

GC-2010 Plus / GC-2010 / GC-2014 / GC-2025 Series

SHIMADZU Gas Chromatograph Parts and Maintenance Brochure





START STOP

Analysis Settings READY
LINE 1 FILE 0: FILE0
Column Oven
Temp(°C) 45.0 45.
Flow
Inlet press(kPa) 100.0 100.0
Column flow($\frac{\text{mL}}{\text{min}}$) 1.74 1.74
Split ratio 14.6 -1.0
Split mode SPLIT
INJ SPL
Temp(°C) 250.0 250.0
File LineConf Customiz

PF1 PF2 PF3
MONIT SET
COL FUNC
FLOW 7 8 9
INJ 4 5 6
DET 1 2 3
OPTIM 0 . -
HELP CE ENTER

Introduction

This brochure describes items that should be prepared by the customer upon purchase of a Shimadzu gas chromatograph and precautions that should be followed to ensure satisfactory analysis.

Gas chromatographs cannot perform analysis by a GC unit alone. Various peripherals and parts are required depending on the purpose of analysis, particularly for the gas supply, configuration of the analysis flow line, and data processing. We hope that you make the most of this brochure to use Shimadzu gas chromatographs more effectively.

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Possible Detector Combinations

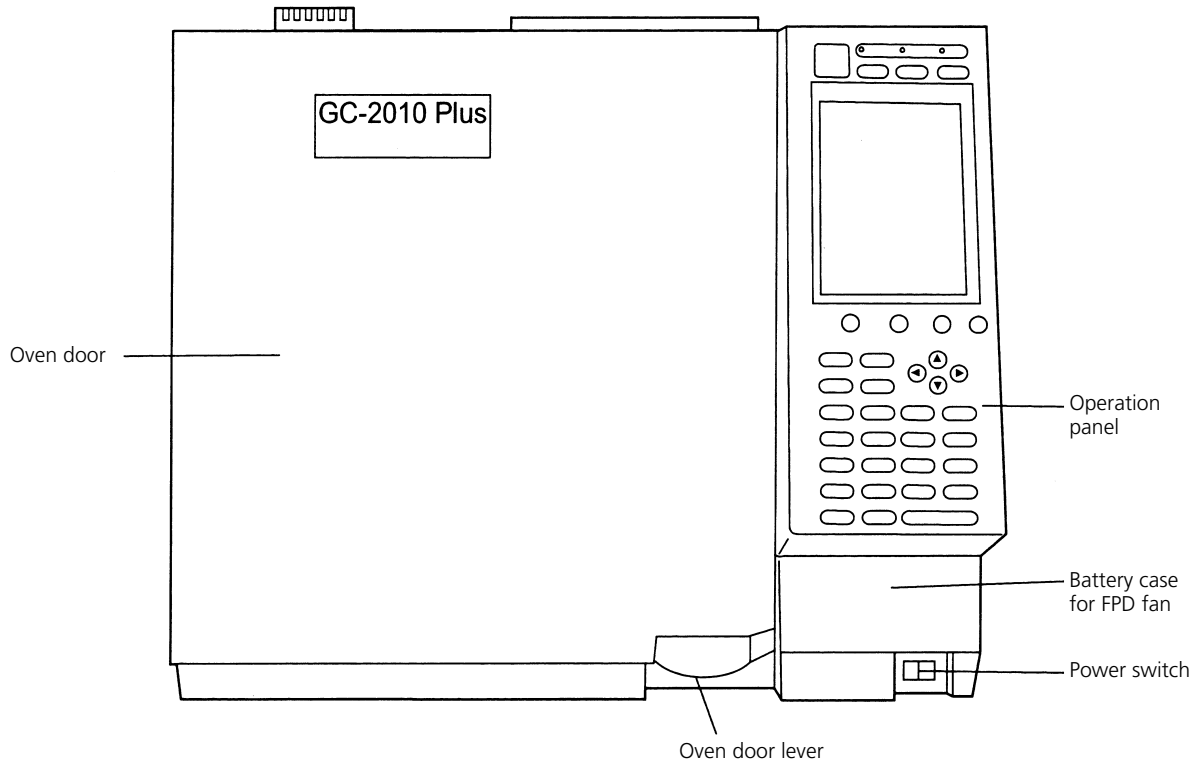
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Names and Functions of Parts

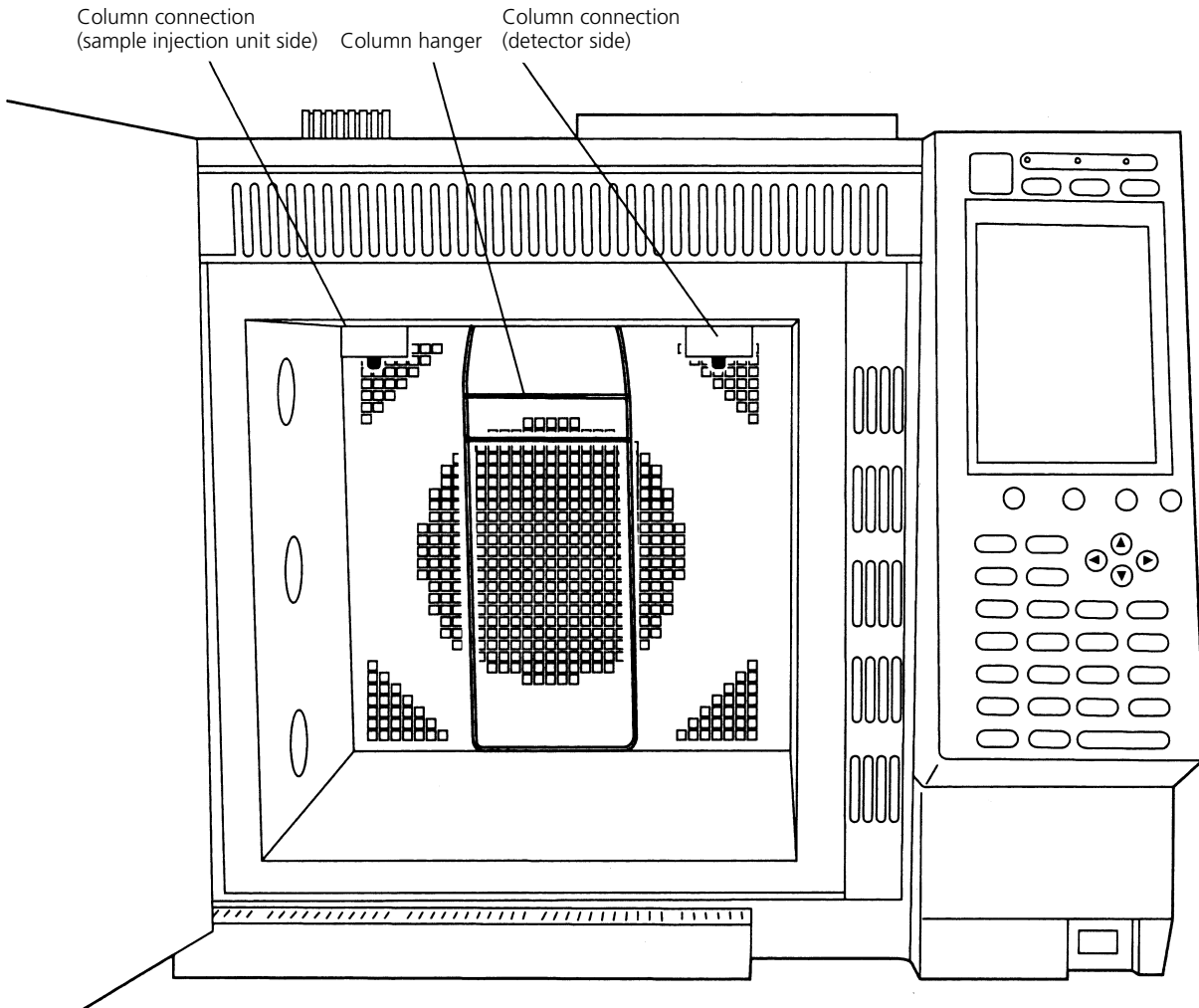
A gas chromatograph comprises a sample injection unit, column oven and detector.

