiping with anything.

3) The dust on the lens can be removed by a gas blow ball or be slightly wiped by alcohol-ether mixture solution with absorbent cotton.

4) If oil stain or fingerprint dirties the lens, wipe them slightly with absorbent cotton dipped with alcohol-ether mixture solution, but the scratches on the surface can not be remained.

5) Do not open the cover of the monochromator randomly. If it has to do so, firstly set the gain of PMT negative high voltage to be “0”V. Don’t touch the surfaces of the grating and the collimating mirror with hands, and don’t wipe them with lens paper or absorbent cotton, too.

6) Don’t talk, breathe out or spatter saliva toward to the grating. If the dust is found on the surface of the grating, use a cleaning blow ball to remove the dust from the grating.

Note: The operations above mentioned should be carried out by professional persons. User can be allowed to do it any more.

6.3.3 Atomization System

Samples of AAS are generally corrosive. For ensuring a long-term use and high performance, the atomizers should be maintained regularly.

6.3.3.1 Atomization System

1) Daily Cleanness and Maintenance

(1) Do the following operations when a group of samples are analyzed:

①keep the flame on and spray the de-ionized water for about 10 minutes thus to remove out all the trace samples remained in the analytical system.

②Clean the overflow sample drops as soon as possible, especially the organic drops.

③ Empty the waste liquid in time.

(2) Routine Maintenance. Clean the spray burner system weekly, including nebulizer, spray chamber and burner. If the sample concentration is very high or the samples are turbid solutions, clean them after the analysis every day. If the samples are the organic solutions or high concentration, such as Cu, Ag or Hg, clean them just after the analysis, because unstable acetylide will be generated, which is easy explosive.

The clean method of the organic solutions is: firstly spray the organic solution mutually soluble with the samples for about 5 minutes; then spray acetone solution for about 5 minutes; and then spray 1% HNO_3 solution for about 5 minutes; at last spray the de-ionized water for about 5 minutes.

2) Maintenance of Nebulizer

(1) If the front end of the capillary in the nebulizer is blocked up, don't use a metal wire to clean it, it will easily damage the glass components. The correct methods are: use the pressed air to blow the capillary in opposite direction or pumping it inversely. For the block of the organic matters, take off the nebulizer from its holder and dip its front end in the potassium dichromate solution so as to dissolve it.

(2) After a long-term use, if some sediment occurs in the nozzle of the nebulizer, amount of the aspirating solution will be decreased and the sensitivity will be affected. In this instance, take off the nebulizer holder, detach the impact bead and take out the nebulizer, purge it with washing solution.

(3) If the plastic aspirating tube is bent not to be used any more, heat it up in hot water. Then make it straight and cool it down.

3) Maintenance of spray chamber

Take off the burner, and pour 50ml de-ionized water into the up neck of the spray chamber each time. Let the water flow out through the waste liquid pipe. Repeat this step for several times. If the spray chamber is still not cleaning, disassemble it and clean it with surfactant solution, and then wash it with de-ionized water. If the instrument will be not used for a period time, dry the inner of spray chamber as possible as it can be.

(1) Do not forcibly impact or wrest the spray chamber and its holder.

(2) Assemble or disassembly the spray chamber holder carefully and slightly. Do not throw it.

(3) Purge the inner wall of the spray chamber with water or agent solution. Do not scratch it with metal or other hard object.

(4) The connection between the neck of the spray chamber and the burner is sealed by O-rings. When disassembling the burner, please turn it slowly and pull it out in the direction of the neck of the spray chamber. Do not overexert to avoid damaging the neck.

4) Maintenance of Burner

The flame should be even on the slot of the burner head. If not so, the flame will vary obviously and irregularly, that shows there should be some sediment on the slot of the burner head. The cleaning method is: blow it with air compressor and scratch the slot on both sides carefully with single side blade. The sediment can be blown away by air.

Note: Both sides of the slot can not be damaged. BE CARFUL! Another method is: clean it with corrosive soapsuds.

6.3.3.2 Graphite furnace system

Maintenance of the graphite furnace system mainly is to keep cleaning as possible as it can be, including graphite tube, graphite cone and quartz windows. There is no dust and resident samples and sample pollution during the graphite furnace analysis generally. The interval of cleaning period should be determined according to the analytical conditions. If the graphite tube keeps unused for a long term, it should be taken out from the graphite furnace system and stored it separately.

6.3.4 Gas piping system

The gas supply system of the flame method includes gas control unit, air compressor, oxygen steel cylinder, acetylene steel cylinder and gas pipelines. For the carrier gas and protection gas supplying in the graphite furnace system, the loop is constructed by gas cylinder, gas control unit and pipelines. Maintenances of gas piping system are as follows:

6.3.4.1 Check if there is the gas leakage on the pipes, valves and connectors in regular. If there is, repair it or replace it in time.

6.3.4.2 Often check if there is water in the loop of the air compressor. If so, drain it off in time. Often drain off the water in the gas-water separator to avoid water entering into the flow meter. For the oil air compressors, drain off the water oil in the filter and the gas tank regularly, and often check if the oil should be added (for the details, refer to operation manual of air compressor).

6.3.4.3 Often check the pressure of the acetylene cylinder. For the oxygen-enriched flame, when the pressure is lower than 0.5 MPa, the steel cylinder should be replaced. For the air-acetylene flame, when the pressure is lower than 0.4 MPa, the replacement should be required. Otherwise, the acetone in the steel cylinder will flow out to affect the flame status and decrease the flame temperature, and the safe problem may also be caused.

6.3.4.4 After using for a period of time, if the pressure loss of the gas piping of the acetylene or oxygen is larger than 0.03MPa, the inlet filter at the back of the acetylene or the oxygen should be replaced.

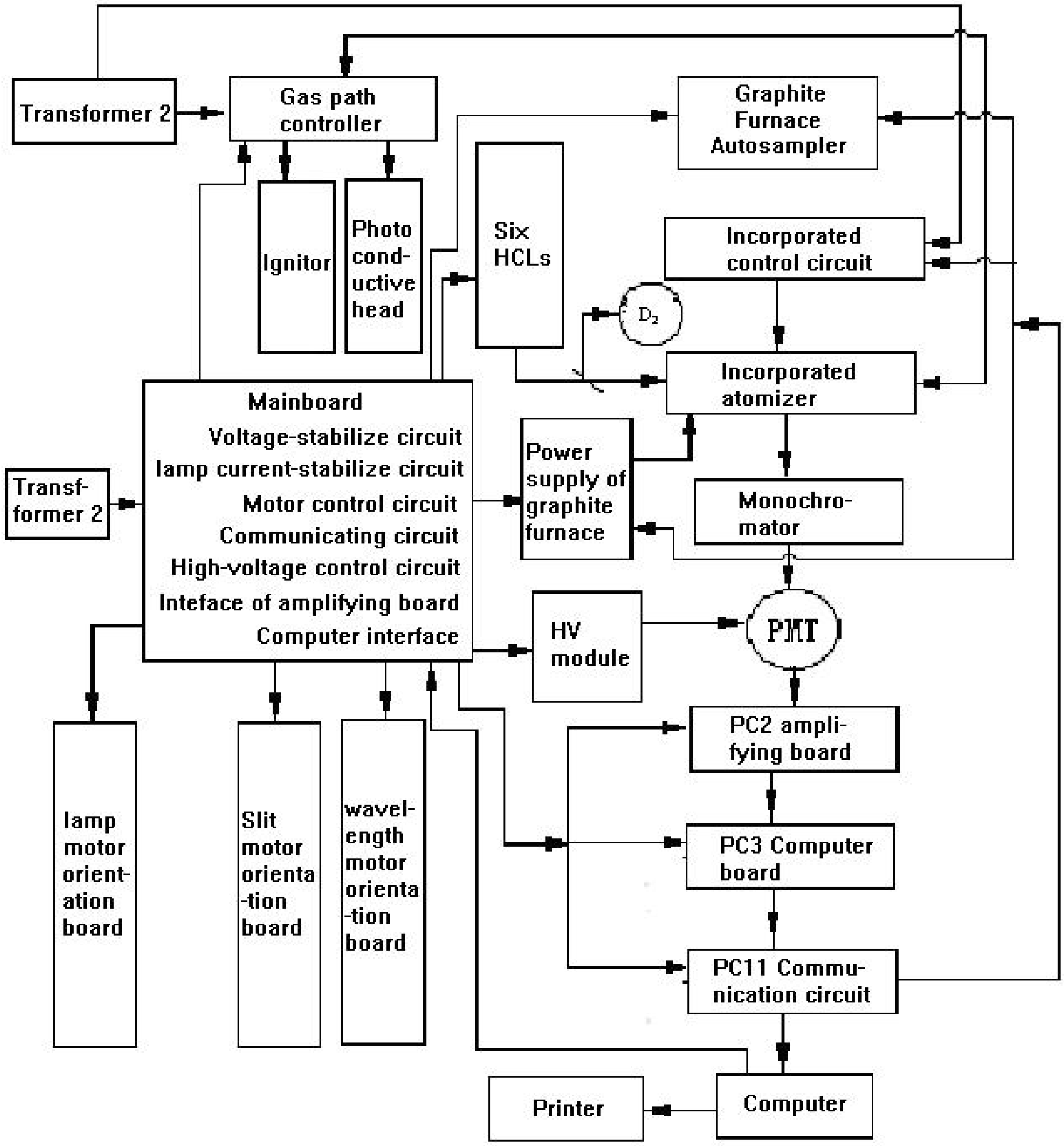
6.3.5 Electric circuit system

6.3.5.1 If the instrument has not been used for a certain time, regularly power on the instrument so as to avoid the circuit components broken. Especially in the moist areas, the short circuit caused by wetting and mildew should be avoided. The short circuit should be avoided caused by corrosion of electric parts. When the instrument is not used, it should be covered with a dust-proof cover.

