GC9310 GAS CHROMATOGRAPH USER'S MANUAL

ANNTENTION NOTES:

Notice:	Special information provided by the manufacturer regarding the instrument for your attention.
Caution:	Important information provided for your attention.
WARNING:	Special attention must be paid to the provided information. Bodily harm or instrument damage may occur if the specified operating procedure is not followed.
DANGER:	Extreme care must be provided due to severe danger exits.

HIGH VOLTAGE DANGER:

- Do not remove the instrument cover, when the instrument is working. High voltage may exist and cause bodily harm inside the instrument when the instrument is working, and removing of the instrument cover will expose electrical components.
- Disconnect the power supply plug from the outlet, before replacing the fuse or assessable/disassemble/maintain the instrument. Turning off the instrument with the power switch just shuts off the instrument, instead of disconnecting it from high voltage.
- Immediately replace the power cable when it is worn out or damaged.

HIGH TEMPERATURE DANGER:

- When the instrument is working and within a certain period after the instrument is turned off, the sample feeder, testing component, column box, rear air outlet, etc. may stay at high temperature. Avoid contact such part to **prevent burns**. Wait for the instrument to cool down or take necessary protective measures, when replacing a part!
- Special attention should be given to the hot gas released from the instrument during cooling to prevent burns.
- **Do not place** flammables behind the instrument, to prevent the released hot gas from igniting them!
- The gas supply pipeline should **be away from** the rear air outlet, to prevent the hot released hot gas from melting the pipeline and causing greater hazards!

GAS SOURCE DANGER:

- Gas cylinders and sources used by the instrument should be transported, stored, managed and used according to applicable rules.
- Note that hydrogen may enter the cylinder box and lead to explosion hazards, if hydrogen is used as the carrier gas or FID fuel gas. Turn off the gas source before all pipelines are safely connected. Install the chromatographic column, connect the sample feeder and detector component, and check all connection points and valves before turning of the hydrogen supply. This is to prevent hydrogen from entering the column box and causing explosion.
- When special samples (such as toxic ones) are analyzed or the instrument may release toxic substances, substances released by the instrument must be led to a safe outdoor place to prevent indoor pollution and even intoxication.

Contents

I. Overview

GC9310 gas chromatography is a general type gas chromatography newly designed and computerized, high in performance and low in price. The apparatus fully absorbs advanced technology of similar products home and abroad at present so that it represents high stability and reliability, simple but reasonable structure, easy operation and beautiful appearance.

Apparatus performances and features:

1. The apparatus's main control circuit adopts micro-processing system and large scale integrated circuit. Human-computer interface and technology of displaying characters with large LCD screen are adopted to display visually, which is easy to learn and use for it's easy to operate. Default values and practical values of all parameters are displayed at real time. It is fit for use in teaching in universities and operation by common apparatus operator in enterprises. Its application range is wide, fit for environment protection, trail weight inspection for pollution of gas and water source, organic chemical, synthesized research, health quarantine, inspecting, analyzing and researching public hazard.
2. Stable and reliable temperature control system.

2.1 Adopt computer auto control circuit to operate fully with keyboard. There is a ten-way high precision control system, in which temperature of pillar box can realize ten-stage programmed temperature. It can analyze complex sample having wide boiling point as required by the customer.

2.2 Advanced back door technology can ensure that column box temperature of the apparatus can have excellent precision in temperature control when working close to room temperature.

3. Stable and reliable gas flow system

3.1 Carrier gas path adopts double stable pneumatic system that first stabilize pressure and then stabilize flow.

3.2 By split/splitless capillary sampler, it is flexible to cooperate with circuit control part to auto split and not split samples.

3.3 By adopting back pressure controlled split/splitless capillary sampler to stably impose column pressure, it largely improves stability of capillary system, particularly used for analyzing capillary column.

3.4 Capillary sampler has the function to self clean the septum, which can efficiently prevent sampler from causing ghost peak at high temperature.

3.5 Flow adjusting valve adopts digital rotary adjustment, visible and reliable.

3.6 Column pressure is displayed on pressure gage.

4. Two types of sampler for option

4.1 Packed column sampler fits for analyzing packed column and heavy caliber capillary column.

4.2 Capillary sampler fits for analyzing light caliber and heavy caliber capillary column.

5. Multi-inspector for selection

5.1 Able to install two fids and amplifier to output signal; and install TCD at the same time.

5.2 Or install only one TCD and one FID.

II. Technical indexes and application requirements

1. Technical indexes

1.1 Indexes of column box temperature:

Column box temperature range: room temperature to 5°C～399°C (the increment is 1°C)

Column box temperature control precision: above ±0.1°C (measured at 200°C)

Column box programmed temperature: 10-stage programmed temperature

Set rate of programmed temperature: 0.1°C～40°C/min (the increment is 1°C), measured at 200°C

Stabilization time at each stage: 0～655min (the increment is 1min)

1.2 Thermal conductivity detector (TCD)

1) Sensitivity: S≥3000mv.ml/mg
2) Baseline noise: ≤20μv
3) Baseline drift: ≤50μv/30min
4) Carrier gas flow rate stability: ≤1%.

1.3 Flame ionization detector (FID)

1) Limit of detection: ≤8×10^{-12}g/s
2) Baseline noise: 5×10^{-14}A
3) Baseline drift: ≤2×10^{-13}A/30min

1.4 Temperature indexes for sampler, inspector, thermal conductivity cell

1) Temperature range: room temperature to 5°C～399°C (the increment is 1°C)
2) Temperature control precision: above ±0.1°C (measured at 200°C)

1.5 Requirements by use of apparatus

Power voltage: 220V～±22V　50Hz±0.5Hz

Rated power: ＜1800W

Environment temperature: +5°C～+35°C

Relative humidity: ≤85%

The chromatograph should work in environments with temperature at 5-35°C and relative humidity of 0-85%. The working environment is preferably to be one also making people feel comfortable (constant temperature and humidity if applicable). Such environment allow the instrument to realize its best performance and longest service life.

Avoid expose the chromatograph to corrosive substances (whether they are gases, liquids or solids) which may endanger the materials and parts of the instrument.

The test bench for mounting the chromatograph must be secure and firm. Vibration of the test bench will affect the stability of the instrument. For releasing of hot air from the column oven, a space (free of any flammable!) of 30cm deep should be left behind the instrument, and a 30-40cm passageway should be provided for installation and maintenance of the instrument.

The power supply to the gas chromatograph should be of a voltage 220V±10% (50Hz±0.5Hz) with power no less than 2000W. To prevent bodily harm, the panel and casing of the gas chromatograph should be earthed with a three-core power cable according to requirements of the International Electrotechnical Commission (IEC).

Notice: The instrument must be well earthed to reduce electrical noise.

WARNING: NO WATER PIPE, GAS PIPE OR ZERO CONDUCTOR MAY BE SUBSTITUTED FOR THE REQUIRED EARTHING CABLE.

For the gas chromatograph to realize the best performance, gases to be used should be of the necessary purity. The following purity classes are recommended.

Detector	Use	Gas	Purity
FID	Carrier gas	N_2	No less than 99.999%
	Carrier gas	He	No less than 99.999%
	Make-up gas	N_2	No less than 99.99%
	Fuel gas	H_2	No less than 99.99%
	Combustion-supporting gas	Air	As dry as possible
TCD	Carrier gas	H_2	No less than 99.999%
	Carrier gas	He	No less than 99.999%

It is recommended to install a purifier in the gas circuit! The molecular sieve and silica gel of the gas purifier should be activated after the purifier has been used for a period of time.

