SHIMADZU

221-79103D
Jun. 2017

Gas Chromatograph

GC-2025

Instruction Manual

Read this manual thoroughly before you use the product.
Keep this manual for future reference.

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Introduction

Read this Instruction Manual thoroughly before using the product.

Thank you for purchasing this product. This manual describes the installation, operation, usage cautions, accessories and options for this product. Read this manual thoroughly before using the product and operate the product in accordance with the instructions in this manual.
Keep this manual for future reference.

■ IMPORTANT

- If the user or usage location changes, ensure that this Instruction Manual is always kept together with the product.
- If this manual or a product warning label is lost or damaged, immediately contact your Shimadzu representative to request a replacement.
- To ensure safe operation, read all Safety Instructions before using the product.
- To ensure safe operation, contact your Shimadzu representative if product installation, adjustment, or re-installation (after the product is moved) is required.

■ Notice

- Information in this manual is subject to change without notice and does not represent a commitment on the part of the vendor.
- Any errors or omissions which may have occurred in this manual despite the utmost care taken in its production will be corrected as soon as possible, although not necessarily immediately after detection.
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■ About the Instruction Manual

The GC-2025 Instruction Manual consists of the following two volumes:

Name	Available Form	Contents
OPERATION MANUAL	Printed document Part No. 221-79105	Describes the instrument operating procedures. The maintenance and inspection procedures required to keep the instrument in good condition are also explained.
INSTRUCTION MANUAL	• CD-ROM (attached to the instrument) Part No. 221-79101-91 • Printed document (for pay) Part No. 221-79103	Describes the instrument features and how to use these features. (This manual)

■ Indications Used in This Manual

Warnings, Cautions, and Notes are indicated using the following conventions:

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or possibly death.
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injury or equipment damage.
NOTE	Emphasizes additional information that is provided to ensure the proper use of this product.

The following symbols are used in this manual:

☞	Indicates the location of related reference information.
[ ]	Indicates text or expressions that appear on the screen, such as buttons, menu items, setting options, window titles and icons. Example: Click [OK].

Safety Instructions

Read the "Safety Instructions" thoroughly before using the product, and use the product correctly.
The instructions described in this section are critical to your safety. Be sure to observe these instructions.

■ Product Applications

The GC-2025 Gas Chromatograph is a gas chromatography system used to perform qualitative and quantitative analysis.
To ensure safe operation of this product, observe the following safety instructions.

1. Be sure to use the system only for analytical purposes.
2. Be sure to follow the procedures described in instruction manual and operation manual.
3. Be sure to observe all warnings and precautions.
4. DO NOT disassemble or modify this system without Shimadzu Corporation permission.
5. Be sure to contact your Shimadzu representative when GC system internal repairs are needed.
6. Contact your Shimadzu representative if product installation, adjustment, or re-installation is required.
7. Wear eye protection when carrying out maintenance or inspecting syringes, glass inserts, columns or detectors.

■ Installation Site

⚠ WARNING

FIRE

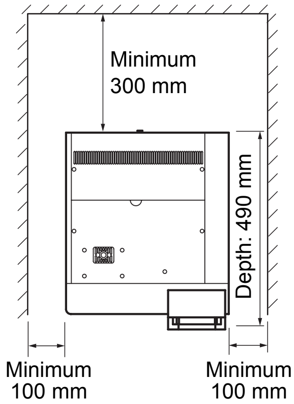
Hot air exhausts from the opening. Blowing hot air directly to flammable materials could cause combustion, resulting in burns or fire. DO NOT place any flammable material near the opening.

● Clearance on Sides and Rear Face

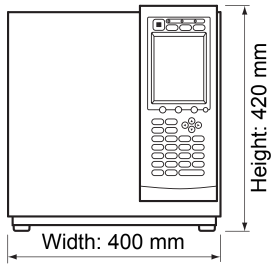
⚠ CAUTION

When the column oven is cooled, extremely hot air is exhausted from the rear face exhaust vent. As a result, when installing the instrument be sure to observe the following.

- DO NOT place flammable materials behind the instrument.
- Be sure to maintain a clearance of 300 mm or more between the rear cover and wall.
- Be sure to maintain a clearance of 100 mm or more on the left side of the instrument.
- To open/close the oven door and to turn on/off the power switch, be sure to maintain a clearance of 100 mm or more on the right side of the instrument.
- Be sure to maintain sufficient space in the rear for maintenance and inspection of the rear face of the instrument.



TOP VIEW



FRONT VIEW

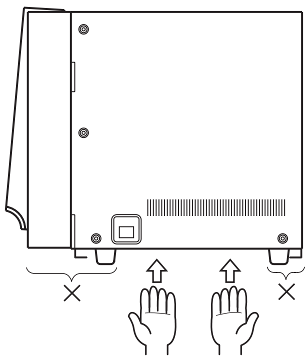
■ Installation

To ensure safe operation, contact your Shimadzu representative if product installation, adjustment, or re-installation (after the product is moved) is required.

⚠ CAUTION

To protect the instrument from damage, move it down carefully without giving any physical shock to it.

- The instrument weighs approximately 30 kg.
- Be sure that two people lift the GC, with each holding the middle section between the rubber feet. (See figures on right.)
- DO NOT hold the column oven door to lift the GC. Doing so may break the door.
- DO NOT hold the instrument’s rubber feet or font/rear edges when lifting the instrument. When the instrument is set down, you may pinch or injure your fingers.



☞ Refer to "1.3 Installation Site" for information about power supply and wiring.

■ Power Supply and Wiring

⚠ WARNING

HIGH VOLTAGE

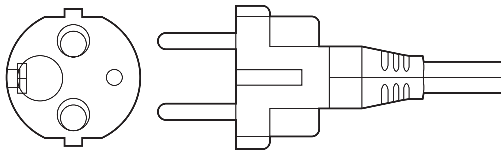
Before connecting the power cable to the distribution board, turn OFF the power to the distribution board.
The power supply must have a switch or a circuit breaker adapted to the power supply capacity.
The switch or circuit breaker must be installed within easy reach of the operation.
The switch or circuit breaker must be marked as the disconnecting device for the GC-2025.
Do not place heavy items on the power cable.

Power supply voltage:	115 VAC, 230VAC Frequency 50/60 Hz
Power supply capacity:	1700 VA (115 V model), 3100 VA (230 V model)

■ Connecting the Power Cable

- 230 V model (P/N 221-73900-44)

  The power cable uses a plug.



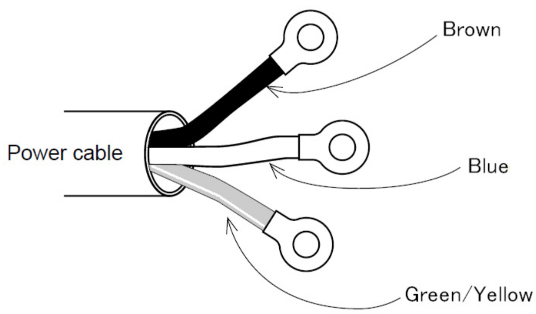
- 115 V model (P/N 221-73900-42) and 230 V model (P/N 221-73900-21)

⚠ CAUTION

Wire the power cable correctly as shown below to avoid damage to the unit or supply fuse.

The power cable is color-coded as follows.

Brown	Connected to HOT of AC line.
Blue	Connected to NEUTRAL of AC line.
Green/Yellow	Grounding (GROUND)



When an electric leak from the wiring or instrument is detected the earth leakage circuit breaker automatically shuts off the electricity in order to reduce the risk of electric shock or fire.

⚠ WARNING

To prevent accidents, such as fire, electric shock or burns, observe the following safety instructions.

General

- Keep flammable materials away from cables and plugs. Failure to observe this instruction could damage the cables or plugs, resulting in an electric shock or fire.
- Fasten or bundle the metallic gas piping for the gas chromatograph neatly and avoid routing them near sockets, power supply cables or power plugs. If a metallic pipe comes into contact with the power source, an explosion due to heating may occur, resulting in burns.

Power socket

- DO NOT exceed the current rating of the socket. Exceeding the rating could cause heating and lead to fire.
- DO NOT share the breaker or socket for the GC-2025 with any equipment such as a data processor. The flow of current higher than the rating could cause heating and lead to fire.
- DO NOT use the socket if it comes loose. When the power plug cannot be plugged securely, this could lead to an electric shock or fire from overheating due to contact failure.

Power plug

- Insert the plug all the way seated in the socket. Imperfect plugging could lead to an electric shock or fire from overheating due to contact failure.
- Plug and unplug the power plug straight.
- Plugging or unplugging in the slanting direction will deform the prongs, which could cause contact failure and lead to heating or fire.
- DO NOT plug or unplug the power plug with a wet hand. This could cause an electric shock.
- Be sure to hold the plug body when unplugging it. Unplugging it from the socket while pulling the cable may lead to fire from overheating due to insulation failure.
- DO NOT unplug the plug while the GC-2025 power switch is on. Doing so will cause electric sparking to occur and could cause the organic solvent to catch fire.
- Using a plug with chipped or broken cover could cause an electric shock or ignition.
- Deformed or damaged prongs could lead to an electric shock or heating due to improper plugging.
- If the power plug is extremely loose or insecure when it is inserted, an electric shock or ignition could occur.
- To prevent fire by tracking phenomenon, clean dust off the plug with a dry cloth at regular intervals (at least once every six months).

About the tracking phenomenon

If a plug is inserted into a socket for a long time, dust may adhere to the socket and the plug. If dust is exposed to moisture, sparking occurs repeatedly between the prongs of the power plug. This heat causes thermal deterioration of insulation in contact with the power socket, which allows the current to flow between the prongs of the power plug and eventually ignites.

Power supply cable

- DO NOT place heavy items, for example, an instrument, on the cable. Any wire inside the cable may be disconnected. Using the instrument with a disconnected wire could lead to heating or ignition.
- DO NOT bend, distort or pull the cable forcibly. Any wire inside the cable may be disconnected. Using the instrument with a disconnected wire could lead to heating or ignition.
- DO NOT secure the cable with a nail or staple. Nailing or stapling the cable will damage its sheath, which could lead to heating or ignition.
- DO NOT connect another cable for the purpose of extension. Wrapping vinyl tape around multiple cables could cause the wrapped portion to overheat and unwrap, resulting in an electric shock or fire from overheating.
- DO NOT bundle cables when using the instrument. This could cause heating, smoking or ignition.
- DO NOT use an extension cable or power strip. Doing so could lead to fire from overheating.
- If the cable is too hot to touch, the flowing current is higher than the current rating. The power plug, power supply cable or power socket could break, resulting in heating or ignition.
- If the power is turned on and off as you move the power supply cable, any wire inside the cable might be disconnected.
  Using the instrument with a disconnected wire could lead to heating or ignition.

■ Action to Take If a Problem Is Found

If any of the following problems is found, immediately turn off the power switch of the gas chromatograph and unplug the power plug from the socket.
For the details about the remedy or solution, consult your supervisor in charge of the instrument or contact your Shimadzu representative.

- Abnormal smell or smoking is issued from the power plug.
- The power plug is deformed due to overheating.
- The prongs of the power plug are darkened or scorched.
- The prongs of the power plug are bent.
- The power plug is inserted loosely and becomes easily unplugged.
- Abnormal smell or smoking is issued from the power supply cable.
- The power supply cable or power plug is heated and too hot to touch.
- The instrument is turned on or off when you touch or fold the power supply cable.
- The power supply cable sheath is worn or cracked.

■ Inspection of Earth Leakage Circuit Breaker

When an electric leak from the wiring or instrument is detected the earth leakage circuit breaker automatically shuts off the electricity in order to reduce the risk of electric shock or fire.
Check the operation of the earth leakage circuit breaker at regular intervals. If the earth leakage circuit breaker does not operate correctly, this could increase the risk of electric shock or fire.

● Inspection procedure

1. Ensure that the power of the gas chromatograph is off.
2. Unplug the power plug of the gas chromatograph from the socket.
3. Press the test button on the earth leakage circuit breaker.
4. Check that the breaker activates and shuts the power off.
5. Reset the breaker.
6. Plug the power plug of the gas chromatograph into the socket.

NOTE

To keep the instrument in good working condition and to maintain accurate temperature control, a suitable power supply must be used.

If either voltage or current of the power source is not suitable, the instrument may not work properly, such as the column oven temperature cannot be raised as required.
The gas chromatograph is equipped with several high-capacity heaters and runs an analysis while controlling the temperature of the column oven, injection port, and detector at an optimal level.

■ Gas Usage Precautions

The following information explains important points concerning the handling of high-pressure gas. Be sure to read all information carefully and follow all instructions.
For information on gas types, purity, and supply pressures, refer to "1.3.11 Gas type and supply purity".

● When handling high-pressure gas cylinders:

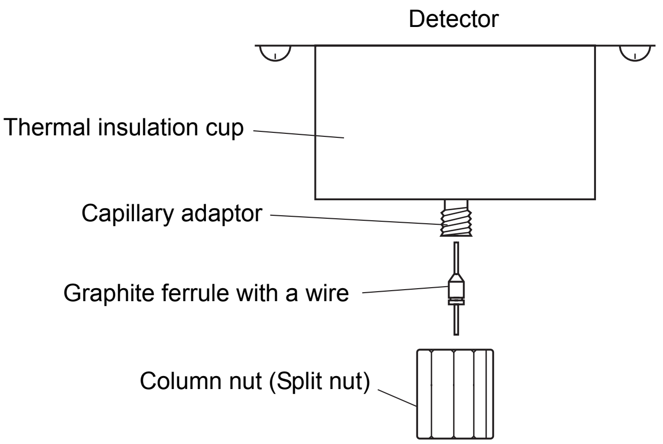
Be sure to observe all laws and regulations in your country.

- Be sure to install gas cylinders in a well-ventilated outdoor area, away from direct sunlight. Use tubing to bring the gases to the lab.
- DO NOT allow the temperature of the gas cylinders to exceed 40 °C. Keep all flammable items at least 2 m away from gas cylinders.
- Be sure the work area is well ventilated when using high-pressure gases.
- Perform a daily leak check before starting operation using soapy water, etc.
- When using flammable gases (e.g. hydrogen), DO NOT smoke or use fire within 5 m of the instrument.
- Locate fire extinguishers nearby for use in case of accident.
- Be sure to secure gas cylinders in place with cylinder clamps or ropes to prevent them from falling over.
- Be sure to use only oil-free reducing valves.
- DO NOT use pipes that have oil on the inner surface.
- Be sure to close the main valve of a gas cylinder immediately after using that gas.
- The "Hydrogen Gas Handling Instructions" label (part No. 221-44025-01) can be supplied free of charge.

⚠ WARNING

WHEN USING HYDROGEN GAS

Risk of explosion.
If hydrogen accumulates in the column oven, it could cause an explosion.
DO NOT leave the hydrogen pressure control valve open when the system is not in use. When not in use, turn the valve OFF and cover the column mounting port with a sealing plug.

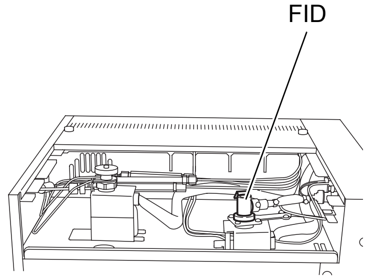


Capping the column mounting port of detectors

⚠ WARNING

WHEN USING HYDROGEN GAS

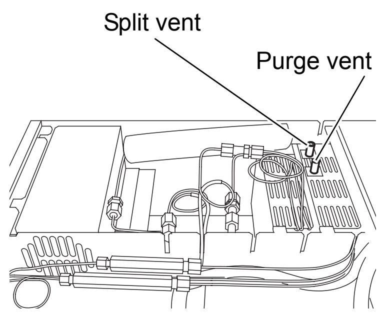
- Be sure to keep the supply pressure to the flow controller at 500 kPa maximum.
  With the default hydrogen flow rate (40.0 ml/min), 300 kPa is sufficient for the supply pressure to APC.
- If the flow controller should malfunction while operating at a pressure in excess of 500 kPa, a large amount of gas will overflow and flames will leak out from the FID detector, which may lead to a serious fire.
- Be sure to ventilate the work area so that any leaking hydrogen is vented out of the room and cannot accumulate. Hydrogen gas is lighter than air and if it leaks, it can accumulate near the ceiling.



WHEN USING HYDROGEN AS A CARRIER GAS

If a large amount of hydrogen is exhausted in an inadequately ventilated room, it could lead to an explosion.

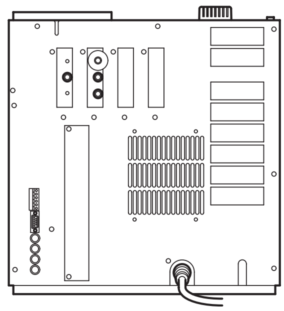
- Be sure to discharge exhaust from the split vent and the purge vent to open air or ventilation equipment such as a draft chamber in order to prevent the accumulation of hydrogen gas in the room.
- Install the instrument inside a draft chamber or in a room where a sufficient gas exhaust system is provided.
- Be sure to install a hydrogen gas sensor in the work area to measure hydrogen gas concentration and keep the hydrogen concentration low.



⚠ CAUTION

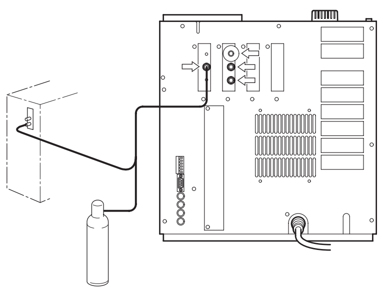
GAS PIPING

DO NOT set a gas inlet pressure that exceeds the allowable maximum pressure range described in the instrument's manual.
If a higher pressure than the specification is applied, the pressure regulator valve, etc. may be damaged, causing gas leak.



GAS SUPPLY PRESSURE

- If a higher pressure than the specification is applied, the related device may be damaged.
- Be sure to verify the pressure specification of each device when using the GC and sharing a single gas source with other devices.
- Be sure to specify a supply pressure that meets all specifications to provide adequate supply of gas to all connected devices.



■ Operation

The contents of files of the gas chromatograph may be lost as the result of an unforeseen accident. Always create a backup to protect critical data from such accidents.

■ Inspection and Maintenance

⚠WARNING

HIGH TEMPERATURE

RISK OF BURN - Be sure to confirm that the temperatures of all components (column oven, injection ports or detectors) are 50°C or less prior to starting maintenance.

NOTE

SEIZE UP

Be sure the temperatures of all related components (column oven, injection ports or detectors) have cooled to 50°C or less before installing or detaching a column.

DO NOT turn the column nut when it is hot.

If the nut is forcibly turned, it could seize and damage the threads.

⚠CAUTION

If you set a high temperature for the column oven immediately after installation, an odor may be issued. This is the odor that is given off from the adhesive (material: corn starch, etc.) at the insulating material used for the oven. The odor will disperse in several hours, but if necessary, ventilate the work area well.

■ In an Emergency

If you find that the GC-2025 has malfunctioned, immediately perform an emergency stop.
Also, prior to starting the system again, inspect the instrument thoroughly and, if required, contact your Shimadzu representative.

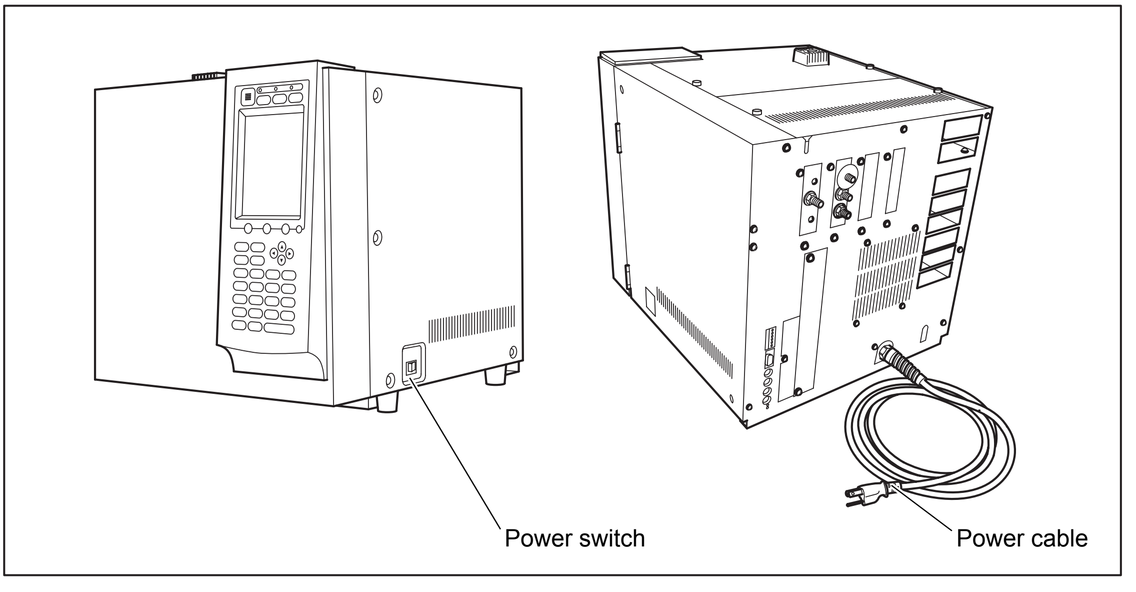
● Emergency Stop Procedure

1. Turn OFF power to the GC-2025.

2. Turn OFF power on all the peripheral units.

3. Close the main valves for carrier gas, hydrogen gas, air, and makeup gas.

4. Unplug the power supply cable from the socket to shut the power off.
(If the GC-2025 unit's power cable is connected to a power distribution board, turn OFF the board's switch.)



■ During a Power Outage

Take the following measures in the event of a power outage.

1. Immediately turn OFF the supply of hydrogen gas.
2. Switch OFF power to the GC.
3. Open all windows and doors of the room to thoroughly ventilate it.
4. After the power is reinstated, use the standard procedure to start the GC.

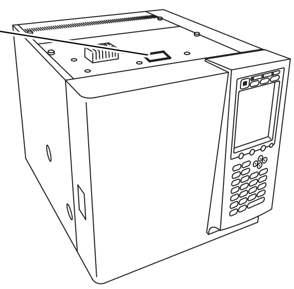
■ System Warning Labels

The following labels are attached to the GC system. Failure to observe the following safety precautions can result in death or serious injury by fire, electric shock, or explosion.

WARNING

HOT SURFACE

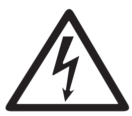
Risk of burn.
DO NOT touch injection port, detector, or INJ/DET cover.



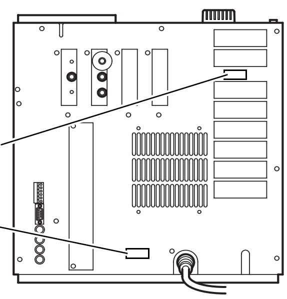
FIRE

Avoid blowing hot air directly to flammable materials.
Hot air blow from the opening could cause ignition within flammable materials resulting in a fire or burns.

HIGH VOLTAGE



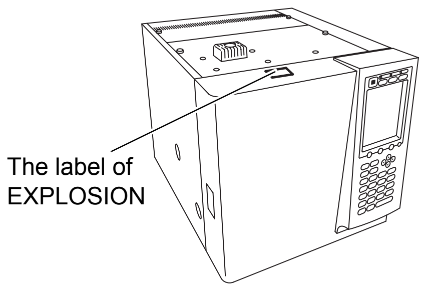
Risk of electric shock.
DO NOT open rear cover. Only qualified service personnel should open this cover.



⚠ WARNING

EXPLOSION

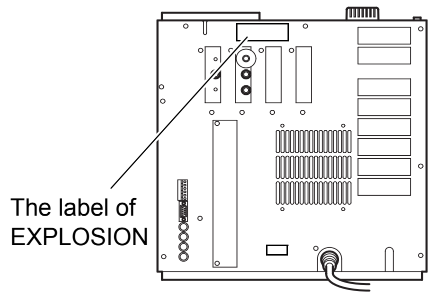
Risk of explosion.
If hydrogen accumulates in column oven, it could cause an explosion.
DO NOT leave hydrogen pressure control valve open when system is not in use. Turn this valve OFF, and cover the column mounting port with a sealing plug.

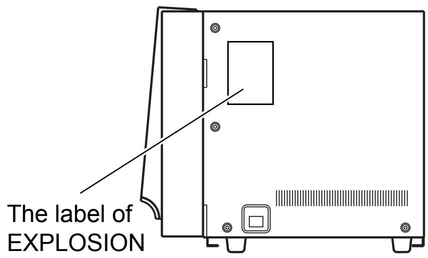


EXPLOSION

Risk of explosion.
If a large amount of hydrogen leaks into an inadequately-ventilated work area, it could cause an explosion.

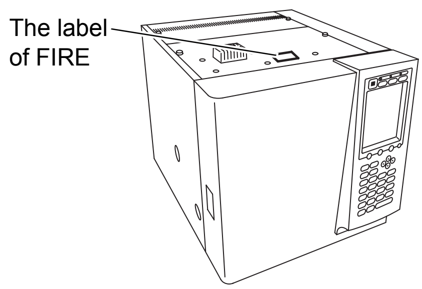
- Connect hydrogen gas piping to the correct supply port.
  If the hydrogen line is accidentally connected to the air inlet, a large amount of hydrogen will be exhausted into the work area.
- Prior to using the GC, be sure to inspect and confirm that no gas is leaking in the hydrogen gas flow lines, from gas cylinders to the GC, and from the end of the exhausting tube.
- Be sure to close the main valve of the hydrogen gas cylinder or generator when instrument is not in use, and confirm that no gas is leaking in the work area.
- To prevent a hydrogen explosion from an accidental hydrogen leak, be sure the instrument's location is well ventilated and avoid using fire.
- When shutting down the GC, (1) immediately close the main valve of the hydrogen gas cylinder, (2) turn OFF instrument power, (3) and perform the shutdown procedures for other units.





FIRE

Danger of fire. DO NOT put anything on top cover.



Warranty

Shimadzu provides the following warranty for this product.

1. Period: Please contact your Shimadzu representative for information about the period of this warranty.

2. Description: If a product/part failure occurs for reasons attributable to Shimadzu during the warranty period, Shimadzu will repair or replace the product/part free of charge. However, in the case of products which are usually available on the market only for a short time, such as personal computers and their peripherals/parts, Shimadzu may not be able to provide identical replacement products.

3. Limitation of Liability:
   (1) In no event will Shimadzu be liable for any lost revenue, profit or data, or for special, indirect, consequential, incidental or punitive damages, however caused regardless of the theory of liability, arising out of or related to the use of or inability to use the product, even if Shimadzu has been advised of the possibility of such damage.
   (2) In no event will Shimadzu's liability to you, whether in contract, tort (including negligence), or otherwise, exceed the amount you paid for the product.

4. Exceptions: Failures caused by the following are excluded from the warranty, even if they occur during the warranty period.
   1) Improper product handling
   2) Repairs or modifications performed by parties other than Shimadzu or Shimadzu designated companies
   3) Product use in combination with hardware or software other than that designated by Shimadzu
   4) Computer viruses leading to device failures and damage to data and software, including the product's basic software
   5) Power failures, including power outages and sudden voltage drops, leading to device failures and damage to data and software, including the product's basic software
   6) Turning OFF the product without following the proper shutdown procedure leading to device failures and damage to data and software, including the product's basic software
   7) Reasons unrelated to the product itself
   8) Product use in harsh environments, such as those subject to high temperatures or humidity levels, corrosive gases, or strong vibrations
   9) Fires, earthquakes, or any other act of nature, contamination by radioactive or hazardous substances, or any other force majeure event, including wars, riots, and crimes
   10) Product movement or transportation after installation
   11) Consumable items
   Note: Recording media such as floppy disks and CD-ROMs are considered consumable items.

* If there is a document such as a warranty provided with the product, or there is a separate contract agreed upon that includes warranty conditions, the provisions of those documents shall apply.

After-Sales Service and Availability of Replacement Parts

After-Sales Service

If any problem occurs with this product, perform an inspection and take appropriate corrective action as described in this manual's troubleshooting section. If the problem persists, or the symptoms are not covered in the troubleshooting section, contact your Shimadzu representative.

Replacement Parts Availability

Replacement parts for this product will be available for a period of seven (7) years after the product is discontinued. Thereafter, such parts may cease to be available. Note, however, that the availability of units or parts not manufactured by Shimadzu shall be determined by the relevant manufacturers.
If Shimadzu receives notice of the discontinuation of units or parts, the necessary quantity for the above period is immediately calculated and secured. However, such units or parts may cease to be available within seven years after the discontinuation of the product, depending on individual manufacturer conditions and on changes in the quantity required.

Maintenance, Inspections, and Adjustment

In order to maintain long-term instrument performance and obtain accurate measurement data, periodic inspections is necessary.

- For details on inspections, see "18 Maintenance and Inspection".
- Contact your Shimadzu representative regarding periodic inspections.
- The replacement frequencies for periodic replacement parts are merely for guidance.
  The replacement frequency may be shorter depending on the environment and frequency of usage.

Disposal Precautions

Dispose of the GC unit using a qualified industrial waste management company, in compliance with the applicable laws in the country where it is used.

Electromagnetic Compatibility

NOTE

Descriptions of this section are only applied to the following models:

221-73900-44 GC-2025AF

This instrument complies with European standard EN61326-1: 2006, class A for electromagnetic interference (emission) and minimum requirement for electromagnetic susceptibility (immunity).

● Electromagnetic Interference (Emission)

This instrument is a class A product, designed not for use in residential environment.

NOTE

When an electromagnetic disturbance occurs to the instruments being used close to this product, make an appropriate distance between the instruments and this product in order to eliminate the disturbance.

● Electromagnetic Susceptibility (Immunity)

Compliance to the standard does not ensure that the instrument can work with any level of electromagnetic interference stronger than the level tested. Interference greater than the value specified in the standard may cause malfunction of the instrument.

NOTE

Take the following measures before installing and/or using the instrument especially in an industrial location:

- Install the instrument away from the device emitting strong electromagnetic noise.
- Supply power from a different power source from the one emitting strong electromagnetic noise.
- Take the following measures to prevent the occurrence of static electricity.
  - Before touching the instrument, discharge the static electricity charged in operator's body by touching metallic structure connected to the ground.
  - Do not touch the terminals and connectors unconnected with cables, while the instrument is operating.

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1.1 System Features

The GC-2025 is a state-of-the-art gas chromatograph which embraces the concepts of natural resource and energy conservation by reducing power consumption during analysis by 25 % or more, while meeting the customers' needs for high performance, advanced functionality, and high reliability.
These concepts are realized through the following features, including the reduced heat capacity of the column oven.

1.1.1 Performance

- Power consumption is reduced by approximately 30 %* for energy conservation.
  Using a design with optimized heat dissipation from the outer walls of the oven, low-power consumption is achieved.
  * Based on a comparison with data measured on the Shimadzu GC-2010 Plus AF under model analysis conditions

1.1.2 Compact design

- Width: 400 mm (approx. 100 mm shorter compared with the GC-2010 or GC-2010 Plus)
- Height: 420 mm (approx. 270 mm shorter compared with the GC-2014)
- Depth: 490 mm (approx. 120 mm shorter compared with the GC-2014)

1.1.3 Operability

- The inlet position is approx. 100 mm lower than that of the GC-2014.
  - Installation and removal of Auto-injector, AOC-20i, as well as manual injection with a microsyringe can be carried out easily.

- Compact design with a column oven of the size that accommodates a variety of capillary columns
  - Front opening: 250 mm × 250 mm
  - Depth: 90 mm

- The common user interface as the GC-2010/-2010 Plus and GC-2014 is adopted.
  - 240 × 320 dots, 16-line large LCD
  - Japanese/English interface selectable
  - Intelligent self-diagnosis function

1.1.4 Compatibility

The same injection port (SPL) and detector (FID) as the GC-2010 are installed.
The consumables are standardized with the existing GC models.

1.1.5 Heating energy generation

The following graph shows the heating values generated by the unit.

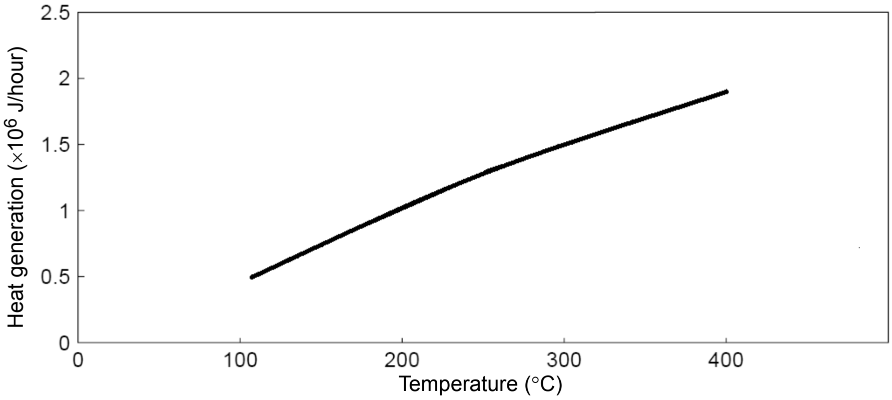


Fig. 1.1.1

1.2 Specifications

1.2.1 Column oven

Dimensions (mm)	: 250 (W) × 250 (H) × 90 (D) (excluding projections)
Volume (L)	: 5.6
Range of temperature	: Room temperature +10 °C to 400 °C -50 °C to 400 °C (When liquid carbon dioxide gas is used.)
Accuracy of temperature	: ±1 % (K) (Calibrated at 0.01 °C)
Deviation of temperature	: Within 3 °C (on a 180 mm diameter column holder 60 mm away from the back wall of the oven)
Temperature coefficient	: 0.01 °C/ °C
Range of linear temperature increase:	(in power voltage 115 VAC) 30 °C/min up to 150 °C 20 °C/min up to 250 °C 10 °C/min up to 380 °C 7 °C/min up to 400 °C (in power voltage 230 VAC) 70 °C/min up to 200 °C 50 °C/min up to 350 °C 35 °C/min up to 400 °C
Cooling speed	: Approximately 6 minutes cooling from 300 °C to 50 °C. (Ambient temperature : 22 °C)
Overheat protection	: Programmable up to 400 °C (A fixed circuit provides protection at 500 °C)

1.2.2 Temperature program

Program ramps	: 20 ramps in total (Heating and cooling available)
Setting	: 0.1 °C increments
Program setting	: -250 to 250 °C/min, 0.01 °C/min increments
Total time of total program	: Up to 9999.99 minutes

1.2.3 Injection port

Overheat protection	: Programmable up to 420 °C
Injection unit	: Split/Splitless injection
Range of temperature	: Up to 400 °C
Temperature setting	: 0.1 °C increments

1.2.4 Detector

Overheat protection	: Programmable up to 420 °C
Time constant	: 4 ms to 2 s selectable

○ Hydrogen flame ionization detector (FID)

Range of temperature	: Up to 400 °C, 0.1 °C increments
Minimum detection	: 2 pgC/s
Dynamic range	: 10^7
Jet material	: Fused quartz

1.2.5 Carrier gas flow control unit

○ Split/splitless mode

Range	: 0 to 970 kPa (The maximum pressure limit is the primary pressure minus 10 kPa.) 0.1 kPa increments
Program ramps	: 7 ramps possible
Program rate	: -400 to 400 kPa/min, 0.01 kPa/min increments
Split rate setting	: 0 to 9999.9, 0.1 increments

1.2.6 Detector gas flow controller

Range	: 0 ~ 1200 ml/min (Air), 0.1 ml/min increments 0 ~ 100 ml/min (H_2) 0 ~ 100 ml/min (Makeup He)
Program ramps	: 7 ramps possible
Program rate	: -400 to 400 ml/min/min, 0.01 ml/min/min increments

1.2.7 Display

Back-light LCD 240 × 320 dots, 16 lines
The display can be switched between Japanese and English.

1.2.8 Dimensions, mass and power supply

Dimensions (mm)	: 400 (W) × 420 (H) × 490 (D) mm
Mass	: 30 kg
Power supply	: 115 VAC, 1700 VA, 50/60 Hz 230 VAC, 3100 VA, 50/60 Hz

1.3 Installation Site

■ Installation location requirements

Consider the following points to ensure safe and appropriate unit operation when selecting the installation site.

1.3.1 Ambient temperature and humidity, and altitude

In order to maintain optimal performance, use the unit in the following indoor environment. This unit can be operated in the following operating temperature (humidity) range.

Temperature range:	18 °C to 28 °C
Relative humidity range:	50 % to 60 % (Avoid use under conditions where condensation forms)
Operating temperature range:	5 °C to 40 °C
Operating humidity range:	5 % to 90 % (Avoid use under conditions where condensation forms)
Altitude:	Below 2000 m

1.3.2 Installation location

Install the unit on a firm, stable and flat base.

1.3.3 Corrosive gas and dust

Avoid exposure to corrosive gas and excessive dust to prolong the service life and maintain optimal unit performance.

1.3.4 Electro-magnetic fields and power supply noise

This unit should not be used near strong electro-magnetic fields. The power supply must have little or no noise. These items can cause instrument problems.
Do not use a cell phone near a detector.

1.3.5 Other precautions

For optimal performance, avoid the following conditions during installation:
(1) Fluctuating ambient temperature.
(2) Temperature changes from heating or air conditioning.
(3) Direct sunlight.
(4) Vibrations.
(5) Spilling of liquid on the unit and personal computer.
(6) If analyzing hazardous substances, exhaust the gas expelled from the unit outdoors.

■ **Installation clearances**

> **⚠ WARNING**
>
> **HOT AIR EXHAUST**
>
> Hot air could ignite the flammable materials.
> Keep any flammable material away from the opening of the hot air exhaust.

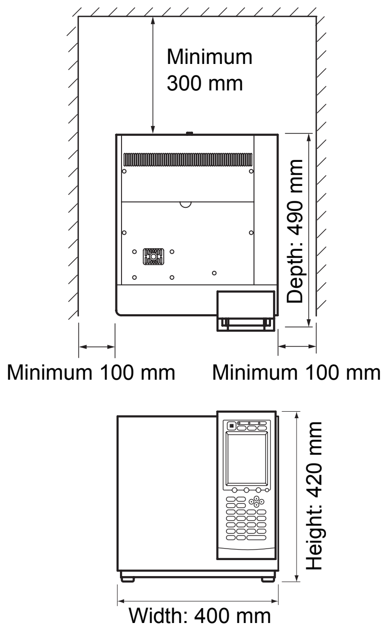


Fig. 1.3.1

1.3.6 Rear clearance

Hot air is vented at the back of the unit when the column oven cools. Consider the following during installation:

- Do not place any flammable materials behind the unit.
- Allow a clearance of 30 cm or more between the back cover and the wall.(*)
- Reserve extra space for maintenance and inspection behind the unit.

(∗) When the optional exhaust duct (221-73965-41) is used, the clearance from the wall can be a minimum of 25 cm.

1.3.7 Side clearance

Allow a clearance of 10 cm or more on the left side. To open/close the oven door and to turn on/off the power switch, be sure to maintain a clearance of 10 cm or more on the right side. The vent slits on the left side is important for properly cooling down the outer wall of the column oven.

■ Power supply and wiring

⚠ WARNING

HIGH VOLTAGE

Before connecting the power cable to the distribution board, turn OFF the power to the distribution board.
The power supply must have a switch or a circuit breaker adapted to the power supply capacity.
The switch or circuit breaker must be installed within easy reach of the operation.
The switch or circuit breaker must be marked as the disconnecting device for the GC-2025.
Do not place heavy items on the power cable.

Before connecting the power supply, verify the following items.

1.3.8 Power supply voltage

Use a power source with the following specifications to maintain optimal unit performance.

Commended power voltage:	115 VAC ± 5 % 230 VAC ± 5 % Frequency 50/60 Hz
Operating power voltage:	115 VAC ± 10 % 230 VAC ± 10 % Frequency 50/60 Hz
Transient overvoltage:	Installation Category II (IEC)
Pollution degree:	2

1.3.9 Power supply capacity

The power supply capacity is shown below.
Connect the power source to a terminal with sufficient capacity.

Standard model:	1700 VA (115 V model)/3100 VA (230 V model)
Short-circuit current rating:	50 A (115 V model)/35 A (230 V model)

NOTE
Performance of the unit may be affected if the power supply voltage fluctuates or the capacity is insufficient.

1.3.10 Connecting the power cable

NOTE
The power cable of the 230 V model uses a plug.

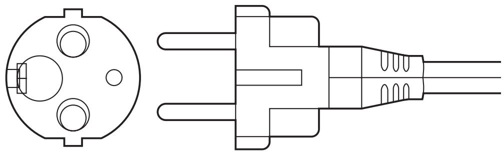
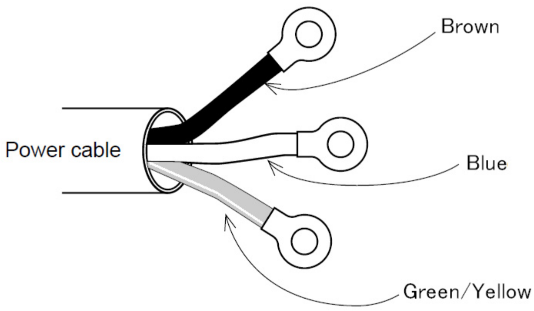


Fig. 1.3.2 Plug

> **CAUTION**
>
> Wire the power cable correctly as shown below to avoid damage to the unit or supply fuse.



The power cable is color-coded as follows.

Brown	Connected to HOT of AC line.
Blue	Connected to NEUTRAL of AC line.
Green/Yellow	Grounding (GROUND)

Fig. 1.3.3 Power cable

■ Gas supply plumbing

The following gases and associated purity valves are required to maintain optimal performance of the unit.

1.3.11 Gas type and supply purity

Carrier gas

Helium purity:	99.999 % or more
Nitrogen purity:	99.999 % or more

Makeup gas

Nitrogen purity:	99.999 % or more
Helium purity:	99.999 % or more

Detector gas

Hydrogen purity:	99.999 % or more
Air	Dry air cylinder (including total hydrocarbons of 1 ppm or less)

NOTE

If the instrument has ever used the gas that does not satisfy the purity described above, the detector, tubing or flow controller may be contaminated with impurities contained in the gas so that the instrument may not satisfy the minimum detection specification even if a high-purity gas is filled.
Gases with a purity of 99.995 %, dry air excluding organic substances, or air compressed using an oilless compressor and then dehumidified can be used when high sensitivity analysis is not necessary.

Gas supply pressures

Carrier gas:	300 - 980 kPa
Makeup gas:	300 - 980 kPa
Hydrogen:	300 - 500 kPa
Air:	300 - 500 kPa

The relationship of kPa and bar is as follows

100 kPa = 1 bar

Convert units between kPa and kgf/cm^2 as follows.

$1\ kPa = 1.0^2 \times 10^{-2}\ kgf/cm^2$

$1\ kgf/cm^2 = 98.1\ kPa$

Convert the units between kPa and psi as follows.

$1\ kPa = 1.45 \times 10^{-1}\ psi$

1 psi = 6.89 kPa

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2.1 Shipment Verification

This unit consists of the following parts. Verify that all items are present.

1. GC-2025 main body
2. Operation manual (Part Number 221-79104)
3. Instruction manual CD-ROM (Part Number 221-79101-91)
4. Standard accessories

Type	Description	Part No.	Q'ty
Tools	Wrench 6 × 8	086-03003	2
	Wrench 10 × 12	086-03011	2
	Wrench for glass insert nut	221-46977	1
Parts	Branch tube	221-72658-91	1
	Injection port column nut	221-16325-01	1
	Column nut	221-32705	1
	Ferrule adjuster (for SPL) (SPL column insertion jig)	221-41532-91	1
	Ferrule adjuster (for FID) (SPL column insertion jig)	221-41532-92	1
	Column hanger *	221-73796	1
	Injection port cover **	221-43597-01	1
	Cable tie (red)***	072-60606-01	2
	Chromatopac signal cable (115 V/230 V)	221-47251-41/-43	1
	G-type blank nut (with 2 pcs)	221-35566-92	1
Consumables	Silicon rubber septum (with 20 pcs)	201-35584	1
	Glass wool stuffing (with 2 g)	221-48600	1
	Graphite ferrule 0.5, for capillary (with 10 pcs)	221-32126-05	1
	Aluminum gaskets (with 100 pcs)	201-35183	1
	Glass insert, for split	221-41444	1
	Glass insert, for splitless	221-48335-01	1
	Fluoride rubber O-ring, for glass insert (with 5 pcs)	036-11203-84	1

* The column hanger is inserted into the support slots in the oven interior.
** Attach the injection port cover to INJ/DET cover in case of manual injection. (Refer to "3 Component Description".)
*** Attach the cable ties to the hydrogen gas line for making a distinction from other gas lines.

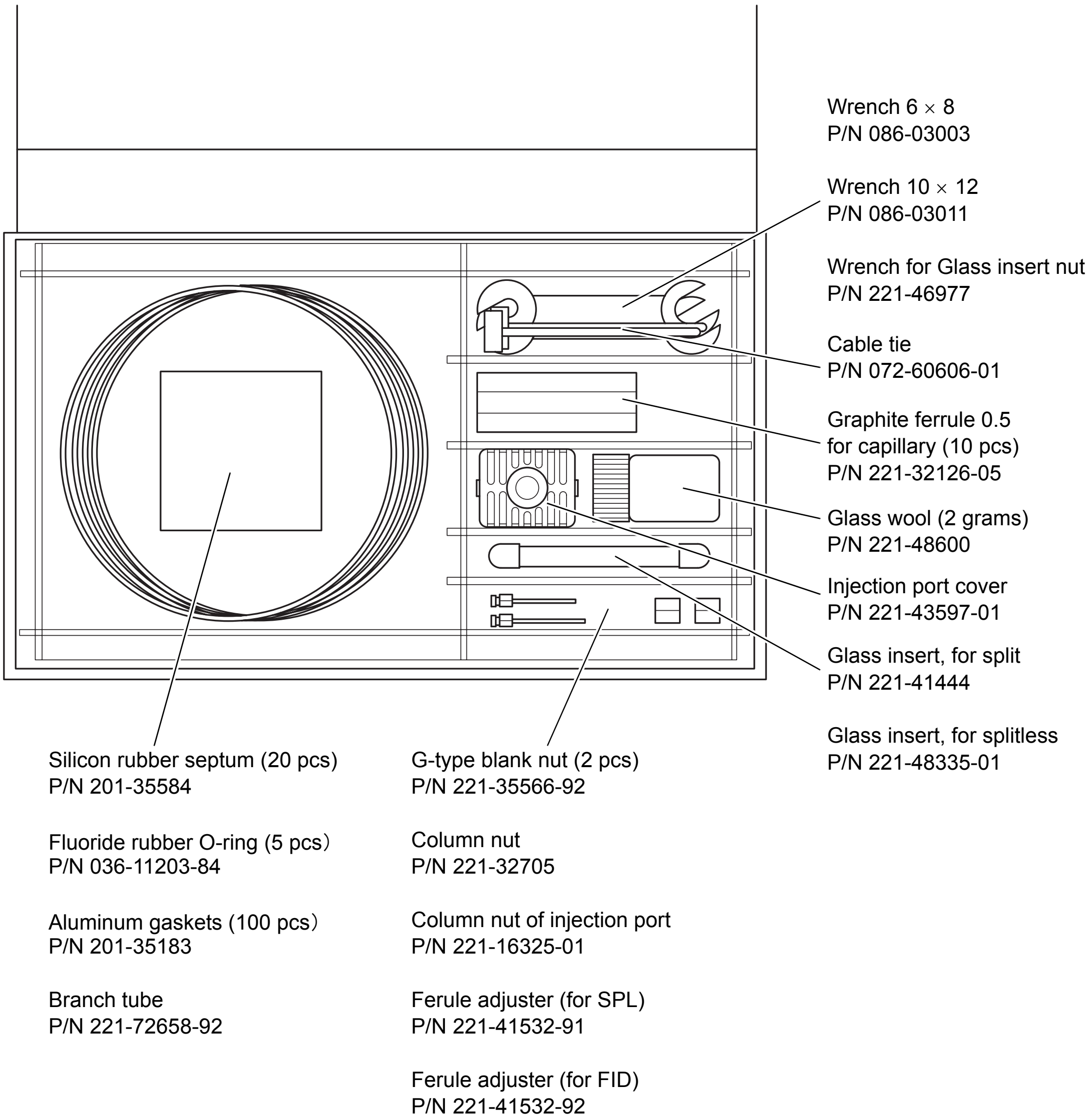


Fig. 2.1.1 Standard Accessories

3.1 General View

WARNING

HIGH VOLTAGE

RISK OF ELECTRIC SHOCK - Only qualified service personnel may remove the right and left side covers.

HIGH TEMPERATURE

1. RISK OF BURNS - DO NOT open the oven door when the oven temperature is high.
2. RISK OF BURNS - Never touch the top cover or injection port cover when the injection port or detector is hot. Never remove the cover nor touch the inside.

NOTE

All the GC unit covers (including the INJ/DET cover and gas controller cover) are influential in the GC-2025 performance. Be sure to put these covers in place before starting analysis.

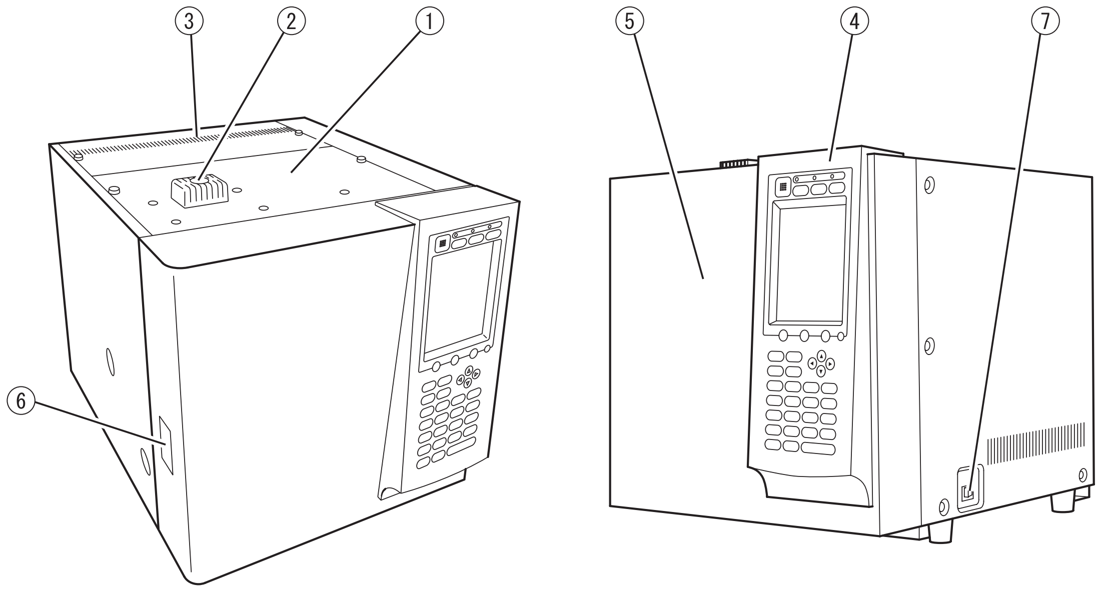


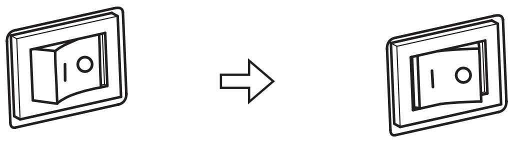
Fig. 3.1.1

No.	Name	Description
1	INJ/DET cover	Remove knurled screws (2 places) and lift the cover to remove it. Remove the cover only when it is required to carry out maintenance for the injection port or detector.
2	Injection port cover	The injection port becomes hot during operation. The injection port cover is a protection provided to protect the operator from burns. Remove this cover when using the Auto-injector, AOC-20i.

No.	Name	Description
3	Gas controller cover	The AFC and APC are housed under the cover.
4	Keys/display	Used for key inputs and operation status display. "5 Basic Key Operation"
5	Oven door	Pull the oven door lever to open the door. Press the center of the door to close it.
6	Oven door lever	Used to open the door. This is located in the opening in the center at the left side of the oven.
7	Power switch	Turns the power of the instrument on/off.

■ Symbol conventions

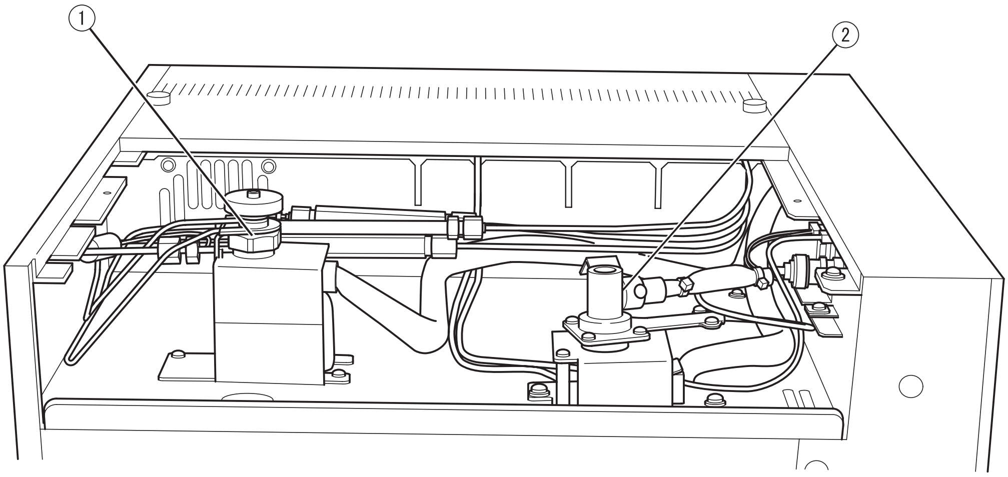
~ : AC
O : Off, Open
| : On, Close



OFF status　　　ON status

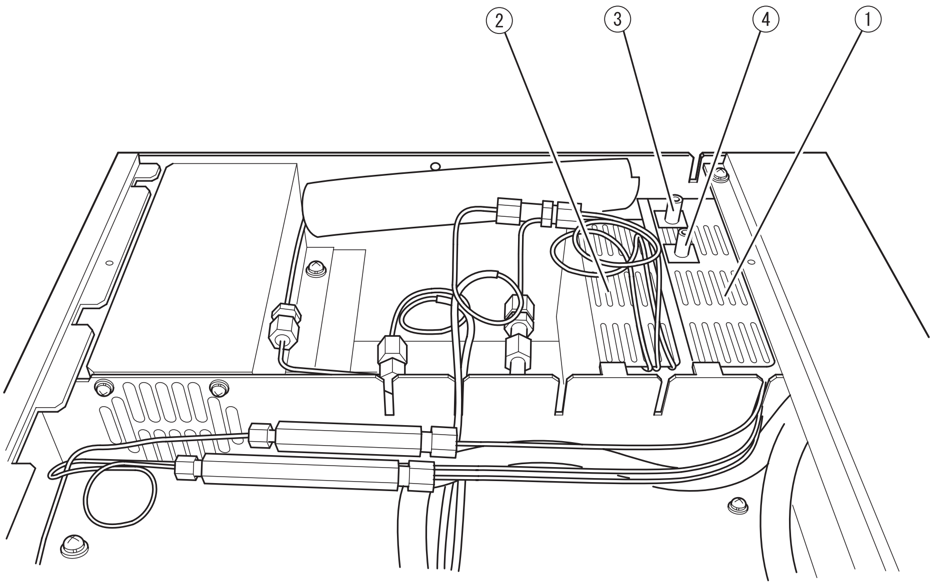
3.2 Inside the Covers

■ Under the INJ/DET cover



No.	Name	Description
1	Injection port (SPL)	Samples are injected into this port. The injection port becomes hot during operation.
2	Detector (FID)	The detector is located under the INJ/DET cover. The detector becomes hot during operation.

■ Under the gas controller cover



No.	Name	Description
1	AFC	Controls carrier gas.
2	APC	Controls detector gas.
3	Split vent	Used for escaping split gas from the injection port.
4	Purge vent	Used for escaping purge gas from the injection port.

3.3 Oven Interior

WARNING

HIGH TEMPERATURE

Danger of burns.
When the injection port or detector temperature is high, never touch the connections or the internal surfaces of the oven.

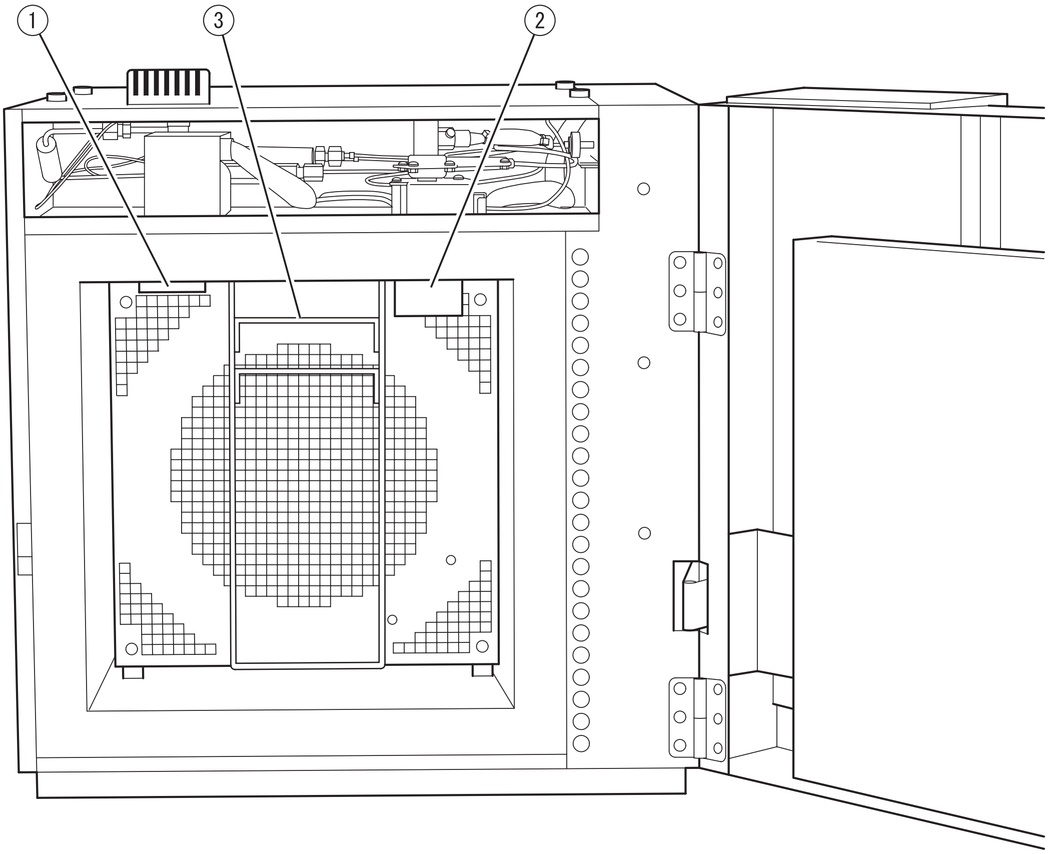
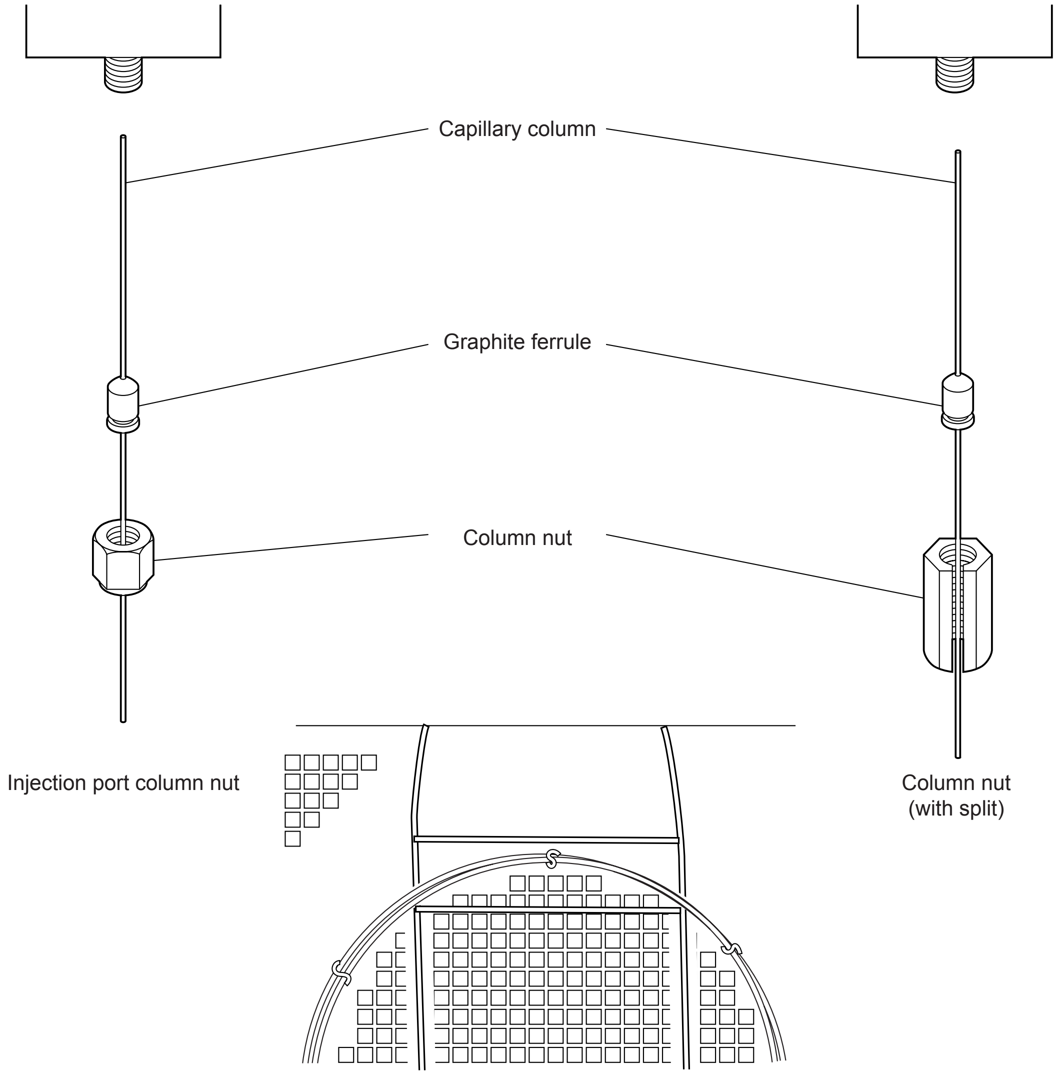


Fig. 3.3.1

No.	Name	Description
1	Column connection (injection port side)	Attaches the column to the injection port. (close-up ①).
2	Column connection (detector side)	Attaches the column to the detector (close-up ②).
3	Column hanger	Install the capillary column here. Attaches to the top of the oven (close-up ③).

Close-up ① (injection port side) **Close-up ② (detector side)**



Close-up ③ (column hanger)

3.4 Rear

WARNING

HIGH VOLTAGE

Danger of electrical shock.
Only qualified service personnel may remove the rear cover.
Ensure that the power distribution board power is off before starting installation if the power cable will be connected directly to terminals on the power distribution board.
Ensure that the power supply is properly grounded.
Never put heavy objects on the power cable.

HIGH TEMPERATURE

Hot air is exhausted from the back of the unit. DO NOT place flammable items behind the unit. DO NOT touch the back of the GC near the exhaust.

HIGH PRESSURE GAS

Frequently check gas flow lines for leaks.
In particular, accumulations of hydrogen gas can cause an explosion.

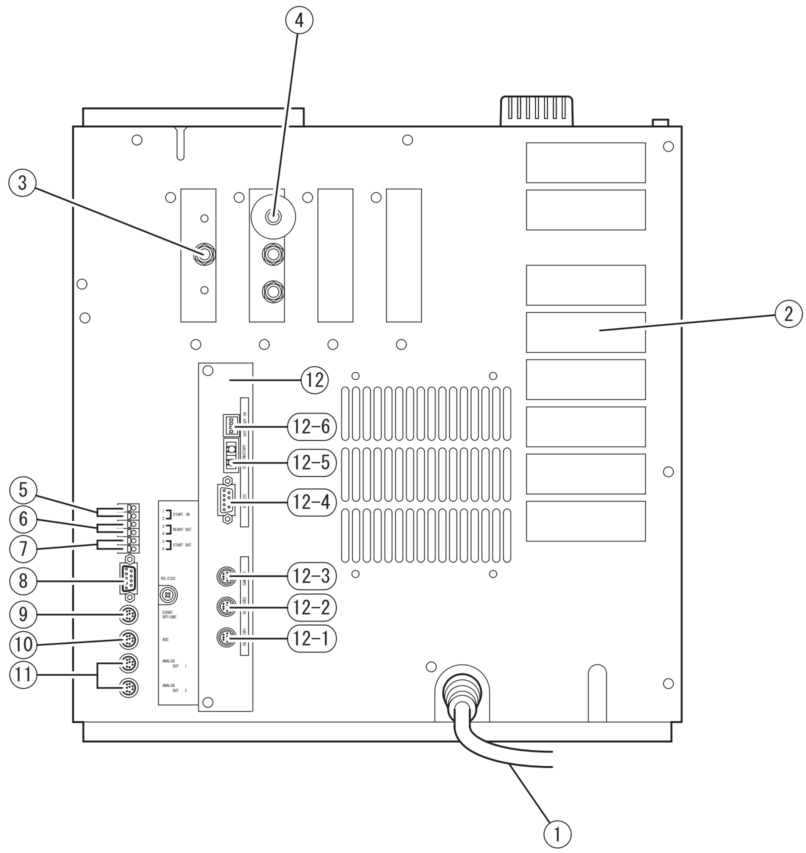


Fig. 3.4.1

NOTE
DO NOT touch the connections or terminals when the power is on. This could damage the circuits.

No.	Name	Description
1	Power cable	Supplies power to the unit.
2	Exhaust vent	This vents the column oven during cooling.
3	Carrier gas inlet	Supplies carrier gas.
4	Detector gas inlet	Supplies detector gas.
5	START signal input terminal	Connect an external device if any to this terminal to receive a start signal.
6	READY signal terminal	Outputs the READY signal to any external device (Such as the auto injector).
7	START signal output terminal	Connect an external device if any to this terminal to output the start signal.
8	RS-232C connector	Connect the RS-232C cable (9-pin) to this connector. For I/O of digital signal.
9	Relay terminal	Relay terminal to switch at EVENT91 and 92.
10	AOC communication connector	Connect this connector to the RS-232C terminal in the power unit of AOC-20 i/s.
11	Detector signal output terminal (analog)	Outputs the detector signal to analog input of a Chromatopac or other type of data processing unit. (ch1, ch2)
12	AOC power supply *	Connects AOC-20i and AOC-20s (option).
12-1 12-2 12-3 12-4 12-5 12-6	INJECTOR1 connector INJECTOR2 connector SAMPLER connector RS-232C connector Fiber optic cable connector Start out/Ready in connector	Connect the auto injector. Not used with the GC-2025 Connect the autosampler carousel. Connector for external control Do not connect RS-232C and fiber optic cables simultaneously. Inputs the ready signal to the gas chromatograph and outputs the start signal from the gas chromatograph.

∗ This comes with AOC-20i for GC-2025.

NOTE
The symbol ⏚ indicates the functional ground terminal.

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4.1 Capillary Column Overview

Two types of columns can be installed in the gas chromatograph.

The first type, the capillary column, chemically fuses the liquid phase to the interior of the column wall.
The other type, the packed column, fills the interior of the column with packing material, with the liquid phase coating the particles. This type of column is becoming obsolete.

Chemically bonded, high-resolution fused silica capillary columns with either stationary phase polarity in a variety of lengths, inner diameters, and stationary phase film thicknesses, are commercially available and can be selected according to the required analytical conditions.
The GC-2025 is designed to be used with capillary columns. This section describes the capillary column installation on the injection port.

4.2 Location of Heated Zones

The capillary column can be installed in the following heated zones.

Injection port	5
Detector	1

Location numbers 4 to 6 are assigned to the injection port, and 1 to 3 are assigned to the detector; however, the locations that can be used are limited to those indicated above.

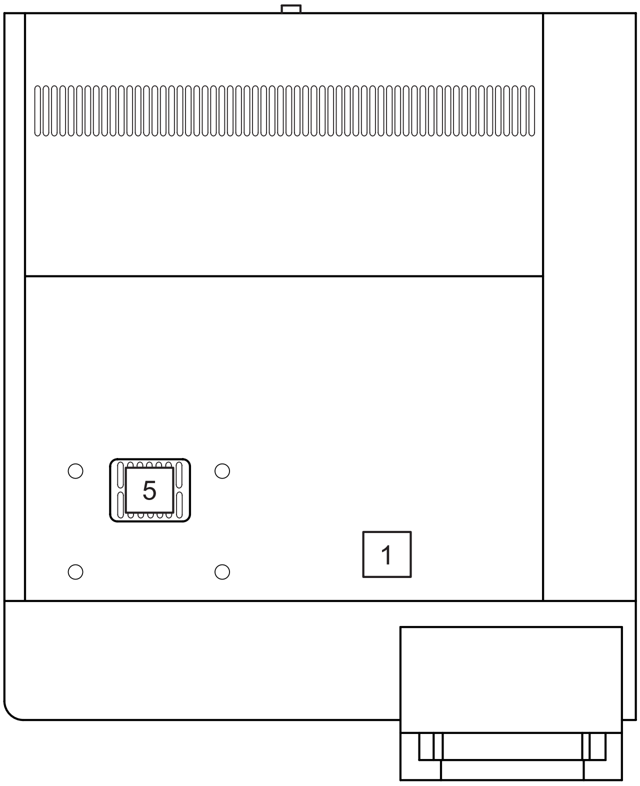
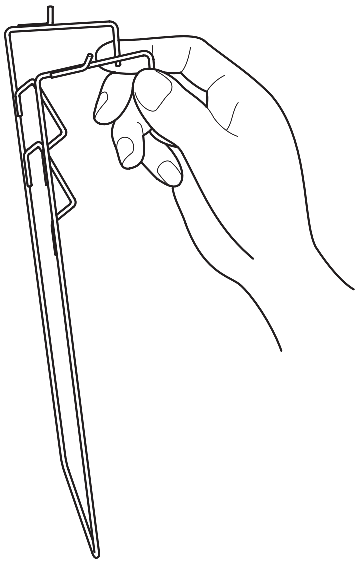


Fig. 4.2.1 Location of heated zones

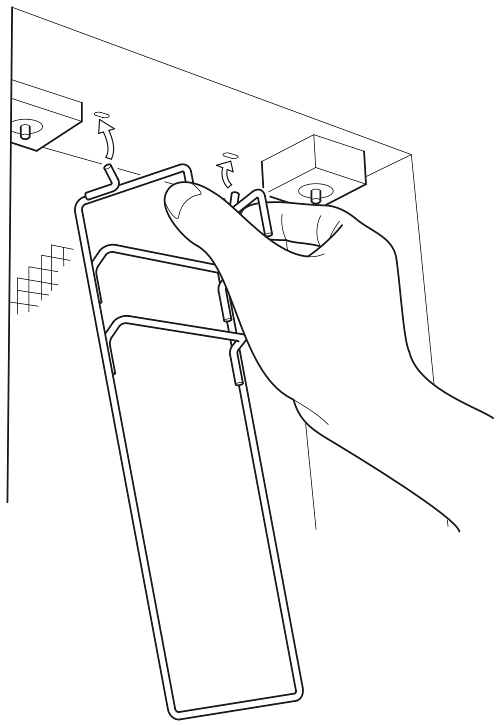
4.3 Installing the Column Hanger

Insert the column hanger into hanger slots inside the column oven as shown.

(1) Hold the column hanger as shown below and push both wire tops to make them close to each other.



(2) Insert the projections of the column hanger into the slots (towards the front) at the ceiling of the column oven.



4.4 Proper Placement of Graphite Ferrules

> **WARNING**
>
> Wear safety glasses when handling the capillary column, to prevent eye injury

4.4.1 Placing graphite ferrules on the column

Graphite ferrules are required for proper sealing. Follow these procedures to place one ferrule at each end of the capillary column.
The graphite adjuster marked with an "S" or "F" to indicate whether it is for the injection port or detector side.

S: For split/spiltless injection port
F: For FID (detector)

(1) Remove the wire from a new graphite ferrule. Slide the graphite ferrule on the capillary column.

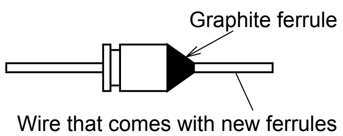


Fig. 4.4.1

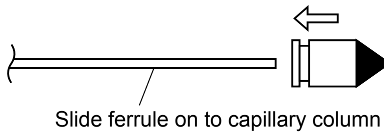


Fig. 4.4.2

(2) Pull the capillary column through the column insertion jig so that 10 mm of column protrudes. Tighten the column nut to fasten the ferrule to the column at that position (tighten the column nut by hand, then 3/4 turn further with two wrenches in opposition).

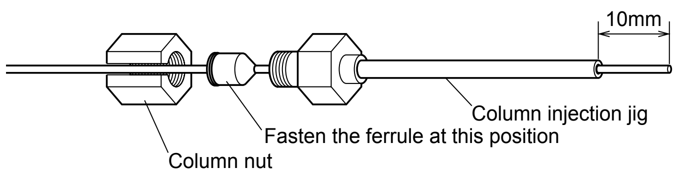


Fig. 4.4.3

(3) Because graphite may be present on the column end, the column must be clipped as shown below.
(a) Clip the column so it is flush with the end of the jig.

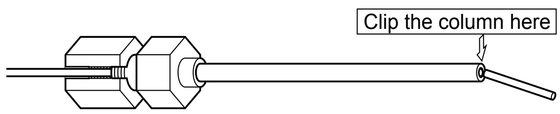


Fig. 4.4.4

(b) The edge of the cut must be completely straight.

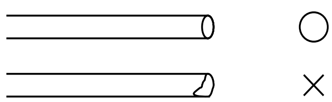


Fig. 4.4.5

NOTE
When cutting the capillary column, use a capillary cutter to cut the end flatly.
<Option> Capillary cutter
Part No.: 221-50595-91

(4) Remove the slipped graphite with tweezers, etc. At that time, be careful not to damage the capillary column.

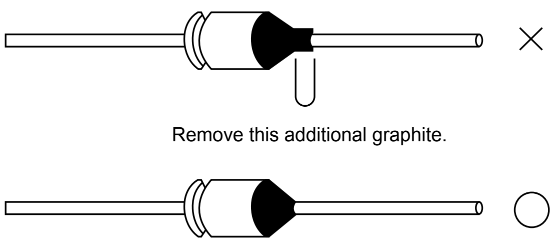


Fig. 4.4.6

NOTE
Graphite which becomes lodged under the adjuster must be removed from the column. If allowed to remain, the graphite could clog the capillary adapter. If this occurs, unclog the adapter with compressed air or a thin wire.

4.4.2 Positioning the graphite ferrule

Position the ferrules as shown below (Fig. 4.4.7).
If the adjusters were used to fasten the ferrules to the column as described in the previous section, the ferrules should already be in the proper location.
In the split injection method using the wide bore column, fix the graphite ferrule at a place 15 mm from the column end. The ferrule adjuster included in the accessories is not available for this case.

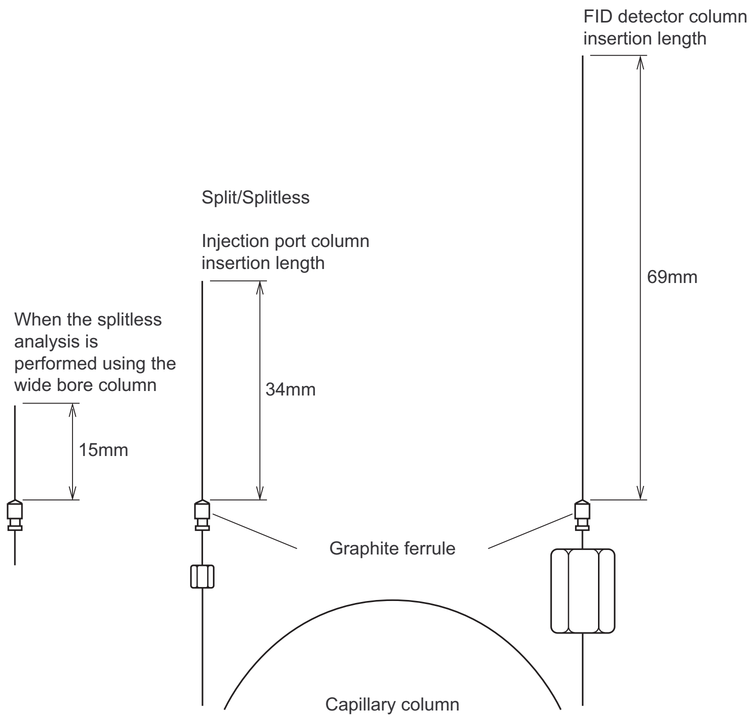


Fig. 4.4.7 Attaching position of graphite ferrule

4.5 Installing and Removing the Capillary Column

WARNING

DO NOT install or remove the capillary column until the temperature of the column oven, injection port and detector have dropped below 50 °C. Danger of burns.

