

**Operating Manual**  
*of*  
**Model GA3202**  
**Graphitic Furnace Production**

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## 1. Overview

GA3202 graphite furnace system is a large accessory of atomic absorption spectrophotometer. The instrument is applied to non-flame atom absorption detection, controlled completely by computer. It is composed by two parts: graphite furnace power controller and furnace device, which is equipped in the combustion chamber of atomic absorption spectrophotometer, i.e. graphite furnace atomizer.

Graphite furnace system has 9 operating steps. Parameters such as temperature, time, inner/outer protection gas open/close state can be preset, and the operations are easy.

Graphite furnace system provides high-power heating function, which can enhance the testing capability with high reliability. When Graphite furnace atomizer is in use, the graphite tube can be easily installed and uninstalled. It can be easily calibrated on light axis and the performance is consistent.

GA3202 graphite furnace system is an accessory of our atomic absorption spectrophotometer products such as AA320, AA370MC and AA320N.

## 2. Installation

### **Warning!!!**

**This instrument should be connected to the 220V/30A electrical power source, water source, and gas source before it is turned on. For the safety reasons, it is prohibited to leave instrument with no operator after it is turned on.**

### 2.1. Laboratory Required

GA3202 graphite furnace system is a large accessory of atomic absorption spectrophotometer, applied to non-flame atom absorption detection, controlled completely by computer. The working environment requirement is the same with atomic absorption spectrophotometer. It should be dustproof and caustic gas proof. The ambient temperature should keep at

+10°C~+30°C and the relative humidity should be less than 85%.

## 2.2. Power, gas, water source required

Laboratory should provide two sets of power sources, 220V, 50Hz, single phase:

- 1) One set of power source is graphite furnace control power: 220V±22V, 50Hz±1Hz, single phase alternate current, 220W, together with good and single grounding connector. It can be used by atomic absorption spectrophotometer.
- 2) Another set of power source is high-power source: 220V±22V, 50Hz±1Hz, 30A, single phase alternate current, which needs high power so the cable should not be connected by any other devices, including furnace control power source and atomic absorption spectrophotometer power source, to avoid any interference.