GC-2010 Plus

■ Front

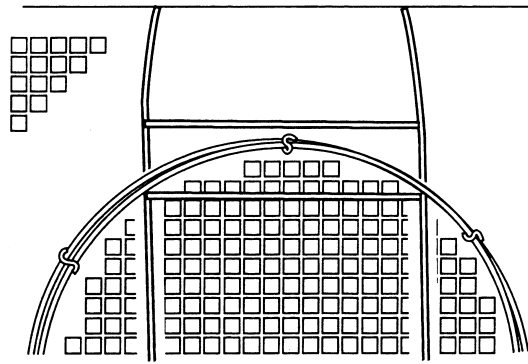
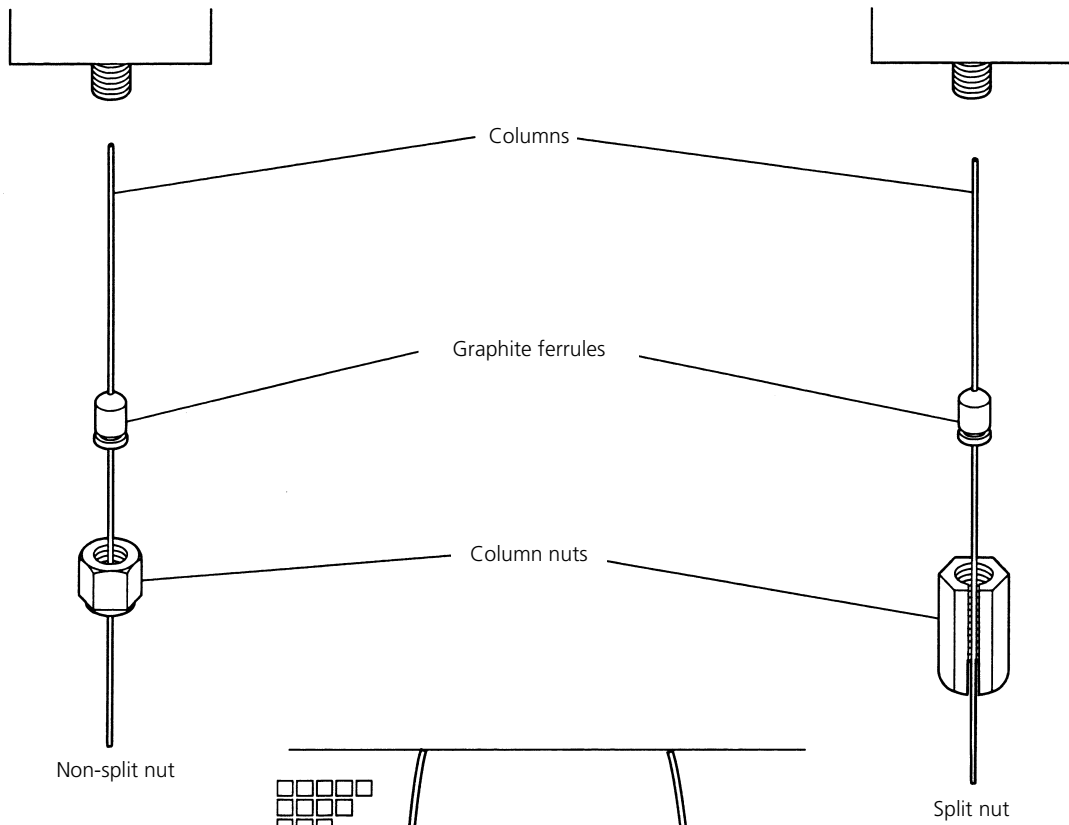


■ Oven Interior



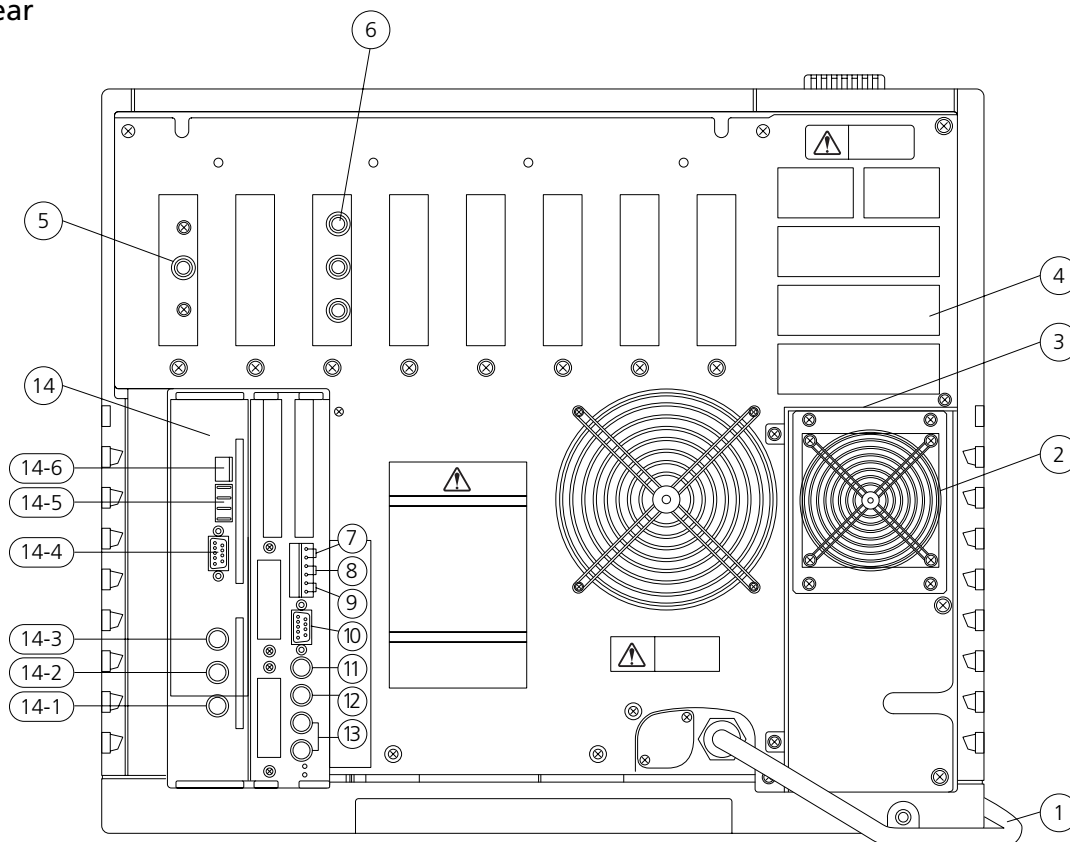
Close-up (1) (sample injection unit side)

Close-up (2) (detector side)



Close-up (3) (column hanger)