2 Apparatus of a complete set and optional attachments and parts

2.1 Complete set

Basic GC9310 gas chromatography is composed of machine case, double packed column sampler, whole set packed column, carrier gas and auxiliary gas path, microcomputer temperature controller, flame ionization detector and micro-current amplifier, and two stainless steel packed columns that are 0.6m in length with an inner diameter of 2mm (7% SE-30chromosorbghb or 5%OV-101, 100 item～120 item).

a) Basic GC9310 gas chromatography 1
b) Attachments and spare parts (see list of attachments and spare parts) 1 box
c) Dimensions: 690x480x480mm
d) Weight: 65 KGS

2.2 Optional attachments and spare parts

GC9310 gas chromatography is provided with the following attachments for the user to select. To place an order, make it clear when ordering the basic model or select to purchase at any time during use of the apparatus.

a) GC9310-TCD (thermal conductivity detector): GC9310- highly flexible TCD
b) Six-channel plane switching valve gas sampler (auto and manual control)
c) Reforming furnace (including methane nickel reforming agent)
d) Split/Splitless capillary sampler
e) Multi-model chromatography workstation

2.3 Working principle of the apparatus

Gas chromatography uses gas as mobile phase (carrier gas). When the sample is “injected” into the sampler by micro-injector to be carried into packed column or capillary chromatography by carrier gas. Because the rate that ingredients in the sample are distributed or absorbed between mobile phase (gas phase) and stationary phase (fluid phase or solid phase) in the chromatography, as rinsed by the carrier gas, all ingredients are repeatedly re-distributed between both phases for many times so that all ingredients are separated in the column to be inspected in an order by the inspector connected to back of the column by physical and chemical features of the ingredients. GC9310 gas chromatography is an

analyzing apparatus manufactured based on the above principle as shown by Figure 1-1.

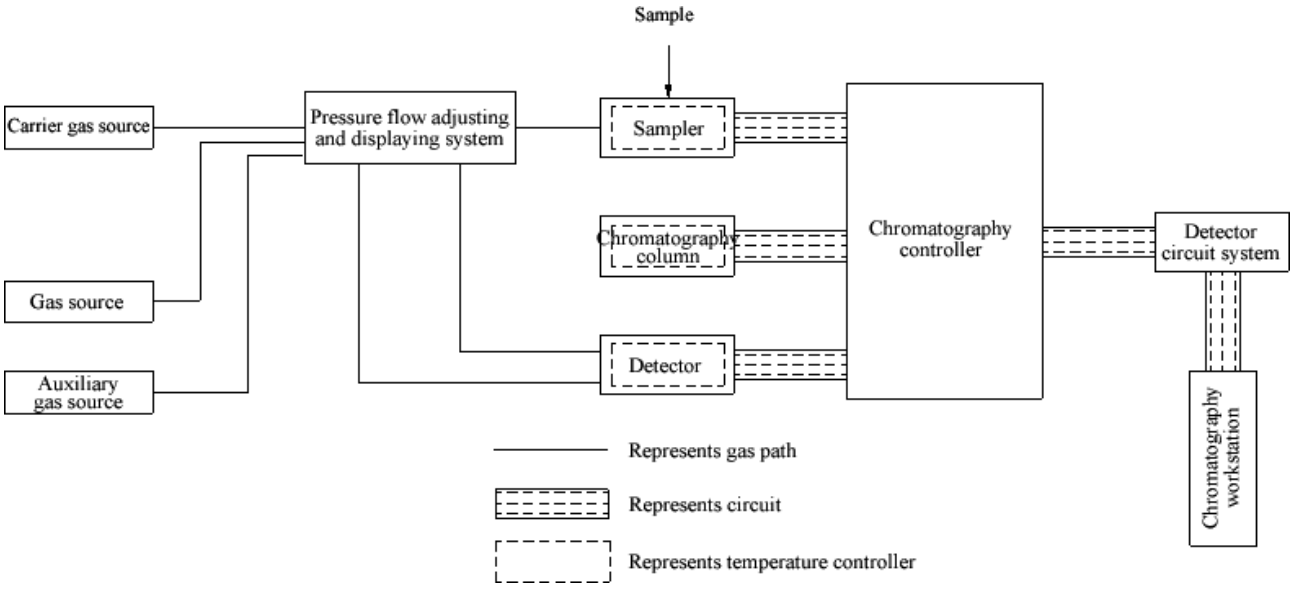
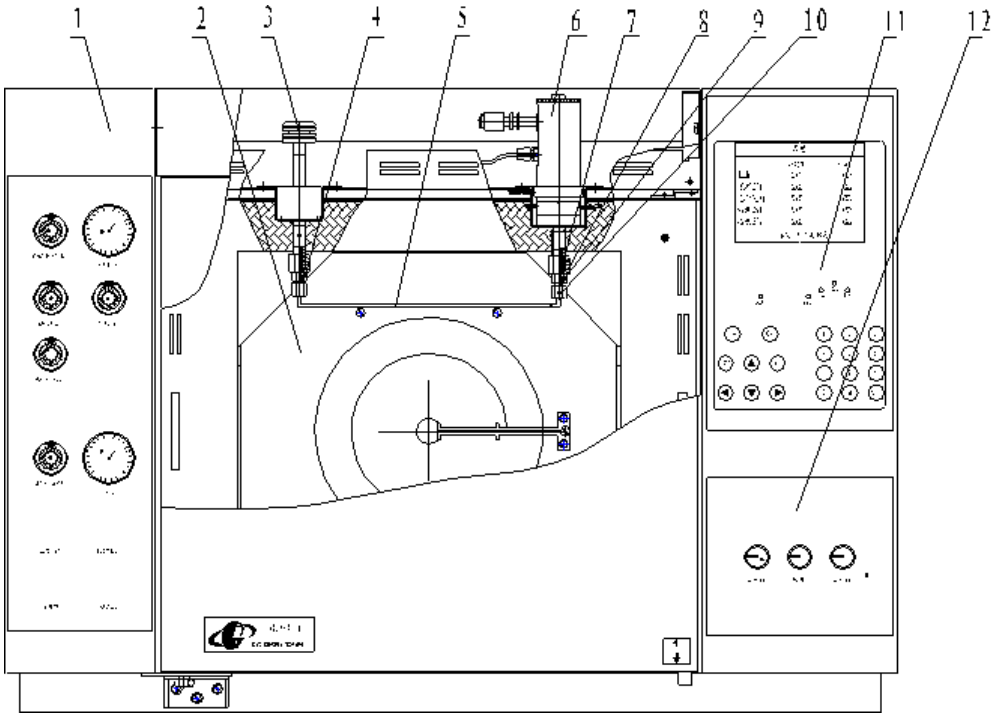


Figure 1-1 Schematic Block Diagram of GC9310 Gas Chromatography

2.4 Main Machine Structure of the Apparatus

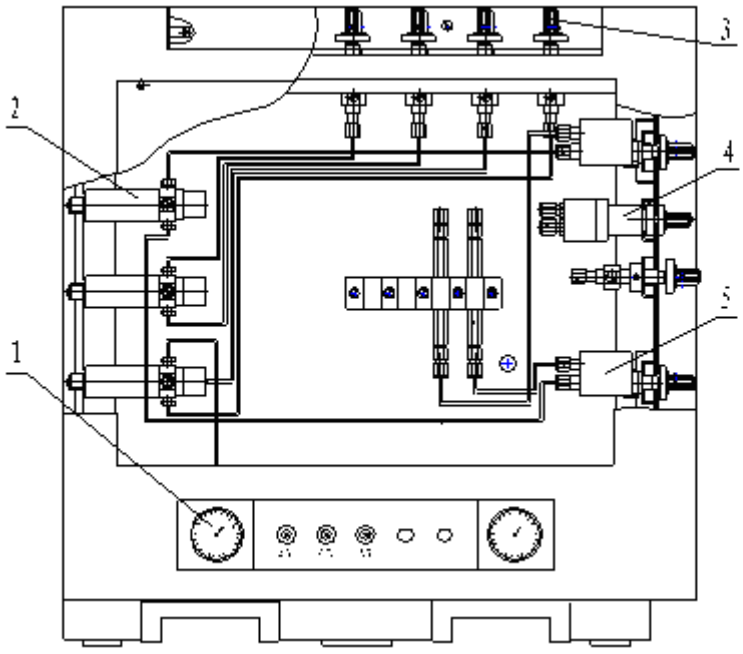
GC9310 gas chromatography is composed of flow controlling part, sampler, chromatography column box, inspector, temperature control and inspector circuits etc.