See figure 2-1 Graphite Furnace Power Source Installation

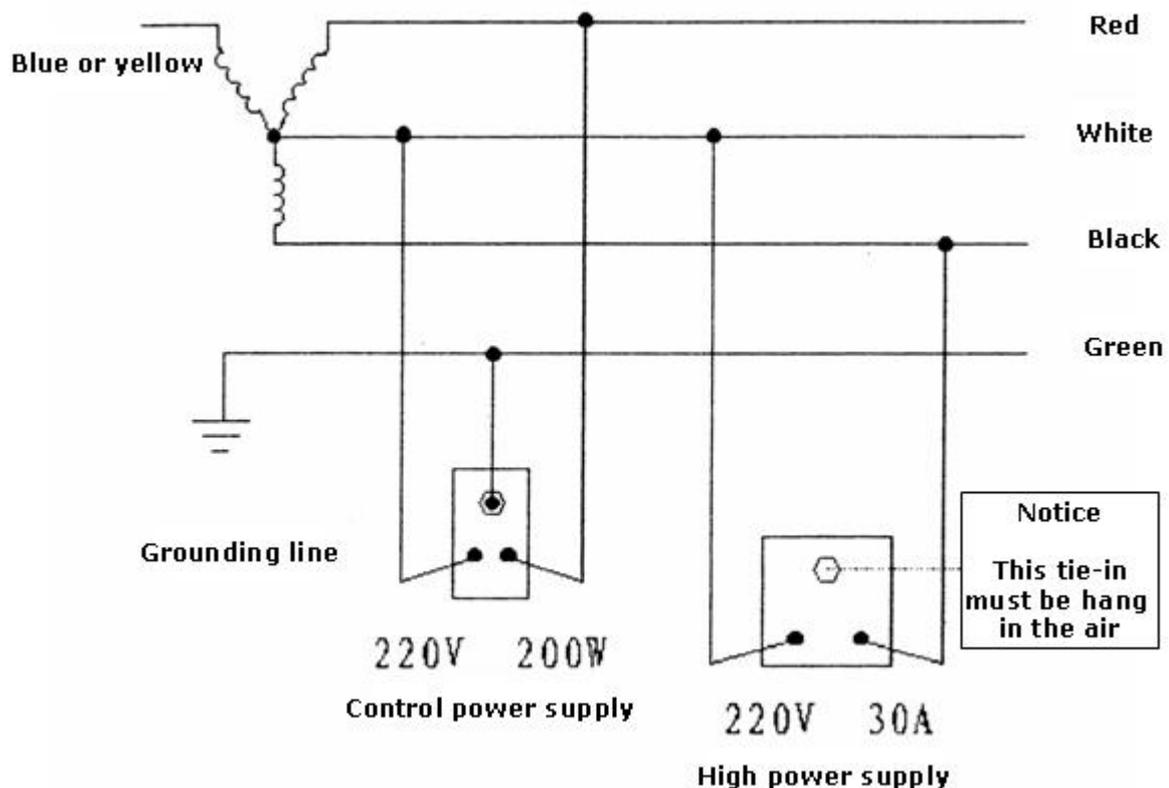


Figure 2-1 Graphite Furnace Power Source Installation

**Notice**  
Only one high-power socket is permitted on the second power source.

Users should prepare Argon steel bottle, which should be mounted drafty.

Water source can be tap water or cycling water, connected through pipe, and flow rate not less than 2L/min.

### **2.3. Open box checking**

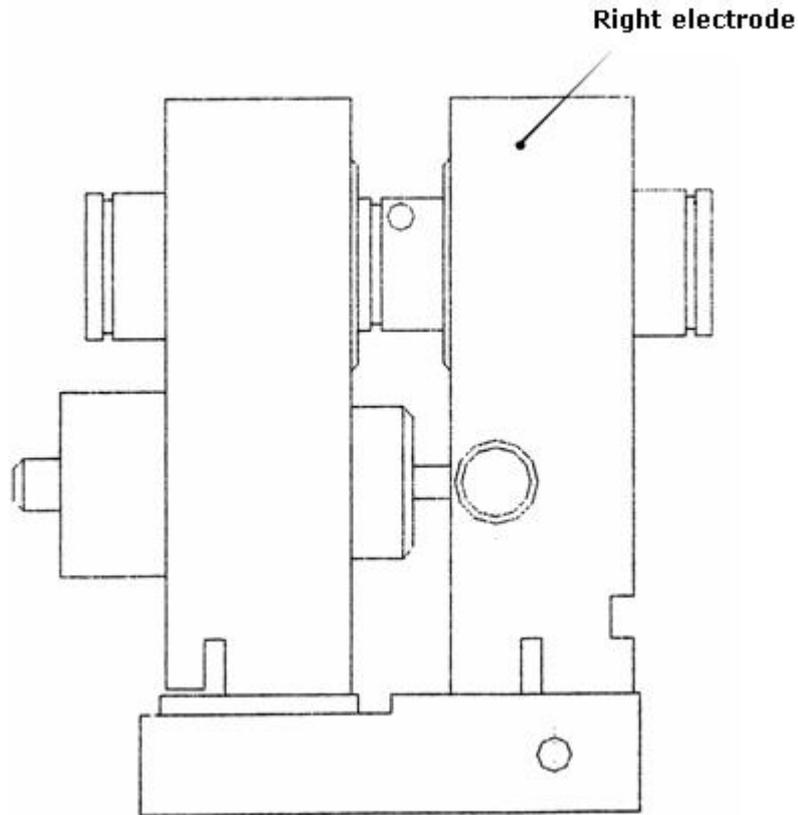
When open the box, refer to accessory and spare parts list, verify whether there is any damage or shortage, take apart airproof envelope of all parts, take out the silica gel bag and mount the instrument on experiment platform and check if there is any obvious damage caused by shipping. Should there be any damage or shortage, please contact with us!