■ Rear

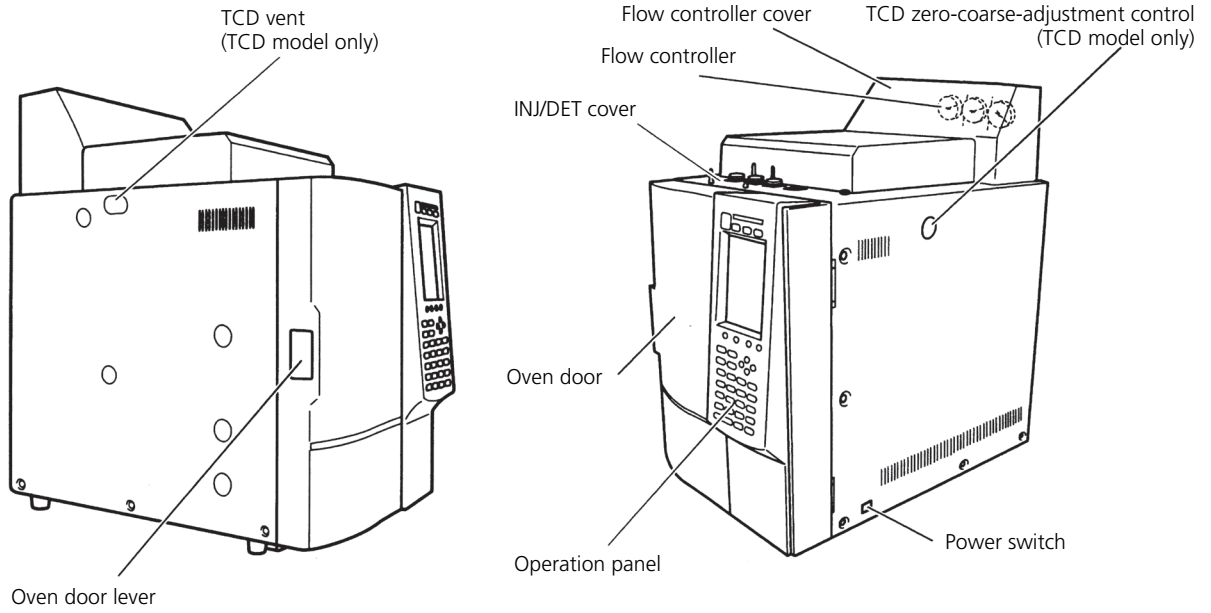


No.	Name	Description
1	Power cable	Supplies power to the unit.
2	Air inlet fan	Sends air to the column oven to cool it down.
3	Partition plate	Prevents the air from flowing back into the column oven.
4	Exhaust vent	Vents the column oven during cooling.
5	Carrier gas inlet	Supplies carrier gas.
6	Detector gas inlet	Supplies detector gas.
7	START signal input terminal	Connect an external device to this terminal to receive the START signal.
8	READY signal output terminal	Outputs the READY signal to an external device (such as the autoinjector).
9	START signal output terminal	Connect an external device to this terminal to output the START signal.
10	RS-232C connector	Connect the RS-232C cable (9-pin) to this connector. For I/O of digital signals.
11	Relay terminal	Switches ON/OFF at EVENT91 and 92.
12	AOC communication connector	Connect this connector to the RS-232C terminal in the power supply of the AOC-20i/s.
13	Detector signal output terminal (analog)	Outputs the detector signal to the analog input of a Chromatopac or other type of data processing unit. (Ch1, Ch2)
14	AOC power supply *	Connect the AOC-20i/s.
14-1	INJECTOR1 connector	Connect the autoinjector. (in single mode)
14-2	INJECTOR2 connector	Connect the main autoinjector in dual mode.
14-3	SAMPLER connector	Connect the subordinate autoinjector in dual mode.
14-4	RS-232C connector	Connector for external control
14-5	Fiber optic cable connector	Do not connect RS-232C and fiber optic cables simultaneously.
14-6	START OUT/READY IN connector	Inputs the READY signal from the gas chromatograph and outputs the START signal to the gas chromatograph.

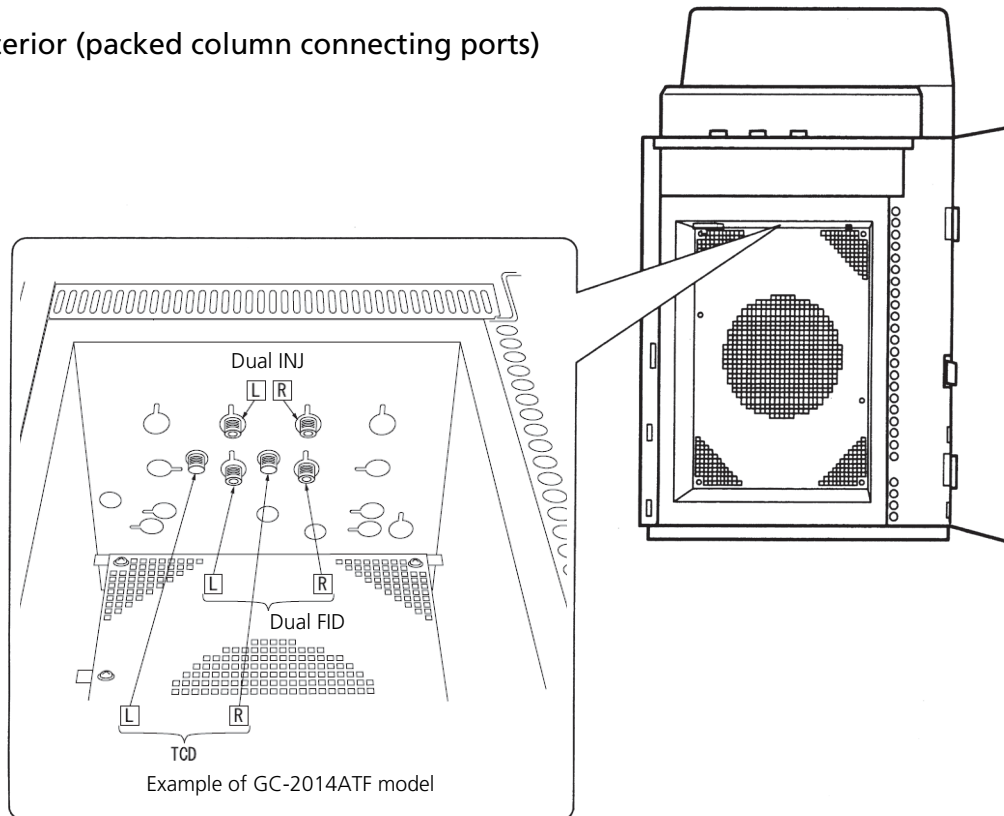
* Only for units with AOC.

GC-2014

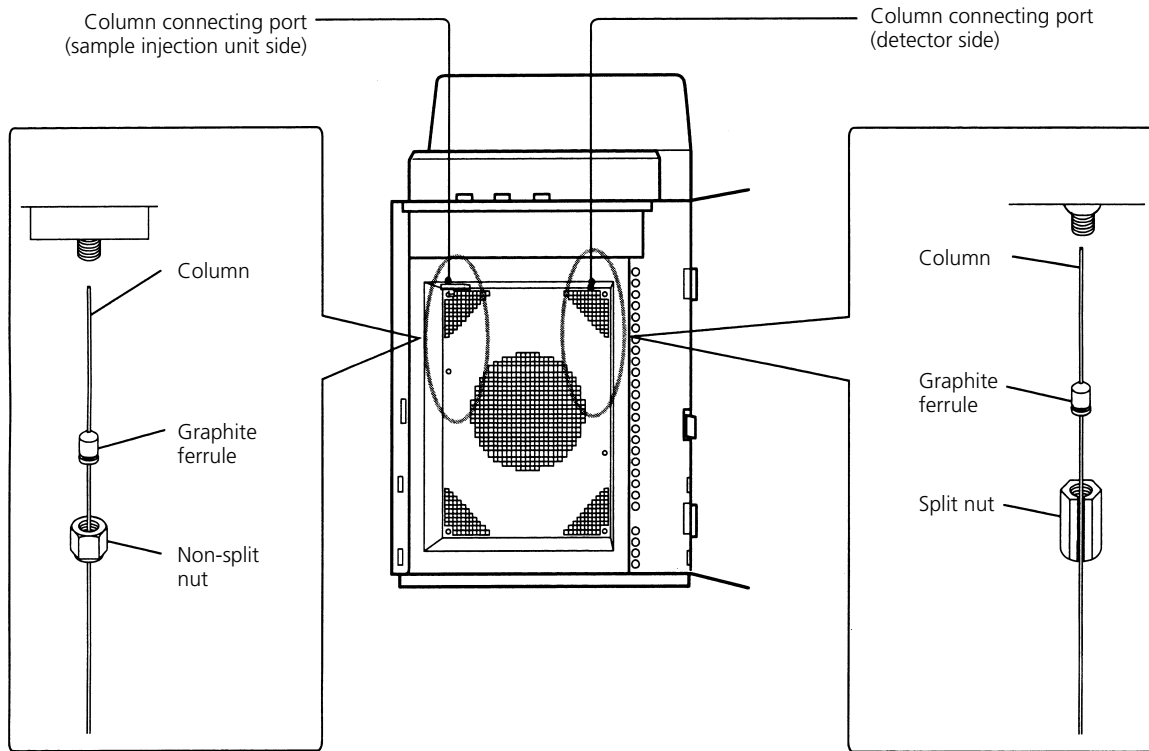
Overall View



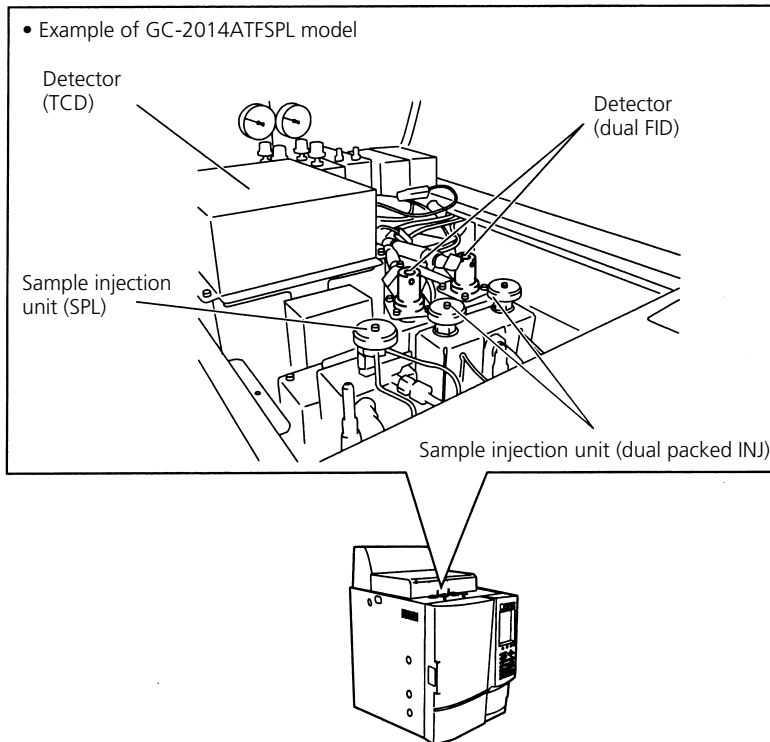
Oven Interior (packed column connecting ports)