4.5.1 Installing the capillary column

NOTE
Refer to "Installing capillary column in oven" in the GC-2025 OPERATION MANUAL.

(1) Attach the capillary column to the column hanger.
(2) Connect the capillary column to the injection port and the detector.
Note the following items during column installation:
(a) Do not force the column to bend too far.
(If the column does not reach the injection port or the detector, unwind a loop of the column.)
(b) Ensure that the capillary column does not touch the oven wall.

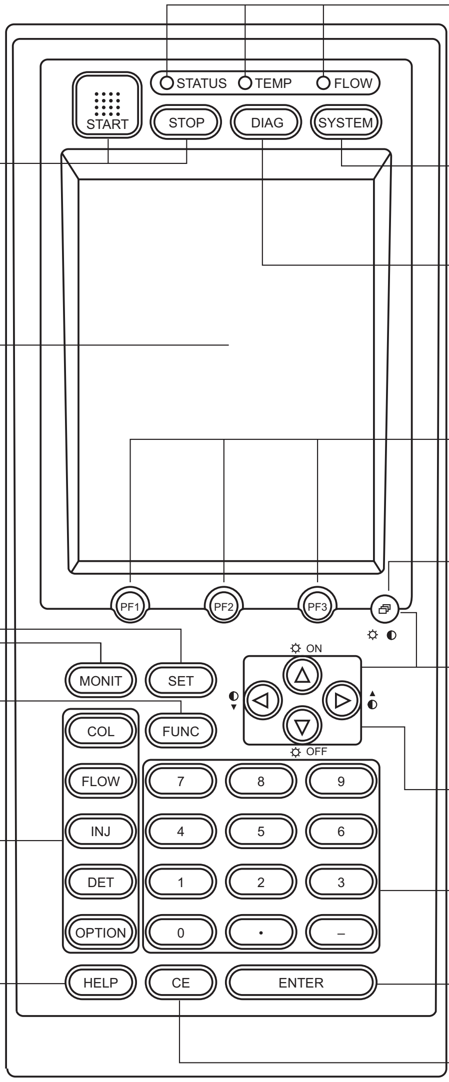
NOTE
Tighten the column nuts first by hand, then an additional half turn by wrench.

4.5.2 Removing the capillary column

(1) If the system is operating, press the [SYSTEM] key and select [Stop GC] (PF menu). The heated zones will begin to cool down.
(2) Press the [MONIT] key, and ensure that the temperatures of the injection port, the detector and the column oven are 50 °C or less. Press the [FLOW] key, and select [Off] (PF menu) to turn off carrier gas flow. When the column inlet pressure decreases to 0 kpa, it is safe to remove the column.
(3) Remove the capillary column by reversing the procedures described in "1. Installing the capillary column".

5.1 Keypad Description and Operation

The keypad functions control the unit, and displays the operational status.



START/ STOP key	Starts/stops analysis.
Screen	Displays 16 lines of information at a time on the large display area.
SET key	Displays the list of frequently accessed items.
MONIT key	Monitors the GC status and the chromatogram.
FUNC key	Displays items which are not frequenty used.
UNIT keys	Displays the setup screen for the zone indicated on the key.
HELP key	Explains currently displayed items.
STATUS/ TEMP/ FLOW lamp	Indicates the status of the entire GC, the heater and the flow controller, respectively.
SYSTEM key	Displays the GC start/stop screen.
DIAG key	Executes and allows diagnosis settings.
PF key	Selects "PF (programmable functions)" displayed at the bottom of the screen.
Toggle key	Toggles among PF items displayed.
Toggle key + Cursor keys	Sets On/Off of backlight and adjustment of contrast.
Cursor keys	Moves the cursor up, down, left and right respectively.
Numeric keys	Inputs numeric values.
ENTER key	Validates input or selection.
CE key	Clears a numeric input or error.

5.1.1 Keypad operation

The keypad is used to operate the system and make parameter settings. The table below shows the function of each key.

Name	Function
START key	Starts the temperature program, pressure/flow rate program and time program. If a Pre-Run program is set, the Pre-Run program starts.
STOP key	Stops the program.
DIAG key	Performs unit self-diagnosis. Also, used for maintenance functions such as confirmation of various logs, part replacement status, and standard signal output.
SYSTEM key	Starts/stops GC. Manages the analytical condition file.
PF key	Selects the PF menu displayed at bottom of the screen. (PF = programmable function)
Toggle key	Toggles through the PF menu displayed at bottom of the screen.
MONIT key	Monitors the GC status and analysis status. Displays the GC temperature, pressure and flow rate status for each heated zone, as well as chromatograms.
SET key	Accesses commonly-used items, such as temperature, pressure and flow rate for each component on one screen. Manages the analytical condition file like the [SYSTEM] key.
FUNC key	Accesses less frequently used items.
COL key	Sets the oven temperature program.
FLOW key	Sets the carrier gas flow rate parameters, such as pressure, flow rate and split ratio.
INJ key	Sets the temperature of injection port.
DET key	Sets the detector temperature, range and current or other detector-related parameters.
OPTION key	Sets the parameters for optional units, such as an auto injector or CRG.
HELP key	Describes the procedure and suggests valid parameter ranges. Jumps to a desired item using an index function.
Cursor key [△], [▽], [◁] and [▷]	Moves cursor up, down, left and right. A blinking cursor indicates the location of parameter value entry. [◁] and [▷] keys may be used to change the selection.
Numeric keys [0] ~ [9]	Enter numeric values.
Clear key [CE] key	・Clears the current numeric value. ・Clears display and alarm during an error.
ENTER key	Validates parameter input or item selection.

5.1.2 Screen

The top line and bottom two lines of the 16-line screen are used to display the certain information.
If all items cannot be displayed on one screen, "△" and "▽" are displayed in the message line. Scroll through the screen by moving the cursors.

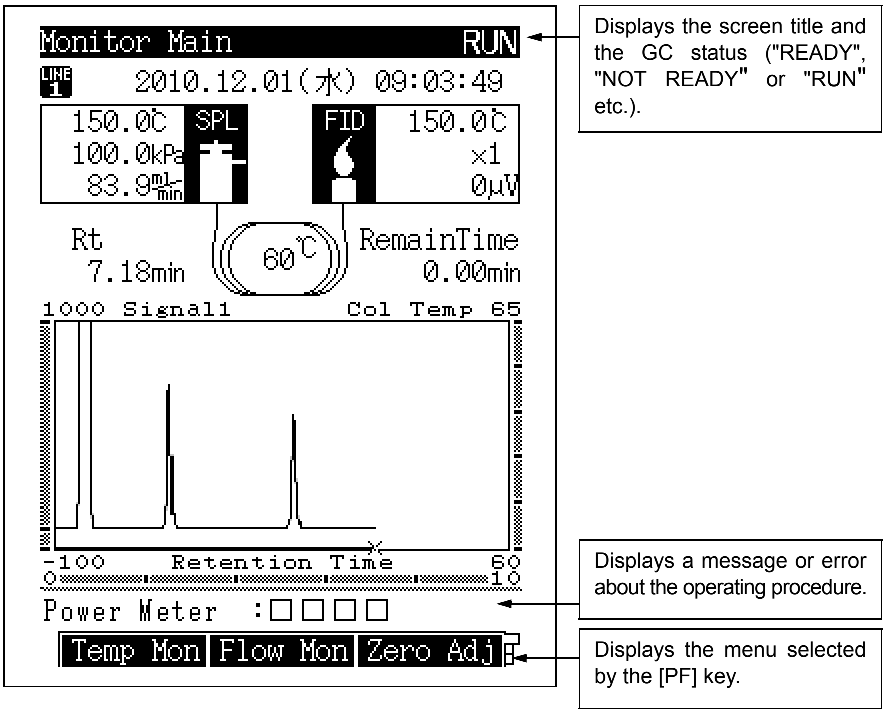


Fig. 5.1.1

■ [Return] (PF menu)

[Return] (PF menu) displayed in the PF menu line returns the display to the previous screen. [Return] (PF menu) is displayed in PF1.

■ Actual and set values

Actual (current) values are highlighted, while set values are underlined. The actual value blinks when it is NOT READY (the actual value has not reached the set value). When the values are equal (READY state), the actual value stops blinking.

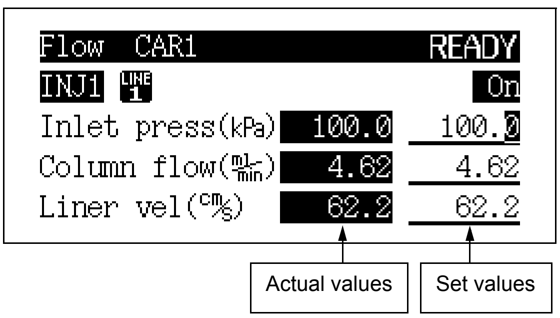


Fig. 5.1.2

5.1.3 Status indicators

Three status lights indicate the GC status regardless of the screen display. The STATUS, TEMP and FLOW lights indicate the GC status, the temperature control status and the gas control status, respectively. Light color and illumination are also used to indicate instrument parameter status.

■ STATUS indicator

Color	Status	Meaning
Off		Power is OFF.
Green	On	System is ready.
	Blinking	Program, like the temperature program, are being executed.
Yellow	On	System is OFF. Alternatively, the system is ON, but is not ready.
	Blinking	Diagnosis, baking or flow controller calibration is being executed.
Red	On	An error has occurred in the system.

■ TEMP indicator

Color	Status	Meaning
Off		Temperature control is not performed.
Green	On	All temperature controlled zones are ready.
	Blinking	Temperature program is running. Alternatively, the column CRG valve is closing (Col-CRG auto off).
Yellow	On	One of the temperature controlled zones is not ready.
	Blinking	Temperature program is finished, and system is being cooled.
Red	On	An error related to temperature control has occurred.

■ FLOW indicator

Color	Status	Meaning
Off		Gas control is not performed.
Green	On	All gas control lines are ready.
	Blinking	Pressure/flow rate program is running, it is sampling time, or high pressure injection is occurring.
Yellow	On	One of the gas control lines is not ready. Alternatively, the system is waiting for restoration. (Gas saver AOC link, Gas saver auto on or Splitless auto off)
	Blinking	Pressure/flow rate program is finished, and default values are being set.
Red	On	An error related to the gas control has occurred.

5.2 Adjusting the Display

NOTE
In the following procedure, [Toggle] + [▽] key indicates that [▽] key is pressed while pressing and holding the [Toggle] key.

Turn the backlit LCD display on and off by pressing [Toggle] + [▽] to turn it off and [Toggle] + [△] to turn it on.
When the keypad is not in use, turning the backlit LCD display off is recommended, to prolong the life of the display.
The display turns off automatically with the backlit display saver (See "16.6.11 Other settings"). When the display turns itself off, turn it back on by pressing any key.
To adjust the contrast, stand in front of the screen and press the [Toggle] + [◁] or [▷] keys.

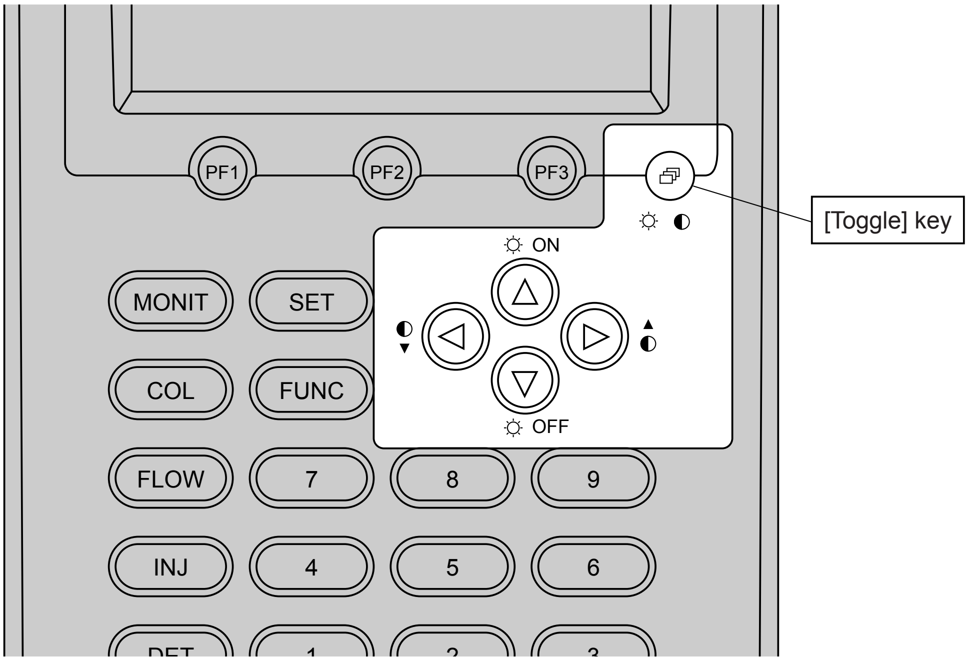


Fig. 5.2.1

5.3 Basic Key Operations

5.3.1 Screen display

Use the following 10 keys to display the parameter and status screens:
[DIAG], [SYSTEM], [MONIT], [SET], [FUNC], [COL], [FLOW], [INJ], [DET] and [OPTION].
Access the main function screens by pressing one of these keys, then the secondary screens by selecting a PF menu item displayed at the bottom of the screen. (Because the PF menu includes direct operations, some PF menu items do not have secondary screens.)

■ PF menu item selection

Select a desired PF menu item by pressing the PF keys ([PF1], [PF2] and [PF3]) underneath the screen, which correspond to PF menu items.

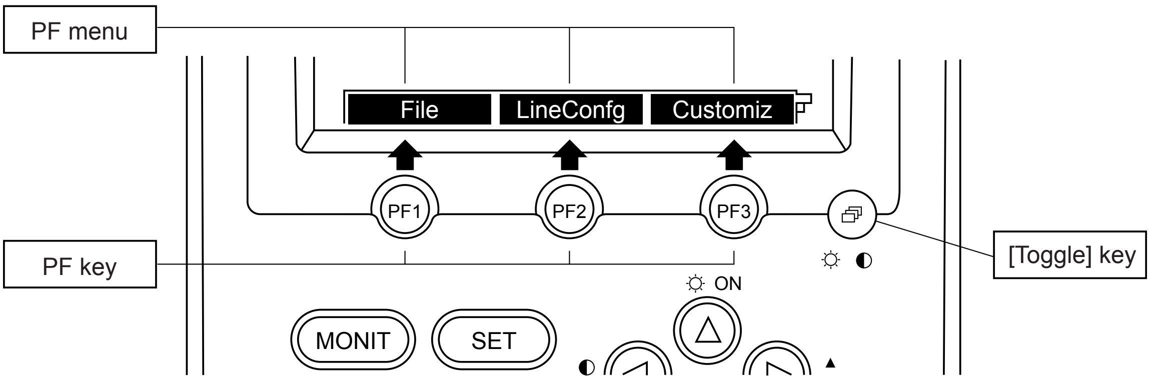
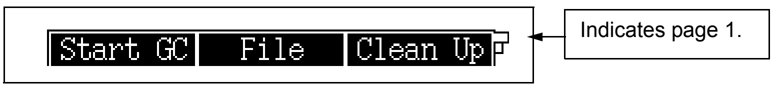


Fig. 5.3.1

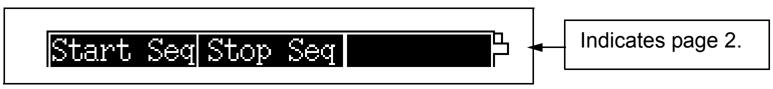
If the PF menu continues over two or more pages, press the [Toggle] key to display the desired PF menu, then press the [PF] key.

Example:

1st page of PF menu



Press the [Toggle] key to display the 2nd page.



5.3.2 Moving the cursor

Use the four keys, [△], [▽], [◁] and [▷] to move the cursor to an item to be set.
However, for screens with listed items, only the [△] and [▽] keys may be available to move the cursor. The [◁] and [▷] keys may perform a different function.

■ Moving the cursor using the [△], [▽], [◁] and [▷] keys

Example: Main screen of the [COL] key

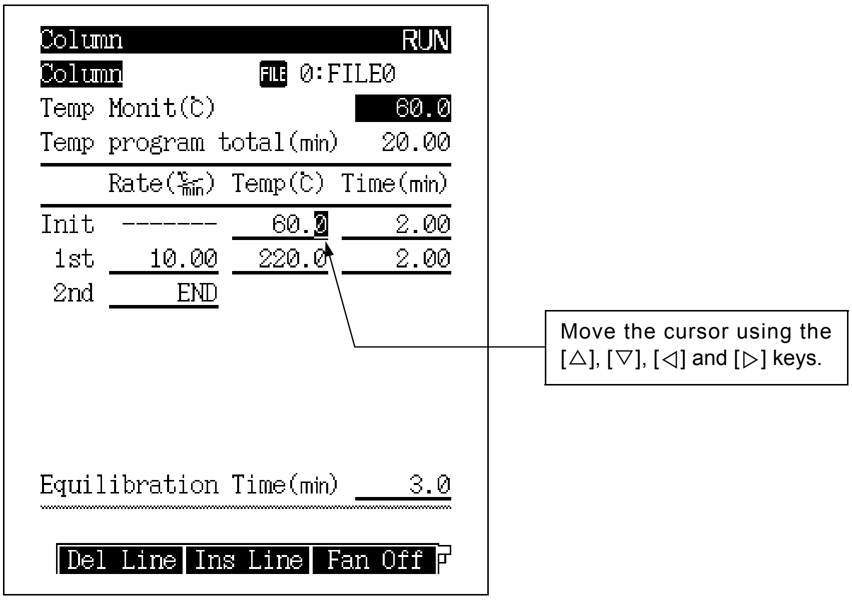


Fig. 5.3.2

■ Moving the cursor using only the [△] and [▽] keys

Example: Main screen of the [FLOW] key

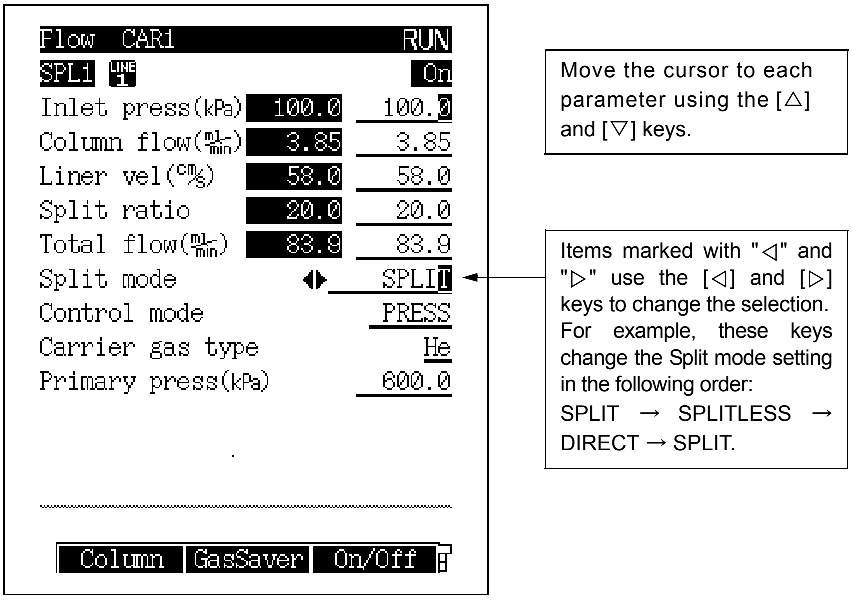


Fig. 5.3.3

5.3.3 Entering numeric values

Enter a numeric value using the following procedure:
(1) Move the cursor to an item to be set.
(2) Use the numeric keys to enter a number.
(3) Press the [ENTER] key to validate the input.

NOTE

The value becomes valid when the [ENTER] key is pressed.

If you move the cursor or display another screen before pressing the [ENTER] key, the value is deleted.

To clear a value before pressing the [ENTER] key, press the [CE] key.

5.3.4 Changing a selection

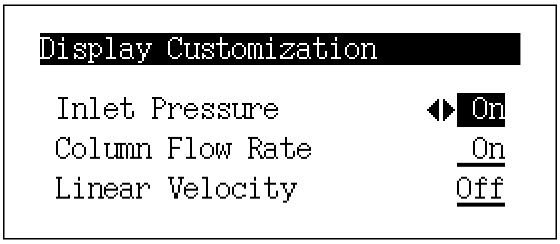
Parameters marked with "◁" and "▷" are changed by making another selection. Change the selection using the following procedure.
(1) Move the cursor to the item.
(2) Select a desired choice by pressing the [◁] and [▷] key.
(3) Press the [ENTER] key to validate the selection.

NOTE

The selection change becomes valid when the [ENTER] key is pressed.

If you move the cursor or display another screen before pressing the [ENTER] key, the change is not made.

To clean the selection before pressing the [ENTER] key, press the [CE] key.



Change the selection by pressing the [◁] and [▷] key. In this example, the selection changes in this order:
On → Off → On ...
Press the [ENTER] key to validate the selection.

Fig. 5.3.4

5.3.5 Changing item names

Customize file names and other names with alphanumeric characters and symbols. Change the name using the following procedure:

(1) Move the cursor to an item to be changed using the [△] and [▽] keys.
(2) Move the cursor to a character to be changed using the [◁] and [▷] keys.
(3) Input a character as described in the following section on entering characters. The character input procedure described below.
(4) Press the [ENTER] key to validate the input.
(5) Repeat steps (2) to (4) to enter a name.
(6) Press the [CE] key to delete one character at the cursor's current position.

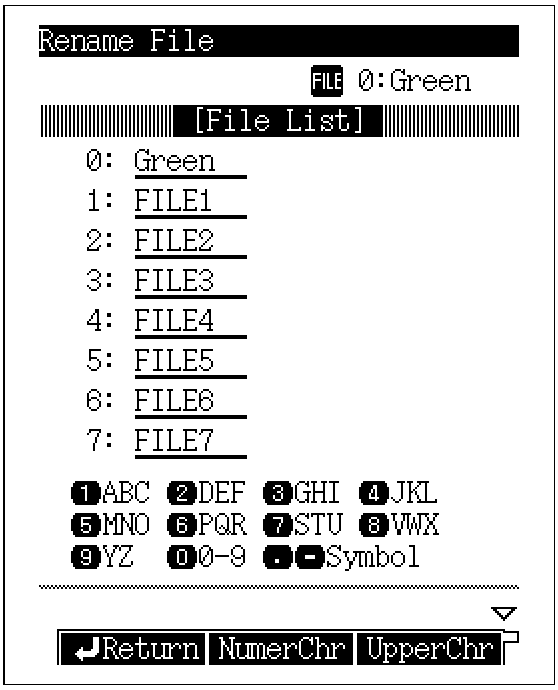


Fig. 5.3.5

■ Entering characters

Initially, the character input screen is in upper case mode.

Press [LowerChr] (PF menu) to select lower case mode. Press [NumerChr] (PF menu) to select numeric mode.

Alphabetic mode (upper case/lower case)

Key	Toggled characters
1	A/a → B/b → C/c → A/a →・・・
2	D/d → E/e → F/f → F/f →・・・
3	G/g → H/h → I/i → G/g →・・・
4	J/j → K/k → L/l → J/j →・・・
5	M/m → N/n → O/o → M/m →・・・
6	P/p → Q/q → R/r → P/p →・・・
7	S/s → T/t → U/u → S/s →・・・
8	V/v → W/w → X/x → V/v →・・・
9	Y/y → Z/z → Y/y →・・・
0	0 → 1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 0 →・・・
.	(blank) → . → , → ＋ → － → ＊ → ／ → ＃ → ＄ → % → & → (blank) →・・・
－	& → % → ＄ → ＃ → ／ → ＊ → － → ＋ → , → . → (blank) → & →・・・

Numeric mode

Press the [0] to [9] keys to input numbers "0" to "9".

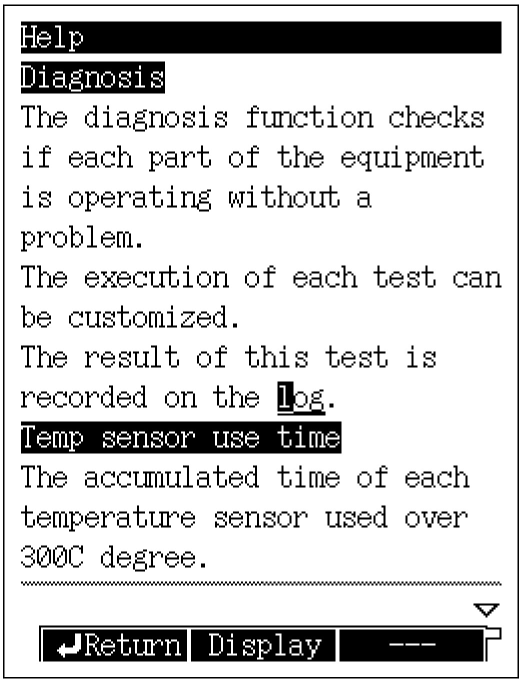
Press the [-] and [・] keys to toggle the symbols.

5.4 Getting Help

The Help function describes items on the setup screens.
Understanding the items helps to quickly and efficiently set up analytical parameters and proceed to the operations.

5.4.1 Screen Help

If you do not know the meaning of an item on the screen, press the [HELP] key on the screen to display the item and its description. For example, Fig. 5.4.1 displays the Diagnosis Help text.
Items which may be difficult to understand are linked to further descriptions. Access these underlined item descriptions by pressing [Display] (PF Menu) with the cursor on the item.
Fig. 5.4.2 shows the pop-up screen linked to the word "Log".



[Display]

[Back]

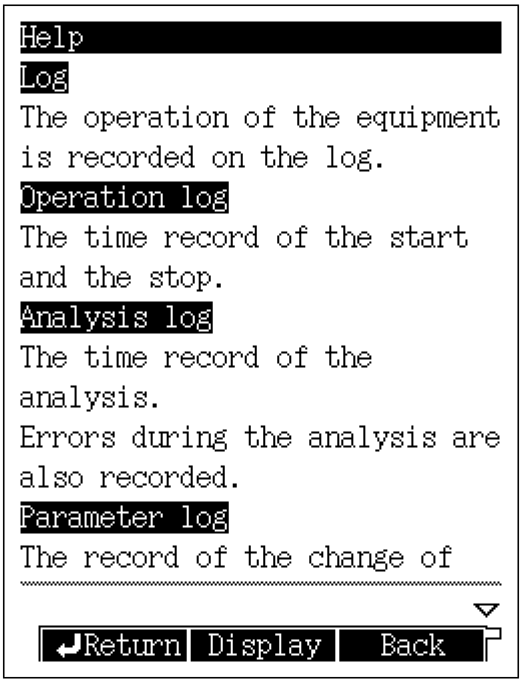


Fig. 5.4.1 Help screen

Fig. 5.4.2 Linked screen

5.4.2 PF menu

PF menu	Description
Return	Returns to the screen displayed before [HELP] key was pressed.
Display	Displays the explanation on item at the cursor position.
Back	Returns to the previous screen.

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6.1 Analysis Flow Chart

For details about the operating procedure, refer to "3.3 Analysis using capillary column" in the GC-2025 OPERATION MANUAL.

6.1.1 Preparation

Glass insert preparation ↓	Confirm that the insert is appropriate for the injection mode, that the silica wool has not moved, and that the glass insert O-ring has not deteriorated.
Septum preparation ↓	After approximately 100 injections, replace the septum. (50 injections for a thick needle)
Column preparation	Attach the column to the hanger, install the hanger, and verify the proper position of the graphite ferrules. Tighten the injection port and detector column nuts.

When the above preparations are complete, turn on the GC.

6.1.2 Setting parameters

Set the column information and the flow rates ↓	From the [Column] (PF menu) of the [FLOW] key screen, set the column inner diameter, the column length and the film thickness. From the [Purge] (PF menu) of the [FLOW] key screen, set the purge flow rate. From the [FLOW] key screen, set the column inlet pressure, the injection mode, the split ratio, the sampling time, etc. Changing the column temperature after the flow rate has been set may change the flow rate.
Set the temperature of the detector and the injection port ↓	From the screens of the [INJ] and [DET] keys, set the temperatures. If the detector is set to "Off", turn it "On". From [DET Gas] (PF menu), set hydrogen, air, makeup gas, etc.
Set the COL temperature and the temperature program ↓	From the screen of the [COL] key, set the column initial temperature and the temperature program. The column temperature settings must be within the permitted column range and must be less than the detector temperature.
Start GC control ↓	Press the [SYSTEM] key to display the main screen. Press [Start GC] (PF menu) to start GC control. Press the [MONIT] key, and ensure that the temperature of each zone, the gas flow rate, the gas pressure, etc. are correct.
Set the detector	From the screen of the [DET] key, set the range and the time filter constant. Ensure that the temperature of the detector is rising before igniting the FID.

When all parameters reach their respective setup values, the STATUS indicator light becomes green and the system is ready for analysis.

The default zero parameter, "Zero at Ready" zeroes the detector signal when the GC is ready.

6.1.3 Analysis

Set the data processing unit

Perform the required settings for the data processing unit, such as specifying the processing parameters.

Check the baseline

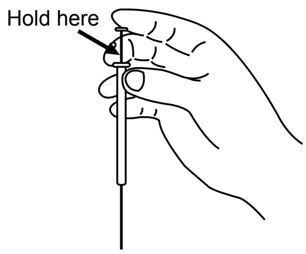
Press the [MONIT] key, and ensure that the baseline is stable.
Press [Zero Adj] (PF menu) to zero the detector output. When the baseline is stable, you can start analysis.

Inject the sample

Aspirate the sample in the syringe, inject it into the GC injection port, and press [START] to analyze it.
For capillary column analysis, normally inject 1 μl or less liquid.
(1-2 μl available)

WARNING

Wear protective goggles when using a syringe to inject samples.
The syringe plunger could be expelled due to injection port back pressure. Sample could get into the eyes.
By holding and supporting the plunger from the side with your middle finger, you can smoothly inject the sample and keep the plunger in the syringe.
DO NOT bend the plunger when holding the syringe in this position.



(Example)
How to hold a syringe when injection

6.1.4 Tips for analysis

■ Glass insert (liner)

- There are two types of glass inserts, one for split analysis and the other for splitless. Select the correct type based on the sample injection method.
  A glass insert for split analysis can be used for splitless analysis. For the AOC-20i auto injector, the silica wool is normally positioned 20 mm from the upper end of the glass insert for split. On the other hand, the silica wool is positioned 25 mm from the upper end of the glass insert for splitless.
- The quantity and position of the glass wool in the insert directly affects the reproducibility of results. For the AOC-20i auto injector, the glass wool is normally positioned 20 mm from the upper end of the glass insert.
- Samples come into direct contact with the inner surface of the glass insert and the silica wool. On these hot surfaces, unstable compounds may be decomposed or adsorbed. If this occurs, use deactivated inserts and glass wool.

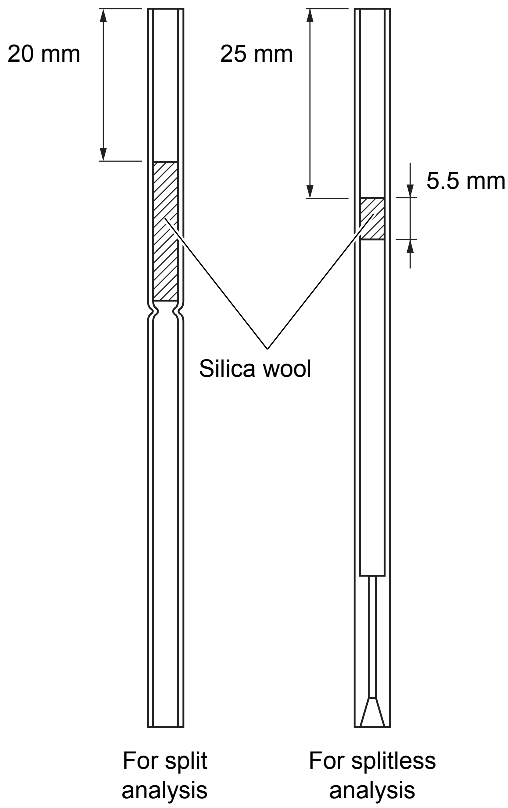


Fig. 6.1.1 Correct placement of silica wool

■ Analytical column

- Verify that carrier gas is flowing for enough time to flush the air in the column before increasing the column oven temperature. Otherwise, the column liquid phase becomes oxidized, and cannot separate compounds properly. This is especially important for polar columns.

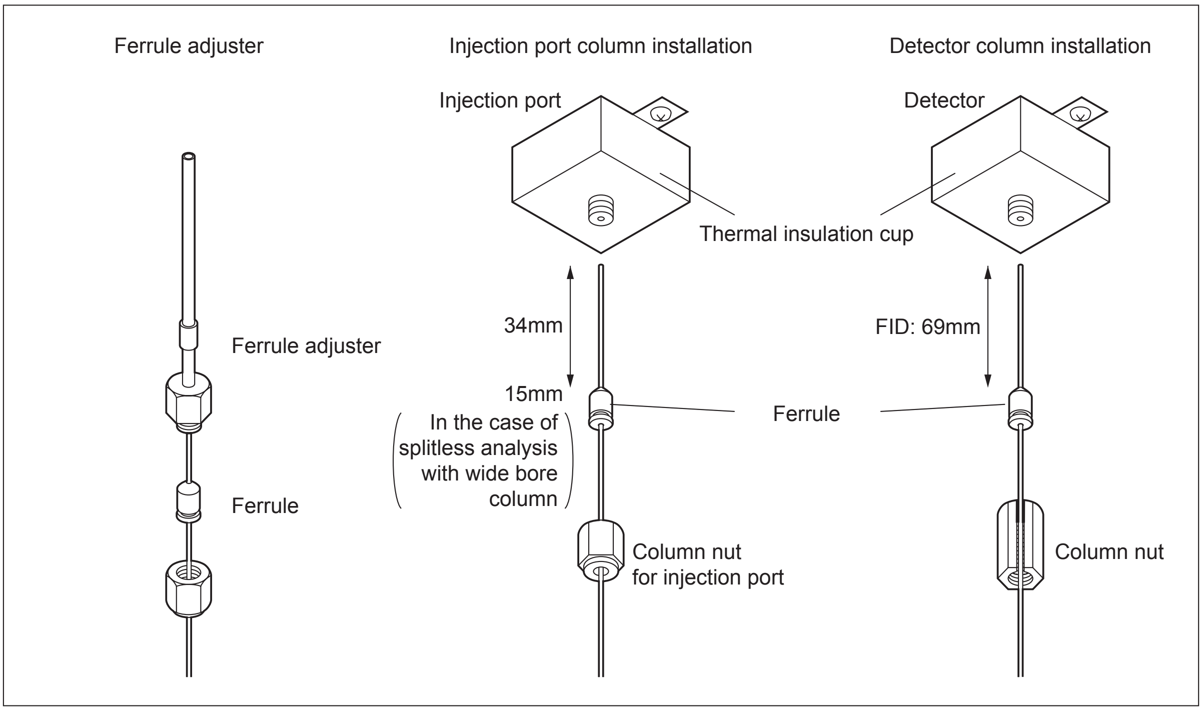
NOTE
Press the [SYSTEM] key, and set a start time. This ensures that carrier gas flows for the set time prior to temperature control of the heated zones.

- Selection of the analytical column is very important in GC analysis. In general, select a column based on the liquid phase whose polarity and chemical characteristics are similar to those of the target compound to obtain a good peak shape.

NOTE
Highly polar columns generally have a low heat resistance and low durability. Therefore, when analyzing an unknown sample, begin by analyzing it on a neutral column with a high heat resistance, then switch to a highly polar column if necessary.

■ Installing the analysis column

Install the column as described in sections 4.3, 4.4, and 4.5.
Use a box nut on the injection port side. Use a column nut on the detector side.



■ Sample injection modes

[Split injection]

In capillary columns, the inner diameter is small and the sample load capacity is low. Unlike packed columns, only a small (less than 0.1 μl) amount of sample can be injected at one time. The split injection mode only allows part of the injected sample to enter the column. This method is useful for samples of high concentration or about which nothing is known.

Try to perform a split injection method first. Set the split ratio to approximately 1:50 for the narrow bore column (ex. 0.25 mm I.D.). If the target peak is too large, increase the split ratio. If the target peak is too small or cannot be detected, decrease the split ratio. Select a proper split ratio in this way.

The standard setting of the split ratio is [column flow rate × (split ratio + 1)] ≥ 30 ml. The value should vary depending on the column's inner diameter and flow rate; however, generally start with the total flow rate of approximately 50 ml.

If the desired sensitivity cannot be achieved at [column flow rate × (split ratio + 1)] < 20 ml, consider another injection method.

[Splitless injection]

In the splitless injection method, almost all of the sample amount injected is introduced in the column by temporarily suspending the split flow.

This method is effective for analyzing a low concentration sample which cannot be easily detected by the split injection method.

To reduce band broadening and to sharpen peaks by condensation and vaporization of the sample in the column, create a temperature ramp program. The column initial temperature is set to a temperature lower than the boiling point of the sample solvent.

The high pressure injection method may reduce the volume of vaporized sample solution and improve analysis repeatability.

■ Setting the heated zone temperatures

The temperature of the injection port, the column oven and the detector are set individually. Usually, the injection port and the detector are set to a temperature higher than the column.

Temperature of the injection port varies according to the target substances. Set the temperature where an injected sample evaporates instantaneously. Always set the detector temperature higher than the column temperature.

Avoid setting a column temperature higher than the detector because the detector could become contaminated, which may lead to background noise.

When creating a temperature program, be careful not to set the final oven temperature higher than that of the detector.

■ Column temperature program

Use a temperature program mainly to analyze samples with a wide boiling point range.

When developing analytical conditions for an unknown sample or a sample which will generate an unpredictable elution attend, use an initial program with a low initial temperature (40 ~ 50 °C) and a temperature increase rate of approximately 10 °C/min. Based on the results, check the temperature range in which the peaks appear, then examine the analytical conditions. This procedure facilitates time program development.

■ Injection counter

The injection port septum and the glass insert are required to be inspected and replaced periodically. The GC-2025 provides a function which counts the number of injections. When the number of injections exceeds the limit, you are prompted to perform maintenance what is actually counted is the number of START times.
Select the analysis counter on the [DIAG] key screen to set and reset the counter limit.

NOTE
The septum/glass insert replacement cycle varies, depending on the analytical conditions and samples. If the glass insert is easily contaminated (when analyzing non-volatile compounds for example), set a low counter limit. On the other hand, when analyzing samples that do not contain non-volatile components, like the standard sample, a high counter limit can be set.

■ Starting up the GC

Turn on the power and/or press the [SYSTEM] key to display the GC starup screen. On this screen, specify the files used for instrument startup and instrument cleaning (column bake-out).
Press [Start GC] (PF menu) to start temperature control of each heated zone according to the parameters set in the file.
A startup method should be used to initialize the system once it has been turned on. Set the startup method to "auto" to start the file as soon as the power is on; this helps with instrument recovery after a power failure.
The initial step in the startup method should be turning on the carrier gas flow. After a set time, increase the injection port and detector temperatures. The column oven temperature can then be set to increase. The oven temperature increases last to protect the column from damage and the detector from contamination. The GC-2025 controls the temperatures so that the column temperature never increases above the detector temperature, even if all temperatures are set to increase at the same time.
A clean up method uses higher oven temperatures than those used for the analysis. After set bake-out time, return the temperatures to their normal analytical parameters.

■ Shutting down the GC

To shut down the system, select [Stop GC] (PF menu) on the [SYSTEM] key screen. Then, the system stops temperature control after the period of time set as the stop time, flows the carrier gas for the period of time set as the flow-off time, then stops.
When shutting down the GC, the temperature of each part should be decreased at first, then the carrier gas should be stopped so that the column can be protected. It is convenient to use the stop time and the flow-off time.
Do not turn off the power, before select [Stop GC] (PF menu).
When shutting down the GC, the heated zones are cooled, and then the carrier gas flow is turned off. To accomplish these in the correct sequence automatically, use a stop time (this stops temperature control at the set time) and flow off time (turns off carrier gas flow at the set time). Do not turn off the GC without first selecting [Stop GC] (PF menu). Because the carrier gas flow stops before the heated zones are cooled.

■ Obtaining reproducible analysis results

Follow these suggestions to obtain reproducible results:
When the Auto-injector, AOC-20i, is used, a liquid sample can be injected into the injection port in a reproducible method.
The GC is designed to perform optimally at room temperatures of 18-28 °C. Room temperatures above 28 °C will negatively impact reproducibility.

7.1 [SYSTEM] Key Main Screen

7.1.1 Screen description

The [SYSTEM] key main screen contains parameters related to starting and stopping the GC. To start and stop the GC, press [Start GC] and [Stop GC] (PF menu).

NOTE
If GCsolution is used, start and stop the GC on the computer.

■ When the GC is in the [SYSTEM Off] status

On pressing the [SYSTEM] key, the screen shown in Fig. 7.1.1 appears.

NOTE
If auto start is set, the GC starts as soon as the power is turned on, and this screen will not be displayed.

Set up parameters related to the GC start (start time, clean-up on/off and method) and press [Start GC] (PF menu) to start the GC. The GC enters standby mode according to the main screen settings.

■ When the GC is in the [SYSTEM On] status

On pressing the [SYSTEM] key, the screen shown in Fig. 7.1.2 appears.
Set up parameters related to the GC stop (stop time, flow off time, sleep time, etc.) and press [Stop GC] (PF menu) to stop the GC.
When the stop time has been counted down, the GC stops according to the main screen settings.

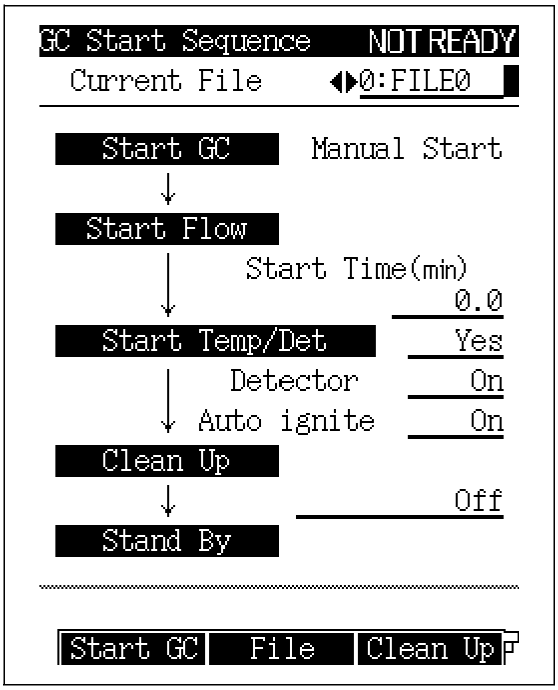


Fig. 7.1.1 Main screen accessed in the [SYSTEM Off] status

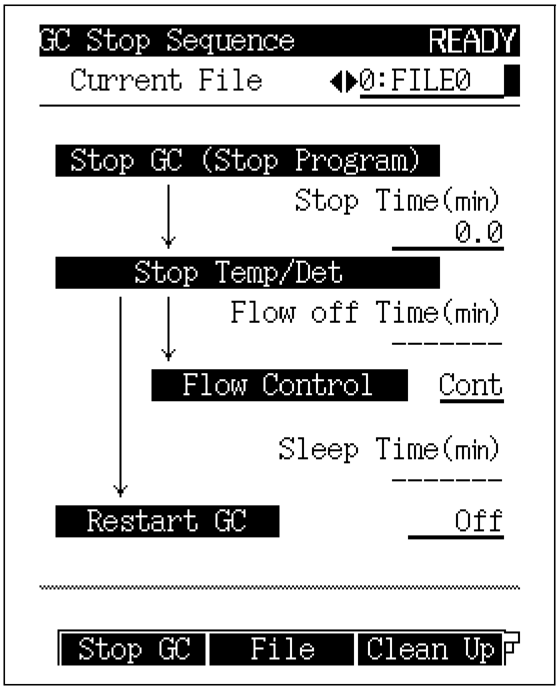


Fig. 7.1.2 Main screen accessed in the [SYSTEM On] status

■ Countdown of the stop time

When all the programs for analysis are finished, the countdown of the stop time begins.

- When the AOC-20i/20s is not used and no batch or program is running
  On pressing [Stop GC] (PF menu), the countdown of the stop time begins immediately.
- When the AOC-20i/20s is used or a batch or program is running
  On pressing [Stop GC] (PF menu), the message "AutomaticStop" appears as shown in Fig. 7.1.3 while continuing operation.

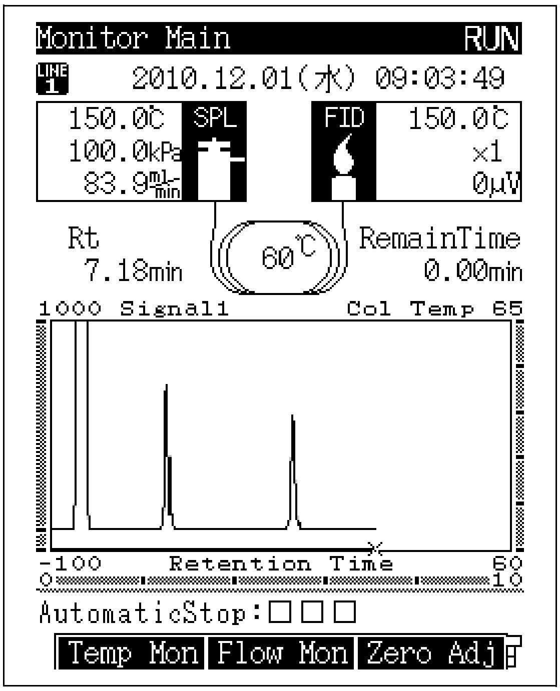


Fig. 7.1.3

When the following conditions are met while "AutomaticStop" is being displayed, the GC recognizes that all the analyses have been finished, and starts the countdown of the stop time.

- Continuous analyses using a batch
  The batch has been finished and all the programs have been executed.
- Continuous analyses of samples with the AOC-20i/20s without using a batch
  The samples set on the AOC have been injected and all the programs have been executed.

NOTE
If the AOC-20i/20s is stopped due to an error, the countdown of the stop time will not begin. If all the programs of the GC-2025 have been executed, reset the AOC-20i/20s to clear the error, and the countdown of the stop time will begin.

- Analysis program execution without using the AOC-20i/20s or batch
  All the programs have been executed.

When the countdown of the stop time has been completed, temperature control and detector control also end.
When temperature control and detector control have ended, the message "Sleep mode" will be displayed as shown in Fig. 7.1.4.

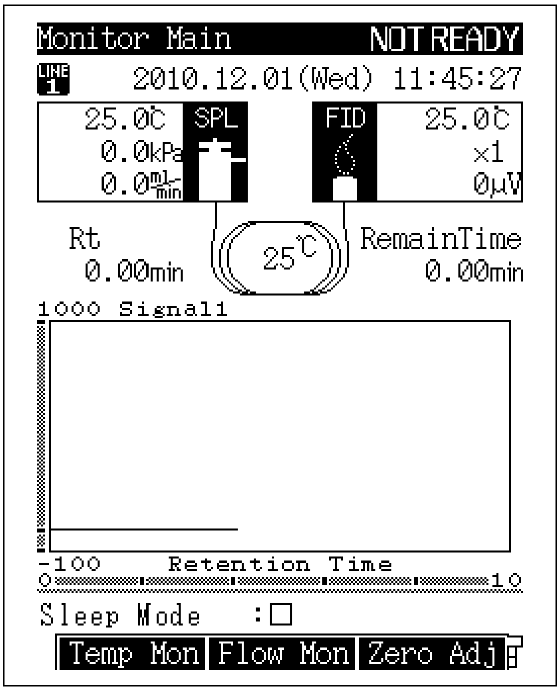


Fig. 7.1.4

7.1.2 Parameter list

CURRENT FILE

Selection: File No. 0–9, Default: File No. 0
Changes the currently loaded file.
The GC will be controlled based on the parameters in the specified file.

START TIME

Range: 0.0–6000.0 min, Default: 0.0 min
Sets the period of time after flow control starts until temperature/detector control starts.

START TEMP/DET

Selection: Yes/No, Default: Yes
Select "Yes" to start temperature/detector control after the start time is finished.
Select "No" to continuously flow the carrier gas and not to start temperature/detector control.

DETECTOR

Selection: On/Off, Default: On
Prepares the configured detector for analysis, but does not ignite the FID.

AUTO IGNIT

Selection: On/Off, Default: On
Ignites the FID detector automatically.
Select "On" for the FID detector to stand by in the ignited state. Select "Off" for it to standby without igniting.

CLEAN UP

Selection: Off/ Analysis Para/Clean Up Para, Default: Off
"Clean up" indicates running a GC program without injecting sample. Select whether to run the clean up program after the GC enters Ready state.
If the maximum temperature of the clean up oven temperature program is too close to maximum temperature of the column, select "Analysis Para" to perform clean up using a regular analysis program.

STOP TIME

Range: 0.0–6000.0 min, Default: 0.0 min
Sets the period of time that elapses before stopping temperature and detector control after [Stop GC] (PF menu) is pressed (or after the message "AutomaticStop" appears if a program is running).

FLOW OFF TIME

Range: 0.0–6000.0 min, Default: --- (because the gas control is set to "Cont".)
Sets the period of time after temperature/detector control ends until gas control ends.
This item cannot be set if "Flow Control" is "Cont" (that is, if carrier gas is kept flowing).

FLOW CONTROL

Selection: End/Cont, Default: Cont
Select [End] to stop gas control after the flow OFF time finishes. This stops the flow of carrier gas.
Select [Cont] to continue the carrier gas flow.

SLEEP TIME

Range: 0.0–6000.0 min, Default: --- (because the RESTART GC is set to "Off".)
Sets the period of time after temperature/detector control ends until the GC restarts.
This item cannot be set if the GC is set to not restart.

RESTART GC

Selection: On/Off, Default: Off
Select [On] to restart the GC after the sleep time elapses.
Select [Off] to disable automatic GC restart.

7.1.3 PF menu

PF menu item	Description	Reference section
Start GC	Starts GC according to the parameters on the [SYSTEM] key main screen.	——
Stop GC	Starts GC according to the parameters on the [SYSTEM] key main screen. If no program is running, the stop time countdown begins immediately when [Stop GC] (PF menu) is selected. If [Stop GC] is selected while a program is running, the stop time countdown begins after the program finishes.	——
File	Displays the file list to change to another method file. On this sub screen, select files to load, edit, copy, initialize and rename.	8.2
Clean Up	Sets clean up parameters. In system ON state, select direct operation (PF menu) to run the clean up.	7.2
Start Seq	Sets the parameters for the next GC start up. Start time, detector and clean up parameters on this sub screen are immediately reflected on the [SYSTEM] key main screen.	7.3
Stop Seq	Sets the stop procedures. This item is not displayed in system ON state.	7.4
Maint INJ	Prepares the GC for maintenance of the injection port (replacement of septum, glass insert, etc.) . When GC is ready for maintenance, the message "GC is ready for maintenance" appears.	18.3, 18.4, 18.5
Anal.	Restores the GC for analysis after performing injection port maintenance. When pressed after maintenance of injection port is completed.	——

NOTE

Once [Maint INJ] in the PF menu is pressed, the [Anal.] button is not displayed until maintenance becomes enabled. This operation cannot be cancelled so wait until INJ maintenance becomes enabled.
When cancellation is necessary, turn off the power after the column temperature has lowered.
Turning off the power when the column temperature is high may deteriorate the column because carrier gas supply is cut off.

7.2 Specifying Clean Up Parameters

7.2.1 Screen description

Select [Clean Up] (PF menu) from the [SYSTEM] key main screen to display the clean up parameter setup screen shown in Fig. 7.2.1. The parameters set for the clean up program are set by including "Clean Up Para" as part of the GC start procedure.
Clean up should be performed to eliminate contamination before analysis.
Initiate the clean up when the gas chromatograph has not been used for a while or if a new column has been installed.

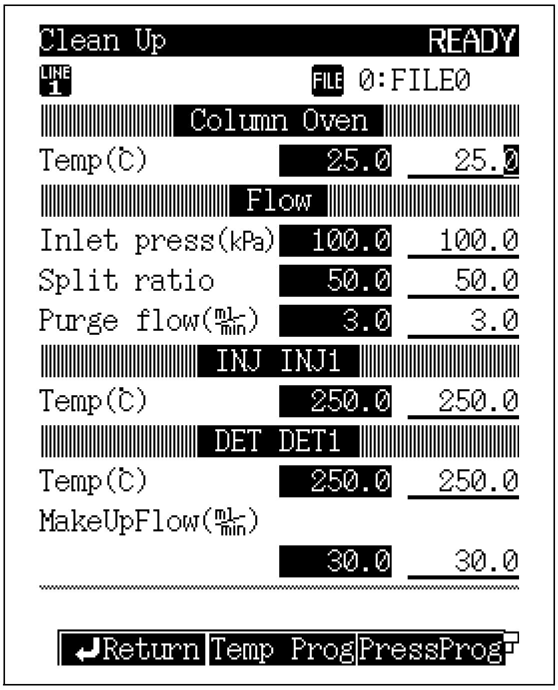


Fig. 7.2.1 Setting the clean up parameters

7.2.2 Parameter list

■ Main screen of clean up

COLUMN OVEN TEMP

Range: 0.0-450.0 °C (set value without exceeding the maximum temperature limits), Default: 25.0 °C
Sets the default value of the column oven temperature when the clean up file is used.
The temperature needs to be set so that the maximum temperature indicated on the column used will not be exceeded.
The regular analysis parameters can be used for clean up by setting "Analysis Para" for the start procedure.
For the maximum temperature limits, see "16.6.4 Setting the maximum temperature limits".

INLET PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 21.5.3.), Default: 100.0 kPa
Sets the default value of the column inlet pressure for the clean up method.

PURGE FLOW RATE

Range: Refer to Fig. 21.5.3, Default: 3.0 ml/min
Sets the septum purge flow rate for the clean up method. The septum purge removes contamination in the injection port near the septum. If the split ratio is set to "-1.0", the total flow rate remains fixed regardless of the oven temperature.

SPLIT RATIO

Range: -1.0/0.0–9999.9, Default: -1.0
Sets the split ratio for the clean up method.
When the split ratio is set to "-1.0", it is controlled so that the total flow rate will be the same as the set value.

INJECTION PORT TEMP

Range: 0.0–400.0 °C, Default: 250.0 °C
Sets the injection port temperature for the clean up method.

DETECTOR TEMP

Range: 0.0–400.0 °C, Default: 250.0 °C
Sets the detector temperature for the clean up method.
For any detector other than an FID, its set temperature must be within the valid range of the detector.

MAKE UP FLOW RATE

The range and default value depends upon the kind of detector. Refer to the values given for each detector.
Makeup gas is inert gas which maximizes detector sensitivity. This sets its flow rate for the clean up method. Each type of detector requires different flow rates of makeup gas.

AUX APC PRESS

Range: 0.0–970.0 kPa, Default: 100.0 kPa
Sets the AUX APC pressure for the clean up method.
This item is only valid when an AUX APC has been installed.

■ Clean up column oven temperature program

(The clean up temperature program consists of a single program ramp.)

CLEAN UP RATE

Range: END/-250.00–250.00 °C/min, Default: END
Sets the rate of column temperature increase for the clean up program.
Refer to "1.2.1 Column oven".

CLEAN UP TEMP

Range: 0.0–400.0 °C, Default: 25.0 °C
Sets the final temperature for the column oven temperature clean up program.
Do not exceed the maximum column temperature.

CLEAN UP TIME

Range: 0.00–9999.99 min, Default: 0.00 min
Sets the final temperature hold time for the clean up program.

■ Clean up column inlet pressure program

(The clean up pressure program consists of a single program ramp.)

CLEAN UP RATE

Range: END/-400.00–400.00 kPa/min, Default: END
Sets the rate of column inlet pressure for the clean up program.
The rate of pressure depends on the total flow rate.

CLEAN UP PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 21.5.1.) , Default: 0.0 kPa
Sets the final pressure for the column inlet pressure clean up program.

CLEAN UP TIME

Range: 0.00–9999.99 min, Default: 0.00 min
Sets the final pressure hold time for the clean up program.

■ Clean up total flow rate program

NOTE
This is not used with the GC-2025.

CLEAN UP RATE

Range: END/-400.00–400.00 ml/min^2, Default: END
Sets the rate of total flow increase for the clean up program.

CLEAN UP FLOW RATE

Range: 0.0–1200.0 ml/min (Refer to Fig. 21.5.1.), Default: 50.0 ml/min
Set the final flow rate for the total flow rate clean up program.

CLEAN UP TIME

Range: 0.00–9999.99 min, Default: 0.00 min
Sets the final flow rate hold time for the clean up program.

7.2.3 PF menu

PF menu	Description	Reference section
Temp Prog	Sets the column oven temperature for the clean up program.	11.2
Press Prog	Sets the column inlet pressure for the clean up program.	12.5.5
Flow Prog	Sets the total flow rate for the clean up program. This is not used with the GC-2025.	——
Run	Displayed only while GC is in system ON state. Immediately runs the clean up program.	——
Stop	Stops clean up. This item is displayed only when the clean up program is in progress.	——
Next Line	Displays the clean up program set up screen for another analytical flow line.	——

7.3 Specifying Start Procedures

7.3.1 Screen description

Select [Start Seq] (PF menu) from the [SYSTEM] key main screen to display the start procedure setup screen shown in Fig. 7.3.1.
On this screen, set whether the system automatically starts (Auto Start) when the power is next turned on, or whether the system does not start until [Start GC] (PF menu) is pressed (Manual Start). Alternatively, only the carrier gas flow is turned on the next time the power is turned on. To start the system, select [Start GC] (PF menu) as for a manual start. This is known as a semi-auto start. Finally, an analysis file can be set to begin the next time the power is turned on or the GC is restarted. Any settings changed on this screen are reflected in the [SYSTEM] key main screen.

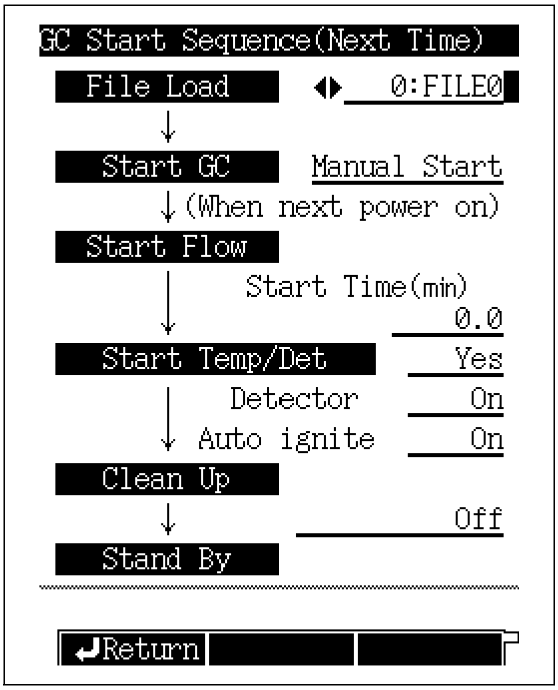


Fig. 7.3.1 Setting the start procedures for the next GC restart

7.3.2 Parameter list

FILE LOAD

Selection: File No. 0–9, Default: Current file
Selects a file to be loaded the next time the power is turned on or the GC restarted.

START GC

Selection: Auto Start/ Manual Start/Semi-Auto, Default: Manual Start
Sets the start method for the next time the power is turned on:
Select "Auto Start" to automatically start the GC.
Select "Manual Start" to start the GC by pressing [Start GC] (PF menu) from the [SYSTEM] key main screen.
Select "Semi-Auto" to start carrier gas flow only. The GC must still be started by pressing [Start GC] (PF menu) from the [SYSTEM] key main screen.

START TIME

Range: 0.0–6000.0 min, Default: 0.0 min
Sets the period of time after gas control starts until temperature/detector control starts.
The "Start Time" value on the [SYSTEM] key main screen is set here.

NOTE

The start time set here can be overridden by entering another start time in the [Start GC] (PF menu) screen.

This function is useful if the preset start time is too long.

START TEMP/DET

Selection: Yes/No, Default: Yes
Select "Yes" to start temperature/detector control after the start time elapses.
Select "No" to continue carrier gas flow only without starting temperature/detector control.

DETECTOR

Selection: On/Off, Default: On
Prepares the configured detector for analysis, but does not ignite the FID.
The "DETECTOR" setting on the [SYSTEM] key main screen is set here.

AUTO IGNITE

Selection: On/Off, Default: On
Establishes FID ignition conditions.
Select "On" for the FID detector to stand by in the ignited state. Select "Off" for it to stand by without igniting.
The "AUTO IGNIT" setting on the [SYSTEM] key main screen is set here.

CLEAN UP

Selection: Off/Analysis Para/Clean Up Para, Default: Off
When performing clean up, select whether to use an analysis method or the program set in [Clean Up] (PF menu).
The "CLEAN UP" setting on the [SYSTEM] key main screen is set here.

7.3.3 Example: starting the system with carrier gas flow

In this example, the carrier gas flows for a certain period of time before temperature control begins. Set the start time considering the polarity of the column used and dead time (time spent until substances not adsorbed by the stationary phase elute).

- In the case of a 30 m neutral column and a 30 cm/sec linear velocity (dead time 100 sec.): Approximately 5 min.
- In the case of a 60 m high-polar column and a 20 cm/sec linear velocity (dead time 300 sec.): At least 10 min.
- If the system has been out of use for a time with no column connected: set a START TIME of 1 to several hours.

7.4 Specifying the Stop Procedures

7.4.1 Screen

Select [Stop Seq] (PF menu) from the [SYSTEM] key main screen to display the stop procedure setup screen shown in Fig. 7.4.1. "Stop Seq" is displayed only when the system is in the OFF state.

The stop procedure setup screen consists of parameters equivalent to those on the [SYSTEM] key main screen when the GC is in the system ON state, except that the current file cannot be changed.

Parameter changes on the stop procedure setup screen are reflected on the [SYSTEM] key main screen.

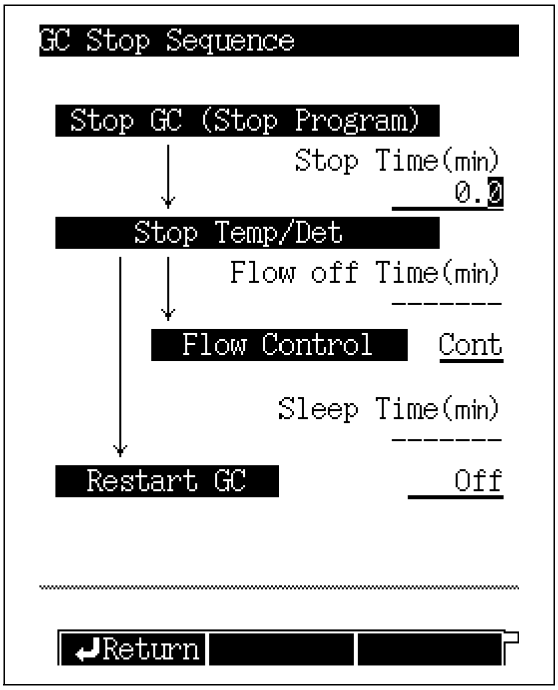


Fig. 7.4.1 Setting the stop procedures

7.4.2 Parameter list

STOP TIME

Range: 0.0–6000.0 min, Default: 0.0 min

Sets the period of time that elapses before stopping temperature and detector control after [Stop GC] (PF menu) is pressed (or after the message "AutomaticStop" appears if a program is running).

The "STOP TIME" value on the [SYSTEM] key main screen is set here.

FLOW OFF TIME

Range: 0.0–6000.0 min, Default: --- (because the gas control is set to "Cont".)

Sets the period of time between the end of temperature/detector control and the end of the gas control.

This item cannot be set if "Flow Control" is "Cont" (that is, if the carrier gas is kept flowing).

The [FLOW OFF TIME] setting on the [SYSTEM] key main screen is set here.

FLOW CONTROL
Selection: End/Cont, Default: Cont
Select "End" to end gas control after the flow off time elapses.
Select "Cont" to continue the carrier gas flow.
The "GAS CONTROL" setting on the [SYSTEM] key main screen is set here.

SLEEP TIME
Range: 0.1–6000.0 min, Default: --- (because the RESTART GC could be set to "Off".)
Sets the period of time after the temperature/detector control ends until the GC restarts.
This item cannot be set if the GC is not set to restart automatically.
The "SLEEP TIME" setting on the [SYSTEM] key main screen is set here.

RESTART GC
Selection: On/Off, Default: Off
Select "On" to restart the GC once the sleep time has elapsed.
Select "Off" to not restart the GC automatically.
The "Restart GC" setting on the [SYSTEM] key main screen is set here.

7.4.3 System shut down examples

The following examples show various situations where the STOP TIME and the FLOW OFF TIME can be used effectively. The FLOW OFF TIME should be longer than the time for the column oven cooling.

- After the end of an analysis, each heated zone is cooled. Once the column oven is cool, the carrier gas flow is shut off.

  STOP TIME = 0 minutes
  FLOW CONTROL = End
  FLOW OFF TIME = Approx. 20 minutes

- A column is conditioned, then the column oven is cooled. The carrier gas flow is then shut down.

  STOP TIME = Column conditioning time
  FLOW CONTROL = End
  FLOW OFF TIME = Approx. 20 minutes

- At the end of an analysis, each heated zone is cooled, but the carrier gas is kept flowing for rapid equilibration for the next day's analysis. The next day, the system is automatically restarted (15 hours = 900 minutes later), and the temperature control resumes.

  START TIME = 0 minutes (because the carrier gas continued to flow)
  STOP TIME = 0 minutes
  FLOW CONTROL = Cont (to keep carrier gas flow on)
  RESTART GC = On
  SLEEP TIME = 900 minutes (at the end of the SLEEP TIME, the GC restarts)

- At the end of an analysis, each heated zone is cooled, and the carrier gas flow is stopped once the column oven is cool. The following day (15 hours = 900 minutes later), the carrier gas flow is turned back on and the temperature control begins.

  START TIME = 10 minutes (because carrier gas flow was off)
  STOP TIME = 0 minute
  FLOW CONTROL = End
  FLOW OFF TIME = Approx. 20 minutes
  RESTART GC = On
  SLEEP TIME = 900 minutes (at the end of the SLEEP TIME, the GC restarts)

NOTE

When the GC is in the system OFF state, the fan automatically stops based on the selection of the Fan Stop Temp. Refer to "16.6.11 Other settings" in "16.6 GC Configuration".

8.1 [SET] Key Main Screen

8.1.1 Main screen

Press the [SET] key to display the main screen shown in Fig. 8.1.1 and to make frequently used parameter settings.
To make changes to the [COL], [FLOW], [INJ], and [DET] parameters, the [customiz] (PF menu) key is pressed. Changes to these parameters are reflected in the [SET] key main screen.
The screen shows parameters for the components which make up one analytical flow line (injection port, detectors, and options). Use the [Line Config] (PF menu) to change the components in the flow line.
When the system is turned on, the temperatures are controlled for the components in the flow line. If the AFC is present, the carrier gas is supplied to the injection port specified. If the APC is present, detector gases are supplied to the detector specified. One injection port and up to two detectors can be included in an analytical flow line.

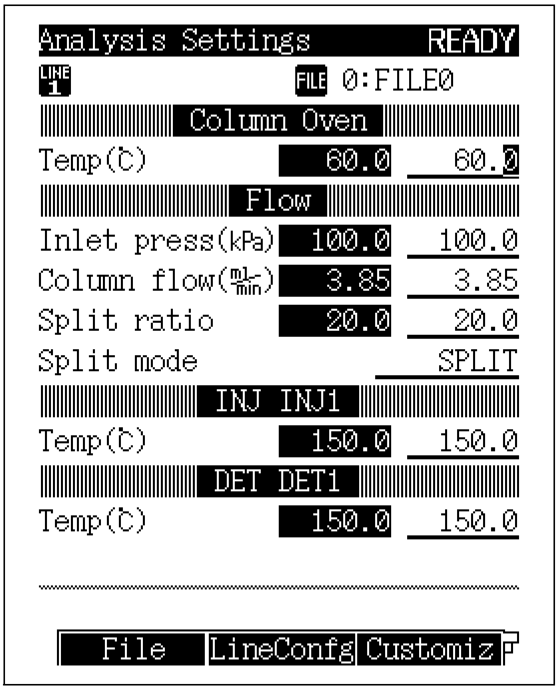


Fig. 8.1.1 [SET] key main screen

8.1.2 Parameter list

COLUMN OVEN

Range: 0.0–400.0 °C[1], Default: 25.0 °C

Sets the default temperature in the oven temperature program.

INLET PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 21.5.1.), Default: 100.0 kPa

Sets the column inlet pressure.

The initial pressure must be set in order to create a pressure program.

When the control mode is set to "pressure", the system keeps the column inlet pressure at a constant value while the column oven temperature program is running.

COLUMN FLOW RATE

Default:[2] 1.00 ml/min

Sets the carrier gas flow rate at the capillary column exit (atmospheric pressure at 25 °C).

When you set the carrier gas flow rate, the system calculates the column inlet pressure based on the inner diameter, the length and the film thickness of the column. The column flow rate is set separately so that the carrier gas flow rate desired occurs at the initial temperature in the column oven temperature program.

LINEAR VELOCITY

Default:[3] 30.0 cm/s

Sets the average linear velocity of the carrier gas flowing in the capillary column.

When you set the linear velocity, the system calculates the column inlet pressure based on the inner diameter, the length and the film thickness of the column. The linear velocity is set separately so that the linear velocity desired occurs at the initial temperature in the oven temperature program.

When the control mode is set to "linear velocity", the column inlet pressure automatically changes so that the linear velocity remains constant even while the column oven temperature program is running.

TOTAL FLOW RATE

Range: 0.0–1200.0 ml/min (Refer to Fig. 21.5.1.), Default: 500.0 ml/min

The total flow rate varies depending on the injection mode as follows:

In split or splitless mode, the total flow rate is equivalent to "column flow rate + split flow rate + septum purge flow rate".

SPLIT RATIO

Range: -1.0/0.0–9999.9, Default: -1.0

The split ratio is "split flow rate / column flow rate."

When you set a split ratio, the system sets the total flow rate based on the calculated carrier gas flow rate and split flow rate, so that the desired split ratio occurs at the column oven temperature.

Set the split ratio to "-1.0" to fix the total flow rate regardless of the column oven temperature.

PURGE FLOW RATE

Default:[4] 3.0 ml/min

Set the septum purge flow rate.

SAMPLING TIME

Range: 0.00–9999.99 min, Default: 1.00 min

Sets the sampling time for splitless analysis.

The sampling time indicates the period of time after analysis starts until the split flow line is opened.

SPLIT MODE

Selection: SPLIT/SPLITLESS/DIRECT, Default: SPLIT

SPLIT: Controls the column inlet pressure and the total flow rate so that the column inlet pressure and split ratio occur as specified.

SPLITLESS: Closes the split flow line during the sampling time so that the set column inlet pressure is controlled by the Total Flow Controller.
Opens the split flow line and controls the Electronic Split Controller so that the preset column inlet pressure occurs (Refer to Fig. 12.5.2.) after the sampling time elapses.
To set the time of the Splitless auto off, refer to "16.6.11 Other settings" in "16.6 GC Configuration".

DIRECT: Closes the split flow line and the set column inlet pressure, linear velocity (in pressure mode) or the set total flow rate (in flow mode) occurs. When making direct injection analyses, select WBI in the setup screen so that SPLIT mode is not available. With the GC-2025, this mode is used only for SPL leak check.

CONTROL MODE

Selection: PRESS/VELOCITY, Default: PRESS

When the injection mode is set to "SPLIT" or "SPLITLESS"

PRESS: Controls the system so that the column inlet pressure remains constant.

VELOCITY: Controls the system so that the linear velocity remains constant.

When the injection mode is set to "DIRECT"

PRESS: Controls the system so that the column inlet pressure remains constant.

VELOCITY: Controls the system so that the linear velocity remains constant.

INJECTION PORT TEMP

Range: 0.0–400.0 °C, Default: 25.0 °C

Set the injection port temperature (the default temperature for a programmable injection port).

DETECTOR TEMP

Range: 0.0–400.0 °C, Default: 25.0 °C

Set the detector temperature.

Allowable temperature ranges vary for each detector. Refer to range specified for the detector(s) in use.

1 Using CRG: -99.0 ~ 400.0 °C (Refer to 15.3)
2 The column flow rate ranges from 0 to the value at which the calculated column inlet pressure is 970 kPa or less and the calculated total flow rate is 1,200 ml/min.
3 The linear velocity ranges from 0 to the value at which the calculated column inlet pressure is 970 kPa or less.
4 The purge flow rate ranges from 0 to the total flow rate subtracted by the column flow rate and the split flow rate.

8.1.3 PF menu

PF menu	Description	Reference section
File	Displays file list to change the current file. On this sub screen, you can select files to load, copy, initialize and rename.	8.2
Line Confg	Specifies the injection port, detectors and options which make up the analytical flow line. Units set on this sub screen are displayed on the [SET] key main screen.	8.3
Customiz	Set the parameters displayed on the [SET] key main screen.	8.4
Print	Prints temperature, pressure and total flow rate on a Chromatopac.	——
Next Line	Switches through each of the parameter screens in turn. Press the [SET] key from the [SET] key main screen to switch to the next screen.	——

8.2 File Management

8.2.1 Screen description

Select [File] (PF menu) from the [SYSTEM] key main screen to display the file list shown in Fig. 8.2.1.
To change the current file, enter a file No. or move the cursor using the [△] and [▽] key; then press the [Load] (PF menu) key.

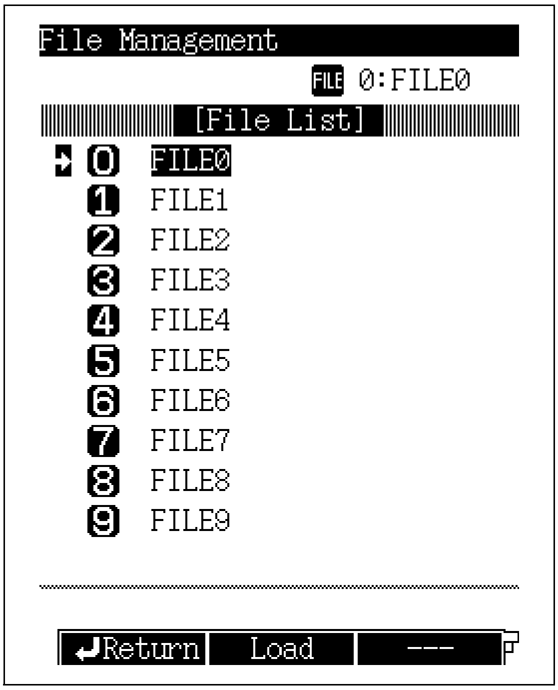


Fig. 8.2.1 File list screen

8.2.2 PF menu

PF menu	Description	Reference section
Load	Selects the current file.	——
Copy	Copies file name and file contents from the source file to a destination file.	8.2.3
File Init	Initializes file name and file contents. The current file cannot be initialized.	8.2.5
Rename	Changes the file name.	8.2.4

8.2.3 Copying a file

Select [Copy] (PF menu) on the file list screen to display the file copy screen shown in Fig. 8.2.2. Enter the source file number (Src. File) and the destination File number (Dst. File), then press [Copy] (PF menu). The name and contents of the source file are copied to the destination file.