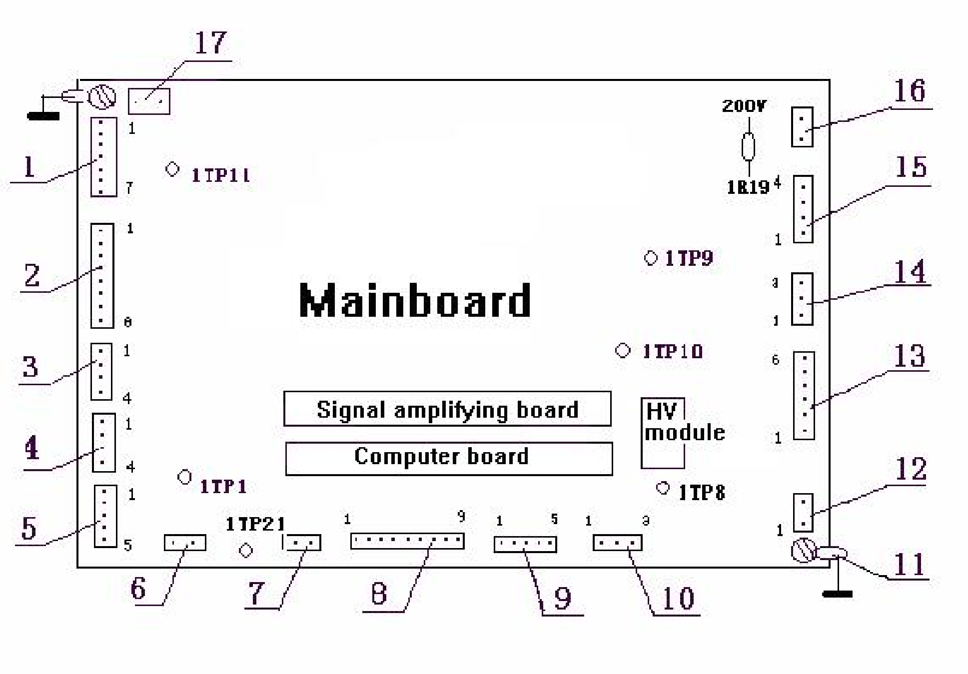
6.3.5.2 For often-used instrument, the circuits should be dusted regularly. Cleaning method is: pull the electronic box out and remove the dust with soft hairbrush or collect the dust by cleaner. After cleaning, cables and circuit panels should be connected well and tightly.

6.4 Circuit principle and function explanation

6.4.1 The circuits of DW-210 type Atomic Absorption Spectrometer mainly include three parts: right electric box is main circuit unit; left electric box is gas control unit. The integrated atomizer is in the middle part. The electric circuit diagram is shown in the following figure.


Transformer 2
Gas path controller
Graphite Furnace Autosampler
Ignitor
Photo conductive head
Six HCLs
Incorporated control circuit
D₂
Incorporated atomizer
Mainboard
Voltage-stabilize circuit
lamp current-stabilize circuit
Motor control circuit
Communicating circuit
High-voltage control circuit
Inteface of amplifying board
Computer interface
Transf-former 2
Power supply of graphite furnace
Monochro-mator
HV module
PMT
PC2 ampli-fying board
PC3 Computer board
PC11 Commu-nication circuit
lamp motor orient-ation board
Slit motor orienta-tion board
wavel-ength motor orienta-tion board
Printer
Computer

6.4.2 Electric circuit diagram of main board



In the above Figure:

1— HCL plug 1. Pin 1 is GND, and the other six pins are connected to lamp HV 400 ~450V.

2— HCL plug 2. Pin 8 is connected to lamp 1, Pin 7 to lamp 2, Pin 6 to lamp 3, pin 5 to lamp 4, pin 4 to lamp 5, pin 3 to lamp 6, pin 2 to lamp 5, pin 1 to lamp 6, auxiliary currents.

3— Control signal of scan motor.

4— Control signal of lamp changeover motor.

5— Control signal of slit motor.

6— Transformer Socket, to AC15V. Supply for +17V stable voltage circuit.

7— Sampling signal of hydride generator or online enrichment.

8— Coupler control sockets are respectively connected to the location plate of changeover lamp, location plate and slit location plate.

9— Connecting to computer communication panel PC11

10—Communication interface, connected with computer interface on the rear panel of main unit.

11—GND (the same with 1TP21).

12—Control socket of HV module. Pin1 to +15V; Pin2 to the yellow line of HV module in the range of 0~5V (1V means HV output 200V and 2.5V means HV output 500V)

13—Transformer socket. Pin1, Pin2 to AC9V; Pin3, Pin4 to AC17V; Pin5, Pin6 to AC17V. They respectively supply for the +5V, +15V and -15V voltage regulator.

14—Transformer socket. Pin1, Pin2 to AC160V. Supply for +200V voltage regulator.

15—D_2 lamp socket. Pin1 to yellow wire; Pin2 to red wire; Pin3, Pin4 to black wires. Pin2 is 200V. The voltage between Pin2 and Pin1 is 80V. The AC voltage between Pin3 and Pin4 is 10V.

16—Transformer socket. Pin1, Pin2 to AC10V.

17—Transformer socket. Pin1, Pin2 to AC300V.

1TP1 is +17V for motor.

1TP8 is +15V.

1TP9 is -15V.

1TP10 is +5V.

1TP11 is +400V for HCLs.

1TP21 is GND.

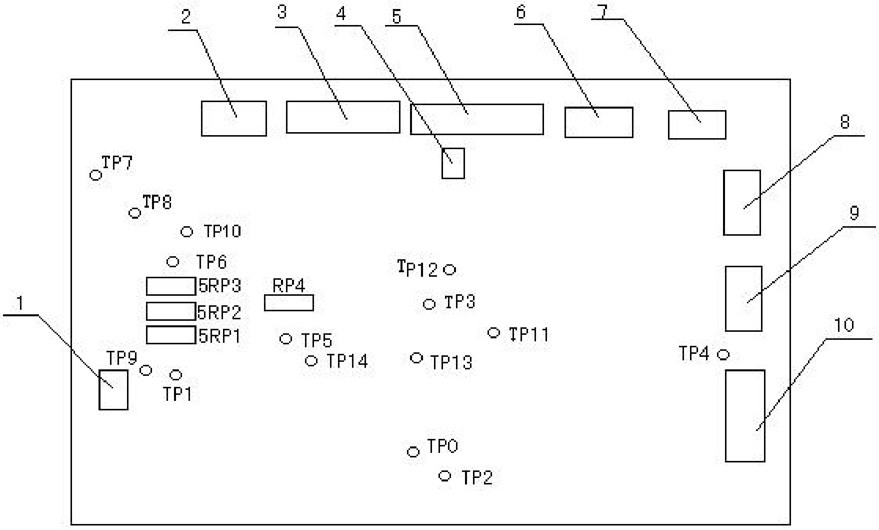
One end of 1R19 is 200V for D2 lamp as shown in Figure.

HV Module – Total four wires. Red and white to HV control socket; black to GND; shielded wire is HV output.

Note: All the above DC voltages are relative to GND voltage and all of the above voltage are approximate values because of deviation.

6.4.3 Gas control board (PC5)

See schematic diagram of gas control board:



In Figure:

1 – Communication plug. Pin1 to GND; Pin1, Pin2 to output; Pin3 to input;.

2—photosensitive plug. Pin 1 to +9V, Pin 2 to detecting voltage; Pin3 to -5.6V

3—socket of oxygen flow meter

4—bouncing pin: down bouncing pin, cleaning function: clean the gas piping of the acetylene and oxygen in big flow; up bouncing pin, that shows in normal work state, the instrument is deliveried with this state.

5—Socket of the acetylene flow meter

6—Socket of electromagnetic valve, pin 1 and pin2 to the electromagnetic valve of the acetylene, Pin 3 and Pin4 to the electromagnetic valve of the oxygen.

7—Ignition plug: Socket of igniting electromagnetic valve: Pin2 to +24V, Pin1 to 5V 18 feet.

8—Ignition switch socket: Pin1 to 3V-, Pin2 to 3V+

9—to transformer AC 2.5V, 0.5A, supply for +3V

10—power supply socket: Pin1, Pin2 to AC17V, 0.5A, for +15V stabilized voltage; Pin3, Pin4 to AC17V, 1A for -15V stabilized voltage; Pin5, Pin6 to AC8V, 1.6A for +5V stabilized voltage; Pin7, Pin8 to AC20V, 2.5A for +24V power source.