At center of the basic apparatus is chromatography column box with computerized temperature controller on its right top and FID micro-current amplifier on its right bottom. Flow controlling part and gas path panel are installed on left of the apparatus. Above column box, ionization inspector (two installed on the basic model) and TCD are installed on the right and double packed column sampler or capillary sampler are installed on the left.



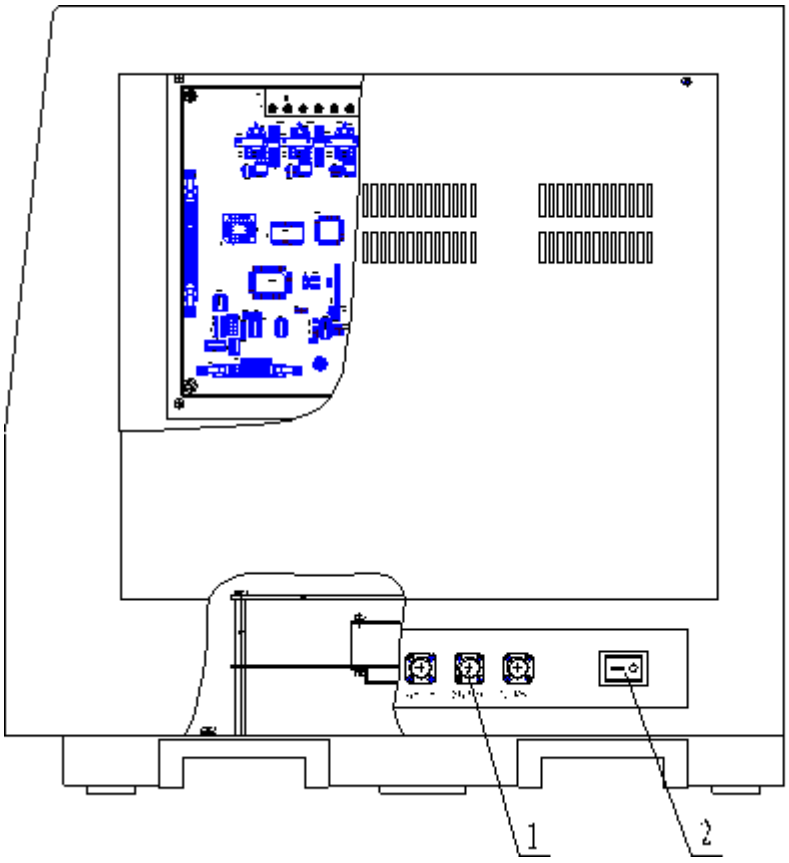
1. Gas path box
2. Temperature control box
3. Packed column vaporizer
4. Sampler connecting pipe
5. Chromatographic column
6. Hydrogen flame part
7. Graphite gasket
8. Nut
9. Hydrogen flame connecting pipe
10. Nut
11. Control box
12. Alignment panel

Main Machine Structural Diagram I (front)



1. Pressure gauge
2. Pressure retaining valve
3. Needle valve
4. Backpressure valve
5. Current stabilizing valve

Main Machine Structural Diagram II (left)



Main Machine Structural Diagram II (Right)

2.5 Column box

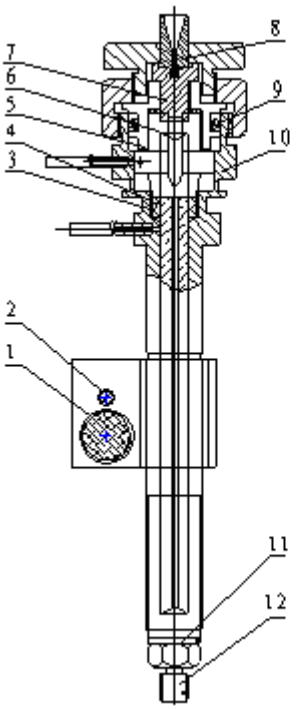
Column box of GC9310 gas chromatography is huge in volume, and can install double packed column or capillary column to be quick in temperature up and down. This machine adopts motor with lowered noise, remains steady with little vibration during operation and is installed with auto back-door equipment.

When the column box needs to be cooled down, cooling air inlet and heated air exhaust at box rear shall be opened automatically. Cooling air can enter the column box through air inlet to replace heated air in the column box to rapidly cool down the column box.

2.6 Sampler

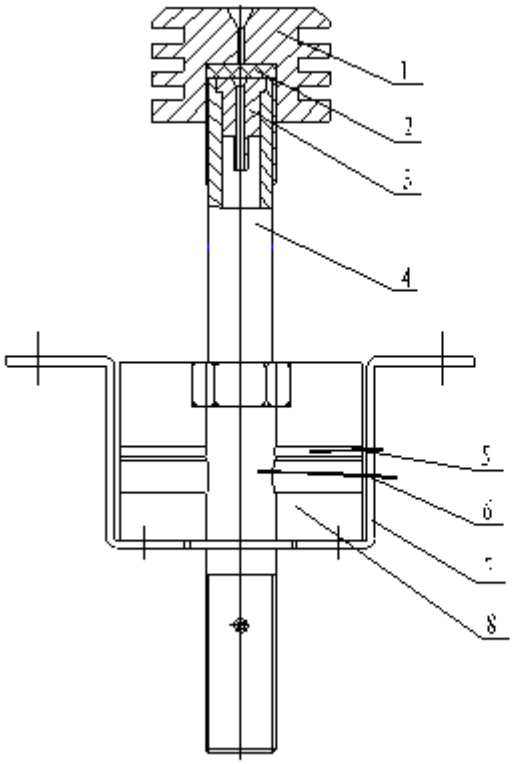
Basic model of this apparatus is configured with double packed column sampler. The user can select to install capillary split/splitless sampler as per requirements. Structure of the sampler is shown in the diagram below. Double packed column sampler is installed inside left conductor on top of the main machine together with electric heating element and porcelain platinum resistance. It temperature is controlled by microcomputer temperature controller.

For example, packed column sampler in the diagram is installed with a ф3mm stainless steel column (column head sampling). Manufactured at the factory, inner diameter of the apparatus is ф3.2mm column connection, fit for column pipe with an outer diameter of ф3. In addition, ф6mm stainless steel column and ф5.7mm glass column can also be installed on this packed column sampler while ф0.32mm and ф0.53mm quartz capillary column can be installed on capillary sampler.