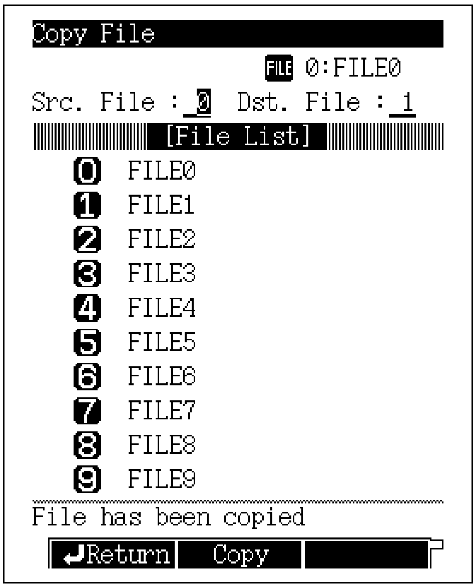


Fig. 8.2.2 Copying File

8.2.4 Renaming a file

Select [Rename] (PF menu) on the file list screen to display the file rename screen shown in Fig. 8.2.3. Move the cursor using the [△] and [▽] keys to select the file to be renamed. Enter the new file name using the numeric keys and the [◁] and [▷] keys. Refer to "5.3.5 Changing item names" for more information.

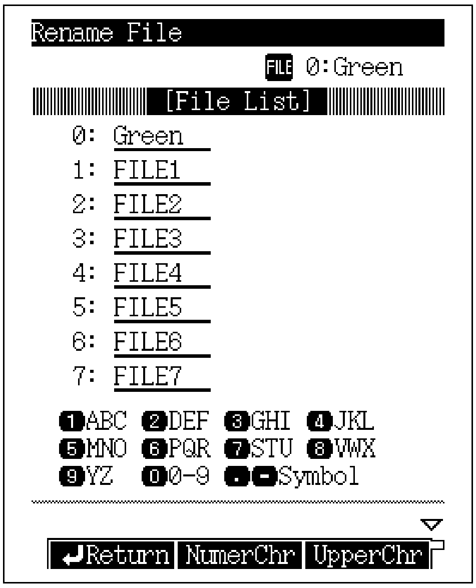


Fig. 8.2.3 Renaming a file

8.2.5 Initializing a file

Select [File Init] (PF menu) on the file list screen to display the file initialization screen shown in Fig. 8.2.4. Enter the file number or move the cursor to select the file. Then press [File Init] (PF menu).
During file initialization, the file name and contents are deleted. The parameters return to their default settings. Once a file is initialized, the action cannot be undone. The current file cannot be initialized.

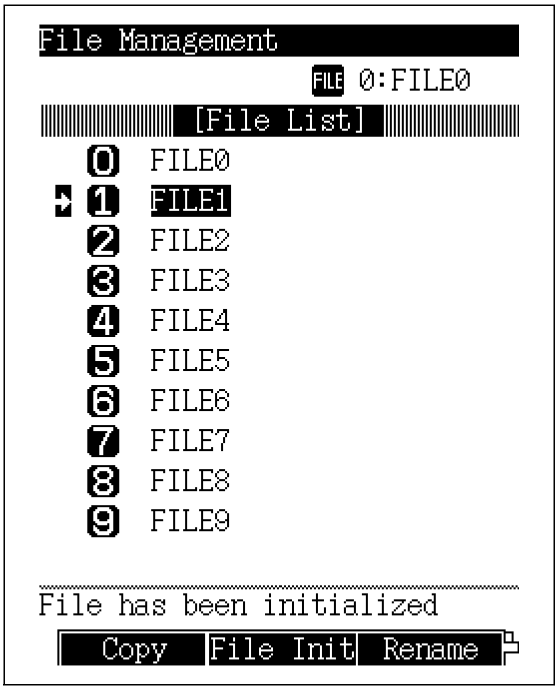


Fig. 8.2.4 Initializing a file

8.3 Specifying the Analytical Flow Line Components ([Line Config])

8.3.1 Screen description

Select [Line Confg] (PF menu) from the [SET] key main screen to display the Line Configuration screen shown in Fig. 8.3.1.
The [SET] key main screen displays the parameters for one analytical flow line. The line configuration screen determines the components (injection port, detector(s), and options) of the analytical flow line.
When the system is turned on, the temperatures are controlled for the components in the flow line. If the AFC is present, the carrier gas is supplied to the specified injection port. If the APC is present, the detector gases are supplied to the detector(s) specified. One injection port and up to two detectors can be included in an analytical flow line. Temperatures are not controlled, and gases are not supplied to components which are not part of the analytical flow line.
The line configuration screen displays all the components installed.
Move the cursor to the desired component using the [△] and [▽] keys. Use the [◁] and [▷] to specify the analytical flow line (1-4) to which the component belongs. Press [Enter] to validate the selection.

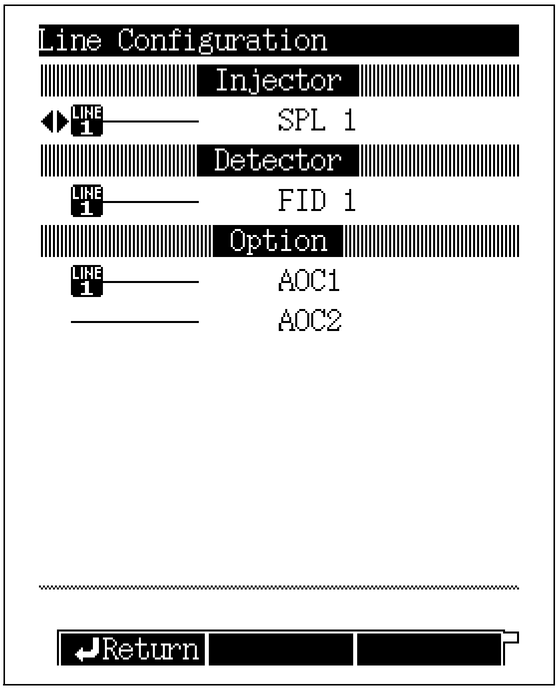
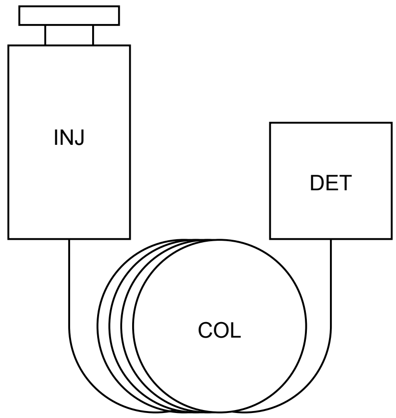


Fig. 8.3.1 Line configuration setup screen

■ Line configuration examples

The GC-2025 settings are explained for the case where an SPL (split/splitless injection port) and an FID (hydrogen flame ionization detector) are installed.
Select the SPL and the FID for line 1.
In this case, only the temperature of the SPL and the FID will be controlled. Carrier gas and detector gas will be supplied.



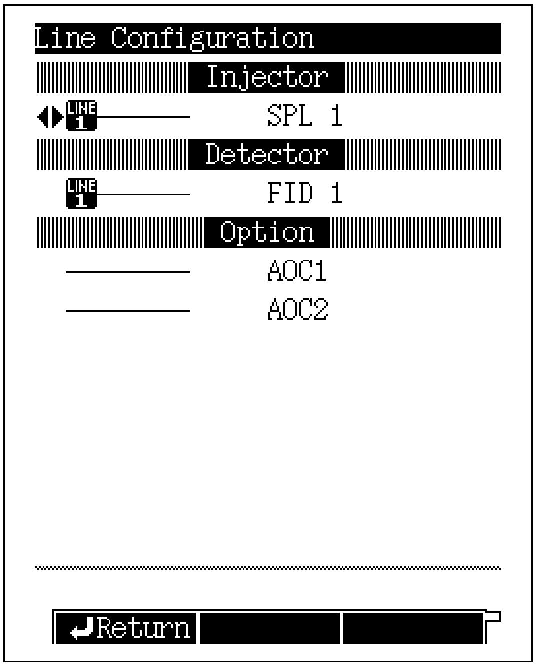


Fig. 8.3.2 Line configuration

8.4 Changing Items Displayed with [Customiz]

8.4.1 Screen description

Select [Customiz] (PF menu) from the [SET] key main screen to display the Display Customization screen shown in Fig. 8.4.1.
On this screen, set the items which will be displayed on the [SET] key main screen. Set an item to "On" to display it on the main screen. Set the item to "Off" to wide its display.
Even if the sampling time display is "On" the sampling time is only displayed in SPLITLESS mode.
Move the cursor using the [△] and [▽] keys to select an item to be changed; select "On" or "Off" using the [◁] and [▷] keys, then press the [ENTER] key to validate the selection.
The default setting displays the column inlet pressures, column flow rate, split ratio, sampling time and the split mode.

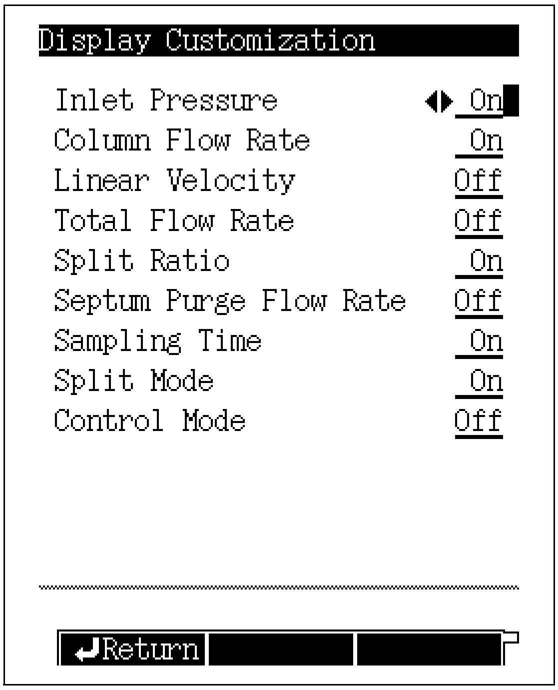


Fig. 8.4.1 Customizing the [Set] key main screen

9.1 [MONIT] Key Main Screen

9.1.1 Screen description

Press the [MONIT] key to display the main monitor screen shown in Fig. 9.1.1. In the upper portion of the main screen, monitor the status of the injection port, the column and the detectors configured in each line. In the lower portion of the screen, monitor the chromatogram, the temperature program, etc.
Select [Temp Mon] and [Flow Mon] (PF menu) to monitor the temperature, the pressure and the flow rate of all injection ports, columns and detectors configured in all configured lines.

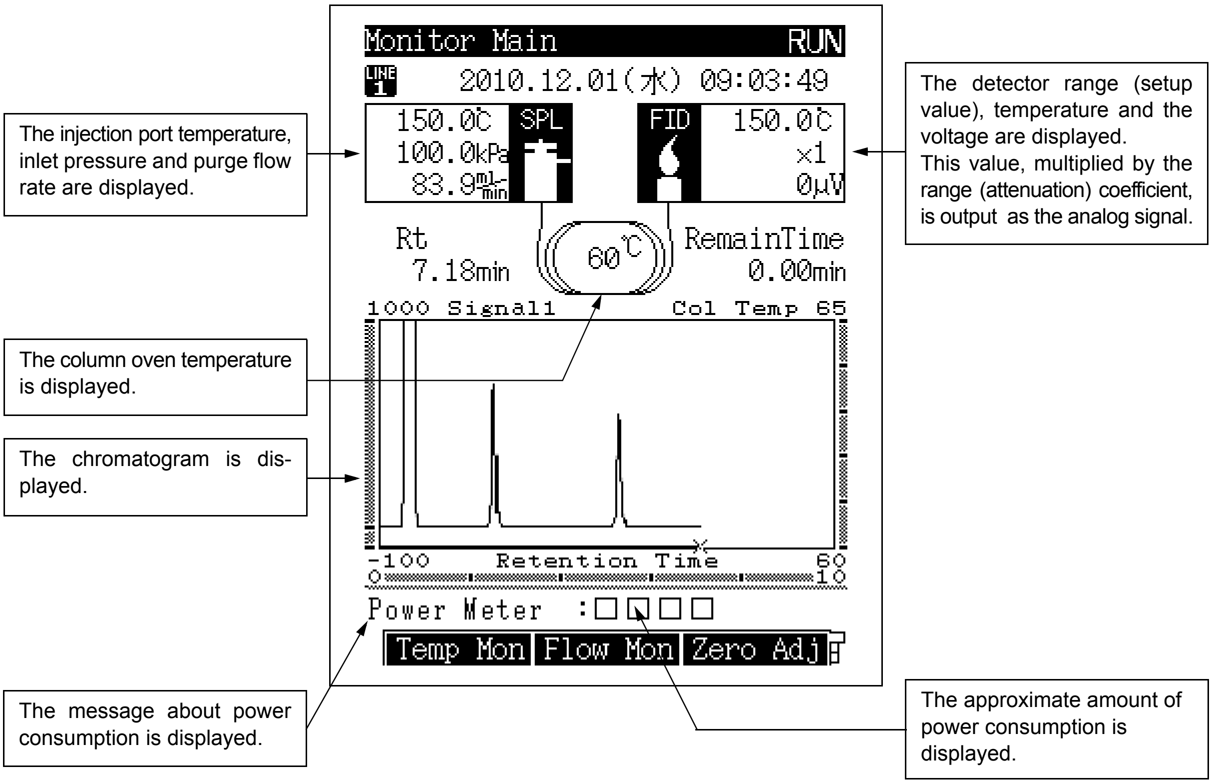


Fig. 9.1.1 [MONIT] key main screen

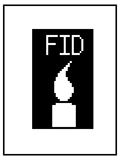
NOTE

- When an error message or warning message appears, the message about power consumption and the level meter will not be displayed. To display the message about power consumption and the level meter, press the [CE] key and clear the error.
- The message about power consumption and the level meter are displayed in the same position on the screen other than the [MONIT] key main screen.

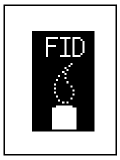
■ Detector status

The ignition status of an FID or FPD detector can be confirmed on the monitor screen.

For a FID:



Flame = On



Flame = Off

Fig. 9.1.2

■ Message display

The message displayed in the comment area will change depending on the amount of power consumption.

PWR Plug check:
(power consumption exceeding 800 W for 100 V model or 1600 W for 230 V model)
Power consumption is at a high level continuously. If the power plug is not inserted securely, ignition may occur due to overheating. Check the condition of the power plug.

NOTE

- Even after power consumption is reduced below 800/1600 W, the message "PWR Plug check" may remain for a while.
- Press the [CE] key to clear the message.

Power Meter: (power consumption of 800/1600 W or below)
Ordinary operation is in progress.

AutomaticStop:
Since analysis is in progress, the GC holds up the countdown of the stop time. (See "7.1 [SYSTEM] Key Main Screen".)

Sleep Mode:
To reduce power consumption during standby, the GC is stopped for the set sleep time. (See "7.4 Specifying the Stop Procedures".)

■ Power consumption level meter

To indicate high power consumption, the level exceeding 800 W is shown with ■ instead of □.

□ and ■ denote 200 W each (at power voltage 100 V).

□ and ■ denote 400 W each (at power voltage 230 V).

	(100V/230V)
□	Up to 200/400 W
□□	200/400 to 400/800 W
□□□	400/800 to 600/1200 W
□□□□	600/1200 to 800/1600 W
□□□□■	800/1600 to 1000/2000 W
□□□□■■	1000/2000 to 1200/2400 W
□□□□■■■	1200/2400 W or above

NOTE

The level meter displays approximate power consumption by heaters at a power voltage of 100 V or 230 V.

When the power voltage is 115 V, the power consumption is approximately 1.32 times higher than the displayed level.

Power consumption by electric circuits such as built-in power supply for Auto-injector is not included.

■ Changing the monitor magnification (zoom)

The chromatogram and the temperature (or pressure) program is displayed on the lower portion of the monitor screen.
The signal axis and the time axis are displayed. If there is a temperature (or pressure) program, the temperature axis (or pressure axis) is also displayed. Use the [Chng Graph] (PF menu) key to switch the graph displayed.
Use the numeric keys and cursor keys to change the magnification and the position of each axis on the screen.

NOTE

If the temperature (or pressure) program is displayed, the time axis (x-axis) cannot be changed.

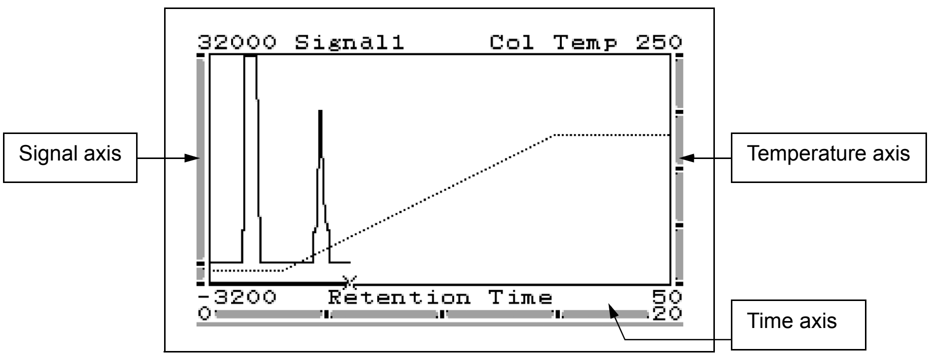
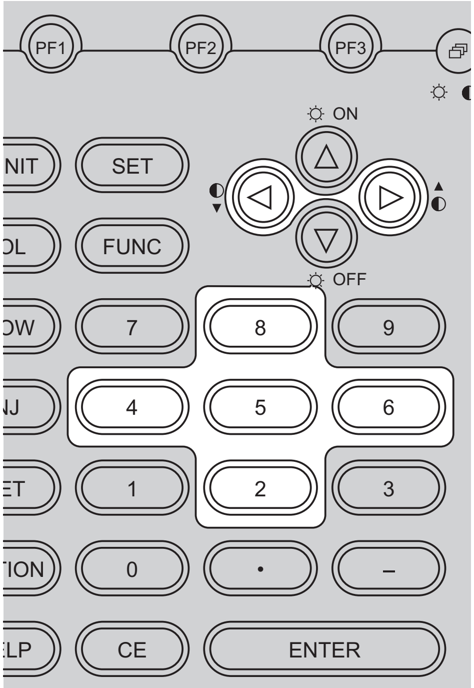


Fig. 9.1.3 Monitor screen (chromatogram and temperature program)



To magnify the time axis:

4 : Zooms the time axis scale.

6 : Unzooms the time axis scale.

To magnify the signal axis:

2 : Zooms the signal axis scale.

8 : Unzooms the signal axis scale.

To maximize the display:

6 : Automatically adjusts the signal axis so that the maximum value of the chromatogram signal is displayed on the screen.

Keys to move along the time axis

▷ : Moves the chromatogram in the + direction.

◁ : Moves the chromatogram in the - direction.

9.1.2 Parameter list

RETENTION TIME (Rt)

Retention time is the length of time from compound injection to detection.

The retention time is specific to each compound. Compounds are identified based on matching the retention time to a standard compound retention time.

REMAIN TIME

The longest program time subtracted by the current retention time is displayed.

LONGEST PROGRAM TIME

The longest program time indicates the total time of the longest program when comparing the temperature program, the pressure program, the flow rate program and the time program.

9.1.3 PF menu

PF menu	Description	Reference section
Temp Mon	Displays the current and set temperatures of column, injection port and detector.	9.2
Flow Mon	Displays inlet pressure, total flow rate and purge flow rate for injection port, and hydrogen flow rate, air flow rate and makeup gas flow rate for detector. The display format depends on the type of flow controller installed.	9.3
Zero Adj	Automatically moves the baseline to zero point.	9.4
Zero Free	Returns to the baseline level before zero point adjustment.	9.4
Up	Moves the baseline up by 100 µV from current level.	9.4
Down	Moves the baseline down by 100 µV from current level.	9.4
Chng Graph	Switches the graph display from chromatogram and column oven temperature program to chromatogram and pressure program.	——
Chng Line	Displays the monitor screen for another configured analytical line. Switches between monitored lines by pressing [MONIT] key from the monitor screen.	——

9.2 Monitoring the Temperature with [Temp Mon]

9.2.1 Screen description

Press [Temp Mon] (PF menu) from the [MONIT] key main screen to display the Temp Monitor screen shown in Fig. 9.2.1.
Monitor the temperature of all installed column ovens, injection ports and detectors from this screen.

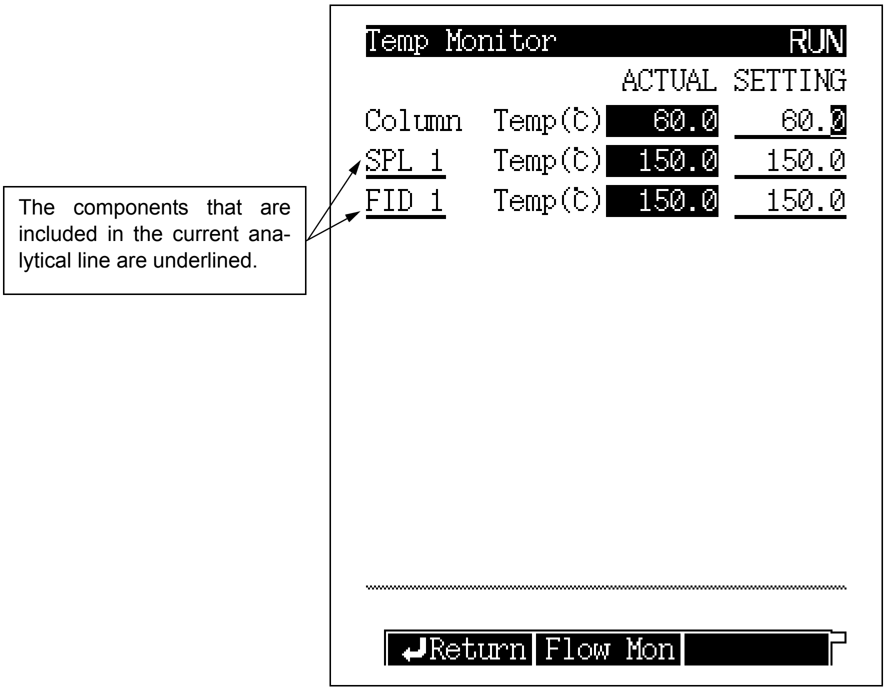


Fig. 9.2.1 Temperature monitor

NOTE
Heated zones without installed components are not displayed on the screen.

9.2.2 PF menu

PF menu	Description	Reference section
Flow Mon	Monitors pressure and flow rate for the injection ports and detectors.	9.3

9.3 Monitoring the Flow Rate with [Flow Mon]

9.3.1 Screen description

Press [Flow Mon] (PF menu) from the [MONIT] key main screen to display the Flow Monitor screen shown in Fig. 9.3.1.
Monitor the flow rate and the pressure of the injection ports, and the detector gas flow rates of the detectors.

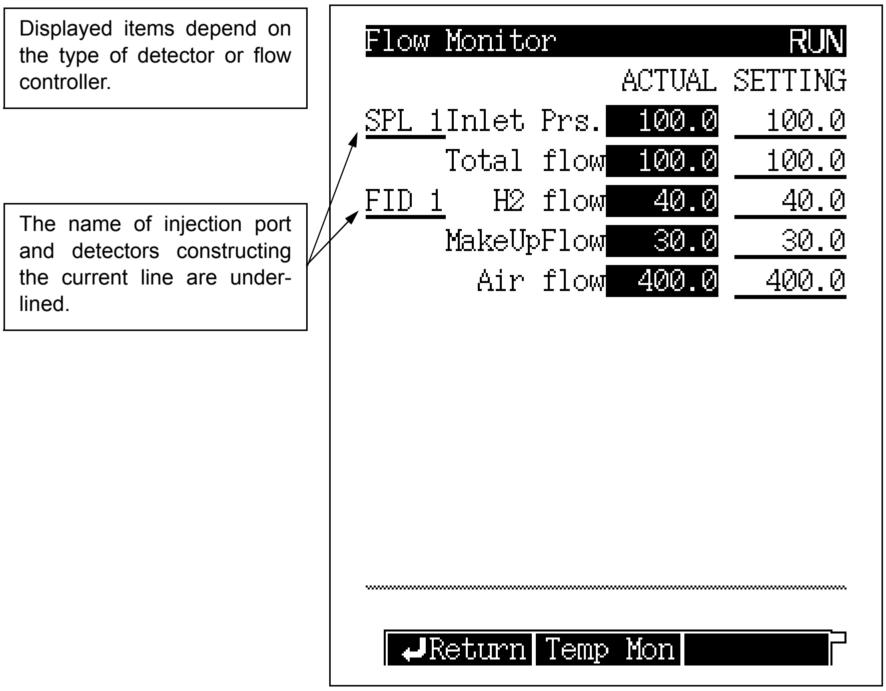


Fig. 9.3.1 Flow rate monitor

NOTE
Flow controllers that have hot been installed are not displayed on the screen.

9.3.2 PF menu

PF menu	Description	Reference section
Temp Mon	Monitors temperature of the column oven, injection ports and detectors.	9.2

9.4 Zero Point Adjustment

Execute zero point adjustment when the baseline is greatly off from zero. Press [Zero Adj] (PF menu) to perform zero point adjustment. Adjustment can also be made for any value.

9.4.1 Screen description

Press [Zero Adj] or [Zero Free] (PF menu) from the [Monit] key main screen, the chromatogram displayed on the monitor screen changes as shown in Fig. 9.4.1 or Fig. 9.4.2.
Press [Up] or [Down] (PF menu) to adjust the baseline level manually.
Zero point adjustments are effective not only for the GC monitor screen, but also a connected PC or Chromatopac. However, zero point adjustments made on the Chromatopac do not adjust the monitor screen baseline level.

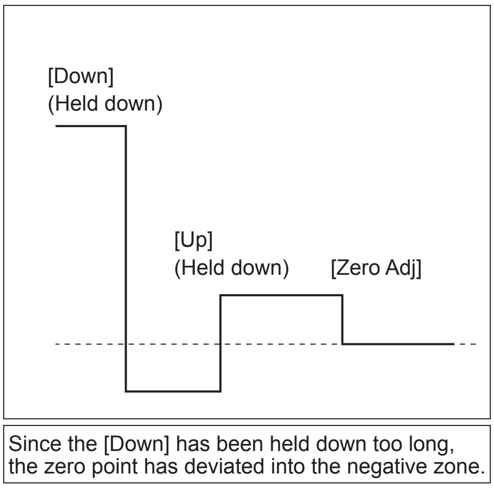


Fig. 9.4.1 Zero point adjustment

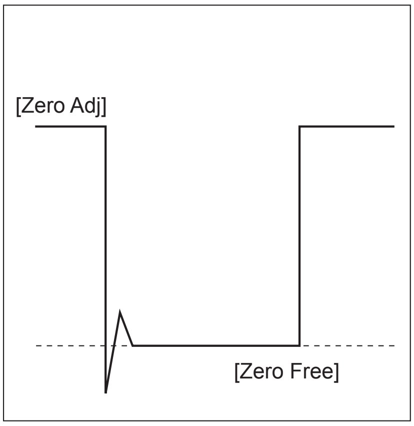


Fig. 9.4.2 Zero free adjustment

NOTE
Zero point adjustments are only valid for the currently displayed detector. To adjust the zero point for another detector, first switch to its display by pressing [Chng Line] (PF menu), then execute the adjustment.

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10.1 Making an Injecting and Starting an Analysis

10.1.1 Verifying the gas chromatograph status

(1) Ensure that the STATUS indicator light is green.
(2) When the STATUS light is green, perform a zero point adjustment (See "9.4 Zero Point Adjustment").
(For a description of the items which determine the Ready state, refer to "16.6.6 Setting the ready check parameters".)

10.1.2 Making manual injection

WARNING

Wear protective goggles when handling samples.

■ Aspiration (for liquid sample)

1. Preparation

- 10 µl syringe
- Sample
- Rinse solvent
- Liquid waste container

2. Syringe handling precautions

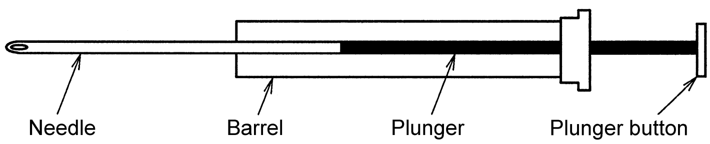


Fig. 10.1.1 Typical syringe

- Do not bend it or touch it. Keep it clean.
- Never bend the needle.

3. Solvent pre-wash

Clean the syringe with solvent 3 to 5 times using the following procedure.
(1) Place the syringe into the rinse solvent. Pull the plunger to aspirate approximately 10 µl of solvent.
(2) Expel the solvent into the liquid waste container.

4. Sample pre-wash

Flush the syringe with sample 3 to 5 times using the following procedure.
(1) Place the syringe into the sample. Pull the plunger to aspirate approximately 10 µl of sample.
(2) Expel the sample into the liquid waste container.

5. Preparing to inject

(1) With the needle in the sample vial, pump the plunger to eliminate air bubbles inside the syringe. Aspirate slowly and discharge quickly for higher effectiveness.

(2) After air bubbles are eliminated, aspirate an exact amount of necessary sample (e.g. 1 μl).

(3) Wipe off the sample on the needle with a clean lint-free paper.

(4) Lift the plunger and aspirate the air so that no sample will remain in the needle.

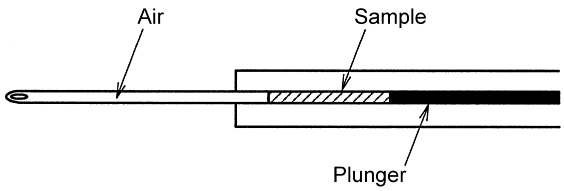
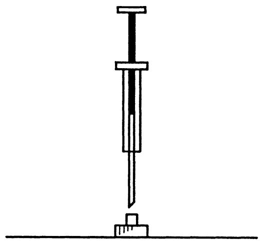
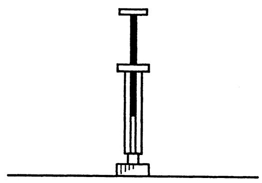
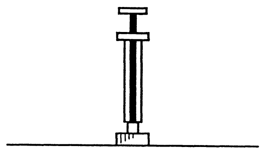
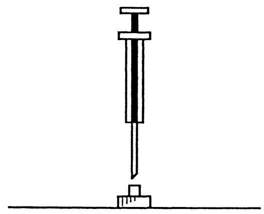


Fig. 10.1.2

■ Injection

			
After the sample is aspirated, insert the syringe into the injection port.	Insert syringe until it touches the needle guide.	Push plunger to inject sample. At same time, press the [START] key of the gas chromatograph.	Promptly pull out the syringe.

10.1.3 Starting the analysis

A green STATUS light indicates that the GC is ready for analysis.
Press the [START] key to start the temperature program, time program and pressure program. The start signal is sent to the data processing unit to start analysis.
Any pre-set programs execute prior to the start of the analysis programs.
Any pre-run programs execute prior to the start of the analysis programs or transmission of the start signal to the data processing unit.

10.2 Terminating the Analysis

10.2.1 Terminating the analysis

When the various programs (temperature, time, pressure, and flow rate) are finished, the gas chromatograph automatically returns to the initial status and becomes ready.
To stop the programs before their completion, press the [STOP] key. The chromatograph automatically returns to the ready state.

10.2.2 External devices

■ When the gas chromatograph is connected to a Chromatopac

- Key operation of the gas chromatograph
  Press the [START] key of the gas chromatograph to start the Chromatopac automatically. Pressing the GC [STOP] key, however, does not stop the Chromatopac.

NOTE
To stop the Chromatopac from starting automatically, refer to "16.6.9 Setting the link device code".

- Key operation from the Chromatopac
  The gas chromatograph is not controlled by the Chromatopac. Pressing the Chromatopac [START] or [STOP] key does not start or stop a GC analysis.

■ When the gas chromatograph is linked to a personal computer (PC)

Press the GC [START] key or the PC [STOP] key to start both units.
However, each unit must be stopped individually. Stopping one unit does not affect the other.
The end of a batch sequence signals both units to stop.

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11.1 [COL] Key Main Screen

11.1.1 Screen description

Press the [COL] key to display the column screen shown in Fig. 11.1.1. The oven temperature program is set from this screen.
Enter a value other than 0 in the rate field displayed with "END". Once a valid rate has been entered, set the temperature (final temp) and time (hold time) for the line.
In addition to the oven temperature program, the equilibration time is set from this screen. The equilibration time is the length of time allowed for the oven temperature to properly equilibrate before the system is ready.

Up to 20 temperature increase/ decrease ramps can be set.

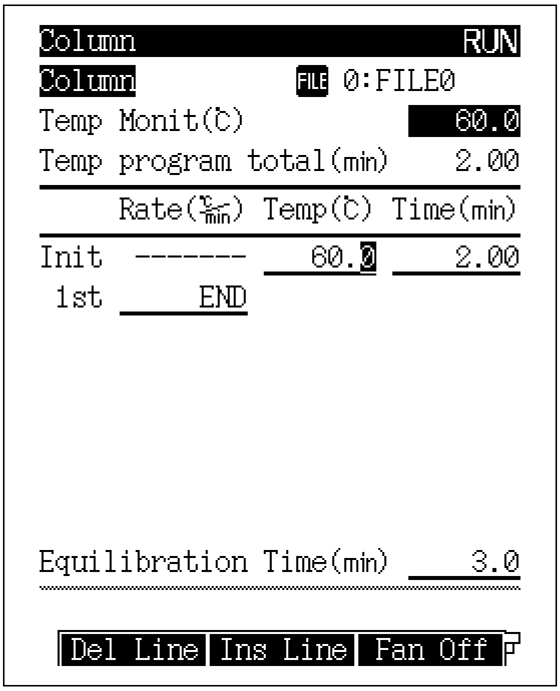


Fig. 11.1.1 [COL] key main screen

NOTE
Press the [COL] key, to move the cursor directly to the initial temperature portion.
This facilitates program edits when only the initial temperature needs to be changed.

11.1.2 Parameter list

TEMP

Range: 0.0–400.0 °C, Default: 25.0 °C

Set the initial and the final temperature for each ramp of in the oven temperature program. The column oven temperature should never exceed the maximum operating temperature of the column. Keep the column temperature as low as possible to prolong the column life and reduce detector noise. To set the maximum oven temperature, refer to "16.6.4 Setting the maximum temperature limits".

CAUTION

Never increase the column oven temperature while air (oxygen) is mixed with the carrier gas. This can damage the column (especially for polar columns).

TIME

Range: 0.00–9999.99 min, Default: 0.00 min

Set the hold time for the initial temperature and the final temperature for each stage of the oven temperature program.

RATE

Range: END/-250.0–250.0 °C/min, Default: END

Set the program rate for the oven temperature program.

Set the rate to "0"; "END" appears and the program finishes at the previous ramp.

Move the cursor to "END" and set any numeric value other than "0" to complete the temperature and the time for that ramp.

EQUILIBRATION TIME

Range: 0.00–9999.99 min, Default: 3.00 min

After the programs finish and the oven temperature returns to the initial value, the equilibration time must elapse before the system is considered ready. This allows for even temperature distribution.

11.1.3 PF menu

PF menu	Description	Reference section
Del Line	Deletes the current line.	——
Ins Line	Inserts a line in line at the current cursor position.	——
Fan Off	Stops the fan operation.	——
Fan On	Restarts the fan operation.	——
Print	Prints the column oven program from a Chromatopac.	——

NOTE

"Fan Off" can not be operated in the following case.

- Oven temperature setting value $\geq$ 50 deg
- Program running

When the GC is in the system OFF state, the fan automatically stops based on the selection of the Fan Stop Temp. Refer to "16.6.11 Other settings" in "16.6 GC Configuration".

11.2 Temperature Programs

11.2.1 Isothermal analysis

The isothermal analysis technique keeps the column oven temperature at a constant value. This method is useful for separating compounds within a narrow boiling point range.

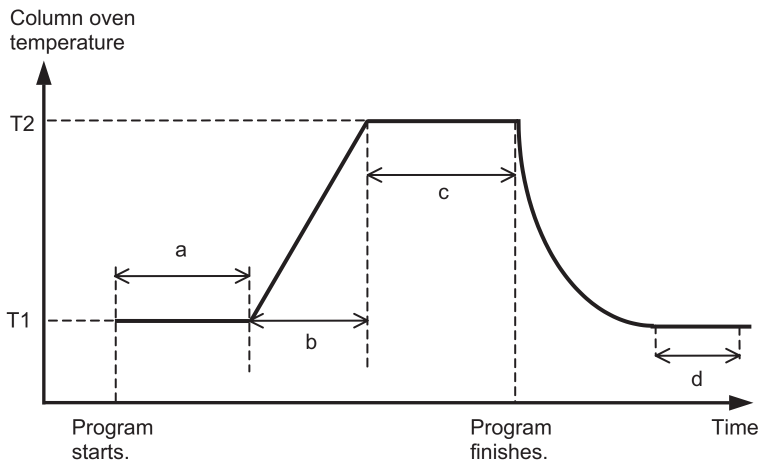
11.2.2 Programmed analysis

Programmed analysis technique increases the column oven temperature.
When isothermal analysis is performed on a sample containing components over a wide boiling point range at a temperature optimum for separating low-boiling components, elution of high-boiling components is delayed. As a result, peaks become wide and the detection of minor components is difficult. When isothermal analysis is performed at a temperature where high-boiling components elute rapidly, low-boiling components elute extremely fast, making separation difficult.
This means there is an optimal temperature for separating each component. In isothermal analysis however, a temperature can be optimum for certain components but inadequate for other components.
When analyzing samples containing components over a wide boiling point range, each component elutes at a temperature suitable for it while the column oven temperature increases gradually from lower temperature.

11.2.3 Creating a temperature program

■ Screen terminology

1-ramp temperature program



Initial setting	(TEMP)....	T1
Initial setting hold time	(TIME).....	a
Program rate	(RATE)....	$\frac{T2-T1}{b}$
Final temperature	(TMP)......	T2
Final temperature hold time	(TIM).......	c
Equilibration time	(ETIM).....	d

■ Program creation

1-ramp temperature program

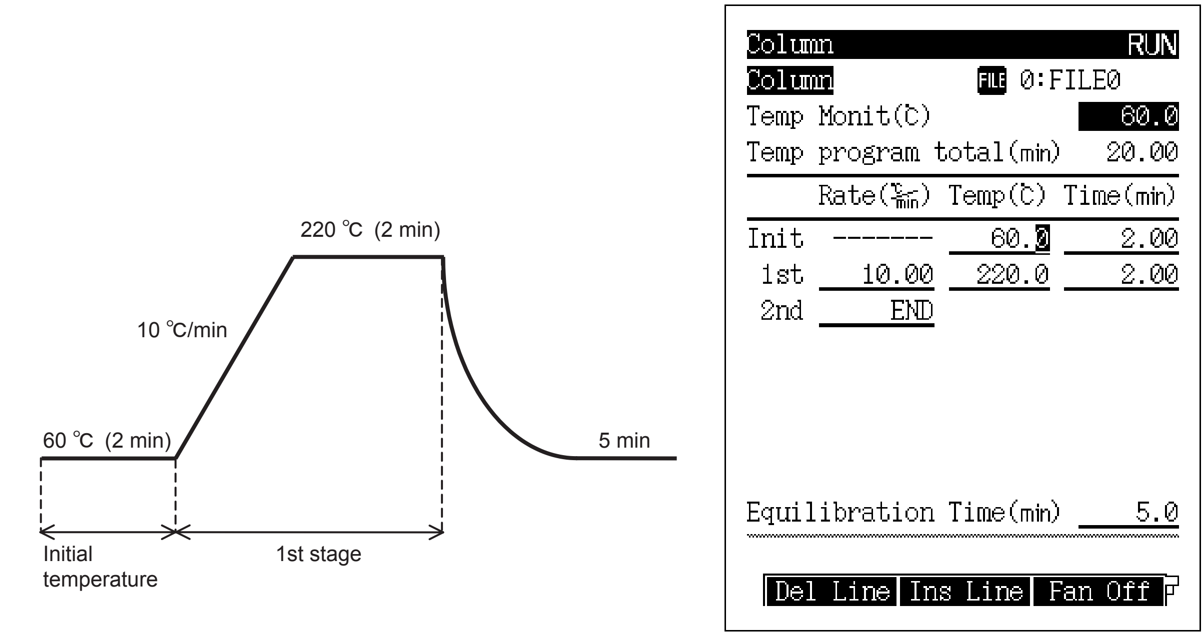


Fig. 11.2.1 Temperature program (Example 1)

2-ramp temperature program

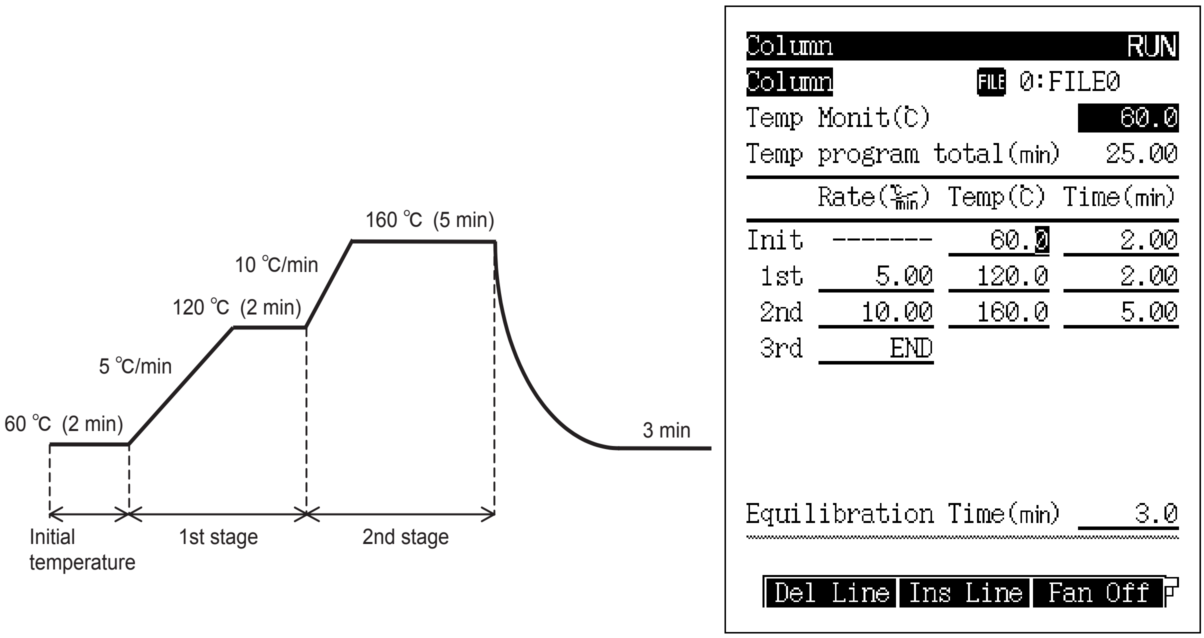


Fig. 11.2.2 Temperature program (Example 2)

Multiple-ramp temperature program (with temp increase /decrease)

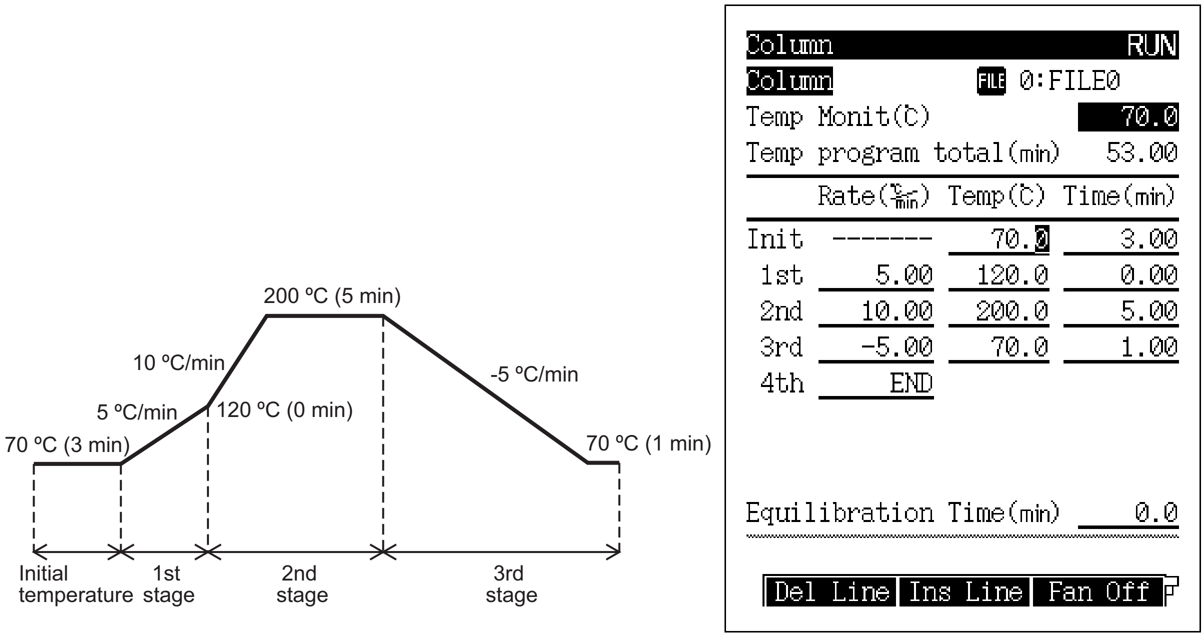


Fig. 11.2.3 Temperature program (Example 3)

■ Allowable temperature settings and ranges for temperature programs

Item			Set Range	Control Range	Default value
Program rate	Heating Normal oven (115 V)	Up to 150 °C	0–250 °C/min	0–30 °C/min	0 °C/min
		Up to 250 °C		0–20 °C/min	
		Up to 380 °C		0–10 °C/min	
		Up to 400 °C		0–7 °C/min	
	Heating High power oven (230 V)	Up to 200 °C	0–250 °C/min	0–70 °C/min	
		Up to 350 °C		0–50 °C/min	
		Up to 400 °C		0–30 °C/min	
	Cooling		–250–0 °C/min	Differ from the room temperature or the oven temperature.	

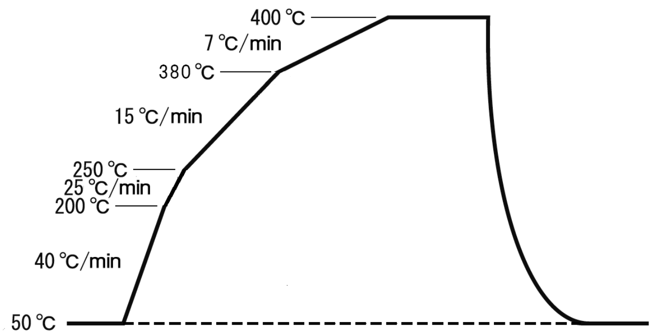


Fig. 11.2.4 Example of column oven temperature increase/decrease curve

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12.1 Introduction

■ Types of injection ports described

There are two types of injection system available for gas chromatography.

- Split injection system
- Splitless injection system

■ Injection system and injection port

Injection system	Injection port	Type of insert
Split injection system	Split/spitless injection port	Glass insert for split
Splitless injection system		Glass insert for splitless

12.2 Glass Insert and Packing Requirements

It is necessary to pack silica (glass) wool into the glass insert (liner) in order to sufficiently mix the vaporized sample and to prevent high-boiling point compounds from contaminating the capillary column.

■ Quantity of silica wool

Quantity of silica wool (standard) = Approx. 10 mg (for split)
= Approx. 2 mg (for splitless)
= Silica wool is not necessarily required when making direct injections. However, if the sample contains non-volatile compounds, less than 5 mg of silica wool can improve the chromatography.

NOTE

For special samples, better results may be obtained by varying the amount of silica wool in the insert.

- Reduce the amount of silica wool for highly absorptive samples, such as agricultural samples.
- Increase the amount of silica wool when injecting solvents with a high latent heat of vaporization, such as water.

■ Position of silica wool

Split and splitless glass inserts are shaped differently, as shown below. Place the silica wool 1–2 mm below the lowest point of the needle at injection. For split analysis, if the wool is too close or too far away from the needle, good reproducibility of results may not be obtained. For splitless analysis, place the wool at the position of 25 mm from the upper end of the glass insert.
The recommended position of silica wool for each insert is shown below.

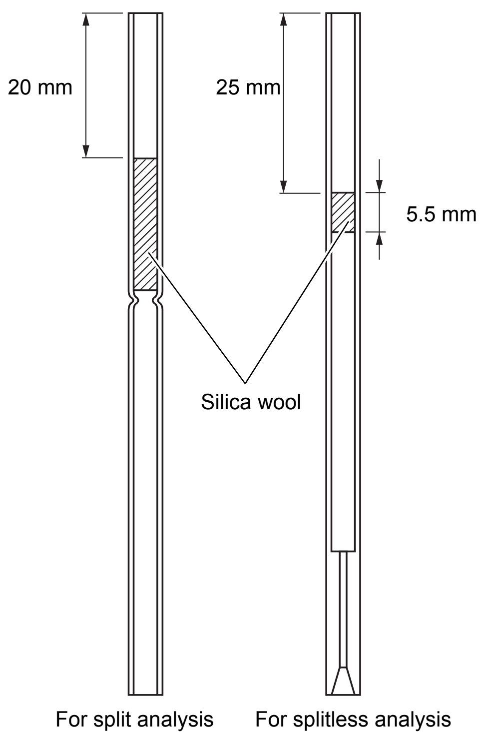


Fig. 12.2.1 Silica wool position for split and splitless inserts (AOC-20i)

NOTE

The position of silica wool being displayed in Fig. 12.2.1 is for injecting by Auto Injector for AOC-20i. During manual injections, the needle often goes further in the insert than for injection by an auto injector. However, there is no need to change the silica wool position for manual injections. By placing a septum on the needle, the length of the needle can be shortened to approximately 40 mm. (Alternatively, change the position of the silica wool for manual injections.)

<Example> Needle length

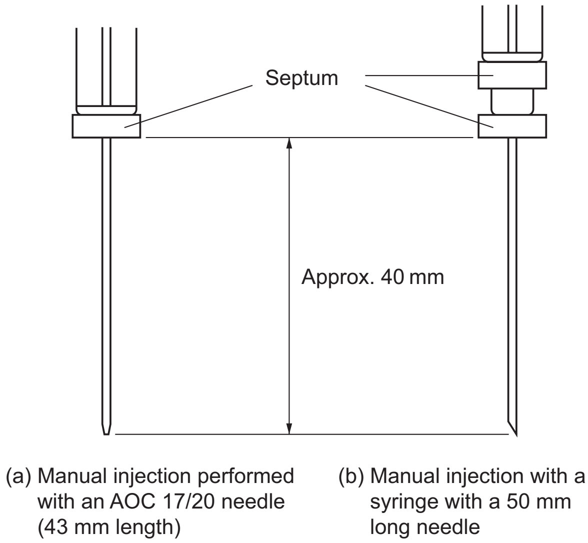


Fig. 12.2.2 Proper needle length for manual injections

■ Packing the silica wool

Pack silica wool flat and evenly without making it too densely placed or too fluffy.

■ Notes for servicing the injection unit or replacing columns

Changing the pressure on the inlet abruptly may move the silica wool to a different position. Make sure not to replace the septum or remove the column when the inlet is under pressure.

12.3 Removing and Inserting the Glass Insert

WARNING

Risk of burns.
DO NOT perform injection port maintenance until the injection port temperature has dropped below 50 °C .

NOTE
Nuts and screws may seize up.
DO NOT turn any nuts or screws when the injection port is at a high temperature.

■ Tool required

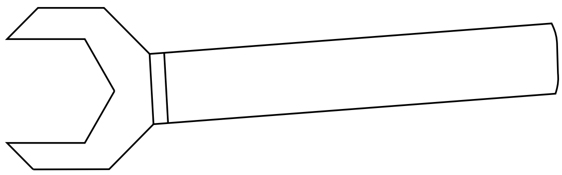


Fig. 12.3.1 Wrench for glass insert nut (P/N 221-46977)

■ Removing the glass insert

The glass insert should be removed carefully to avoid breakage.

NOTE
It is important to hold the septum nut while removing the glass insert nut, otherwise, the gas tubing can pull out the insert, and the septum nut can break the insert.

(1) Hold the septum nut and remove the glass insert nut from the injection port. Lift the septum nut straight up and move it out of the way.

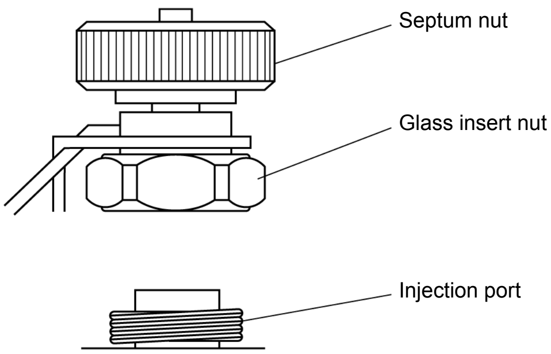


Fig. 12.3.2

(2) Use tweezers to remove the glass insert.

NOTE
If the O-ring has become fixed, turn the O-ring using tweezers and then lift the glass insert. DO NOT forcibly lift the glass insert with the O-ring fixed because it may break the glass.

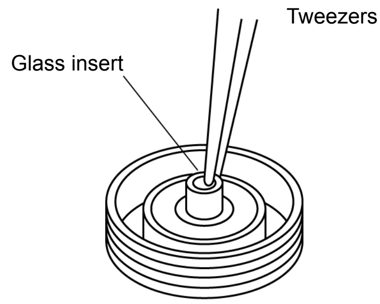


Fig. 12.3.3

■ Attaching a fluoride rubber O-ring

Use a fluoride rubber O-ring when the temperature of the injection port is 350 °C or less. Attach the fluoride rubber O-ring as shown below and insert the glass insert in the injection port.
Fluoride rubber seals the injection port better than graphite, and is normally used. However, it tends to deteriorate and leak over prolonged periods at high (>350 °C) temperatures. Check frequently for leaks.
Ensure that the insert is touching the bottom of the injection port. This will place the O-ring 3 mm from the top of the insert.

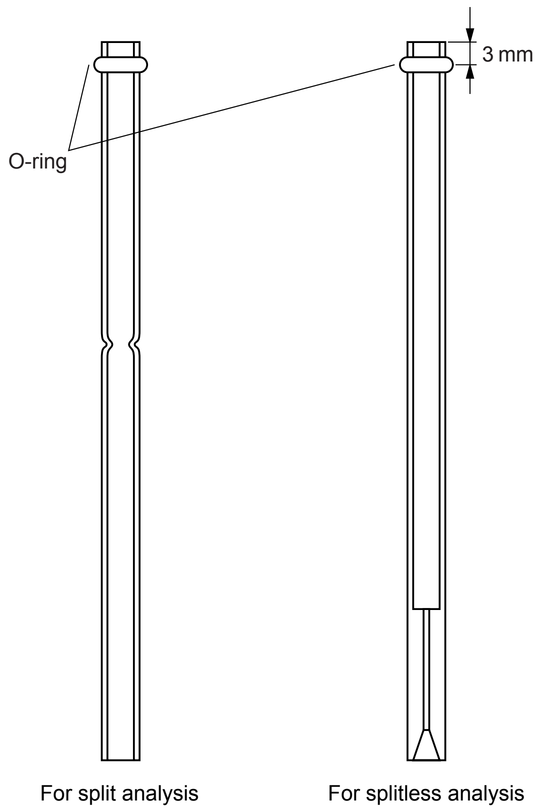


Fig. 12.3.4 Attaching graphite and fluoride rubber O-ring

■ Inserting the glass insert

Insert the glass insert according to the following procedure after attaching the fluoride rubber O-ring.

(1) Insert the glass insert with the fluoride rubber O-ring into the injection port.

(2) Move the septum nut back over the glass insert and slowly tighten the glass insert nut by hand at first, then do a 1/3~1/2 turn with wrench.

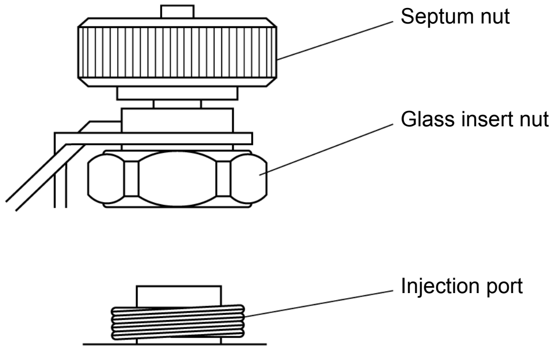


Fig. 12.3.5

NOTE

The position of the injection port components is shown below.

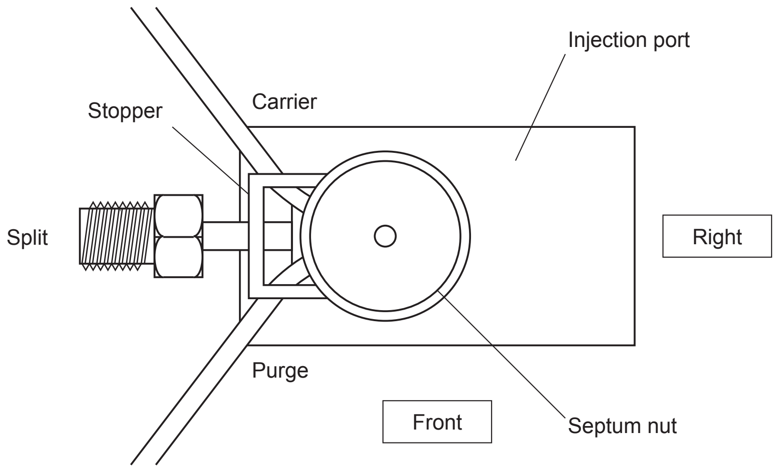


Fig. 12.3.6

■ Checking for injection port leaks

Leaks can negatively impact reproducibility of results, and can waste carrier gas.

NOTE

Septum purge leaks do not affect performance. These error messages can be cleared.

(As for the following procedure, there could be cases in which the error message "purge leaks" etc. appears. However, it does not matter to the test. Then select "Reset Error".)

Check for leaks according to the following procedure.

(1) Turn off the system, and then turn on the system pressing "-" key and "0" key.
(2) Press [Start GC] (PF menu) from the [SYSTEM] key screen.
(3) Set the "Flow Control" to "Cont" from the [SYSTEM] key screen.
(4) Press [Stop GC] (PF menu) to stop the system temperature control.
(5) User the [MONIT] key to verify that the oven, injection port and detector temperatures have dropped below 40 °C.
(6) Press [Off] on the [FLOW] screen to stop AFC control. Carrier gas flow stops. Set the purge flow rate to 0 ml/min.
(7) Remove the capillary column, and seal the connections with a new graphite ferrule (with wire) and column nut.
(8) Install a blank nut (G-type) on both the split vent and purge vent.
(9) Verify that the gas cylinder pressure is above 300 kPa.
(10) Set the Split mode to "Direct" and Control mode to "Press" (from the [FLOW] key main screen).
(11) Set the inlet pressure to 150 kPa and set the purge flow to 500 ml/min. Press [On/Off] (PF menu) to start AFC control.
(12) Wait five minutes. Confirm that the inlet pressure is from 125 to 175 kPa.
If the inlet pressure is above 175 kPa, loosen the column nut slightly to reduce the pressure.
If the inlet pressure is below 125 kPa, increase the pressure from the gas cylinder slightly.
(13) Verify that the total flow is less than 2 ml/min. If the flow is above 2 ml/min, a leak exists.
(14) Press [On/Off] (PF menu) on the [FLOW] key screen to stop AFC control.
(15) Verify that the pressure does not drop more than 15 kPa in one hour. If the pressure drops more than 15 kPa, a leak exists. It is possible to verify that pressure does not drop more than 2.5 kPa in 10 minutes.
(16) If there are no leaks, restore the connections and operational status of the GC-2010 Plus.

■ Resolving leaks

If the leak test procedure reveals the presence of an injection port leak, use the following procedure to resolve the problem.
Use Snoop or a similar leak detection fluid to check the column connection for leaks. Tighten the connections at the septum nut, injection port nut, split and purge vents (if the blank nuts are in place for the leak test), and gas supply tubing.

If a leak is found, replace the defective part.

Leaking part	Replacement
Near septum nut	Replace septum
Around injection port nut	Tighten the glass insert nut Replace glass insert O-ring
At column connection	Replace graphite ferrule and column nut
At split or purge vent (during leak test)	Replace blank nut

CAUTION

When Snoop or a similar leak detection fluid is used, be careful not to splash it on the electric wiring or detector. This could cause an electric shock.

NOTE

NEVER use the leak detection fluid nor soapy water for the connection above the carrier gas controller (AFC) and the detector gas controller (APC). Dripping may damage the controller. In some sensitive analyses, Snoop can interfere with proper detection. In those situations, use an electronic leak detector.

12.4 Removing and Installing the Septum

⚠ WARNING

Danger of burns.
DO NOT perform injection port maintenance until the temperature has dropped below 50 °C.

NOTE
Wait until the injection port has cooled to loosen screws and nuts to prevent them from binding.

■ Type of septum

The type of septum to install depends on the temperature of the injection port.

(1) Silicon rubber septum ··· When the temperature of the injection port is below 350 °C.
(2) Low bleed septum ··· When the temperature of the injection port is above 350 °C.

NOTE
The low bleed septum is an option. See "20.1.1 Septum".

■ Removing the septum

Remove the septum according to the following procedure.

(1) Check the following items before removing the septum.
- The temperature of the column oven and injection port should be below 50 °C. (Check this before setting the column inlet pressure to 0 kPa.)
- The column inlet pressure should be 0 kPa.

NOTE
Removing the septum when the injection port is under pressure causes an abrupt pressure shift which can change the position of the glass wool in the insert.

(2) Remove the septum nut, and take out the needle guide and septum.

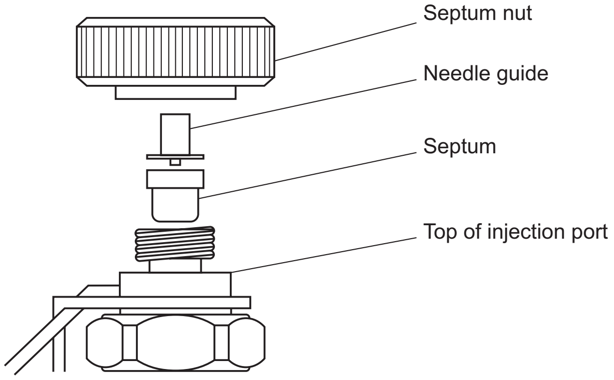


Fig. 12.4.1

NOTE
The septum nut marked with "P" is dedicated to the SPL for the GC-2010 Plus. DO NOT confuse these septum nuts with those for the GC-2025.

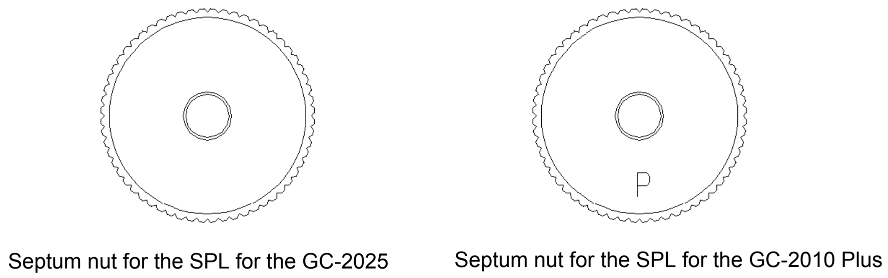


Fig. 12.4.2

■ Installing the new septum

(1) Insert the septum into the injection port.

NOTE
Use tweezers to handle the septum. Touching the septum will contaminate it, causing ghost peaks.

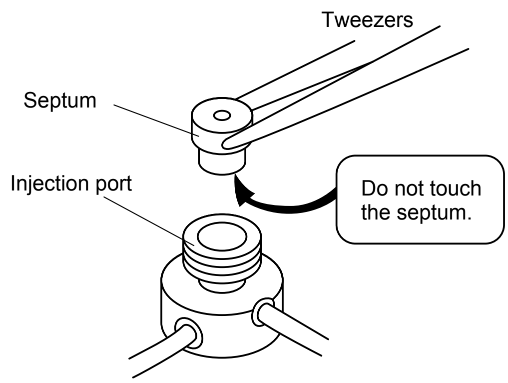


Fig. 12.4.3

(2) Replace the needle guide, then the septum nut. Tighten the septum nut by hand as far as possible and return it a semicircle.

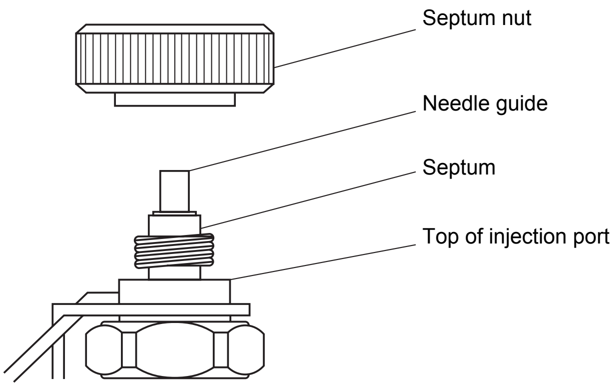


Fig. 12.4.4

12.5 Split/Splitless Injection System

■ Split injection system

In a split injection system, only a portion of the sample injected into the injection port is introduced into the capillary column. The remaining sample is sent to the split line due to high sample volume. (Refer to "21.4 AFC and APC Control".)

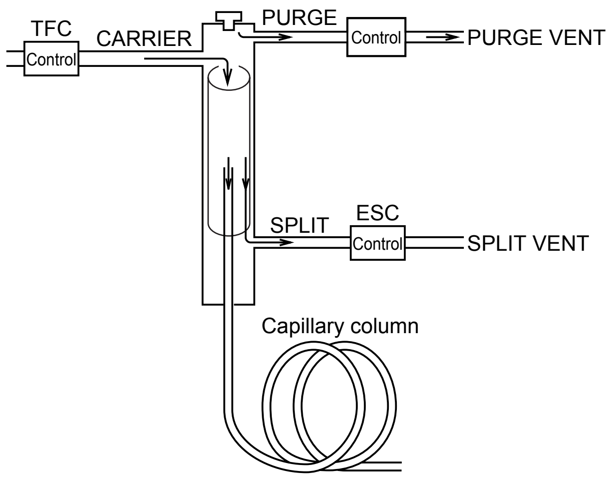
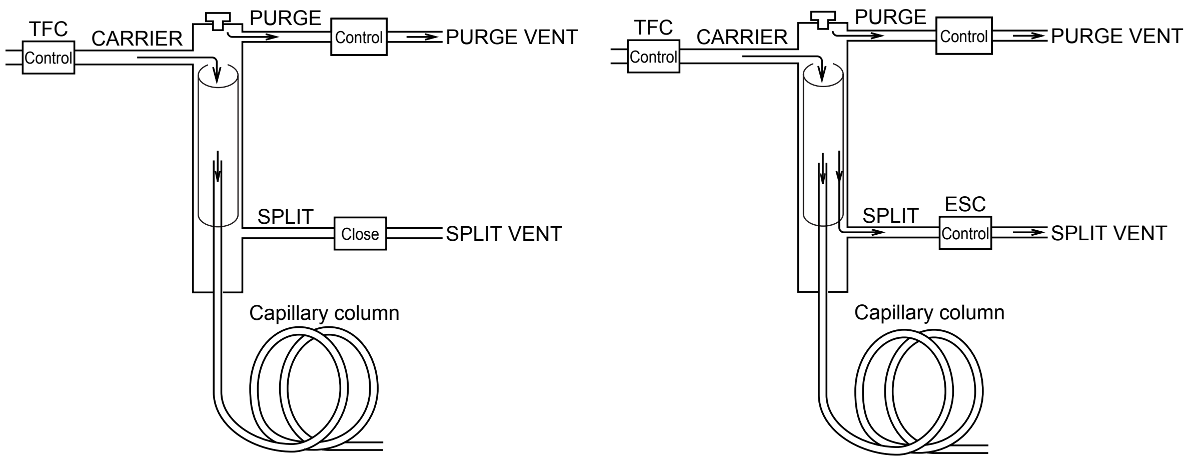


Fig. 12.5.1

■ Splitless injection system

The splitless injection system is used to analyze samples of low concentration.
In a splitless injection system, the split vent is closed and the initial temperature of the column oven is low. Then, after injection, and once the vaporized sample has moved to the column, the split vent is open and the column temperature increased so that the condensed sample inside the column is vaporized again and separated. (Refer to "21.4 AFC and APC Control".)



(a) During sampling time (b) After sampling time

Fig. 12.5.2

12.5.1 Setting the temperature with [INJ] key

12.5.1.1 Screen description

Press the [INJ] key to display the main screen shown in Fig. 12.5.3 and to set the temperature of the injection port.

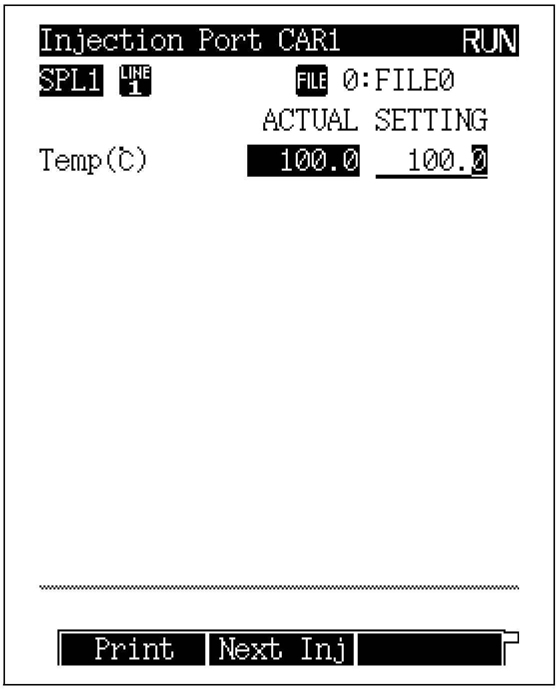


Fig. 12.5.3 [INJ] key main screen

12.5.1.2 Parameter list

TEMP

Range: 0.0–400.0 °C, Default: 25.0 °C

Set the temperature of the injection port.

Keep the injection port temperature as low as is practical to prevent a decrease in the service life of the temperature sensor. To instantly vaporize the injected sample, set the injection port temperature which is suitable for the sample. Due to the minute quantity of sample injected, the sample vaporizes at temperatures lower than the boiling point of sample elements. To set the injection port maximum temperature limit, refer to "16.6.4 Setting the maximum temperature limits" in "16.6 GC Configuration".

12.5.1.3 PF menu

PF menu	Description	Reference section
Print	Prints the injection port temperature on Chromatopac.	——

12.5.2 Setting the flow rate with [FLOW] key

12.5.2.1 Screen description

Press the [FLOW] key to display the screen shown in Fig. 12.5.4 and to set the AFC (advanced flow controller) parameters. The AFC controls the pressure and the flow rate of the carrier gas.

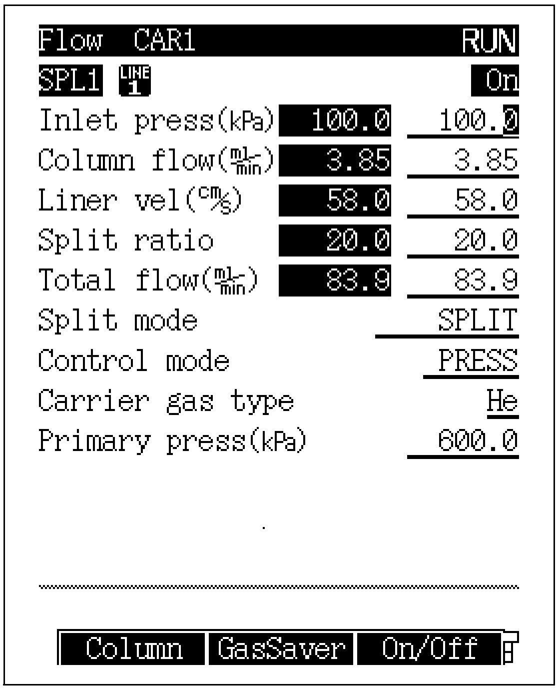


Fig. 12.5.4 [FLOW] key main screen

12.5.2.2 Parameter list

INLET PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 21.5.1.), Default: 100 kPa
Set the column inlet pressure.
This sets the initial temperature of a pressure program.
When the control mode is set to "PRESS", the system controls the column inlet pressure so that it remains constant during an oven temperature program.

COLUMN FLOW RATE

Default:[1] 1.00 ml/min
Sets the carrier gas flow rate at the capillary column outlet (atmospheric pressure at 25 °C).
When you set the carrier gas flow rate, the system calculates the column inlet pressure based on the inner diameter and the length of the column and the film thickness of the column. The column flow rate is set separately so that the carrier gas flow rate desired occurs at the initial temperature in the oven temperature program.

LINEAR VELOCITY

Default:[2] 30.0 cm/s
Sets the average linear velocity of the carrier gas flowing in the capillary column.
When you set the linear velocity, the system calculates the column inlet pressure based on the inner diameter and the length of the column and the film thickness of the column.

The linear velocity is set separately so that the linear velocity desired occurs at the initial temperature in the oven temperature program.
When the control mode is set to "VELOCITY", the column inlet pressure automatically changes so that the linear velocity remains constant even while the oven temperature program is running.

SPLIT RATIO

Range: -1.0/0.0–9999.9, Default: -1.0
The split ratio is "split flow rate / column flow rate."
When you set a split ratio, the system sets the total flow rate based on the calculated carrier gas flow rate and split flow rate, so that the desired split ratio occurs at the oven temperature.
Set the split ratio to "-1.0" to fix the total flow rate regardless of the oven temperature.

TOTAL FLOW RATE

Range: 0.0–1200.0 ml/min (Refer to Fig. 21.5.1.), Default: 500.0 ml/min
In split or splitless mode, the total flow rate is equivalent to "column flow rate + split flow rate + septum purge flow rate".

SPLIT MODE

Selection: SPLIT/SPLITLESS/DIRECT, Default: SPLIT

SPLIT: Controls the column inlet pressure and the total flow rate so that the column inlet pressure and split ratio occur as specified.

SPLITLESS: Closes the split flow line during the sampling time so that the set column inlet pressure is controlled by the Total Flow Controller.
Opens the split flow line and controls the Electronic Split Controller so that the preset column inlet pressure occurs (Refer to Fig. 12.5.2.) after the sampling time elapses.
To set the time of the Splitless auto off, refer to "16.6.11 Other settings" in "16.6 GC Configuration".

DIRECT: Closes the split flow line and the set column inlet pressure and linear velocity (in pressure mode) or the set total flow rate (in flow rate mode) occurs. When making direct injection analyses, select WBI or OCI in the setup screen so that SPLIT mode is not available. With the GC-2025, this mode is used only for SPL leak check.

SAMPLING TIME

Range: 0.00–9999.99 min, Default: 1.00 min
Sets the sampling time for splitless analysis.
The sampling time indicates the period of time after analysis starts until the split flow line is opened.

NOTE

When setting the sampling time, ensure that the program time is longer than the sampling time, otherwise, the sampling time cannot function correctly.

CONTROL MODE

Selection: PRESS/VELOCITY, Default: PRESS
When the injection mode is set to "SPLIT" or "SPLITLESS"
PRESS: Controls the system so that the column inlet pressure remains constant.
VELOCITY: Controls the system so that the linear velocity remains constant.

CARRIER GAS TYPE

Selection: He/N2/H2/Ar, Default: He

Specify the carrier gas type supplied to the AFC.

This parameter is used for the measurement/control of the flow rate.

If this parameter is not set correctly, flow rate calculations may not be performed correctly.

Example: If this parameter is set to "N_2" when He is actually used, the displayed total flow rate, column flow rate and linear velocity are lower than the actual values.

CARRIER GAS PRIMARY PRESSURE

Range: Cannot be set by user. For display only.

A rough pressure level (primary pressure) of the carrier gas supplied to the AFC is displayed.

1 The column flow rate ranges from 0 to the value at which the calculated column inlet pressure is 970 kPa or less and the calculated total flow rate is 1,200 ml/min.