TP0—GND

TP1—+5V power supply

TP2—+15V power supply

TP3—-15V power supply

TP4—+24V power supply

TP5—A/D. D/A parameter power supply +5V

TP11---Set the voltage of the acetylene flow

TP12—Feedback voltage of acetylene flow

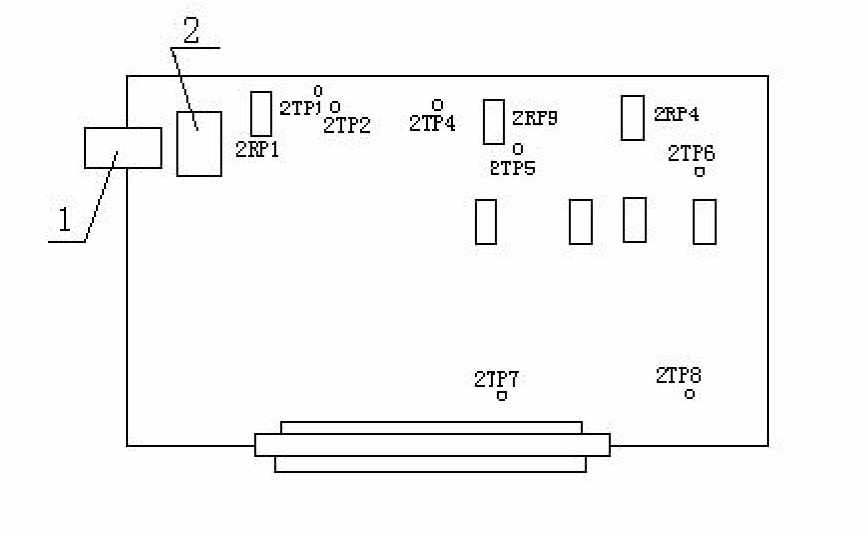
TP13—Set voltage of oxygen flow

TP14—Feedback voltage of oxygen flow

1) Alarm of not enough air pressure: according to requirements of analysis sensitivity, change lowest limit of air pressure and adjust the output pressure of the air compressor to be 0.3MPa. Adjust the limited pressure valve inside of the gas piping box to be 0.2MPa. Adjust potentiometer RP2 between TP8 and TP9 to be 0. After the adjustment, it is necessary to adjust it back to 0.24MPa.
2) Alarm of gas sensitive sensor: to change its sensitivity to the acetylene leakage, adjust potentiometer RP1 to make the voltage value of TP10 to GND being 2.5V.
3) Alarm of light sensitive sensor: to adjust response sensitivity of sensor to flameout and abnormal ignition state, when igniting the flame, adjust the acetylene flow to be 1.0L. Adjust the potentiometer 5RP4to make the voltage of TP7 being 0.2V more than TP6.
4) Zero point of the mass flow meter: Due to not accord with ±15V on the control boards of each gas piping system, it causes the zero point on the mass flow-meter to be drafted, so the difference between the control voltage and the actual flow will be produced. Its adjustment method is: After preheating for 15 minutes with passing through the gas, adjust the zero-adjust potentiometer located at a hole of the side on the mass flow-meter. Check TP12 or TP12 to the ground voltage, adjust the potentiometer until the voltage is 0.

6.4.4 Signal amplifying board (PC2)

See schematic diagram of signal amplifying board:



1— Net connector. To the output signal of PMT.

2— Preamplifier. Transfer the current signal of PMT to voltage signal.

2RP1—Zero-adjust potentiometer: under the condition of no voltage or no lamp current, AA value of the instrument should be 0. Otherwise, adjust the potentiometer to be 0.

2RP9—Adjust potentiometer of HCL signal-

2RP4—Adjust potentiometer of background signal-

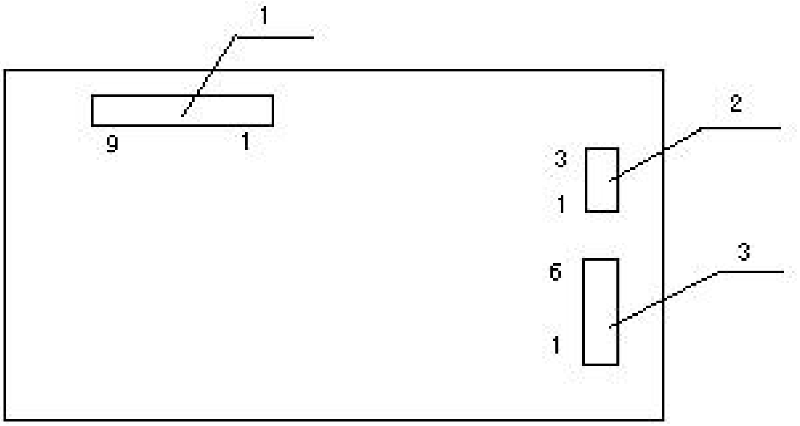
6.4.5 Computer board (PC3)

As computer board is comprised of chips mainly and some chips should be written on programs, please do not disassemble or replace the board and components randomly!

6.4.6 Motor control board (PC4, PC6, PC8, PC9 and coupler board 2)

The principles of these boards are all the same, controlled by the optical coupler. Power supply is +5V. When the LED in optical coupler is powered on about 2.5V voltage, the terminal voltage of CE will vary if something blocks the light from the LED, thus to control the running of motor.

6.4.7 PC11 board, computer communicating board



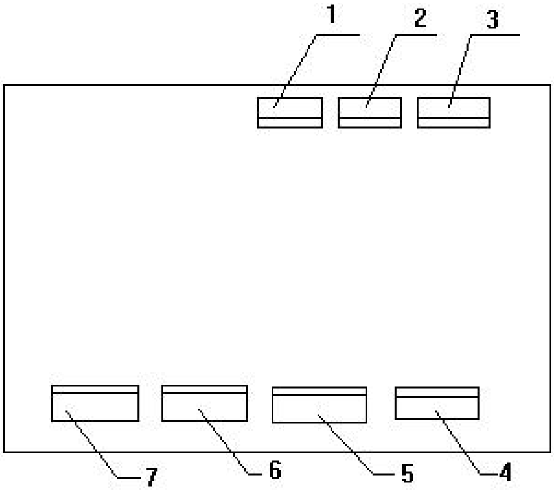
Socket 1: Pin 1, Pin2, Pin3 to gas path control board; Pin5, Pin6, Pin7, Pin9 to integrated control board

Socket 2: Connect to serial interface socket of main unit

Socket 3: Pin1, Pin2, Pin3 to communication socket of graphite furnace on the rear panel of main unit and connect with graphite furnace power supply;

Socket 3: Pin4, Pin5, Pin6 to sampler interface on the rear panel of main unit and connect with auto- sampler.

6.4.8 Integrated control board



Socket 1: Pin1, pin2 is voltage~9V, pin3, pin4 is voltage~21V.

Socket 2: Connect to Vertical moving motor inside of the integration.

Socket 3: Connect to horizontal moving motor inside of the integration.

Socket 4: Connect with vertical light coupler control board inside of the integration

Socket 5: Connect with horizontal light coupler control board inside of the integration

Socket 6: Connect with the main unit control board (PC11). Pin1, pin2 are the feedback signals, pin3 to the ground wire of the main unit, pin5 is +5V DC voltage.

Socket 7: Connect to switch of integrated protection (at the front end of the integration). When selecting the flame analysis, while the auto-sampler of the graphite furnace is still located at the front of the integrated atomizer, so the instrument will be automatically protected.

Plug 1: Pin 1 to "CP" of electrode driver
Pin3 to "DIR-" of electrode driver

Plug 2: Pin1 to "DC24+" of electrode driver
Pin2, pin4 to "DC24-" of electrode driver

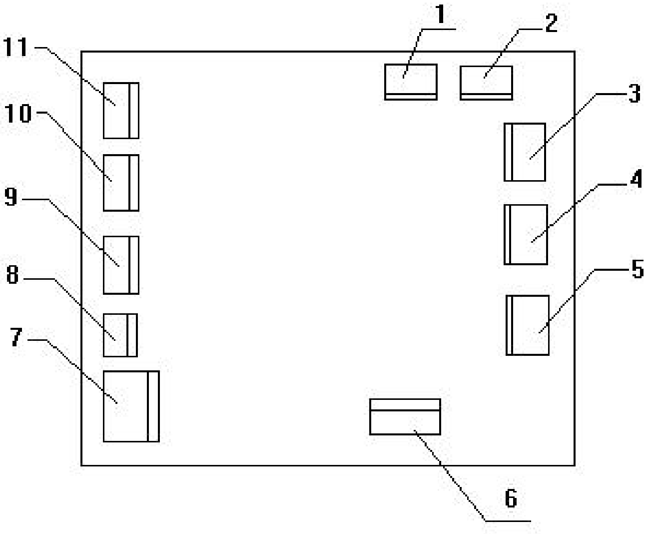
Plug 3: To 42BYCH of electrode (tray disk rotation)

Plug 4: To 57BYG of electrode (sampling arm up and down)

Plug 5: The communication interface of auto-sample is connected with the main unit.

Plug 6: To sampling pump

Plug 7: Keybord



6.5 Troubleshooting

6.5.1 Handle with emergency

(1) Suddenly Power Off

In this instance, shut down the instrument, computer and other devices immediately, and cut all the gas sources in time. Make the instrument returning to the state of powering off. When switching on again the instrument, restart it in compliance with the operation procedures.

(2) Flame color is in abnormal case and Flame disorderly

It is caused by the fuel gas seriously polluted. The normal color of the air-acetylene flame is dark blue. In this instance, close the fuel gas immediately. Purify the fuel gas and ignite it again.

6.5.2 Setting of wavelength parameter

Because of transportation, shock or other reasons, the wavelength translation or nonlinear movement will occur, thus resetting the instrument parameters is required.

(1) Wavelength displacement. Solving method: Adjusting methods: Power on Cu lamp and set the lamp current to be 3mA. Click “Wavelength scan” key in Fig.4-8, input the voltage to be 230~260V, the wavelength is in the range of 300~350 nm. Scanning interval is 10nm. Scanning will be ended until the graphics are appeared as shown in Fig. 6-1. Move the mouse on to the highest area of the first peak and its actual wavelength value X will be displayed on the screen. Use the formula: δ_1=(X-324.8) and record δ_1 value to close the program. Refer to Fig. 4-1, click “Help (H) — setting of instrument parameter. Input δ_1 value into Fig.6-2.

The methods are as follows: Click “Add” in Fig.6-2, input the wavelengths of 324.7nm and 327.4nm below the wavelength of the first format. Input δ_1 value calculated above in error and click “Calculation” and “OK”.