### **2.4. Installation**

#### **2.4.1. Installation of graphite furnace body, gas source, and water source**

GA3202 graphite furnace control system should be placed to the left of the atomic absorption spectrophotometer; graphite furnace atomizer should be placed in the combustion chamber of atomic absorption spectrophotometer. The installation procedures are listed as follow:

- 1) Uninstall the flame atom system for absorption from firebox, and mount graphite furnace on the elevator and fix it with bolt.
- 2) Move cursor to "REPLACE TUBE", press Enter, open graphite furnace and draw the right electrode, mount the graphite tube. Make sure the sample feeding hole of the graphite tube at the hole on the graphite base. Use localizer in the accessories to locate the position, and then press the right electrode slowly. Press enter again will press out the graphite furnace. See figure 2-2, Press Out Graphite.



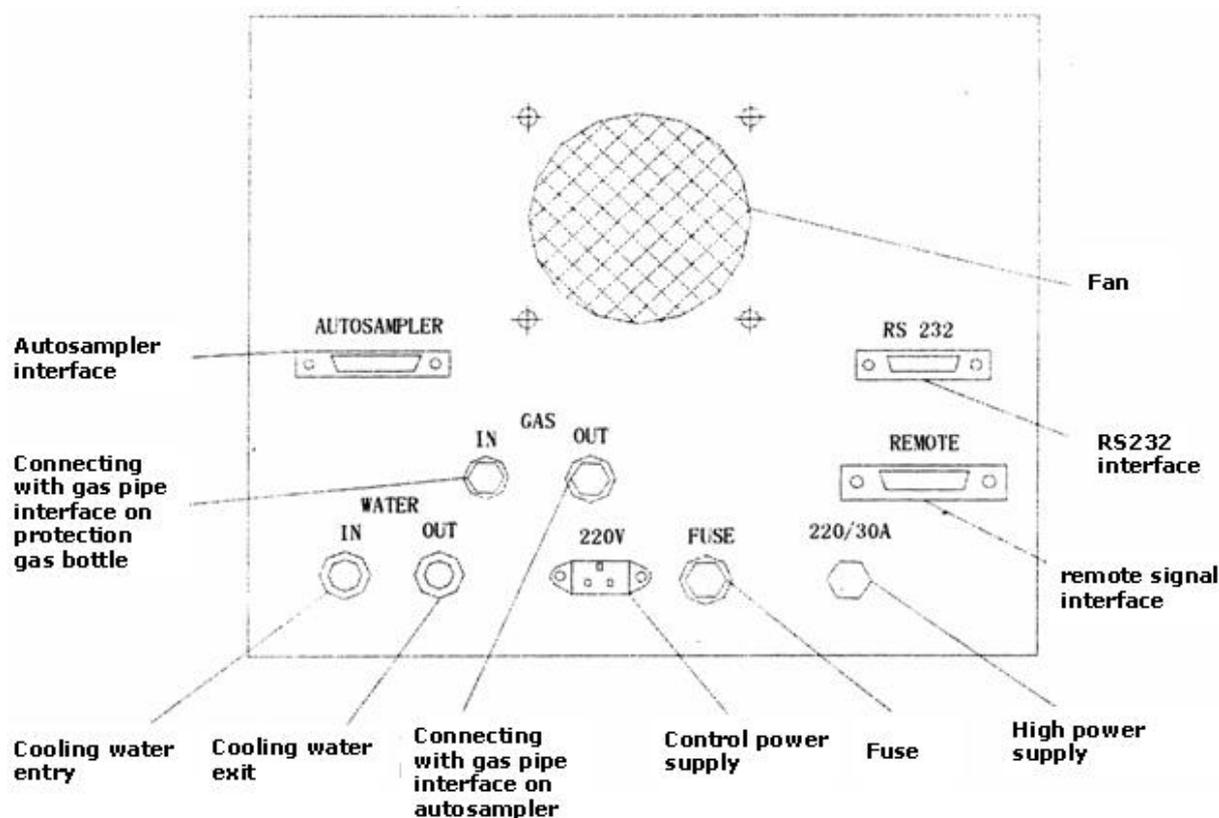
**Figure 2-2 Press out Graphite**

- 3) Adjust height and the position of the elevation to calibrate graphite to the same line with light axis.
- 4) Take out the polyethylene pipe,  $\phi 3 \times 0.5$  (cut it to the proper length), stainless steel bush,  $\phi 2$ , cut polyethylene airproof pad,  $\phi 5 \times 1$ , copper airproof pad and hexangular screw and connect gas pipe on the back of the graphite furnace system to the oxygen decompressing valve output of argon steel bottle. Take out tow polyethylene pipes,  $\phi 10 \times 2$ . One connects cooling water input on the back of graphite furnace with water faucet in the laboratory; the other connects water faucet (nozzle aims at sewer) with the back of furnace cooling output.