2 The linear velocity ranges from 0 to the value at which the calculated column inlet pressure is 970 kPa or less.

12.5.2.3 PF menu

PF menu	Description	Reference section
Column	Sets inner diameter, length and film thickness of capillary column. Values set here are used in column inlet pressure calculations from column flow rate or linear velocity (or vice versa). If these parameters are not set correctly, calculations are not performed correctly.	12.5.3
Gas Saver	The gas saver saves carrier gas by reducing the split flow rate.	12.5.4
On/Off	Sets flow controller to be used to "On". Default value is "Off". When [Start GC] is pressed, the AFC in the current analytical line which is set to "On" starts. If AFC is set to "Off" during carrier gas control, the control stops. When it is set to "On" again, the carrier gas control restarts.	——
Press Prog	Sets the column inlet pressure program.	12.5.5
Split Prog	Sets the split ratio program.	12.5.6
Purge	Sets the septum purge flow rate and program for flow rate.	12.5.7
Advanced	High Pressure Injection: Sets high pressure injection, where the column inlet pressure is kept at a high value for a certain period of time during injection. Splitter Fix: Keeps the split flow rate constant. Back Flush: Sets back flush, where the column inlet pressure is kept at a low value after analysis.	12.5.8
Offset	Performs offset calibration of the AFC sensor. This calibration contributes to good reproducibility of results.	21.6
Next Flow	Toggles among the AFC set up screens if two or more AFCs are installed in this system. The [FLOW] key can also be used to switch screens. (The GC-2025 is equipped with one AFC; the screen is not switched.)	——

12.5.3 Setting column parameters

For capillary columns, the column inner diameter, length, and film thickness are used to calculate the column flow rate and linear velocity. Enter the column inlet pressure, and the column flow rate and linear velocity are calculated based on the column parameters. Alternatively, by entering the column flow rate and linear velocity valves, the column parameters are used to calculate the corresponding column inlet pressure.

12.5.3.1 Screen description

Select [Column] (PF menu) from the [FLOW] key main screen to display the Column Diam. screen shown in Fig. 12.5.5.

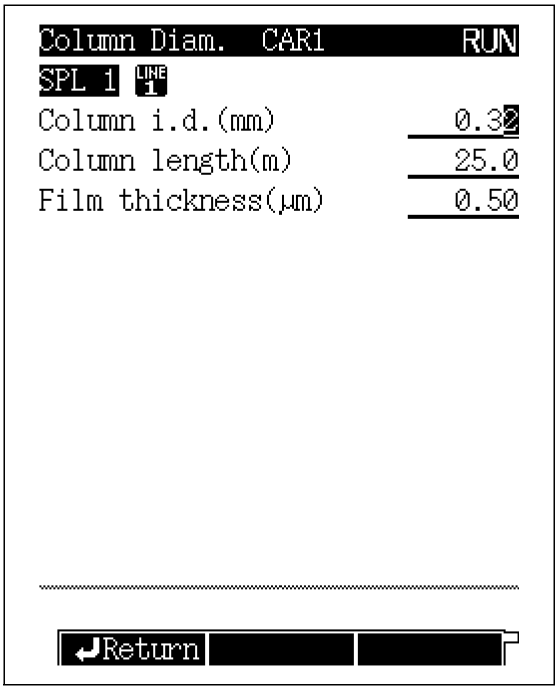


Fig. 12.5.5 Column setup screen

12.5.3.2 Parameter list

COLUMN I.D.

Range: 0.01–6.00 mm, Default: 0.32 mm

COLUMN LENGTH

Range: 0.1–250.0 m, Default: 25.0 m

FILM THICKESS

Range: 0.00–300.00 µm, Default: 0.50 µm

NOTE

Set these parameter values carefully to avoid calculation errors.

12.5.4 Gas saver

The gas saver function reduces the split ratio during a split or splitless analysis. This reduces the amount of carrier gas flowing through the split flow line, conserving carrier gas. Even though this can change the split ratio, the column inlet pressure is kept at a constant value. In other words, changing the split ratio does not affect the carrier gas flow rate in the column.

NOTE

To set the Gas Saver AOC link and the time of the Gas Saver auto on, refer to "16.6.11 Other settings" in "16.6 GC Configuration".

12.5.4.1 Screen description

Select [Gas Saver] (PF menu) from the [FLOW] key to display the Gas Saver screen shown in Fig. 12.5.6.

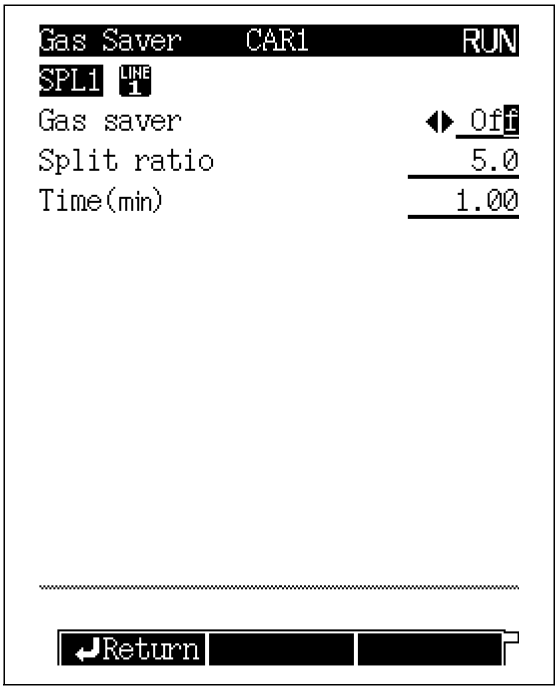


Fig. 12.5.6 Gas saver setup screen

12.5.4.2 Parameter list

GAS SAVER

Selection: On/Off, Default: Off
Select "On" to use the gas saver function.
Select "Off" to disable the gas saver function.

GAS SAVER SPLIT RATIO

Range: 0.0–9999.9, Default: 5.0
Set the split ratio which will reduce the split flow to conserve carrier gas.
Setting "0" closes the split flow line.

NOTE

If an extremely small split ratio is set, the instrument may be contaminated due to the flowback of contamination from the split line, resulting in an increase of the baseline noise.

GAS SAVER START TIME

Range: 0.00–9999.99 min, Default: 1.00 min
Specify the period of time after analysis starts until the split ratio switches to gas saver mode.
This period of time should be longer than the time required for the sample to move from the injection port to the column.
Setting the gas saves start time too early can provide unpredictable quantitative results.

12.5.5 Pressure program

You can set a program to increase and decrease the column inlet pressure during analysis. When the column inlet pressure is raised after the elution of target compounds, it is possible to elute unnecessary compounds having a high boiling point in a short time. This saves you from setting the column oven temperature higher than necessary and helps prevent the column from deteriorating.

12.5.5.1 Screen description

Select [Press Prog] (PF menu) from the [FLOW] key main screen when the control mode is set to "PRESS," to display the carrier press screen shown in Fig. 12.5.7 appears.

Up to 7 ramps of pressure increase or decrease can be set.

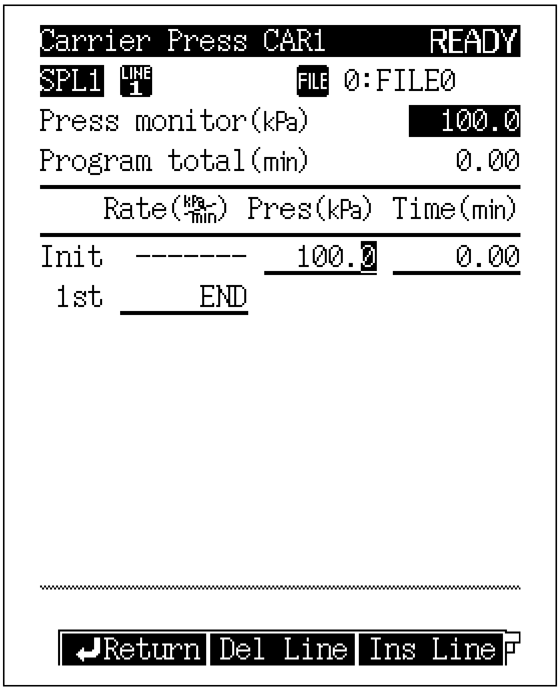


Fig. 12.5.7 Pressure program setup screen

12.5.5.2 Parameter list

PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 21.5.1.), Default: 100 kPa
Set the initial pressure and the final pressure for each stage of the pressure program.

TIME

Range: 0.0–9999.99 min, Default: 0.00 min
Set the hold time for the initial pressure and the final pressure for each stage of the pressure program.

RATE

Range: END/-400.00–400.00 kPa/min, Default: END
Set the pressure program rate.
If you set the rate to "0", "END" appears and the program finishes at the previous ramp.
If you move the cursor to "END" and set any numeric value other than "0", the pressure and the time for that ramp can be entered.

NOTE

The pressure increase/decrease program rate control range may be limited depending on the total flow rate setup value, the column in use and the purge flow rate.

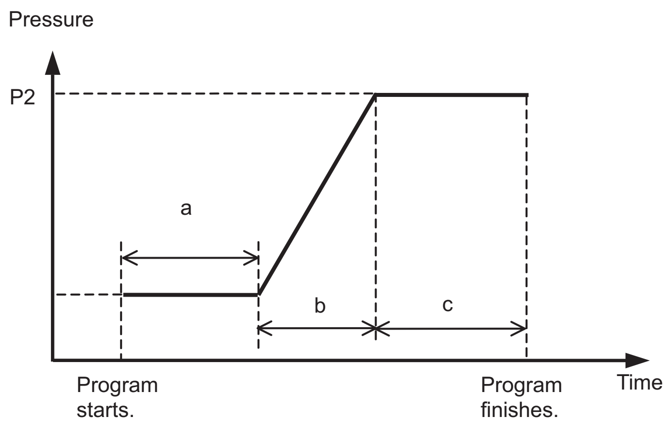
12.5.5.3 PF menu

PF menu	Description	Reference section
Del Line	Deletes a line at the current cursor position.	——
Ins Line	Inserts a line in line at the current cursor position.	——
PRINT	Prints the pressure program to a Chromatopac.	——

12.5.5.4 Setting a pressure program

■ Screen terminology

<1-ramp pressure program>



Initial pressure	(PRSS).....	P1
Initial pressure hold time	(TIME)......	a
Program rate	(RATE).....	$\frac{P2-P1}{b}$
Final pressure	(PRS).......	P2
Final pressure hold time	(TIM)........	c

■ Program creation

<1-ramp pressure program>

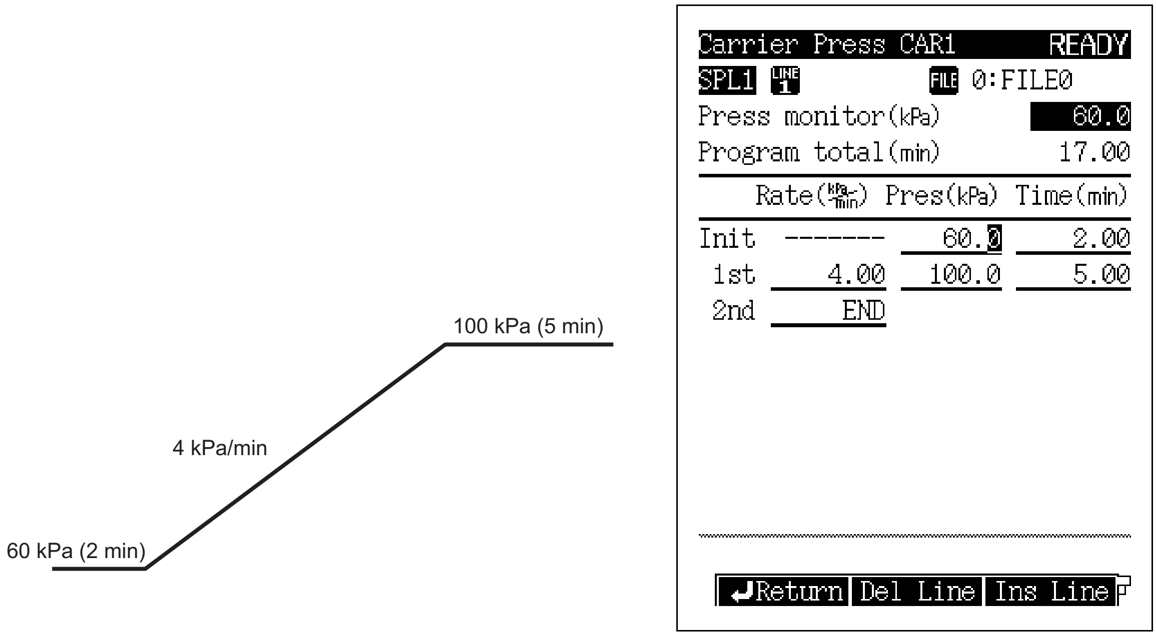


Fig. 12.5.8 Pressure program example

12.5.6 Split ratio program

You can change the split ratio during a split analysis. In addition, you can set a split ratio program after the sampling time has elapsed during splitless analysis.
The split ratio program and the gas saver perform basically the same operation. However, the split ratio program is used for more flexible programming.

12.5.6.1 Screen description

Select [Split Prog] (PF menu) from the [FLOW] key main screen when not in "DIRECT" mode to display the Split Ratio screen shown in Fig. 12.5.9.

A program can contain up to 7 ramps.

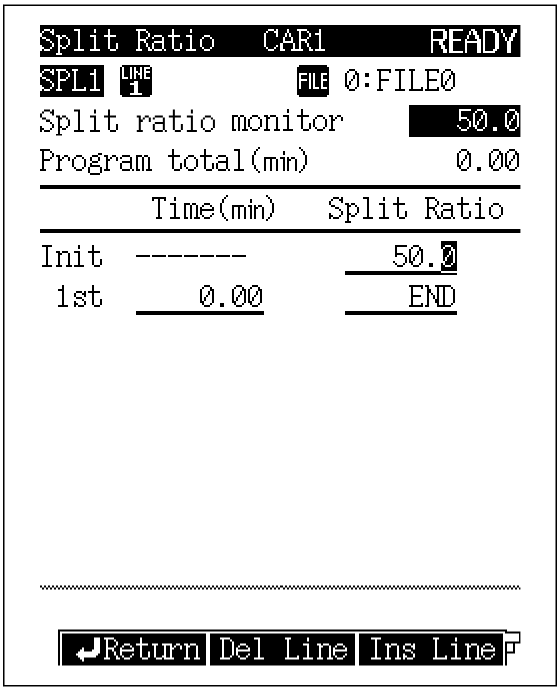


Fig. 12.5.9 Split ratio program setup screen

12.5.6.2 Parameter list

TIME

Range: 0.00–9999.99 min, Default: 0.00 min
Set this parameter to display the split ratio used previously in the Split Ratio column.

SPLIT RATIO

Range: -1.0/0.0–9999.9, Default: -1.0
Set the split ratio.
If the split ratio is set to "-1.0", the total flow rate remains constant regardless of the oven temperature.

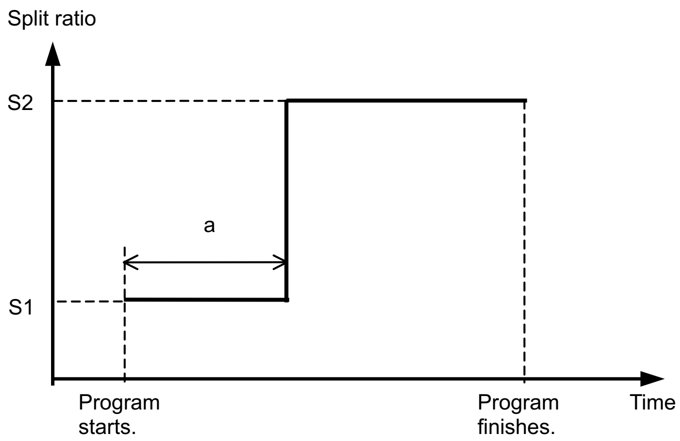
12.5.6.3 PF menu

PF menu	Description	Reference section
Del Line	Deletes a line at the current cursor position.	——
Ins Line	Inserts a line in line at the current cursor position.	——
Print	Prints the split ratio through to a Chromatopac.	——

12.5.6.4 Setting a split ratio program

■ Screen terminology

<1-ramp program>



Initial ratio	(SPLIT)	……S1
Initial program run time	(TIME)	……a
Final ratio	(SPLT)	……S2

■ Program creation

<1-ramp program>

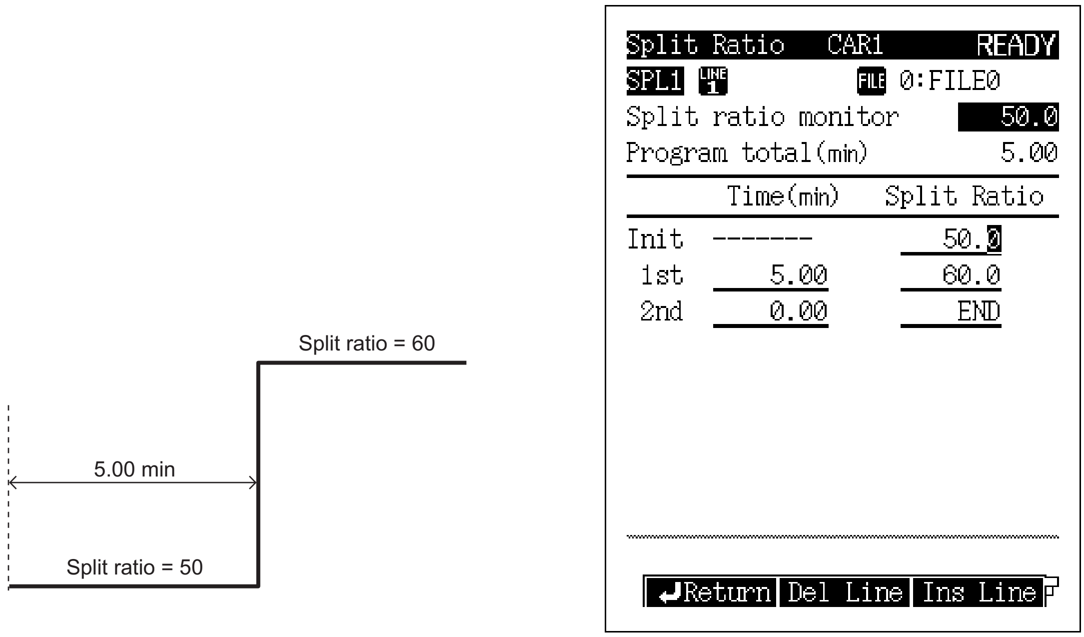


Fig. 12.5.10 Example of split ratio program

12.5.7 Septum purge

Set the septum purge flow rate. The septum purge removes contamination from the injection port at the septum.
The septum purge flow rate is set here. In addition, you can create a program to change the septum purge flow rate during analysis.

12.5.7.1 Screen description

Select [Purge] (PF menu) from the [FLOW] key main screen to display the septum purge screen shown in Fig. 12.5.11.

A program can contain up to 7 ramps.

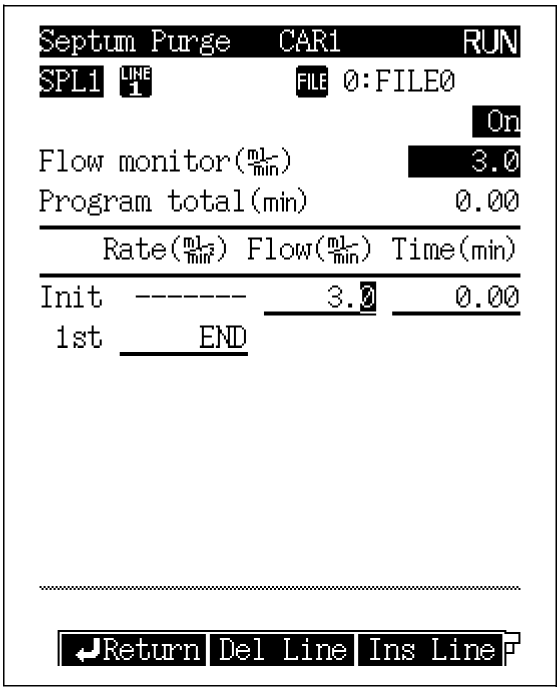


Fig. 12.5.11 Septum purge setup screen

12.5.7.2 Parameter list

FLOW RATE

Refer to Fig. 21.5.3, Default:[1] 3.0 ml/min
Set the initial flow rate of the flow rate program and the final flow rate for each stage.
Even if no program is set, specify septum purge flow rate in the initial flow rate column.

TIME

Range: 0.00–9999.99 min, Default: 0.00 min
Set the initial flow rate for the flow rate program and the hold time of the final pressure at each stage.

RATE

Range: END/-400.00–400.00 kPa/min[2], Default: END
Set the program rate for the flow rate program.
If you set the rate to "0", "END" appears and the program finishes at the previous ramp.
If you move the cursor to "END" and set any numeric value other than "0", the pressure and the time for that ramp can be entered.

1 The purge flow rate range is from 0 to the total flow rate subtracted by the column flow rate and the split flow rate.

12.5.7.3 PF menu

PF menu	Description	Reference section
Del Line	Deletes a line at the current cursor position.	——
Ins Line	Inserts a line in line at the current cursor position.	——
On/Off	Set On for septum purge flow.	——

12.5.8 High pressure injection splitter mode and back flush

■ High Pressure Injection

High pressure injection is a split/splitless injection method which keeps the column inlet pressure at a value higher than the analysis pressure for a specified period of time while the sample is injected. Then, the column inlet pressure returns to the normal analysis value.
High pressure injection is effective especially for the splitless injection system. High pressure injections, can reduce the total gas volume and improve percent recovery valves. Sensitivity may be improved by reducing adsorption by increasing the speed of transition to the column and by increasing the injection amount in some cases.

NOTE
Although it is usable for split analysis, note that the split ratio is different from the set value at high pressure injection.

■ Splitter Fix

If the injected sample consists of a solvent with a high vaporization expansion coefficient, the pressure inside the injection port drastically increases when the solvent vaporizes. As a result, ESC may operate to lower the inlet pressure which is higher than the set pressure and too many sample components may be discharged from the split vent, reducing sensitivity.

In the splitter fix mode, the voltage on the split flow valve is fixed right before the injection of the sample, which prevents the discharge of the sample at more than the specified split ratio.

NOTE
When the splitter fix state is kept for a long time, the pressure cannot be maintained at a specific level and analysis cannot be performed with good reproducibility.
To use the splitter fix mode during manual injection, turn the mode on when it gets ready, inject the sample at certain intervals, and start analysis.

■ Back Flush

This is not used with the GC-2025.

12.5.8.1 Screen description

Select [Advanced] (PF menu) from the [FLOW] key main screen when not in "DIRECT" mode to open the advanced screen shown in Fig. 12.5.12.

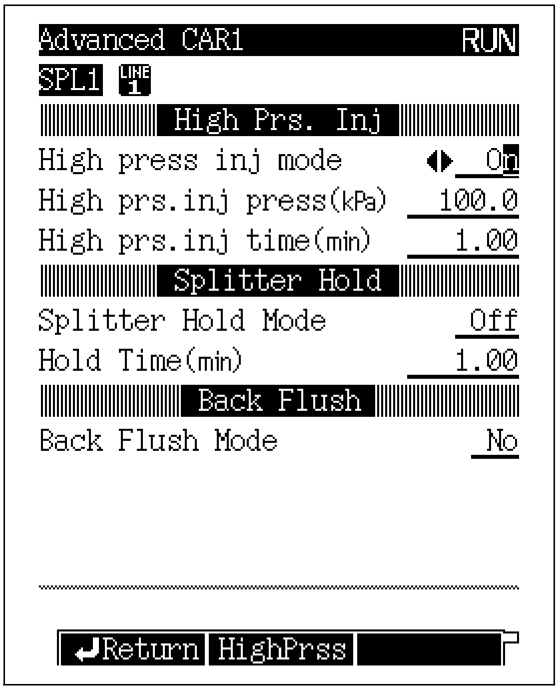


Fig. 12.5.12 Setup screen for high pressure injection and splitter fix mode

12.5.8.2 Parameter list

■ High Pressure Injection

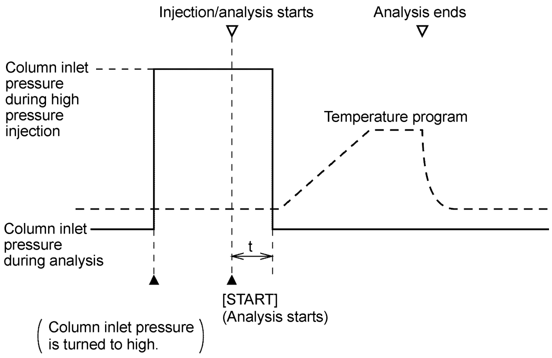
HIGH PRESS INJECTION MODE

Select One of the following three modes.

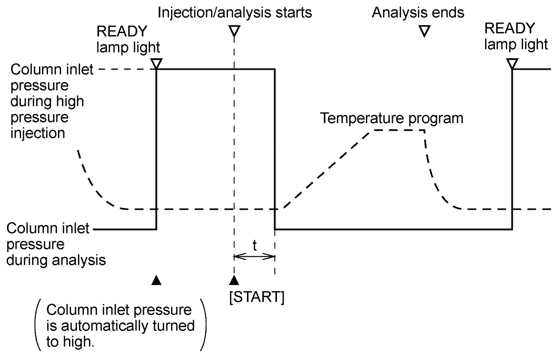
Off : Disables high pressure injection.

On : Sets the column inlet pressure for high pressure injection immediately.

Auto : Immediately sets the column inlet pressure for high pressure injection. When analysis is finished and the GC returns to the ready state, the column inlet pressure automatically increases.



HIGH PRESS INJECTION MODE = On



HIGH PRESS INJECTION MODE = Auto

HIGH PRESS INJECTION PRESS

Range: 0.0–970.0 kPa (Refer to Fig. 21.5.1.), Default: 100.0 kPa
Set the column inlet pressure for high pressure injection.

HIGH PRESS INJECTION TIME

Range: 0.00–9999.99 min, Default: 1.00 min
Set the period of time after analysis starts until the column inlet pressure returns to the value for analysis.
Usually, set this equal to the sampling time for splitless analysis.

■ Splitter Fix

SPLITTER FIX MODE

Selection: Off/On/Auto, Default: Off
Select one of the following three modes.

Off : Disables splitter fix mode.
On : Fixes the split flow line immediately.
Auto : Automatically enters splitter fix mode after analysis finishes and the system returns to ready state.

FIX TIME

Range: 0.0–9999.99 min, Default: 0.10 min
Set the period of time to be in splitter fix mode.
When "SPLITTER FIX MODE" is set to "On", indicate the period of time after "SPLITTER FIX MODE" is set to "On" to exit splitter fix mode.
When "SPLITTER FIX MODE" is set to "Auto", set the period of time after the analysis starts to exit splitter fix mode.

NOTE

Using splitter fix mode for long periods of time may interfere with constant pressure, negatively affecting reproducibility of results.

■ Back Flush

This is not used with the GC-2025.
Set to "No".

12.6 Setting the Flow Rate Parameters

■ Linear velocity and carrier gas selection

In capillary analysis, the type and the liner velocity of the carrier gas have a considerable effect on the column efficiency. The figure below shows changes in the HETP (Height Equivalent to Theoretical Plate) at different linear velocity values for nitrogen, helium and hydrogen carrier gas. HETP is a parameter for column efficiency. The smaller the value is, the higher the column efficiency.

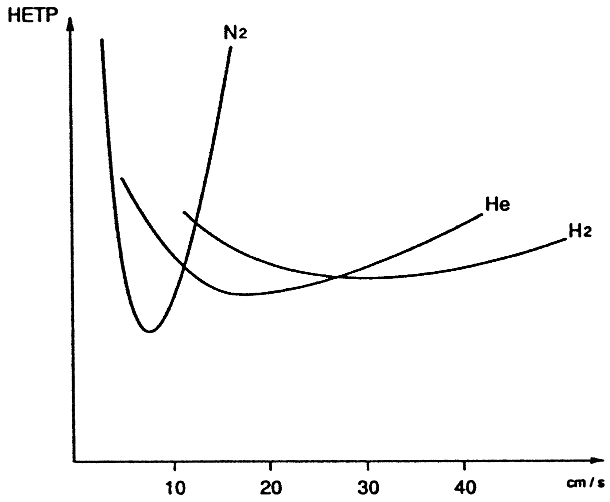


Fig. 12.6.1 Relationship between linear velocity and HETP for various carrier gases (H-u curve)

The graph above shows that the lowest HETP values are obtained when nitrogen is used as the carrier gas and the linear velocity is set to a value a little less than 10 cm/s. However, nitrogen is not a good carrier gas for capillary analysis for the following reasons.

(1) If the linear velocity deviates only slightly from the optimum value, the HETP increases dramatically. The resolution of peaks changes dramatically.
(2) To obtain the optional linear velocity, the flow rate must be low, resulting in long analysis times.

The lowest HETP value for helium is larger than the value for nitrogen. But helium is frequently used as the carrier gas because the HETP is low over a considerably wider linear velocity range starting at 20 cm/s.
The column efficiency of hydrogen is good at higher linear velocities than for helium. For this reason, hydrogen can be used for rapid analyses. However, hydrogen is seldom used in reality because it is extremely flammable, and therefore too dangerous.

■ Efficiency of an analysis

Usually, analyses are performed with a flow rate that is a higher than the optimal flow rate, as long as separation of compounds is sufficient. This reduces the analysis time. For helium carrier gas, setting the linear velocity to 30 cm/s is recommended.
The tables below show the column inlet pressure at which the linear velocity becomes approximately 30 cm/s. Use the tables as the guideline for setting the column inlet pressure.

Example 1: Column oven temperature = 50 °C (carrier gas = helium)

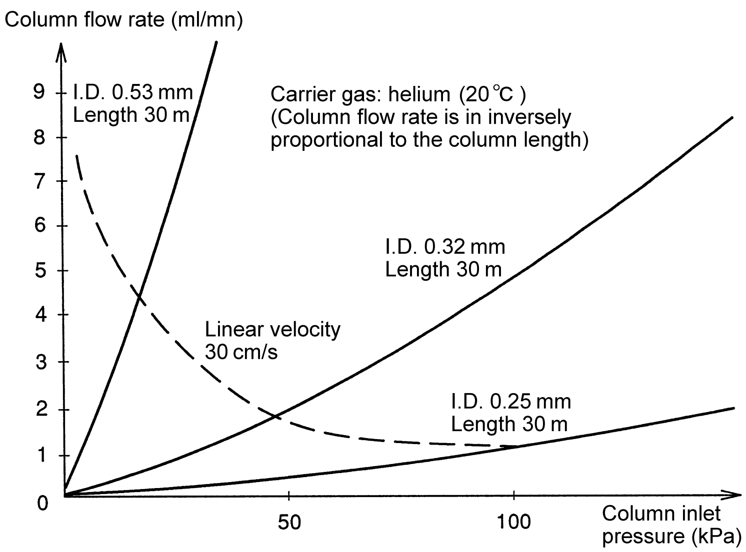
I.D. of column	Film thickness \ Length	30 m	60 m
0.25 mm	0.25 µm	100 kPa	210 kPa
0.32 mm	0.25 µm	60 kPa	120 kPa
0.53 mm	1.5 µm	20 kPa	40 kPa

Example 2: Column oven temperature = 200 °C (carrier gas = helium)

I.D. of column	Film thickness \ Length	30 m	60 m
0.25 mm	0.25 µm	130 kPa	275 kPa
0.32 mm	0.25 µm	80 kPa	160 kPa
0.53 mm	1.5 µm	30 kPa	60 kPa

NOTE

Fig. 12.6.2 shows the relationship between the column flow rate and the column inlet pressure.



$$Fc = \frac{60\pi d^4}{256\,\mu l} \times \frac{(P + P_0)^2 - P_0^2}{P_0} \times 10^3$$

Fc	: Column flow rate [ml/min]
d	: Column I.D [mm]
L	: Column length [m]
P	: Column inlet pressure [kPa]
P_0	: Column outlet pressure = atmospheric pressure [kPa]
µ	: Viscosity coefficient (19.4 µPa•s (helium, 20 °C))

Fig. 12.6.2

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13.1 Hydrogen Flame Ionization Detector (FID)

This section describes the operating procedure for the FID detector.

13.1.1 Principle of FID operation

In the hydrogen flame ionization detector (FID), hydrogen gas is mixed with the column outlet gas at a certain ratio and then the gas mixture is combusted in the air atmosphere as shown in Fig. 13.1.1. DC voltage is applied on the jet. A collector is located on the upper area of the FID. When only pure carrier gas (nitrogen, helium, or argon) and hydrogen gas are mixed, almost no current is produced between the FID jet and collector. When carrier gas containing an organic compound, which is sample components injected into the injection port and then separated by the column, is discharged from the FID jet, current is produced between the FID jet and collector proportionally to the amount of the organic compound.
This is because ions (mainly carbon ions) are generated when an organic compound combusts within the hydrogen flame and the generated ions are captured by the collector. For isomers, the ion quantity generated is almost proportional to the number of carbons contained in the compound. However, carbon atoms in a "C=O" form do not create a signal. The presence of halogens in the molecular construction decreases the ion quantity generated.
Because the ion current obtained by the FID as described above is very low, it is amplified by an amplifier and then output to a Chromatopac or personal computer as a proper voltage.

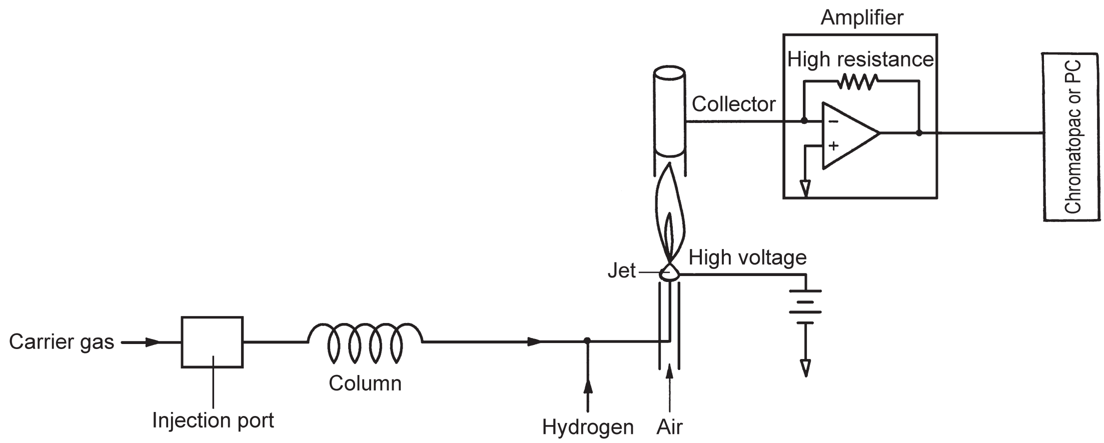


Fig. 13.1.1

13.1.2 Setting the detector

13.1.2.1 Screen description

Press the [DET] key to display the detector main screen shown in Fig. 13.1.2. Here, set the detector temperature, the detector gas flow rate, etc.
When the detector is configured in the analytical line, the output signal settings appear in the lower portion of the screen.

For the detector signal output, refer to "13.3 Setting the Output Signals".

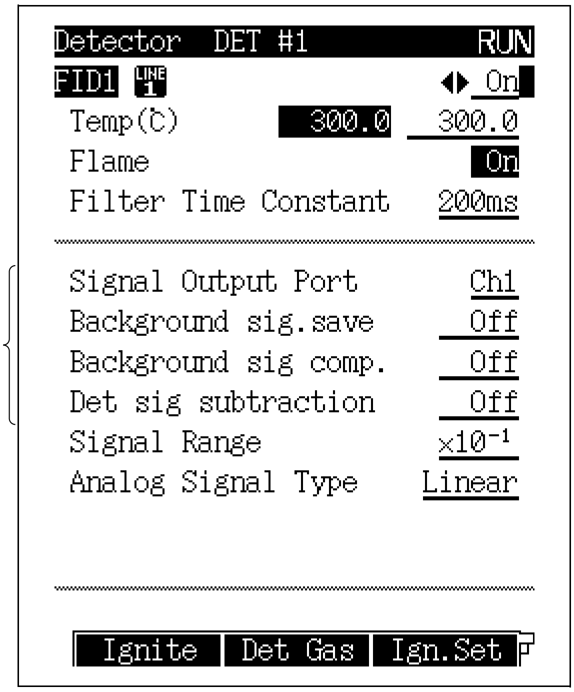


Fig. 13.1.2 [DET] key main screen

13.1.2.2 Parameter list

DETECTOR CONTROLLER

Selection: On/Off, Default: On
When a detector is set to "On", its current and voltage are controlled.
When a detector is configured in an analytical line and set to "On" here, the detector is controlled and its signal monitored. However, even if a detector is set to "Off", the gas flow and the detector temperature are controlled, if the detector is configured in an analytical line.

TEMP

Range: 0.0–400.0 °C, Default: 25.0 °C
Set the detector temperature. Normally, set the detector temperature approximately 30 °C higher than the final column oven temperature to prevent contamination by high boiling point compounds. To set the maximum temperature limit, refer to "16.6.4 Setting the maximum temperature limits" in "16.6 GC Configuration".

FLAME

For display only
On: ignite the flame.
Off: extinguish the flame.

FILTER TIME CONSTANT

Selection: 4 ms/5 ms/10 ms/20 ms/50 ms/100 ms/200 ms/500 ms/1 s/2 s, Default: 200 ms
This constant affects the processing of the detector signal.
As the time constant increases, noise as well as the peak height are reduced, but the peak width becomes wider.
Select the optimum value in accordance with the peak half width. (Refer to "13.2 Filter Signal Time Constant".)

SIGNAL OUTPUT PORT

Selection: Off/Ch1/Ch2/Ch3/Ch4, Default: (Channel is automatically assigned.)
Select the digital and analog signals output channels. Four channels are available.
However, for analog output, only Ch1 and Ch2 are available.

BACKGROUND SIG. SAVE

Selection: Off/Buff 1/Buff 2, Default: Off
Background baseline signals can be saved for the purpose of background subtraction.

BACKGROUND SIG COMP.

Selection: Off/Buff 1/Buff 2, Default: Off
Subtracts the saved background signal baseline from the actual baseline. This produces a stable baseline despite considerable baseline fluctuations.

DET SIG SUBTRACTION

This is not used with the GC-2025.
Selection: Off/DET# 1/DET# 2/DET# 3/DET# 4, Default: Off
Subtracts the detector signal of one detector from the signal of another detector. This function is mainly used in a dual column flow line to subtract the data acquired without an injection from the data acquired with an injection. The background signal is eliminated.
For the details on "SIGNAL OUTPUT PORT", "BACKGROUND SIG. SAVE", "BACKGROUND SIG COMP." and "DET SIG SUBTRACTION", refer to "13.3 Setting the Output Signals".

SIGNAL RANGE

Selection: $\times 1/\times 10^{-1}/\times 10^{-2}/\times 10^{-3}/\times 10^{-4}$, Default: $/\times 10^{-1}$
Multiplies the analog signal by the coefficient "10^{-x}" for a linear analog signal type.
If the signal intensity of a peak is beyond the input range of the data processing unit, for example, change the setting from "$\times 1$" to "$\times 10^{-1}$", from "$\times 10^{-2}$" to "$\times 10^{-3}$". If the peak is too small, for example, change the setting from "$\times 10^{-1}$" to "$\times 1$", from "$\times 10^{-3}$" to "$\times 10^{-2}$". In case of the digital signal, the signal is always output with "$\times 1$".

SIGNAL ATTENUATION

Selection: $\times 1/\times 2^{-1}/\times 2^{-2}/\times 2^{-3}/\times 2^{-4}$, Default: $/\times 2^{-1}$
Multiplies the analog signal by the coefficient "2^{-x}" for a wide analog signal type.
If the signal intensity of a peak is beyond the input range of the data processing unit, for example, change the setting from "$\times 1$" to "$\times 2^{-1}$", from "$\times 2^{-2}$" to "$\times 2^{-3}$". If the peak is too small, for example, change the setting from "$\times 2^{-1}$" to "$\times 1$", from "$\times 2^{-3}$" to "$\times 2^{-2}$". In case of the digital signal, the signal is always output with "$\times 1$".

ANALOG SIGNAL TYPE

Selection: Linear/Wide, Default: Linear
Set this item when the GC is connected to a Chromatopac in analog format.

Wide ... Select wide when connecting the GC to the C-R8A/C-R7A/C-R7A plus with the signal cable in the standard accessories.
The signal, raised to the 1/2 (one-half) power, is output from the GC; then, the signal received by the Chromatopac is squared.
When connecting the GC to a C-R8A/C-R7A/C-R7A plus for the first time, or replacing the Chromatopac, set the detector signal output to "Off" and perform the wide range calibration. (For the wide range calibration procedure, refer to "22 Connecting External Device Cables".)

Linear ... Select linear when connecting the GC to any Chromatopac other than the C-R8A/C-R7A/CR-7A plus. When connecting the GC to a C-R8A/C-R7A/C-R7A plus and setting the "ANALOG SIGNAL TYPE" to "Linear", the optional signal cable (linear, P/N 221-47251-92) is required.
In case of "Linear", the Chromatopac does not need the wide range calibration.

13.1.2.3 PF menu

PF menu	Description	Reference section
Ignite	Reduces the air flow rate, heats filament, and ignites detector when pressed when "FLAME" was "Off". If "AUTO IGNIT" is set to "On" on the [SYSTEM] key screen, the detector is automatically ignited after each temperature of detector, the control of which is "On", reached the setting value.	13.1.2.4
Det Gas	Sets the flow rate of makeup gas, hydrogen and air.	13.1.3
Ign. Set	If the Advanced Pressure Control (APC) is installed, you can set automatic ignition and automatic re-ignition. Default value is "On".	———

13.1.2.4 Igniting the FID

■ Ignition procedure

(1) When "DETECTOR" is set to "On" and "AUTO IGNITE" is set to "On" on the [SYSTEM] key main screen.

On the [DET] key main screen, set the detector to "On".

↓

Press [Start GC] (PF menu).
([SYSTEM] key main screen)

↓

GC control starts. The FID ignites once it has reached the set temperature.

↓

The baseline should indicate whether ignition was successful.

↓

The message "Ignition finished." appears, and the ignition is completed.

(2) When "DETECTOR" is set to "On" and "IGNITE" is set to "Off" on the [SYSTEM] key main screen.

On the [DET] key main screen, set the detector to "On".

↓

Press [Start GC] (PF menu). ([SYSTEM] key main screen)

↓

Wait until the detector temperature increases to the temperature set.

↓

Press [Ignit] (PF menu) to ignite the FID.

↓

The baseline should indicate whether ignition was successful.

↓

The message "Ignition finished." appears, and the ignition is completed.

(3) When "DETECTOR" is set to "Off" on the [SYSTEM] key main screen.

Press [Start GC] (PF menu) on the [SYSTEM] key main screen.

↓

On the [DET] key main screen, set the FID Control to "On".

↓

Wait until the detector temperature increases to the temperature set.

↓

Press [Ignit] (PF menu) to ignite the FID.

↓

The baseline should indicate whether ignition was successful.

↓

The message "Ignition finished." appears, and the ignition is completed.

NOTE

When the ignition fails initially, ignition sequence is reattempted. If the ignition is successful in the reattempted sequence, the message "Ignition finished (retried)" appears. If the ignition sequences are failed five times, the message "DET#n ignition failed" appears and the ignition sequence finishes.

■ Ignition troubleshooting

When ignition has failed and the message "Ignition failed." appears, check the following items.

Cause	Solution
Column is not connected.	Connect the column for FID to be ignited, and ensure that carrier gas is flowing.
Gas leaks at the detector side column connection.	Tighten the nut. Replace the ferrule.
Hydrogen is not supplied.	Supply hydrogen.
Hydrogen flow rate is incorrect.	Set the hydrogen flow rate to a proper value.
Air is not supplied.	Supply air.
Air flow rate is incorrect.	Set the air flow rate to a proper value.
FID jet is clogged.	Clean the FID jet. Replace the FID jet.
Igniter filament is broken.	Replace the igniter.

13.1.2.5 Extinguishing the FID

This section describes how to extinguish the FID when the Advanced Pressure Control (APC) is installed. Tighten the main valve of the cylinder after extinguishing, if necessary.

■ Auto extinguisher

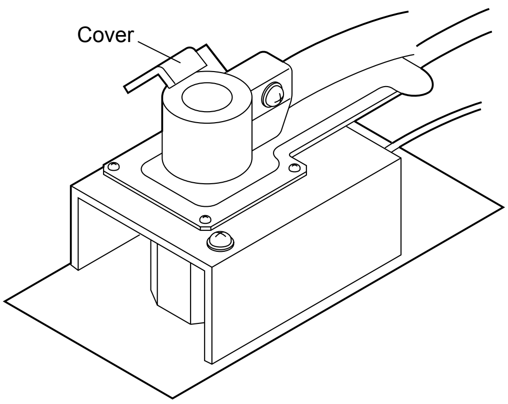
From the [SYSTEM] key main screen, press [Stop GC] (PF menu).
The detector temperature gradually decreases, supply of hydrogen and air is automatically stopped, and the flame is extinguished.
When a time program is running or a stop time has been set, the detector gas is automatically shut off at the end of the program, extinguishing the FID flame.

■ Manual extinguishment

To extinguish the detector flame without waiting automatic extinguishment, set the gas control of "H2" and "Air" to "Off" on the [Det Gas] (PF menu) screen. The detector gas is shut off, extinguishing the FID flame.

NOTE

The cover of FID detector should be raised and set up using tweezers for prevention of scalding in case of maintenance and inspection. Put down the cover on its side using tweezers in case of analysis.



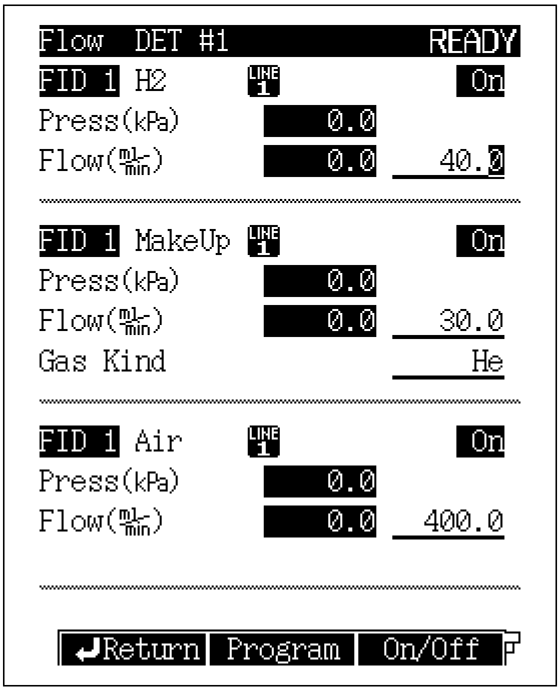
13.1.3 Setting the detector gas flows

The FID detector gas consists of makeup gas, hydrogen and air. The makeup gas is inert gas supplied to the detector to optimize FID sensitivity and prevent peak tailing. Usually, the carrier gas is used as the makeup gas. Hydrogen gas and air are supplied to be combusted inside the detector, creating the FID flame.

13.1.3.1 Screen description

Select [Det Gas] (PF menu) from the [DET] key main screen to display the flow screen shown in Fig. 13.1.3.

When the start sequence is the "Start Flow" status on the [SYSTEM] key screen, the makeup gas flow starts. Just before the ignition procedure begins, the hydrogen and air flow starts. When the stop sequence is "Stop Temp/Det" status on the [SYSTEM] key main screen, gas flow stop.



Refer to "OPTIMAL FLOW" in "13.1.3.2 Parameter list", and check whether the flow rate of each detector gas is set correctly. If not, set it to the correct value.

Fig. 13.1.3 Setting the detector gas flows

13.1.3.2 Parameter list

H_2

Range: 0.0-100.0 ml/min, Default: 40.0 ml/min

MAKE UP

Range: 0.0–100.0 ml/min, Default: 30.0 ml/min

Make up gas is supplied to the detector to optimize its sensitivity. For the FID, both nitrogen and helium can be used. Nitrogen offers higher absolute sensitivity and higher baseline noise than helium.

GAS TYPE

Selection: N_2/He/Ar, Default: He

Set the type of gas used as the makeup gas.

Do not use hydrogen for makeup gas. Do not select Ar for FID makeup gas.

Air

Range: 0.0–1000.0 ml/min, Default: 400.0 ml/min

OPTIMAL FLOW (Refer to Fig. 21.4.4-Fig. 21.4.6.)

Normally, set the flow rate of the makeup gas, hydrogen and air as follows to maximize the FID sensitivity.

Makeup gas : Approx. 30 ml/min
Hydrogen : Approx. 40 ml/min
Air : Approx. 400 ml/min

13.1.3.3 PF menu

PF menu	Description	Reference section
Program	The flow rate of makeup gas, hydrogen and air supplied to detector can be controlled by a program.	13.1.3.4
On/Off	Select "Off" to stop gas flow. Select "On" to restart the gas flow. Default value is "On".	——
Offset	Performs offset calibration of APC sensor. This calibration improves the reproducibility of results.	21.6

13.1.3.4 Flow rate program for detector gas

Press [Program] (PF menu) from [Det Gas] (PF menu) to display the Detector gas screen shown in Fig. 13.1.4. Here, set a flow rate program for detector gas.
The flow rate program procedure is the same for the makeup gas, hydrogen gas and air.

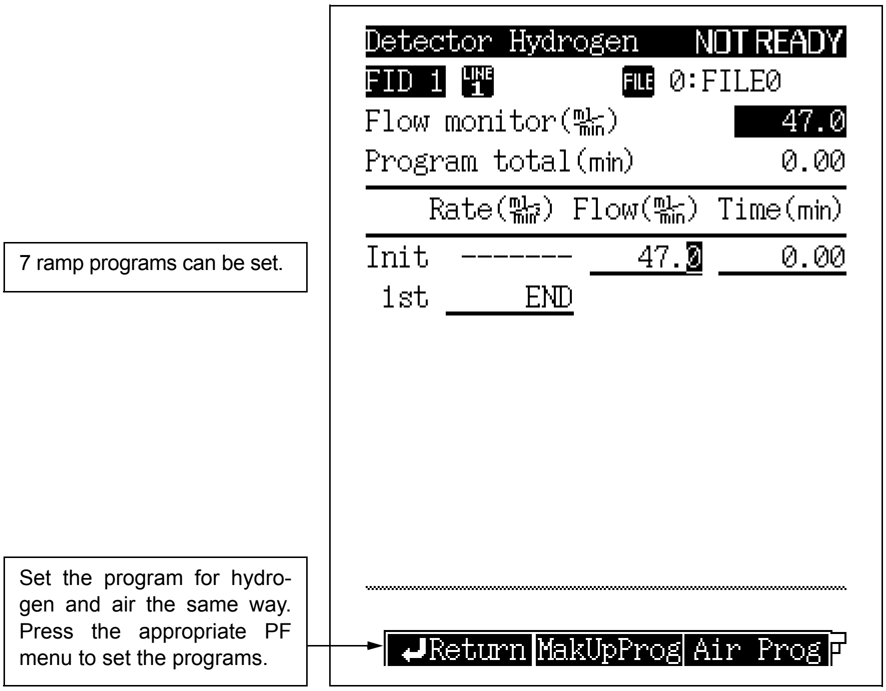


Fig. 13.1.4 Detector gas program

13.1.3.5 Detector gas program parameters

FLOW RATE

The range and the default valve differs for each gas. See "13.1.3.2 Parameter list".
Set the default flow rate and the final flow rate for each stage of the detector gas flow rate program.

TIME

Range: 0.00–9999.99 min, Default: 0.00 min
Set the retention time for the initial flow rate and the final flow rate for each ramp of the detector gas flow rate program.

RATE

Range: END/-400.0–400.0 ml/min^2, Default: END
Set the program rate of the detector gas flow rate program. If you set the rate to "0", "END" appears and the program ends at the previous ramp. Move the cursor to "END" and set any numeric value other than "0", to enter the pressure and the time for that ramp.

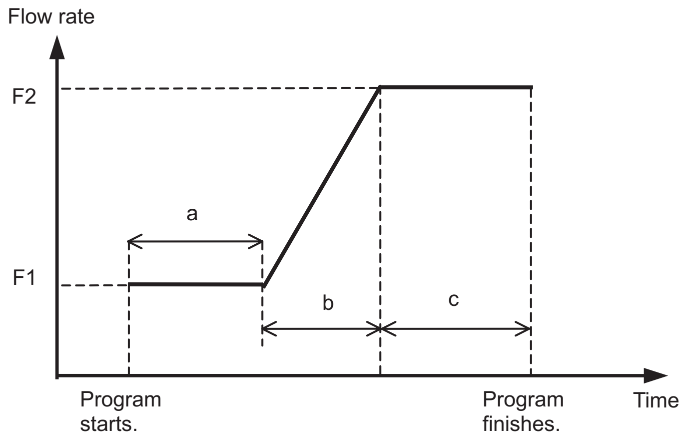
13.1.3.6 PF menu

PF menu	Description	Reference section
Make Up Prog	Displays the setup screen of the flow rate program for makeup gas.	——
H2 Prog	Displays the setup screen of the flow rate program for hydrogen gas.	——
Air Prog	Displays the setup screen of the flow rate program for air.	——
Del Line	Deletes a line at the current cursor position.	——
Ins Line	Inserts a line in line at the current cursor position.	——

13.1.3.7 Setting a flow rate program

■ Screen terminology

<1-ramp flow rate program>



Initial flow rate	(FLOW)....	F1
Initial flow rate hold time	(TIME)......	a
Program rate	(RATE)......	$\frac{F2-F1}{b}$
Final flow rate	(FLW)........	F2
Final flow rate hold time	(TIM).........	c

■ Program creation

<1-ramp flow rate program>

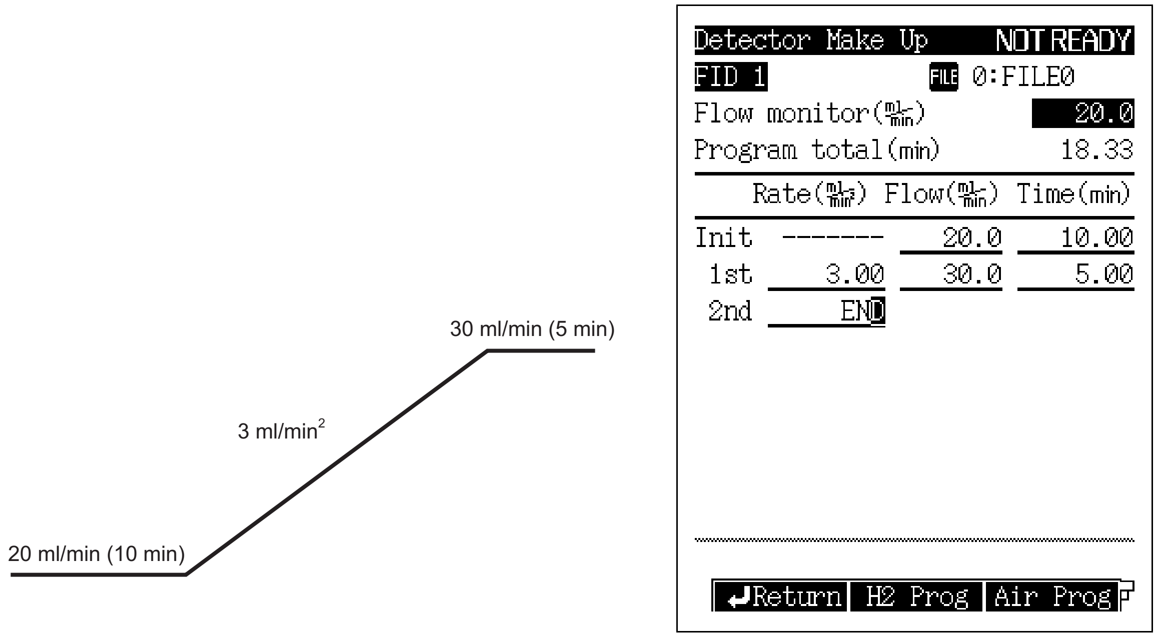


Fig. 13.1.5 Flow rate program example

13.2 Filter Signal Time Constant

■ Selecting the filter time constant

Normally, analyses can be performed with the time constant set to the default value. However, in some cases the S/N ratio is improved by changing the time constant.
For example, if the half width of a FID peak is "0.1 sec", the S/N ratio is maximized when the time constant is set to "20 ms."

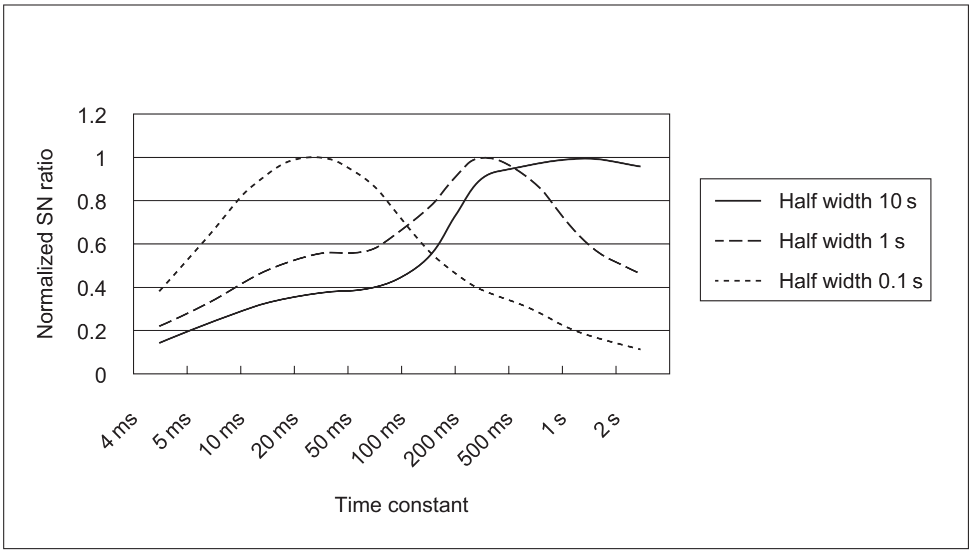


Fig. 13.2.1 Relationship between time constant and S/N ratio

13.3 Setting the Output Signals

13.3.1 Detector signal output

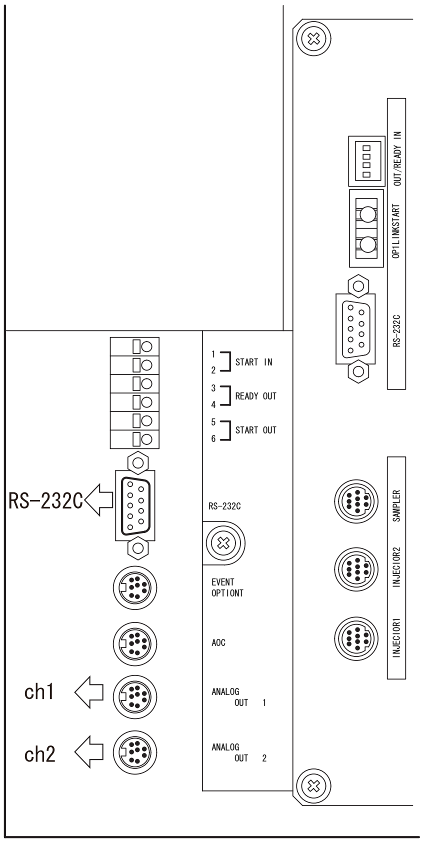


Fig. 13.3.1 Location of connector

Set the detector signal (digital and analog signals) output from the gas chromatograph. There are four signal output channels. Analog signals can be output only from ch1 and ch2. Both digital and analog signals can be output from one channel. Even if two or more channels are set, signals can be output from each channel at the same time.
Detector signals are transferred through an RS-232C cable (for digital signals, only when a personal computer is used) and the Chromatopac signal cable (for analog signals).

13.3.2 Background compensation

If the baseline fluctuates considerably during programmed analysis, the baseline fluctuation can be saved as a background baseline by the GC. Afterwards, the background is subtracted from the baseline (background compensation).
This section describes how to save the background baseline and perform background compensation.

(1) Setting the signal output channel
On the [DET] key main screen, set "SIGNAL OUTPUT PORT" to either "Ch1" or "Ch2".

(2) Background storage setup
On the [DET] key main screen, set "BACKGROUND SIG. SAVE" from "Off" to "Buff 1" (or "Buff 2") to save the background baseline.

(3) Saving the background baseline
Without making an injection, press the [START] key on the gas chromatograph to execute analysis. The background baseline is saved.

(4) Background compensation settings
On the [DET] key main screen, set "BACKGROUND SIG. COMP." from "No" to "Buff 1" (or "Buff 2") the same selection from in "BACKGRND SAVE".

(5) Analysis
Make an injection, and press the [START] key to execute analysis. The background compensation is in effect.

NOTE
Background baseline can be saved for 30 minutes maximum. If analysis extends more than 30 minutes, the detector signal which is compensated by subtracting the value saved as a background baseline for 30 minutes is output after the retention time of 30 minutes.

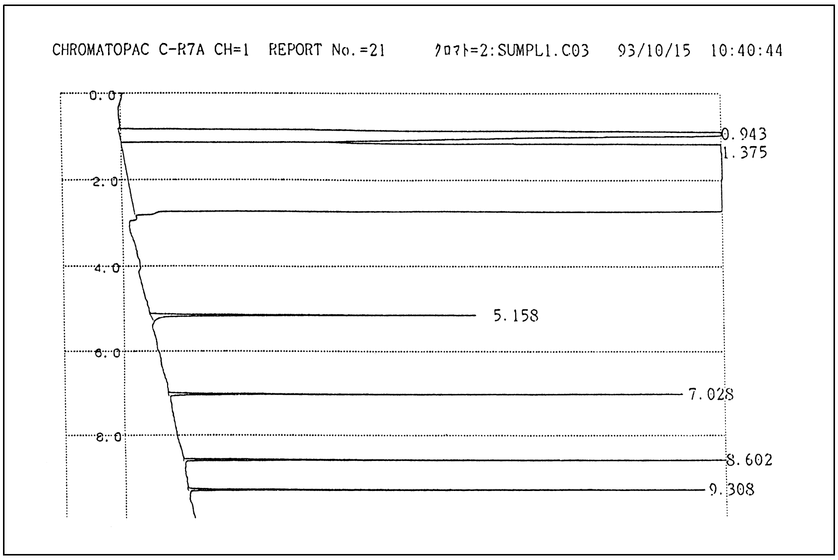


Fig. 13.3.2 Example of programmed analysis without compensation

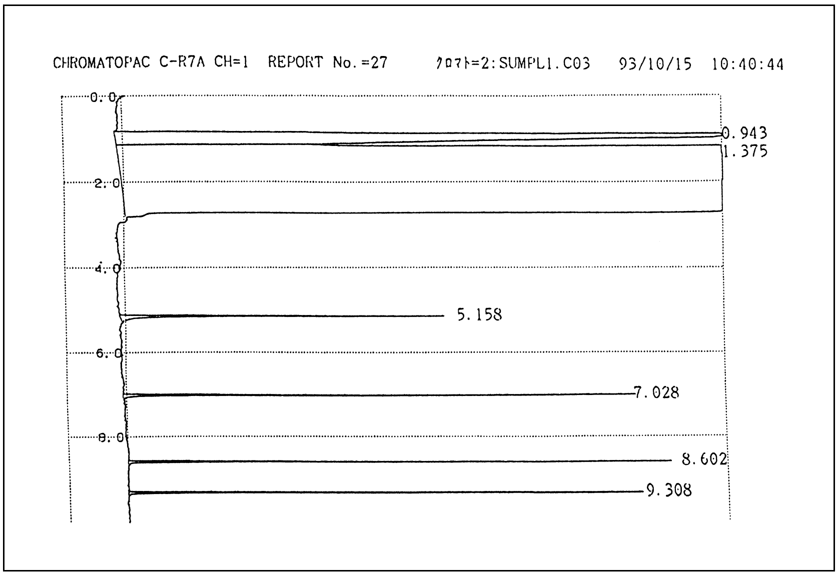


Fig. 13.3.3 Example of programmed analysis with compensation

∗ The chromatograms shown above are given for example only.

13.3.3 Detector signal subtraction

Since the GC-2025 is equipped with only one FID detector, the detector signal subtraction cannot be used.

14.1 Standard Diagnosis

Each part of the gas chromatograph is checked for problems with the self-diagnosis function.
Perform the standard diagnosis periodically to maintain optimal performance and prevent failures.

14.1.1 Screen description

Select "STANDARD DIAGNOSIS" from the [DIAG] key main screen to display the Standard Diagnosis screen shown in Fig. 14.1.1.

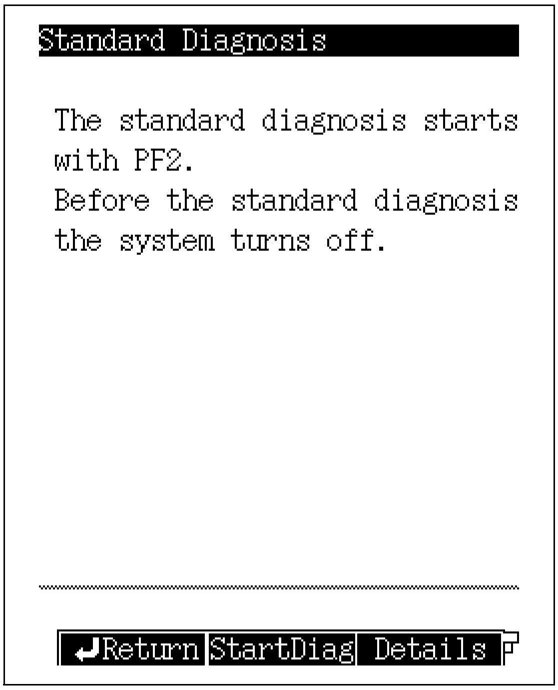


Fig. 14.1.1 Diagnosis main screen

14.1.2 PF menu

PF menu	Description	Reference section
Start Diag	Starts standard diagnosis program.	14.1.5
Details	Displays result of the most recent diagnosis. However, if standard diagnosis has not been executed since the power has been turned on, default values are displayed. [Print] (PF menu) prints out the displayed diagnosis results to Chromatopac.	14.1.9
Diag Param	Selects diagnosis items and determines setup values used for diagnostic reference.	14.1.3

14.1.3 Diagnosis parameters

Press [Diag Param] (PF menu) from the Standard Diagnosis main screen to display the Diagnosis Parameters screen shown in Fig. 14.1.2.
Select the items to be checked during the self-test.

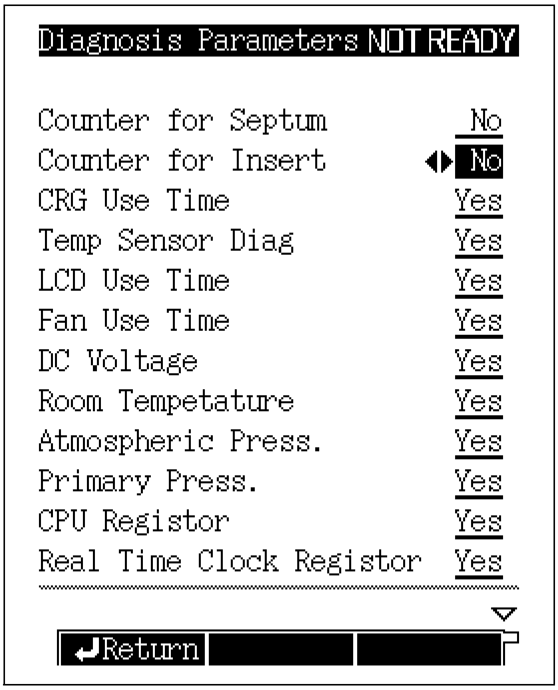


Fig. 14.1.2 Diagnosis setup screen

14.1.4 Diagnosis parameter list

For each item, specify whether it is to be checked or tested. Test items are marked "Yes". Items which are ignored are marked "No". Each item is marked either "Yes" or "No".

NOTE
At the time of diagnosis, set the split mode to "SPLIT".

COUNTER FOR SEPTUM
COUNTER FOR INSERT
Verifies whether the preset number of injections has been exceeded.
The "ANALYSIS COUNTER" limit is displayed.

CRG USE TIME
Verifies whether the CRG valve "On" time exceeds the preset operating time.
The "COOLANT CONSUMPTION" limit is displayed.

TEMP SENSOR USE TIME
The operating time for the temperature sensor in use at 300 °C or above is displayed. Refer to the guidelines for operating time.

TEMP SENSOR DIAG
Verifies whether noise has been generated, to detect deterioration of the platinum sensor.

LCD USE TIME
Verifies whether the accumulated backlight ON time exceeds the preset operating time.
The limit 46,380 hours.

FAN USE TIME
Verifies whether the accumulated fan operating time exceeds the preset operating time.
The limit is 61,320 hours.

DC VOLTAGE (5 VDC, 24 VDC, -15 VDC, FTD 24 VDC)
Verifies whether each DC voltage has exceeded its limit.

ROOM TEMPERATURE
Verifies whether the current room temperature is within the optimal range.
The range is 5 to 40 °C.

ATMOSPHERIC PRESS
Verifies whether the atmospheric pressure is within the optimal range.

PRIMARY PRESS
Verifies whether the gas supply pressure is within the maximum set pressure.

CPU REGISTER
REAL TIME CLOCK REGISTER
Verifies that each register is correctly written and read.

DETECTOR ROM
Verifies that the data saved in the detector ROM is read correctly.

DETECTOR ADC REGISTER
Verifies that the data saved in the detector A/D converter register is read correctly.

DETECTOR HV SOURCE
Verifies whether the detector high voltage power supply is within the threshold.

DETECTOR IGNITE
Checks that the ignition pulse is normal.

DETECTOR IGNITION
Verifies whether the ignition operation is normally executed.

ECD FREQUENCY
Verifies whether the frequency of the pulse voltage applied to the ECD is below the limit.
(The ECD cannot be installed on the GC-2025.)

CARRIER GAS ROM, DETECTOR GAS ROM, APC ROM

Verifies whether the data saved in the ROM on the flow controller PCB can be read correctly.

CARRIER GAS AD CONVERTER, DETECTOR AD CONVERTER, APC AD CONVERTER

Verifies whether the contents of the A/D converter on the flow controller PCB can be read correctly.

GAS CONTROL

Checks that the pressure flow rate is normally controlled.

OVER TEMP PROTECTION

Ensure that the overheat protection circuit is normal.

CPU PERIPHERAL

RESET IC

Verifies that the reset circuit works normally.

WATCH DOG TIMER

Ensures that the IC which checks for software problems is functioning normally.

ROM

Checks that the ROM is intact.

RAM

Verifies whether the RAM can be correctly written and read.

14.1.5 Starting the diagnosis

Press [Start Diag] (PF menu) from the standard diagnosis main screen shown in Fig. 14.1.1 to start diagnosis and to display the screen shown in Fig. 14.1.3.

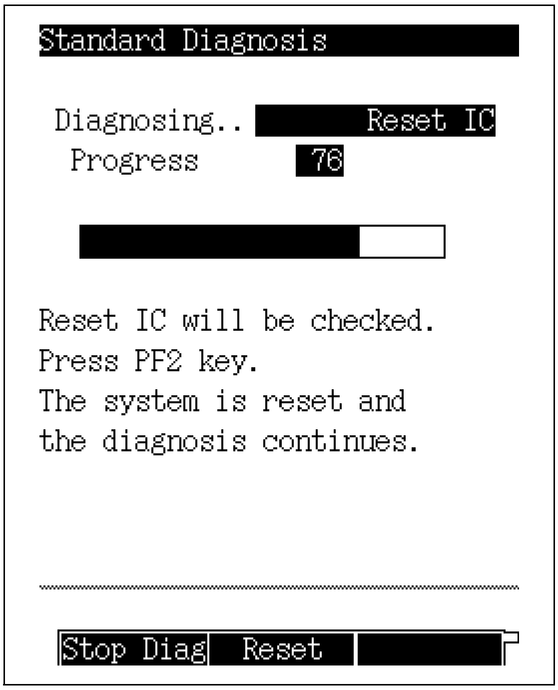


Fig. 14.1.3 Starting the diagnosis

14.1.6 PF menu

PF menu	Description	Reference section
Stop Diag	Stops the diagnosis. If the program is stopped, items not yet executed are canceled.	14.1.7
Reset	Before starting the IC diagnosis, the message "Reset IC will be checked. Press PF2 key." appears. Press [Reset] (PF menu) to check whether reset IC is functioning normally.	——

14.1.7 Stopping/exiting the diagnosis

Press [Stop Diag] (PF menu) during diagnosis to display the diagnosis stop screen shown in Fig. 14.1.4.
When the diagnostics are allowed to complete, the total diagnosis results (Test Result) and the number of abnormalities (Number of NG) are displayed.

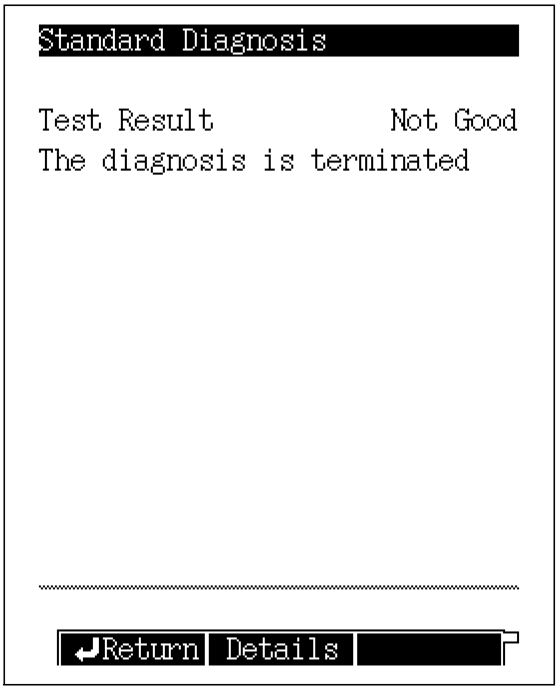


Fig. 14.1.4 Diagnosis stops

14.1.8 PF menu

PF menu	Description	Reference section
Details	When the diagnosis is stopped, diagnosis results up to that time are displayed. When the diagnosis ends, the diagnosis results of all items are displayed. Press [Print] (PF menu) to print out the displayed diagnosis results to a Chromatopac.	14.1.9

14.1.9 Diagnosis results

Press [Details] (PF menu) from the screen shown in Fig. 14.1.4 once the standard diagnosis is have stopped or ended; the Test Result screen shown in Fig. 14.1.5 appears.
Press [Details] (PF menu) from the standard diagnosis screen shown in Fig. 14.1.4 to display the results of the last test since the power was turned on. Once the power is turned off, the diagnosis results are cleared.

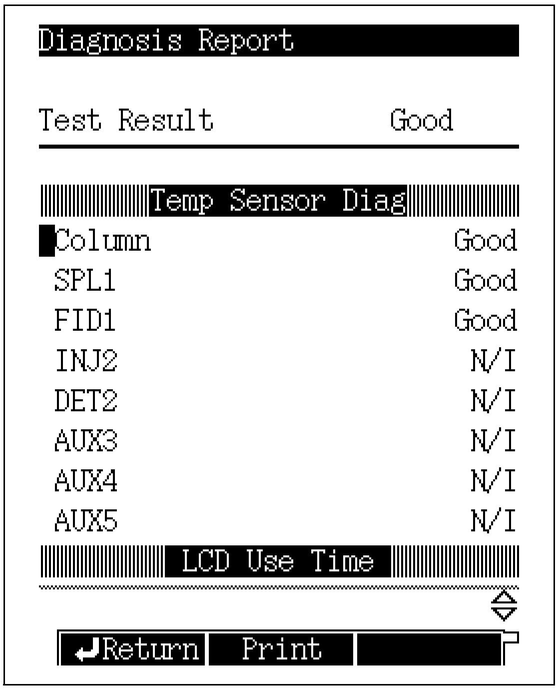


Fig. 14.1.5 Diagnosis results

14.1.10 PF menu list

PF menu	Description	Reference section
Print	Prints out the results of the diagnosis to a Chromatopac.	——

■ diagnosis results

- Good : Displayed when the diagnosis result satisfies the requirements.
- Not Good : Displayed when the diagnosis result does not satisfy the requirements.
- N/T (= Not Tested) : Displayed when the diagnostic test was stopped or when an item is excluded from the test.
- N/A (= Not Applicable) : Displayed when diagnostic test is disabled for the item (ignition test for a TCD, for example).
- N/S (= Not Selected) : Displayed when the diagnosis was not performed on an item because it has not been configured in an analytical line.
  Certain diagnosis items can be performed for components which have not been configured. For example, for a detector not configured in any line, Make Up Gas Control is not checked, but its detector ROM check can be executed.
- N/I (= Not Installed) : Displayed when the diagnosis item is not installed.