(2) Non-linearity wavelength. If some peaks are still not found using the above method, that shows the wavelength is not linear. Adjusting methods are: power on Hg lamp and set the lamp current to be 3mA. All wavelengths of Hg lamp are scanned in turn (253.7nm, high voltage, 200V; 546.1 nm , high voltage: 300V; 871.6nm, high voltage: 400V, the high voltages of other

wavelengths are no more than 500V), record all X values. Modify them in the page of Fig.6-2 according to the wavelength displacement mentioned in the section (1).

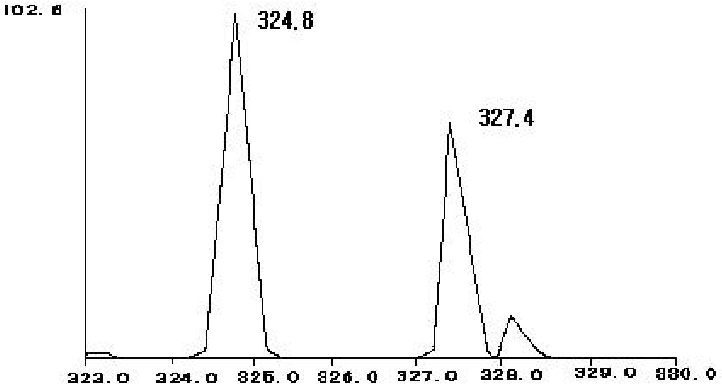
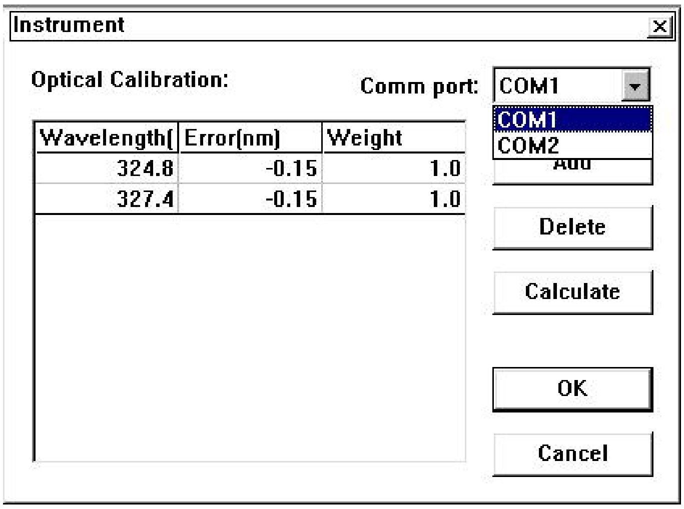


Fig. 6-1



Optical Calibration:

Comm port: COM1

Wavelength(	Error(nm)	Weight
324.8	-0.15	1.0
327.4	-0.15	1.0

Fig. 6-2

Note: 1) Please do not change the instrument parameters without the authorization. Contact with local dealer if the modification is required.

2) If the parameters must be modified, firstly find out the method mentioned in the section of 6.5.4, record the parameters!!!

3) If the top terminal of the graphics scanned has platform, that shows the gain is too high, it should be decreased. If there are many peaks appearing in the graph, even there is a high peak existing, it is not correct. The graphs scanned must be in accordance with Figure 6-1.

6.5.3 Troubleshooting

1). Power Indicating Lamp is not lit

Reason	Solution
(1) Power cable breaking or bad connecting (2) Fuse breakage or fuse holder dropout (3) Short circuit in the power input circuit. (4) Signal input cable is loosen or bad connected.	Check it with universal meter. Resistance between fire wire and instrument shell should be more than 20MΩ. After powering off, the resistance between power cables should be

	10Ω.

2). Troubles of hollow cathode lamp

Status	Reason	Solution
No light.	(1)Lamp power supply is broken or connected. (2)Lamp fuse has broken..	Check if the voltage of 1TP11 on main board and connections of all sockets are normal.
	(3)Lamp has gas leakage.	Replace a new lamp.
(1)Radiate only out of cathode; (2)energy of measuring line is lower; (3) working voltage rises high.	Pressure intensity of inert gas is too low to support the normal discharge.	(1) Lamp's lifetime is over. (2) Replace a new one.
Glowing is in normal case, but energy of analysis line is too low, even hardly to be detected.	For long time use, the cathode metal is exhausted or the radiation intensity of weak light elements (As, Te, Se, Bi, Sb, etc) is too low.	(1)Lifetime of lamp is over. Replace a new one. (2) Only choose a lamp with high intensity for element lamps with weak light.
Sensitivity is low during the determination.	Emitting background of lamp is too large.	Replace a lamp with low emitting background after confirming the low sensitivity to be caused by the lamp..
Light is very strong and lamp current is very large.	There have problems with lamp circuits.	If the phenomenon only happens on one lamp, its power tube (1794) is broken down; if it happens on six lamps, take them off and check if screws of±15V, +5V on the main board are normal.
When raising the lamp current, the tails of anode and cathode is shinning.	The electric masking performance between anode and cathode is bad, so breakdown and discharge occur when lamp current is large.	Replace a new lamp.

3) Light source is normal, but there is no energy after scanning.

(1) Touch the rear of the pre-amplifier on the amplifier board slightly with the fingers and observe if energy is displayed.

(2) If the energy is displayed, the reason may be concerned with the followings:

① There is no high voltage output from HV module. Checking method: In the instrument alignment page, input the gain to be 300V and use the universal meter at the step of high voltage of 500~1000VDC to measure the shielded wire of HV module if there has -300VDC output. If it is not so, measure the control plug of HV module. Red wire should be +15VDC and white wire should be +1.5VDC. If these two voltages are normal, that shows there has something wrong with HV module or bad connections in HV module. If these two voltages are abnormal, problems may occur on the main board. Please turn off the instrument and check if all the chips and plugs are connected well. If troubles can not be eliminated, please contact with your local dealer or the manufacturer.

② Wavelength displacement: Refer to the section 6.5.2.

③ Wavelength Nonlinearity: Refer to the section 6.5.2.

(3) If no energy is displayed, check if the ±15VDC, +5VDC on the main board are normal. If it is abnormal, it may be caused by bad connection of AC18V and AC8V voltage plugs. Check every wire of these two plugs after switching off the instrument. If it is normal, please switch on the instrument first and then check if all the chips and circuit board are connected well. If the instrument is still in abnormal case, please contact with the local dealer.

(4.) Display “Please power on the instrument” on the screen during the initialization.

① Check if the instrument has been powered on.

② Check if the communication cable between instrument and computer is connected well.

③ Check if the cable plug of the computer is connected correctly (one end of the main unit is connected with the socket of the computer; one end of the computer is connected with “COM2” only serial interface of computer). If all are right, click “Help” and “Instrument parameter set” to enter into the page of Fig. 6.2, change “COM2” into “COM1” at “communication” window. Restart the program of the instrument.

④ Check if +5VDC voltage on the main board is normal. Computer pin on the main board is connected well.

⑤ Check if The LM323 chip on PC3 board (computer board) is damaged.

5) Other abnormal cases when switching on the instrument.

(1) The wavelength mechanism doesn’t stop for a long time during scanning, the moment, the main unit should be powered off. If it still doesn’t work after retrying it, input the gain of HV to be “0” V and then open the monochromator. Check if the optical coupler of controlling wavelength motor block light well or is damaged according to methods described in the section 3.6.

(2) Abnormal sounds occur during the self-checking of the slit mechanism and the lamp holder, check their optical couplers as same as the before.

Note: Ensure the negative HV (gain) of PMT is set to be “0” before opening the monochromator. Do not touch the surface of optical parts when the monochromator is open.

(3) When selecting the element, there is a dialogue frame appearing “XX item is empty” can not enter the page of “Instrument control, the analytical method should be edited again. When “√” is made at the standard blank on the page of Fig.4-7, the page of “Instrument control” is entered.

6) Sudden lamp is off and the lamp position changes during the measurement.

(1) If the power supply is suddenly cut off, only switching off the instrument and restart it for initialization.

(2) Power cable is not connected well. Three-phase socket of the main unit may be not connected well. The moment, power off the main unit and pull two ends of the power wire out, rotate three connecting feet a little with a clamp to make the connection well.

(3) The replacement is required for the aged element lamps.

7) Instrument alarm

Status	Reason	Solution
Alarm is given after setting the ignition and display flow error window.	Three kinds of flow ratio are not set properly, or oxygen and acetylene filter are blocked.	Reset the flow ratio or replace new filters
Ignition is failure and alarm is given. Display the clewing window.	Air exists in acetylene piping.	Reignite it for several times to drain off the air thoroughly.
	Instrument parameters are changed.	Adjust the modified parameters on gas path control board according to the section 6.4.3.
	Air pressure is not enough.	Adjust outlet pressure of air to be 0.24MPa more.
Flame is off after igniting it for a while and the alarm is given	The acetylene leakage exists in the piping of the instrument	Check the piping and jointers with soap water.
.There is no fire in the igniting pin when the ignition is made.	The igniting pin is oxidized due to a long time use.	Clean the igniting pin with sand paper.
Alarm is given and display the optical sensitive abnormal window	Gas sensitive circuit sends alarm.	Change based on adjusting points of gas path control board in section 6.4.3.
Display pressure sensitive abnormal window	Light sensitive circuit alarms.	Adjust it on the gas path control board according to the section 6.4.3.
Alarming sound is a longer but has pause.	Pressure-sensitive circuit sends alarm.	Adjust it on the gas path control board according to the section 6.4.3.

8) Energy is too low.