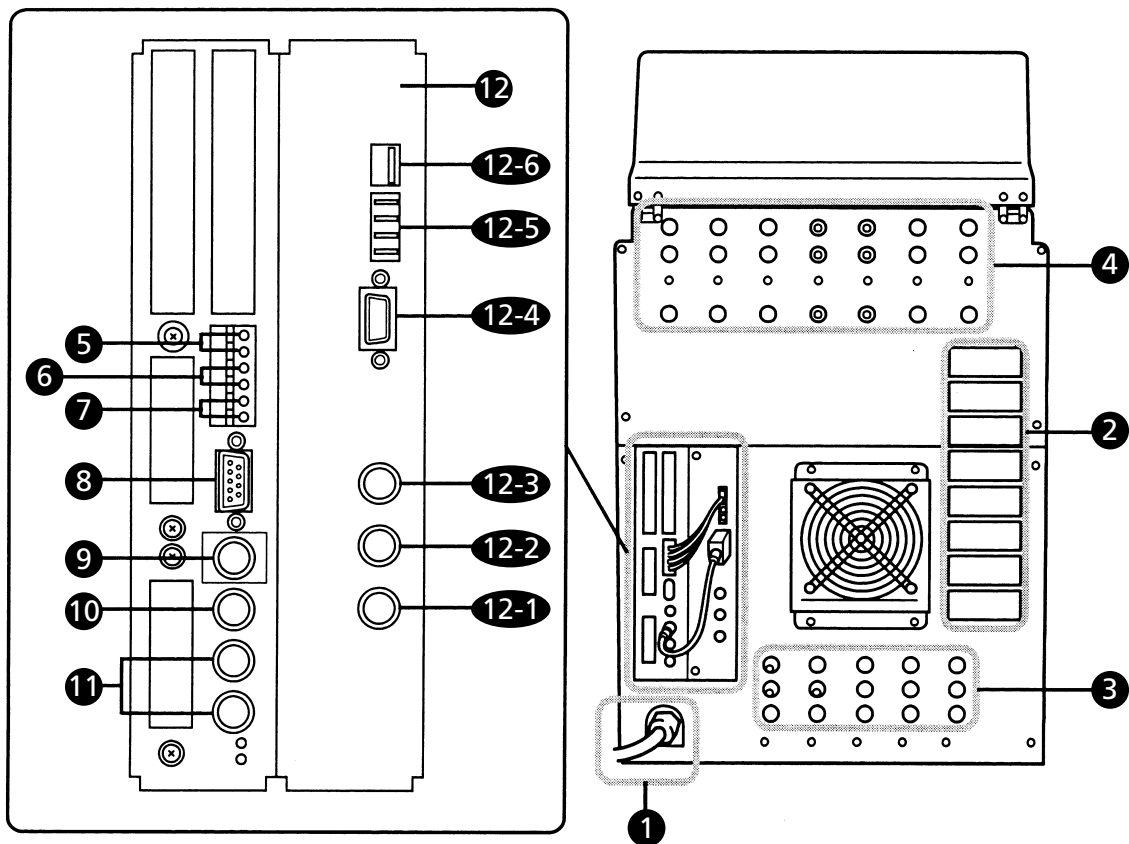
■ Oven Interior (capillary column connecting ports)



■ Inside of INJ/DET Cover



■ Rear

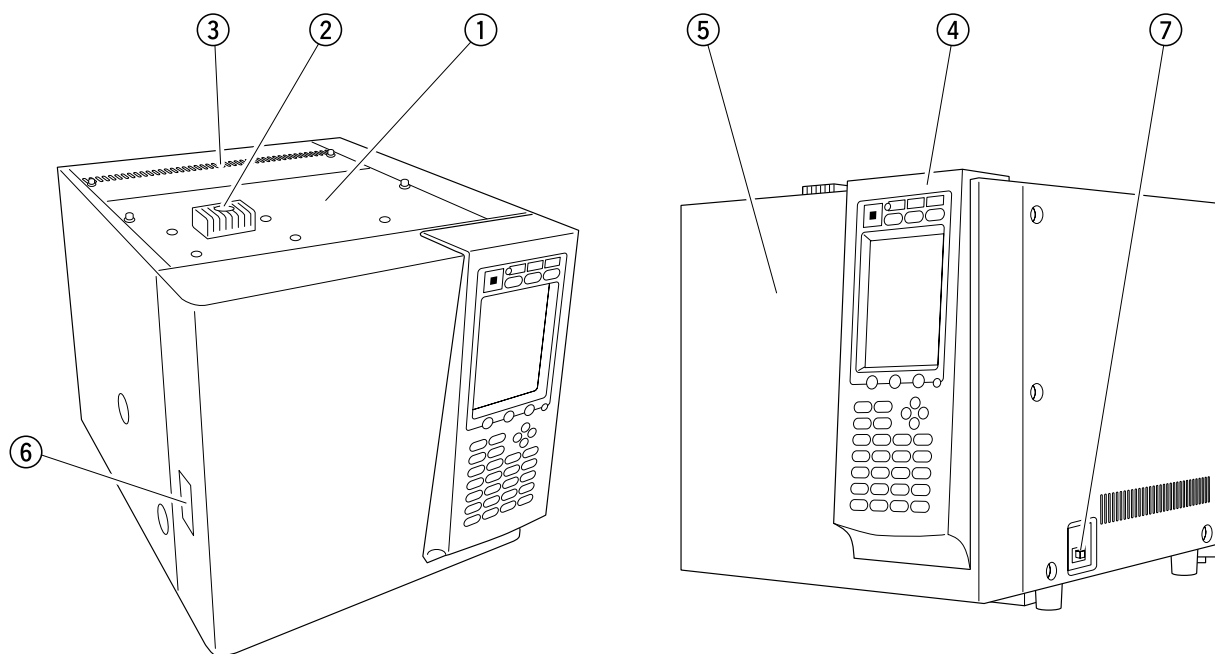


No.	Name	Description
1	Power cable	Supplies power to the unit.
2	Exhaust vent	Vents the column oven during cooling.
3	Gas inlet for AFC and APC	Supplies carrier gas etc.
4	Gas inlet for manual flow controller	Supplies detector gas etc.
5	START signal input terminal	Connect an external device to this terminal to receive the START signal.
6	READY signal output terminal	Outputs the READY signal to an external device (such as the autoinjector).
7	START signal output terminal	Connect an external device 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 signals.
9	Relay terminal	Switches ON/OFF at EVENT91 and 92.
10	AOC communication connector	Connect this connector to the RS-232C terminal in the power supply of the AOC-20i/s.
11	Detector signal output terminal (analog)	Outputs the detector signal to the analog input of a Chromatopac or other type of data processing unit. (Ch1, Ch2)
12	AOC power supply *	Connect the AOC-20i/s (option).
12-1	INJECTOR1 connector	Connect the autoinjector.
12-2	INJECTOR2 connector	(Not used.)
12-3	SAMPLER connector	Connect the autosampler.
12-4	RS-232C connector	Connector for external control
12-5	Fiber optic cable connector	Do not connect RS-232C and fiber optic cables simultaneously.
12-6	START OUT/READY IN connector	Inputs the READY signal from the gas chromatograph and outputs the START signal to the gas chromatograph.