■ Troubleshooting items which are "Not Good"

Diagnosis item	Countermeasures
SEPTUM COUNTER	Replace the septum. (Refer to "18.2 Inspection and Maintenance: Septum".)
INSERT COUNTER	Replace the glass insert. (Refer to "18.4 Inspection and Maintenance: Glass Insert".)
ROOM TEMPERATURE	Check the operation range.
ATMOSPHERIC PRESS	Check the operation range.
GAS PRIMARY PRESS	Increase supply pressure to the GC. For example, adjust the regulator.
DETECTOR IGNITION	Refer to "19 Troubleshooting".
ANY OTHER ITEM	Contact your Shimadzu representative.

14.2 Log Reading Menu

14.2.1 Screen description

Select "2. LOG READING MENU" from the [DIAG] key main screen to display the Log Reading Menu screen shown in Fig. 14.2.1.

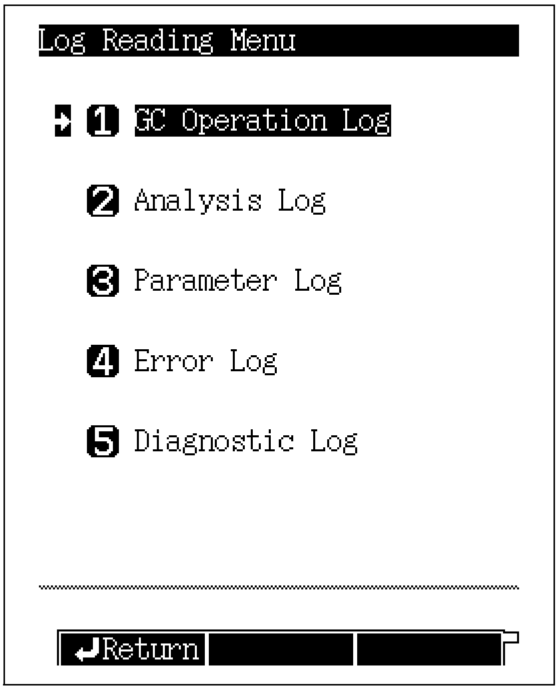


Fig. 14.2.1 Log reading menu main screen

14.2.2 Parameter list

GC OPERATION LOG
Displays the power On/Off log and the system On/Off log.

ANALYSIS LOG
Displays the analysis log. This log records whether analyses were finished and whether controls have deviated from their target valves.

PARAMETER LOG
Displays the key operation log and the parameter change log.

ERROR LOG
Displays the log of displayed error messages.

DIAGNOSTIC LOG
Displays the diagnosis log.

14.2.3 GC operation log

Select "1. GC OPERATION LOG" to display the system On/Off log and the heater On/Off log.

(1) Screen description
Select "2. LOG READING MENU" from the [DIAG] key main screen, then select "1. GC OPERATION LOG". The screen shown in Fig. 14.2.2 appears.
Up to 50 logs are stored. If the number of logs exceeds 50, existing logs are deleted starting with the oldest.

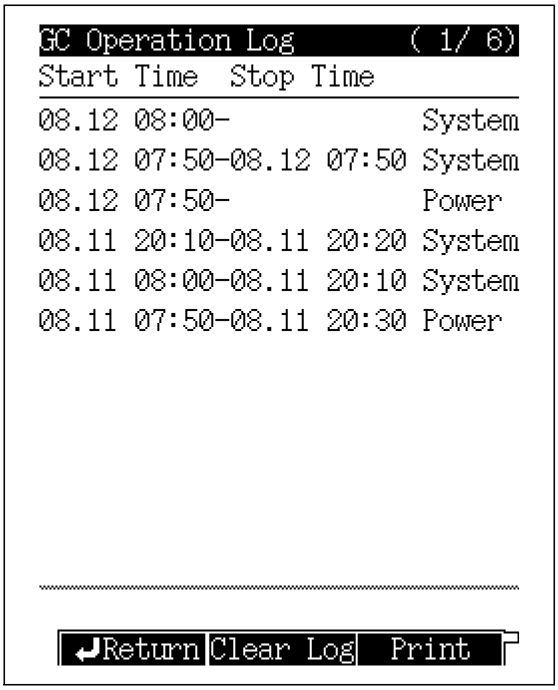


Fig. 14.2.2 Operation log screen

NOTE
If there are more items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menu

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message "Clear log with PF2" appears. Press [Clear Log] (PF menu) to clear the log.	——
Print	Prints the operation log to a Chromatopac.	——

14.2.4 Analysis log

When "2. ANALYSIS LOG" is selected, the analysis log is displayed. This log records whether analyses were allowed to finish and whether controls deviated from their set values.

(1) Screen description
Select "2. LOG READING MENU" from the [DIAG] key main screen, then select "2. ANALYSIS LOG" to display the screen shown in Fig. 14.2.3.
25–545 logs are saved. The number of saved logs depends on the size of each log. If the number of logs exceeds the capacity, existing logs are deleted starting from the oldest.

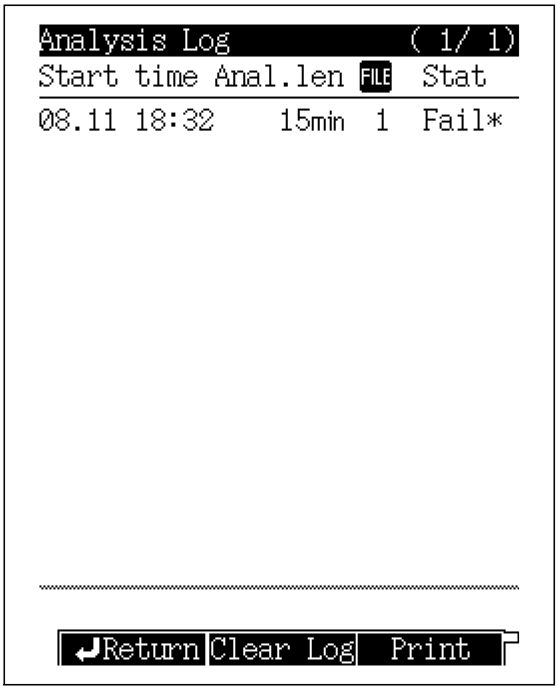


Fig. 14.2.3 Analysis log screen

NOTE

- During a temperature program, if the rate of temperature increase is too great, the GC may not be within the Ready range temporarily. When this occurs, the analysis log shows "Fail".
- If there are more items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menu

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message "Clear log with PF2" appears. Press [Clear Log] (PF menu) to clear the log.	——
Print	Prints the analysis log to a Chromatopac.	——

(3) Analysis log details

On the analysis log main screen, use the cursor to select a log item with "*" on the right and press the [ENTER] key to display the screen shown in Fig. 14.2.4.

The screen provides details about an alarm or warning which was issued during the analysis.

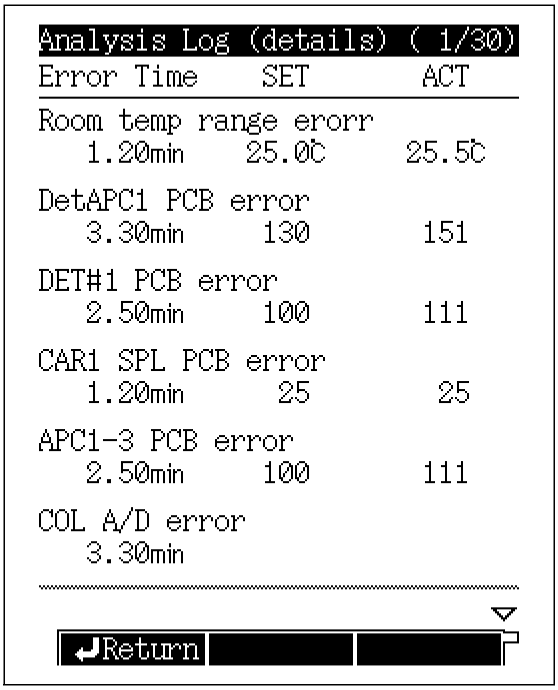


Fig. 14.2.4 Details screen

14.2.5 Parameter log

When "3. PARAMETER LOG" is selected, parameter names and new values are displayed when parameters are changed. In addition, the direct operation of valves, etc. are also displayed.

(1) Screen description
Select "2. LOG READING MENU" from the [DIAG] key main screen, then select "3. PARAMETER LOG". The screen shown in Fig. 14.2.5 appears.
Up to 50 logs are saved. If the number of logs exceeds 50, existing logs are deleted starting from the oldest.

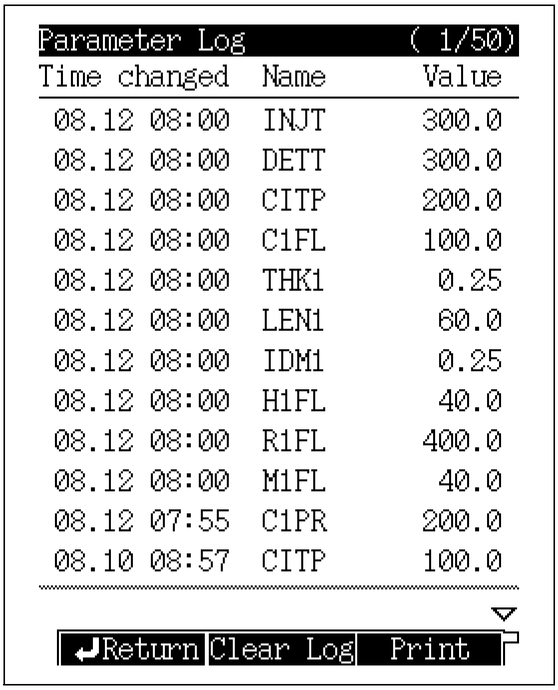


Fig. 14.2.5 Parameter log screen

NOTE
If there are more items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menu

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message "Clear log with PF2" appears. Press [Clear Log] (PF menu) to clear the log.	——
Print	Prints the parameter log to a Chromatopac.	——

14.2.6 Error log

When "4. ERROR LOG" is selected, the log of all errors which have been displayed is shown.

(1) Screen description
Select "2. LOG READING MENU" from of the [DIAG] key main screen, then select "4. ERROR" to display the screen shown in Fig. 14.2.6.
Up to 100 logs are saved. If the number of logs exceeds 100, existing logs are deleted starting from the oldest.

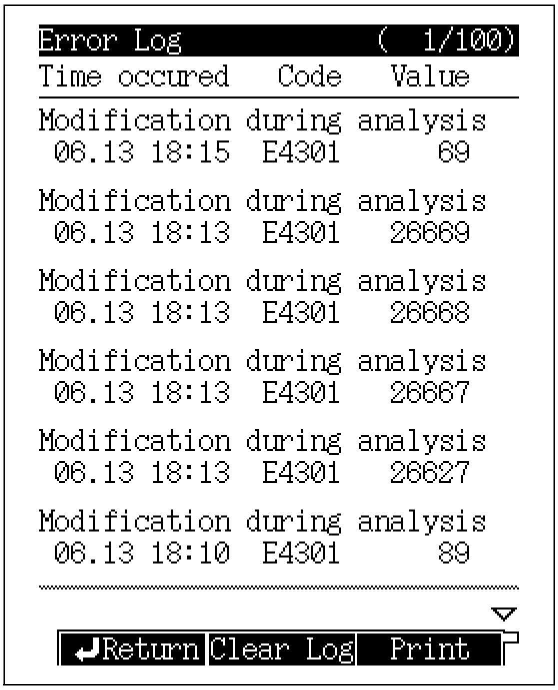


Fig. 14.2.6 Error log screen

NOTE
If there are more items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.
"Ignition finished (retried)" is not saved, when only one ignition sequence was re-attempted.

(2) PF menut

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message "Clear log with PF2" appears. Press [Clear Log] (PF menu) to clear the log.	——
Print	Prints the error log to a Chromatopac.	——

14.2.7 Diagnostic log

When "5. DIAGNOSTIC LOG" is selected, the results of the standard diagnosis are displayed. The results of the last diagnosis are shown in the [Details] (PF menu) screen described in "14.1 Standard Diagnosis".

(1) Screen description
Select "2. LOG READING MENU" from of the [DIAG] key main screen, then select "5. DIAGNOSTIC LOG". The screen shown in Fig. 14.2.7 appears.
Up to 50 logs are saved. If the number of logs exceeds 50, existing logs are deleted starting from the oldest.

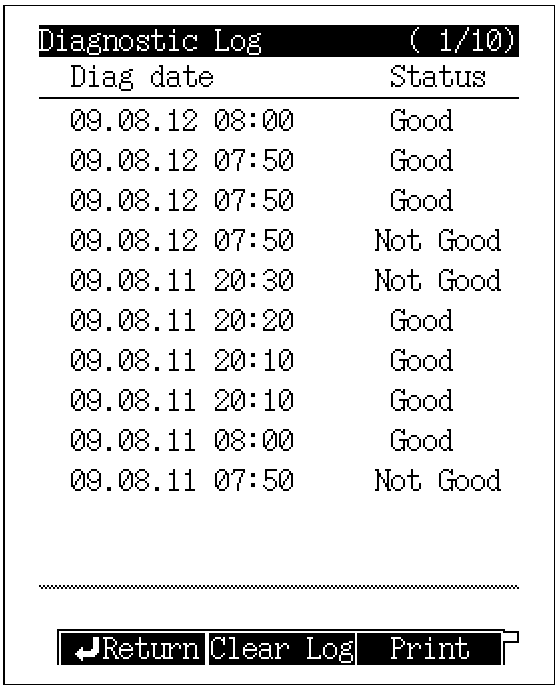


Fig. 14.2.7 Diagnosis log screen

NOTE
If there are more items than items than can be displayed on one screen, scroll through the screen using the left and right arrow keys.

(2) PF menu

PF menu	Description	Reference section
Clear Log	Deletes all displayed logs. When [Clear Log] (PF menu) is pressed, the screen changes and the message "Clear log with PF2" appears. Press [Clear Log] (PF menu) to clear the log.	——
Print	Prints the diagnostic log to a Chromatopac.	——

14.3 Analysis Counter

Use the analysis counter to set the replacement timing of the septum, and the glass insert, when the counter exceeds the limit, an error message is displayed.

14.3.1 Screen description

Select "3. ANALYSIS COUNTER" from the [DIAG] key main screen to display the screen shown in Fig. 14.3.1.

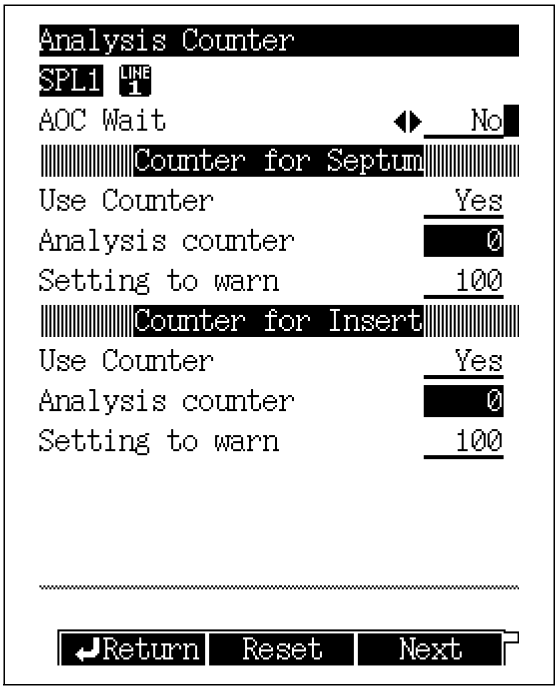


Fig. 14.3.1 Analysis counter screen

14.3.2 Parameter list

AOC WAIT

Selection: Yes/No, Default: No

When [Yes] is selected, the output of the ready signal to the AOC can be stopped and operation can be paused temporarily if each threshold is exceeded during continuous analysis using AOC.

USE COUNTER

Selection: Yes/No, Default: Yes

ANALYSIS COUNTER

Selection: 0

SETTING TO WARN

Range: 0–999, Default: 100

NOTE

The septum/glass insert replacement interval depends on the type of samples and outer diameter of the syringe needle. Replace them promptly when the warning message for the use count exceeding the limit is displayed. Check the analysis counter and threshold value prior to analysis. Reset the analysis counter after the replacement.

14.3.3 PF menu

PF menu	Description	Reference section
Reset	Resets analysis number counter of the current item.	——
Next	Displays the setup screen of the analysis counter of another injection port.	——

14.4 Coolant Consumption Counter

The coolant consumption display allows you to confirm the total time that the CRG valve has been "On" (The CRG is an optional accessory.)
If the coolant consumption exceeds the time limit specified (setting to warn), a warning message is displayed.

14.4.1 Screen description

Select "4. COOLANT CONSUMPTION" from the [DIAG] key main screen to display the Coolant consumption screen shown in Fig. 14.4.1.

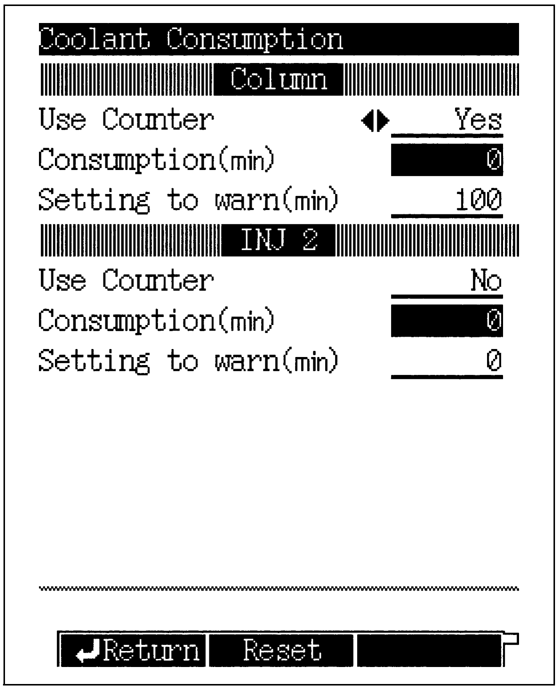


Fig. 14.4.1 Coolant consumption screen

14.4.2 Parameter list

USE COUNTER

Selection: Yes/No, Default : Yes

CONSUMPTION

Default: 0 min

The total time that the CRG is "On" is displayed.

Refer to "15.3 Setting the CRG Parameters".

SETTING TO WARN

Range: 0–9999 min, Default : 100 min

NOTE

The coolant consumption time depends on the gas cylinder volume and the temperature settings which require CRG. Set the warning time according to the analysis conditions. It is necessary to count the time for the actual analysis condition once.

14.4.3 PF menu

PF menu	Description	Reference section
Reset	Resets the Use counter.	——

14.5 Standard Installation Test

After the system has been installed by your Shimadzu representative, the standard installation test is performed to check whether the system is functioning properly.

14.5.1 Screen description

Select "5. STANDARD INSTALLATION" from the [DIAG] key screen to display the Standard installation screen shown in Fig. 14.5.1.
The installation test can be performed at any time to check for proper functioning. From this screen, load the analytical conditions of the standard installation test.

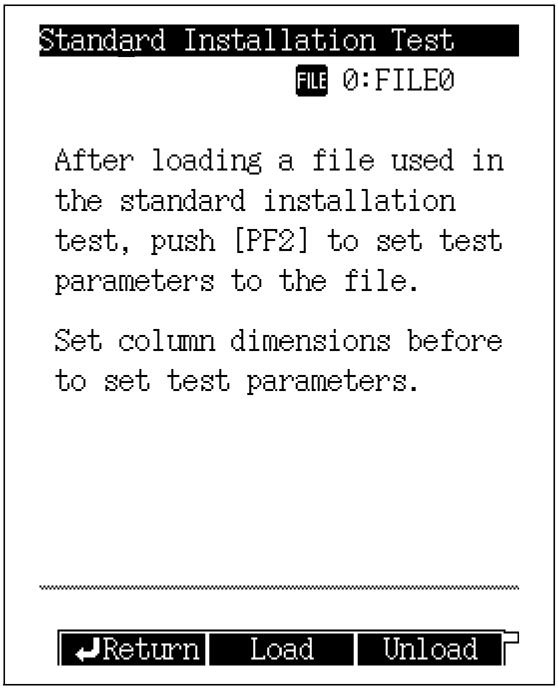


Fig. 14.5.1 Standard installation test main screen

14.5.2 PF menu

PF menu	Description	Reference section
Load	Automatically sets the analytical conditions of the standard installation test. When [Load] (PF menu) is pressed, "TEST" is displayed for the used file name.	——
Unload	Returns analytical conditions to their former status.	——

14.5.3 Test procedure

(1) Specify the analytical conditions file of the standard installation test.
Example: Load "File 1" using [File] (PF menu) of the [SET] key.

(2) Configure the injection port and the detector used to execute the standard installation test in an analytical here.
However, if two or more analytical lines have been configured, the lowest No. analytical line is set with the test conditions.
In the standard installation test, only one detector can be set per analytical line. If two or more detectors are set, an error message appears.

(3) Set the dimensions of the column installed.
Example: Set the internal diameter, length and film thickness of the column using [Column] of the [FLOW] key.

(4) Press [Load] (PF menu) to load the analytical conditions of the standard installation test.
If the analytical condition need to be changed for the installation test, change the parameters after loading.

(5) Make an injection, then verify whether the data has been acquired correctly.

(6) When analysis finishes, press [Unload] (PF menu) to return the analytical conditions to their former status.

14.6 Peak Generator

Select "6. PEAK GENERATOR" to generate electronic peaks to confirm of the operation of the data processing unit.

14.6.1 Screen description

Select "6. PEAK GENERATOR" from the [DIAG] key screen to display the Peak Generator screen shown in Fig. 14.6.1.

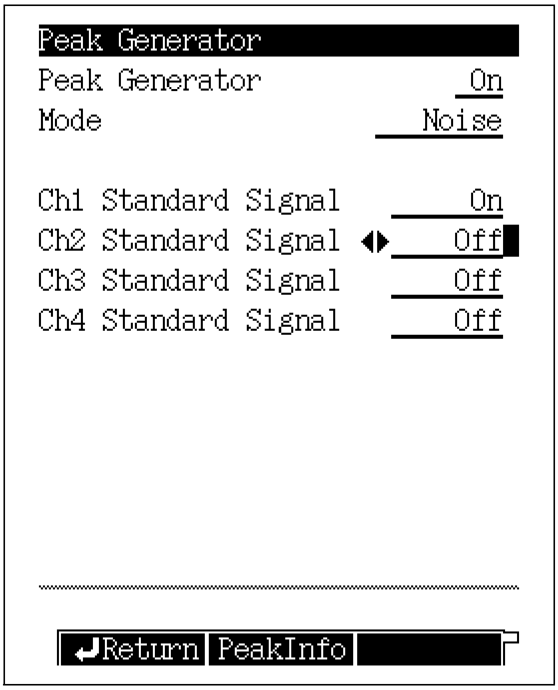


Fig. 14.6.1 Peak generator setup screen

14.6.2 Parameter list

PEAK GENERATOR
Range: On/Off, Default: Off

MODE
Range: Noise/No Noise/Trunc, Default: Noise

Ch1–Ch4 STANDARD SIGNAL
Range: On/Off, Default: Off

14.6.3 PF menu

PF menu	Description	Reference section
Peak Info	Specify the parameters (retention time, full width at half height and peak height) of the peaks to be generated.	——

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15.1 Auto Injector Parameters

From the gas chromatograph, specify the parameters of the Shimadzu AOC-20i Auto Injector and the AOC-20s Auto Sampler Carousel, which automatically inject liquid samples into the gas chromatograph.
For detailed setting procedures, refer to the User's Manual for AOC-20.

15.1.1 Screen description

After installing the auto injector on the gas chromatograph, access the line configuration screen from the [SET] key, and then select AOC1 for the analytical line (Since the AOC2 is not used, it is not necessary to select it for the line.)
Press the [OPTION] key again or press [Next] (PF menu) several times on the [OPTION] key screen to display the AOC parameter screen shown in Fig. 15.1.1. The screen toggles among the AOC parameters → AUX APC → CRG screens.

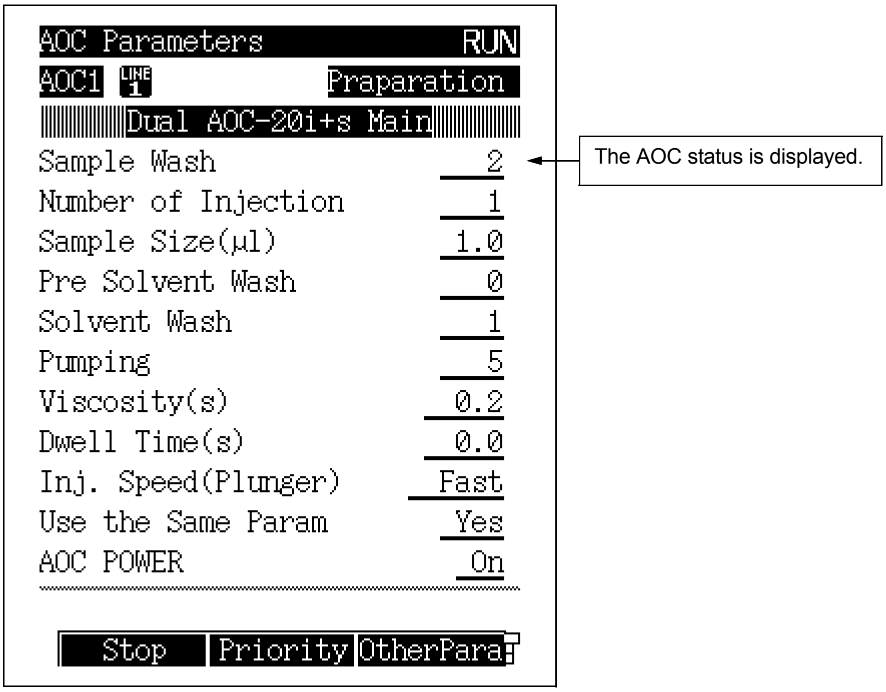


Fig. 15.1.1 AOC setup screen

■ AOC STATUS

The AOC status can be monitored.

Screen display	Description
Inactive	AOC is not operating.
Taking vial	A vial is being picked up from the tray.
Preparation	AOC is operating (before injection).
Rinse	AOC is operating (after injection).
Putting vial	A vial is being returned to the tray.
Wait	AOC is waiting for analysis.

15.1.2 Parameter list

SAMPLE WASH

Range: 0–99, Default: 2
Set the number of times to rinse the syringe with sample before injection.

NUMBER OF INJECTION

Range: 0–99, Default: 1
Set the number of times the sample should be injected.

SAMPLE SIZE

Range: 0.1–8.0 μl, Default: 1.0 μl
Set the sample injection amount.

PRE SOLVENT WASH

Range: 0–99, Default: 0
Set the number of times to rinse the syringe with solvent before injection.
This item is valid only when the injection mode is set to "0 (normal)".
Refer to "3.3.3 Injection Modes" in AOC-20 instruction manual for more information of the injection mode.

SOLVENT WASH

Range: 0–99, Default: 1
Set the number of times to rinse the syringe with solvent after injection.

PUMPING

Range: 0–99, Default: 5
Set the number of times to raise and lower the plunger with the needle tip inside the sample to eliminate syringe air bubbles.

VISCOSITY

Range: 0.0–99.9 sec, Default: 0.2 sec
During rinsing with sample and pumping, the plunger waits for the specified period of time.
When aspirating sample before injection, the plunger waits for either the valve set here or 4 seconds, which ever is longer.
The wait time during rinsing with solvent is always 0.2 seconds.

DWELL TIME

Range: 0.0–99.9 sec, Default: 0.0 sec
Set the length of time for the syringe to remain in the injection port after injection.

INJ. SPEED (PLUNGER)

Selection: Slow/Middle/Fast, Default: Fast
Specifies the plunger speed during injection.

AOC POWER

Selection: On/Off, Default: On
Turns the AOC power on and off (built-in GC-2025 power supply).

15.1.3 PF menu

PF menu	Description	Reference section
Start	Starts AOC gas chromatograph starts when the sample is injected.	——
Stop	Temporarily stops the AOC. If [Start] (PF menu) is pressed in stop status, the AOC resumes the operation before [Stop] (PF menu) was pressed.	——
Priority	Sets up a Priority analysis.	15.1.4
Other Para	Sets AOC options and customization.	15.1.7
Sampler	Sets the auto sampler, sub injector and bar code reader.	15.1.10
Reset	Resets AOC to the status before control was started.	——
Upload	Loads parameters from the AOC to the AOC setup screen of the gas chromatograph.	——
Print	Prints the parameters on the Chromatopac.	——
Next	Toggles among these screens, in order: AOC parameters → AUX APC → CRG.	——

NOTE

- When "AOC" is not selected for the line, AOC parameters screen is not displayed.
- When the AUX APC is not installed, the AUX APC screen is not displayed.

15.1.4 AOC priority analysis

Select [Priority] (PF menu) from the AOC main screen to display the AOC priority sample screen shown in Fig. 15.1.2.
The batch can only be interrupted when the AOC is operating.
Enter the sample injection No., and press [Set] (PF menu).

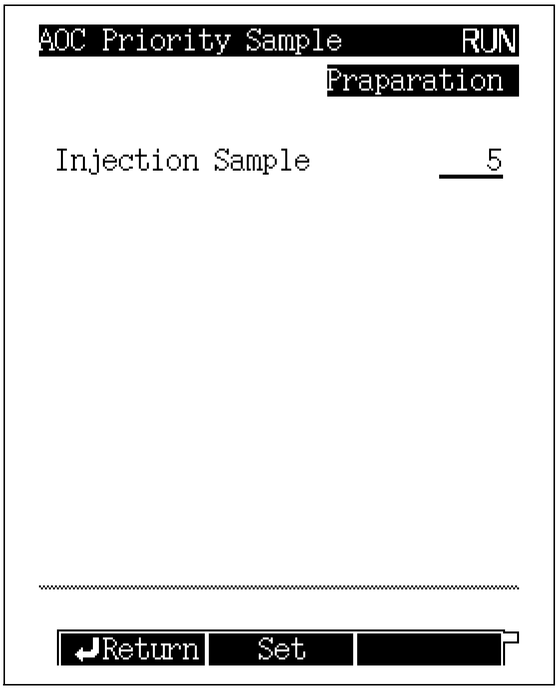


Fig. 15.1.2 Priority analysis setup screen

15.1.5 Parameter list

INJECTION SAMPLE

INJECTION SAMPLE NUMBER

NOTE

Enter the sample vial No. designated for priority analysis.

- When an auto sampler carousel is not in use,
  Short rack No. 1–6
  Long rack No. 1–12 (1-15 allowable, with an additional rack)
- When an auto sampler carousel is installed, No. 1–150 (maximum; for 1.5 ml vial)
  No. 1–96 (maximum; for 4.0 ml vial)

When an auto sampler carousel, the allowable vial No. range depends on the vial rack type and the number of racks. A valve of 0 (default) indicates no priority sample.

15.1.6 PF menu

PF menu	Description	Reference section
Set	Analyzes the vial No. specified after the analysis of the current sample is finished.	——

15.1.7 Other AOC parameters

Select [OtherPara] (PF menu) from the AOC main screen to display the other parameters screen shown in Fig. 15.1.3.
Specify options and AOC custom parameters.

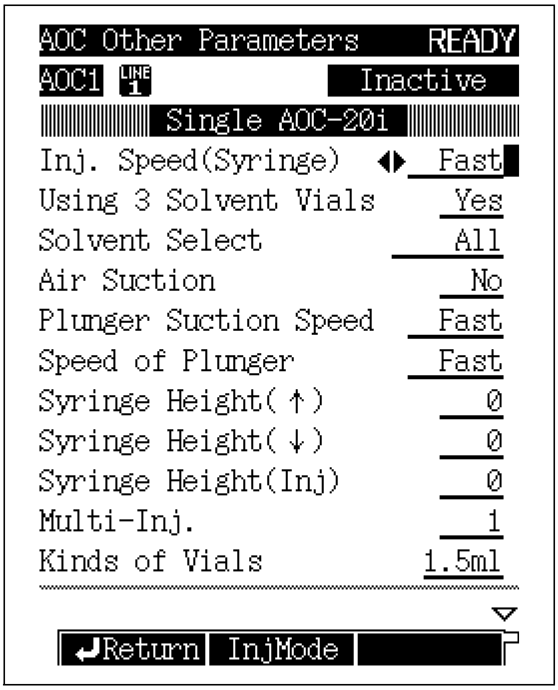


Fig. 15.1.3 Additional AOC parameter setup

15.1.8 Parameter list

INJ. SPEED (SYRINGE)

Selection: Slow/Fast, Default: Fast
Set the syringe injection speed.

USING 3 SOLVENT VIALS

Selection: Yes/No, Default: No
Specifies whether three solvent vials are present and the autosampler carousel is not in use. This item is only available when "USE OF THE SAMPLER" in [Sampler] (PF menu) is set to "Not Use".

SOLVENT SELECT

Selection: All/A only/B only/C only, Default: All
This item is available when "USING 3 SOLVENT VIALS" is set to "Yes" or "USE OF THE SAMPLER" in [Sampler] (PF menu) is set to "Use".
All: Three solvent types are used.
For the details, refer to Fig. 3.4.1 in "3.4 Auto Sampler" in the AOC-20 User's Manual.

AIR SUCTION

Selection: Yes/No, Default: No
Set whether or not 1 μl of air is aspirated into the syringe after aspirating sample.
This type of injection is useful for samples with a wide boiling point range, when compound discrimination problems can occur.

> **CAUTION**
>
> When the column initial temperature is high or when a PEG-based, polar column is used, the column life may be shortened by injecting air.

PLUNGER SUCTION SPEED

Selection: Slow/Middle/Fast, Default: Fast
Set the plunger speed during sample injection.

SPEED OF PLUNGER

Selection: Slow/Middle/Fast, Default: Fast
Set the plunger speed during rinsing with sample or pumping.

SYRINGE HEIGHT (↑)

Range: 0–20 mm, Default: 0 mm
Set the syringe height when it moves down to a sample vial (moves syringe up from default).

SYRINGE HEIGHT (↓)

Range: 0–2 mm (1.5 ml vial)/0–10 mm (4 ml vial), Default: 0 mm
Set the syringe height when it moves down to a sample vial (moves syringe down from default).

SYRINGE HEIGHT (INJ)

Range: 0–22 mm, Default: 0 mm
Set the syringe height when it moves down during sample injection (moves syringe up from default).

MULTI-INJ

Range: 1–99, Default: 1
Set the number of times to inject the same sample for each analysis.

KINDS OF VIALS

Selection: 1.5 ml/4 ml, Default: 1.5 ml

Specify the vial type.

RACK

Selection: Short/Long, Default: Short

Set the rack type.

KINDS OF THE SYRINGE

Selection: 0.5 µl/5 µl/10 µl/50 µl/250 µl, Default: 10 µl

Set the syringe type.

SUCTION VOLUME FOR WASHING

Selection: 80 %/60 %, Default: 80 %

Set the aspiration volume during sample wash and pumping.

RACK POSITION

Range: 0–2, Default: 1

Set the auto injector position while sampler is used.

15.1.9 PF menu

PF menu	Description	Reference section
Inj Mode	For details, refer to "3.3.3 Injection mode" in AOC-20 User's Manual.	——

15.1.10 Auto-sampler carousel and other optional parameters

Select [Sampler] (PF menu) from the AOC main screen to display the sampler screen shown in Fig. 15.1.4.

Specify the options installed on the AOC, such as sampler carousel.

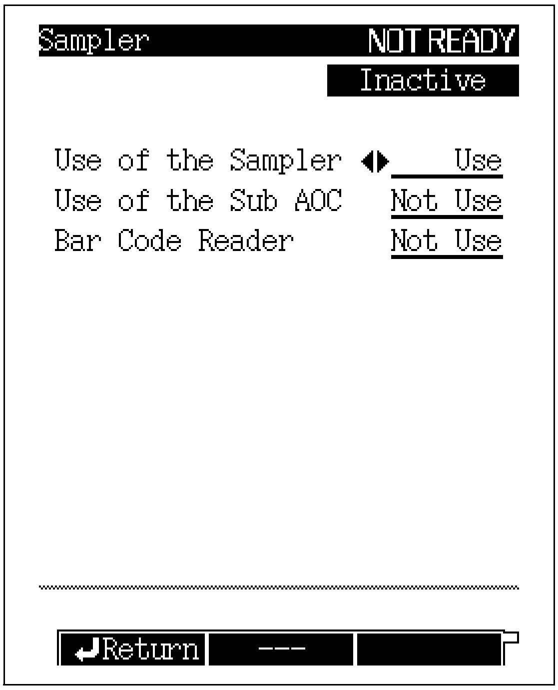


Fig. 15.1.4 Sampler carousel and other options setup

15.1.11 Parameter list

USE OF THE SAMPLER

Selection: Use/Not Use, Default: Not Use

This is automatically set to "Use" when "USE OF THE SUB AOC" is set to "Use"; however, the sub AOC is not used with the GC-2025.

USE OF THE SUB AOC

Selection: Use/Not Use, Default: Not Use

With the GC-2025, the sub AOC is not used; be sure to set "Not Use".

BAR CODE READER

Selection: Use/Not Use, Default: Not Use

Select "Use" to use each optional unit.

15.1.12 PF menu

PF menu	Description	Reference section
Alloc	This is displayed when "USE OF THE SUB AOC" is set to "Use"; however, the sub AOC is not used with the GC-2025.	——

15.2 Setting the AUX APC Parameters

The pressure, the flow rate and the gas type can be set for the AUX APC.

15.2.1 Screen description

If an AUX APC is installed, press the [OPTION] key from the [OPTION] key main screen, or press [NEXT] (PF menu) until the AUX APC screen, show in Fig. 15.2.1, appears.

The [NEXT] (PF menu) key toggles among the AOC parameters → AUX APC → CRG screens, in that order.

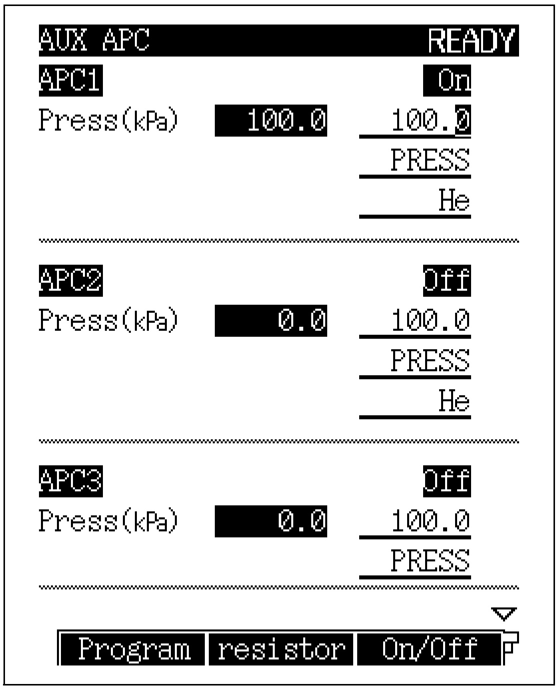


Fig. 15.2.1 AUX APC main screen

15.2.2 Parameter list

PRESS

Range: 0.0–400.0 kPa, Default: 100 kPa

Set the pressure when the control mode is set to "PRESS".

FLOW RATE

Range: 0.0–1200.0 ml/min, Default: 50 ml/min

Set the flow rate when the control mode is set to "FLOW".

CONTROL MODE

Selection: PRESS/FLOW, Default: PRESS

PRESS: Controls the system to obtain the preset pressure.

FLOW: Controls the system to obtaint the preset flow rate.

NOTE

When using the AUX APC in flow mode, a restrictor is used to ensure that the actual flow rate is equal to the set flow rate. Confirm the actual flow rate with a flow meter.

GAS TYPE

Selection: He/N2/H2/Ar, Default: He

Set the type of gas supplied to the APC. If the gas type is set incorrectly, the flow rate can not be set as specified in "FLOW" mode. This is because a restrictor is used to calculate the flow rate.

15.2.3 PF menu

PF menu	Description	Reference section
Program	Displays the pressure or flow rate program setup screen for the AUX APC.	15.2.4
Resistor	In flow mode, the difference between the set and actual value can be eliminated by installing a restrictor in the flow line. On the resistor screen, enter the i.d., length, and resistance of the restrictor tubing.	15.2.5
On/Off	Set APC to be used to "On". Default value is "On".	——
Offset	Performs offset calibration of APC sensor to improve the reproducibility of results.	21.6
Next	Toggles among AOC parameters →AUX temperature →AUX APC → CRG screens, in that order.	——

NOTE

- When "AOC" is not selected for the line, AOC parameters screen is not displayed.
- When the AUX APC is not installed, the AUX APC screen is not displayed.

15.2.4 Setting a program

A pressure of flow rate program can also be created for the AUX APC. Set the control mode to "Pressure" on the AUX APC main screen, select the desired APC, and then press [Program] (PF menu). The APC program screen, shown in Fig. 15.2.2, opens.
Similarly, a flow rate program can be created by selecting "FLOW" mode and pressing [Program] (PF menu). This opens the flow rate program screen.
For the program setting procedure, refer to "12.5.5 Pressure program".

A program can contain up to 7 ramps of pressure or flow rate increase/decrease.

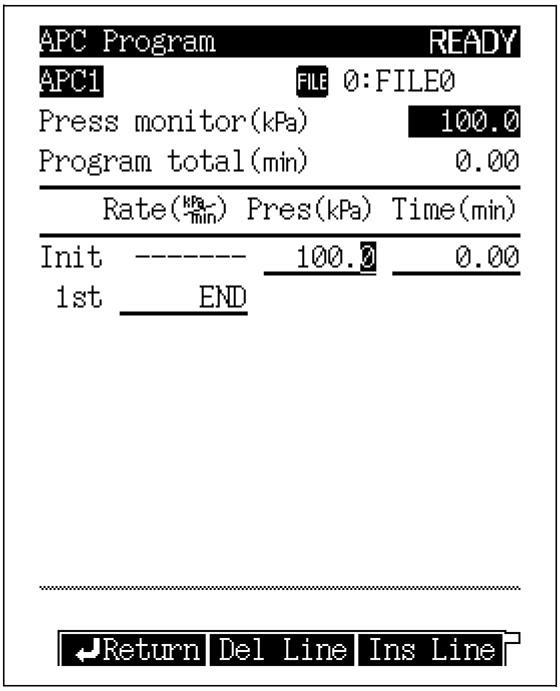


Fig. 15.2.2 APC pressure program setup

15.2.5 Using restrictor tubing

Select the desired APC from the main APC screen. Then press [Resistor] (PF menu) from the AUX APC main screen to display the restrictor tube setup screen shown in Fig. 15.2.3.
The difference between set and actual flow rates can be eliminated by installing a restrictor.
Enter the restrictor's inner diameter, length, and resistance.

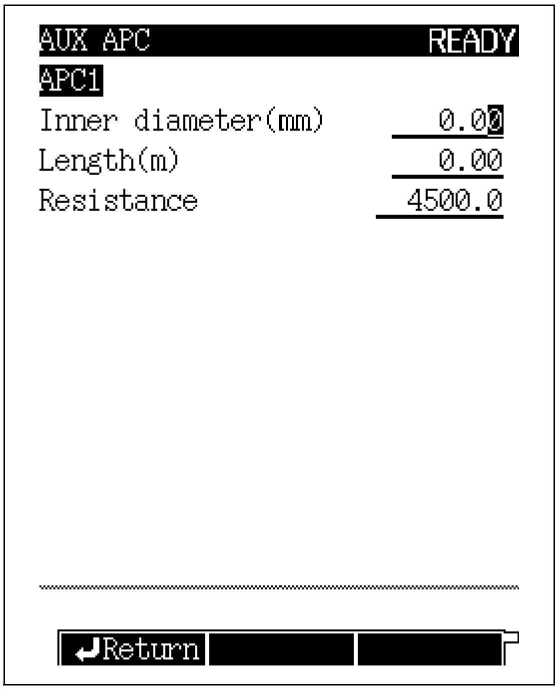


Fig. 15.2.3 Restrictor setup screen

NOTE

If the necessary pressure to flow rate conversion information is not saved in the GC, the actual and measured flow rate may still not be equivalent.

15.2.6 Parameter list

INNER DIAMETER

Range: 0.01–6.00 mm, Default: 0.00

LENGTH

Range: 0.1 –250.0 m, Default: 0.00

RESISTANCE

Range: 0.01–100000.0, Default: 1000.0

When the inner diameter and the length have been entered, the resistance is automatically calculated. Alternatively, enter only the resistance.

NOTE

The resistance is calculated according to this formula: $\frac{(\text{i.d. (mm)})^4}{\text{length (m)}} \times 10^6$.

Resistance valves greater than 10^5 can not be calculated.
The resistance of the restrictor should be smaller than 10^5, when the "CONTROL MODE" of AUX APC is FLOW.

15.3 Setting the CRG Parameters

The CRG (option) allows temperatures below room temperature to be set. The CRG can be connected to the column oven or the INJ2.

15.3.1 Screen description

Press the [OPTION] key from the [OPTION] key main screen, or press [NEXT] (PF menu) until the CRG screen, shown in Fig. 15.3.1, appears.
The [NEXT] (PF menu) key toggles among the AOC parameters → AUX APC → CRG screens, in that order.

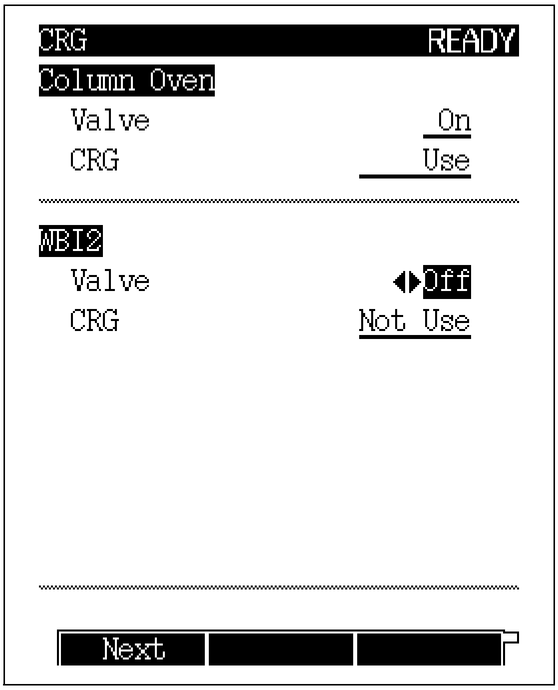


Fig. 15.3.1 CRG main screen

NOTE

If the CRG is turned off after a negative temperature valve has been set, the temperature cannot be achieved, and the GC cannot become ready. When turning off the CRG, ensure that the temperature valve is set properly.

To set the time of the CRG for the column over (COL CRG) auto off, refer to "16.6.11 Other settings" in "16.6 GC Configuration".

15.3.2 Parameter list

COLUMN OVEN

VALVE Selection: On/Off, Default: Off

CRG Selection: Use/Not Use, Default: Not Use
When the CRG is connected to the column oven, the column oven temperature control range is extended to -99.0 – +400.0 °C.
When using the CRG, set "VALVE" to "On" and "CRG" to "Use".
When using valve control only, set "VALVE" to "On" and set "CRG" to "Not Use".

INJ 2
This is not used with the GC-2025.

VALVE Selection: On/Off, Default: Off

CRG Selection: Use/ Not Use, Default: Not Use
When the PTV is installed on INJ2 and the CRG is connected, the injection port temperature control range is extended to -99.0 – +400.0 °C.
When using the CRG, set "VALVE" to "On" and "CRG" to "Use".
When using valve control only, set "VALVE" to "On" and set "CRG" to "Not Use".

15.3.3 PF menu

PF menu	Description	Reference section
Next	Toggles among the AOC parameters → AUX APC → CRG screens, in that order.	——

NOTE

- When "AOC" is not selected for the line, AOC parameters screen is not displayed.
- When the AUX APC is not installed, the AUX APC screen is not displayed.

16.1 Time Scheduler

Use the Time Scheduler to establish a weekly or daily schedule of automated GC operations.

16.1.1 Screen description

Select "1. TIME SCHEDULER" from the [FUNC] key main screen to display the Time Scheduler menu shown in Fig. 16.1.1.

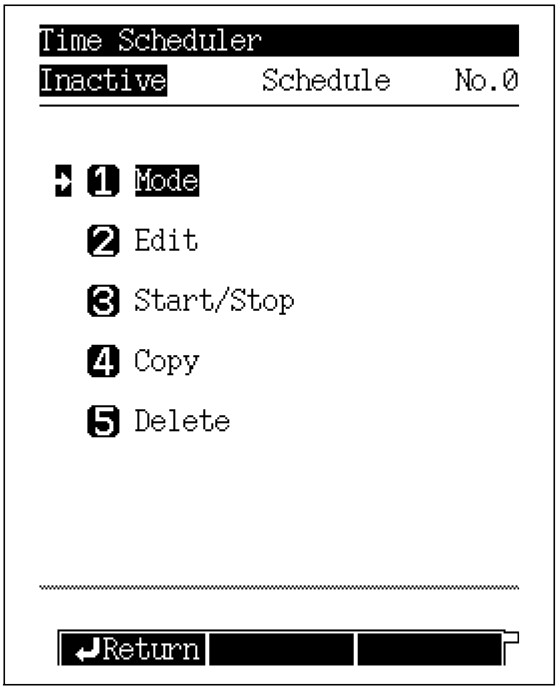


Fig. 16.1.1 Time scheduler menu

16.1.2 Parameter list

MODE
Select whether the same schedule will be executed every day or a different schedule will be executed on each day of the week.

EDIT
Edit the schedule.

START/STOP
Set the schedule start/stop procedure.

COPY
Copy the contents of a schedule to a specified schedule.

DELETE
Delete the contents of a specified schedule.

16.1.3 Setting the mode

Select "1. MODE" from the time scheduler menu to display the mode setup screen shown in Fig. 16.1.2.
When the schedule mode is set to "Number", the same schedule is executed every day. Up to 8 schedules can be set in this mode. Select the schedule number to be executed.
When the schedule mode is set to "Day", a different schedule can be executed for each day of the week. Only one schedule can be set for each day of the week in this mode.

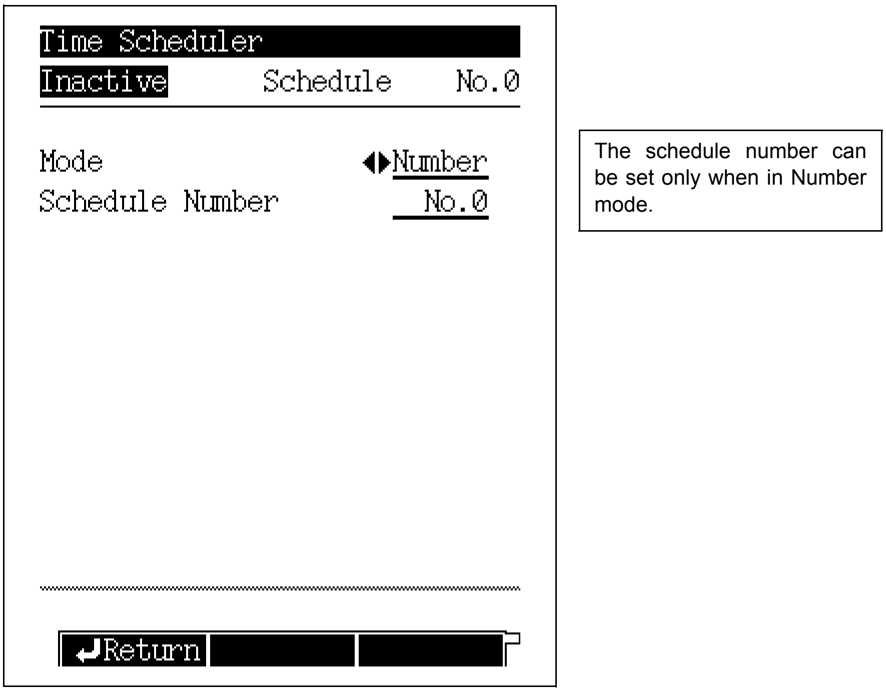


Fig. 16.1.2 Mode setup screen

NOTE
When the time scheduler is operating, the mode cannot be changed.

■ Schedule number and day of the week

The table below shows the relationship between the schedule number and the day of the week.

Mode 1 (schedule number)	Mode 2 (day)
No. 0	Sun.
No. 1	Mon.
No. 2	Tue.
No. 3	Wed.
No. 4	Thu.
No. 5	Fri.
No. 6	Sat.
No. 7	——

16.1.4 Editing a time schedule

Select "2. EDIT" from the time scheduler menu to display the schedule number or the day of the week setup screen shown in Fig. 16.1.3. Before editing a schedule, select the schedule number or the day of the week, and press [Edit] (PF menu). Then, the schedule edit screen shown in Fig. 16.1.4 appears.
You do not have to set schedules in the order of execution time.
After editing time schedules, they are automatically sorted. More than one schedule can be set to the same time. These schedules will be executed at the same time.

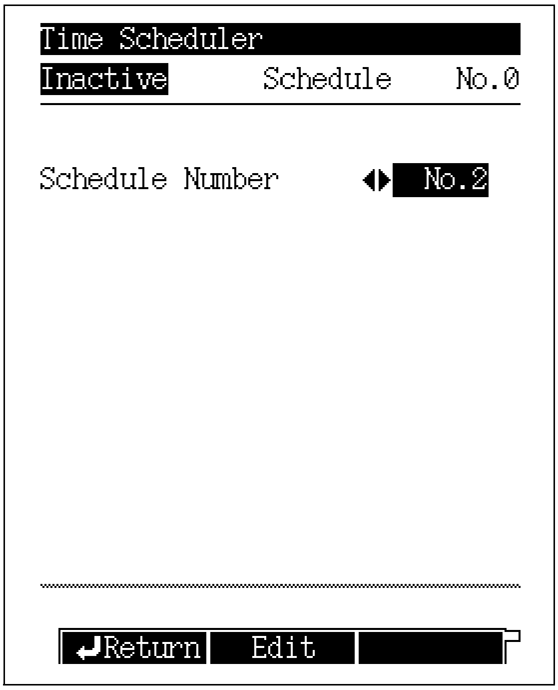


Fig. 16.1.3 Schedule number selection screen

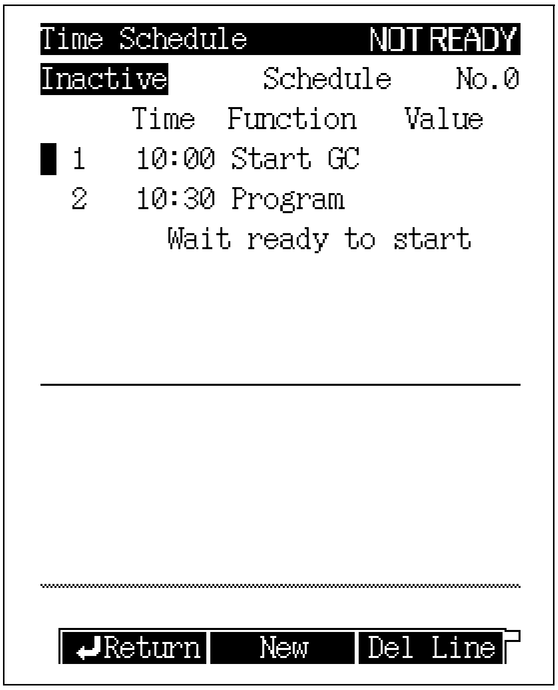


Fig. 16.1.4 Schedule edit screen

16.1.5 PF menu

PF menu	Description	Reference section
New	Creates a new time schedule. This menu does not appear when 100 lines of the schedule is used.	16.1.6
Del Line	Deletes a schedule line at the current cursor position.	

16.1.6 Creating a new time schedule

Select [New] (PF menu) from the time schedule screen to display the Time Schedule screen shown in Fig. 16.1.5.
Set an item using the [△] and [▽] keys and [ENTER] key. When [Finish] (PF menu) appears after you have set items, press [Finish] to validate the schedule. The set items will not be updated or saved unless [Finish] is pressed.
In the upper half of the screen, the contents of the set schedule are displayed. In the lower half of the screen, the schedule edit screen is displayed.
Up to 100 lines are available per schedule.
The schedule execution time range is from 00:00 to 23:59. The unit is 1 minute.

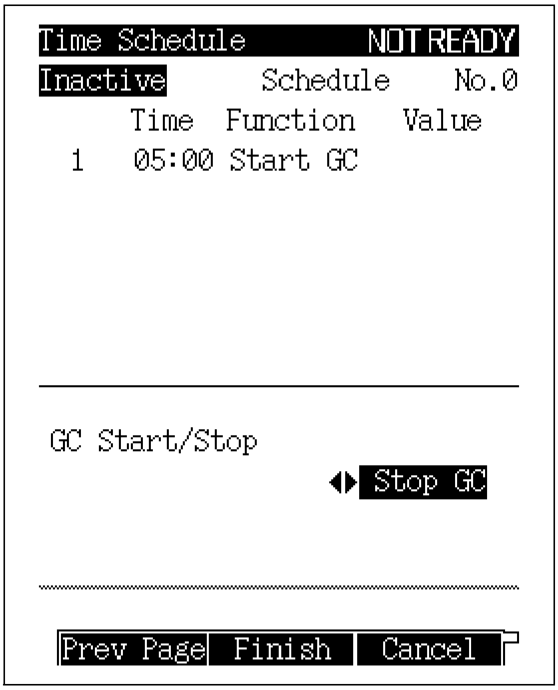


Fig. 16.1.5 Creating a new schedule

16.1.7 PF menu

PF menu	Description	Reference section
Finish	Validates and saves the time schedule.	——
Prev Page	Returns to previous setup screen.	——
Next Page	Moves to next item. The cursor can also be moved to next item by pressing [ENTER] key.	——
Cancel	Cancels the time schedule currently being created.	——

16.1.8 Parameters available in the time scheduler

Parameter			Description
Relay[1]			
Detector	Zero Adj		Turns zero adjustment for each detector on/off.
	Flame		Turns ignition on/off.
	FTD		This is not used with the GC-2025.
	Detector controller		Turns control of each detector on/off during analysis program.
Flow controller	Splitter Ctrl		Opens/closes splitter.
	Air(value)		Opens/closes air solenoid valve.
	Flow controller On/Off		Turns control of flow controller on/off.
	High press inj mode		Turns high pressure injection mode on/off.
	Gas saver		Turns gas saver split rate function on/off for each injection port.
Temperature			Turns all heated zones on/off.
Stop	NUMBER OF TIMES OF RUN	Time scheduler stop	Specifies the number of times the program can execute before the schedule stops or switches to another file. If greater than one, the choices are "Continuous" or "Pause at end of repeat". For an AOC, select "Pause at end of repeat". When "Continuous" is chosen,the program executes at set intervals continuously. If another program (such as a temperature program) is running when time schedule execution time expires, priority is given to the running program. When the current program finishes, the time schedule stops or file is changed to another file.
		Schedule 0-9 Load	
File load			Selects the next file when switching to another file.
Program start	Program		Starts gas chromatograph after reaching ready state, or starts it immediately.
	Clean Up		Starts clean up program after reaching ready state, or starts it immediately.
	Pre-Run program		Starts Pre-Run program after reaching ready state, or starts it immediately.
GC Start/Stop			Sets start/stop of gas chromatograph.
Other			Set the parameter to input event No. (Refer to "17.4 Event No.".)

1: "Relay" Description

Relay	Relay	Switch point	Event 91,92	V91–92	Point A or B
			PRG	V93–94	Point A or B
		On/Off point	Event1–16	On or Off	
	AC On/Off	Blower	On or Off		
		Cooling Fan	On or Off		
		CRG INJ	On or Off		
		CRG Colum	On or Off		

Event91 and Event92: Switches A-contact and B-contact for each relay on the CPU PCB (offered as standard).
PRG Event: Not used with the GC-2025
Event of On/Off point: Not used with the GC-2025
AC On/Off: The power supplied to the AC connector on the power controller PCB is turned on/off.
Blower, Cooling Fan, CRG INJ and CRG Column: Turns the power of each option on/off.

16.1.9 Changing schedule parameters

To change the contents of an existing time schedule, move the cursor using the [△] and [▽] keys to select the schedule to be changed, and press the [ENTER] key.

- To change the time:
  When the Time Schedule select screen appears, enter new numeric values and press the [ENTER] key. Then press [Finish] (PF menu), if you would like to change only the time.
- To change the parameters:
  Move the cursor, change the parameter, and then press [Finish] (PF menu) to complete the change.
- To cancel any changes:
  If you have changed the schedule but would like to return to the former schedule, press [Cancel] (PF menu) before pressing [Finish] (PF menu). The schedule returns to its former status.

16.1.10 Time schedule example

Example:7:00 System starts.
19:00 System stops.

・First program

Screen display

1. Time: 7:00

```
Edit program
Time[hh:mm]            7:00
```

2. Start/stop

```
Edit program
  Program start
→ GC Start/Stop
  Other
```

3. Start

```
GC Start/Stop
                    ◀▶Start GC
```

・Second program

4. Time: 19:00

```
Edit program
Time[hh:mm]           19:00
```

5. Start/stop

```
Edit program
  Program start
→ GC Start/Stop
  Other
```

6. Stop

```
GC Start/Stop
                    ◀▶ Stop GC
```

7. Setting is completed.

```
     Time   Function   Value
 1   07:00 Start GC
 2   19:00 Stop GC
```

16.1.11 Starting/stopping a time schedule

Select "3. START/STOP" from the time scheduler menu when no time schedule is executing to display the screen shown in Fig. 16.1.6.
Select "3. START/STOP" while a time schedule is being executed to display the screen shown in Fig. 16.1.7.

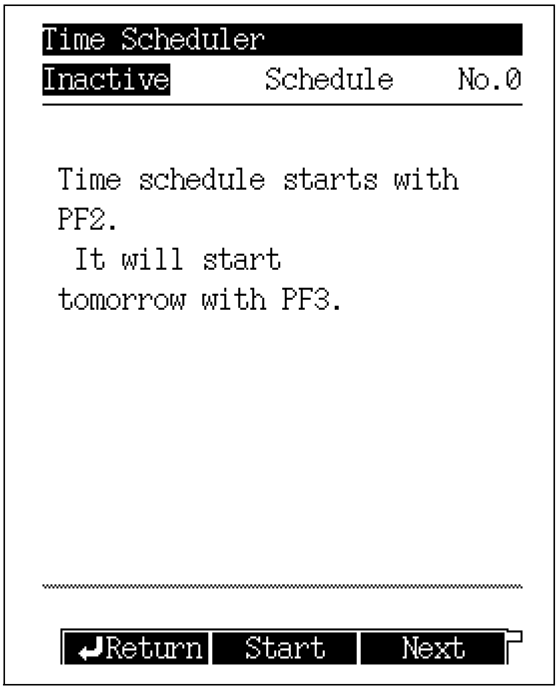


Fig. 16.1.6 Schedule start screen

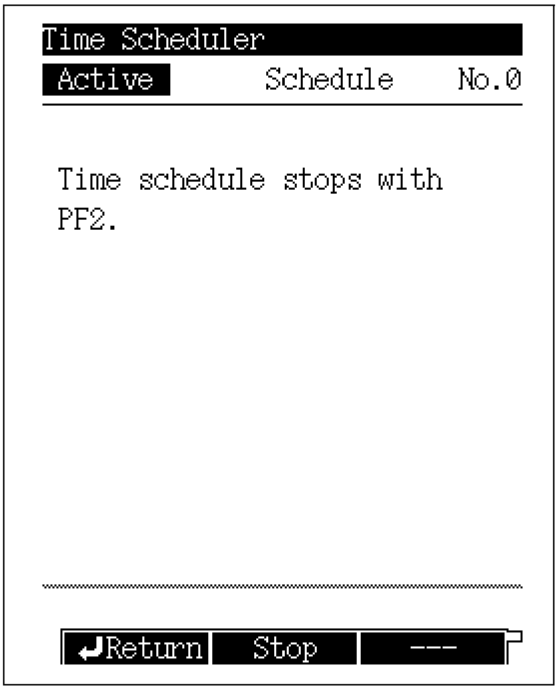


Fig. 16.1.7 Schedule stop screen

16.1.12 PF menu

PF menu	Description	Reference section
Start	Starts a time schedule. This item is displayed when no time schedule is running. If mode is set to "number", the same schedule will be executed on the following day and beyond when schedule finishes. If mode is set to "day", the schedule for the current day is executed, and the schedule for each day will be executed on the following day and beyond.	——
Next	Runs the selected schedule on the following day. If mode is set to "day", the schedule for the next day is executed.	——
Stop	Stops the current schedule. This item is displayed when a time schedule is running.	——

16.1.13 Copying and deleting a time schedule

Select "4. COPY" or "5. DELETE" from the time scheduler menu screen to display the time schedule copy screen or the time schedule delete screen shown in Fig. 16.1.8 or Fig. 16.1.9. To copy, specify the copy source schedule and the copy destination schedule, then press [Copy] (PF menu).
To delete, specify a schedule number to be deleted, then press [Delete] (PF menu).

NOTE
A currently running schedule cannot be copied or deleted.

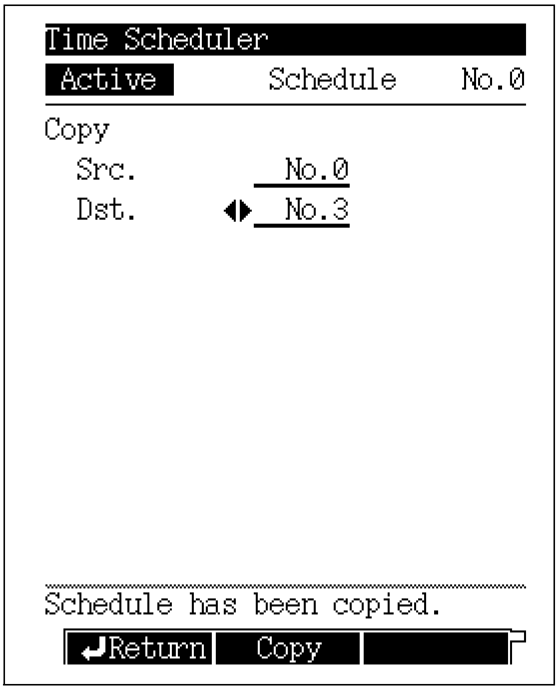


Fig. 16.1.8 Schedule copy screen

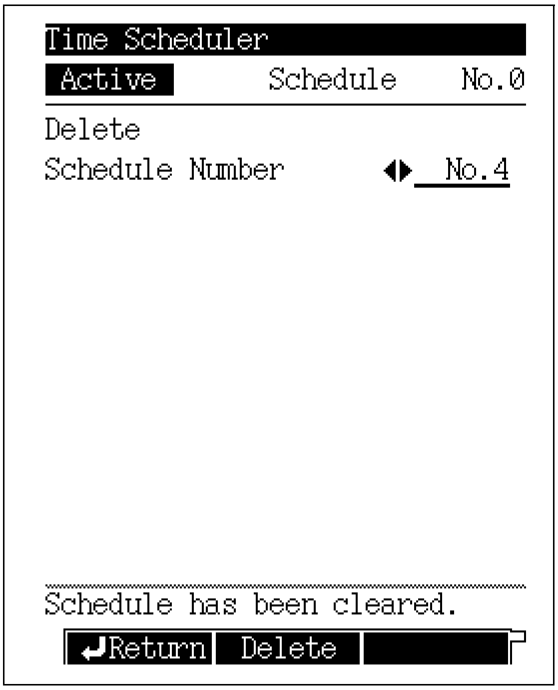


Fig. 16.1.9 Schedule delete screen

16.2 Batch Schedule

Use the batch schedule to continuously and automatically perform analyses.
A batch is useful for switching methods automatically during the analyses.

NOTE
GCsolution uses the batch schedule function to control the GC-2025. When GCsolution is used, do not change the settings for batch schedule.

16.2.1 Screen description

Select "2. BATCH" from the [FUNC] key screen, the Batch screen shown in Fig. 16.2.1 appears.

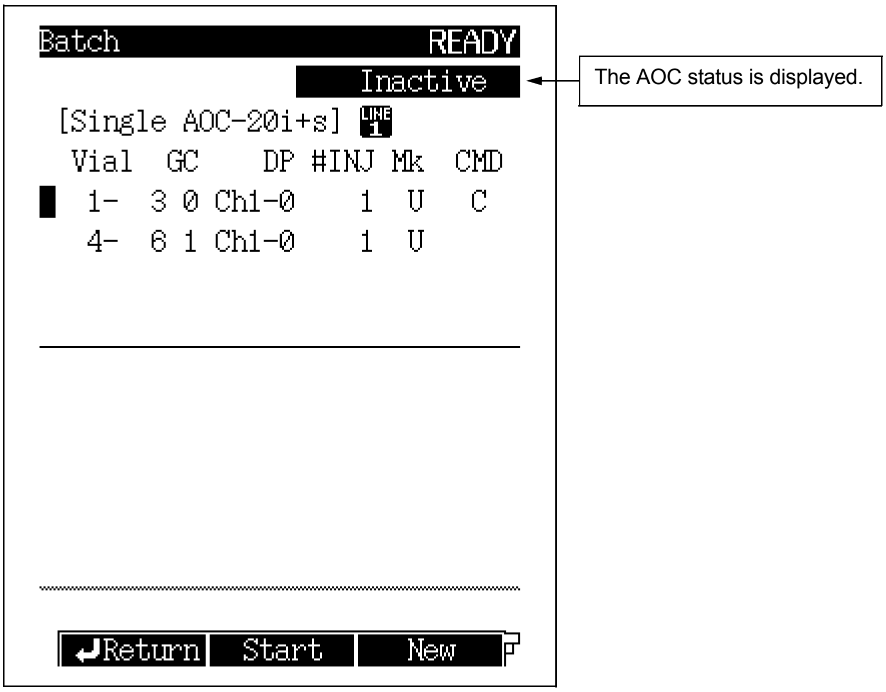


Fig. 16.2.1 Batch schedule screen

■ AOC status

The AOC status is displayed on the Batch screen.

Screen display	Description
Inactive	AOC is not operating.
Taking vial	Auto sampler arm is picking up a vial.
Preparation	AOC is operating (before injection).
Rinse	AOC is operating (after injection).
Putting vial	Auto sampler arm is returning a vial to the tray.
Wait	AOC is waiting for analysis.

16.2.2 Parameter list

Vial Initial No. and final vial No.
Example: 1-9 (Analysis starts from vial No. 1 and ends at vial No. 9.)

GC GC method file for analyses

DP Channel No. of Chromatopac and file No.
Example: 1-5 (Channel 1 and data processing file No. 5 are used.)

#INJ Number of times to inject

Mk "U" is displayed when "SAMPLE TYPE" is set to "Unknown".
"S" is displayed when "SAMPLE TYPE" is set to "Standard".

CMD "S" is displayed when "SLOPE TEST" is set to "On".
"C" is displayed when "CLEAN UP" is set to "On".

16.2.3 PF menu

PF menu	Description	Reference section
Start	Starts the batch schedule.	——
Stop	Stops the batch schedule.	——
New	Creates a new batch schedule.	16.2.4 16.2.7
Del line	Deletes the line at the current cursor position.	——
Print	Prints the schedule to a Chromatopac.	——

16.2.4 Creating a new batch schedule

Select [New] (PF menu) from the batch schedule screen to display the new batch schedule screen shown in Fig. 16.2.2.
Set an item using the [△] and [▽] keys and [ENTER] key. When [Finish] (PF menu) becomes available and the items have been set, press [Finish] to validate the schedule.
At the top of the screen, the contents of the set schedule are displayed. At the bottom of the screen, the schedule can be edited.
Up to 100 lines are available per schedule.

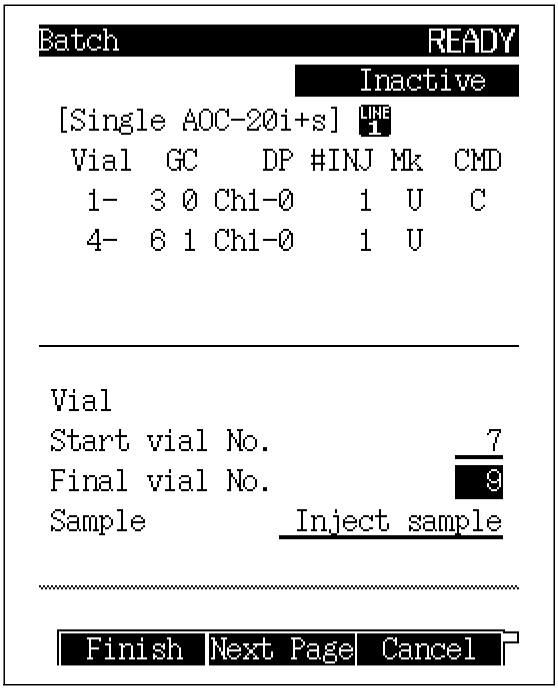


Fig. 16.2.2 New batch schedule screen (for single injector)

16.2.5 Parameter list

START VIAL NO.

Range:[1] Default: 0

FINAL VIAL NO.

Range:[1] Default: 0

1: With no auto sampler
Short rack ... 1–6
Long rack ... 1–12 (1–15 allowable, with an additional rack)
With auto sampler 1–150 (maximum; for 1.5 ml vial)
1–96 (maximum; for 4 ml vial)

When the auto sampler is used, the possible depends on the vial rack type and the number of racks.

The default, "0", indicates that the setting is not given.

SAMPLE

Inject sample

The specified sample vial No. is analysed.

Without sample

Vials are not used for samples. Instead samples are introduced from a gas sampler with a valve.

GC FILE NO.

Range: FILE 0–9, Default: FILE0

Set the file No. of the GC method to be used.

CHANNEL NO.

Range: Ch1/Ch2, Default: Ch 1

Set the channel No. connecting the GC to the Chromatopac.

DATA PROCESSOR FILE NO.

Range: FILE 0–9, Default: FILE0

Specify a date processor (Chromatopac) data integration file.

NUMBER OF INJECTION

Range: 0–99, Default: 0

Set the number of times to inject each sample.

SAMPLE TYPE

Unknown Select this item to analyze an unknown sample.
Analyze a standard and create a calibration curve before quantifying an unknown sample.

Standard Select this item to analyze a standard for creating a calibration curve.

SLOPE TEST

Range: On/Off, Default: Off

When "On" is selected, the slope test is performed before running the batch schedule.

CLEAN UP

Range: On/Off, Default: Off

When "On" is selected, clean up is performed before running the batch schedule.

16.2.6 PF menu

PF menu	Description	Reference section
Finish	Validates and saves the schedule.	——
Prev Page	Returns to previous setup screen.	——
Next Page	Moves to setup screen for next item.	——
Cancel	Cancels the schedule being created.	——

16.2.7 Editing a batch schedule

To change an existing batch processing schedule, move the cursor using the [△] and [▽] keys to the schedule to be edited and press the [ENTER] key. The schedule to be edited appears on the edit screen.
To change the vial number, enter the new number from the edit screen and press the [ENTER] key. Then press [Finish] (PF menu).
To change the other parameters, move the cursor and make the change from the edit screen, and then press [Finish] (PF menu).
To cancel the edits and restore the original batch schedule, press [Cancel] (PF menu) before pressing [Finish] (PF menu).

16.2.8 Batch processing setup example

Sample vials No. 1 to 3 are analyzed. The GC method file No. 2 is used. The Chromatopac data processing file No. 0 is set to Ch 1.
A standard is injected once.
Clean up is performed, but the slope test is not performed.

Screen display

1. Start vial No.: 1
   Final vial No.: 3

```
Vial
Start vial No.              1
Final vial No.              3
Sample      ◄► Inject sample
```

2. GC file No.: FILE2

```
GC file No.
  0:FILE0
  1:FILE1
► 2:FILE2
  3:FILE3
```

3. Data processing file No.:
   Ch 1, FILE0

```
Dataprocessor
Channel No.              ◄►Ch1
File No.                     0
```

4. Number of injections: 1
   Sample type: Standard

```
Sample
Number of Injection          1
Sample type        ◄►Standard
```

5. Slope test: Off
   Clean up: On

```
Command
Slope test                 Off
Clean up                 ◄► On
```

6. The batch is set up.

```
 [Single AOC-20i+s] LINE 1
  Vial  GC   DP #INJ Mk  CMD
   1-  3 2 Ch1-0   1  S   C
```

16.3 Time Program

Use a time program to execute a zero point adjustment and relay control during analysis.