#### **2.4.2. Connection of power source, control cable and signal cable**

Plug the pin of white cable for high-power of 220V/30A on the back of graphite furnace into power source socket. Take out 220V220W cable for power control and connect furnace power controller and the socket.

Argon, cooling water, power source and control signal cable connection refers to figure 2-3 GA3202 back view.



**Figure 2-3 GA3202 Back view**

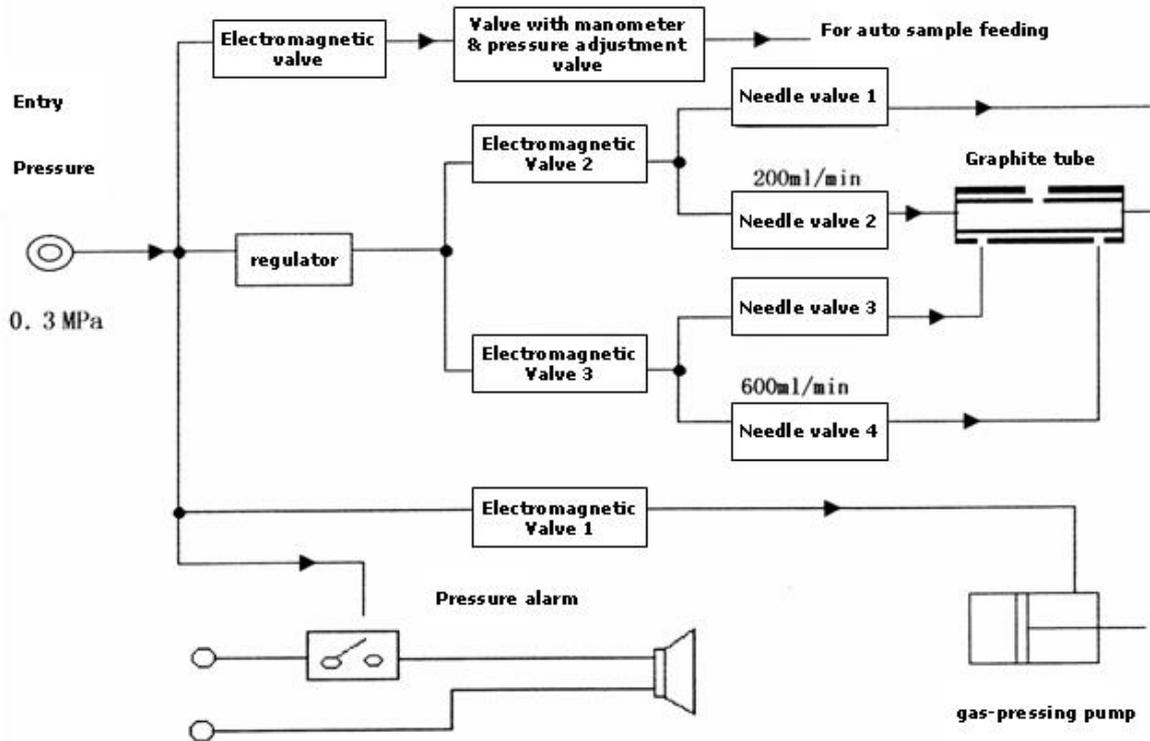
**Notice**

**All cable connection should be done under normal working state of instrument.**

**3. Theory of Operation**

Graphite furnace system is used to test trail sample using graphite furnace atom absorption, working together with atomic absorption spectrophotometer. Infuse sample into graphite furnace and it will be atomized under high temperature through various temperature settings. Atomic absorption spectrophotometer records energy, in the form of light when atomization, then the content of target element can be calculated. The main function of graphite furnace is to facilitate sufficient atomization, which can achieve high characteristics quantities under inert gas protection, separating water and other impurity from sample with programmatic temperature elevation and keeping no element loss in sample.