* 111111111111111111111111111111111111

GC-2025

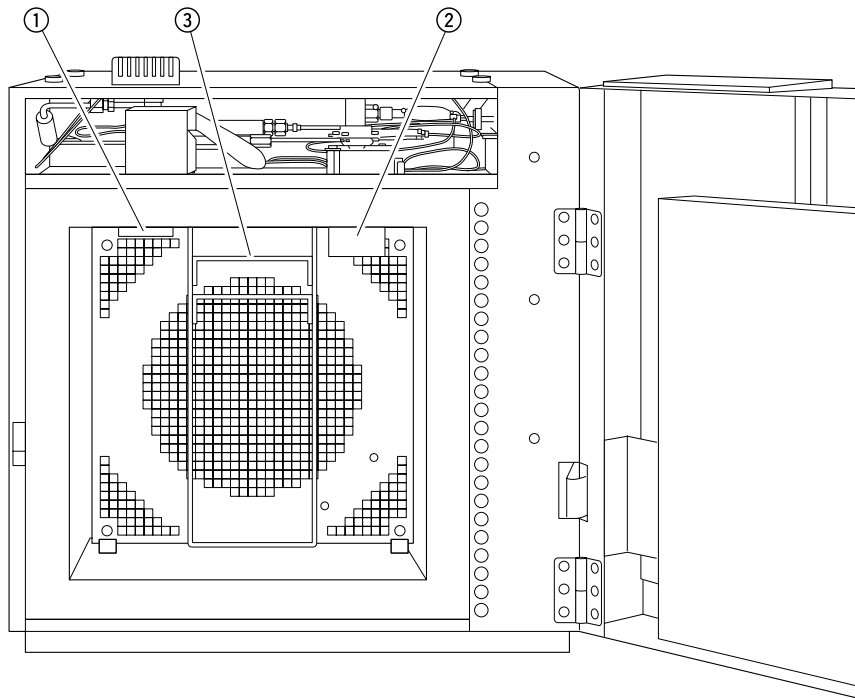
■ Overall View



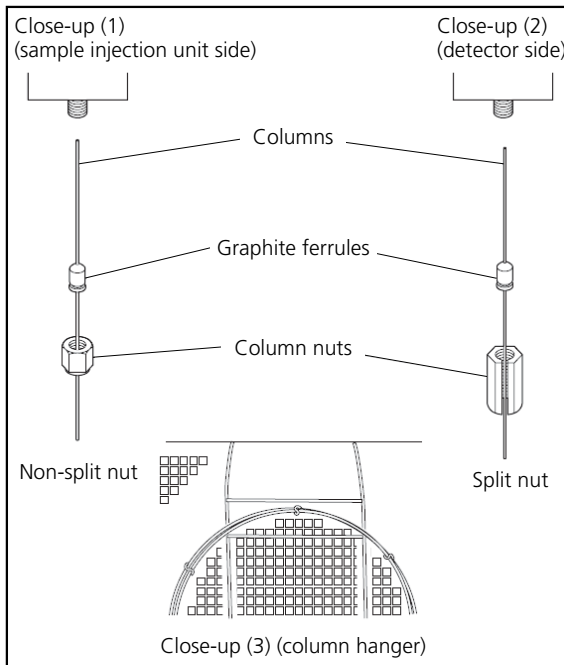
No.	Name
1	INJ/DET cover

No.	Name
2	Radiation fin cover
3	Gas controller cover
4	Key/Display
5	Oven door
6	Oven door lever
7	Power switch

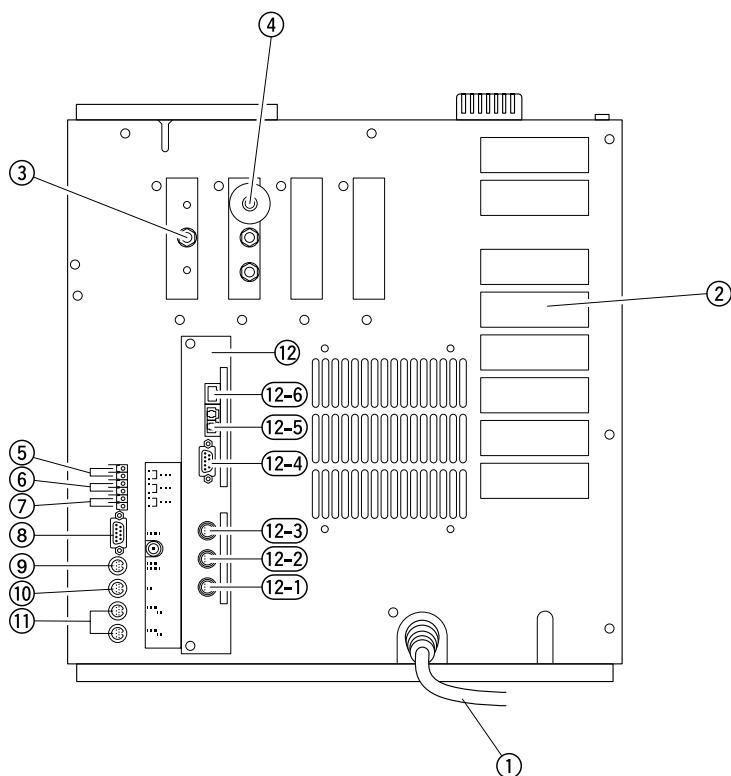
■ Oven Interior



No.	Name
1	Column connection (sample injection unit side)
2	Column connection (detector side)
3	Column hanger



■ Rear



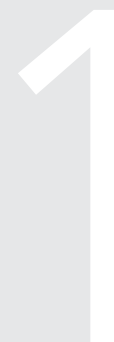
No.	Name	Description
1	Power cable	Supplies power to the unit.
2	Exhaust vent	Vents the column oven during cooling.
3	Carrier gas inlet	Supplies carrier gas.
4	Detector gas inlet	Supplies detector gas.
5	START signal input terminal	Connect an external device to this terminal to receive the START signal.
6	READY signal output terminal	Outputs the READY signal to an external device (such as the autoinjector).
7	START signal output terminal	Connect an external device 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 signals.
9	Relay terminal	Switches ON/OFF at EVENT91 and 92.
10	AOC communication connector	Connect this connector to the RS-232C terminal in the power supply of the AOC-20i/s.
11	Detector signal output terminal (analog)	Outputs the detector signal to the analog input of a Chromatopac or other type of data processing unit. (Ch1, Ch2)
12	AOC power supply *	Connect the AOC-20i/s (option).
12-1	INJECTOR1 connector	Connect the autoinjector.
12-2	INJECTOR2 connector	Not used with the GC-2025.
12-3	SAMPLER connector	Connect the autosampler.
12-4	RS-232C connector	Connector for external control
12-5	Fiber optic cable connector	Do not connect RS-232C and fiber optic cables simultaneously.
12-6	START OUT/READY IN connector	Inputs the READY signal from the gas chromatograph and outputs the START signal to the gas chromatograph.

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

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Preparing Gas

The performance of gas chromatographs changes greatly according to the gas that is supplied. Gas must be prepared carefully to ensure high-grade analysis.



Note: Descriptions in this chapter are basically as per Japanese regulations and may not be applicable in some countries. Please check your local regulations in advance and arrange the gas supply and necessary instruments in accordance with the regulations in each country.

1. Preparing Gas

1.1 Gas Cylinders

Use of ultrapure gas is vital to ensure that a gas chromatograph performs analysis satisfactorily. Any impurities in the gas will cause ghost peaks or noise in analysis. Even when ultrapure gas is used, ghost peaks or noise will occur if external air is mixed in with the gas by mistake.

Use the following gases to maintain the performance of the gas chromatograph.

Detector Type	Carrier Gas			Detector Gas		
	He (recommended)	N ₂ (may be used)	Other (Ar etc.)	H ₂	Air	Makeup Gas
TCD	99.999% min.	99.999% min.	99.999% min.			He, N ₂ , Ar, etc. 99.999% min.
FID	99.999% min.	99.999% min.		99.999% min.	Total hydrocarbons 1 ppm max.	He, N ₂ , etc. 99.999% min.
ECD	99.999% min.	99.999% min.				N ₂ , etc. 99.999% min.
FPD	99.999% min.	99.999% min.		99.999% min.	Total hydrocarbons 1 ppm max.	He, N ₂ , etc. 99.999% min.
FTD	99.999% min.			99.999% min.	Total hydrocarbons 1 ppm max.	He etc. 99.999% min.