1. Heating wire
2. Platinum resistance
3. Ferrule (capillary)
4. Sliding bush (capillary)
5. Graphite sliding bush (capillary)
6. Sealing sliding bush (capillary)
7. Sliding bush (capillary)
8. Sampling gasket
9. O-shape gasket
10. Component of vaporizing pipe (capillary)
11. Shim
12. Connector

1-6 Figure (1) Structure of Capillary Sampler



1. Radiating cap
2. Silicone rubber
3. Guide bushing
4. Pipe components (vaporizer)
5. Platinum resistance
6. Heating wire
7. Tray
8. Heating block of the sampler

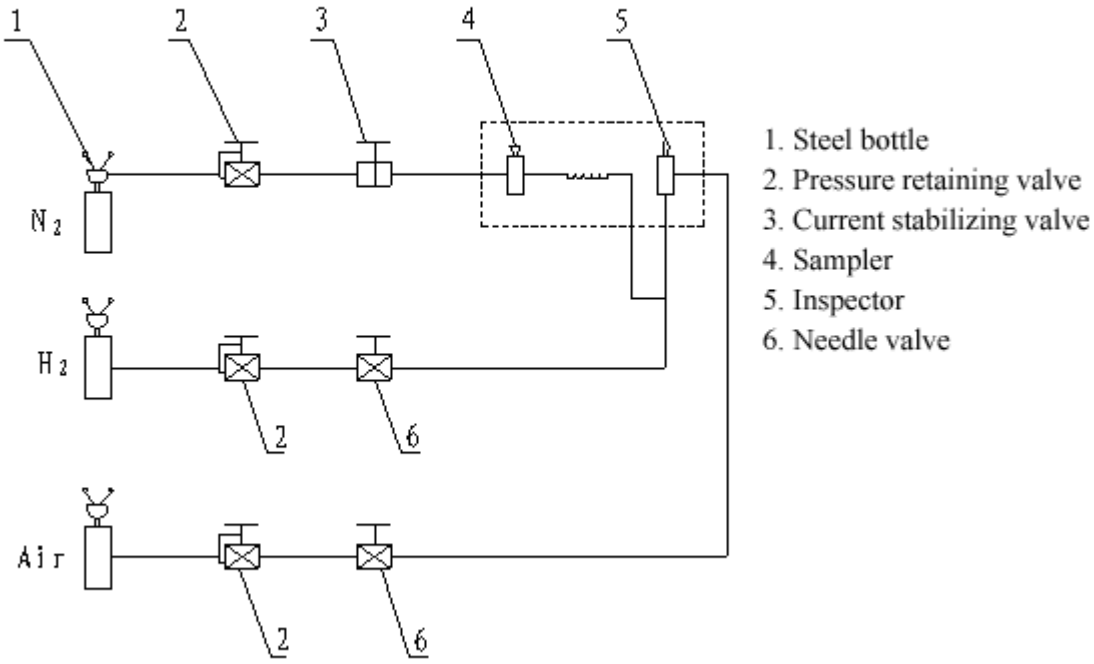
1-6 Figure (2) Packed cell sampler

2.7 Gas path controlling system

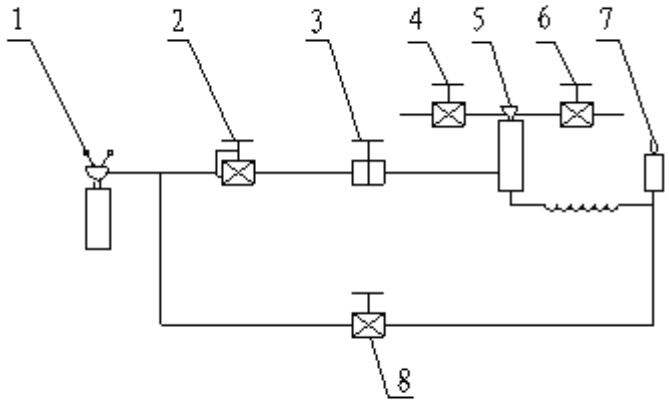
Carrier gas flow path of GC9310 gas chromatography adopts a structure of double packed column flow paths in addition to a set of independent capillary split adjusting valves. Based on requirements, capillary analyzing flow path can be installed and two flow paths for different carrier gases can be installed at the same time. Hydrogen and air flow path are double flow path, each can be adjusted independently.

2.7.1 Carrier gas flow path

Flow of carrier gas is adjusted by current stabilizing valve. The carrier gas current stabilizing valve with a mechanical scale is provided with stable input pressure by upstream pressure retaining valve. Output flow of current stabilizing valve can be found on relative flow curve (notice: flow is related to gas type), that is: each scale on rotary button of current stabilizing valve has a standard curve relationship with the flow amount it represents. Scale-flow curve is same to 3 current stabilizing valves (channel A, channel B and channel C capillary flow paths of the packed column) on the apparatus. If required, soap bubble flow meter can be used to measure for more accurate flow).



1-7 Figure (1)



1. Steel bottle
2. Pressure retaining valve
3. Current stabilizing valve
4. Split
5. Sampler (capillary)
6. Septum self-clean
7. Inspector
8. Make-up

1-7 Figure (2)

2.7.2 Hydrogen and Air Flow Path

Auxiliary air path of GC9310 gas chromatography has air and hydrogen, installed on upper left of the apparatus. Scale-type needle valve can be adopted to adjust hydrogen and air flow. Hydrogen and air needle valve is provided with stable input pressure by upstream pressure stabilizing valve. Output flow of hydrogen and air needle valve can be found in relative table of scale-flow curve. That is: to set and change hydrogen and air flow, it is required only to change scale indication by rotary button of relative needle valve. Air and hydrogen adjusting rotary button and panel are at upper left of the main machine (cover board on the panel should be turned over at time of use).

Advices

Don’t change output pressure of pressure stabilizing valve in the air path randomly, that is: don’t adjust 3 axostyles at back of air path system in order not to affect validity and output precision of scale-flow curve.

3. Microcomputer Temperature Controller

Microcomputer temperature controller of GC9310 gas chromatography can control temperature of 5-way objects under the control such as chromatography column box, sampler, detector, thermal conductivity cell and capillary sampler with wide temperature scope and high precision. Column box among them can realize 5-stage programmed temperature. Because this control system adopts advanced software and hardware technologies, its performance is reliable and stable, excellent in anti-disturbance and small in temperature overload. In addition to completing temperature control and programmed temperature, it also has such functions as temperature limit setup, analyzing timing, maintaining temperature, scanning practical temperature dynamically, automatically opening back door of the column box when temperature is reduced and protecting date when power is off. The apparatus has self-check function. If at mistake, it

can close temperature controller automatically. Moreover, many chromatography workstations can be selected to connect. This controller can also adopt microcomputer to select range and polarity of FID amplifier, set up and display TCD current.

III Keyboard and Operation

1 Panel and Keyboard Configurations:

The instrument has a 320*240 LCD display and an easy-to-use panel.

The upper part of the display is for working information, and the lower part is for status indication.

The working information screen is for information (such as temperature control mode, detector mode, network mode, etc.) of the instrument under different mode (which is switched by pressing the corresponding numeral key).

The status indication screen indicates the working status (such as temperature control, fault alarm, etc), auto-start status, stopwatch and time from the left to the right.

Status indicators are for Online, Ready, Init Temp, Rate, Final Temp and Post Run. The meaning of each indictor is given below:

Online: This indicator is lit up when the chromatograph is connected to a workstation.

Ready: This indicator is lit up when the chromatograph column box reach the preset temperature.

Init Temp: This indicator is lit up when the chromatograph enters the initial temperature holding status while it executes the temperature ramp process.

Rate: This indicator is lit up when the chromatograph enters the temperature ramp status while it executes the temperature ramp process.

Final Temp: This indicator is lit up when the chromatograph enters the oven temperature holding status while it executes the temperature ramp process.