Refer to figure 3-1 Gas Diagram of GA3202 Graphite Furnace System



**Figure 3-1 Gas Diagram of GA3202 Graphite Furnace System**

#### **4. Technical specification**

- 1) Heating steps: 9 steps
- 2) Temperature range (nominal Temperature): 20°C~3000°C
- 3) Slope heating time: 0~999s
- 4) Heating holding time: 1s~999s (the sum of both time should be less than 999 seconds)
- 5) Inert gas needed: argon, pressure of entry larger than 0.3Mpa
- 6) Cooling water: tap water or cycling water, flow rate no less than 2L/min
- 7) Output: LCD
- 8) Gas pressure alarm, furnace overheated alarm
- 9) Interface with Atomic absorption spectrophotometer, autosampler and RS232
- 10) High-power temperature heating function (1000°C~2700°C)
- 11) Test sample together with atom absorption equipment. Cd  $\leq 1 \times 10^{-12}$ g; Cu  $\leq 1 \times 10^{-10}$ g

12) Working Conditions:

Power source: 220V±22V, 50Hz±1Hz, 3A

220V±22V, 50Hz±1Hz, 30A

Power: 5.1kW for 220V on about 2700°C

Ambient temperature: +10°C~+30°C

Relative humidity: less than 85%

Instrument rating power: 7.2kW

13) Dimension:

Graphite furnace power controller: 440mm×510mm×400mm

Graphite atomizer: 160mm×190mm×200mm

14) Weight:

Graphite furnace system: 60 kg

## 5. Keyboard operation and control, drive function

### 5.1. Control panel setting

### 5.2. Display and instructor

### 5.3. Function keys

1) Number: 0~9, set parameters

2) Control key: ↑, ↓, ←, →, move cursor

+ , - , set signal such as inter and outer protection gas signal and read signal,

add or delete step settings

Page Up, Page Down,

F + num, stands for function page

3) Function keys: CE, delete original data

Start/Stop

Enter

#### 5.4. Key operation example

Element	Cd	Sample volume 20 $\mu$ l				
Step	1	2	3	4	5	6
Temperature ( $^{\circ}$ C)	110	200	1900	1950		
Slope time (S)	15	10	1	1		
Holding time (S)	30	20	5	2		
Inner gas	+	+	No	+		
Outer gas	+	+	No	+		
Read	No	No	+	No		

#### 5.5. Error Code:

**Error1:** air pressure alarm

**Error2:** Over-heated alarm

**Error3:** Over-power alarm

**Error4:** in high-power temperature control and adjustment mode, photosensitive equipment finds no temperature value

**Error5:** graphite tube not pressed out

**Error6:** no input for heating program

#### 5.6. Control function

##### 5.6.1. Gas control

Gas controller of graphite furnace system can manage inner and outer protection gas through computer

##### 5.6.2. Signal control

The interfaces between Graphite furnace system, atom absorption equipment and

autosampler are placed on the panel at the back of graphite furnace system, which can be connected if need, see figure 2-3.

## **6. Operation**

### **6.1. Operating steps**

Based on the requirements in 2.4, GA3202 graphite furnace atomizer should be fixed in firebox of spectrophotometer. According to accessories selected and type of atomic absorption spectrophotometer, refer to figure 2-3, keep signal cable, protection gas pipe, cooling water pipe and power source cable well connected.

Following operating procedures of atomic absorption spectrophotometer specification, mount hollow cathode light of target element and adjust it to optimal state, and then adjust graphite furnace atomizer to make sure light beam of hollow cathode light passing graphite tube. After adjustment, replace a new graphite tube.

Open the valve of inert gas, adjust pressure to about 0.3MPa. Open tap water or cycling water pump and let cooling water pass two electrodes of graphite furnace atomizer.