Reason	Solution
Hollow cathode lamp lights weak.	Compare it with other lamps first. If is so, replace a new one.
Optical system is not adjusted well.	Re-adjust the optical system and make the light spot just aimed at the incidence slit. Check if lamp position, wavelength precision and slit position are all correct.
Lens is polluted seriously.	Clean the lens with alcohol-ether mixture (ratio 1:3) or replace a new one.
Slits or optical parts in the monochromator are dirty.	Clean the optical parts according to the methods in the section 6.3.2 or replace them. NOTE: User can never be allowed to open the monochromator.
Performance of HV module is decreased.	Replace a new one. Check if HV module is normal according to the method mentioned in the item 3).

9) Energy is too high.

The gain is often displayed to be 75 after peaking. Check if HV module and control voltage are normal according to the method mentioned in item 3). If 300V has changed to be 500V, that shows HV module has been damaged, otherwise MAX531 chip on the main board is broken.

10) The instrument is unstable when ignition and spray

(1) Stop spraying if the instrument is unstable after ignition and spray. If the instrument becomes

stable, the reasons for it may be the following.

Reason	Solution
Position of impact bead is changed.	Readjust it after flameout: turn impact bead slightly to make its neck located at the down position. Slightly move it forth and back to make the fogs upward uniformly.
Capillary is corroded and blocked.	Blow it with air compressor or clean it with cleaning solution or replace a new one.
Spray chamber is polluted seriously.	Clean it with acetone, HNO_3 and deionized water.
Drain pipe of waste liquid is blocked or waste liquid bucket is full.	Replace the pipe or empty the bucket.
Solution components produce strong emission in the flame	Eliminate it with the chemical method.

(2) The flame should be off if the instrument is unstable. After so, if the instrument becomes stable, the reasons may be the following.

Reason	Solution
Fuel gas is not pure.	Filter it in strong degree.
Ratio of fuel gas is too big and flame emission is large.	Use narrow slit.
Flame absorption in short-wave band is strong.	Use background correction.
	Verify it with Cu or Mg lamp.
The burner head is blocked.	The method refers to the section 6.3.3.1.
Burner position in optical path is not right.	Adjust the burner up or down, front or back and adjust its turning angle.
Air supply is unstable.	Replace the air compressor.

(3) After extinguish the flame and the instrument is still unstable, the reasons may be the following.

<table>
<tr><th>Lamp Status</th><th colspan="2">Reason</th><th>Solution</th></tr>
<tr><td rowspan="4">Lamp is damaged</td><td rowspan="3" colspan="2">Emission intensity is low and negative HV (gain) used is high.</td><td>Increase the current. (normally not over 4mA)</td></tr>
<tr><td>Widen the slit. Refer to analytical manual of flame method.</td></tr>
<tr><td>Replace a new lamp.</td></tr>
<tr><td colspan="2">Lamp emission is unstable or lamp background is large.</td><td>Replace the lamp with high performance.</td></tr>
<tr><td rowspan="7">Hollow cathode lamp is good</td><td colspan="2">Wavelength is not correct.</td><td>Readjust the instrument parameters according the the method mentioned in the section 6.5.2.</td></tr>
<tr><td colspan="2">Wavelength is not right.</td><td>See section 6.5.2. Recalibrate instrument parameters.</td></tr>
<tr><td rowspan="5">Troubles in electric system.</td><td>Voltage of electric network changes bigger.</td><td>Use a voltage regulator.</td></tr>
<tr><td>Ground wire is not connected well.</td><td>Use copper board directly to the earth.</td></tr>
<tr><td>Output of HV module is unstable.</td><td>Replace the HV module.</td></tr>
<tr><td>Some components are not connected well in circuit.</td><td>Shut off the instrument and check chips and pins carefully.</td></tr>
<tr><td>Some components are damaged in circuit.</td><td>Repaired by factory.</td></tr>
</table>

		Strong magnetic field or high frequency interference exist.	Far away from the interference sources.

11) Results are not good enough.

(1) Sensitivity is low.

Reason	Solution
Wavelength is not right.	Adjust it according to the section 4.2.
Flame property is not right.	Refer to relative manuals.
Flame position is not right.	Adjust up and down and forth and back positions of the flame and horizontally rotate turning angle of the burner head.
Nebulizer is not good enough and spray efficiency is too low.	Adjust the position of impact bead or replace a new one.
Lamp current is too large.	Decrease the current to improve the sensitivity but if it is too low, the stability will be affected.
Slit is too wide.	Choose the proper value according to analysis manuals.
Nozzle is blocked up and the sampling quanty is too low.	Clean the nozzle or replace a new one.
Atomization efficiency is low because of physical reasons, such as, sample concentration, vapor pressure or matrix concentration.	Prepare the samples again to change their physical properties.
Blank solution is polluted or standard samples are stored for a long time.	Replace bland solution or standard solution.
Outlet pressure of air compressor is above 2.4MPa, while outlet pressure of adjust pressure valve inside of the gas box is not correct.	Unscrew four screws on the back panel of gas box, take the gas box out and observe the pressure of pressure-reducing valve; adjust pressure to be 2.4MPa

(2) Detection limit is unqualified.

Reasons	Solution
Integral time is not long enough.	Increase proper integral time.
Sensitivity is too low.	Solve it referring to the above table
Noise is big.	Increase the lamp current properly.
Spray is unstable.	Check spraying status of the nebulizer.

(3) Results are comparatively low.

Reasons	Solution
Matrix or chemical interference exists.	Verify it with standard solutions and process the samples to eliminate the interference.
Standard solution is wrongly prepared or polluted.	Verify it with other element standard solution or samples and re-prepare it.
Sample concentration is decreased because of container absorption.	Verify it with other element solution and re-prepare it.
Blank solution is polluted.	Prepare new blank solution.

(4) Results are comparatively high.

Reasons	Solution
Do not carry out blank calibration.	Recalibrate it with sample blank.
Ionization interference exists. Standard solution is prepared improperly or metamorphic, thus its real concentration is lower than the calculated value.	Re-prepare standard solution, adding ionization buffer or ionization depressor.
The method is improper.	Change other wavelengths, use background corrector or higher-temperature flame.

(5) Calibration curve doesn’t pass through the zero point.

Reasons	Solution
When preparing the samples, the agent or solvent used is polluted.	Re-prepare the samples

(6) Results drift.

Reasons	Solution
Lamp for pre-heating time is not long enough and is still unstable.	Prolong the pre-heating time.
Light intensity is always changing, lamp is not good enough	Replace a stable lamp or adjust zero automatically.
Lamp current is changeable after the adjustment.	Don't change lamp current any more after adjusting it well.
Pre-heating time for burner is not long enough.	Prolong the pre-heating time for 3~5 min.
Capillary is blocked up or corroded.	Clean it or replace a new one.
Waste liquid is not drained off smoothly.	Make it smoothly.
Gas piping system is unstable.	Check if there has water in piping or if the gas supply is unstable.
Solution temperature is changed	Check it and solve it soon.

12) Flashback occurs.

Reasons	Solution
No water seal at the outlet of waste liquid.	Add water seal.
Burner slit becomes wider.	Replace a new burner. (If slit width is < 0.7mm, it will be flashback)
Oxygen content in air cylinder is too large.	Replace a proper steel cylinder.
Acetylene, oxygen flow has difference with their actual value.	When selecting the flow, add acetylene flow while keeping oxygen flow unchanged.

Note: If the flashback occurs, check if the explosion proof film is damaged. Mount the good explosion proof film into the rear part of the burner. Also should open the nebulizer and check if the burner head or pipelines are damaged. If all are in normal case, please ignite it again.

13) It is abnormal with the graphite furnace method.

Reasons	Solution
The power supply of the graphite furnace can not be switched on.	Communication cable is not connected well.
	After changing the parameters of graphite furnace power supply, firstly click "Read" key in the dialog frame.
Graphite furnace supply runs abnormally.	Details refer to the operation manual of graphite furnace power supply system.
Energy is low with the graphite furnace method.	Adjust the graphite furnace up and down position.

14) Troubles of background corrector

(1) D_2 lamp is not lit

Reasons	Solution
Lamp lifetime is over.	Replace a new one.
Starting voltage increases after long time use.	Replace a new one.
Troubles occur in the power supply circuit.	Measure the voltages of the four wires of D_2 lamp. Voltage between red and yellow wires is about DC80V, and that between the two black wires is about AC10V.
Software is not set correctly.	Set signal type as "D2".

(2) D_2 lamp energy is low.

Reasons	Solution
Light spot of D_2 lamp isn't in optical path.	Readjust the position of D_2 lamp.
Wavelength range used is not correct.	Should be used in short wave band for D2 lamp.

D_2 lamp lifetime is over after long time use.	Replace a new one.

(3) Noise is large with the background correction method.

Reasons	Solution
Energy of D_2 lamp is low, so that the high voltage is used too high.	Increase lamp currents of D_2 lamp and elements or increase the slit width.
Damps of both two background correction circuits are smaller.	There is no problem for it.

(4) Background correction result is not good.

Reasons	Solution
Electric balance is bad.	User cannot adjust it.
Optical balance is bad.	Re-adjust the positions of D_2 lamp and HCL and make two light spots overlapped.
Background value is > 1.0A (D_2 lamp method); Background value is > 1.8A (S-H method).	Process the samples and decrease the background value properly.
Atomization temperature is too high.	Choose proper atomization conditions.

15) Auto-sampler of graphite furnace (refer to Chapter 7)

(1) No motions after switching on the auto-sampler

Check: if the plug of the power supply is connected well; if the electricity exists in the socket of the power supply; if the fuse of auto-sampler is burned out.

(2) Sampler can not be communicated with the main unit.

Check: if the power supply of the auto-sampler is switched on; if the auto-sampler is correctly connected with the communication cable of the main unit.

(3) Auto-sampler can not get samples.

Check: if the cleaning tube of the auto-sampler has been already inserted into the cleaning solution actually; if there has solution leakage at the jointer of the sampling pump.