16.3.1 Screen description

Select "3. TIME PROGRAM" from the [FUNC] key screen to display the time program screen shown in Fig. 16.3.1.
A time program starts as soon as analysis starts.
Time programs do not need to be set up in order.
After you finish editing time programs, they are automatically sorted.
More than one step can be set for the same time. The specified actions are executed at the same time.

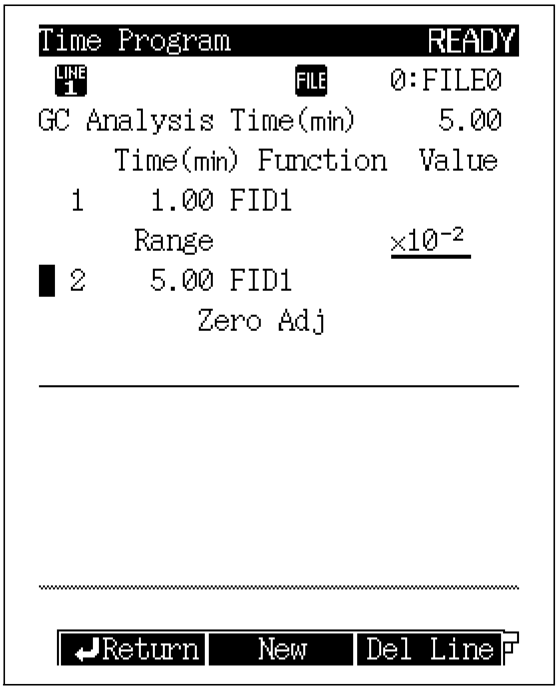


Fig. 16.3.1 Time program main screen

16.3.2 PF menu

PF menu	Description	Reference section
New	Creates a new time program.	16.3.3
Del Line	Deletes the time program line at the current cursor position.	——
Chng Line	The GC-2025 uses only one line; there is no need to feed the line.	——
Print	Prints the program to the Chromatopac.	——

16.3.3 Creating a new time program

Select [New] (PF menu) from the time program screen to display the time program edit screen shown in Fig. 16.3.2.
Set an item using the [△] and [▽] keys and the [ENTER] key. When [Finish] (PF menu) becomes available and the items have been set, press [Finish] to validate the program.
At the top of the screen, the contents of the set program are displayed. At the bottom of the screen, the program edit screen is displayed.
Up to 100 lines are available for one program.
The possible program execution time ranges from 0.00 to 9999.00 minutes.

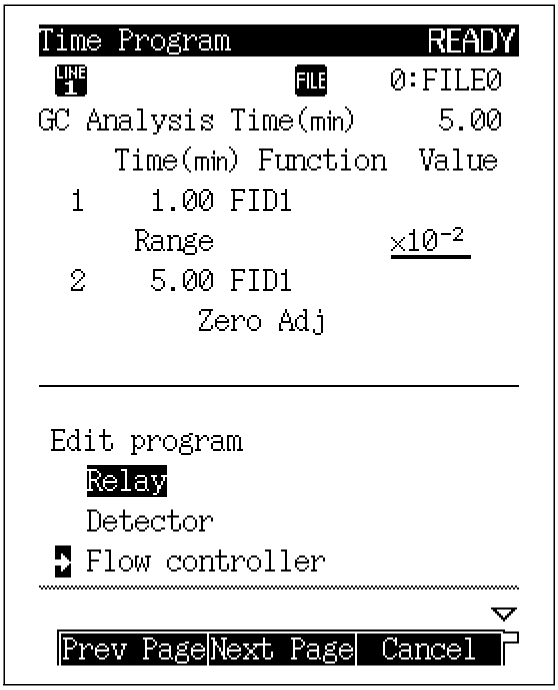


Fig. 16.3.2 Time program edit screen

16.3.4 PF menu

PF menu	Description	Reference section
Finish	Validates and saves the time program.	——
Prev Page	Returns to previous setup screen.	——
Next Page	Moves to next item.	——
Cancel	Cancels the time program being created.	——

16.3.5 Time program parameters

Parameter			Description
Relay[1]			
Detector	Range		Sets range or attenuation for the detector configured in the analytical line.
	Polarity		This is not used with the GC-2025.
	Current		This is not used with the GC-2025.
	Zero Adj		Turns on/off zero adjustment for the detector configured in the analytical line.
	Flame		Ignites / Extinguishes the flame.
	FTD		This is not used with the GC-2025.
	Detector controller		Turns on/off control of detector configured in the analytical line during analysis program.
Flow controller	Splitter Ctrl		Opens/closes splitter.
	Flow controller On/Off		Turn carrier gas, septum purge, detector gas and APC on/off.
	High press inj mode		Turns high pressure injection mode on/off.
	Gas saver		Turns gas saver function on/off.
Temperature	DET1, DET2, AUX3, AUX4, AUX5		Use a time program to change temperature of heated zones, which cannot be programmed. AUX3 to AUX5 are not used with the GC-2025.
Stop	NUMBER OF TIMES OF RUN	End of program	Specify the number of times to execute the GC program. Then, either the program stops or the next file is executed. If greater than 2, the choices are "continuous" or "pause at each run." For an AOC, select "pause at each run". When "continuous" is selected, the program executes continuously at set intervals. If another program (such as a temperature program) is running when time program execution time expires, priority is given to running the program. When the current program finishes, the time program stops or file is changed to another file.
		0: FILE 0–9 Load	
Other			Set the parameter to input event No. (Refer to "17.4 Event No.".)

1: "Relay" description

Relay	Relay	Switch point	Event 91,92	V91–92	Point A or B
			PRG	V93–94	Point A or B
		On/Off point	Event 1–16	On or Off	
	AC On/Off	Oven Exhaust Fan	On or Off		
		Cooling Fan	On or Off		
		CRG INJ	On or Off		
		CRG Colum	On or Off		

Event91 and Event92: Switches a-contact and b-contact of each relay on the CPU PCB (standard).
PRG Event: Not used with the GC-2025
Event of On/Off point: Not used with the GC-2025
AC On/Off: Turns the power supplied to the AC connector on the power controller PCB on/off.
Blower, Cooling Fan, CRG INJ and CRG Column: Turns the power of each option on/off.

16.3.6 Editing a time program

To change the contents of an existing time program, move the cursor using the [△] and [▽] keys to the program line to be edited changed and press the [ENTER] key.
To change only the time, enter the new time from the edit screen and press the [ENTER] key. Then press [Finish] (PF menu).
To change the other parameters, move the cursor and make the changes from the edit screen, and then press [Finish] (PF menu).
To cancel the edits and restore the original time program, press [Cancel] (PF menu) before pressing [Finish] (PF menu).

16.3.7 Time program setup example

Use File No.0, for then two AOC analyses use file No.1.
(The execution time is set to 30 min.)

Screen display

1. Time: 30 min

```
Edit program
Time(min)              30.00
```

2. Stop

```
Edit program
  Temperature
→ Stop
  Other
```

3. Run: 2 times

```
End of program
Run      2 times
```

4. File 1 is loaded.

```
End of program
  End of program
  0:FILE0 Load
→ 1:FILE1 Load
```

5. Pause at each run (AOC)

```
End of program
  Continuous
→ Pause at each run(AOC)
```

6. The time program is set up.

```
     Time(min) Function  Value
 1    30.00     End

End of program    30.00(min)
   Run    2times
   Next file           FILE1
   Pause at each run
```

16.4 Pre-Run Program

The Pre-Run program controls flow controllers and relays before the analysis starts.

16.4.1 Screen description

Select "4. PRE-RUN" from the [FUNC] key screen to display the Pre-Run screen shown in Fig. 16.4.1. A Pre-Run program is executed after the [START] key is pressed, but before an analysis.
While the Pre-Run program is running, the elapsed time is displayed in the "Time" field on the [MONIT] key screen.
Program steps do not need to be entered in order.
After you finish editing the Pre-Run program, programs are automatically sorted.
More than one step can be set for the same time. The specified actions are executed at the same time.

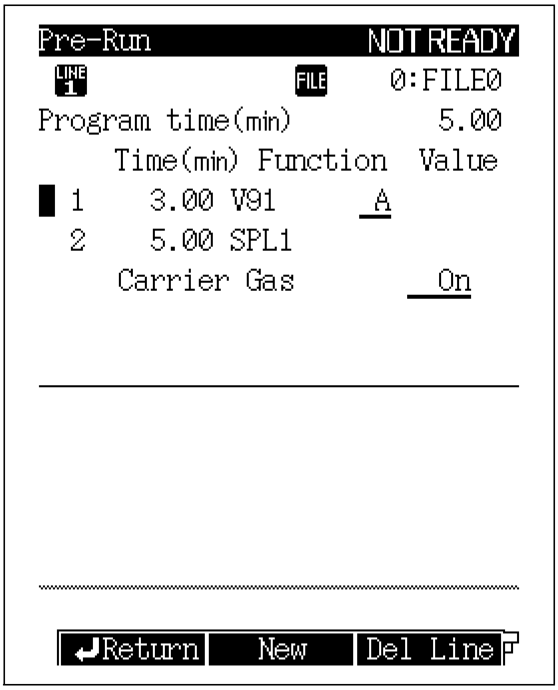


Fig. 16.4.1 Pre-Run program main screen

16.4.2 PF menu

PF menu	Description	Reference section
New	Creates a new Pre-Run program.	16.4.3
Del Line	Deletes the program at the current cursor position.	——
Chng Line	Changes over the screen of Pre-Run program every line.	——
Print	Prints the program to the Chromatopac.	——

16.4.3 Creating a new Pre-Run program

Create a Pre-Run program following the same procedure described in "16.3.3. Creating a new time program" in "16.3 Time Program".
The parameters are equivalent to those shown in "16.3.5. Time Program Parameters" except for "STOP". The "STOP" parameter is described below.
Up to 100 lines are available for the Pre-Run program.
The possible Pre-Run program execution time ranges from 0.00 to 9999.00 minutes.

Parameter		Description
End of program	Auto	The AOC starts after the Pre-Run program is finished. If no AOC is configured in the analytical line, the GC starts.
	Manual (Stop program)	After the Pre-Run program is finished, the system becomes ready.
	GC starts	After the Pre-Run program is finished, the GC starts. For example, select this item to activate an automated gas sampler, switch the valve when the program stops.
	AOC/HSS starts	After the Pre-Run program is finished, the AOC/HSS starts. After sample is injected, GC starts.
	Clean up	After the Pre-Run program stops, clean up starts. After clean up finishes, the system becomes ready.

NOTE

In the following case, "AUTO" of the "STOP" parameter is carried out when the pre-run program is finished.

- There is no "STOP" parameter in the pre-run program.
- Running the batch schedule.

16.4.4 Editing a Pre-Run program

To change the contents of the existing Pre-Run program, move the cursor using the [△] and [▽] keys to the program line to be edited and press the [ENTER] key.
To change only the time, enter the new time from the edit screen and press the [ENTER] key, then press [Finish] (PF menu).
To change the other parameters, move the cursor and make the changes from the edit screen, and then press [Finish] (PF menu).
To cancel the edits and restore the original time program, press [Cancel] (PF menu) before pressing [Finish] (PF menu).

16.4.5 After Pre-Run program is finished

When the Pre-Run program is finished, certain events automatically return to their pre-programs status.
These events are listed below.

Event No.	Description
131–134	Turn detector controller on/off.
141–146	Turn carrier gas and septum purge on/off.
147–158	Turn detector gas on/off.
171	Turns high pressure injection on/off.
181–198	Turn AUX APC on/off.

For details about the event No., refer to "17.4 Event No."

16.4.6 Pre-Run program setup example

Switch B-contact of Event 91 four minutes in to the program.

Screen display

1. Time : 4.0 min

```
Edit program
Time(min)                4.00
```

2. Relay

```
Edit program
  Relay
  Detector
  Flow controller
```

3. Relay

```
Relay
  Relay
  AC On/Off
```

4. Switch point

```
Relay
  Switch point
  On/Off point
```

5. Event 91, 92

```
Switch point
  Event91,92
  AUX I/O
```

6. Event 91

```
Event91,92
  V91
  V92
```

7. Point B

```
Event91
                      Point B
```

8. Setting is completed

```
    Time(min) Function  Value
 1     4.00 V91          B
```

16.5 Direct Operation

16.5.1 Screen description

Select "5. DIRECT OPERATION" from the [FUNC] key screen to display the screen shown in Fig. 16.5.1.
Input the event No. and press the [Execute] key to execute the specified event.
For a description of the event No., refer to "17.4 Event No."

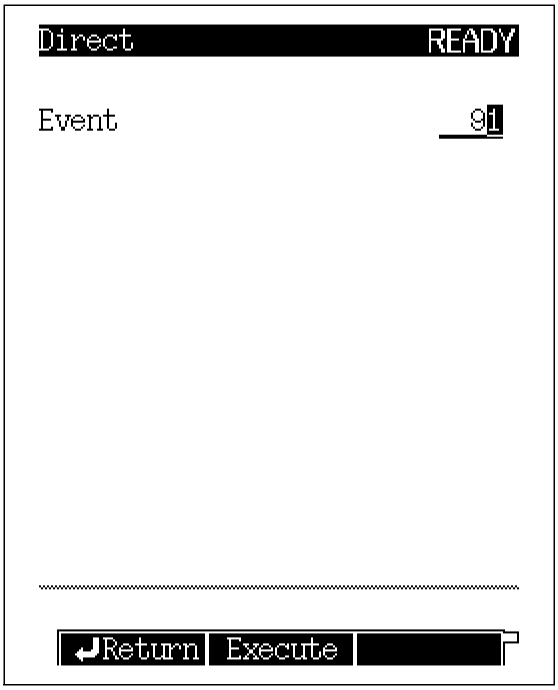


Fig. 16.5.1 Direct operation setup screen

16.5.2 Parameter list

EVENT

Range: -500–+500, Default: ---
Runs the operation assigned to the event No.
Refer to "17.4 Event No."

16.5.3 PF menu

PF menu	Description	Reference section
Execute	Runs the specified operation. Input event No. to be run, and press [Execute] (PF menu).	——

16.6 GC Configuration

16.6.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen to display the GC configuration screen shown in Fig. 16.6.1.

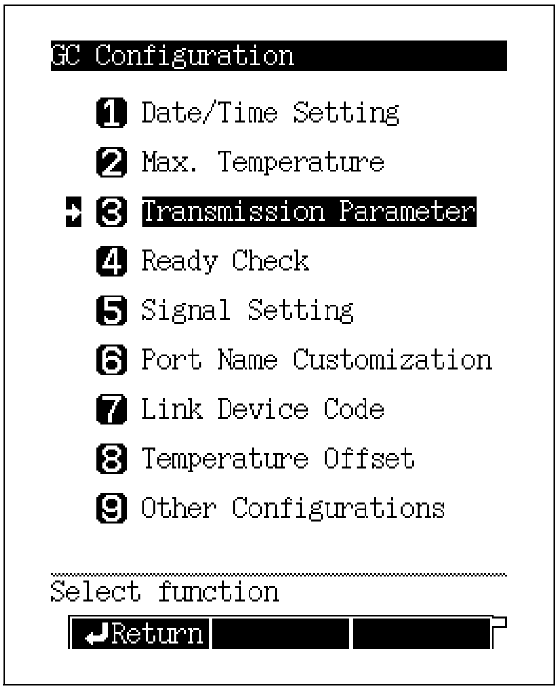


Fig. 16.6.1 GC Configuration setup screen

16.6.2 Parameter list

DATE/TIME SETTING
Set the date and the time.

MAX. TEMPERATURE
Set the maximum temperature limit for each heated zone.

TRANSMISSION PARAMETER
Set the parameters related to transmission.

READY CHECK
Indicate the conditions, which should be satisfied in order for the system to be ready and the STATUS light to illuminate.

SIGNAL SETTING
Set the signals which can be output from the gas chromatograph.

PORT NAME CUSTOMIZATION
Customize the names of various GC items.

LINK DEVICE CODE
Set the link device code the GC is linked to a Chromatopac.

TEMPERATURE OFFSET

Set the temperature offset for each heated zone.

OTHER CONFIGURATIONS

Specify the configuration of miscellaneous setup items.

16.6.3 Setting the date and time

16.6.3.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "1. DATE/TIME SETTING",to display the Date/Time setting screen shown in Fig. 16.6.2.
The date and the time can be set. This setting is automatically saved, even when the GC power is off.

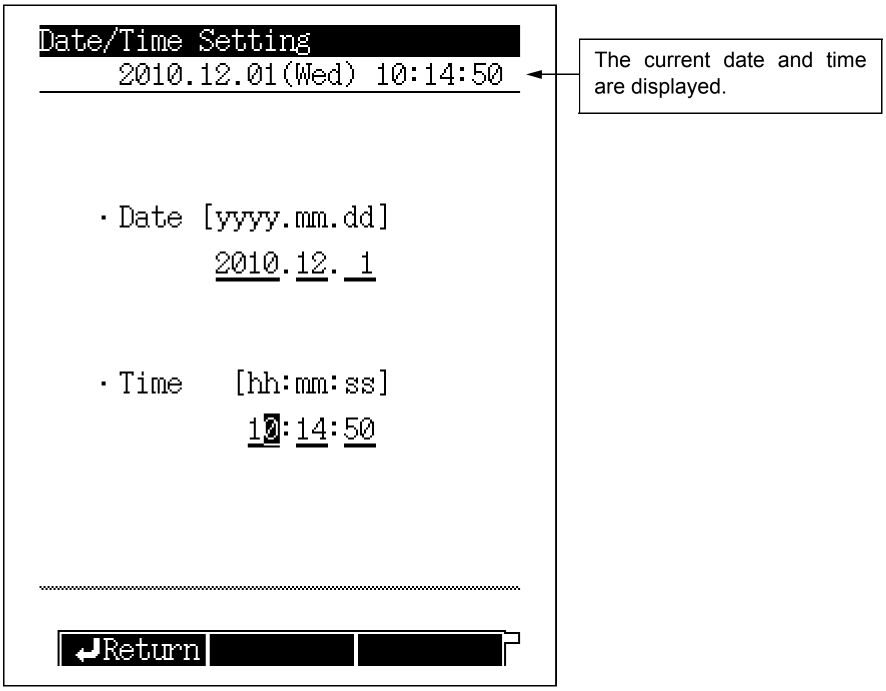


Fig. 16.6.2 Date/time setup screen

16.6.3.2 Parameter list

DATE

Range: 2000.01.01–2099.12.31

TIME

Range: 00:00:00–23:59:59

16.6.4 Setting the maximum temperature limits

16.6.4.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "2. MAX TEMPERATURE" to display the Max. Temperature screen shown in Fig. 16.6.3.
Set the maximum temperature limits of 8 heated zones.

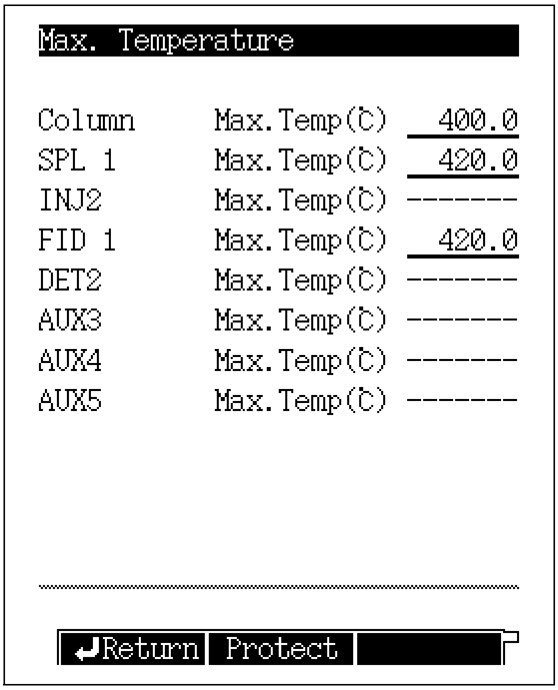


Fig. 16.6.3 Maximum temperature setup screen

16.6.4.2 Parameter list

COLUMN

Range: 0.0–420.0 °C, Default: 400.0 °C
In order to protect the column, do not allow the maximum oven temperature to exceed the maximum column temperature.

INJ1/DET1/DET2

Range: 10.0–420.0 °C, Default: 420.0 °C

INJ2

Range: 0.0–420.0 °C, Default: 420.0 °C

16.6.4.3 PF menu

PF menu	Description	Reference chapter
Protect	Protection against contamination	——

Selection: Yes/No, Default: Yes
When "Yes" is selected, the detector temperature setting value must be greater than the oven temperature setting value.

16.6.5 Setting transmission parameters

16.6.5.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "3. TRANSMISSION PARAMETER", to display the Transmission Parameter screen shown in Fig. 16.6.4.

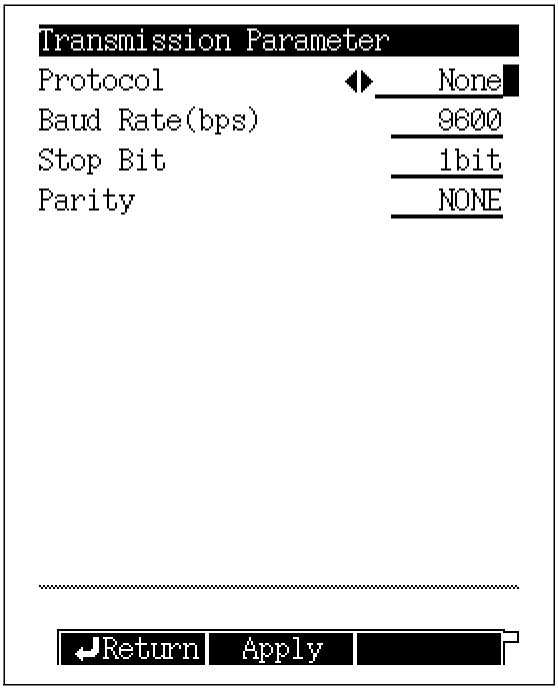


Fig. 16.6.4 Transmission parameter setup screen

16.6.5.2 Parameter list

PROTOCOL

Selection: None/LEVEL1/LEVEL2/LEVEL3, Default: LEVEL2

BAUD RATE

Selection: 2400/4800/9600/19200/38400/57600/115200 bps, Default: 9600 bps
Set the communication speed.

STOP BIT

Selection: 1 bit/ 2 bit, Default: 1 bit

PARITY

Selection: NONE/EVEN/ODD, Default: NONE
"STOP BIT" and "PARITY" can be set when "PROTOCOL" is set to "None" or "LEVEL1" or "LEVEL2".
Set to "EVEN" in case of connecting a Chromatopac.

NOTE

Refer to "22 Connecting External Device Cables".

When LEVEL3 is set for "Protocol", it is not necessary to set "Stop Bit" and "Parity".

16.6.5.3 PF menu

PF menu	Description	Reference section
Apply	Downloads the parameters immediately.	——

16.6.6 Setting the ready check parameters

The Ready Check verifies whether the preset analytical conditions have been met.
When the selected items reach the specified settings, the STATUS light illuminates in green.

16.6.6.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "4. READY CHECK", to display the Ready Check screen shown in Fig. 16.6.5.
Set each parameter to "yes" or "no". All parameters with "yes" must reach their initial parameter starts in order for the GC to be ready and the STATUS light to turn green.

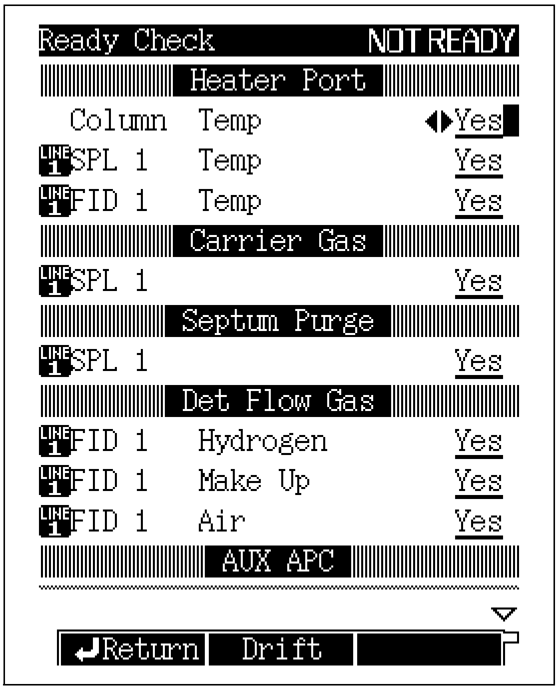


Fig. 16.6.5 Ready Check setup screen

16.6.6.2 Parameter list

TEMP. PORT

TEMP

Selection: Yes/No, Default: Yes
Indicate which heated zones should be included in the ready check.

CARRIER GAS

Selection: Yes/No, Default: Yes
Indicate which injection port carrier gas flow line should be included in the check.
The displayed items depend on the injection port type.

SEPTUM PURGE

Selection: Yes/No, Default: Yes

Indicate which injection port septum purge flow lines should be included in the check.

The displayed items depend on the injection port type.

DET FLOW GAS

MAKE UP

Selection: Yes/No, Default: Yes

HYDROGEN

Selection: Yes/No, Default: Yes

AIR

Selection: Yes/No, Default: Yes

Indicate which detector APC zones should be included in the check.

The displayed items depend on the detector type.

AUX APC

APC1–APC18 PRESS/FLOW

Selection: Yes/No, Default: Yes

This item is available only when optional APC units are installed.

DETECTOR

DRIFT

Selection: Yes/No, Default: No

This item compares the baseline drift to the drift limit for 10 minutes.

Once the GC becomes ready, the GC re-evaluates the ready state 10 minutes later.

WAIT SIGNAL

Selection: Yes/No, Default: Yes

The wait signal applies to all detectors configured in analytical lines.

NOTE

User-specified names are used in this screen.

16.6.6.3 PF menu

PF menu	Description	Reference section
Drift	Set the baseline drift limit.	——

16.6.7 Parameter configuration

Signals are output from four gas chromatograph channels.
To assign detector channels, see "13 Detector".
This section describes the detector signal configuration as well as the configuration of various other parameters which can be monitored on the screen.

16.6.7.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "5. SIGNAL SETTING", to display the signal settings screen shown in Fig. 16.6.6.
This screen allows you to adjust the GC signal parameters.

Use the cursor to select the desired channel.
Press [ENTER] to open that channel's setup screen.

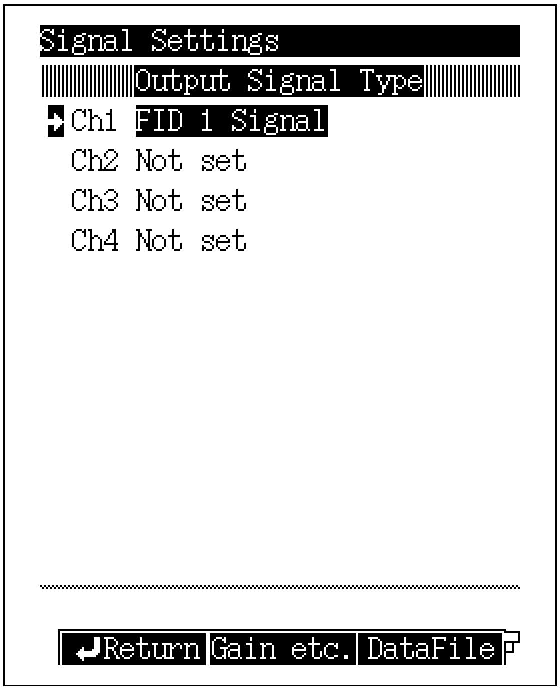


Fig. 16.6.6 Signal setup screen

16.6.7.2 PF menu

PF menu	Description	Reference section
Gain etc.	Sets the signal gain and offset for each detector.	16.6.7.6
Data File	Sets the format of digital signals. When GC is linked to a personal computer, this item is automatically set to "PC". When link is ended, this item automatically reverts to "Chromatopac".	——
Det Sig	Sets signal output channels for all detectors. The signal output channels can also be specified for installed detectors which have not been configured in an analytical line. If two or more detectors are set to one channel, data can be output to either channel without switching the output signal cable simply by changing the analytical line configuration.	——

16.6.7.3 Selecting the detector signals

Select the signal type from the main screen, and then press "DET SIG" to display the screen shown in Fig. 16.6.7.

Select the type of signal to output. For a description of the settings, refer to "13.3 Setting the Output Signals" in "13. Detector".

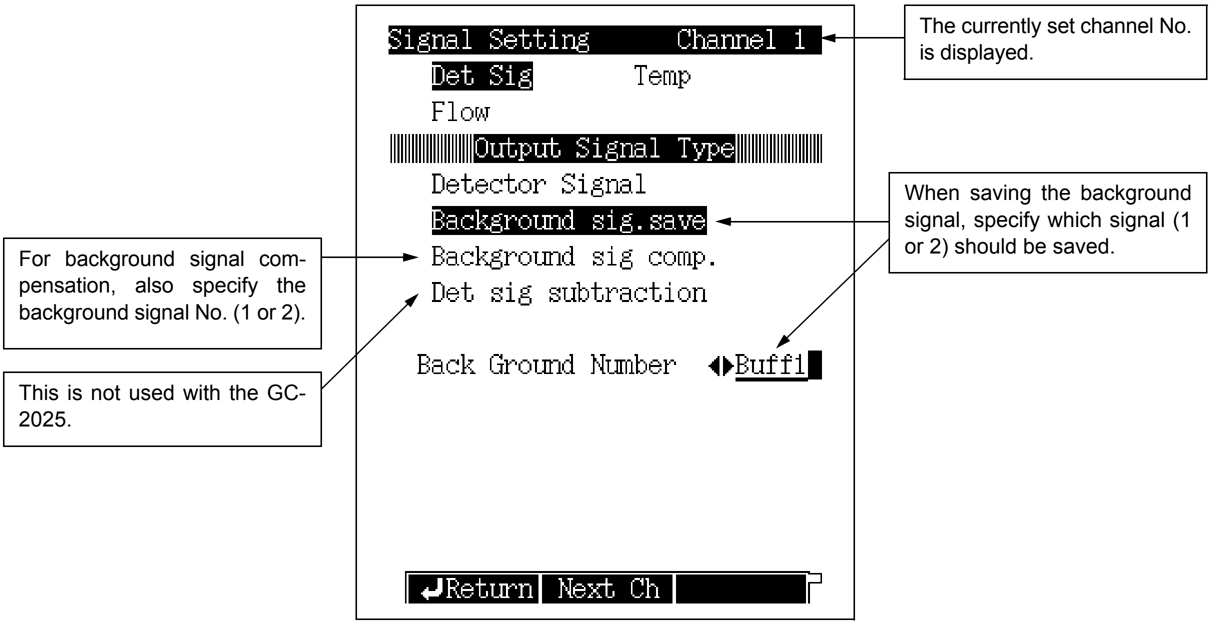


Fig. 16.6.7 Detector signal setup screen

16.6.7.4 Selecting the temperature signal

Select the signal type from the main screen, and then press "TEMP" to display the screen shown in Fig. 16.6.8.

Select the temperature signal to be output.

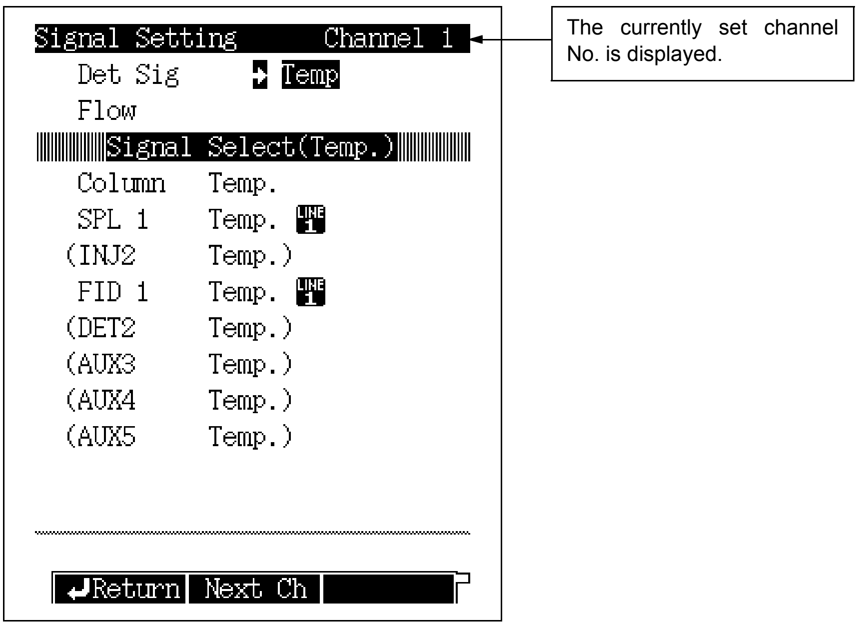


Fig. 16.6.8 Temperature control signal setup screen

16.6.7.5 Selecting the flow signal

Select the signal type from the main screen and then press "FLOW" to display the screen shown in Fig. 16.6.9.
Select the flow signal to be output.
Select the carrier gas, detector gas and APC gas items. These items can be set when an optional AUX APC is installed.

■ Carrier gas

If you select the carrier gas for the flow signal selection, the screen shown in Fig. 16.6.9 appears.

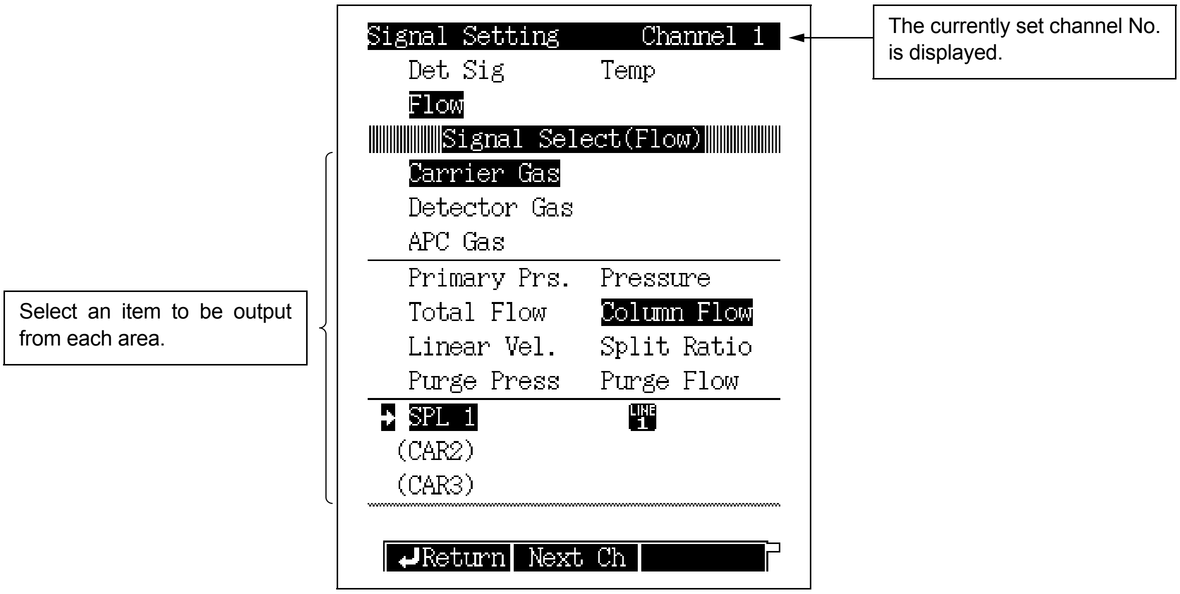


Fig. 16.6.9 Carrier gas signal setup screen

■ Detector gas

If you select the detector gas for the flow signal selection, the screen shown in Fig. 16.6.10 appears.

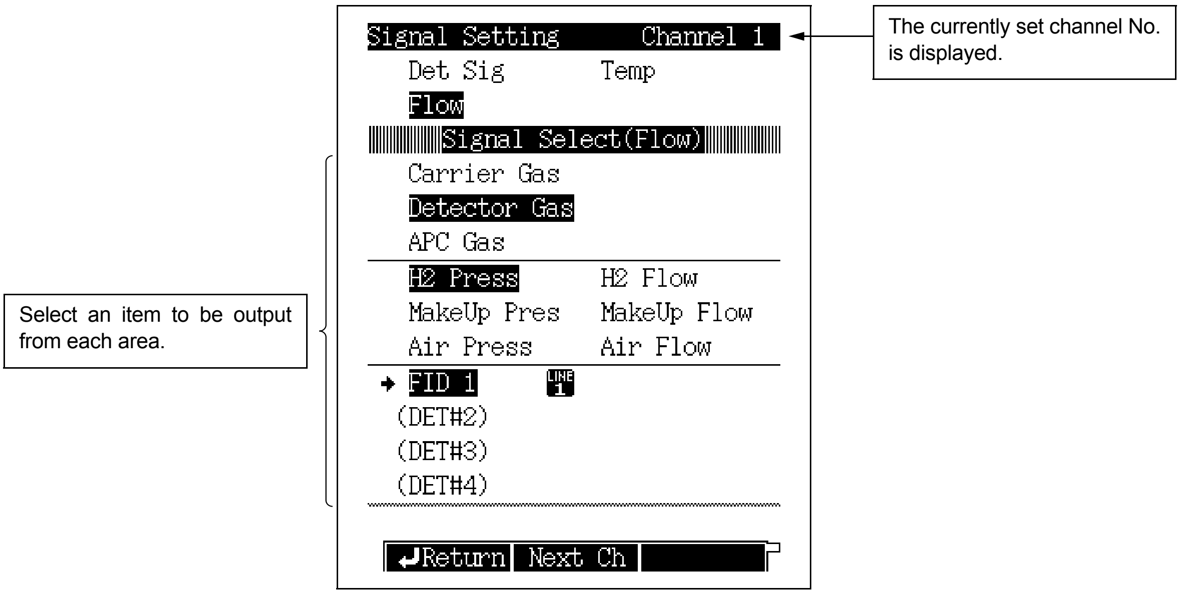


Fig. 16.6.10 Detector gas signal setup screen

■ APC gas

If you select the APC gas for the flow signal selection to display the screen shown in Fig. 16.6.11.

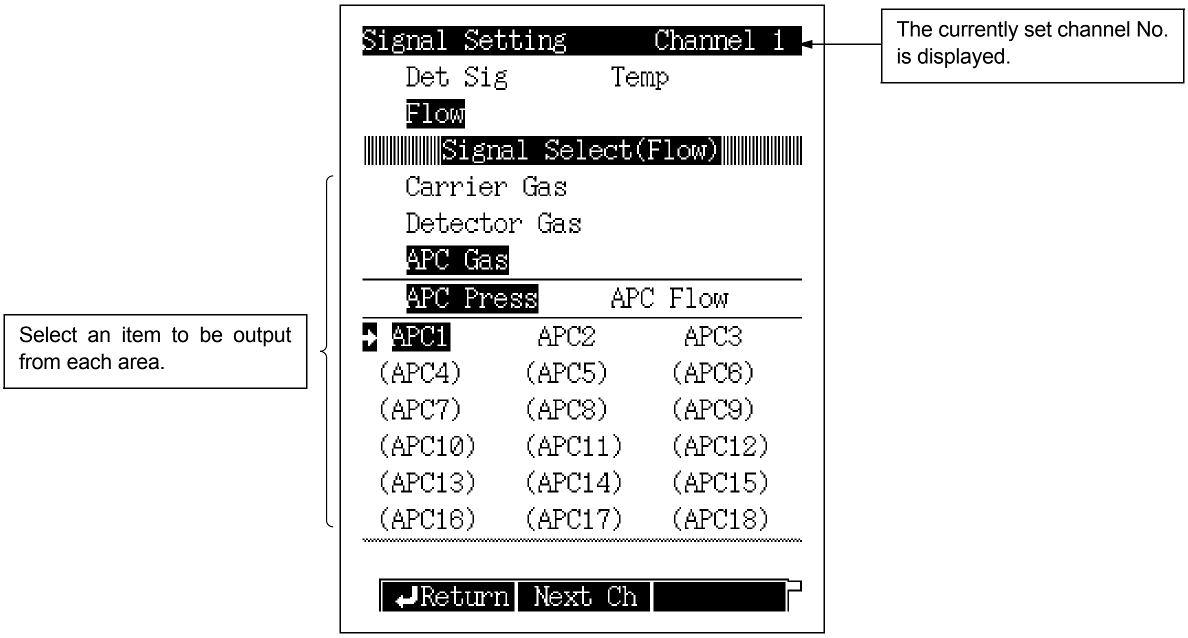


Fig. 16.6.11 APC gas signal setup screen

16.6.7.6 Signal offset

When you select [Gain etc.] (PF menu) from the signal setup main screen, the Gain and Offset screen shown in Fig. 16.6.12 appears. Set the offset and the the detector signal gain here.

Select [Sig. Ch] (PF menu), to set the gain and the offset for any signal other than defector signals (such as temperature or pressure). In addition, you can set the time constant and the zero adjustment of the signal for each channel.

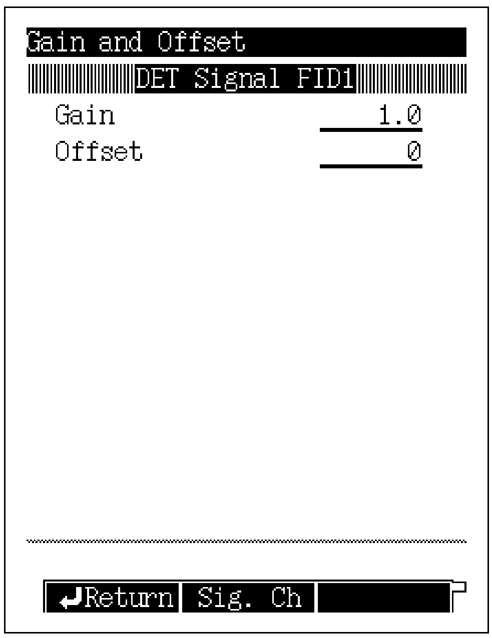


Fig. 16.6.12 Detector signal gain and offset screen

16.6.8 Customizing component names

16.6.8.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "6. PORT NAME CUSTOMIZATION", the Name customization screen shown in Fig. 16.6.13 appears.
Specify the names of GC components (8 characters, alphanumeric and symbols).
To customize the name, refer to "5.3.5 Changing item names" in "5.3 Basic Key Operations".

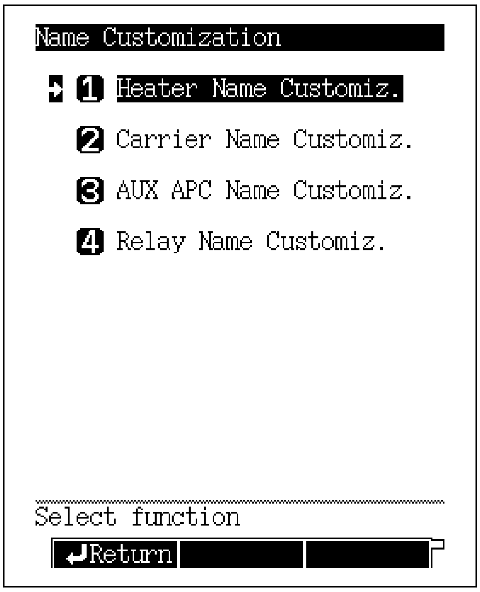


Fig. 16.6.13 Name setup screen

16.6.8.2 Customization example

If the "Heater Name" and "Carrier Name" are customized, the "Line Configuration" screen changes as shown in Fig. 16.6.14.

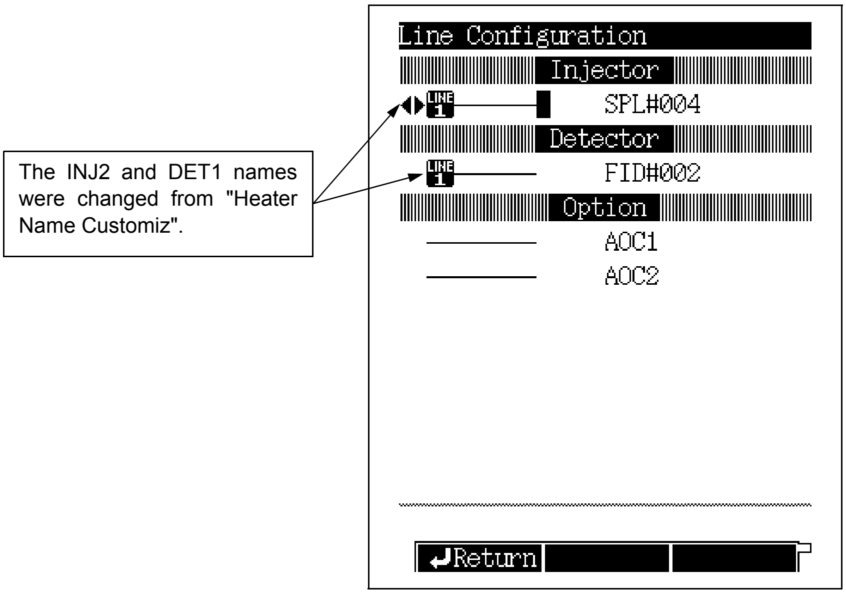


Fig. 16.6.14 Name customization example

NOTE
When there is no injection port and only a carrier flow controller is provided, the port name that is set using "CARRIER NAME CUSTOMIZ." is displayed on the "Line Configuration" screen.

16.6.8.3 Heater name customization

Select "6. GC CONFIGURATION" from, the [FUNC] key screen, and then "6. PORT NAME CUSTOMIZATION", and finally, select "1. HEATER NAME CUSTOMIZ", to open the screen shown in Fig. 16.6.15.

Only listed heated zone names can be changed.

To change the names, refer to "5.3.5 Changing item names" in "5.3 Basic Key Operations".

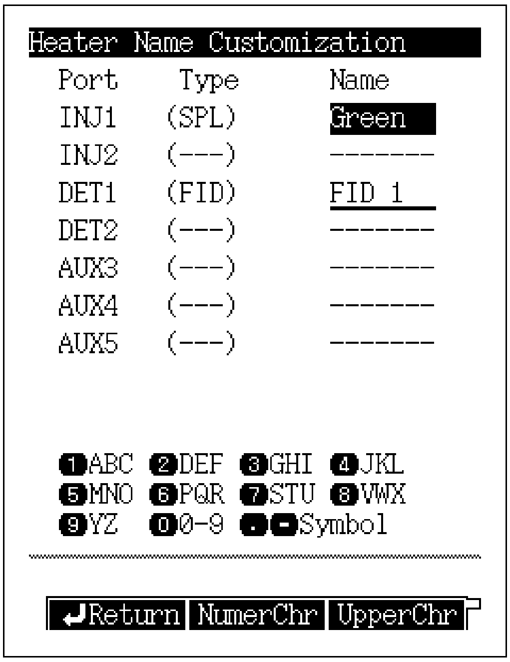


Fig. 16.6.15 Heater port name setup screen

16.6.8.4 Carrier name customization

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then "6. PORT NAME CUSTOMIZATION", and finally select "2. CARRIER NAME CUSTOMIZ", to open the screen shown in Fig. 16.6.16.

To change the names, refer to "5.3.5 Changing item names" in "5.3 Basic Key Operations".

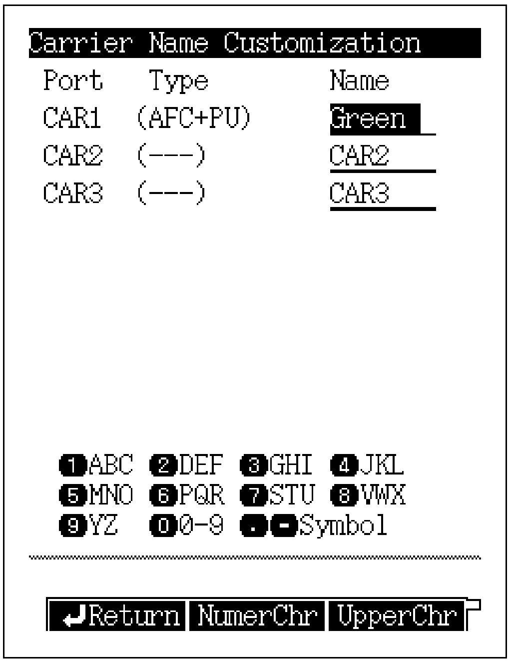


Fig. 16.6.16 Carrier name setup screen

16.6.8.5 AUX APC name customization

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then "6. PORT NAME CUSTOMIZATION", and finally "3. AUX APC NAME CUSTOMIZ", to open the screen shown in Fig. 16.6.17.

It is not possible to change the name of the APC port if the AUX APC (option) is not installed.

To change the names, refer to "5.3.5 Changing item names" in "5.3 Basic Key Operations".

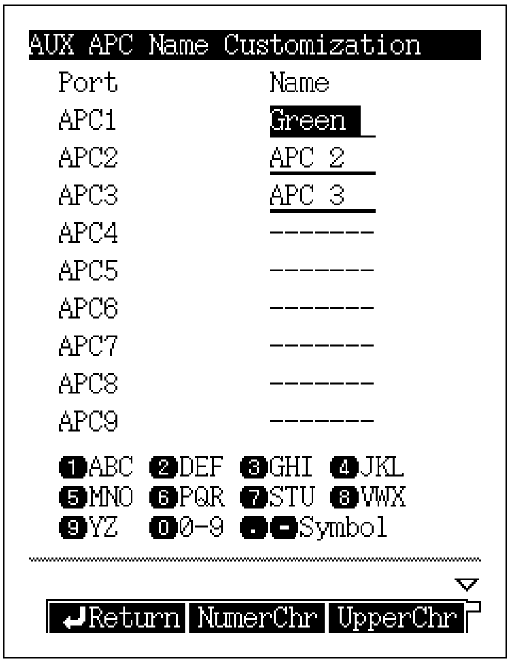


Fig. 16.6.17 AUX APC name setup screen

16.6.8.6 Relay name customization

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then "6. PORT NAME CUSTOMIZATION", and finally "4. RELAY NAME CUSTOMIZ", to open the screen shown in Fig. 16.6.18.

Only listed relays can be named.

To change the names, refer to "5.3.5 Changing item names" in "5.3 Basic Key Operations".

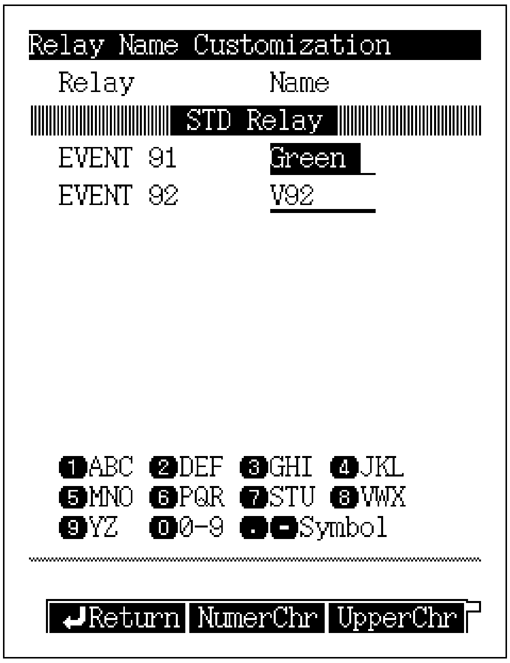


Fig. 16.6.18 Relay name setup screen

16.6.9 Setting the link device code

When the gas chromatograph is connected to a Chromatopac, the link device code must be set.
The link device code specifies which GC channel should start when the GC [START] key is pressed.

16.6.9.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "7. LINK DEVICE CODE", to open the screen shown in Fig. 16.6.19.

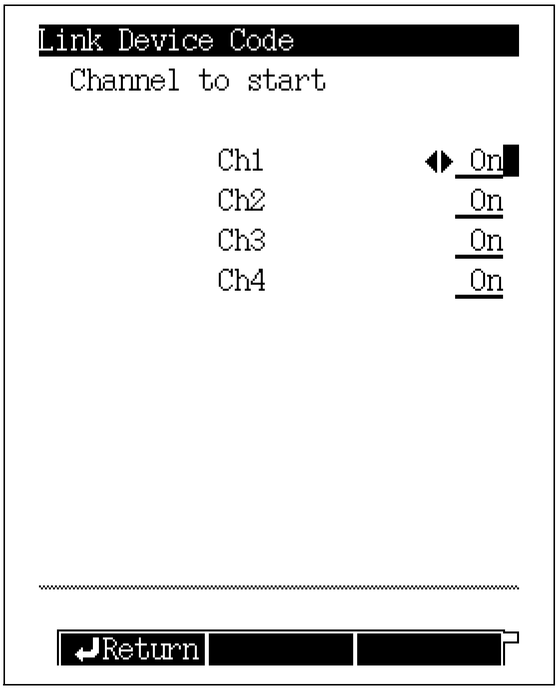


Fig. 16.6.19　Link device code setup screen

16.6.9.2 Parameter list

CHANNEL TO START

Ch1–Ch4 Selection: On/Off, Default: On
Set "On" or "Off" for the start signal of each channel.

16.6.10 Temperature offset

If the actual temperature of the various heated zones (as measured by a thermometer) differs from the temperature displayed on the GC screen, set a temperature offset value to compensate.

16.6.10.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key and select "8. TEMPERATURE OFFSET" to display the temperature offset screen shown in Fig. 16.6.20.

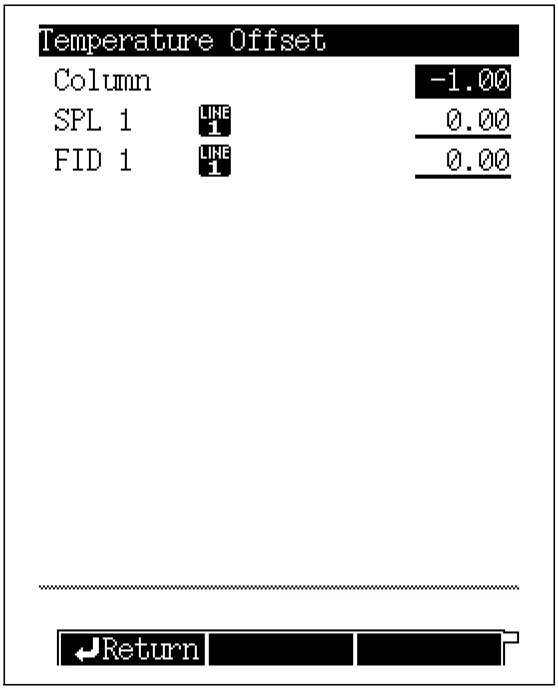


Fig. 16.6.20 Offset set up screen

16.6.10.2 Parameter list

COLUMN/INJ1/INJ2/DET1/DET2

Range: -10.00–+10.00, Default: 0.00

The temperature of each heated zone can be offset. Uninstalled ports are not displayed. For example, when "-1 °C" is obtained by subtracting the column oven temperature measured by thermometer from the gas chromatograph value with an offset value of "0", input "-1" as the offset value.

16.6.11 Other settings

16.6.11.1 Screen description

Select "6. GC CONFIGURATION" from the [FUNC] key screen, and then select "9. OTHER CONFIGURATIONS" to open the configurations screen shown in Fig. 16.6.21.

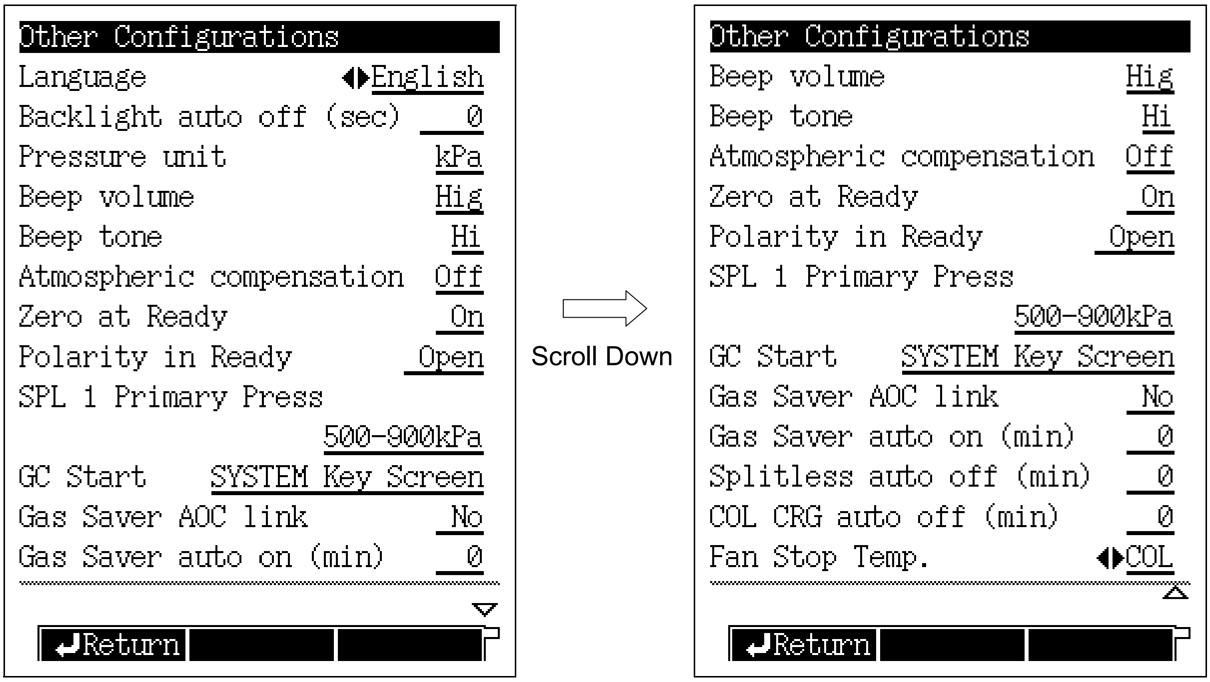


Fig. 16.6.21 Setup screen of other configuration

16.6.11.2 Parameter list

LANGUAGE

Selection: Alt./English, Default: English

Switch between Japanese (Alt.) and English screen languages.

BACK LIGHT AUTO OFF

Range: 0–9999 (sec)., Default: 0 (sec)

Set the period of time when the backlight LCD display automatically turns off.

PRESSURE UNIT

Selection: kPa/bar/psi., Default: kPa

Set the pressure units for display.

	Range (kPa = 1)	Increase quantity
kPa	1	0.1
bar	1/100	0.01
psi	1/6.895	0.1

NOTE

In the case that the pressure unit of "bar" or "psi" are used, pay attention to the following.

The range of the primary pressure is not displayed in the value of "bar", "psi". Set up it with the value that consults the following table and transformed into "kPa".

kPa	bar	psi
300 - 500	3.00 - 5.00	43.5 - 72.5
500 - 900	5.00 - 9.00	72.5 - 130.5
900 - 980	9.00 - 9.80	130.5 - 142.1

The pressure axis on the screen after pressing the [MONIT] key is displayed in the value of "kPa" regardless of the "pressure unit" sets.

The setting value, measured value of the primary pressure of the diagnosis result of the standard diagnosis is displayed in the value of "kPa" regardless of the "pressure unit" sets.

The display, printing of each log file is displayed in the value of "kPa" regardless of the "pressure unit" sets.

BUZZER VOLUME

Selection: Off/Low/Mid/Hig, Default: Low

BUZZER TONE

Selection: Lo/Hi, Default: Hi

Use a different tone for different GCs to be able to discern which GC has a problem.

ATMOSPHERIC COMPENSATION

Selection: On/Off, Default: Off

Select "On" to compensate for the atmospheric pressure.

ZERO TO READY

Selection: On/Off, Default: On

Set "On" for, the gas chromatograph to automatically perform zero adjustment when the GC is ready and the STATUS light is illuminated in green.

POLARITY IN READY

Selection: Open/Close, Default: Open

Set the polarity of GC ready signal.

INJ1 PRIMARY PRESS

Selection: 300–500 kPa/500–900 kPa/900–980 kPa, Default: 500–900 kPa

Select the pressure range of the carrier gas cylinder.

Example: If the gas cylinder pressure supplied to the GC-2025 is 700 kPa, select "500–900 kPa".

GC START

Selection: SYSTEM Key Screen/ SET Key Screen/ MONIT Key Screen

Default: SYSTEM Key Screen

Select the screen, which is displayed automatically after pressing the "Start GC" key (PF1 key of the [SYSTEM] key main screen).

Gas Saver AOC link

Selection: Yes/No Default: No

This function is displayed on the screen only when the AOC is selected for the line.

This function can be used to perform batch analysis using the AOC. To enable this function, the Gas Saver function must be set to "On".

No: When the GC enters the READY state after the completion of analysis, the split ratio will return from the Gas Saver split ratio to the split ratio specified on the [FLOW] key screen (at analysis start).

Yes: The Gas Saver split ratio is retained even when the GC enters the READY state after the completion of analysis.

The split ratio will be changed to the split ratio specified on the [FLOW] key screen when the signal for starting the AOC is sent via the GC at a start of the next analysis. (This is available only for batch analysis.)

NOTE

- When the GC is in the READY state and the split ratio set by Gas Saver is used after the Gas Saver AOC link function was activated, the FLOW indicator emits yellow light.
- To return the split ratio to the ratio specified on the [FLOW] key screen (at analysis start) when the GC is in the READY state and the split ratio set by Gas Saver is used after the Gas Saver AOC link function was activated, press [Restore] (PF menu) on the [SYSTEM] key screen.
  When this function is ON, PF3, which usually serves for [Clean Up], serves for [Restore].

Gas Saver auto on (min)

Range: 0/10 - 120 (min) Default: 0 (min)

Use this function to set a period of time to return the split ratio to the Gas Saver split ratio after the completion of analysis.

This function is displayed on the screen only when the AFC is attached to the GC.

This function is activated when the Gas Saver is set to "On."

0 (min): When the GC enters the READY state after the completion of analysis, the split ratio will return to the ratio specified on the [FLOW] key screen (at analysis start). (Gas Saver split ratio will not be applied.)

10 - 120 (min): When the GC enters the READY state after the completion of analysis, the split ratio will return from the Gas Saver split ratio to the ratio specified on the [FLOW] key screen (at analysis start). Then, the Gas Saver split ratio will be automatically applied after the preset time has elapsed.

Splitless auto off (min)

Range: 0/10 - 120 (min) Default: 0 (min)

Use this function to set a period of time for the Split Vent to automatically open and create split state after the completion of analysis.

This function is displayed on the screen only when the AFC is attached to the GC.

This function is activated when the split mode of the AFC is set to "SPLITLESS."

0 (min): When the GC enters the READY state after the completion of analysis, the Split Vent will close and will remain closed. (Stays ready in the splitless state.)

10 - 120 (min): When the GC enters the READY state after the completion of analysis, the Split Vent will close to create the splitless state. When the READY state has lasted for the preset period of time, the Split Vent will automatically open and will remain open.

COL CRG auto off (min)

Range: 0/10 - 120 (min)   Default: 0 (min)

Use this function to set a period of time for the CRG valve in the column oven to be forcibly closed after the completion of analysis.

This function is displayed on the screen only when CRG is set to "Use" in the Column Oven section on the CRG screen which can be accessed by pressing the [OPTION] key.
This function is activated when both the CRG is set to "Use" and the valve is set to "On" on the CRG screen.

0 (min): CRG valve control will continue after the GC enters the READY state after the completion of analysis in order to maintain the initial temperature.

10 - 120 (min): After the GC enters the READY state after the completion of analysis, the CRG valve in the Column Oven will be forcibly closed when the preset time has elapsed so that the consumption of coolant is reduced.

NOTE

- The following three functions are designed to be activated after the completion of analysis and remain disabled before performing analysis:
  "Gas Saver auto on (min)," "Splitless auto off (min)," and "COL CRG auto off (min)"
  For instance, even when the time for the "COL CRG auto off (min)" is set, the CRG valve in the Column Oven will not be forcibly closed before analysis.
- The FLOW indicator emits a yellow light when the split ratio specified by Gas Saver is used for control after the "Gas Saver auto on (min)" function is activated or when the split vent remains open after the "Splitless auto off (min)" function is activated.
- The TEMP indicator emits a yellow light when the CRG valve in the Column Oven is forcibly closed after the "COL CRG auto off (min)" function is activated.
- To return to the state where the next analysis can be started when either "Gas Saver auto on (min)," "Splitless auto off (min)," or "COL CRG auto off (min)" is running, press [Restore] (PF menu) on the [SYSTEM] key screen. (When any of these functions are running, PF3, which usually serves for [Clean Up], serves for [Restore].) [Restore] needs to be pressed to start analysis.
  The GC will automatically exit these functions once a batch analysis starts. In such a case, however, analysis may start in a state where the temperature or the flow controller is not sufficiently stable.
  It is recommended to manually restore the GC and confirm that the GC is in a stable state before starting batch analysis.

Fan Stop Temp.

Selection: ALL/COL   Default: COL

Use this function to set the turn-off conditions for the Oven Fan when the temperature control function is set to off.

COL: The Oven Fan will be turned off when the column oven temperature drops below 50 °C.

ALL: The Oven Fan will be turned off when both the column oven temperature drops below 50 °C and the temperature of heater ports such as the detector or sample injection port drops below 100 °C.

16.7 Service and Maintenance

16.7.1 Screen description

Select "7. SERVICE/MAINTENANCE" from the [FUNC] key screen to display the Service/ Maintenance screen shown in Fig. 16.7.1.

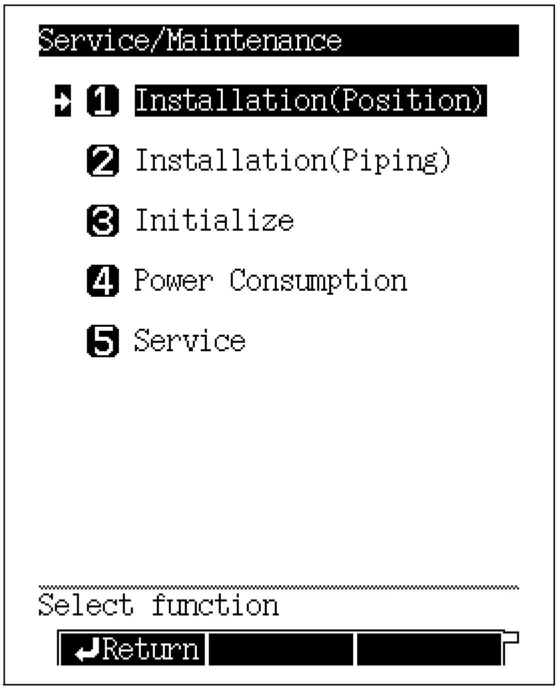


Fig. 16.7.1 Service/maintenance menu screen

16.7.2 Parameter list

INSTALLATION (POSITION)
Specify the heated zone locations for installed components.

INSTALLATION (PIPING)
Set the installation status of the carrier gas and the detector gas flow controllers.

INITIALIZE
Initialize the RAM, configuration, and installation settings.

POWER CONSUMPTION
Displays the power consumption of all heated zones.

SERVICE
Reserved for the use of Shimadzu service personnel during maintenance or inspections.

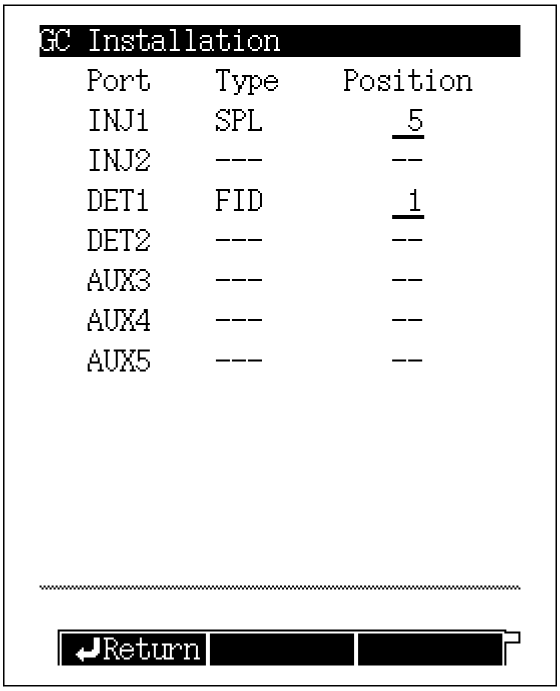
16.7.3 Installation (Position)

16.7.3.1 Screen description

Select "7. SERVICE/MAINTENANCE" from the [FUNC] key screen, and then select "1. INSTALLATION (POSITION)", to open the GC installation screen shown in Fig. 16.7.2 appears.

After installing injection ports and detectors, specify the location of installed components by entering the heated zone number while. referring to Fig. 16.7.3.

The component type of installed injectors and detectors is automatically determined.



Enter the heated zone number to specify the unit installation position in a number. (Refer to Fig. 16.7.3.)

Fig. 16.7.2 GC installation setup screen

16.7.3.2 Parameter list

INSTALLATION POSITION

Range: 0–7, Default: 0

Specify the component installation location by entering the numbers shown in Fig. 16.7.3.

Set "0" when the component is not installed, and set "7" when it is installed in a position other than those shown in Fig. 16.7.3. Installation positions are given a number from 1 to 6; however, in practice, the component can be installed as shown in Fig. 16.7.3.

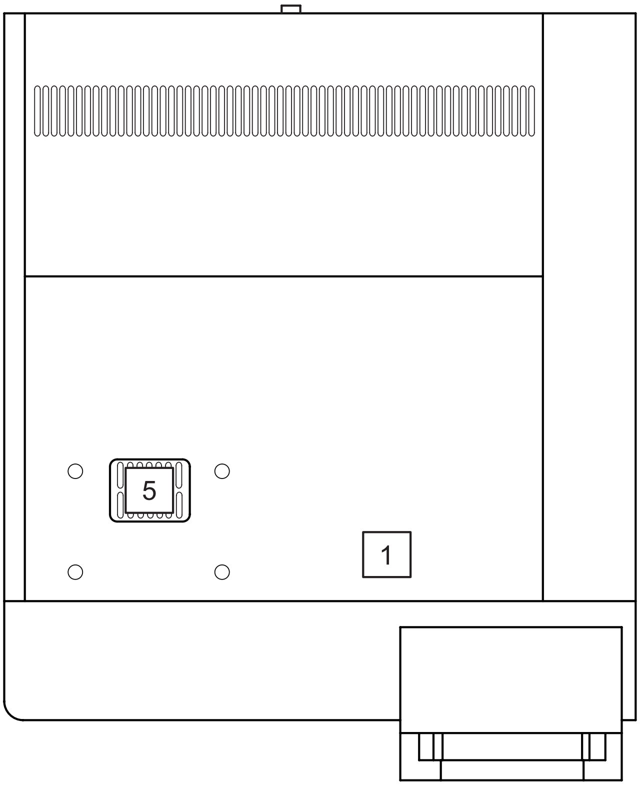


Fig. 16.7.3 Component installation location

NOTE

Changes are not in effect until the GC has been turned off and on.

16.7.4 Installation (Piping)

16.7.4.1 Screen description

Select "7. SERVICE/MAINTENANCE" from the [FUNC] key screen, and then select "2. INSTALLATION (PIPING)", to open the Installation (Piping) Screen shown in Fig. 16.7.4.

In the carrier gas, flow controller fields, specify where the temperature control port of the injection unit is connected.

In the detector gas flow controller fields, specify the slot number of flow control unit and the temperature control port of the detector unit.

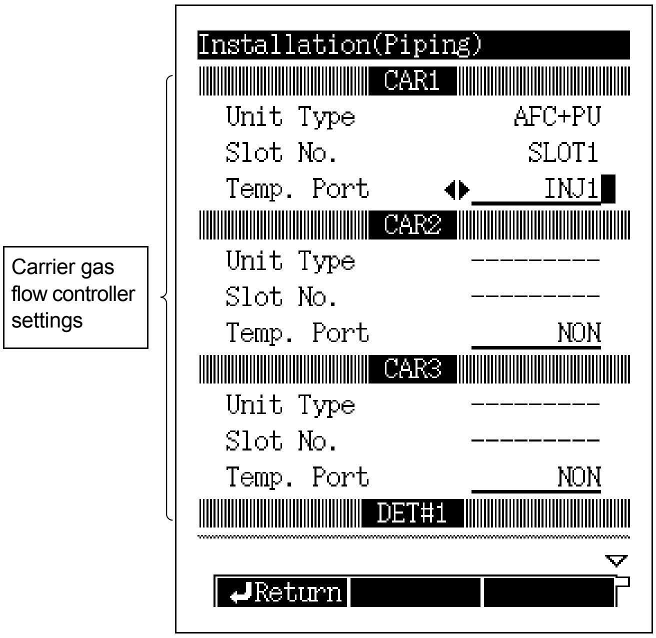


Fig. 16.7.4 Installation status setup screen

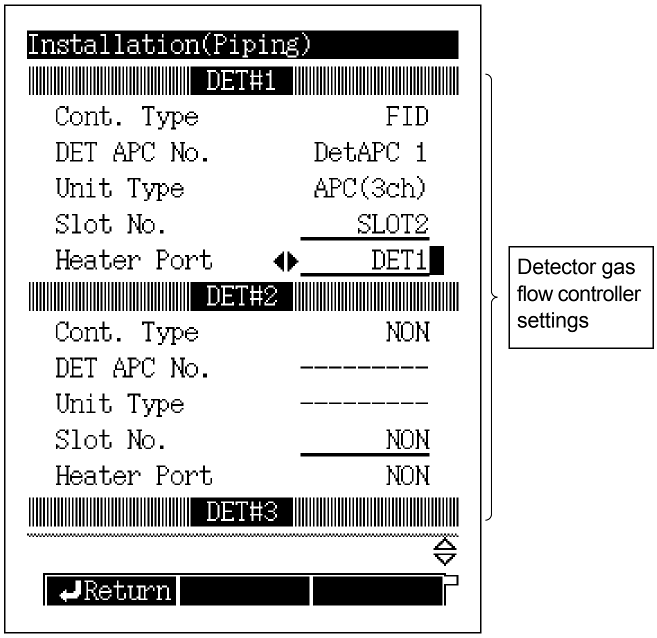


Fig. 16.7.5 Installation status setup screen (continued)

16.7.4.2 Parameter list

■ **Carrier gas flow controller settings**

The names CAR1, CAR2 and CAR3 are automatically assigned in ascending order of the slot No. for each installed AFC.

Specify the flow controller carrier gas settings for each CAR.

UNIT TYPE

For, display only.

When an AFC is installed, this is automatically displayed.

If a manual flow controller is installed, specify the installation Slot No. (See below.) "SPLITTER" is automatically displayed for the Unit Type.

SLOT NO.

Selection: NON/SLOT1/ SLOT3/SLOT5/ SLOT6, Default: NON

The AFC slot number is automatically recognized and displayed. SLOT1 to SLOT4 are used with the GC-2025.

TEMP. PORT

Selection: NON/INJ1/ INJ2/DET1/DET2, Default: NON

Specify the injection port heated zone where the flow controller tubing is connected. This associates the flow controller to an injection port.

■ **Detector gas flow controller settings**

When installing detector flow control units, the names DET#1 to DET#2 are automatically assigned starting with the one nearest to the GC.

Specify the to flow controller detector gas settings for each detector No. (DET#1 to DET#2). DET#1 to 4 are displayed on the screen. With the GC-2025, DET#1 or 2 can be set.

CONT. TYPE

For display only.

The type of each installed detector control unit is automatically recognized and displayed.

DET APC No.

For display only.

When the slot No. is selected for each installed detector gas flow controller, the name DET APC 1 to DET APC 4 is automatically assigned to each flow controller.

UNIT TYPE

When an APC is installed, the APC type is displayed for the Slot No. selected.

"APC (3ch)" indicates an APC for FID.

When manual flow controllers are selected for the SLOT No, "DET GAS" is automatically displayed.

SLOT NO.

Selection: NON/SLOT1/ SLOT2/SLOT3/ SLOT4/SLOT5/ SLOT6/SLOT7/ SLOT8, Default: NON

Select a slot for the detector APC from the available slot numbers. A slot number already used cannot be selected. Instead the GC-2025, SLOT1 to SLOT4 must be used.

HEATER PORT

Specify the detector heated zone where the flows controller tubing is connected.

This associates the flow controller to a detector.

NOTE

Changes are not in effect until the GC has been turned off and on.