Post Run: This indicator is lit up when the chromatograph enters the temperature drop status while it executes the temperature ramp process.

The operation panel of the gas chromatograph has 20 pressing keys.

Start: is used to start temperature control (when being pressed for the first time after the instrument is started) or signal processing or to start temperature programming (after the instrument enters the temperature control status);

Shut: is used to stop signal analysis or stop temperature programming under the temperature programming mode;

Time: is used for start or the stopwatch;

Ignite: is used to start the FID and FPD detector;

Mode/Type: is used to make the instrument enter the setting mode; the setting to be made will be highlighted in the setting mode;

↑: is used to scroll up in the screen;

↓: is used to scroll down in the screen;

Enter: is used to confirm parameter setting.

There are 12 composite numeral keys. The composite numeral keys are function keys under non-setting status, and are numeral keys under the setting status.

Notice: The instrument will automatically exit from the setting status, if the operation panel is not used for 5 minutes.

2 EXTERNAL EVENT CONTROL AND COMMUNICATION OUTPUT

The external event control of GC9310 is within the instrument. Every two (upper and lower) terminals are a group, respectively for external event 1, external event 2, external event 3 or external event 4 output.

3 POWER SWITCH

The power switch is used to turn on the instrument.

WARNING: DISCONNECT THE POWER SUPPLY PLUG FROM THE OUTLET, BEFORE YOU UNCOVER THE INSTRUMENT AND GO IN CONTACT WITH THE ELECTRICAL PARTS! THE ELECTRICAL CIRCUIT INSIDE THE INSTRUMENT MAY RETAIN HIGH VOLTAGE EVEN IF THE INSTRUMENT HAS BEEN TURNED OFF WITH THE POWER SWITCH!

4 Operation

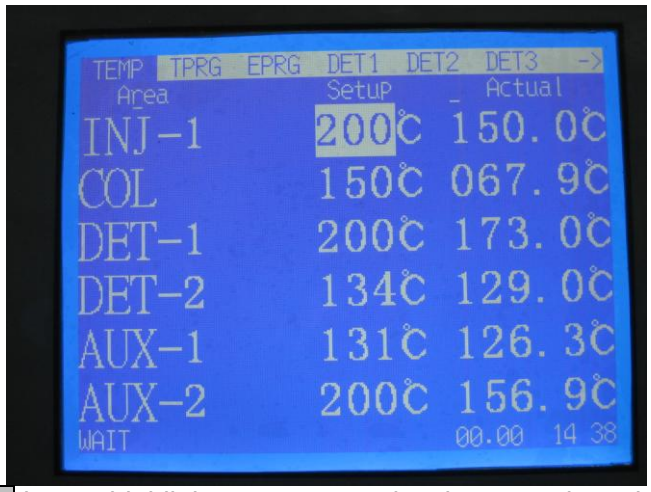
The gas chromatograph has 6 channels of temperature control algorithms, which provide independent temperature control settings and temperature control for 6 temperature control zones. The chromatographic column has eight levels of temperature programming. The rear door of the gas chromatograph's column box is automatically opened or closed with the temperature algorithms of the column box.

If the temperature control system fails, the temperature may be out of control. In this case, if the actually measured temperature in a temperature control zone exceeds the preset protection temperature, the microcomputer's controller will automatically turn off the power supply for heating, and show notification in the status indication screen with over-temperature alarm (See Troubleshooting for more details.) When the temperature inside the chromatographic column box exceeds 450°C, the fuse inside the box will break to disconnect the power supply for heating of the box to protect it. Replace the fuse before turning on the instrument again.

4.1 Start the machine and the screen shows

4.2 Temperature Setting

When the instrument has been turned on, press the Temp key to enter the temperature display status, as shown below:



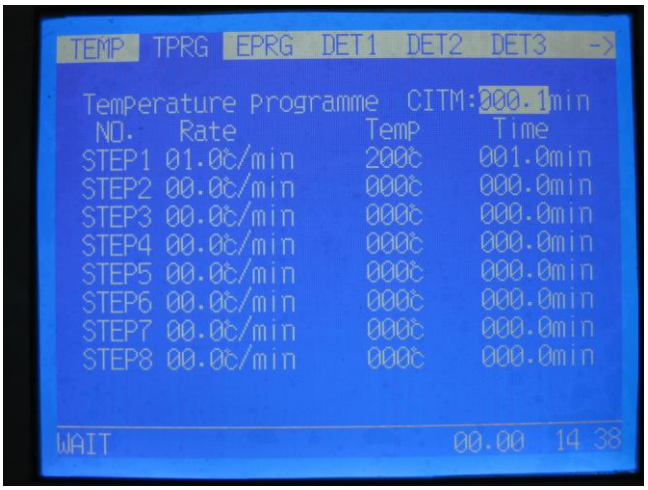
Press the Mode/Type key to highlight a parameter (setting status), and press the ⇓ and ⇑ keys to select another value and/or enter a value with the numeral keys. Press the Enter key to save the parameter.

Notice: When a parameter value is changed without pressing the Enter key, the value will not be saved and executed by the instrument. The same principle applies in the following descriptions.

Notice: The instrument will automatically exit from the parameter setting status, if no key has been pressed for 5 minutes in the setting status. The same principle applies in the following contents.

4.3 Programmed temperature setting

When the instrument has been turned on, press the Oven key to enter the temperature programming display status, as shown below,



Temperature programming

When the instrument has been turned on, press the Start key to enter the temperature control system. If temperature programming contents has been edited in the instrument (The temperature programming contents will be invalid if the level 1 temperature ramp speed is 0!), press the Start key for the instrument to start temperature programming control when the “Ready” indicator is lit up. The stopwatch (00.00) in the status screen will start timing.

When the “Init Temp” indicator is lit up, it indicates that the chromatograph enters the initial temperature holding status of the temperature programming process.

When the “Rate” indicator is lit up, it indicates that the chromatograph enters the temperature ramp status of the temperature programming process.

When the “Final Temp” indicator is lit up, it indicates that the chromatograph enters the temperature holding status of the temperature programming process.

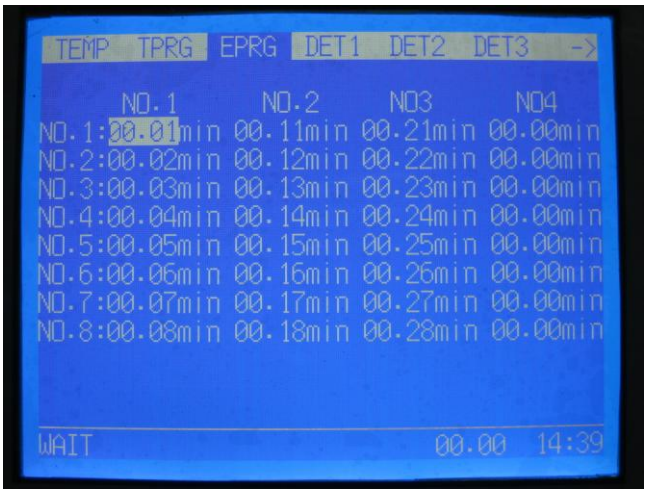
When the “Post Run” indicator is lit up, it indicates that the chromatograph enters the temperature dropping status of the temperature programming process.

After the instrument has completed a temperature programming cycle, the stopwatch in the status screen will stop timing and be zeroed, and the instrument automatically opens the rear door of the column box for the temperature inside the column box to quickly drop to the initial temperature and shorten the time needed for cooling. After the temperature inside the column box has dropped to the initial temperature (±1°C), the “Ready” indicator is lit up and the instrument is ready for the next temperature programming rise process. The process is repeated likewise.