* If gas that does not meet the above purities is used even once, the specifications of the minimum detection amount may not be satisfied even after the gas is changed to high-purity gas due to dirty piping, for example. Also, even if gas having the above purities is used, the various utilities (e.g. pressure regulator, piping, and valves) may not satisfy the specifications of the minimum detection amount.

* Various gases of purity 99.995 %, desiccated air with organic substances extracted, or air dehumidified by an oil-less compressor may be used only when high-sensitivity analysis is not required.

The following shows an example of procurement of gas cylinders.

Taiyo Nippon Sanso Corporation

	Type: G1	Type: G2	Type: G3
Helium (He)	99.99995%	99.999%	
Nitrogen (N ₂)	99.99995%	99.9998%	99.9995%
Hydrogen (H ₂)	99.99999%	99.999%	
Argon (Ar)	99.9999%	99.9995%	99.999%
Air	CO,CO ₂ ,THC<0.1ppm NOx,SO ₂ <0.01ppm	CO,CO ₂ ,THC<0.5ppm NOx,SO ₂ <0.05ppm	CO,CO ₂ ,THC<1ppm

ATTENTION

Nitrogen is used as the ECD makeup gas.

TIP

For example, a gas cylinder of purity 99.99 % is referred to as "four 9s."

TIP

"THC" is an abbreviation for "total hydrocarbons."

1. Preparing Gas

1.1 Gas Cylinders

Iwatani Corporation

Helium (He)

Type: Ultrapure Helium	Type: Ultrapure Helium
99.9999%	99.995%

Nitrogen (N₂)

Type: HQ-6	Type: HQ-5	Type: HQ Nitrogen
99.9999%	99.9995%	99.999%

Hydrogen (H₂)

Type: HQ-7	Type: HQ-6	Type: HQ-5
99.99999%	99.9999%	99.9995%

Argon (Ar)

Type: HQ-6	Type: HQ-5A	Type: HQ-5B	Type: HQ Argon
99.9999%	99.9995%	>99.999%	≥99.999%

Air

* Supplied by Sumitomo Seika Chemicals Co., Ltd. For details, see the section for "Sumitomo Seika Chemicals Co., Ltd."

Takachiho Inc.

	Type: T.E.R.R.A.	Type: S	Type: R	Type: P
Helium (He)	99.99995% * VOC-free	99.9995%	99.999%	99.995%
Nitrogen (N ₂)	99.99995% * VOC-free	99.99995%	99.999%	99.99%
Hydrogen (H ₂)		99.99995%	99.9995%	99.99%
Argon (Ar)		99.9999%	99.9995%	99.995%
Air		CO, CO ₂ , THC, NO _x <0.1ppm	CO, THC<1ppm CO ₂ <3ppm	

ATTENTION

Consult the respective gas manufacturer when actually procuring gas.

1. Preparing Gas

1.1 Gas Cylinders

Sumitomo Seika Chemicals Co., Ltd.

	Type: ZERO-U	Type: ZERO-F	Type: ZERO-A
Helium (He)	99.9999%		99.999%
Nitrogen (N ₂)	99.9999%		99.999%
Hydrogen (H ₂)	99.9999%	99.9995%	99.998%
Argon (Ar)	99.9999%		99.999%
Air	CO,CO ₂ <1ppm THC<0.1ppm NO _x ,SO ₂ <0.01ppm H ₂ O<5ppm	CO,CO ₂ <1ppm THC<0.5ppm H ₂ O<5ppm	CO<1ppm CO ₂ <2ppm THC<3ppm H ₂ O<10ppm

Hydrogen Generator

Hydrogen generator made by Parker Hannifin



P/N 221-73500 hydrogen generator A9150-100

Specifications

Principle of generation	Proton exchange membrane (PEM) water electrolysis system
Purity of generated gas	99.995 % min. (excluding moisture)
Max. generation flowrate	160mL/min

ATTENTION

Hydrogen gas generators are generally regarded as being safer than hydrogen gas cylinders filled at high pressure.

ATTENTION

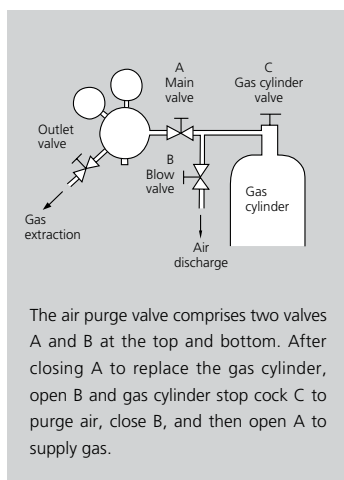
Water of specific resistance 5.0 MΩ·cm or more must be supplied to the hydrogen gas generator.

1. Preparing Gas

1.2 Regulators

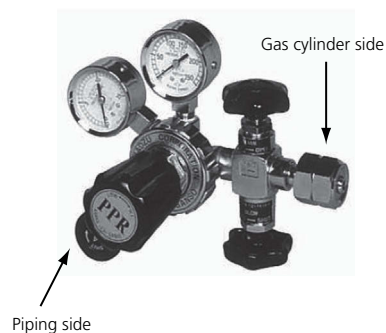
A pressure regulator must be connected to the gas cylinder to supply gas to the gas chromatograph. There are two types of pressure regulator, the PPR series for high-purity gas and the custom series that cannot be used for high-sensitivity analysis.

- PPR series pressure regulators (for high-purity gas)



When performing high-sensitivity analysis, dirt originating from the pressure regulator, of course, becomes problematic during use of high-purity gas. Also, if air (oxygen) that enters the pressure regulator during replacement is introduced into the gas chromatograph, this may promote the oxidation of the column liquid phase. PPR series pressure regulators generate extremely little dirt and are ideal for high-sensitivity analysis. They also are equipped with an air purge valve that allows air mixed in at replacement to be removed.

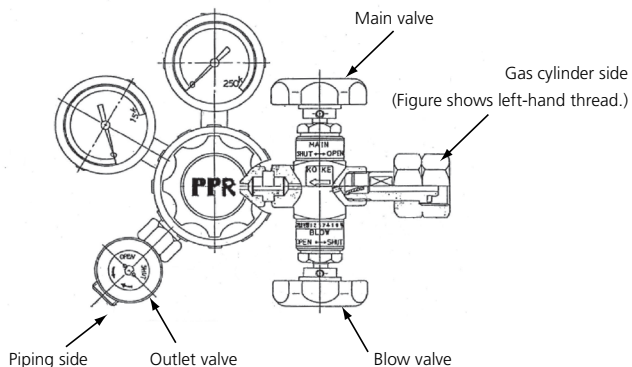
When performing high-sensitivity analysis on a GC-2010 Plus or even on other GCs, Be sure to use the PPR series pressure regulator. Furthermore, the purity of supplied gas can be further improved by connecting a gas filter (see pp. 20 to 22). (The gas filter must be maintained periodically since its effectiveness is limited.) Ghost peaks originating from the purge gas sometimes appear also when performing a nitrogen gas purge by sample enrichment. Use the PPR series pressure regulator for gas purging as well.



PPR series pressure regulator (for high-purity gas)

Part Name	Applications	P/N	Gas-Cylinder-Side Screw	Piping-Side Screw
PPR-N2	For nitrogen, argon, air (blue)	221-35999-01	Right-hand thread (W22-14, right)	Right-hand thread (M16 × 1.5, right)
PPR-H2	For hydrogen (red)	221-35999-02	Left-hand thread (W22-14, left)	Right-hand thread (M16 × 1.5, left)
PPR-He	For helium (yellow)	221-35999-03	Left-hand thread (OGA-350, left)	Right-hand thread (M16 × 1.5, right)

PPR Series External View



TIP

A slit is provided on the nut of left-hand threads to distinguish it from right-hand threads.

1. Preparing Gas

1.2 Regulators

- Custom series pressure regulators

This series can be used in TCD or FID analysis that does not require much high sensitivity in packed column analysis. To reduce dirt originating from the pressure regulator, be sure to use a gas filter (see pp. 20 to 22). (The gas filter must be maintained periodically since its effectiveness is limited.) Do not use custom series regulators when performing high-sensitivity analysis.

Part Name	Applications	P/N	Pump-Side Screw	Piping-Side Screw
N2 regulator	For nitrogen, argon, air (gray)	042-41099-01	Right-hand thread	Right-hand thread
H2 regulator	For hydrogen (red)	042-41099-02	Left-hand thread	Left-hand thread
He regulator	For helium (yellow)	042-41099-03	Left-hand thread	Right-hand thread



Custom series pressure regulator

1. Preparing Gas

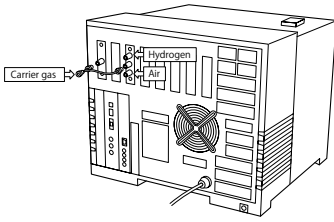
1.3 Pipes

Joints for connecting external piping are located on the instrument rear.