16.7.5 Initialization

16.7.5.1 Screen description

Select "7. SERVICE/MAINTENANCE" from the [FUNC] key screen, and then select "3. INITIALIZE", to display the Initialization screen shown in Fig. 16.7.6.
When you move the arrow cursor and press the [ENTER] key, the initialization confirmation screen (Fig. 16.7.7) appears. On this screen, press the [INIT] (PF menu) key to initialize the selected item.

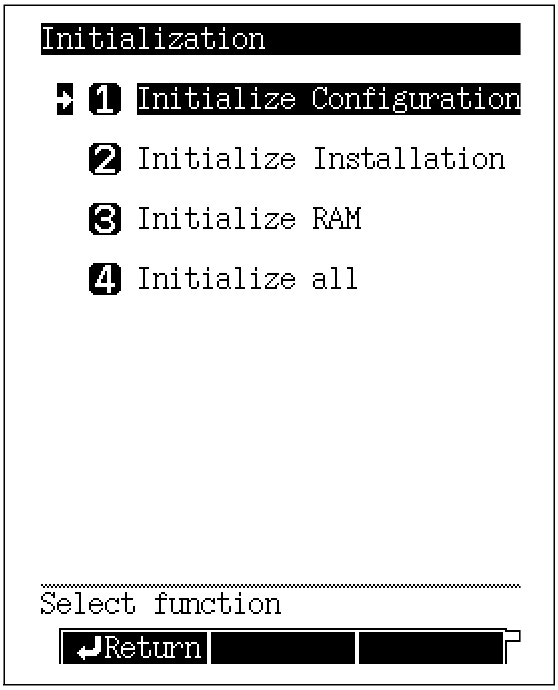


Fig. 16.7.6 Initialization menu screen

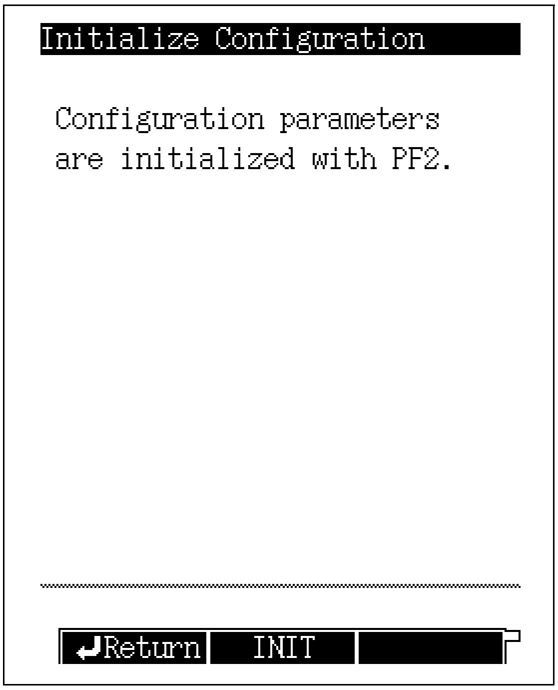


Fig. 16.7.7 Initialization confirmation screen

16.7.5.2 Parameter list

INITIALIZE CONFIGURATION

This item initializes configuration settings such as heated zone temperature limits and ready check parameters. However the column temperature limit is saved in the analysis file and is not reset. Analysis files 0–9 cannot be initialized.

INITIALIZE INSTALLATION

This item initializes the installation settings of injection ports, flow controllers, etc.

INITIALIZE RAM

This item initializes the RAM, erasing all data, including analysis files 0–9, configuration and installation settings.
Initialize the RAM when there is a RAM problem.

INITIALIZE ALL

This item initializes all settings including.
Analysis files 0–9

16.7.6 Power consumption

16.7.6.1 Screen description

Select "7. SERVICE/MAINTENANCE" from the [FUNC] key screen, and then select "4. POWER CONSUMPTION", to open the Power consumption screen shown in Fig. 16.7.8.

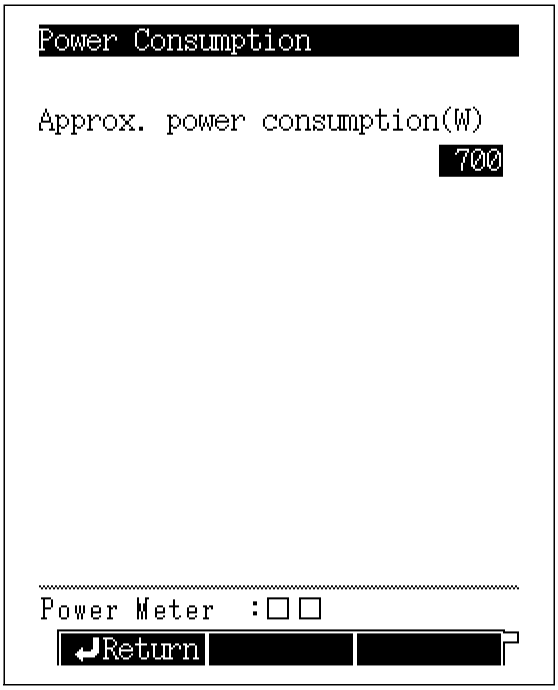


Fig. 16.7.8 Power consumption monitoring screen

16.7.6.2 Parameter list

APPROX. POWER CONSUMPTION

The calculated total power consumption of all heated zones is displayed.
Power consumption by electric circuits such as built-in power supply for the AOC is not included.

NOTE
Power consumption is displayed in graph on the message display area on the respective screens.

16.8 Stopwatch

16.8.1 Screen description

Select "8. STOP WATCH" from the [FUNC] key screen to display the stopwatch screen shown in Fig. 16.8.1.
The stopwatch can display elapsed time up to 99:99:99.9 in units of 0.1 seconds. When the counted time exceeds 99:99:99.9, the stopwatch is reset and the time restarts at 0.0 seconds.
The stopwatch can function even when other keys are pressed. However, once the stop key is pressed, the stopwatch is reset to 0.0 seconds if another key is pressed.

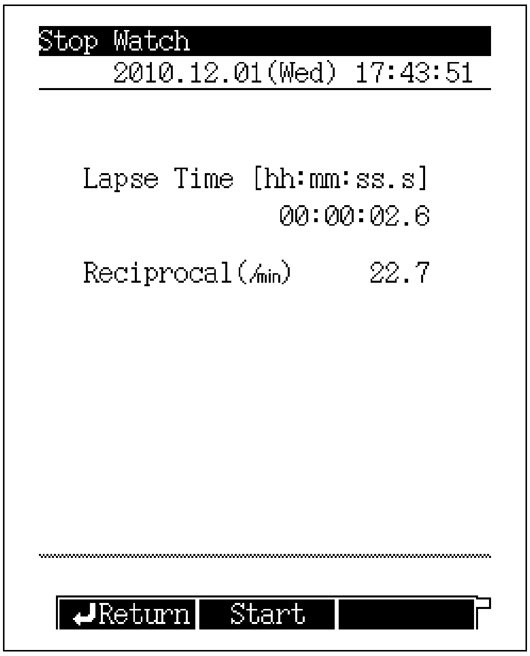


Fig. 16.8.1 Stop watch screen

16.8.2 PF menu

PF menu	Description	Reference section
Start	Starts timing. If "Start" is pressed again when the timing has stopped, the stopwatch is reset to 0.0 seconds.	——
Stop	Stops counting.	——

16.8.3 Timing with inverse measurement

When using a bubble film flow meter of V ml, obtain the flow rate using the inverse number.

V x (Inverse number of measurement time) ml/min

16.9 Key Lock and Parameter Lock

16.9.1 Screen description

Select "9. LOCK" from the [FUNC] key screen to display the Lock screen shown in Fig. 16.9.1.
If either key lock or parameter lock has already been activated, the Unlock screen appears instead.

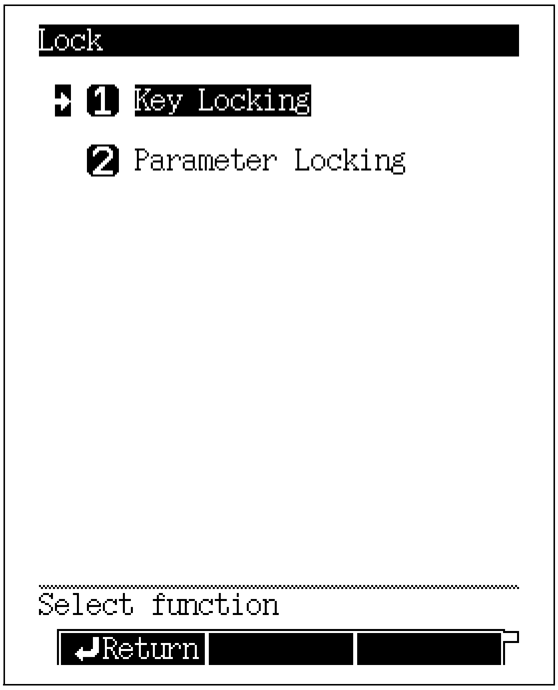


Fig. 16.9.1 Lock menu screen

16.9.2 Key locking

Select "9. LOCK" from the [FUNC] key screen, and then select "1. KEY LOCKING" to display the Key locking screen shown in Fig. 16.9.2. This screen indicates that the current status is "not locked".

When keys are locked, key operations are disabled. This function is useful to prevent analysis mistakes because no key operation is accepted. When the keys are locked, an icon indicating the lock state is displayed at the lower left corner of the screen.

When the keys are locked, analyses can still be started and stopped, and parameters can be monitored.

Fig. 16.9.2 Key Locking main screen

■ Unlocking keys

Press the [FUNC] key when the keys are locked, to open the screen shown in Fig. 16.9.3.
Once the keys are unlocked, the screen shown in Fig. 16.9.1 appears.

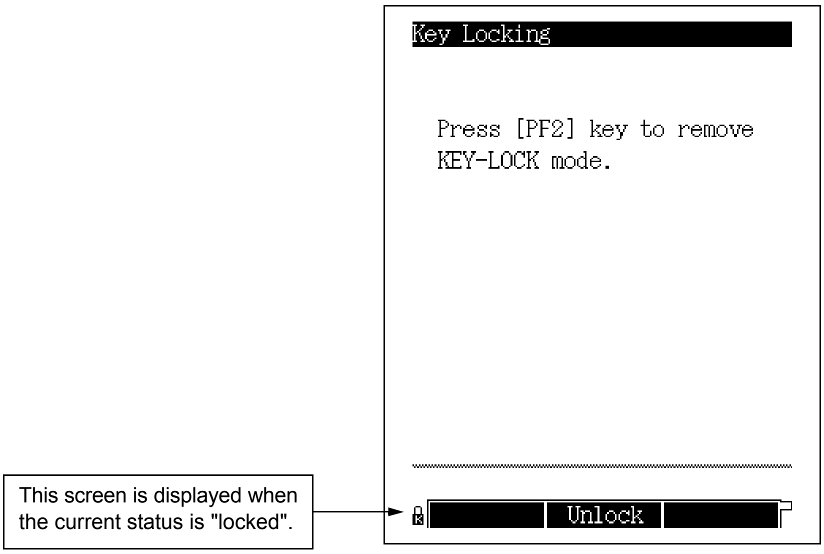


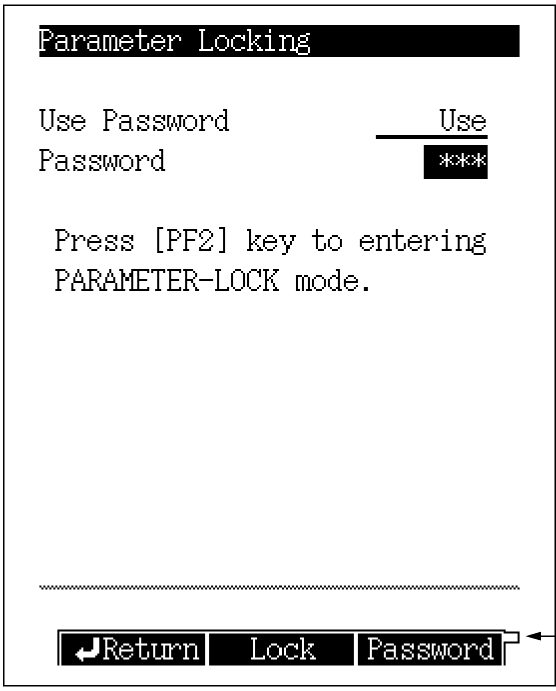
Fig. 16.9.3 Key unlock screen

16.9.3 Parameter locking

Select "9. LOCK" from the [FUNC] key screen, and then select "2. PARAMETER LOCKING" to display the screen shown in Fig. 16.9.4.
The parameter lock function prevents unauthorized parameter changes (for analytical conditions such as temperature, pressure and flow rate). Setup values can be monitored, but cannot be changed.

When the password is to be required, set "USE PASSWORD" to "USE", enter a password, then press [Lock] (PF menu).

The parameter lock function is also available without password.



Press [Password] (PF menu) to display the password setup screen.

Fig. 16.9.4 Parameter locking main screen

■ Setting a password

Select [Password] (PF menu) from the screen shown in Fig. 16.9.4 to display the password screen shown in Fig. 16.9.5. The password is a number ranging from 1 to 9999. The factory set password is "2010".

＜ Setting a password ＞

Enter each required password, and press [Set] (PF menu).

Enter the new password twice to confirm it.

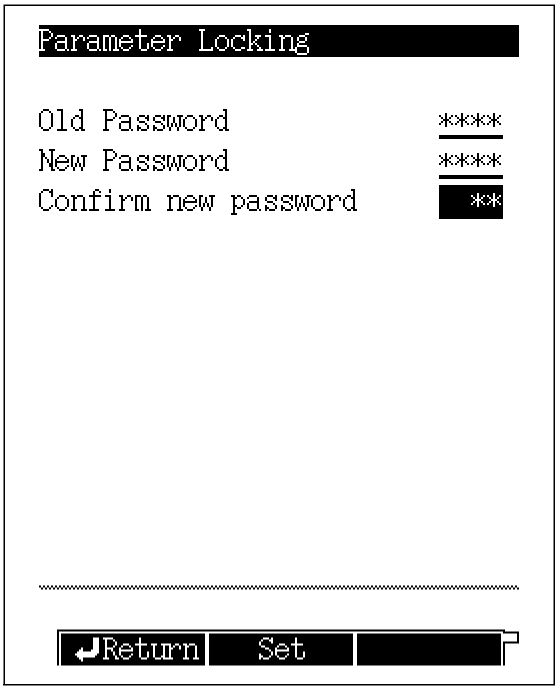


Fig. 16.9.5 Password setup screen

NOTE

- If the "Old Password" or "Confirm new password" is incorrect, an error message appears. Confirm the password to be input, entering it correctly.
- Only the system supervisor should have password access. Change the factory-set password promptly. Do not forget your password, and keep it secure.

■ Unlocking the parameters (without password)

If parameters are locked and no password is required, when you select "9. LOCK" from the [FUNC] key screen, the screen shown in Fig. 16.9.6 appears.
When the parameter are unlocked, the screen shown in Fig. 16.9.4 appears.

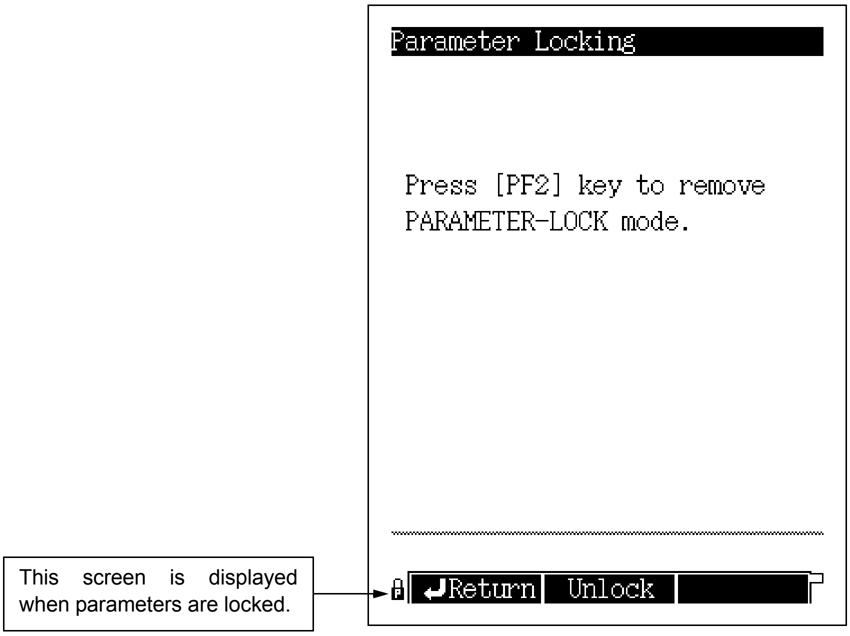


Fig. 16.9.6 Parameter unlock screen (without password)

■ Unlocking parameters (with password)

If parameters are locked and a password is set, when you select "9. LOCK" from the [FUNC] key screen, the screen shown in Fig. 16.9.7 appears.
When you input the correct password and press the [Unlock] (PF menu) key, the parameters are unlocked and the screen shown in Fig. 16.9.4 appears.

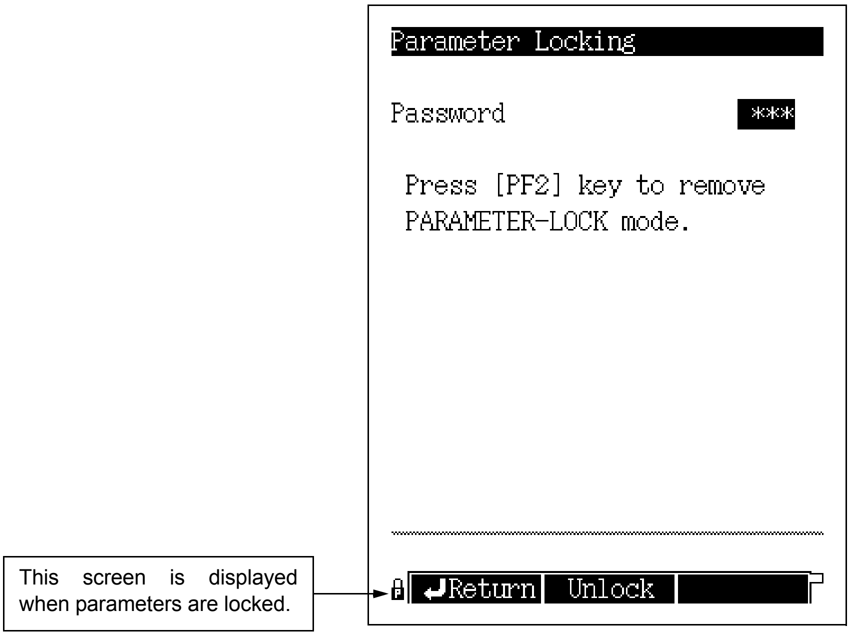


Fig. 16.9.7 Parameter unlock screen (when a password is set)

16.10 ROM Version No.

The system ROM version No. can be displayed.

16.10.1 Screen description

Press [Version] (PF menu) from the [FUNC] key screen to display the version screen shown in Fig. 16.10.1.

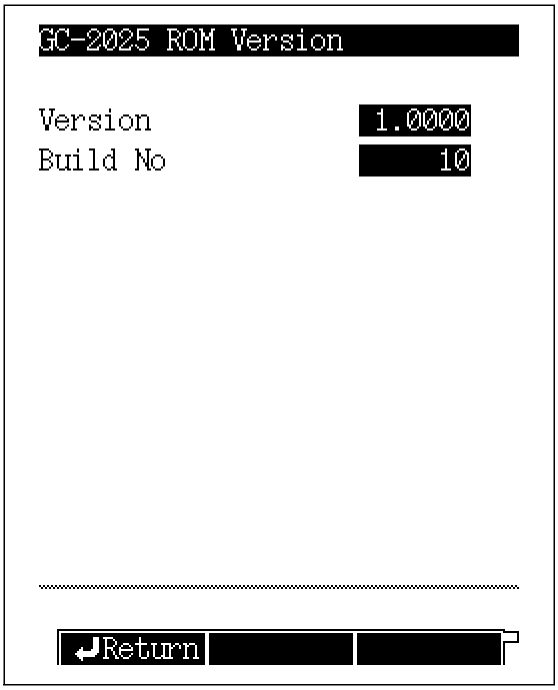


Fig. 16.10.1 ROM version No. screen

16.10.2 Parameter list

VERSION
BUILD NO.
The ROM version may be required during system maintenance.

17.1 Printing

17.1.1 Connection to Chromatopac

Connect the gas chromatograph to the Chromatopac, then press [Print] (PF menu) from the GC screen to print to the Chromatopac.
For the GC and Chromatopac connection, refer to "22 Connecting External Device Cables".

17.1.2 Parameters to be printed

17.1.2.1 Program

The current file program can be printed.
This includes the following screens: temperature program (COL, INJ1, INJ2), pressure program (CAR1, CAR2, CAR3), flow rate program (CAR1, CAR2, CAR3) and split ratio program (CAR1, CAR2).
Press [Print] (PF menu) from any screen to print the same parameters for a saved program.

- COLUMN OVEN TEMP PROGRAM -			
	RATE	TEMP	TIME
0	-------	100.0	1.00
1	6.00	220.0	25.00
- INJ1 TEMP PROGRAM -			
	RATE	TEMP	TIME
0	-------	25.0	0.00
- INJ1 PRESSURE PROGRAM -			
	RATE	TEMP	TIME
0	-------	100.0	0.00
- INJ1 SPRIT RATIO -			
	TIME	RATE	
0	-------	-1.0	
- END -			

Fig. 17.1.1

17.1.2.2 AOC parameters

The current file's AOC parameters and the parameters of AOC settings can be printed. All printed items are listed by command name. To match command names to screen items, refer to "17.2 AOC Commands".

- AOC PARAMETER -

	AOC1
WRPT	2
WMOD	1
REPT	1
IVOL	1.0
WPRS	0
PUMP	5
WTPP	0.2
WAIT	0.0
ISPD	2
SSPD	1
SAND	0
SOLV	0
SINT	0
SSNO	0
SNO2	0
AAIR	0
USPD	2
DSPD	2
HIGH	0
LOWS	0

Fig. 17.1.2

17.1.2.3 Main parameters

Press [Print] (PF menu) from the [SET] key to print the temperature values for all heated zones, the CAR1 pressure value, and the total flow rate value from the current file.

- GC PARAMETER 0:FILE0 -

COLUMN OVEN	TEMP	25.0
INJ1	TEMP	25.0
DET1	TEMP	25.0
INJ1	PRESS	100.0
INJ1	FLOW	50.0

- END -

Fig. 17.1.3

17.1.2.4 Time program and Pre-Run program

The time programs and Pre-Run programs can be printed as Event No. or parameter names. To match Event No. and parameter names to screen items, refer to "17.3 Program Parameters" and "17.4 Event No."

NOTE

For all functions treated as events in the printout, the line No. is displayed as "0" regardless of the line number.

- GC TIME PROGRAM -

TIME	FUNC	VALUE	LINE
0.0	EVNT	91.0	0
2.0	D1RG	1.0	1
3.0	D1RG	0.0	1
200.0	STOP	1990.0	0

- END -

Fig. 17.1.4

17.1.2.5 Batch schedule

Press [Print] (PF menu) to print the batch schedule as shown below.

- GC SAMPLE SCHEDULER -

START	FINAL	GC-FILE	DP-FILE	#INJ	MK	COMNAD
1	5	0	Ch.1-2	1	STANDARD	STEST
6	15	0	Ch.1-2	3	UNKNOWN	

- END -

Fig. 17.1.5

17.1.2.6 Log

From each screen of the GC operation log, the analysis log, the parameter log, the error log and the diagnostic log, press [Print] (PF menu) to print the parameters displayed on the screen.
For the analysis log, only the list screen is printed. The contents of the detailed analysis screen are not printed.
For example, press [Print] (PF menu) from the error log screen, to obtain the following printed results.

NOTE
The log items are printed in chronological order, starting from the oldest.

- GC ERROT LOG -

TIME OCCURED	CODE	ERROR MESSAGE (VALUE)
200.05.16 14:21	[E1020]	DET1 sensor down error (530.00)
200.05.16 14:27	[E0031]	INJ-DET2 A/D error
200.05.16 14:27	[E0032]	AUX1-AUX3 A/D error
200.05.16 14:27	[E0011]	CAR1 AFC PCB error (7.00)
200.05.16 14:27	[E0030]	COL A/D error
200.05.16 14:27	[E0001]	DC5 V range error (8.43)
200.05.16 14:27	[E0002]	DC24 V range error (20.34)
200.05.16 14:27	[E0034]	Battery voltage error (0.26)
200.05.16 14:27	[E0005]	Room temp range error (84.27)
200.05.16 14:27	[E1019]	INJ1 sensor down error (530.00)
200.05.16 14:27	[E1018]	COL sensor down error (530.00)
200.05.16 14:27	[E1020]	DET1 sensor down error (530.00)
200.05.16 14:28	[E0031]	INJ1-DET2 A/D error
200.05.16 14:28	[E0032]	AUX1-AUX3 A/D error
200.05.16 14:28	[E0011]	CAR1 AFC PCB error (7.00)

Fig. 17.1.6

17.1.2.7 Diagnosis results

Press [Print] (PF menu) from the detailed results screen of the standard diagnosis to print a report similar to the ones shown below.
The date, the version No. and the installation status, which are not displayed on the screen, are also printed.

- GC DIAGNOSIS REPORT -

DATE	2000.06.15 14:35
GC SERIAL NUMBER	“C11123380069SM”
ROM VERSION	0.0202
DET#1	FID WIDE
DET#2	NON
DET#3	NON
DET#4	NON
CAR1	AFC+PU
CAR2	NON
CAR3	NON
DET APC 1	APC(3Ch)
DET APC 2	NON
DET APC 3	NON
DET APC 4	NON
TEST RESULT	Not Good
- INJ1 Septum Counter -	
Threshold	100
Count value	0
Judgement	Good

Fig. 17.1.7

17.2 AOC Commands

When you press [Print] from the AOC screen, all items are printed as command names. The list below shows correspondence of command names to item names.
The setup values, such as "Fast" and "Yes/No" are printed as numbers. Correspondence of setup values to numbers is shown in the range and default columns in the list below.

■ Command list

Command name	Item	Range	Default
WRPT	Sample Wash	0–99	2
WMOD	Solvent Wash	0–99	1
REPT	Number of Injection	1–99	1
IVOL	Sample Size	0.1–8.0	1.0
WPRS	Pre solvent Wash	0–99	0
PUMP	Pumping	0–99	5
WTPP	Viscosity	0.0–99.9	0.2
WAIT	Dwell Time	0.0–99.9	0
ISPD	Inj. Speed (Plunger)	Slow: 0, Fast: 2	Fast: 2
SSPD	Inj. Speed (Syringe)	Slow: 0, Fast: 1	Fast: 1
SAND	Inj. Mode	0–4	0
SOLV	Solvent selection	All: 0, only A: 1, only B: 2, only C: 3	All: 0
SINT	Priority Sample No.	1)	0
*SSNO	Injected sample No. (Only this sample is analyzed.)	1)	0
*SNO2	Injected sample No. (for sub AOC)	1)	0
AAIR	Air Aspiration	No: 0, Yes: 1	No: 0
USPD	Plunger Aspiration Speed	Slow: 0, Middle : 1, Fast: 2	Fast: 2
DSPD	Speed of Plunger	Slow: 0, Middle : 1, Fast: 2	Fast: 2
HIGH	Syringe Height (↑)	0–20	0
LOWS	Syringe Height (↓)	1.5 ml vial: 0–2 4 ml vial: 0–10	0
INJH	Syringe Height (Inj)	0–22	0
STRI	Multi - Inj	1–99	1
*FSAM	Final sample No. (Samples after that are not analyzed.)	1)	0
*WKEY	Washing with solvent before injection in solvent flush mode	0, 1	0
*UVOL	Aspiration volume during pumping	8 μl: 0, 6 μl: 1	8 μl: 0
SLMD	Using 3 Solvent Vials	No: 0, Yes: 1	No: 0
VIAL	Vial size	1.5 ml: 0, 4 ml:1	1.5 ml: 0
*CKTR	With/without tray check	With: 0, Without: 1	Without: 0
*TANL	Analysis time	0–655	0
*TSTR	Analysis start time	0.0–99.9	0.0
LSYR	Syringe Volume	10 μl: 0, 50 μl: 1, 250 μl: 2	10 μl: 0

Command name	Item	Range	Default
SAMU	Use of the sampler	Not use: 0, Use: 1	Not use: 0
SUBU	Use of the sub AOC	Not use: 0, Use: 1	Not use: 0
BARC	Bar Code Reader	Not use: 0, Use: 1	Not use: 0
SPMD	Distribution of sample for dual AOC	0–8	0
PAR1	Use of Same Param	No: 0, Yes: 1	No: 0
*GLPM	Setting of validation mode	0, 1	0
*GRPT	Number of times of GLP sample discharge	1–99	50
*GVOL	GLP sample discharge volume	1–80	20
*GPMP	Number of times of pumping after second GLP	0–5	1
*ATSP	Automatic stop function	Off: 0, On: 1	On: 1
*ARSG	Ready signal polarity	Open: 0, Close: 1	Open: 0
TLET	Rack	Short: 0, Long: 1	Short: 0
TSEL	Rack position while sampler is used	0–2	1

1): Without autosampler, short rack: 1–6
Without autosampler, long rack: 1–12 (1–15 allowable with an additional rack)
With autosampler: 1–150 (maximum; for 1.5 ml vial)
1–96 (maximum; for 4 ml vial)
When an autosampler carousel, the allowable vial No. range depend on the vial rack type and the number of racks. A value of 0 (default) indicates no sample number to be set.

NOTE

- Command names marked with " * " cannot be set on the GC screen. Use the keys on the AOC-20i.
- The GC-2025 does not support dual-AOC configuration and cannot use the sub AOC commands.

17.3 Program Parameters

Press [Print] (PF menu) from a time program or Pre-Run program to print the program as event No. or parameter names.
This paragraph describes the parameter names and the display when a program stops.

■ Event No. (EVNT)

Refer to "17.4 Event No.".

■ Temperature

Heated zone names from a temperature program are printed with the parameter names shown below.

Column temperature	: CITP
INJ2	: AITP (Pre-Run program only)
DET1	: DETT
DET2	: AUXT

■ Detector range, polarity and current value

Detector range, polarity and the current value from a program are printed with the parameter names shown below.

Range of DET #1	: D1RG
Range of DET #2	: D2RG
Range of DET #3	: D3RG
Range of DET #4	: D4RG

■ Time program STOP and repetitions

When a time program STOP value is specified, it is printed with the four digits described below.

① $\underbrace{② \quad ③}$ ④

- Digit 1] value
  - 0: Continuous
    When a program finishes, the next program automatically starts without waiting for the start command.
  - 1: Pause at each run (AOC)
    When a program finishes, the GC waits for the start command.

- Digit 2] and 3] valves
  Number of times of run (00–99)
  "00" indicates 1 repetition.
  When both digits 2] and 3] are set to "0", nothing is printed but the number of repetition times is set to "1".

- Digit 4] value
  File No. to switch to after repetitious run is finished (0–9)
  In order to stop the program, input the current file No.

■ Pre-Run program (STRT)

Pre-Run program values are printed with numbers 0–4, described below.

0: Auto
1: Manual (Stop program)
2: GC start
3: AOC/HSS start
4: Clean up

17.4 Event No.

Many parameters are printed with event No. The list below shows the correspondence of event No. to functions.

■ Event No. list

No.	Meaning of "Event xx" (Example: Event 1)	Meaning of "Event-xx" (Example: Event -1)
0	Reverses contact status of Events 91 and 92.	Switches Events 91 and 92 to NC contact type (normal).
51	Performs zero adjustment of DET #1.	Frees zero adjustment of DET #1.
52	Performs zero adjustment of DET #2.	Frees zero adjustment of DET #2.
61	Turns on CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 1.	Turns off CAR1 gas saver. Returns split ratio to value of analysis parameter.
62	Turns on CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 2.	Turns off CAR1 gas saver. Returns split ratio to value of analysis parameter.
71	Ignites flame.	Extinguishes flame.
91	N/O contact between two contacts in one circuit	N/C contact between two contacts in one circuit
92	N/O contact between two contacts in one circuit	N/C contact between two contacts in one circuit
103	Closes CAR1 splitter control.	Opens CAR1 splitter control.
105	Turns On AC blower.	Turns Off AC blower.
106	Closes air (solenoid valve).	Opens air (solenoid valve).
107	Closes air (solenoid valve). (only in 17A mode)	Opens air (solenoid valve). (only in 17A mode)
109	Turns On AC CRG INJ.	Turns Off AC CRG INJ.
110	Turns On AC CRG Column.	Turns Off AC CRG Column.
111	Turns On AC Cooling Fan.	Turns Off AC Cooling Fan.
131	Turns On DET #1 detector controller.	Turns Off DET #1 detector controller.
132	Turns On DET #2 detector controller.	Turns Off DET #2 detector controller.
141	Turns On CAR1 carrier gas.	Turns Off CAR1 carrier gas.
142	Turns On CAR1 septum purge	Turns Off CAR1 septum purge.
147	Turns On DET #1 makeup gas.	Turns Off DET #1 makeup gas.
148	Turns On DET #1 H2.	Turns Off DET #1 H2.
149	Turns On DET #1 Air.	Turns Off DET #1 Air.
150	Turns On DET #2 makeup gas.	Turns Off DET #2 makeup gas.
151	Turns On DET #2 H2.	Turns Off DET #2 H2.
152	Turns On DET #2 Air.	Turns Off DET #2 Air.
161	Turns On CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 1. When GC becomes ready, split ratio returns to value of analysis parameter.	Turns Off CAR1 gas saver. Returns split ratio to value of analysis parameter.
162	Turns On CAR1 gas saver. Sets split ratio to value of CAR1 gas saver split ratio 2. When GC becomes ready, split ratio returns to value of analysis parameter.	Turns Off CAR1 gas saver. Returns split ratio to value of analysis parameter.

No.	Meaning of "Event xx" (Example: Event 1)	Meaning of "Event-xx" (Example: Event -1)
171	Turns On CAR1/CAR2/CAR3 high pressure injection mode.	Turns Off CAR1/CAR2/CAR3 high pressure injection mode. Returns column input pressure to value of analysis parameter.
181	Turns On APC1 flow controller.	Turns Off APC1 flow controller.
182	Turns On APC2 flow controller.	Turns Off APC2 flow controller.
183	Turns On APC3 flow controller.	Turns Off APC3 flow controller.
184	Turns On APC4 flow controller.	Turns Off APC4 flow controller.
185	Turns On APC5 flow controller.	Turns Off APC5 flow controller.
186	Turns On APC6 flow controller.	Turns Off APC6 flow controller.
187	Turns On APC7 flow controller.	Turns Off APC7 flow controller.
188	Turns On APC8 flow controller.	Turns Off APC8 flow controller.
189	Turns On APC9 flow controller.	Turns Off APC9 flow controller.
190	Turns On APC10 flow controller.	Turns Off APC10 flow controller.
191	Turns On APC11 flow controller.	Turns Off APC11 flow controller.
192	Turns On APC12 flow controller.	Turns Off APC12 flow controller.

18.1 Inspection and Maintenance Intervals

Periodical inspection and maintenance are required to maintain the gas chromatograph in good condition.
The recommended inspection interval for each part is described below. Refer to each section for details.

18.1.1 Glass insert

Inspect the glass insert before starting a series of analysis.
Take care of dirt and silica wool position and quantity.
An insert counter feature is available in the GC.
For details, refer to diagnosis parameters described in "14.1 Standard Diagnosis" as well as "14.3 Analysis Counter".

18.1.2 Septum

Replace the septum periodically to avoid carrier gas leakage.
The guideline for replacement is 100 injections. (50 injections for thick needles.)
A septum counter feature is available in the GC.
For details, refer to the diagnosis parameters list described in "14.1 Standard Diagnosis" as well as "14.3 Analysis Counter".

18.1.3 O-ring for glass insert

Replace the O-ring when replacing the glass insert or if there is a carrier gas leak.

18.1.4 Graphite ferrule

Replace the graphite ferrule if a carrier gas leak is not stopped by tightening.
Replace the ferrule if it is completely compressed.

18.1.5 Capillary column

Re-condition the column if it has not been used for a long time, if ghost peaks are present or if baseline noise is high.

18.1.6 Flow controller

Re-condition or replace the carrier gas molecular sieve filter if the baseline is unstable.
Every 6 months check the split flow line and the septum purge flow line traps and replace any saturated traps.

18.1.7 Hydrogen flame ionization detector (FID)

Rinse or replace the igniter and the jet if ignition is not smooth, if the flame often goes out during the analysis or no peaks are obtained.

18.1.8 Door switch

The GC-2025 is equipped with a built-in door switch to detect the open/close state of the oven door. Check the door switch before starting a sequence of analysis. If the instrument is used for a long time without turning the power OFF, inspect the door switch more often than once every 6 months.

18.1.9 Cleaning the unit

If the exterior unit surfaces become dirty, clean using a cloth with a neutral detergent.

18.2 Inspection and Maintenance: Septum

WARNING

Danger of burns.
DO NOT perform injection port maintenance until the tempelature of the injection on port has dropped below 5 °C.

NOTE
Wait until the injection port has cooled to loosen screws and nuts to prevent them from binding.

Repeated injections can deteriorate the septum, inerfering with its sealing ability and causing carrier gas leaks. This can cause retention time shifts and poor producibility. In addition, septum fragments can fall into the glass insert, causing ghost peaks. Periodically inspect and replace the septum as described in this section.

18.2.1 Inspection/maintenance cycle

The guideline for inspection/maintenance is 100 injections.
Replace the septum every 100 injections. (every 50 injections for thick needles ; ex. gas tight syringe)
In addition, perform inspection and maintenance in the following cases.

・When the retention time/shifts/reproducibility is poor
・When ghost peaks are detected

If ghost peaks are obtained although no septum fragments are found in the glass insert, ensure that new septa are conditioned properly.

18.2.2 Inspection/maintenance

■ Preparing the gas chromatograph

Select "Maint INJ" (PF menu) from the [SYSTEM] key main screen.
If the system is operating, press the [SYSTEM] key and select [Maint INJ] (PF menu). The temperature of the injection port and the column oven automatically drops, and the carrier gas stops when the temperature drops below 50 °C.
When the message "GC is ready for maintenance" appears on the screen, injection port inspection/maintenance can begin.
Remove the auto injector if it exists.
Lift up the entire INJ/DET cover, and remove it. Because the detector is hot when the flame is "On", use tweezers or pliers to handle the detector cover.

NOTE
For "Maint INJ", refer to "7 Starting and Stopping the GC [SYSTEM]".

■ Conditioning the septum

For high sensitivity analysis, impurities from the septum may be detected as ghost peaks. Condition the septum as described below.

(1) Soak the septum in hexane for 10 to 15 hours.
The septum will absorb hexane and swell into approximately twice its size. Therefore, use a container with a wide opening and a lid.

(2) Take out the septum, and put it into a rinse container.
Pay strict attention when handling a septum swollen with hexane because it can easily crumble.

(3) Let the septum air dry in a clean area.

(4) After drying, bake the septum at 130 to 150 °C for approximately 2 hours.

NOTE
Store the septum in a clean, sealed container to prevent contamination.

■ Inspection

When inspecting only the septum, remove the septum nut above the septum, take out the septum, then condition it or replace it with a new one.

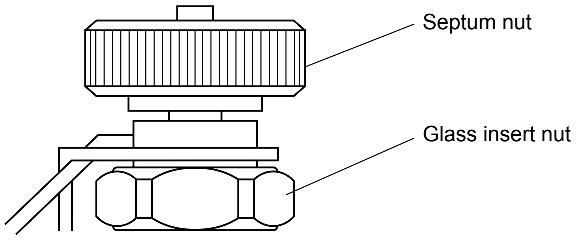


Fig. 18.2.1

NOTE
The septum nut marked with "P" is dedicated to the SPL for the GC-2010 Plus. DO NOT confuse these septum nuts with those for the GC-2025.

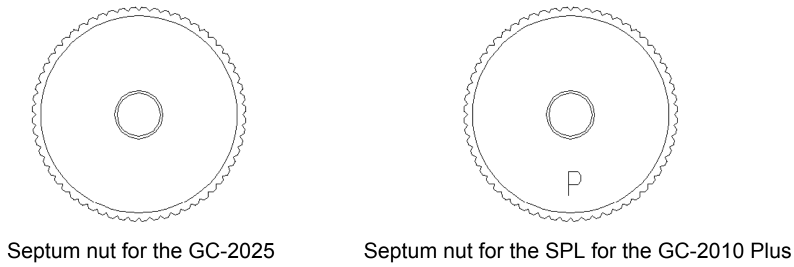


Fig. 18.2.2

■ Septum installation

Install the conditioned septum or a new septum using the following procedure.
When using an autosampler, tighten the septum nut by hand until it touches the nut below the screw, then loosen a half turn. When performing manual injections, you can extend the life of the septum and prevent the carrier gas leakage by tightening the septum nut by one thread after approximately 10 injections.

■ Restarting the gas chromatograph main body

Using tweezers, replace the derector cover, then the INJ/DET cover.
When starting up the GC again, select [Anal.] (PF menu). The GC automatically flows the carrier gas for 5 minutes, and then restores the temperatures set prior to maintenance.
When the STATUS indicator light turns green and the baseline becomes stable, you can start analysis.

18.3 Inspection and Maintenance: O-ring for Glass Insert

WARNING

Danger of burns.
DO NOT perform injection port maintenance until the temperature of the injection on port has dropped below 50 °C.

NOTE

- Wait until the injection port has cooled to loosen screws and nuts to prevent them from binding.
- For the details on handling the glass insert and O-ring, refer to "12 Injection Port".

18.3.1 Inspection/maintenance cycle

If a fluoride O-ring is installed to the glass insert and is used at the injection port temperature higher than 350 °C for a long time, the durability will be lowered. Check carrier gas leak every week. The fluoride O-ring can be used multiple times if there is no leak; however, it is recommended that it should be replaced at the same time with glass insert replacement.
Normally, rubber O-ring is used. If the rubber O-ring is used above 350 °C for an extended period, it deteriorates rapidly. Use a graphite ferrule on the glass insert in this case, although its sealing ability is inferior to the rubber type. Perform inspection and maintenance of the O-ring when the carrier gas leaks.
To stop leaks, tighten the glass insert nut. If the leak continues, inspect the O-ring and replace if necessary.

18.3.2 Inspection/maintenance

■ Preparing the gas chromatograph

Select "Maint INJ" (PF menu) from the [SYSTEM] key main screen.
If the system is operating, press the [SYSTEM] key and select [Maint INJ] (PF menu). The temperature of the injection port and the column oven automatically drops, and the carrier gas stops when the temperature drops below 51 °C.
When the message "GC is ready for maintenance" appears on the screen, injection port inspection/maintenance can begin.
Remove the auto injection if it exists.
Lift up the entire INJ/DET cover, and remove it. Because the detector is hot, use tweezers or pliers to handle the detector cover.

NOTE

For "Maint INJ", refer to "7 Starting and Stopping the GC [SYSTEM]".

■ Replacing the O-ring

Take out the glass insert, remove the O-ring, and install a new O-ring.

NOTE

Refer to "18.4 Inspection and Maintenance: Glass Insert" to remove and install the glass insert.

Place the fluoride rubber O-ring approximately 4 mm from the top of the glass insert. When inserting the glass insert in the injection port, push the glass insert in until the glass insert touches the bottom of the injection port. This correctly places the O-ring 3 mm from the top of the glass insert.

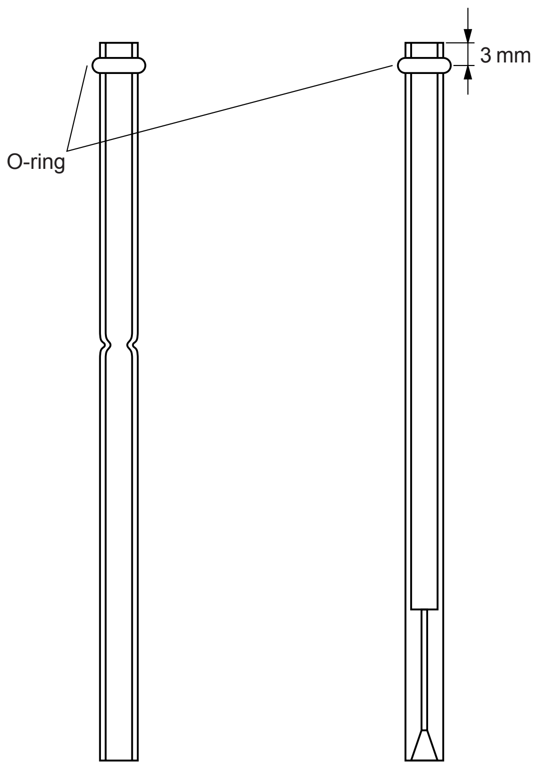


Fig. 18.3.1 Attaching graphite and fluoride rubber O-ring

■ Leak check

A leak will affect reproduceability and carrier gas will be wasted.

Confirm whether there is a leak or not according to the following procedure:
(As for the following procedure, there could be cases in which the error message "purge leaks" etc. appears. However, it does not matter for the test. Simply, select "Reset Error".)

(1) Set the "Flow Control" to "Cont" on the screen after pressing [SYSTEM] key.
(2) Push the [Stop GC] (PF menu), and the system stops.
(3) Wait that all oven temperature, injection port temperature and detector temperature is below 40 degrees on the screen after pressing the [MONIT] key.
(4) Push the [On/Off] (PF menu) on the screen after pressing the [FLOW] key, and the control of AFC stops.
Set the purge flow rate to "0 ml/min".

(5) Remove the capillary column, and blank off with a column nut and the graphite ferrules with a wire.
(6) Install the blind (G-type blank nut) to the split vent and purge vent port.
(7) Make sure that the supply pressure to the carrier gas (the pressure from a gas cylinder) is above 300 kPa.
(8) Set the "Split mode" to "DIRECT" and "Control mode" to "PRESS" on the screen of the after pressing the [FLOW] key.
(9) Set the inlet pressure to 150 kPa. Push the [On/Off] (PF menu), and the control of AFC starts.
(10) Wait for five minutes. Confirm that the inlet pressure is 125 ~ 175 kPa. If the inlet pressure is above 175 kPa, unfasten the column nut a little and release the pressure.
If the inlet pressure is below 125 kPa, raise the supply pressure a little.
(11) Confirm that the total flow is below 2 ml/min. If the total flow is above 2 ml/min, then there is a leak somewhere.
(12) Push the [On/Off] (PF menu) on the screen of the [FLOW] key, and the control of AFC starts.
(13) Verify that the pressure does not drop more than 15 kPa in one hour. If the pressure drops more than 15 kPa, a leak exists. It is possible to verify that pressure does not drop more than 2.5 kPa in 10 minutes.
(14) When the leak check has passed set the system back into operating status.

■ Possible leak positions

In case the leak check conditions has failed check the following items on the GC for possible leaks:
Septum injection inlet, around the injection port, the connection of piping, split vent (around the blind plug), purge vent (around the blind plug) and the connection of column with a leak detector or snoop.
In case you have localized a leak in one of the above positions do the following according to the leak localization:

- Septum injection inlet : replace septum.
- Around the injection port : replace O-ring of glass insert.
- Split vent : replace blind plug seal.
- Purge bent : replace blind plug seal.
- Connection of column : replace graphite ferrules and column nut.

⚠ CAUTION

When Snoop or a similar leak detection fluid is used, be careful not to splash it on any electric wiring or detector. This could cause an electric shock.

NOTE

- NEVER use the leak detection fluid or soapy water for the connection above the carrier gas controller (AFC) and the detector gas controller (APC). Dripping may damage the controller.
- When using snoop liquid for detecting leaks there is always a possibility that a part of the liquid enters into the pipings which in case of trace analysis can give ghost peaks which may interfere with your peaks of interest. Then it is recommended to use a leak detector instead.

18.4 Inspection and Maintenance: Glass Insert

WARNING

Danger of burns.
DO NOT perform injection port maintenance until the tempelature of the injection on port has dropped below 50 °C.

NOTE

- Wait until the injection port has cooled to loosen screws and nuts to prevent them from binding.
- For the details of handling of the glass insert, refer to "12 Injection Port".

18.4.1 Inspection/maintenance cycle

Inspect the glass insert before starting a series of analysis.
In addition, inspect and maintain the glass insert if the following problems occur.
・If the retention time shifts or reproducibility is poor.
・If ghost peaks are detected.
When the problems above occur, the silica wool may have moved, or become dirty, or the glass insert could be dirty.

18.4.2 Inspection/maintenance

■ Preparing the gas chromatograph

Select "Maint INJ" (PF menu) from the [SYSTEM] key main screen.
If the system is operating, press the [SYSTEM] key and select [Maint INJ] (PF menu). The temperature of the injection port and the column oven automatically drops, and the carrier gas stops when the temperature drops below 51 °C.
When the message "GC is ready for maintenance" appears on the screen, injection port inspection/maintenance can begin.
Remove the auto injector if it exists.
Lift up the entire INJ/DET cover, and remove it. Because the detector is hot, use tweezers or pliers to handle the detector cover.

NOTE

For "Maint INJ", refer to "7 Starting and Stopping the GC [SYSTEM]".

■ Removing the glass insert

Remove the glass insert using the following procedure.
Loosen and remove the glass insert nut while holding the septum nut. Remove the septum nut assembly by lifting it straight up and moving it to the side.
The glass insert could break if the septum nut assembly is not lifted straight up.

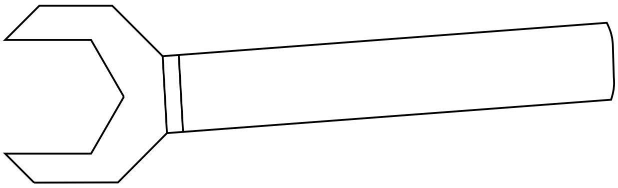


Fig. 18.4.1 Tool: Glass insert wrench, standard accessory Part No. 221-46977

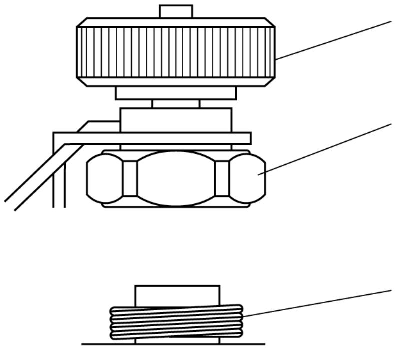


Fig. 18.4.2

(2) Use tweezers to lift the glass insert out of the injection port.

NOTE
If the O-ring has become fixed, turn the O-ring using tweezers and then lift the glass insert. DO NOT forcibly lift the glass insert with the O-ring fixed because it may break the glass.

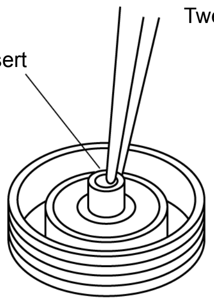


Fig. 18.4.3

■ Cleaning the glass insert

NOTE
Remove the O-ring before rising the glass insert with solvent. After cleaning, use a new O-ring.

(1) Removing the silica wool.
Septum fragments and other contaminants on the silica wool affect reproducibility. Ghost peaks may also be present.
Push the silica wool out using a long thin wire.

WARNING

When using reagents such as organic solvents or acids, work in a well-ventilated area using a draft chamber or other ventilation equipment.
Wear protective clothing, such as goggles, gloves, and a lab coat.
If reagents get onto the skin or in the eyes, flush with copious amounts of water and consult a medical professional.

(2) Removing particles from the glass insert
After removing the silica wool, rinse the interior of the insert by wiping with gauze soaked in solvent (such as acetone), etc. or soak the insert in organic solvent and clean with an ultrasonic cleaning unit.

(3) If the the glass insert is extremely dirty
If particles and stains cannot be removed, soak the glass insert in an aqueous solution of alkaline detergent for glass for approximately 1 day; rinse the insert with large amounts of water, then, rinse it with organic solvent such as acetone, and let it air dry.
If the glass insert still cannot be cleaned, you can soak it in an aqueous solution of 1 N nitric acid for 7 to 8 hours, then wash, rinse and air dry as described above.

■ Silica wool packing

To repack the silica wool in the glass insert, see "12.2 Glass Insert and Packing Requirements".

18.5 Inspection and Maintenance: Graphite Ferrule

WARNING

Risk of burns.
DO NOT perform maintenance until the temperature of the injection port, detector, and oven have dropped below 50 °C.

NOTE

- Wait until the heated zones have cooled to loosen screws and nuts to present them from binding.
- For the details on handling of the graphite ferrule, refer to "4 Installing the Column".

18.5.1 Inspection/maintenance cycle

A graphite ferrule is used at both ends of the capillary column.
In the following situations, inspect or replace the graphite ferrule.
- When a new graphite ferrule is being installed.
- When ghost peaks are detected during temperature increase.
- When the baseline drifts significantly during temperature increase.

18.5.2 Inspection/maintenance

■ Troubleshooting

(1) Check for carrier gas leaks
Deteriorating ferrules can cause carrier gas leaks and poor reproducibility.
Check the gap between the back ring and the side ring of the graphite ferrule. If it is in poor condition, replace it with a new graphite ferrule.

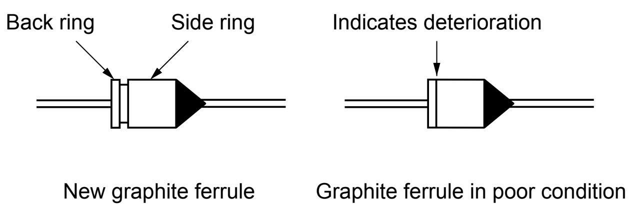


Fig. 18.5.1 Graphite ferrule

(2) Check for the source of contamination.
Ghost peaks can be caused by a poorly made column inlet connection.
Baseline drift can be caused by a poor connection at the column outlet (provided the column has been sufficiently conditioned).
If a contaminated graphite ferrule is causing problems, condition the graphite ferrule using the procedure described below.

■ Preparing the gas chromatograph

If the system is operating, press the [SYSTEM] key and select [Stop GC] (PF menu). The temperature of the injection port, the column oven and detector automatically decrease.
Press the [MONIT] key, and ensure that the temperature of the injection port, the detector and the column oven are 50 °C or less.
Press the [FLOW] key, and select [Off] (PF menu). The injection port/detector inspection/ maintenance can begin.

■ Conditioning the graphite ferrule

If a contaminated graphite ferrule is causing problems, condition the graphite ferrule using this procedure.
Condition the graphite ferrule just before using the system if possible. Otherwise, the ferrule may become re-contaminated.
Hold the graphite ferrule in the blue flame of a gas burner for 1 to 2 seconds until it becomes red hot.

> **⚠ CAUTION**
>
> RISK OF BURNS
> Support the graphite ferrule with a tool having a heat-resisting handle such as long nose pliers.

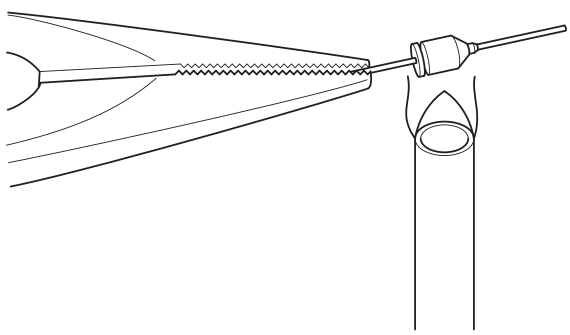


Fig. 18.5.2 Conditioning the graphite ferrule

18.6 Inspection and Maintenance: Capillary Column

⚠ WARNING

Risk of burns. DO NOT perform maintenance until the temperature of the injection port, detecor, and oven have dropped below 50 °C

NOTE
For the details on removing the capillary column, refer to "4 Installing the Column".

18.6.1 Inspection/maintenance cycle

In the following situations, inspect and/or maintain the capillary column.
- When using a new column or a column which has not been used for a long time
- When ghost peaks are detected
- When the baseline is unstable
- When the baseline noise is high

18.6.2 Inspection/maintenance

■ Troubleshooting

Check whether the baseline is unstable or ghost peaks are present.
A contaminated column can cause an unstable baseline or ghost peaks. If these problems occur, the column should be conditioned.

■ Preparing the gas chromatograph main body

If the system is operating, press the [SYSTEM] key and select [Stop GC] (PF menu). The temperature of the injection port, the column oven and detector automatically decrease.
Press the [MONIT] key, and ensure that the temperature of the injection port, the detector and the column are below 50 °C
Press the [FLOW] key, and select [Off] (PF menu). The inspection/maintenance can then begin.

NOTE
For the details on handling the capillary column, refer to "4 Installing the Column".

■ Conditioning the capillary column

Condition the capillary column using the following procedure.

(1) Setting the carrier gas
To condition the column, use the analysis flow rate. However, reduce the split ratio to conserve carrier gas.

(2) Setting the column oven temperature
Set the column oven to a temperature approximately 30 °C higher than the column operating temperature during analyses.
Do not exceed the maximum column temperature limit.

(3) Setting the injection port temperature and the detector temperature
Use the same temperatures normally set for analyses.
Set the detector to a temperature approximately 30 °C higher than the column operating temperature.

(4) Conditioning time
Generally condition the column for 2 to 3 hours usually.
If the column is considerably contaminated, increase the conditioning time.
The condition time should be less than 24 hours to avoid unnecessary damage to the column.

NOTE

Certain column liquid phases can be easily damaged.

Verify the maximum column temperatures limit before use and conditioning. High temperatures can damage the column, particularly if oxygen is present in the columns. If oxygen concentration in the carrier gas is high, the column liquid phase will be damaged badly. In such a case, the use of an oxygen trap can reduce the damage.

18.7 Inspection and Maintenance: Flow Controller

Three areas in the flow controller should be inspected: the molecular sieve filter and two traps (PURGE and SPLIT) in case of split/speitless.

Part name	Part No.	Reference No.
Molecular sieve filter	221-34121-94	①
Trap (PURGE)	221-42559-92	②
Trap (SPLIT)	221-42559-92	③

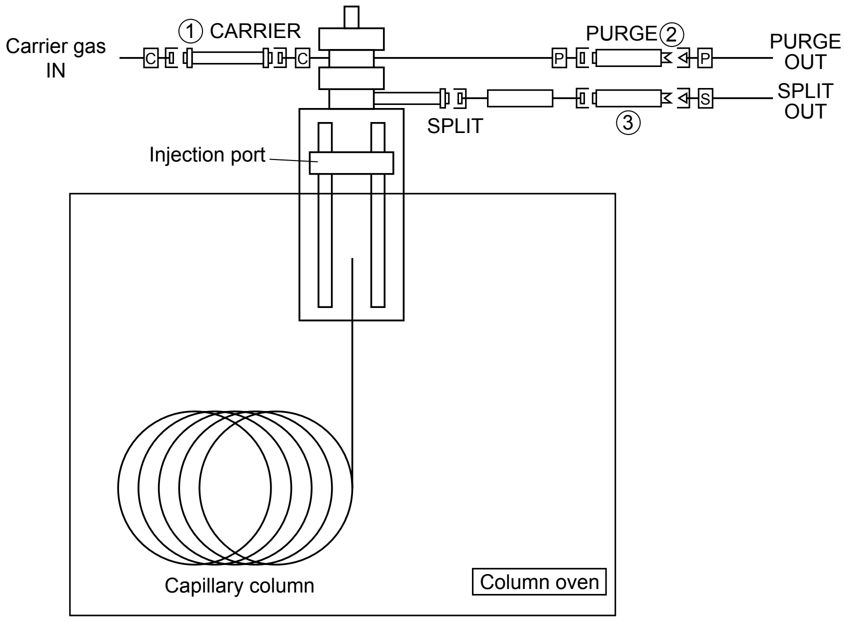


Fig. 18.7.1 Filter locations (split/splitless)

18.7.1 Inspection/maintenance cycle

Replace the purge and split vent traps periodically. The guideline for replacement is usually 6 months. However, when analyzing many samples with high boiling point compounds, or compounds which are solid at room temperature, you should replace the traps more frequently.

Additionally, in the following cases, you should inspect and maintain the filter and the traps.

- When the baseline is unstable or there is significant noise.
  These problems often occur when the molecular sieve filter is saturated. Replace or regenerate it.
- The replacement cycle of each trap is 6 months. However, if the traps is clogged, replace it. The following section describes how to decide whether a trap is clogged or not.

18.7.2 Inspection/maintenance

■ Trap inspection

The procedure below describes how to inspect the trap when capillary column is used. (The procedure for wide bore columns is described in parentheses.)

Internal diameter

Capillary column: ≦ 0.32 mm
Wide bore column: ≧ 0.45 mm

(1) Set the purge flow rate to "0". For the procedure, refer to "12.5.7 Septum purge".
(2) Leave the column installed. (For wide bore columns, disconnect the column at the injection port only, and attach a column nut and a graphite ferrule with a wire to the injection port.)
(3) Set the Split mode to "SPL".
(4) Set the column inlet pressure and the total flow rate to the following values.
Column inlet pressure (PRSS) = 0 (kPa)
Total flow rate (FLOW) = 400 (ml/min)
For details, refer to "8 Setting the Analytical Parameters and File Management".
(5) Monitor the column inlet pressure. If the measured value is 50 kPa or more, replace the trap (SPLIT).
(6) When replacing the split vent trap, replace the purge vent trap also.

■ Trap replacement

Perform the following procedure to replace the trap.

(1) Stop the carrier gas flow.
(2) Remove the panel from the INJ/DET unit.
(3) To prevent confusion, replace one trap at a time.
(4) Disconnect the blank nuts from a new trap.
These blank nuts are sealed the trap.
(5) Install the new trap.
The tubing codes indicate they should be used to filter the following flow lines.
S ... Split flow line
P ... Septum purge flow line
C ... Carrier gas inlet flow line

■ Molecular sieve filter regeneration

Regenerate the molecular sieve filter using the following procedure.

(1) Stop the carrier gas flow.
(2) Remove the panel from the INJ/DET unit.
(3) Remove the molecular sieve filter.
(4) Regenerate the molecular sieve filter under the following conditions.
Nitrogen or helium gas flow direction ... Reverse of operation direction
Gas flow rate ... 10 to 20 ml/min
Temperature ... 300 °C
Time ... 3 to 4 hours
(5) After regeneration, immediately reinstall the molecular sieve filter into the gas chromatograph so that it does not become contaminated.

■ Joint connection

There are two types connections in the Gas Chromatograph: Type M and Type G. Type M connections are located at the main tubing connections in the instrument interior and exterior. The metal fittings contact directly.

Type G connectors, which are used in high temperature areas, are connected by tightening three to five aluminum gaskets between the fittings.

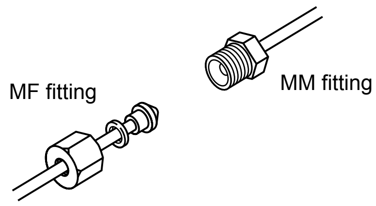


Fig. 18.7.2 Joining Type M fittings

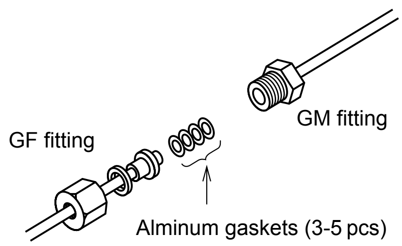


Fig. 18.7.3 Joining Type G fittings

Tightening the tubing connections

Tools

2 wrenches 10×12 (standard accessory)

Use the 12 mm wrench for Type M connections and the 10 mm wrench for type G connections.

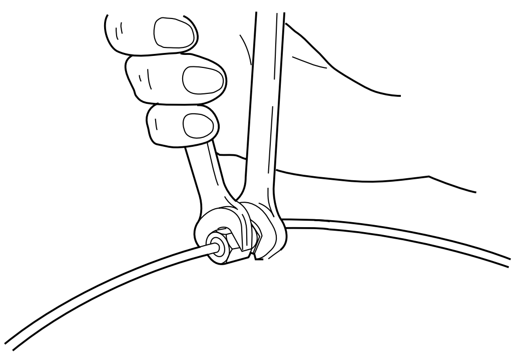


Fig. 18.7.4 Tightening the joints

■ Checking for gas leaks

After plumbing the unit, check for gas leaks according to the following guidelines.

(1) Open the main valve of the gas cylinder.
(2) Adjust the gas supply to the specified pressures.
(3) Check for leaks with leak detecting fluid (option) or soapy water on all connections. Bubbles can be observed if a leak exists.
(4) If a leak is detected:
- Further tighten the connection, or retighten it.
- Replace the seal material.

(5) Wipe off the leak detecting fluid or soapy water using a wet cloth.
Electronic leak detectors can also be used for hydrogen and helium leaks.

<Option> "Snoop" Gas leak detecting fluid (P/N 670-11514)

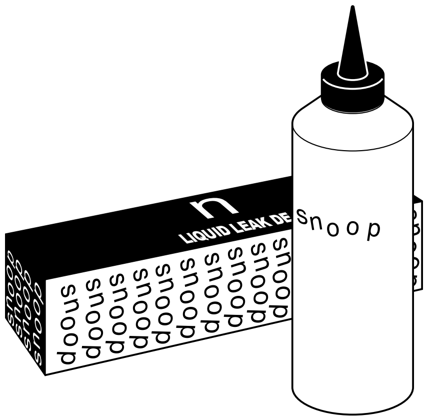


Fig. 18.7.5 Leak detecting fluid

NOTE

DO NOT use the leak detecting fluid or soapy water for gas leak check on the connections above the carrier and detector gas controllers (AFC/APC). The drips may damage the controller.

18.8 Inspection and Maintenance: FID

WARNING

Verify that the following items have been checked before starting FID inspection/maintenance.
1.Stop the supply of hydrogen gas, and extinguish the hydrogen flame.
2. Set the detector temperature to 50 °C or less.
3. Turn off the power of the FID.
4. Remove the capillary column from the FID.
Risk of burns. DO NOT perforem maintenance until the temperature has dropped below 50 °C

NOTE
- When the FID is hot, DO NOT loosen screws and nuts or move parts to prevent binding.
- For correct FID handling procedures, refer to "13 Detector".

18.8.1 Inspection/maintenance cycle

When the following problems occur, inspect the FID and perform maintenance if necessary.
・When the FID cannot be ignited
・When peaks are not detected.
・When noise is high
・When the peak shape is abnormal

18.8.2 Inspection/maintenance

18.8.2.1 Igniter

■ Troubleshooting

Check for blown filaments.
Replace the igniter with a new one, if the filament is blown.

■ Removing and installing the igniter

Loosen the igniter mounting screw shown in Fig. 18.8.1, and pull out the igniter in the direction indicated by arrow.
When replacing the igniter, detach the cables at the connection.
Install a new igniter by connecting the cable, insert the igniter, and tighten the screw.

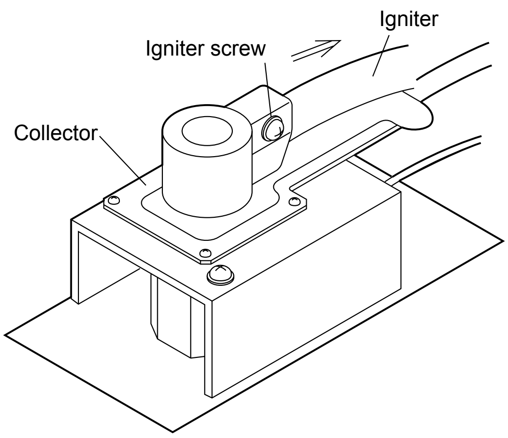


Fig. 18.8.1

18.8.2.2 FID jet

■ Troubleshooting

(1) Checking whether the jet is clogged
If the jet is clogged, ignition may be difficult or peaks may not be detected.
If the tip of the jet is clogged, clean the jet by inserting a slender, long wire into the tip.

(2) Checking whether the jet is dirty
If the jet is dirty, noise may be significant.
If the jet is dirty, wipe off dirt with a cotton swab soaked in organic solvent (such as acetone), etc.

(3) Checking whether the jet is damaged
If the jet is damaged, the peak shape may be abnormal.
Replace the jet.

NOTE
The quartz FID jet can be broken easily. Treat it gently.

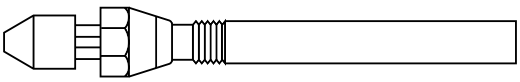


Fig. 18.8.2

Check the type of Jet, because there are some different types of jets.

■ Preparing the gas chromatograph

If the system is operating, press the [SYSTEM] key and select [Stop GC] (PF menu). The temperature of the injection port, the column oven and detector automatically decreases.
Press the [MONIT] key, and ensure that the temperature of the injection port, the detector and the column oven has dropped below 50 °C.
Press the [FLOW] key, and select [Off] (PF menu). The inspection/maintenance can begin.

■ Removing the FID

Remove the FID parts using the following procedure.

(1) Removing the igniter and the FID collector
The igniter is integrated into the FID collector. Remove them together. Loosen and remove the two collector screws. Lift the collector and its screws up at the same time.

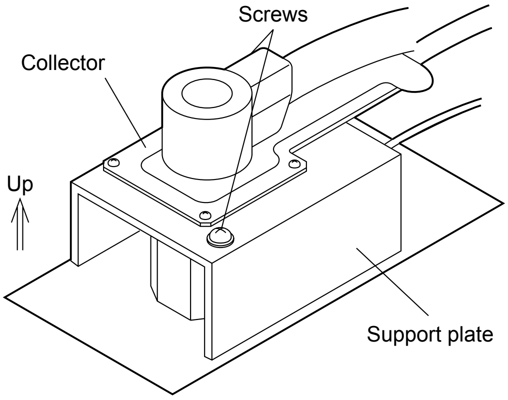


Fig. 18.8.3 Removing igniter and FID collector

(2) Removing the FID high voltage unit
① Lift the high voltage plate up.
② Then pull the high voltage cable and its spring out horizontally as shown in Fig. 18.8.4.

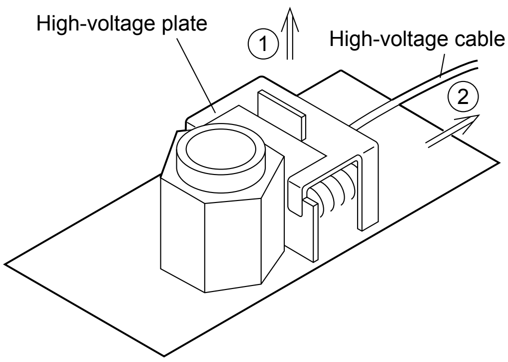


Fig. 18.8.4 Removing the FID high voltage unit

■ Removing the FID jet

Remove the FID jet using a hexnut screwdriver.

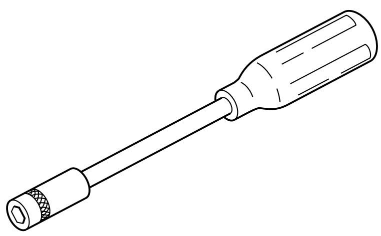


Fig. 18.8.5 Hexnut screwdriver (option, part No. 670-18800)

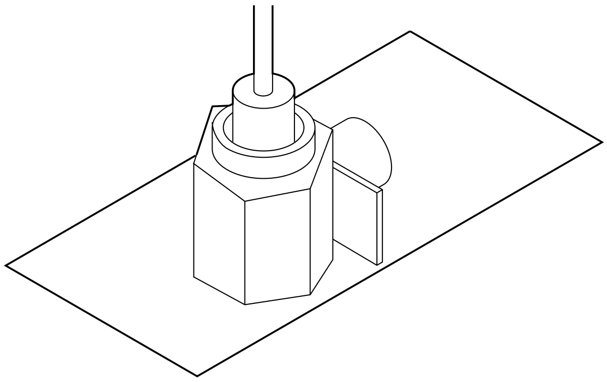


Fig. 18.8.6 Removing the FID jet

■ Installing the FID jet

Tighten the FID jet securely using a hexnut screwdriver

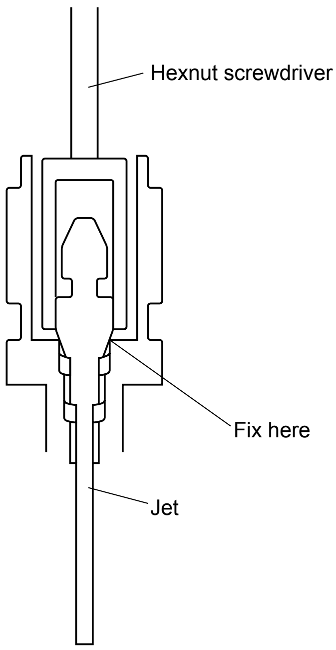


Fig. 18.8.7 Installing FID jet

Reinstall other parts in reverse order.

18.9 Inspection: Door Switch

WARNING

Inspect the door switch when the column oven temperature is lowered to 50 °C or below.
RISK OF BURNS - DO NOT attempt to carry out maintenance while the component is hot.

18.9.1 Inspection intervals

Before placing the instrument in the [SYSTEM On] status after power-up or when it is placed in the [SYSTEM Off] status for maintenance or inspection, check the door switch. If the instrument is used for a long time without turning the power OFF, place the instrument in the [SYSTEM Off] status and inspect the door switch at least once every 6 months.

18.9.2 Inspection procedures

■ Troubleshooting

The GC-2025 is equipped with a built-in door switch to detect the open/close state of the oven door.
If the door is opened with column oven temperature control disabled, such as during column replacement, an alarm beep sounds and the message "Oven door is opened" appears.

■ Preparing the gas chromatograph

If the system is operating, press the [SYSTEM] key and select [Stop GC] (PF menu). The temperature of the injection port, the column oven and the detector automatically decreases. Press the [MONIT] key, and ensure that the temperature of the injection port, the detector and the column oven has dropped below 50 °C. Press the [FLOW] key, and select [Off] (PF menu). The inspection can begin.

■ Door switch inspection

(1) Open the oven door in the [SYSTEM Off] status.
(2) If an alarm beep sounds and the message "Oven door is opened" appears, the door switch is working properly.

■ Action to take if the message is not displayed

If the message "Oven door is opened" is not displayed when the oven door is opened with column oven temperature control disabled, the door switch may have failed. Since the switch needs repair, contact your Shimadzu representative.

WARNING

When the door switch is not working properly, the power to the heater cannot be shut off immediately even if the oven door is opened with temperature control enabled. This could cause hot air to blow out from the oven, resulting in burns or ignition of any surrounding flammable materials.

19.1 Troubleshooting

This section describes possible problems, causes and solutions. They are divided by analytical procedure.
If the problem is not solved by following the recommended solutions, or if other problems occur, contact your Shimadzu representative.

19.1.1 Gas and pressure settings

19.1.1.1 When the pressure/flow rate cannot be set or does not attain the set value

Possible Cause	Solution
No gas is supplied.	Open gas cylinder main valve to supply gas.
Supply pressure is low.	Set carrier gas supply pressure to 300 to 980 kPa. Hydrogen: 300 to 500 kPa Air: 300 to 500 kPa Makeup gas: 300 to 980 kPa
Gas leaks	Check for gas leaks, and tighten leaking connections. Replace gasket or septum. (Refer to "1.3.11 Gas type and supply purity" in the Instruction Manual.)
The injection port or detector is not selected for the analytical flow line.	Select the unit for the line correctly. (See "8.3 Specifying the Analytical Flow Line Components ([Line Config])".)
AFC/APC: Incorrect valve set. Set value is outside controllable range.	Set pressure to proper value. (Refer to "21 AFC, APC" in the Instruction Manual.)
Carrier gas type, column length, inner diameter and film thickness are incorrect.	Set carrier gas type, column length, inner diameter and film thickness correctly. (Refer to "12.5.2" and "12.5.3 Setting column parameters" in the Instruction Manual.)
Total flow rate is set too low, and pressure cannot increase. (In this case, measured flow rate of split vent is extremely low.)	Increase the total flow rate. (Refer to "21 AFC, APC" in the Instruction Manual.)
Split vent trap is clogged. (Even if total flow rate is set high, the measured flow rate from the split vent is low and the pressure is high.)	Replace trap. (Refer to "18.7 Inspection and Maintenance: Flow Controller")
Response of the sensor located inside the AFC or APC changes over time.	Carry out offset calibration. (See "21.6 AFC and APC Offset Calibration".)