(4) Swing position of sampling arm deviates too much and the sampling pin can not enter into the sampling cups to get the samples.

Adjust the swing position of the sampling arm. Refer to operation manual of auto-sample. Adjustment procedures are as follows:

Loose the armed screws back of sampling arm by six turret spanner, then click "Autosmapler adjustment", height of sampling pin entering sample flask will be adjusted. When vibrating motion finishes, vibrate sampling pin just over the sampling flask by hand, screw down armed screw by spanner, click "Finish" to return.

16) Product Warranty Information

The troubles happening in 15 months with general operations can be deal with freely from the date of shipment to user. In the following instances the manufacture can not bear the responsibility at free of charge:

(1) Instrument has been randomly disassembled by user and cannot be retrieved.

(2) This instrument is a kind of precision instrument and can't be placed in strong corrosive, moist and dusty environment. Optical parts are fast deteriorated and damaged because of unqualified working conditions.

(3) Parts or components are damaged because of error operations.

6.5.4 Usage and Maintenance of Computer

6.5.4.1 Points for attention

(1) Do not plug in or out the communication cable to avoid breaking serial interface down when the instrument or computer is powered on.

(2) Avoid frequently to power on and off the instrument or the computer.

(3) To close the computer, do the following steps: click "Begin" →"Close system" → "Close the computer"→ "YES". Don' directly press the switches.

(4) There should be no strong magnetic field around the computer to avoid magnetizing the screen of the computer.

(5) Do not pull out or insert floppy disk when the indicating lamp of the floppy disk on the computer is on.

(6) When turning many pages on the computer, it may cause the program error or dead, that shows the inter memory of the computer is not enough. Restart the computer.

(7) Upgrading the computer or changing parameters should be done by professional personnel.

(8) The instrument can only work under Windows98 or Windows XP system.

(9) Backup the old parameters when changing the instrument parameters.

Record methods: Click the left lower angle on the computer "Begin" →"Run" → input "REGEDIT" → click "Ok" → double click "HKEY-CURRENT-USER" →double click "software" double click "BRAIC" → double click "BRAIC"→ double click "General" →double click "computer display parameter page" →record "Optical Origin" parameter and "Optical Ratio" parameter.

(10) When operating the computer, error operations may also cause the computer to dead or other phenomena.

(11) When the software is re-installed, the dialogue frame may appear on the instrument, in this case, power on the power supply of the main unit or there is no communication. The moment , the user can enter into the software again. In the page of Fig.4-1, click "HELP" to appear the Fig.6-2, modify the series interface on the right upper angle.

6.5.4.2 Software backup and installation.

(1) Software backup: If user wants to update the operation system or replace a new computer. Record the instrument parameters before the operation so as to avoid the parameters newly installed not to be calibrated directly, so that the instrument will be influenced on the normal operation.

(2) Software installation:

In resource manager

a) Insert the setup CD

b) Open the CD， display "DW-210 setup.exe" ;

c) Recommend that the software backup is saved on the hard disk of the computer.

d) Double click "DW210 setup.exe" icon, start the installation:

Click "Begin" to display "C:\program files\DW210" setup path will be given, change it to be "c:\ DW210".

e) After finishing the installation, create the shortcut file automatically;

f) Click left lower angle of the computer, "Begin"→"Run"→ input "REGEDIT"→ click "Ok"→ double click "HKEY-CURRENT-USER" →double click "software" →double click "BRAIC" → double click "BRAIC"→ double click "General" → double click "computer display parameter page" → double click "Optical Origin" → Input the parameter (mark on the CD) → click "Ok" → double click "Optical Ratio">> input the parameter (mark on the CD) →click "Ok".

d) Close "REGEDIT" editor, the instrument can run normally.

Chapter 7 Instruction of Model WF-10A Auto-sampler

7.1 Summary

7.1.1 Application

DW-10 Automatic Sampler works with DW-210 Atomic Absorption Spectrophotometer together. It can be controlled by the microcomputer when carrying out graphite furnace analysis, including automatic sample collection, sampling, cleanness and automatic conversion. The content of the element determined can be read out on the computer.

7.1.2 Technical Specification

1) Precision and repeatability of sampling pump: volume precision:1%; repeatability:0.3%

2) Maximum volume of sampling pump is 100μl; the program setting is 1 ~ 80 μl selectable adjustment;

3) Maximum volume of cleaning pump is 1ml; big flow water should be used to clean off the resident sample on the sampling pin as cleaning as possible after sampling.

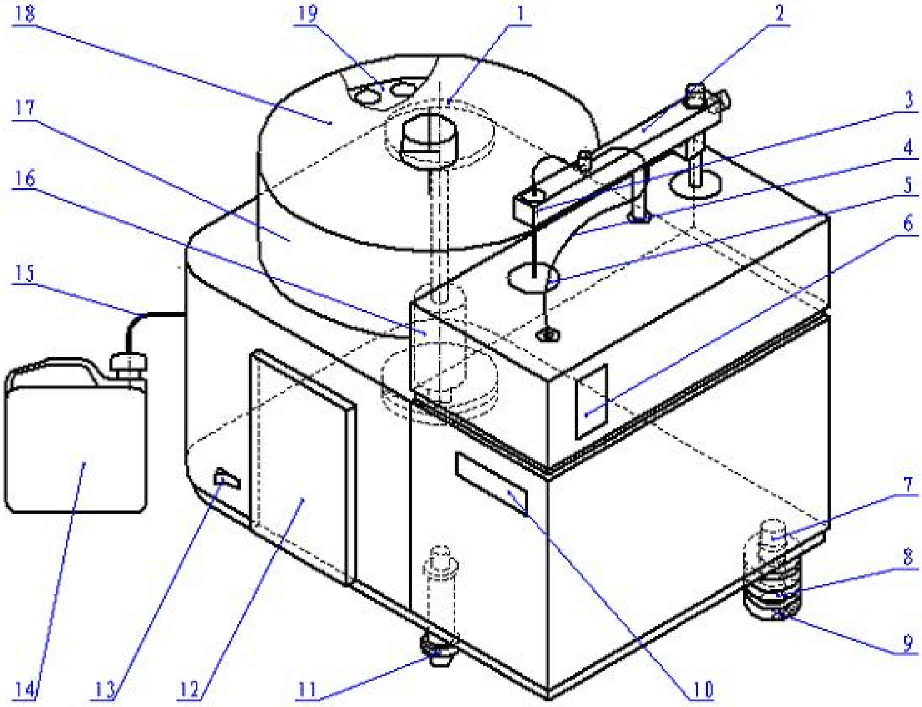
4) There are 55 sample cups providing on the sample tray, maximum volume of each cup is 2 ml; also providing five pieces of matrix modifier cups, the maximum volume is 20 ml.

5) When the sampling pin of sampling arm is re-adjusted to aim at the sampling hole of the center of the graphite tube, its position reproducibility is not more than 0.15mm;

6) When sampling is made in a certain cup continuously, the liquid height can be traced automatically.

7.2 Structure

The structure of auto-sampler is shown in Fig. 7-1.



1.Clamping hand-wheel	2. Swinging Arm	3. Lock Screw
4. Capillary tube	5. Waste liquid cup	6. Keyboard
7. Clamping Bolt	8. Flat washer	9.Clamping hand-wheel
10. Trade mark	11. Support Wheel	12. Observing Window
13. Power Switch	14. Cleaning Bucket	15. Capillary tube of cleaning liquid
16. Rotary shaft	17. Protection cover of sample tray	18. Sample cover
19. Sample tray		

Fig. 7-1 Schematic diagram of auto-sampler structure

7.2.1 Inner Structure

The inner structure consists of swinging arm, pallet tray, sampling system and electronic parts. All of them have been adjusted well before the delivery. User should not detach them randomly.

7.2.2 External Structure

Refer to Fig. 7-1

1) Rotary shaft (16 in Fig. 7-1)

It is located at the left back part of the sampler. It functions: (1) fixing the sampler; (2) the sampler is rotated away from the sample chamber using this shaft when the main unit is carrying out the flame analysis.

2) Clamping Bolt (7 in Fig 7-1)

Clamping bolt is located at the right side of the rear of the sampler. When making the graphite furnace analysis, the sampler should be moved to the front of spray chamber of the main unit. This bolt can be entered into in the V-shape slot of right support board of main unit base (see Fig. 3-1). The clamping hand-wheel (9) support the flat washer (8) and rotated into the bolt (7) and then rotate it tightly upward from the bottom of the bolt (7) to make the connection of the sampler with the main unit.

3) Support wheel (11 in Fig 7-1)

Support wheel locates at the down front of the sampler. It functions helping to support the sampler.

Note: when the sampler needs rotating, first unscrew this wheel to make it untouched with the work bench.

4) Clamping hand-wheel (1 in Fig.7-1)

This clamping hand-wheel is located at the up end of the sampler of left back bottom part of sample tray protection cover. After the sampler is installed well, screw this wheel down to make the sampler fixing on the left support plate of the main unit base.

Note: when the sampler needs rotating, it must be loosened!!!

5) Sample tray (19)

The tray is installed on the terminal of the center shaft of support tray mechanism. When analyzing samples, if the sample solution is sprayed on its surface. Take it off for cleaning and then mount it again.