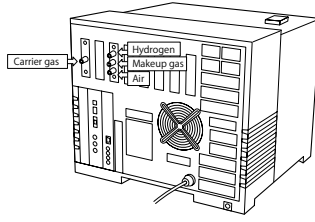
The joints are indicated as follows for identifying piping.

- Carrier gas CARRIER
- Makeup gas MAKE UP
- Hydrogen HYDROGEN
- Air AIR

When the carrier gas and makeup gas are the same type



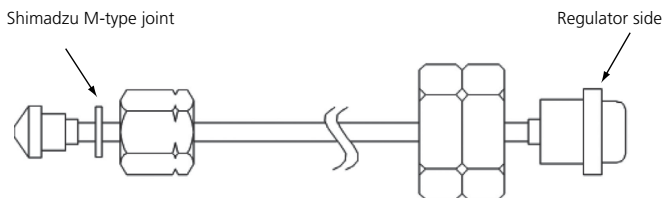
When the carrier gas and makeup gas are different types



For details on piping parts to connect to the regulator, see the following table.

GC	Part Name	P/N	Regulator-Side Joint	GC-Side Joint	
Common	Gas conduit	2.5 m	201-48067	Right-hand thread	Right-hand thread
		5 m	201-48067-05		
		10 m	201-48067-10		
		15 m	201-48067-15		
GC-2014	Hydrogen gas conduit	2.5 m	221-18990-25	Left-hand thread	Right-hand thread
		5 m	221-18990-50		
		10 m	221-18990-00		
GC-2010 Plus GC-2025	Hydrogen gas conduit	2.5 m	221-73474-25	Left-hand thread	Left-hand thread
		5 m	221-73474-50		
		10 m	221-73474-00		
Common	Air conduit (set of 2 pipes, total 3 m)	201-48070	-	All right-hand thread	

The following is an example of piping to connect to the regulator.



ATTENTION

For piping from gas cylinders outdoors up to the gas extraction port indoors, use piping whose inner surface has been cleaned with solvent. Even new piping is sometimes dirty. In particular, when using ECD, it is recommended to locate the gas cylinder next to the GC main unit and shorten the piping.

ATTENTION

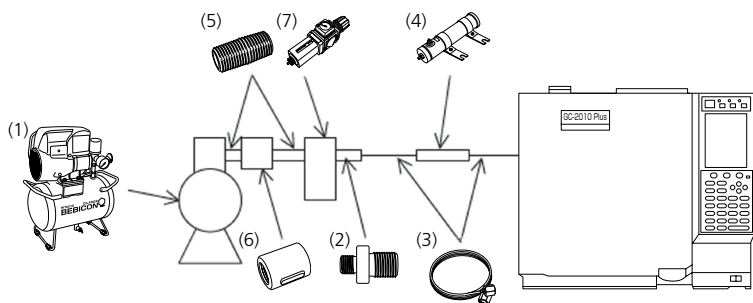
The hydrogen gas conduit used for the GC-2010 Plus/GC-2025 differs from that used for the GC-2010 and GC-2014. The joints on the hydrogen gas conduit for the GC-2010 Plus/GC-2025 are left-hand threaded (with reverse thread) to prevent erroneous piping connections.

1. Preparing Gas

1.3.1 Pipes: For Air Compressor

The following parts are required to use an air compressor.

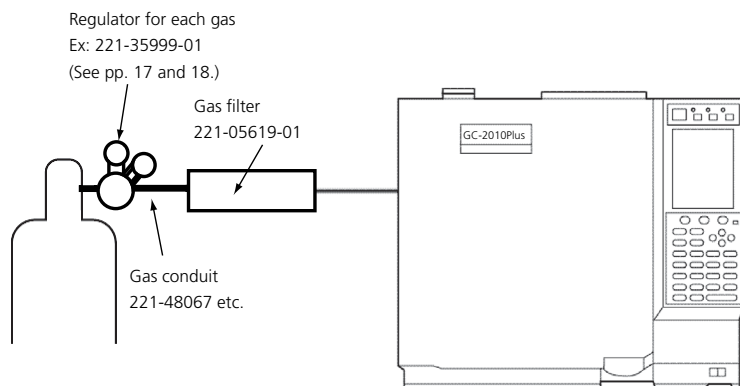
(GC-2010 Plus/GC-2010/GC-2014/GC-2025)



No.	Part Name	P/N
(1)	Air compressor	221-72380
(2)	Compressor joint	201-49801
(3)	Air pipe (set of 2 pipes)	201-48070
(4)	Silica gel container	201-36688
(5)	Nipple, barrel SGP1/4	035-45332
(6)	Socket, FCMB1/4	035-42002
(7)	Air filter regulator 1/4, with pressure gauge	221-56748-03

1.3.2 Pipes: For Carrier Gas, Makeup Gas, Air (gas cylinder)

(GC-2010 Plus/GC-2010/GC-2014/GC-2025)



ATTENTION

For the FTD detector, use gas cylinder air, not an air compressor. The baseline does not stabilize by air compressor air.



Air compressor



Compressor joint



Air pipe



Silica gel container



Nipple, barrel SGP1/4



Socket, FCMB1/4



Air filter regulator

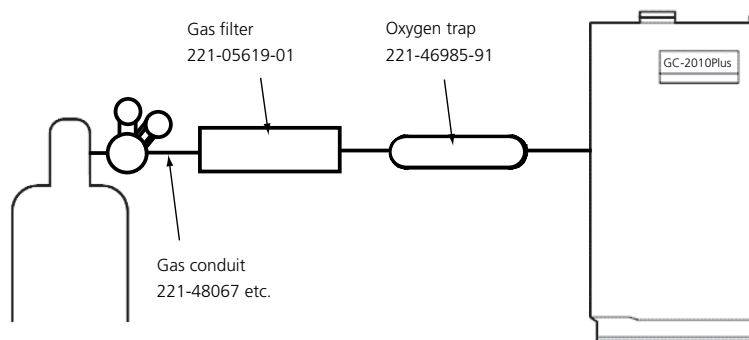
Conduit connection

JIS standard B6803 joints are used for conduit mounting ports.

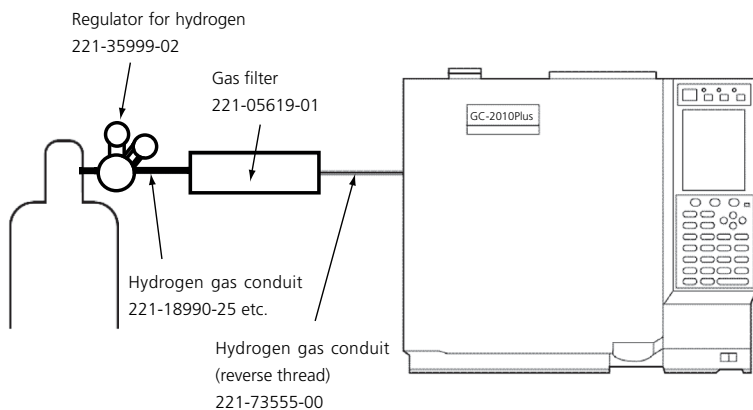
1. Preparing Gas

1.3.3 Pipes: For ECD (makeup gas: nitrogen)

The oxygen trap 221-46985-91 is required for the nitrogen gas line used for ECD. When using the oxygen trap jointly with a gas filter, connect the oxygen trap between the gas filter and the gas chromatograph.
(GC-2010 Plus/GC-2010/GC-2014)



1.3.4 Pipes: For Hydrogen Gas (GC-2010 Plus/GC-2025)



TIP

The gas filter (221-05619-01) is provided with MF (2 × 1 × 100) MF piping.