When the instrument is executing temperature programming, under the temperature control system, press the “Stop” key to end the temperature programming and the stopwatch (00.00) on the status screen is stopped and zeroed, the instrument returns to the initial temperature.

4.4 Time Programming setting

When the instrument has been turned on, press the Event key to enter the time programming display status, as shown in figure below.



Notice: The setting of parameters is the same as the setting for temperature in 3.1.1.
Notice: The 4 channels of external control output are odd level output disconnection status, even level output closing status; and output disconnection status if no time programming is executed.
Notice: If the fourth time programming is entirely set to be 00, the output of the fourth external output event is the start signal of 0.6 second (outputted synchronously with starting analysis).

4.5 Detector setting

When the instrument has been turned on, press the Detect 1, Detect 2 or Detect 3 key for the instrument to view the respective display status of detector 1, detector 2 or detector 3 which have been installed.

FID display:

The screens for detectors of other types are similar to the screen. If a detector has not been installed or has not been recognized by the system, the system will show:

“No sample baseline” means that the baseline data recorded for a period of time after the Enter key is pressed when the cursor stays at No sample baseline; and press the End key to stop recording the no sample baseline. The maximum recording time of no sample baseline is 8 hours and the records are saved in the instrument. The saved no sample baseline will be automatically updated when the next “No sample baseline” command is run.

“Deduction active” and “Deduction inactive” is used to determine when the saved baseline participates in baseline deduction in the analysis status.

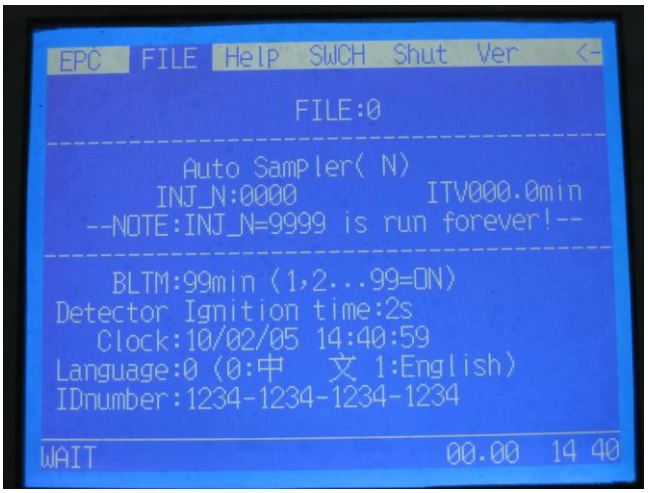
Notice: The setting of parameters is the same as the setting for temperature in 2.1.1.
Notice: The current sampling rate inside the instrument must be set to be 20times/s for use with the data processing software.
Notice: If the deduction is active, the baseline saved in the instrument must be correct; otherwise the output of the instrument is unknown status.
Notice: Working with the TCD detector must follow the sequence of “gas connection, temperature programming and then power supply”. That is, when the TCD detector is not connected with the carrier gas, do not set the bridge circuit current; otherwise, the tungsten wire will be damaged! When the instrument is turned off, follow the sequence of turning off the bridge circuit, temperature dropping, and turning off the carrier gas after the TCD temperature drops to the room temperature.
Notice: Do not use too high current for TCD operations. Too high current will accelerate the oxidization of the tungsten wire and shorten the life of the TCD detector.
Notice: To protect the TCD detector, the bridge current value is designed not to be saved after the instrument is turned off. That is, the TCD bridge current value is automatically set to be 0mA when the instrument is turned on again.
WARNING: IF THE CARRIER GAS CONTAINS OXYGEN, IT WILL SHORTEN THE LIFE OF THE TCD’S TUNGSTEN WIRE. THEREFORE, OXYGEN MUST BE REMOVED FROM THE CARRIER GAS!

4.6 Flow Rates Setting

When the instrument has been turned on, press the Flow key to enter the gas parameter display status, as shown in figure below.

Notice: The setting of parameters is the same as the setting for temperature in 2.1.1.
Notice: The parameter is valid only when the instrument has an EPC control module.

4.7 OPERATION FILES, SCREENSAVERS, AUTOMATIC SAMPLE FEEDING TIME AND CLOCK SETTING



Notice: The setting of parameters is the same as the setting for temperature in 2.1.1.
Notice: You must select “No automatic sample feeder” if the chromatograph has no automatic sample feeder.
Notice: Press the Delete key to select Yes or No.

The instrument is able to save 10 instrument operation parameter files. You can select a file from files 0-9 to be the current operation file of the instrument. If a new operation file has been selected, the instrument will conduct re-initialization. This will take several minutes.

The “Screensaver” is used to automatically turn off the backlight if no key is pressed for the preset time.

The “Clock” is the real-time clock built in the clock in the format of YY/MM/DD HH:MM:SS. The clock may be changed remotely with the workstation software.

Notice: The backlight will not be automatically turned off if the screensaver time is set to be 99 minutes.
Notice: The default screensaver time is 5 minutes after the instrument is turned off. The preset screensaver time will be activated only after any key is pressed.
Notice: The turning off of the backlight would lead to changes of 10-20uV to the FID baseline. Please se the screensaver time to be an appropriate value or 99 minutes to prevent the analysis from being affected.

“With automatic sample feeder” or “Without automatic sample feeder” indicates whether an automatic sample feeder has been installed or not.

“Sample feeding: 0006 times” indicates that the system will perform 6 times of sample feeding. If the value is 0, no automatic sample feeding will be performed; if the value is 9999, the instrument will perform unlimited times of automatic sample feeding until the feeding is manually stopped.

“Interval: 030.0 m” indicates the time interval when the system will perform automatic sample feeding. It includes automatic repeating of temperature programming (in the case of valid temperature programming parameters), external event time programming (in the case of valid time programming parameters) and remote starting of the workstation software for analysis. If the interval is 0 minute, no automatic sample feeding programming will be started.

Notice: When the instrument is in the “Ready Status” and either the sample feeding times or sample feeding interval is 0, the instrument will enter the “Automatic sampling time” status by pressing the Start key or starting analysis with the workstation software, and “INJ0001” will flash on the status bar. “INJ0001” indicates that the instrument has entered the automatic sample feeding status and is currently performing analysis with the 0001st sample.

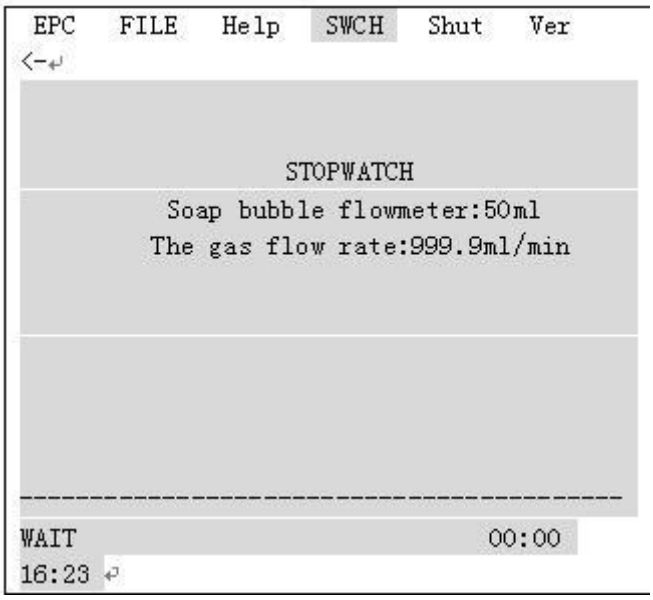
4.8 VIEW HELP INFORMATION

When the instrument has been turned on, press the Help key to enter the help display status, as shown in figure below.