Turn on power source and LCD will show auto-checking function, and then move cursor to "REPLACE TUBE", press enter to press out furnace body.

### **6.2. Programmatic measure**

Graphite furnace system equipment has 9 heating steps and user can select any of them. Users can set parameters from keyboard: temperature, slope time, holding time, has inner/outer gas or not and host computer control signal included. Temperature setting is required and the others can be set according to the demand. After setting parameters for the first step, then set parameters of next step, and so forth. User can decide how many steps are needed based on their needs. General sample can set 4 steps: desiccation,

incineration, atomization and high temperature cleanup. Feed sample after setting parameters and press "Start/stop" key to carry out heating process. Testing result will be recorded and displayed by LCD of atomic absorption spectrophotometer. After one sample analysis, namely one programmatic test, graphite tube needs 30s cooling before next programmatic test. During heating process, if user wants to stop heating, he can press "Start/Stop" again to terminate heating process.

If high-power heating is needed in a certain step, set the temperature (larger than 1000°C) first, set slope time to 0, and press "Start/stop" key, the instrument will adjust to high-power mode automatically. After adjustment, set slope time to 0 in this step. When run to this step, the instrument will change to high-power mode.

While working with autosampler, please turn on furnace power and autosampler power, then press start key of autosampler to run before setting parameters for all steps of graphite furnace, and lastly enable autosampler to work again. Therefore, the continuous auto feeding test can be achieved.

### **6.3. Manual heating operation**

The Instrument has manual control key. If manual heating needed or in graphite tube pretreatment, move cursor on LCD to CLEAN TUBE, then press enter, the instrument will increase the temperature to 2700°C. Once the manual control key is released, the heating process will be terminated. Furthermore, user should notice that the instrument has inert gas and overheating alarm functions.

### **6.4. Sample infusion**

Using a drop suction pipet (20µl) to infuse sample from the hole of graphite tube (if using autosampler, the sample will be infused automatically). When infusing sample, to ensure the accuracy of test, user should pay attention to keep the environment clean.

When drop suction pipet is using to transfer sample, pipet point dip into the liquid surface 1mm~2mm. Please do not touch container inner side. Sucking should be slow and the infusion should be quick to avoid any drop remains on pipet point. When sample is infusing into tube hole, try not to let pipet point touch side of the hole.

### 6.5. Graphite tube pretreatment and cleaning

Before each test, graphite tube must be cleaned up or heated twice (move cursor to "CLEAN TUBE", and then press enter). Cleanup before load sample can remove dust and remains from the last test, which ensure clean tube and testing quality.

Graphite tube should be cleaned up regularly. Especially when used frequently, maintenance will be rather important.

While graphite tube working under high temperature, carbon particles will be separated out and form sediments on the inner side of graphite bush. So, it should be cleaned up. User can take down quartz windows on both ends of furnace. If they are stained, lens cleaning paper can be used to clean them. Carbon particles on inner side of quartz bush can be cleaned by brush or ear washing bulb. After all are cleaned, quartz windows should be put back.

## 7. Quantities and Characteristics

Standard solution:

Cd      0.001µg/mL      (Blank solution: de-ionized water)

Cu      0.1µg/mL

Through actual operation calibration, select suitable condition, and then test sample three times to calculate average absorbency. Actual absorbency is:

Average absorbency  $\overline{A}_2$  subtracts blank average absorbency  $\overline{A}_1$ , i.e.  $\overline{A} = \overline{A}_2 - \overline{A}_1$

Calculate after the following formula:

$$Q_c = \frac{C \times H \times 0.0044}{\overline{A}} \quad (\text{unit: g})$$

In the formula,

C: Standard solution concentration,  $\mu\text{g/mL}$ ;

H: Sample quantity,  $\mu\text{L}$  ;

$\bar{A}$  : Average standard solution absorbency for 3 tests.

Result should follow  $\text{Cd} \leq 1 \times 10^{-12}\text{g}$ ,  $\text{Cu} \leq 1 \times 10^{-10}\text{g}$

## **8. Maintenance**

All of the maintenance related works will be implemented by technician from the maintenance division of our marketing department. When the instrument failure is detected, please contact us in time.