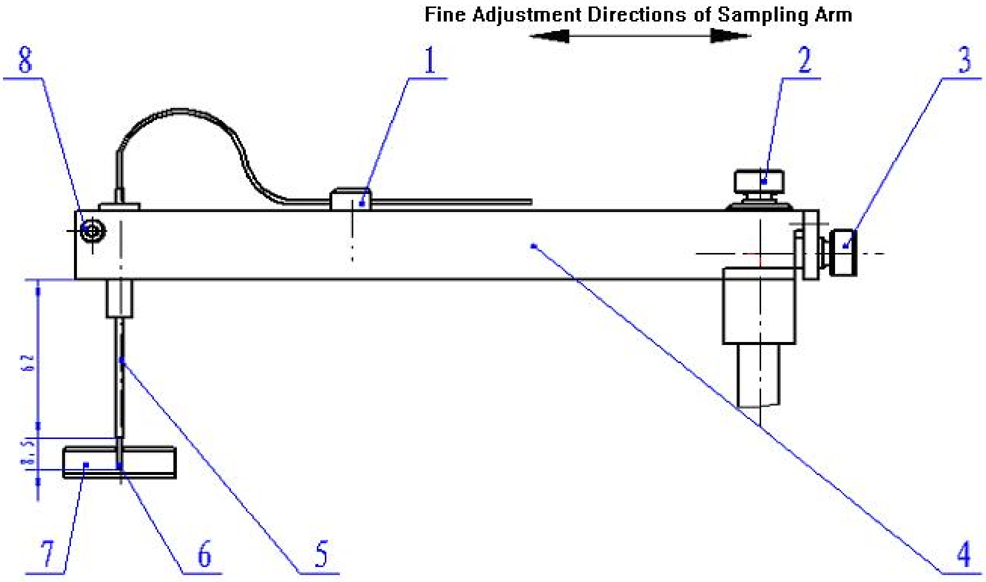
When the unknown sample is pulled into the sample cup, and then put the sample cups into holes of sequence numbers of the support tray. The corresponding cup numbers are input by the computer.

After so, the determination can be made.

If the sampler has not been operated for a long period, the resident solution in the sample cups must be cleaned off, otherwise, the volatilization of the sample solution will corrode the components and parts of the sampler.

6) Swinging arm mechanism (2)

The swinging arm part (2) shown in Fig 7-1is amplified as shown in Fig 7-2)



1. Fixed Hole	2. Lock knob	3. Adjust knob
4. Swinging arm	5. Sampling Pin	6. Sampling capillary
7. Graphite tube	8. Lock screw	

Fig. 7-2 Schematic diagram of swinging arm mechanism

(1) Sampling capillary (6 in Fig. 7-2)

The sampling capillary has been well connected with the inner parts before the delivery. User is only to make it through the fixed hole (1) and sampling pin of metal tube shape (5), and ensure the plastic capillary tube to be 8.5mm length at the outer side of the terminal port of the sampling pin. As shown in Fig. 7-2.

The sampling capillary may be damaged after a period of using time, so the damaged part should be cut off, the concrete cutting procedures refer to the section 7.4.1 (3). But the length of 8.5mm should be ensured. The plastic is consumable part, the replacement is required after using it for a certain time.

(2) Lock Screw (8 in Fig. 7-2)

The screw is used for clamping the sampling pin (5). As there have strict requirements to the terminal port of the sampling pin from the height of the bottom of the swinging arm. Its height 62mm has been adjusted well as shown in Fig. 7-2. User should not adjust it randomly if it is in normal case.

(3) Lock knob (2 in Fig. 7-2) and Adjust knob (3 in Fig. 7-2)

The microcomputer controls the sampling pin to move to the sampling hole position of the graphite tube center. Rotate these two knobs to adjust forth and back positions between the sampling pin and the sampling hole of the graphite tube.

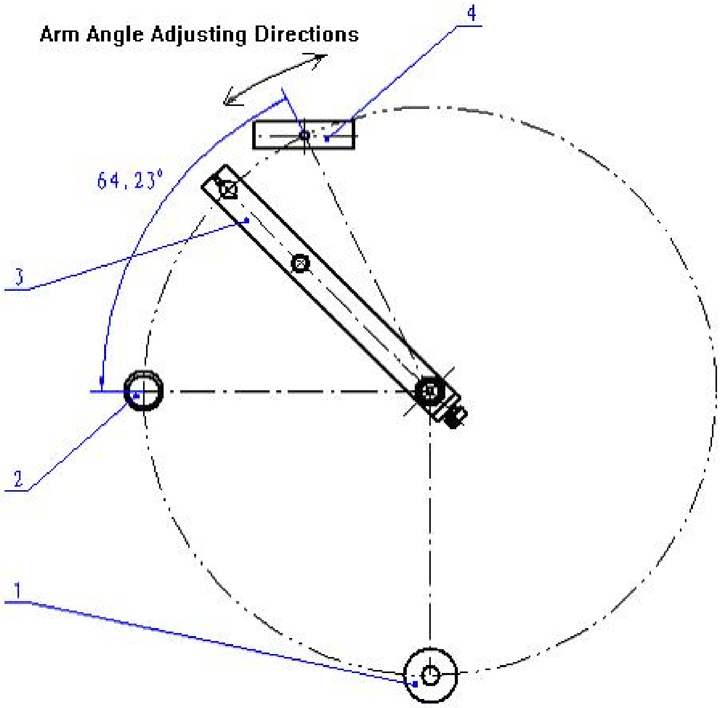
The adjustment procedures are: loosen the lock knob 2; rotate the adjust knob to carry out fine adjustment; After confirming the position to be OK, screw the lock knob again.

7) Keyboard (6)

There have two keys on the keyboard: "→↑" and "←↓". Use these keys to adjust the position of the sampling pin and the sample cups or the positions between the sampling pin and the sampling hole of the graphite tube via the program of the main unit.

For example: The rotation of the swinging arm is controlled by the computer to make the sampling pin swinging to the sampling hole position of the graphite tube (4), and then the corresponding selection is made via the main control board of the sampler, use the keyboard (6) to make the adjustment of swinging arm and rotating angle in the direction as shown in Fig7.3 the corresponding selection is made via the main control board of the sampler, use the keyboard (6) to adjust the sampling pin in the graphite tube up and down depth as shown in Fig. 7-2.

At the same time, when the sampling pin is moved to the sample cup (2), then make the corresponding selection via the main control board of the sampler. Also use the keyboard (6) to adjust the depth of the sampling pin in the sample cup. When pressing "→↑" or "←↓"keys, the sampling arm raises first and then fall it down to the expected depth. One time press "→↑" or "←↓"keys, the sampling arm will raise or fall down 0.3mm correspondingly.



1. Purging cell 2. Sample cup
3. Sampling Arm 4. Graphite tube

Fig. 7-3 Rotary Angle Adjustment Schematic Diagram of Sampling Arm

7.3 Installation

7.3.1 Connection of sampler to main unit

The installation is made according to Fig. 7-4. Detailed installing steps are as follows:

1) Take out the sampler from the packing box; screw down the lock screw (3) and flat washer below the shaft; install the rotary shaft into the center hole at the left support board of main unit base;

2) Tighten two block screws (1) at the side of the shaft; re-screw tightly the disassembled flat washer and block screw (3) back to the original positions. Then screw these two screws (1) down, otherwise, the flame atomizer can not be converted to the graphite furnace method.

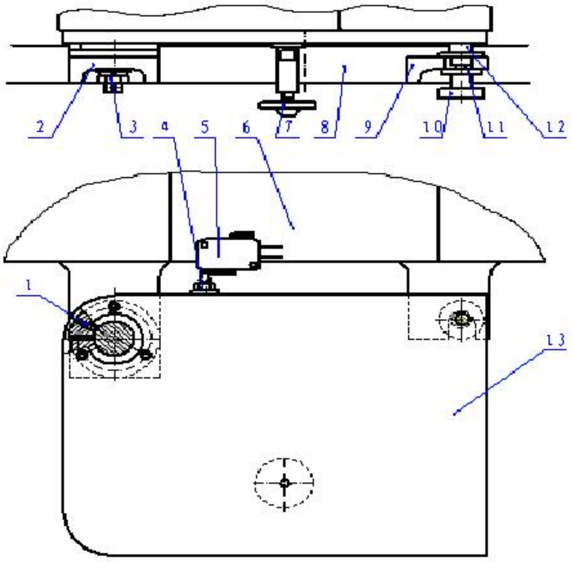
3) Take out the support wheel (7), block hand-wheel (10) and flat washer (11) from the packing box, and install them to the base of the sampler in sequence according to Fig. 7-4.

4) Rotate the sampler to screw the clamping bolt (12) located at the right bottom side into V-shape slot of right support board (9) on the main unit base. Lock tightly the hand-wheel (10).

5) Rotate the support wheel (7) to make it on the surface of the workbench.

6) Rotate tightly the fixed hand-wheel (1) as shown in Fig. 7-1.

Clews: limit switch (5) is installed on the incorporated atomizer of the main unit; limit nail (4) is installed on the inner side of the base (13) of the sampler. When the sampler is in working state, the limit switch (5) is in “Open” state, the moment, the graphite furnace with the flame atomizer can not be changed over. Only when the sampler moves out and the limit switch is “close”, the flame analysis can be done.



1. Clamping screw	2. Left support board of main unit base	3. Lock Screw
4. Limit nail	5. Limit switch	6. Atomizer
7. Support wheel	8. Main unit base	9. Right support board of main unit
10.Clamping hand-Wheel	11 Flat washer	12.Clamping bolt
13 Sampler base		

Fig. 7-4 Installation Schematic Diagram of Sampler

7.3.2 Dust-proof cover of observing window

1) The observing window is protected by plastic adhesive tape before the delivery, tear it down when installing.

2) Take out the dust-proof cover from the packing box, and cover it on the observing window directly.

7.3.3 Capillary

There are two plastic capillaries: one is mounted on the sampler, its up end passes through the hole to enter into the fixed hole and insert the sampling pin into it.

Note: ensure the length of the capillary to be 8.5mm length from the outer port of the sampling pin.

Another one passes the side hole of the sampler, and insert it directly into the plastic bucket filled with the distilled water (cleaning liquid).