Notice: No setting is provided in this screen.

4.9 USE STOPWATCH

When the instrument is on, press the ⇓ or ⇑ key to enter the stopwatch screen as shown in figure below.



The function is used to help you by automatically calculation of the gas flow rate being measured.

Press the Menu key to highlight the setting of soap bubble flow-meter reading: 10ml, and enter the value of the soap bubble flow-meter to be read from with the numeral keys and press the Enter ke0079 for confirmation. After that, press the Time key to start/stop the stopwatch, and then the instrument will automatically calculate the gas flow rate for you.

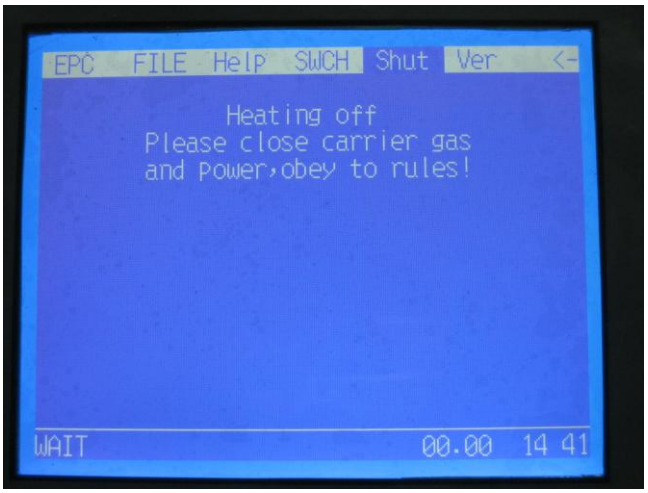
Notice: Pressing the Time key is only for starting or stopping the stopwatch, instead of entering the stopwatch screen.

4.10 START OR SHUT TEMPERATURE CONTROL SYSTEM OPERATION

When the instrument has been turned on, press the Start key to enter the temperature control system. Now, you can hear the sound of relay engagement inside the instrument, and the temperature control will start heating for each channel. When the sample feeder temperature reaches the preset temperature ±6°C, the column box temperature reaches the preset temperature ±1°C, and the detector temperature reaches the preset temperature ±6°C, the “Ready” indicator is lit up.

Notice: When the “Ready” indicator is lit up, if the temperature programming parameter file is valid for the current temperature control file, press the Start key again for the instrument to enter the temperature programming status.

When the instrument has been turned on, press the Shut key to enter the screen as shown below:



Press the Enter key to turn off temperature control. Now, you can hear the sound of relay releasing inside the instrument, and the rear door will be automatically opened for cooling.

4.11 VIEW VERSION

When the instrument has been turned on, press the Ver. key to enter the electrical part version display status The screen displays the versions of the electrical parts for use in future maintenance activities. No setting is provided in the screen.

4.12 FID IGNITION

FID ignition can be done, when the FID detector temperature control reaches the preset value (over than 100°C to avoid water accumulation in the detector) and the gas source has been connected.

FID ignition may be done in the detector screen or with the Ignite key on the operation panel, or directly with workstation software. The ignition time is automatically controlled with “Detector ignition time 5s” and no user intervention is required.

Notice: **To facilitate initiation, the hydrogen flow may be appropriately larger upon ignition. Reduce the hydrogen flow after the flame is table to avoid excessive baseline noise.**

Notice: **The electronic igniter is an optional part. If the instrument is not equipped with an electronic igniter, use a lighter or ignition gun for ignition.**

4.13 GAS FLOW CONTROL

The gas chromatograph's gas circuit control system uses manual stabilizing valve and needle valve for regulating gas flow. Please consult the manufacturer, if you want to control the flow by electronic means.
The carrier gas is stabilized with the stabilizing valve for the pressure to be around 0.294MPa (3kg/cm2), which has been set by the manufacturer and not to be set by the user! The carrier gas from the stabilizing valve will be of a constant flow.

Adjust the “carrier gas flow regulation valve A” (or carrier gas flow regulation valve A) to regulate the flow of carrier gas A (or carrier gas B).
“Pre-column pressure A” (or “Pre-column pressure A”) indicates the corresponding pre-column gas pressure.

The air is stabilized with the regulation valve for the pressure to be around 0.147Mp (1.5kg/cm2),

which has been set by the manufacturer and not to be set by the user! The air from the needle valve will be of a certain flow.

The hydrogen is stabilized with the regulation valve for the pressure to be around 0.98MPa (1kg/cm2), which has been set by the manufacturer and not to be set by the user! The hydrogen from the needle valve will be of a certain flow.

IV GC9310FID Operation Steps:

1. Connect to N_2
2. Install column in column box (packed column or capillary column)
3. Turn on N_2 to regulate the flow
4. Start the machine to set up temperature required by FID, column box and sampling
5. Till the temperature is constant, open air and hydrogen to set flow required and then ignite.
6. Adjust range of the amplifier and chromatography workstation. After the baseline becomes stable, conduct sampling analysis and record data.
7. When shut down, close hydrogen and air first; then close N_2 till the machine cools down.

V Apparatus Maintenance and Removal of Faults

5.1 Apparatus Maintenance

Correct maintenance of the apparatus can not only work normally but also can prolong the apparatus's lift span. Pay attention to the following when maintaining the apparatus:

a) The apparatus should work strictly under regulated conditions. The power supply should be well grounded.

b) Operate in strict line with the operation rules. Forbid the oil pollutant, organics and other matters entering the detector and pipeline to prevent the pipeline from being blocked or performances of the apparatus from deteriorating.

c) Forbid column temperature from exceeding temperature of stationary liquid allowed to be used in the stationary phase. Usually column temperature is lower than temperature of stationary liquid allowed to be used. When conducting high flexibility operation, column temperature selected should be lower.

d) Pressure of external air source input to GC9310 should be at 343000Pa (equivalent to 3.5kg/cm^2～5kg/cm^2), pressure of air input is at 294000Pa～588000Pa (equivalent to 3kg/cm^2～6kg/cm^2); pressure of hydrogen input should be at 196000Pa～343000Pa (equivalent to 2kg/cm^2～3.5kg/cm^2).

e) If N_2 is used as carrier gas, input till pressure at carrier gas entrance should be 343000Pa (equivalent to 3.5kgf/cm^2).

5.2 Methods to judge and eliminate faults of common chromatographic output signals are shown in table below.

Faults	Judgment	Inspection Method and Repair
1. No peak	1. Power supply of the amplifier is OFF 2. Ion cable is broken 3. No carrier gas flow 4. Micro-injector blocked 5. Silicone rubber of the sampler leaks 6. Connection of chromatography column can be released 7. No fire (FID) 8. FID polarized voltage not connected or bad contacted	1) Check amplifier and fuse 2) Check ion cable 3) Check flow path of the carrier gas, whether it is blocked or gas source in gas bottle is used up 4) Replace injector 5) Replace silicone rubber 6) Screw tight conductivity column 7) Ignite 8) Connect to polarized voltage or eliminate ill connected polarized voltage
2. Hold-up time is normal while flexibility is reduced	1) Detector has not high voltage (FID)	1) Check or install high voltage
3. Tailing Peak	1) Sampling temperature is too low 2) Sampling pipe polluted (sample or silicone rubber remained) 3) Temperature of chromatography column stove is too low 4) Sampling technology is too low 5) Selection of chromatography column is not appropriate (sample and column support or stationary fluid react)	1) Readjust temperature of sampler 2) Use solvent to clean sampler pipe 3) Increase temperature of chromatography column 4) Improve sampling technology to be fast to put in and take out the needle 5) Re-select appropriate chromatography column
4. Peak fronting	1) Column exceeding load, sample size too large 2) Sample clumped in the system	1) Reduce sample size 2) First increase column temperature, then select proper sampler, chromatography column and detector temperature
5. No separating peak	1) Column temperature too high 2) Column too short 3) Stationary fluid lost 4) Selection of stationary fluid or support is not correct 5) Flow speed of carrier gas too high	1) Reduce column temperature 2) Select longer chromatography column 3) Replace chromatography column or aged chromatography column 4) Select proper chromatography column 5) Reduce flow speed of carrier gas
6. Flat peak	1) Amplifier input saturated	1) Reduce sample quantity and flexibility of amplifier
7. Negative peak	1) Sample enters another column 2) Position of positive and negative switches are wrong	1) Sample enters proper column 2) Correct position of positive and negative switches