19.1.1.2 Continual gas leaks

Possible Cause	Solution
Part is incorrectly installed.	Install part correctly. (Refer to "1.3.11 Gas type and supply purity" in the Instruction Manual.)
Graphite ferrule or other seal is damaged.	Replace damaged gasket part with a new one.

If tubing or connections are damaged, replace them.
If the problem can not be solved, contact your Shimadzu representative.

19.1.2 Temperature control

19.1.2.1 When the temperature does not increase or reach the set value

Possible Cause	Solution
GC has not started yet. (Press [SYSTEM] key to display GC startup procedure screen.)	Press [SYSTEM] key, and press [Start GC] (PF menu).
Heater control is set to "Off"	Set control to "On" on COL/INJ/DET setup screen.
Because start time is set to a high value (or "9999"), heating has not started yet.	Set start time to a lower value. (Note: Immediately after this setup value is changed, the new value is in effect.)
The injection port or detector is not selected for the analytical flow line.	Select the unit for the line correctly. (See "8.3 Specifying the Analytical Flow Line Components ([Line Config])".)
Heat loss is being caused by an open oven door or insulation out of place.	Close the oven door. Replace the insulation.
Because maximum temperature is set to a very low value, an overheat error has occurred.	Increase the maximum temperature setting. (See "16.6.4 Setting the maximum temperature limits".)
Because DET actual temperature is lower than the set value of COL temperature. (According to keep the detector clean, column oven temperature can not exceed DET actual temperature.)	Set DET temperature larger than COL temperature.

Only an oven with the CRG option can attain a temperature below room temperature. The lower temperature setting may cause an error if the CRG option is removed or turned off. Change the temperature setting.

19.1.3 Detector

19.1.3.1 FID

1. The FID flame does not ignite properly

Possible Cause	Solution
Column is not connected.	Connect the column.
Hydrogen gas is not supplied or its flow rate is incorrect.	Supply hydrogen gas, or set its flow rate to a proper value.
Hydrogen gas has not been flowing long enough to replace the air in the tubing.	Wait for 30 to 60 minutes to allow the air to be completely replaced with hydrogen.
Air is not supplied or its flow rate is incorrect.	Supply air, or set its flow rate to a proper value.

Refer to "18.8 Inspection and Maintenance: FID", and inspect the FID.
If a jet is clogged, clean or replace it.
A defective Igniter filament must be replaced.

WARNING

If the FID ignition has failed, shut off the hydrogen gas supply immediately and inspect the FID.

2. The FID baseline is fluctuating

Possible Cause	Solution
Carrier gas leaks.	Tighten leaking connections. Replace tubing or septum. (Refer to "1.3.11 Gas type and supply purity" in Instruction Manual.)
Carrier gas or makeup gas quality is poor.	Replace gas with higher purity gas. Provide a molecular sieve filter in the gas flow line.
Molecular sieve filter is saturated.	Recondition the molecular sieve filter. (Refer to "18.7 Inspection and Maintenance: Flow Controller" in Instruction Manual.)
Injection port is contaminated. Column is contaminated.	Inspect the glass insert. Clean or replace the glass insert. (Refer to "18.4 Inspection and Maintenance: Glass Insert" in Instruction Manual.) Re-condition the column.
Compressed air is contaminated (the baseline fluctuates according to the compressor pressure).	Install a silica gel trap on either end of the pressure regulator. Use air from a gas cylinder instead (with the FID on).
Hydrogen gas has not been flowing long enough to replace the air in the tubing.	Wait for 30 to 60 minutes to allow the air to be completely replaced with hydrogen.
Room temperature is not within the recommended range and/or is fluctuating considerably.	Keep the room temperature within the recommended range and move the system away from heat or A/C vents, etc.

3. Baseline noise is high

Possible Cause	Solution
Carrier gas quality is poor.	Replace carrier gas with higher purity gas. Provide a molecular sieve filter in the carrier gas flow line.
Hydrogen gas quality is poor.	Replace hydrogen gas with higher purity gas.
Gas leaks	Check the leak in injection port and column connection area. Tighten leaking connectors.
The quartz jet is dirty.	Inspect, clean, or replace the jet.

If the jet is damaged, replace it. If the collector is coated with white powder, contact your Shimadzu representative for replacement.

19.1.4 Chromatogram and data

19.1.4.1 No peaks or extremely small peaks

Peaks may not be able to be detected because of high noise.
Refer to 19.1.3.1.3 and 19.1.3.2.3, "baseline noise is high."

Possible Cause	Solution
Carrier gas is not flowing.	Start carrier gas flow.
Carrier gas leaks.	Tighten leaking connectors.
Split ratio is too high (for split analysis).	Reduce split ratio.
Sample concentration is low. Or injection volume is too low.	Increase sample concentration or injection volume.
Wrong column is used.	Replace existing column with one appropriate for the compounds analyzed (more polar, less polar, etc.)
Column temperature is too low.	Increase column temperature.
Signal cable of detector is connected incorrectly.	Connect signal cable correctly.
Detector is set to "Off".	Set detector to "On".
Detector parameter have been is set incorrectly.	Increase range and attenuation sensitivity.
Hydrogen flame is extinguished.	Check hydrogen/air flow rate, then ignite.
Zero level far below "0".	Press "MONIT" key then press "ZERO Adj" (PF menu) to execute zero point adjustment.
Another analytical condition, such as temperature or column flow rate is incorrect.	Change the analytical conditions.

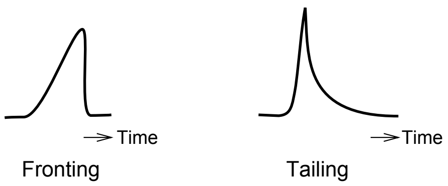
If the jet or the cable is damaged, contact your Simadzu representative for replacement.

19.1.4.2 Presence of ghost peaks

Possible Cause	Solution
Septum purge is not flowing.	Flow septum purge.
Peaks which did not elute during previous analysis is detected.	Increase column oven temperature to maximum temperature in analysis to eliminate sample remaining inside column.
Sample is contaminated.	Prepare sample newly.
Micro syringe is dirty.	Clean micro syringe. Or replace it with a new one.
Carrier gas purity is low.	Replace carrier gas with one of higher purity. Provide molecular sieve filter in carrier gas flow line.
Substances of high boiling point accumulated at column inlet end are flowing out.	Re-condition column. Clip the injection port end of the column.
Injection port is dirty.	Clean or replace glass insert. (Refer to "18.4 Inspection and Maintenance: Glass Insert" in Instruction Manual.)
Tubing, pressure regulator, etc. are contaminated with oil, etc.	Replace tubing, pressure regulator, etc. with clean ones.
Septum chips are present inside glass insert or column.	Clean or replace glass insert. Fold tip of capillary column, and remove folded portion.

19.1.4.3 Abnormal peak shape

Fronting (leading) : The peak increases slowly. The first half peak area is higher.
Tailing : Once the peak has eluted, the baseline does not immediately return to its zero level. The second half peak area is higher.



Possible Cause	Solution
Fronting: the column Column is overloaded.	Dilute sample. Decrease injection volume, or increase split ratio. Use a column with a greater film thickness.
Peaks are co-eluting	Change an analysis condition. Replace column to obtain better separation.
Tailing, fronting Injection port temperature is low.	Increase injection port temperature.
Tailing Column is contaminated.	Re-condition column. (Refer to "18.6 Inspection and Maintenance: Capillary Column" in Instruction Manual.)
Tailing Glass insert is damaged.	Replace glass insert. (Refer to "18.4 Inspection and Maintenance: Glass Insert" in Instruction Manual.)
Tailing Septum purge is not flowing or is too low.	Verify septum purge flow. Increase septum purge flow rate. (Refer to "21 AFC, APC" in Instruction Manual.)
Tailing Septum fragments are present inside glass insert or column.	Clean or replace glass insert. Clip the injection port end of the column.

19.1.4.4 Poor retention time reproducibility

Possible Cause	Solution
The carrier gas cylinder is almost empty.	Replace the gas cylinder with one of at least 3 MPa pressure.
Carrier gas flow rate is fluctuating due to a gas leak.	Tighten leaking connections. Replace tubing or septum.
Column is overloaded.	Decrease sample size. Dilute sample. Increase split ratio. Use a column with a thicker film.
Room temperature is not within the recommended range or is fluctuating considerably.	Keep the room temperature within the recommended range or reduce temperature fluctuations.
Syringe tip is clogged, and sample is not properly injected.	Clean or replace syringe.

If the gas supply pressure is fluctuating due to failure of the gas cylinder pressure regulator, repair or replace it. Contact your Shimadzu representative.

19.1.4.5 Poor peek area reproducibility

Possible Cause	Solution
The carrier gas cylinder is almost empty.	Replace the gas cylinder with one of at least 3 MPa pressure.
Carrier gas flow rate is fluctuating due to a gas leak.	Tighten leaking connections. Replace tubing.
Sample is not injected completely.	Perform injections accurately. Replace the syringe with a new one.
Column is overloaded.	Decrease sample size. Dilute sample. Increase split ratio. Use a column with a thicker film.
Room temperature is not within the recommended range or is fluctuating considerably.	Keep the room temperature within the recommended range or reduce temperature fluctuations.
Syringe tip is clogged, and sample cannot be aspirated well.	Clean or replace syringe.
Syringe tip is clogged, and sample is not properly injected.	Clean or replace syringe.
Syringe plunger is stiff, and does not move smoothly.	Clean syringe barrel and plunger. Clean or replace syringe.
Silica wool inside glass insert is packed incorrectly.	Re-pack the silica wool.

If the gas supply pressure is fluctuating due to failure of the gas cylinder pressure regulator, repair or replace it. Contact your Shimadzu representative.

19.1.5 GC display (In cases where in the setting screen is reinitialized each time power is turned on)

For GC-2025, various analysis conditions are stored, and during installation environmental settings are set by our field engineer and stored in the GC's memory. When the power of the GC main unit is turned off, these parameters are backed up in the memory by the built-in battery (CPU battery). However, because the CPU battery is a consumable, the supplied voltage decreases with long-term use.
The battery life / replacement frequency for the CPU battery life is about 5 years. The error message "Battery voltage error" will be displayed when the battery is exhausted. If you continue to use the GC in this state, the memory will be initialized at startup and all parameters, including analysis conditions, will be reset to the initial values; this will be shown in English on the GC display. In such an event, you will need to reconfigure all parameters such as GC environmental setting parameters and analysis conditions.
For this reason, we suggest as a rough guide, to replace the batteries every five years. Please contact our sales office, distributor or service representative. We will assign a field engineer to visit your location.

19.1.5.1 Battery voltage error is shown

Possible Cause	Solution
Voltage drop of CPU battery.	When battery replacement of the CPU is required, contact our business office or a sales representative.

19.2 Error Messages

The system is programmed to diagnosis certain errors. When an error is detected, an alarm sounds and one of the error messages shown below is displayed. The detected errors are recorded in the "Error Log".
When confirmation screens are shown select one of the following actions:

Reset Error	Resets the system parameters, restoring the conditions prior to the error. System control resumes. Remove the cause of the error before selecting "reset".
Ignore Error	Keep the system as it is. Check for the error to resolve it.

The codes provided with the errors help the service representative identify the errors.
Provide the code when calling about an error. These codes are also recorded in the error log.

NOTE
When the system cannot be started due to an abnormality in the ROM, the messages below are displayed. The error does not have any error code.

Rom Error Please call a service person.
Rom Error (Fatal) Please call a service person.

When these messages are displayed, the system cannot be used. Turn off the power of the system and contact your Shimadzu representative.

19.2.1 System errors

Power supply failure

Code	Message	CS	Note
1	DC 5 V is out of range	No	
2	DC 24 V is out of range	No	
3	DC -15 V is out of range	No	

PCB failure

Code	Message	CS	Note
7-10	DET#n PCB error	No	n=1-4
11-12	CARm AFC PCB error	No	m=1-2
13-16	Det APCn PCB error	No	n=1-4
23-28	APC a-b PCB error	No	a-b= 1-3, 4-6, 7-9, 10-12, 13-15, 16-18

A/D converter failure

Code	Message	CS	Note
30	COL A/D conv. error	No	
31	INJ1 - DET2 A/D error	No	

Feed back loop communication error

Code	Message	CS	Note
33	Loop back test error	No	

If the above error messages appear, the hardware has failed. The GC system cannot be used in the event of these total errors. Turn off the the system, and contact your Shimadzu representative.

Room temperature sensor/atmospheric pressure sensor error

Code	Message	CS	Note
5	Room temperature is out of range	Yes	
6	Atm. pressure is out of range	Yes	

The room temperature or the atmospheric pressure is out of the AFC performance range.
If this error occurs although the actual room temperature/atmospheric pressure is within the range, the AFC sensors may have failed. The system cannot be used. Turn off the system, and contact your Shimadzu representative.

Low voltage of CPU board battery

Code	Message	CS	Note
34	Battery voltage error	Yes	

The CPU battery is exhausted and needs to be replaced. Please contact a Shimadzu sales representative.
If you continue to use the GC in this state, the memory will be initialized at startup and all parameters, including analysis conditions, will be reset to the initial values.
For this reason, we suggest as a rough guide, to replace the batteries every five years. Please contact our sales office, distributor or service representative. We will assign a field engineer to visit your location.

Cooling fan error

Code	Message	CS	Note
35	Cooling fan error	No	

The GC cooling fan is out of order. Turn off the system, and contact your Shimadzu representative.

Damage in electronics

Code	Message	CS	Note
36	ROM error	No	
37	RAM error	No	
38	CPU register error	No	

Repair is necessary. Contact your Shimadzu representative.

Clock reset

Code	Message	CS	Note
29	Clock is initialized	No	

The built-in clock has reset. As a result, other saved parameters may have changed. Check the installation, temperature and flow rate settings. Initialize the parameters or reset them if necessary.
If the same message is displayed repeatedly, the hardware has failed. The system cannot be used. Turn off the system, and contact your Shimadzu representative.

19.2.2 Operations errors

Value outside of range was entered

Code	Message	CS	Note
5001	Input parameter out of range	No	

The numeric value entered is out of the valid range. Enter a valid number.
File operation errors

Code	Message	CS	Note
5002	Invalid file no.	No	
5003	This file is now used	No	
5004	File initialize failure	No	
5005	File can't be copied	No	

These messages appear when an incorrect file operation was attempted.
Press another key, and continue operation.

Overflow of calculated pressure value

Code	Message	CS	Note
5006-5008 5070-5072	CARx calc. prss out of range	No	x=1-3

The carrier gas pressure calculated from the linear velocity, the flow rate or the split ratio. The input is outside the set range. Change the conditions so that the pressure is within the set range, and enter the new value.

Overflow of calculated flow rate value

Code	Message	CS	Note
5009-5011	CARx calc. flow out of range	No	x=1-3

The carrier gas total flow rate calculated from the split ratio or the pressure you have input is outside the set range. Change the conditions, and enter a new value.

Overflow of calculated APC pressure value

Code	Message	CS	Note
5012, 5015 5018, 5021 5045-5048	MUPn calc. prss out of range	No	n=1-4 makeup gas
5013, 5016 5019, 5022	HGNn calc. prss out of range	No	n=1-4 Hydrogen
5014, 5017 5020, 5023	AIRn calc. prss out of range	No	n=1-4 Air
5024-5041 5049-5066	APCy calc. prss out of range	No	y=1-18 AUX APC
5042-5044 5067-5069	PURx calc. prss out of range	No	x=1-3 septum purge

The pressure calculated from the flow rate you have input is outside the set range. Change the conditions, and enter a new value.

Overflow of calculated flow rate value in programs

Code	Message	CS	Note
5073, 5074 5077, 5078	CAR m calc.flow out of range	No	m=1-2
5075, 5076	CAR m calc.ratio out of range	No	m=1-2

The carrier gas total flow rate calculated from the split ratio program you have input is outside the set range.

19.2.3 Optional device error (AOC-20i/s)

Code	Message	CS	Note
6001, 6023	AOCm rack error	No	m=1-2 1: Main AOC, 2: SUB AOC
6002, 6024	AOCm syringe error	No	
6003, 6025	AOCm plunger error	No	
6004, 6026	AOCm can not start	No	
6005, 6027	AOCm RAM initialized	No	
6006, 6028	AOCm ROM error	No	
6007, 6029	AOCm CH2 command error	No	
6008, 6030	AOCm sample vial is not set	No	
6009, 6031	AOCm RAM error	No	
6010, 6032	AOCm installation error	No	
6011, 6033	AOCm CH1 error	No	
6012, 6034	AOCm CH2 error	No	
6013, 6035	AOCm waste vial is not set	No	
6014	AOC-20s rotating error	No	
6015	AOC-20s exp. and ctrl. Error	No	
6016	AOC-20s up/down error	No	
6017	AOC-20s can not start	No	
6018	AOC-20s vial setting error	No	
6019	AOC-20s vial returning error	No	
6020	AOC-20s holding error	No	
6021	AOC-20s sample vial removed	No	
6022	AOC-20s vial is not set	No	

One of the these messages appear when an error has occurred in the AOC-20i auto injector or the AOC-20s auto sampler.
For details, refer to the AOC-20 User's Manual.

19.2.4 Communication errors

External device communication error (i.e., Chromatopac)

Code	Message	CS	Note
4001	Time out	No	
4002	Parity error	No	
4003	Message is not accepted	No	
4004	Data is invalid	No	
4005	Command is invalid	No	

Code	Message	CS	Note
4006	Data is out of range	No	
4007	TRS port is shut down	No	
4008	TRS file error	No	

One of these messages appear during a link failure or communication failure. (When a communication error occurs, the link is automatically disconnected.)
When one of these messages appears, check the connection status, and reset the link.
AOC communication errors

Code	Message	CS	Note
4009	AOC command is invalid	No	
4010	AOC data is out of range	No	
4011	AOC time out	No	
4013	AOC link error	No	

One of these messages appear during a link failure or communication failure. (When a communication error occurs, the link is automatically disconnected.)
When one of these messages appears, check the connection status, and reset the link.

19.2.5 Detector errors

Detector flame error

Code	Message	CS	Note
4109-4112	DET#n flame is out	No	n=1-4

The detector flame (FID) has been extinguished.
Check the gas supply, and ingnite the detector again.
If the flame error occurs repeatedly, the hardware has failed. The system cannot be used.
Turn off the system, and contact your Shimadzu representative.

Detector ignition errors

Code	Message	CS	Note
4203-4206	DET#n ignition failed	No	n=1-4

This message appears when the FID does not ignite within a certain time.
When the message appears, hydorogen gas flow does not stop automatically for manual flow control.
Shut off the hydrogen gas first for safety, then check the following items.

(1) The column is connected
(2) Hydrogen is supplied at proper flow rate
(3) Air is supplied at proper flow rate
(4) Filament in igniter is intact
(5) The jet in the FID is not clogged
(6) Unused FID is not set to On

Code	Message	CS	Note
4207	H2, AIR APC are not ready	No	

This message appears when the APC for hydrogen or air is not ready at the time of ignition.
Check whether the gas supply pressure is stable and whether gas does not leak.
If there is no problem with the gas supply, the hardwere has failed. Turn off the system, and contact your Shimadzu representative.

19.2.6 Other errors

Code	Message	CS	Note
4301	Settings were changed	No	

This message appears when a set value was changed while the program is running. If the paramenter or event has not yet been executed, the new value is used for the analysis.

Code	Message	CS	Note
4302	Program time is over	No	
4303	Clean up time is over	No	
4304	Pre-run prog. time is over	No	

This message appears when the program execution time exceeds the maximum allowable value (9999.99 min). Change the program so that its total execution time does not exceed "9999.99 min".
The program continues running after this error occurs, and stops at 9999.99 min.

Code	Message	CS	Note
1001	Heat is escaping	Yes	

This message appears when large heat loss is occurring. The oven door may be open, or the insulation may not be in place.
If the column over door is open, close it and select "Reset Error".
If the insulation has been disturbed, replace the insulation, and then restart the system.

Code	Message	CS	Note
1002-1009	xxx temp exceed the limit	Yes	xxx=COL, INJ1, DET1, INJ2, DET2

This message appears when the maximum temperature limit has been exceeded. Change the maximum limit temperature if necessary.

Temperature sensor errors

Code	Message	CS	Note
1010-1017	xxx sensor is short circuit	Yes	xxx=COL, INJ1, DET1, INJ2, DET2
1018-1025	xxx sensor is down	Yes	
1026-1033	xxx sensor is error	Yes	

When one of these messages appears, the temperature sensor may have failed.
The sensor cannot be used. Replace or repair it. Turn off the system, and contact your Shimadzu representative.

Unstable temperature with CRG

Code	Message	CS	Note
1034	COL CRG cannot be controlled	Yes	
1035	INJ2 CRG cannot be controlled	Yes	

This message appears when the column over or the INJ2 cannot be cooled down because the column oven door remains open or insufficient coolant (also for INJ2) prevents the oven CRG from cooling.
If the column oven door is open, close it and select "Reset Error".
Turn off the system, replace the coolant, and then restart the system.

Overheat

Code	Message	CS	Note
1036	Overheat is sensed	Yes	Overheat detected by thermocouple
1037-1044	xxx temp controller broken	Yes	xxx=COL, INJ1, DET1, INJ2, DET2

An error may have occurred in the temperature control circuit.
Turn off the system, and contact your Shimadzu representative.

Relay/heater control errors

Code	Message	CS	Note
1045	COL relay error	No	
1046	INJ1-DET2 relay error	No	
1048	Heater controller error	No	

An error may have occurred in the control circuit. Turn off the system, and contact your Shimadzu representative.

Code	Message	CS	Note
1049-1052	DET#n set temp is low	No	n=1-4

This message appears when the detector temperature setting value is smaller than that of the oven.
If this message appears, change the setting value of the detector temperature.
If set the setting of protection against contamination to "No", need not to change the setting value of the detector temperature. (Refer to 16.6.4.3)

Pressure/flow rate control errors

Code	Message	CS	Note
2005-2007	CARx purge leaks	Yes	x=1-3
2014, 2017 2020, 2023	DetAPC n makeup gas leaks	Yes	n=1-4
2015, 2018 2021, 2024	DetAPC n hydrogen leaks	Yes	
2016, 2018 2022, 2025	DetAPC n air leaks	Yes	
2026-2043	APC y leaks	Yes	y=1-18

The pressure cannot reach the set value. Check whether gas is supplied and whether gas is leaking from connections.

NOTE
Gas leaks may be occurring in several locations.

(Example) If the purge flow rate is too low, the message "Purge leaks" may appear. If the carrier gas is also leaking, the ESC or TFC error message may not be displayed first.

Pressure/flow rate control errors (valve leak error)

Code	Message	CS	Note
2048-2050	CARx purge valve leaks	Yes	x=1-3
2057, 2060 2063, 2066	DetAPC n makeup valve leaks	Yes	n=1-4
2058, 2061 2064, 2067	DetAPC n hydrogen valve leaks	Yes	
2059, 2062 2065, 2068	DetAPC n air valve leaks	Yes	
2069-2086	APC y valve leaks	Yes	y=1-18
2132, 2133	CAR m AFC valve leaks	Yes	m=1-2

Gas is flowing even though the set value is 0 kPa (or ml/min).
If gases are supplied, an AFC/APC valve error may have occurred.
Turn off the system, and contact your Shimadzu representative.

Abnormal component operation

Code	Message	CS	Note
2091-2093	CARx purge is out of control	Yes	x=1-3
2100, 2103 2106, 2109	DetAPCn makeup gas is out of control	Yes	n=1-4
2101, 2104 2107, 2110	DetAPCn hydrogen is out of control	Yes	
2102, 2105 2108, 2111	DetAPCn air is out of control	Yes	
2112-2129	APCy is out of control	Yes	y=1-18
2130, 2131	CARm AFC leaks	Yes	m=1-2
2134-2137	CARm AFC is out of control	Yes	
2138-2140	CARx prim is out of range	No	x=1-3

Verify whether a continuous supply of gas is available at the required pressure.
If there is no problem in the gas supply, the control system, such as the APC, may have failed.
Turn off the system, and contact your Shimadzu representative.

Code	Message	CS	Note
2141, 2142	CARm is not controlled	No	m=1-2

This message appears when the temperature control starts without carrier gas control.
If this message appears, set the setting of the flow controller to "On" or remove the flow controller from the line configuration.

19.2.7 Warning messages

Code	Message	CS	Note
9000	COL CRG use time is over	No	
9001	INJ2 CRG use time is over	No	
9002	Fan use time is over	Yes	
9004-9006	CARx septum counter is over	No	x=1-3
9007-9009	CARx insert counter is over	No	
9012-9016	xxx sensor use time warning	Yes	xxx=COL, INJ1, DET1, INJ2, DET2

These messages appear when the time or the count exceeds the set value, but does not indicate any error. Refer to "14 Diagnosis", and clear the message.
In case of "Fan use time is over", "LCD back light use time over" and "xxx sensor use time warning", turn off the power, and contact your Shimadzu representative.

Code	Message	CS	Note
9010	System is not ready	No	

This message appears when the analysis was started before it was ready. Normally, do not start the analysis until the system is ready.
If this message appears when all the parameters are ready, check the ready setting for unused components and check the equilibration time.

Code	Message	CS	Note
9011	Ignition finished(retried)	No	

Ignition sequence was re-attempted, because the ignition failed initially.
This does not affect the analysis. If this massage appears frequently, check "DETECTOR IGNITE" and "DETECTOR IGNITION" by the standard diagnosis procedure.
Also check for gas leaks and verify the gas flow rates. If set values are correct, contact your Shimadzu representative.

19.2.8 Messages other than error and warning messages

If the oven door is opened while column oven temperature control is disabled, such as in the [SYSTEM Off] status, an alarm sounds and the message "Oven door is opened." is displayed.
Before enabling column oven temperature control, ensure that the oven door is closed completely.
If power consumption is continuously at a high level, the message "PWR Plug check" is displayed.
If the power plug is not inserted securely, ignition may occur due to overheating. Check the condition of the power plug.
Press the [CE] key to clear the message.

20.1 Maintenance Parts

The following tables list maintenance parts and their part numbers (P/N). These parts are consumable parts.

20.1.1 Septum

Parts name	P/N	Purpose
Silicon rubber septa (with 20 pcs)	S201-35584	Injection port septa (Up to 350 °C)
Septa for high temperature (with 20 pcs)	S221-48398-91	Injection port septa (above 400 °C)
LL long-life septa (with 20 pcs)	S221-48972-91	Injection port septa (above 400 °C)
Thermogreen LB-2 (with 10 pcs)	S221-35507-01	Injection port septa (Up to 350 °C)

The type of bleeding differs according to the type of septum and bleeding appears on a chromatogram in different patterns. For high sensitivity analysis, select a septum for which bleeding does not appear in positions that hinder the peaks of the subject compounds.

20.1.2 O-ring for glass insert

Part name	P/N	Purpose
Fluoride rubber O-ring (with 5 pcs)	S036-11203-84	standard (Up to 400 °C)

20.1.3 Glass insert

Part name	P/N	Purpose
Glass insert (For split)	S221-41444-01	For split injection technique
Glass insert (For splitless)	S221-48335-01	For splitless injection technique
Deactivated glass insert (For splitless)	S221-48876-03	5 pcs with deactivated wool
Glass insert (For residual solvent analysis kit)	S221-38107-01	
Glass wool (with 2 g)	S221-48600	Packed in glass insert

20.1.4 Graphite ferrule

Part name	P/N	Purpose
Graphite ferrule G0.5 (with 10 pcs)	S221-32126-05	Capillary column installation (less than 0.5 mm o.d.)
Graphite ferrule G0.8 (with 10 pcs)	S221-32126-08	Wide bore capillary column installation (0.5 mm to 0.8 mm o.d.)

20.1.5 Capillary column

To select a capillary column, refer to a column manufactuer's catalog.

20.1.6 Flow controller

Part name	P/N	Purpose
Molecular sieve filter	S221-34121-94	For removing contamination in carrier gas
Trap (SPLIT)	S221-42559-92	Split flow line trap
Trap (PURGE)	S221-42559-92	Septum purge flow line trap
Aluminum gaskets (with 500 pcs)	S201-35183-84	For tubing connections

20.1.7 Hydrogen flame ionization detector (FID)

Part name	P/N	Purpose
Jet	S221-48258-91	Standard jet for FID, 0.3 mm inner diameter
Jet, ϕ0.8	S221-49373-91	For water analysis, 0.8 mm inner diameter
FID collector	S221-72322-91	
Igniter	S221-41847-93	Igniter for FID

21.1 AFC and APC Overview

The AFC (Advanced Flow Controller) is an electronic flow controller which sets and controls carrier gas pressures and flow rates based on entered parameters.
The APC (Advanced Pressure Controller) is an electronic flow controller for controlling detector gas pressures. The AUX APC can control the gas pressure of other optional devices.

21.2 Definition of Terms

■ Column inlet pressure

Column inlet pressure refers to the injection port pressure.
When set to "0 kPa", the injection port pressure is equal to atmospheric pressure.

■ Total flow rate

Total flow rate is the flow rate controlled by the TFC (Total Flow Controller) located upstream of the injection port.
(Refer to Fig. 21.3.1)

■ Column flow rate

The column flow rate in the GC-2025 gas chromatograph indicates the volume flow rate inside the column converted at atmospheric pressure and room temperature, which corresponds to the flow rate measured at room temperature by a flow meter connected to the column outlet.
The column flow rate can be calculated with the following equation:

$$\mathrm{Fc} = \frac{60\pi d^4}{256\mu LT} \times (P^2 - P_0^2) \times \frac{T_S}{P_S}$$

where

Fc : Column flow rate (ml/min)
d : Column inner diameter (mm)
L : Column length (m)
P : Column inlet pressure (kPa)
T : Column temperature (K)
P_0 : Column outlet pressure (= atmospheric pressure) (kPa)
μ : Viscosity coefficient *
(19.4 μPa•sec, helium at 20 °C)
Ts : Standard temperature (K)
Ps : Standard pressure (kPa)

* The viscosity coefficient depends the column oven temperature.

■ Linear velocity

Linear velocity indicates how many cm the carrier gas moves inside the column.
The terms "VELOCITY", "linear velocity" in this instruction manual indicate the average linear velocity inside the column.
The average linear velocity can be obtained with the following equation:

$$\mathrm{V} = \frac{0.75 \times d^2}{32\mu L} \times \frac{(P^2 - P_0^2)^2}{(P^3 - P_0^3)}$$

V : Average linear velocity

■ Split ratio

For the GC-2025, split ratio refers to $\dfrac{\text{split flow}}{\text{column flow}}$.

21.3 Flow Line Diagram

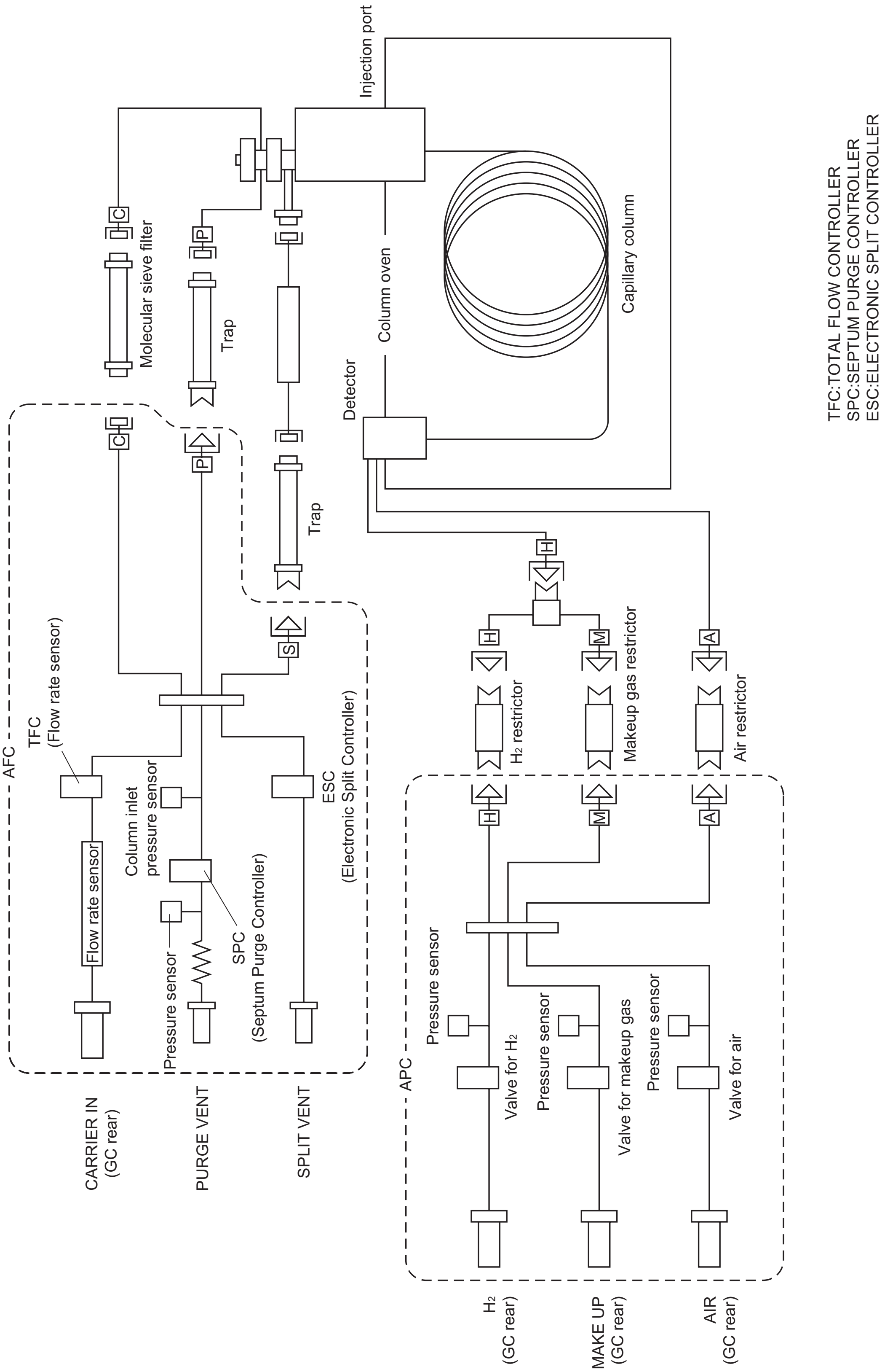


Fig. 21.3.1

21.4 AFC and APC Control

21.4.1 AFC control

AFC control is illustrated in the following sections.

Split mode / Control mode	Split	Splitless	DIRECT(*1)
Pressure	Section 21.4.2	Section 21.4.3	Not used with the GC-2025
Linear velocity	Section 21.4.2	Section 21.4.3	Not used with the GC-2025

∗1. Since the GC-2025 uses the same AFC as the GC-2010/2010 Plus and GC-2014, "DIRECT" is displayed as an option on the carrier gas setting screen; however, with the GC-2025, do not select "DIRECT" for injection mode except for carrier gas leak check.

21.4.2 Split mode: "SPLIT" (AFC)

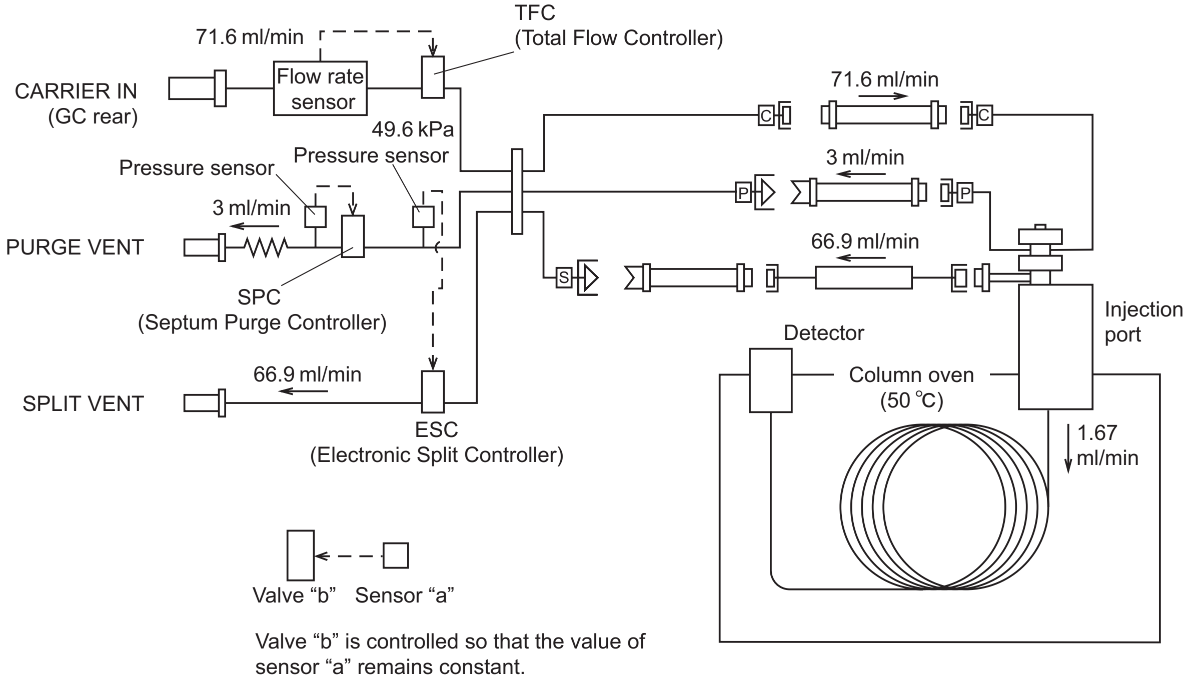
The AFC controls the total flow rate to keep it at a constant value. The TFC (Total Flow Controller) inside the AFC feeds back output from the column inlet pressure sensor, which controls the ESC (Electronic Split Controller), which, in turn, controls the column inlet pressure.

Fig. 21.4.1 shows the control status with a split ratio of 1:40, a velocity of 30 cm/sec, a purge flow rate of 3 ml/min, and a column oven temperature of 50 °C.
The column inlet pressure is calculated based on the linear velocity, the oven temperature, the column inner diameter, and the column length, and is automatically set to 49.6 kPa. In the same way, the column flow rate is automatically set to 1.67 ml/min, and the total flow rate is set to 69.8 ml/min (= 1.67 ml/min × 40 + 3 ml/min (= purge flow rate)).

When the Control mode is set to "PRESS", the column inlet pressure is controlled to remain at 49.6 kPa regardless of the column oven temperature.

When the Control mode is set to "VELOCITY", the column inlet pressure is set to a value which keeps the linear velocity constant despite changes in the column oven temperature. Even if the column oven temperature changes, as in programmed temperature analysis, the linear velocity is always kept constant. Generally, when the column oven temperature increases, the viscosity of the carrier gas also increases, and does not flow as easily.

Regardless of the Control mode, the ESC controls the column inlet pressure and the TFC controls the total flow rate as shown in Fig. 21.4.1.

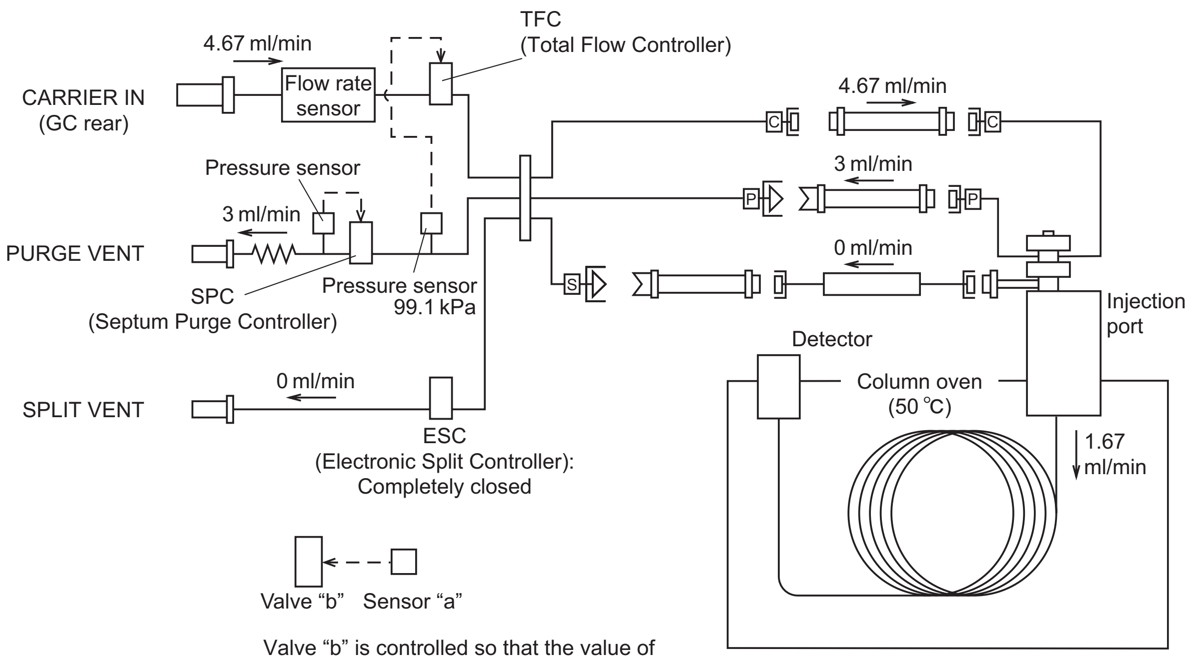


Column inner diameter	: 0.30 mm
Column length	: 25.0 m
Film thickness	: 0.50 μm
Carrier gas	: He
Split ratio	: 40 = 66.9 ml/min / 1.67 ml/min (split flow rate)(column flow rate)

Fig. 21.4.1 Split control

21.4.3 Split mode: "SPLITLESS" (AFC)

The control method changes only during the sampling time.
During sampling time, the AFC controls the TFC (Total Flow Controller) so that the output from the column inlet pressure sensor becomes constant, and then controls the column inlet pressure.
After the sampling time, the AFC controls the total flow rate to keep it at a constant value using the TFC (Total Flow Controller) inside the AFC. As in split mode, the ESC (Electronic Split Controller) is controlled to maintain the column inlet pressure constant.
Fig. 21.4.2 shows the control status during the sampling time with a split ratio of 1:40, a velocity of 30 cm/sec, a purge flow rate of 3 ml/min, and a column oven temperature of 50 °C. The column inlet pressure is calculated based on linear velocity, oven temperature, column inner diameter, column length and column film thickness, and is automatically set to 49.6 kPa. In the same way, the column flow rate is automatically set to 1.67 ml/min.
When the sampling time expires, control is identical to the split mode, shown in Fig. 21.4.1
When the Control mode is set to "PRESS", the column inlet pressure is controlled to remain at 49.6 kPa regardless of the column oven temperature.
When the Control mode is set to "VELOCITY", the column inlet pressure is set to a value which keeps the linear velocity constant despite changes in the column oven temperature. Even if the column oven temperature changes, as in programmed temperature analysis, the linear velocity is always kept constant. Generally, when the column oven temperature increases, the viscosity of the carrier gas also increases, and does not flow as easily.
Regardless of the Control mode, the ESC controls the column inlet pressure and the TFC controls the total flow rate as shown in Fig. 21.4.1 (after the sampling time).



Column inner diameter	: 0.32 mm
Column length	: 25.0 m
Film thickness	: 0.50 μm
Carrier gas	: He

Fig. 21.4.2 Splitless control (during sampling time)

21.4.4 Control by APC

The APC performs its control as illustrated in the figure below.

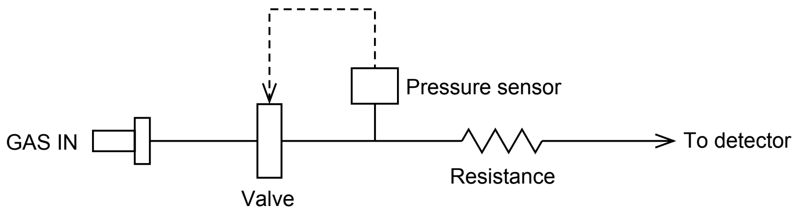


Fig. 21.4.3

As shown in Fig. 21.4.4, the APC controls the pressure.
The flow rate is calculated based on resistance and pressure.
For example, for a flow rate of 400 ml/min of air, the pressure is controlled and set to approximately 61 kPa based on the pressure-flow rate characteristics of air stored in the memory of the GC-2025. (Refer to Fig. 21.4.4)
The resistance depends on the detector type and the gas type (air, hydrogen or makeup gas).
Fig. 21.4.4-21.4.6 show the pressure-flow rate characteristic curves of the standard restrictor.
AUX APC offers "PRESS" and "FLOW" mode.
When the Control mode is "PRESS", AUX APC controls the pressure as shown in Fig. 21.4.4.
When the Control mode is "FLOW", the pressure is calculated based on the set flow rate, calculated from the restrictor inner diameter, and length. (Refer to column flow rate in "21.2 Definition of Terms".) The equation in 21.2 is accurate when the flow in the restrictor is layer. Therefore, the flow rate accuracy depends on the restrictor used.

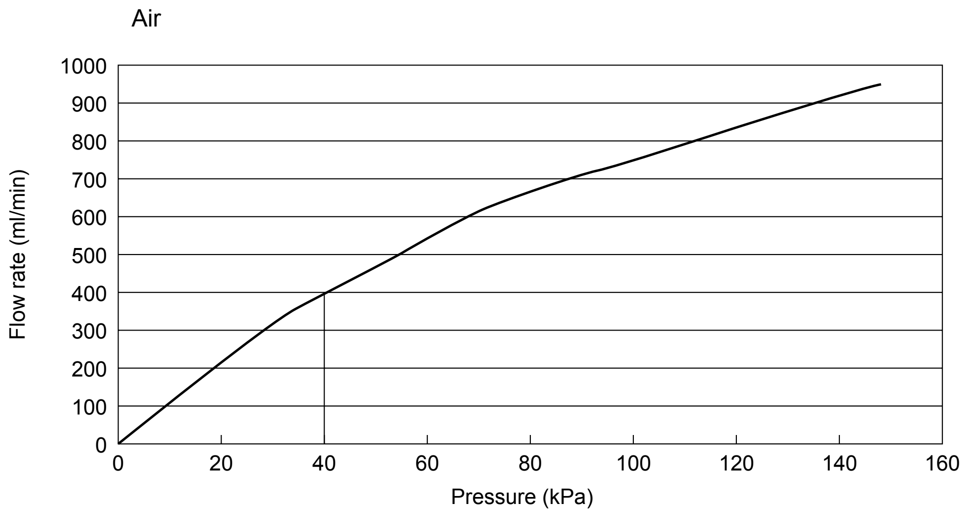


Fig. 21.4.4

H_2

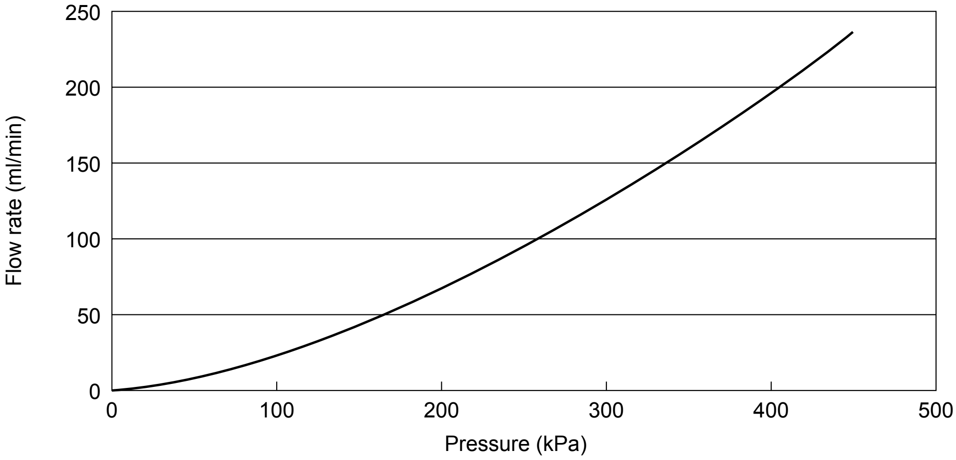


Fig. 21.4.5

Makeup gas (FID)

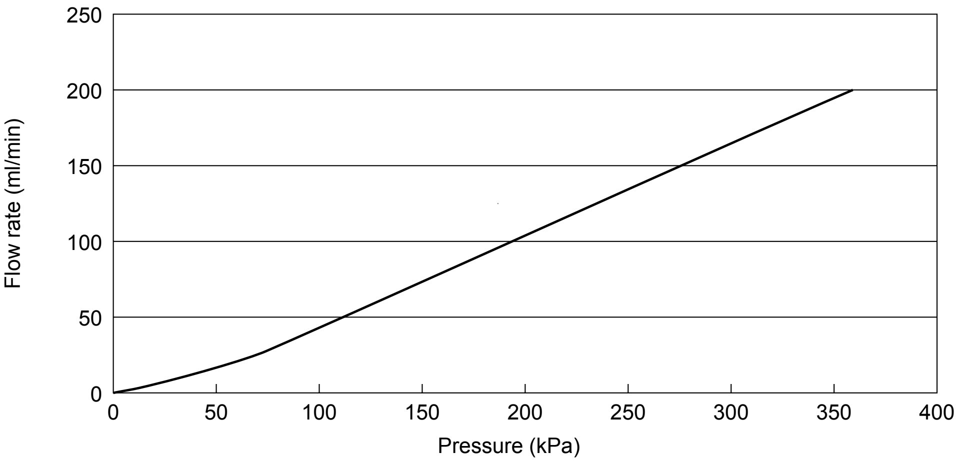


Fig. 21.4.6

21.5 AFC and APC Control Ranges

NOTE
When options are added to the flow line, the range above becomes narrow.

For the AFC, the column inlet pressure can be set from 0 to 970 kPa, and the total flow rate can be set to 0 to 1,200 ml. (Refer to Figs. 21.5.1 and 21.5.2.) However, these values are instrument specifications, valid when the primary pressure supplied to the GC-2025 is 980 kPa.
The allowable pressure and flow rate settings are limited by the primary pressure, as shown in Fig. 21.5.1, Fig. 21.5.2. In addition, the pressure settings are limited by the column type and the purge flow rate.

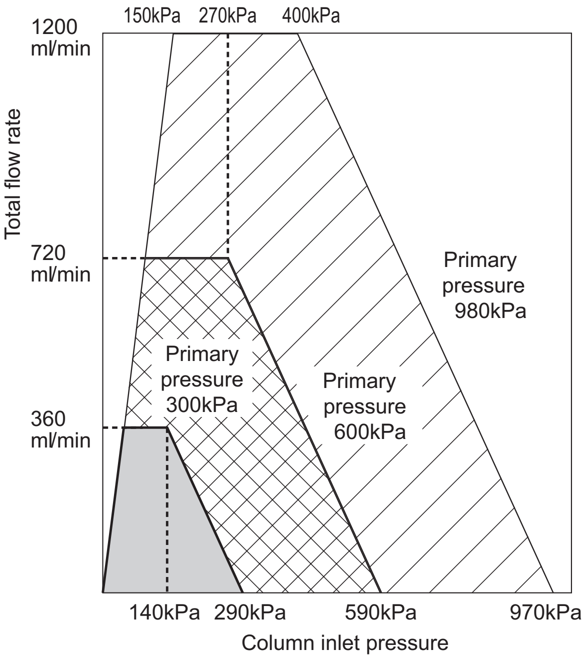


Fig. 21.5.1 Available setting ranges (He, H_2)
0-1 ml/min, 0-1 kPa is not a valid setting

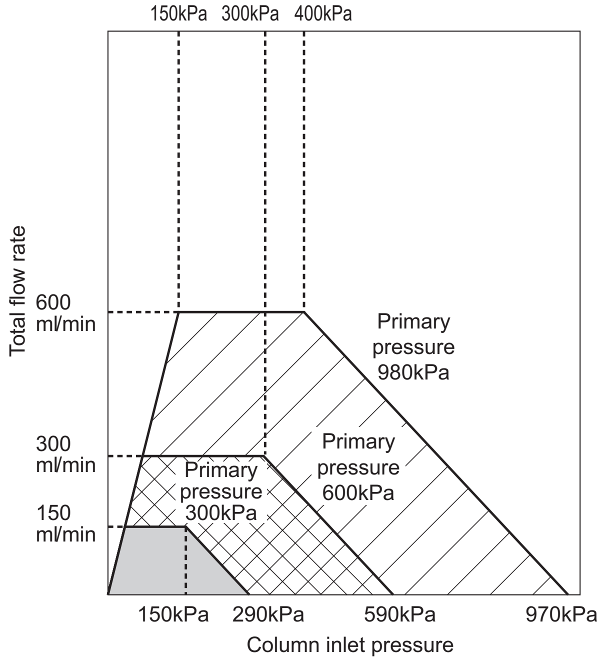


Fig. 21.5.2 Available setting ranges (N_2)
0-1 ml/min, 0-1 kPa is not a valid setting

The allowable pure flow rate setting depends on the column inlet pressure. Fig. 21.5.3 shows the range of purge flow rates permitted.

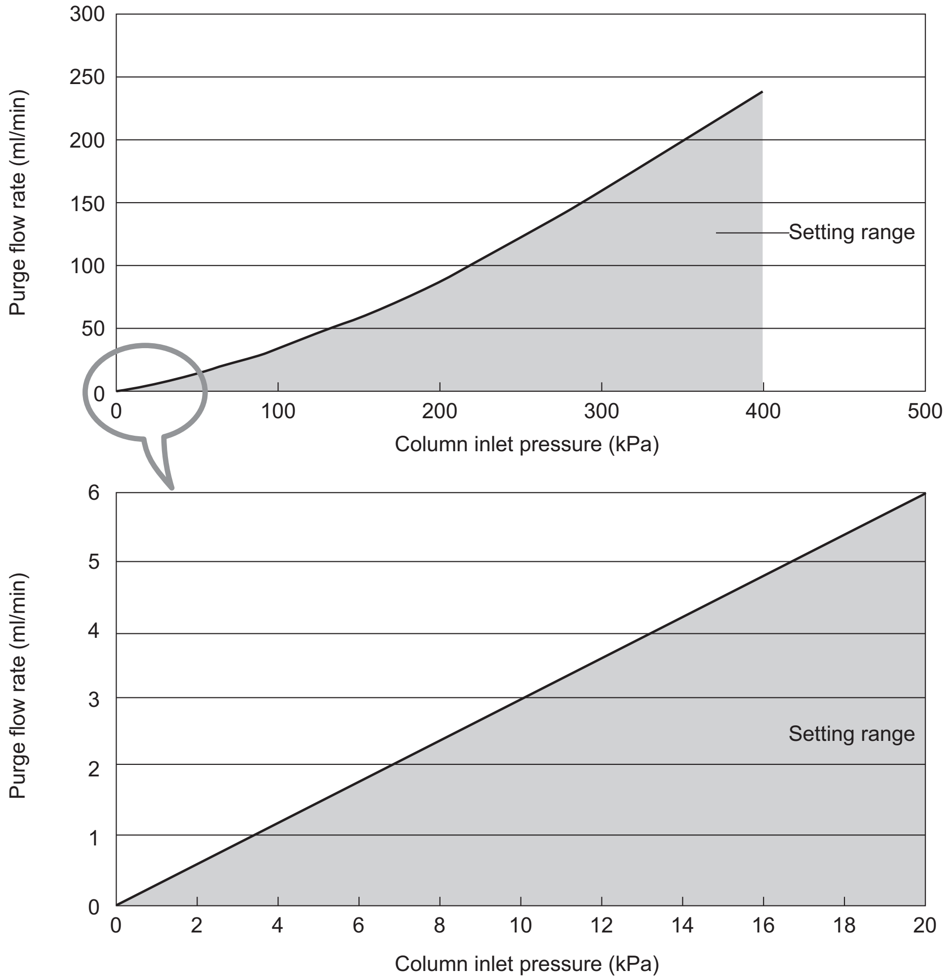


Fig. 21.5.3

Allowable APC settings are shown below, for a supply pressure of 500 kPa. (When the supply pressure is less than 500 kPa, the available maximum flow rate decreases proportionally.) When the set value is more than the set range, displayed values may not be accurate, or APC cannot control the flow.

Air	: 0 to 1200 ml/min
H_2	: 0 to 100 ml/min
Makeup gas	: 0 to 100 ml/min

21.6 AFC and APC Offset Calibration

The AFC and APC pressure and flow rate sensors can be calibrated (zeroed).
This calibration is required to correct minute deviations of the sensor values which may occur after long periods of use. If the sensor values deviate, a value greater than "0" may be displayed, for example, even through there is no actual pressure or flow. When data reproducibility is important, perform the offset calibration.
For the AFC, perform the offset calibration using the following procedure.

(1) Press the [SYSTEM] key, the toggle key, and the PF1 key, and change "Start GC" to "Manual Start" (refer to Fig. 21.6.1 or 21.6.2).
If "Manual Start" was already set, proceed to the next step.
(2) Turn off the power. Wait until the column oven, the injection port and the detector have cooled down to 50 °C or less.
(3) Turn on the power. Wait for approximately 1 minute.
(4) Press the [FLOW] key once and the toggle key twice, in that order. Then, the Fig. 21.6.2 opens.
(5) Press the PF2 key. The message "Zero Calibration Start" appears at the bottom of the monitor. Approximately 10 seconds later, the message "Zero calibration completed" appears. Calibration of the AFC is complete.
(6) Return the "Start GC" setting to its original status.

NOTE
Refer to "5 Basic Key Operation".

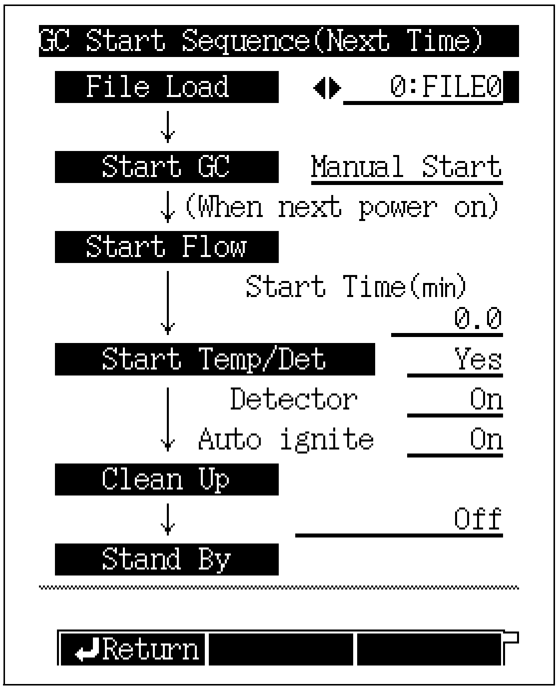


Fig. 21.6.1

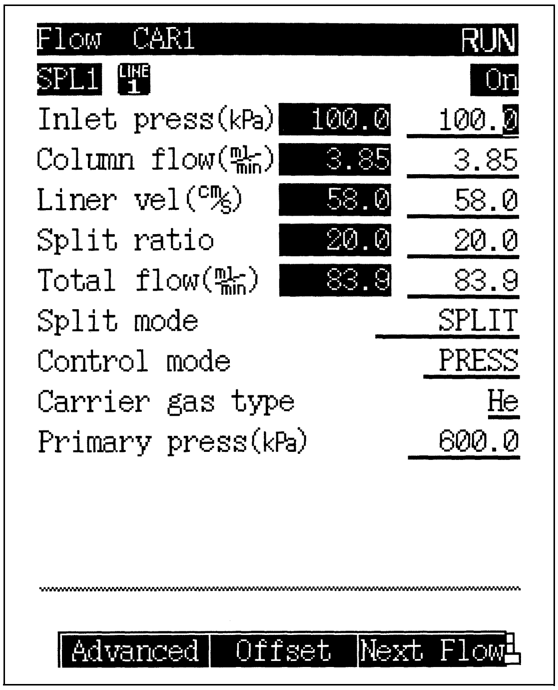
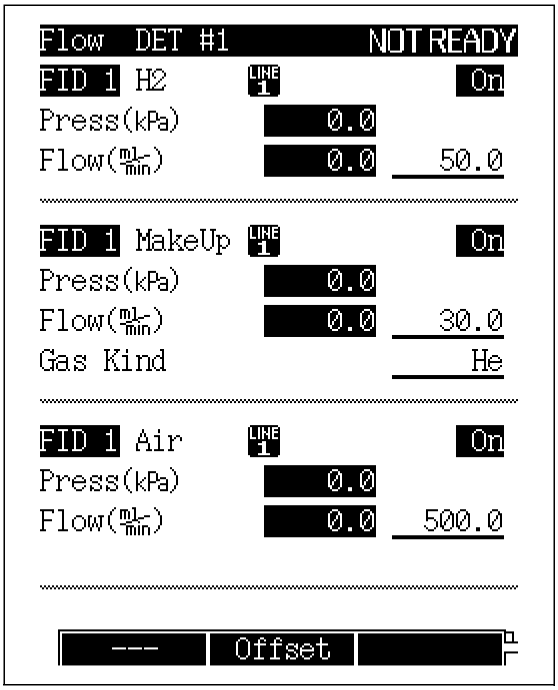


Fig. 21.6.2

Perform the offset calibration of the APC using the following procedure.

(1) Press the [SYSTEM] key, the toggle key, and the PF1 key, and change "Start GC" to "Manual Start" (refer to Fig. 21.6.1 or 21.6.2).
    If "Manual Start" was already set, proceed to the next step.
(2) Turn off the power. Wait until the column oven has cooled down sufficiently.
(3) Turn on the power. Wait for approximately 1 minute.
(4) Press the [DET] key, the [PF2] key and the toggle key, in that order. The screen shown in Fig. 21.6.3 opens.
(5) Make sure that flow monitors of each gas do not change. When they change, wait for a while. Press the PF2 key. The message "Zero calibration Start" appears at the bottom of the monitor. Approximately 10 seconds later, the message "Zero calibration completed" appears. Calibration of the APC is complete.
(6) Return the "Start GC" setting to its original status.


Flow DET #1 NOT READY
FID 1 H2 On
Press(kPa) 0.0
Flow(ml/min) 0.0 50.0
FID 1 MakeUp On
Press(kPa) 0.0
Flow(ml/min) 0.0 30.0
Gas Kind He
FID 1 Air On
Press(kPa) 0.0
Flow(ml/min) 0.0 500.0

Offset

Fig. 21.6.3

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22.1 Connecting the RS-232C Cable

Connect the RS-232C cable to its terminal on the rear panel.

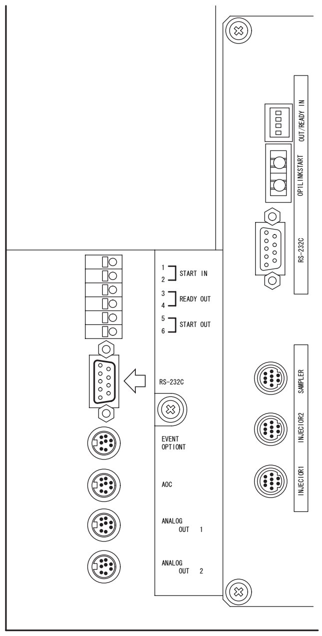

Fig. 22.1.1 Connecting the RS-232C cable

Chromatograph control signal I/O and digital detector signal output occur through the RS-232C cable.
RS-232C cable connection parameters

- Connection to C-R8A
  Set data transmission parameters to equivalent values between the GC system and the C-R8A.
  Example of C-R8A settings: (For details, refer to the C-R8A instruction manual)
  Make the following settings on the transmission parameter setup screen for "LEVEL 2" and "9,600 bps". (CONFIG T (T:TRS) ▽).

PORT	MODE	#No.	BPS
STD2	12917	8	9600

  Power cycle the C-R8A after changing transmission parameters.
- Transmission parameter setting example (on the instrument)

Protocol	LEVEL2
Baud rate (bps)	9600
Stop bit	1 bit
Parity	EVEN

  For GC-2025 data transmission parameters, refer to "16.6.5 Setting transmission parameters".
  Input "OPEN TRS 8" on the C-R8A keyboard, and press the ENTER key to open the transmission port and start transmission.
  (The detector signal is not transmitted from the GC-2025 to the C-R8A)
- Connection to the personal computer
  To use GC solution, get GC-2025 transmission parameters to "LEVEL3", "115200 bps".

22.2 Connecting the Chromatopac Signal Cable

Use the Chromatopac signal cable to send detector analog signals to the Chromatopac. Connect the 4-PIN signal cable to the connector (Ch1 or Ch2) on the rear panel. The START signal between the GC and Chromatopac is communicated through this signal cable. Therefore, there is no need to connect the START OUT terminals on the GC or the Chromatopac.

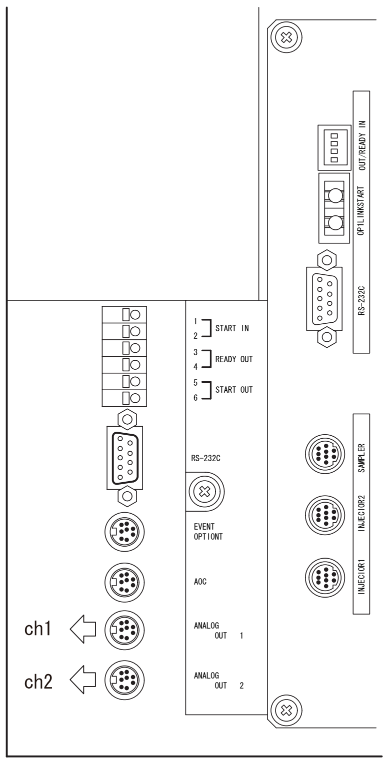

Fig. 22.2.1 Connecting the Chromatopac signal cable

■ Calibration of analog wide range signal

When the GC is connected to the Chromatopac C-R8A/C-R7A/C-R7A plus with a chromatopac signal cable (for analog signals), and the signal type is set to "Wide" on the [DET] key screen, perform a calibration for proper signal transmission. For details of the [DET] key, refer to "13 Detector".

- C-R8A

(1) Set the detector controller on the [DET] key screen to "off". (Refer to 13.1.2.)
(2) On the Chromatopac, type the following:
LOAD "8:ZCALIB.BAS"
(3) Press the [RUN] key of the Chromatopac.
(4) When "CH No. (1:CH1, 2:CH2)" is displayed, enter the Chromatopac Channel number (1 for Ch.1, 2 for Ch. 2).
(5) When "Save to the disk? (Y: save N: No)" is displayed, enter "Y".
(6) When "COMPLETED" appears on the screen, set the detector controller to "on".

- C-R7A/C-R7A plus

(1) Set the detector controller on the [DET] key screen to "off". (Refer to 13.1.2.)
(2) On the Chromatopac, press the [Win 3] key and type the following:
LOAD "ZCALIB"
(3) Press the [RUN] key of the Chromatopac.
(4) When "Channel No.(1:CH1, 2:CH2)" is displayed, enter the Chromatopac Channel number (1 for Ch.1, 2 for Ch. 2).
(5) When "Save to disk ? (Y: Yes, N: No)" is displayed, enter "Y".
(6) Set the detector controller to "on".

Check whether the calibration has done correctly as the following procedure, while the GC status is "System On" and the detector is set to "On". (Refer to "7 Starting and Stopping the GC [SYSTEM]" and "13 Detector".)

(1) Set "Signal Attenuation" to "x1".
(2) Press the [Win 1] key and press "F" to set Chromatopac zero level to FREE.
(Refer to User's manual of Chromatopac.)
(3) Press [Zero adj.] (PF menu) on the screen of [MONIT] key. The detector signal level moves to 0 μV. (Refer to "9 Monitoring the GC".)
(4) The signal level on the display of the Chromatopac is within ±50 μVe, the calibration has done correctly.

If the calibration failed, perform the above-mentioned calibration procedure again.

The maximum difference between the signal level GC and Chromatopac is equal or less than ±5 % (±50 μV, in case signal level is form −1000 to 1000 μV).
In case of SYSTEM off and/or detector controller off, the detector signal level on screen of the [MONIT] key is 0 μV but Chromatopac shows −1000 μVe when the signal type is "Wide".

NOTE
For correct quantitation, perform this calibration when changing GC's or changing Chromatopac channels.

When the GC and the chromatopac C-R6A or previous models are connected with Chromatopac signal cable (for analog signal), the signal type is set to "Linear" on the screen of the [DET] key. The calibration is not necessary.
This is the same when the C-R8A/C-R7A/C-R7A plus is connected with the optional analog cable (linear, P/N 221-47251-42/-44: 115 V/230 V).

22.3 Connecting the Auto-injector Cable

NOTE

This section describes the connection between the AOC-20i unit and GC-2025, the AOC power cable connection, and the method of turning the AOC on and off. For details of AOC-20 operation, refer to the AOC-20 User's Manual.

■ Cable connections

Connect the cables as follows.

The AOC-20 power source is housed within the unit.

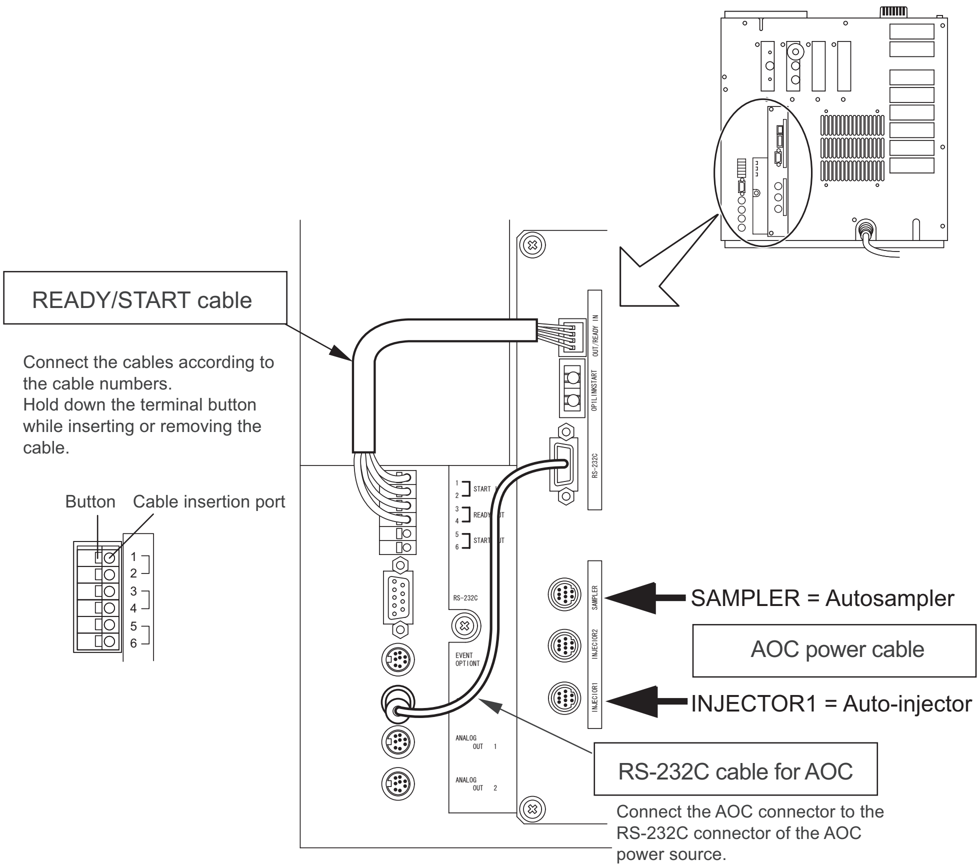

Fig. 22.3.1

NOTE

In the case of 230 V model, attach one ferrite core to each end of the cable when connecting the AOC cable to SAMPLER1. Connect the cable in the same way as well when an external AOC power supply is installed.

■ Turning the AOC power on and off

When using the AOC-20i with the GC-2025, the AOC power is turned on and off along with the GC power. However, for units with the AOC-20 power supply installed in the GC-2025, turn the AOC-20, which is specified for an analytical flow line, on and off from the AOC parameter screen, accessed from the [OPTION] key. (Refer to "15.1 Auto Injector Parameters".)

22.4 Connecting the Relay Cable

Connect the 8-PIN relay cable (P/N 221-48568-91).
The relay terminal can be opened and closed by EVENT91 and 92. (Refer to "16.3 Time Program".)

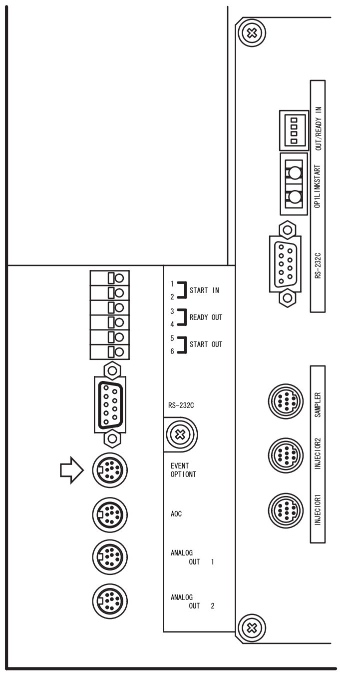

Fig. 22.4.1

EVENT91

Pin No.1 red COM	
Pin No.2 white NC	Conducted to Pin No. 1 COM at EVENT-91
Pin No.3 black NO	Conducted to Pin No. 1 COM at EVENT91

EVENT92

Pin No.4 yellow COM	
Pin No.5 blue NC	Conducted to Pin No. 4 COM at EVENT-92
Pin No.6 black NO	Conducted to Pin No. 4 COM at EVENT92

OPTION

Pin No.7 brown	(GROUND)
Pin No.8 gray	(GROUND)

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23.1 Key Function List

Key	Item	Sub-item	Function
SYSTEM			The parameter related to start and stop of the GC can be set. And on the sub screen, the file management, the clean up and the maintenance of injection port can be set.
SET			The parameters which are frequently set can be set. And on the screen of [LineConfg], the combination of injection ports, detectors,etc. can be changed.
MONIT			The status of the injection port, the column, the detector configured and the chromatogram etc. in each line can be monitored.
COL			The oven temperature or the oven temperature program can be set.
INJ			The injection port temperature can be set.
FLOW			The parameters of the AFC which controls the pressure and the flow rate of the carrier gas can be set.
DET			The detector temperature, the deterctor gas flow rate, the detector signal output, etc. can be set.
OPTION	AOC parameters		The Auto Injector AOC-20i and the Auto Sampler AOC-20s used to automatically inject liquid sample to the gas chromatograph can be set.
	AUX Temp		The AUX Temp (option) can be set.
	AUX APC		The AUX APC (option) can be set.
	CRG		The CRG (option) can be set.
DIAG	1. Standard Diagnosis		Diagnose each part of the gas chromatograph to check for abnormality. By executing standard diagnosis periodically, the system can be managed and the failures can be prevented.
	2. Log Reading Menu	1. GC operation Log	Display the power On/Off log and the system On/Off log.
		2. Analysis Log	Display the log on whether analysis was executed to the end and whether the control was not deviated from the target value.
		3. Parameter Log	Display the key operation log and the parameter change log.
		4. Error Log	Display the log of displayed error messages.
		5. Diagnostic Log	Display the diagnosis log.
	3. Analysis Counter		The replacement timing of the septum or the glass insert can be displayed as a warning message.
	4. Coolant Consumption		The total time that the CRG is "On" can be confirmed. If the consumption counter is larger than the time of setting to warm, the warning message is displayed.

FUNC

1. Time Scheduler		The key operations of the gas chromatograph can be automated by setting the weekly or daily schedule using the timer.
2. Batch		Use to continuously and automatically perform analysis with auto injector.
3. Time Program		Use time program when the parameter is changed during analysis.
4. Pre-Pun		Use Pre-Run program when the parameter is changed before analysis is started.
5. Direct Operation		Input the event No. and run at once.
6. GC Configuration	1. Date/Time Setting	Use to set tha date and the time.
	2. Max. Temperature	Use to set the maximum temperature of each heater ports.
	3. Transmission Parameter	Use to set the parameter related to transmission.
	4. Ready Check	Use to set the items, which should be satisfied to light the STATUS indicator lamp and make the system ready.
	5. Signal Setting	Use to set the signals, which can be output from the gas chromatograph.
	6. Port Name Customization	Use to change heater ports name, carrier ports name, AUX APC name, relay name displayed on the screen.
	7. Link Device Code	Use to set the link device code when using it.
	8. Temperature Offset	Use to set the temperature offset for each heater port.
	9. Other Configuration	Use to set the language and the beep, etc.
7. Service/ Maintenance		Use to set the flow controller or initialize, etc.
8. Stop Watch		The stop watch can be used.
9. Lock		The key locking and the parameter locking can be used.

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