7.3.4 Power on

1) Wire connection

Plug the power cord into 220V socket on the side of auto-sampler, and connect the communication cable to “auto-sampler” socket of main unit and “communication” socket of the sampler respectively.

2) Switch on the instrument

The sequences of the switching on the instrument are: First switch on the auto-sampler, and then the power supply of the main unit.

7.4 Operation & Maintenance

7.4.1 Operating procedures

1) Adjustment of the main unit

First switch on the main unit and computer, after running well, select the working conditions of the instrument on the page of working parameters on the computer, set the lamp current of the hollow cathode lamp, seeking the analytical wavelength peak, adjust the energy to be around 100%; at last click “Finish” to enter the measurement page.

2) Adjustment of auto-sampler

Click adjustment key of auto-sampler at the left side of measurement page to carry out the adjustment.

(1) Position adjustment of the sampling pin and the graphite tube

Firstly click “Turn arm” key to make the sampling arm rotating to the above of the graphite furnace, observe if the sampling pin is just located at the above of the sampling hole of graphite tube. If it is not, loosen the lock knob (2) shown in Fig. 7-2 and carry out fine adjustment with the adjust knob (3), synchronously make the adjustment of the rotary angle as shown in Fig. 7-3. If it is still unable to aim at the sampling hole of the graphite tube, press “ “ key, the sampling arm rises, repeatedly adjust the sampling pin forth and back, right and left positions. After completing the adjustment, click “Down arm” key to make the sampling arm falling down and adjust the depth of the sampling pin in the graphite tube via "→↑", "←↓" keys. During performing this step, a medical reflector is used to observe as the adjustment. The entered depth of the sampling pin should be about 0.5 ~ 2mm from the terminal port of the capillary to the bottom of the graphite tube so that the sample solution can all be dropped into the graphite tube. For accurately adjustment, it is available repeatedly to drop the arm to adjust the depth of the sampling pin. After all adjustments are finished, click "Finish" key to return to the original position. Repeat "Turn arm" and "Down arm" program to check if all positions are located correctly.

(2) Height adjustment for the sampling pin entering into the sample cups.

Click "test" key to make the sampling pin moving to the above of the sample cup and stop. Adjust the sampling pin to enter into the height of the sample cups via "→↑", "←↓" keys of sampler. Press "Finish" key to return after completing the adjustment.

(3) Operations of cutting the capillary.

When the sampling capillary is dust or broken, it should be cut off a certain length. Click "Cut tube" key to lift the sampling arm, cut about 10mm with a sharp-knife. The sampling capillary should be cut by knife quickly and there should be smooth at the port of the tube. The port should be slope or flat. After so, click "Finish" key to return.

3) Selection of working mode

Click the icon >> Un-auto/Auto/Manual (cycling) key to control the sampling mode of the graphite furnace auto- sampler. Auto-mode or manual mode can be selected. When the background color of the icon and ">>" are all in deep color, the mode is Un-auto mode (default mode). When the background color of the icon is in white color while ">>" is in deep color, it is automatic mode. The sampler will carry out sampling automatically and continuously according to edited standard points of working curves and corresponding cup numbers.

4) Setting of edited number

Click ◎ Auto-sampler configuration key to set the standard solution and cup numbers in the sampler and fill the corresponding solution in the sample cup edited numbers.

7.4.2 Maintenance

7.4.2.1 Cut off capillary

When the capillary in sampling pin is used for some times, the top end may be damaged. So cut it off according to the method mentioned in the section 7.4.1 (3).

7.4.2.2 Replacing capillary

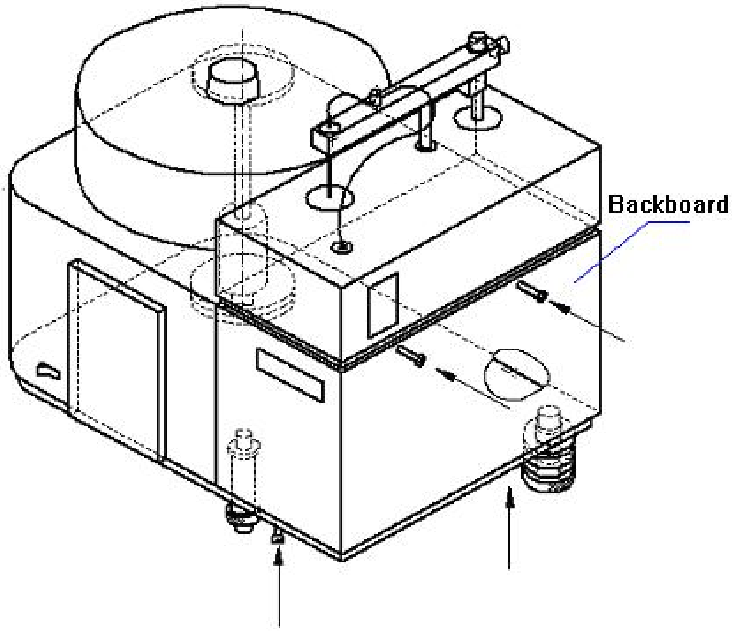


Fig. 7.5 Schematic Diagram of Disassembling Backboard

For a long-term use, the capillary of the sampler is not long enough or it need the replacement. Unscrew four internal hexagonal screws referring to the directions pointed by the arrow in Fig. 7-5. Take off the backboard of the sampler, you can see Teflon reducing valve of the capillary connection, the jointer of the black plastic piping of the reducing valve and the capillary are all detached, and then replace a new one and well connected.

Note: Pipeline test should be done after the replacement. If there has blocks or liquid leakage, that shows the problem happens on the connecting position of the reducing valve and the capillary. Disassembly the capillary and observe if the capillary border is good enough, if it is so, screw the piping jointer on the reducing valve tightly. Again observe it, if it is still not good, please contact with your local dealer or the manufacturer.

7.4.2.3 Circuit maintenance

(1) Circuit flow chart

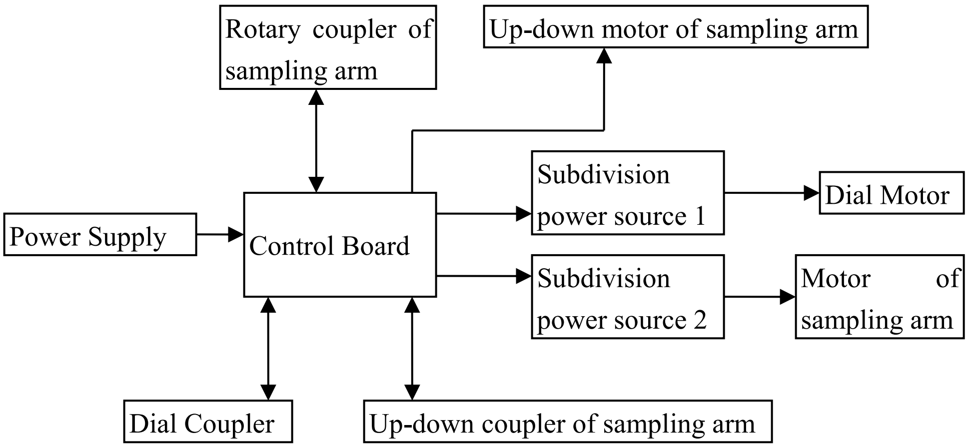


Fig. 7-6 Circuit Flow Chart of WF-10A Auto-sampler

(2) Maintenance of control board

When the trouble happens in the sampler circuit, disassembly the backboard of the sampler according to the method described in the section 2) to see the control board. User can diagnose the trouble based on the positions shown in Fig. 7-7. The user can never detach any of boards on the sampler, please contact the local dealer or the manufacture.

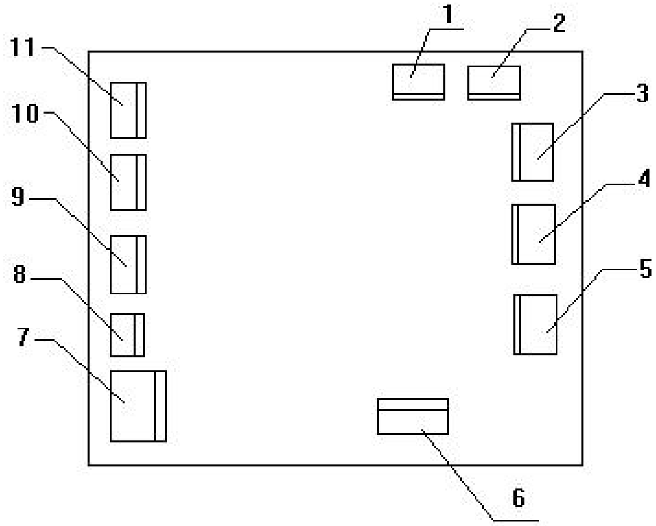


Fig. 7-7 Circuit board of sampler

Plug 1: +24V power supply
Plug 2: +24V power supply
Plug 3: Connected to subdivision driver of rotary motor of sampling arm
Plug 4: Connected to subdivision driver of dial motor
Plug 5: connected to up-down motor of sampling arm
Plug 6: Serial interface communication
Plug 7: Pump power supply and communication interface
Plug 8: Interface of small keyboard
Plug 9: Photo-coupler location of sampling arm Rotary
Plug 10: Photo-coupler location of rotary dial
Plug 11: Photo-coupler location of Up/down sampling arm

7.4.2.4 Memory chip data

When there is something wrong with the position of the sampling arm, but the moving direction is correct, this might be caused by the loss of data in the position memory chip. The moment, press down the two keys on the auto-sampler simultaneously until the sampling arm starts to move. Release the two keys.

IMPORTANT NOTE: After this operation, please re-adjust the sampling arm to the positions of the graphite tube and sampling depth.

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