Faults	Judgment	Inspection Method and Repair
8. When operated at constant voltage, baseline fluctuation is irregular	1) Apparatus not well grounded 2) Column stationary fluid lost 3) Carrier gas leaks 4) Detector polluted 5) Carrier gas flow improperly selected 6) Hydrogen and air improperly selected (FID) 7) Amplifier not stable itself	1) Apparatus should be well grounded 2) Select proper stationary fluid; column should be sufficiently aged; don't increase column temperature to limit allowed by stationary fluid (especially for highly flexible detector) 3) Check for leakage 4) Clean the detector 5) Adjust current stabilizing valve of carrier gas, to adjust carrier gas flow improper, ensure total pressure of carrier gas bottle at 50kg/cm^2～150kg/cm^2 6) Adjust hydrogen and air flow properly 7) Check and repair amplifier
9. Record at peak returns to baseline suddenly and fire is distinguished (FID)	1) Sample quantity too large 2) Hydrogen or air flow too low 3) Flow rate of carrier gas too high 4) Flame jet polluted (or blocked) 5) Hydrogen used up	1) Reduce sample quantity 2) Readjust hydrogen and air flow speed 3) Select proper flow speed of carrier gas 4) Clean flame jet (jab flame jet) 5) Ensure the hydrogen source has enough hydrogen
10. Baseline not return to zero	1) Due to overly lost column (FID) 2) Detector polluted	1) Use chromatography column having less loss 2) Clean the detector
11. Certain short blur between equal intervals	1) Water condensed in hydrogen pipeline (water usually comes from hydrogen source) 2) Gas leaks 3) Flow path is blocked 4) Flame jumps	1) Remove water from pipeline and replace or activate drier in hydrogen filter 2) Check for leakage 3) Remove impurity in flow path. If there is impurity in chromatography column, improve column temperature properly 4) Adjust proper hydrogen and air flow
12. Baseline big noise	1) Chromatography column polluted or chromatography column loss too large 2) Carrier gas polluted 3) Flow speed of carrier gas too high 4) Carrier gas leaks 5) Ill grounding 6) Sampler polluted 7) Hydrogen flow speed too high or too low (FID) 8) Air flow speed too high or too low (FID)	1) Replace chromatography column 2) Replace or regenerate carrier gas filter 3) Readjust flow speed of carrier gas 4) Check for leakage 5) Ensure apparatus is well grounded 6) Clean sampling pipe in sampler and remove silicone rubber remaining 7) Readjust flow speed of hydrogen 8) Readjust flow speed of air

Faults	Judgment	Inspection Method and Repair
	1) Air or hydrogen polluted 2) Water condensed in FID 3) Detector cable ill contacted 4) Detector insulation reduced (Ionization detector) 5) Detector polarity or nozzle and bottom polluted	1) Replace hydrogen and air filter 2) Increase FID temperature to remove water 3) Replace or repair cable 4) Clean insulation terminal of the detector 5) Clean detector

VI WARRANTY

The manufacturer offers free maintenance (easily worn parts excluded) for a period of one year since the date of purchase if, during which, this product proves defective under normal handling.

Attached Table1　List of Attachments and Spare Parts

No.	Name and Specifications	Quantity	Unit	Remarks
1	User's Manual	1	Book	
2	Flow curve table	1	Piece	
3	Conducting wire (integration signal)	2	Pieces	
4	Sealing gasket (FID nozzle)	5	Pieces	
5	Sealing ring　6x1.9	30	Pieces	
6	Graphite gasket　Φ6	12	Pieces	
7	Graphite gasket　Φ3	12	Pieces	
8	Sealing liner pipe　Φ2xΦ0.5x20	15	Pieces	
9	Nut M8x1　Φ3.2	20	Pieces	
10	Nut M12x1　Φ6.2	2	Pieces	
11	Relief valve joint	3	Pieces	
12	Nut M8x1　Φ2.1	2	Pieces	
13	Polyethylene plastic pipe	30	M	
14	Solid wrench 6～24	1	Set	
15	Micro-sampler　0.5, 1, 10μl	Each 1	Piece	
16	Fuse pipe　5x20mm　5A, 1A, 10A	Each 3	Piece	
17	Sampling gasket　Φ10x5 (silicone rubber)	50	Pieces	
18	3-core sleeve power cable　15A 250V	1	Piece	

Attached Table2 List of Optional Parts

Name of Part	No.	Name and specifications of component	Quantity	Unit	Remarks
I. Capillary sampler:					
	1	Glass inner liner pipe	1	Piece	(Installed in the main machine)
	2	Nut M5x0.5	3	Pieces	
	3	Nut M12x1 Φ6.2	1	Piece	(Installed in the main machine)
	4	Glass tube Φ5x30	1	Piece	
	5	Glass tube Φ5x84	1	Piece	
	6	Capillary frame	1	Piece	(Installed in the main machine)
	7	Graphite gasket Φ6	10	Pieces	
	8	Soap film flowmeter	1	Piece	
	9	Stainless steel sleeve	5	Sets	
	10	Sealing ring 16x2.5	5	Pieces	
	11	Sampling gasket Φ7x5	20	Pieces	
	12	Capillary Graphite gasket 2.4x8 x4	20	Pieces	
	13	Graphite gasket 7.5x5.5 x5	5	Pieces	

Note: Optional parts can be configured as required by the user.

Attached Table 3 Table of Air Flow

Number of turns of knob	Current stabilizing valve of carrier gas		Hydrogen needle valve	Air needle valve	Self clean	Make-up
	N_2	H_2	H_2	AIR		
				0		
				0		
				0		
				2		
				7		
				20		
3				27.45	1	4.0
				47.0		7.5
				70.0		13
4	18		16.88	83.0	2.78	16.8
4.2	24.4		21.0	95.0		21
4.4	30.8		26.5	110.0		26.5
4.8	43.6		37.5	143.0		37.5
5	50.0		43.90	159.38	6.03	43.9
5.2	56.4		52.0	178.0		52.0
5.4	62.8		60.0	198.0		60.0
5.6	69.2		68.0	215.0		
5.8	75.6		78.0	233.0		
6	82.0		87.41	252.31		
6.2			98.0	274.0		
6.4			110.0	293.0		
6.6			120.0	315.0		
6.8			135.0	338.0		
7	142		145.19	358.15		
7.2			157.5	380.0		
7.4			172.0	405.0		
7.6			185.0	427.0		
7.8			200.0	450.0		
8	201		216.86	474.36		
8.2			230.0	500.0		
8.4			250.0	522.0		
8.6			265.0	550.0		
8.8				575.0		
9	260			600.0		