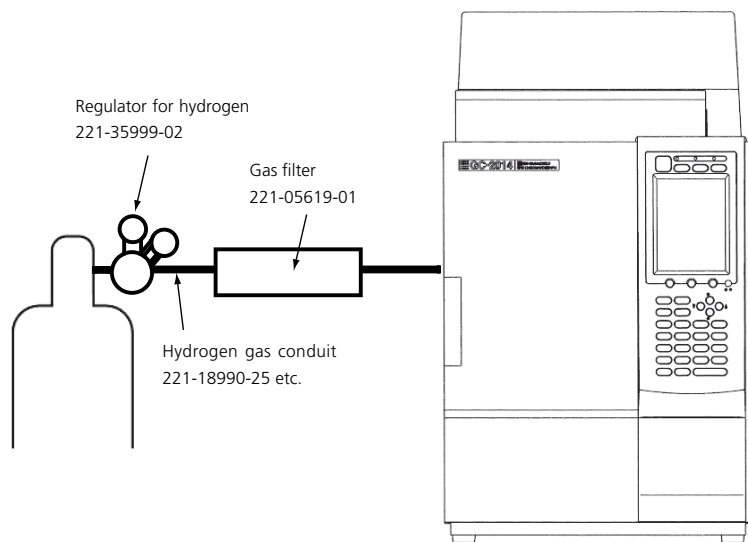
The oxygen trap (221-46985-91) is provided with M-type ferrules (male × 1 location, female × 1 location).

ATTENTION

The GC-2010 Plus and GC-2025 use left-hand threads only on hydrogen gas supply joints to prevent accidents caused by erroneous piping.

1. Preparing Gas

1.3.5 Pipes: For Hydrogen Gas (GC-2010/GC-2014)



1.4 M-Type and G-Type Pipes

There are two types of piping joints used on Shimadzu gas chromatographs, M-type and G-type.

- M-type** ➔ These adopt a metal contact system by which metal surfaces are pressure-welded, and are used for connecting the main piping inside and outside the gas chromatograph.
- G-type** ➔ These adopt a gasket system by which silicon or aluminum packing is fitted into connecting sections for tightening, and are used mainly for SUS columns.

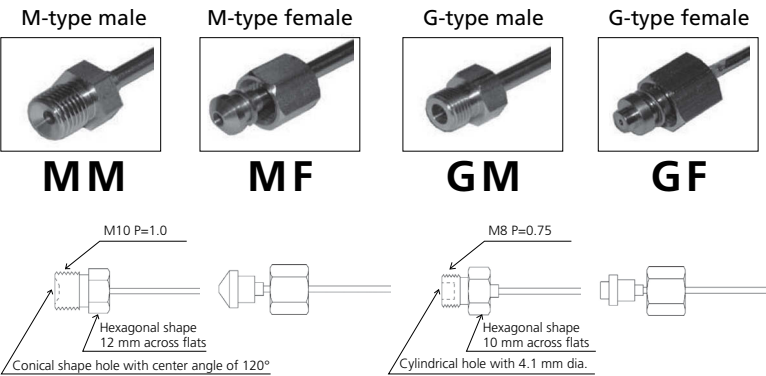
With either of these, the socket is butt-fitted against the nipple welded (or brazed) to the end of the pipe, and the joint is tightened by the male screw of the socket and nut provided with the nipple.

G-type piping joint needs two or three aluminum packing.
 Aluminum packing (100 pieces per unit) 201-35183
 Aluminum packing (500 pieces per unit) 201-35183-84

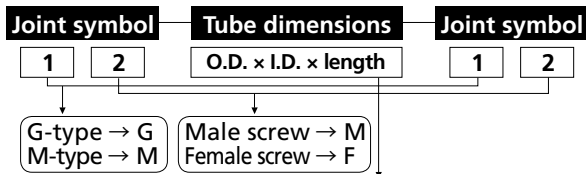
1. Preparing Gas

1.4 M-Type and G-Type Pipes

Joint shapes



Annotation conventions



Tube dimensions are indicated in mm units. ("mm" may be omitted.)
 Dimensions exceeding 1 meter may be indicated as "M." Append the letter "M" to the end of the numeral.
 The unit is not required for inch size O.D. tubes.
 Example: 100 mm → 100, 1500 mm → 1.5M

* When there is a joint on one side and the intermediate tube is cut off on the other side, enter "XX" at the joint symbol position.

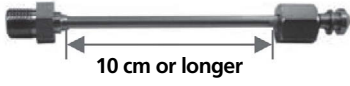



Stainless steel pipes



Lead tube
 This is a tube 10 cm or longer with a joint attached to one or both of its ends.

Connector
 This is the same as a lead tube but is less than 10 cm long.

Joint
 All-in-one structure





3-way block joint
PTFE connection joint

1. Preparing Gas

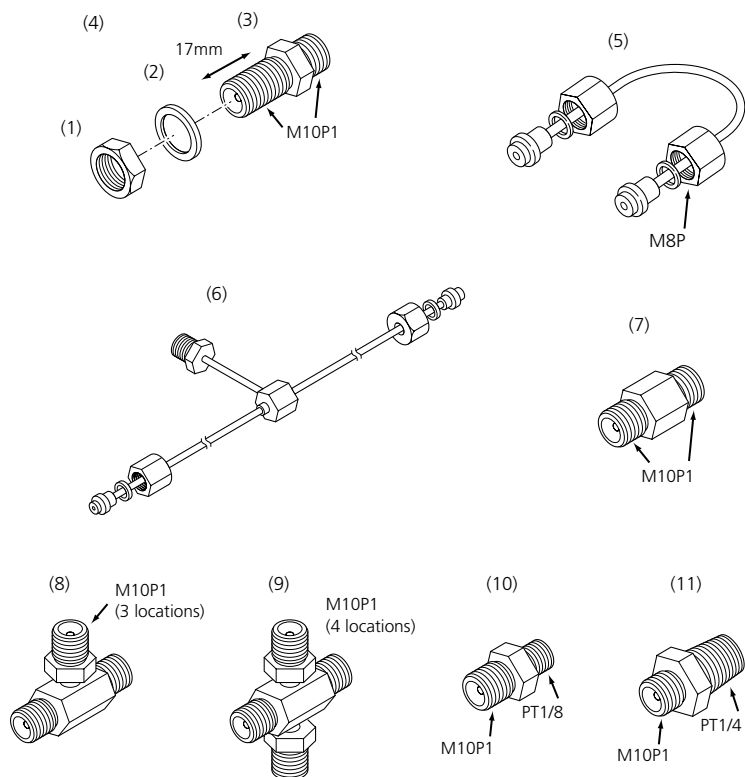
1.4 M-Type and G-Type Pipes

■ List of M-Type and G-Type Pipes

O.D. 2 mm × I.D. 1 mm Type	
P/N	Specifications
201-48557-05	MF(2×1×50)MM
201-48557-10	MF(2×1×100)MM
201-48557-15	MF(2×1×150)MM
201-48557-25	MF(2×1×250)MM
201-48557-30	MF(2×1×300)MM
201-48557-36	MF(2×1×360)MM
201-48557-40	MF(2×1×400)MM
201-48557-45	MF(2×1×450)MM
201-48557-50	MF(2×1×500)MM
201-48557-60	MF(2×1×600)MM
201-48557-80	MF(2×1×800)MM
201-48557-00	MF(2×1×1000)MM
201-48555-08	MF(2×1×80)MF
201-48555-10	MF(2×1×100)MF
201-48555-15	MF(2×1×150)MF
201-48555-16	MF(2×1×160)MF
201-48555-20	MF(2×1×200)MF
201-48555-22	MF(2×1×220)MF
201-48555-24	MF(2×1×240)MF
201-48555-26	MF(2×1×260)MF
201-48555-30	MF(2×1×300)MF
201-48555-36	MF(2×1×360)MF
201-48555-40	MF(2×1×400)MF
201-48555-44	MF(2×1×440)MF
201-48555-45	MF(2×1×450)MF
201-48555-50	MF(2×1×500)MF
201-48555-60	MF(2×1×600)MF
201-48555-65	MF(2×1×650)MF
201-48555-80	MF(2×1×800)MF
201-48555-00	MF(2×1×1000)MF
201-48563-10	MF(2×1×100)GM
201-48563-20	MF(2×1×200)GM
201-48563-30	MF(2×1×300)GM
201-48563-50	MF(2×1×500)GM
201-48563-60	MF(2×1×600)GM
201-48563-70	MF(2×1×700)GM
201-48563-75	MF(2×1×750)GM
201-48563-80	MF(2×1×800)GM
201-48563-00	MF(2×1×1000)GM
201-48560-05	MF(2×1×50)GF
201-48560-10	MF(2×1×100)GF
201-48560-20	MF(2×1×200)GF
201-48560-30	MF(2×1×300)GF
201-48560-35	MF(2×1×350)GF
201-48560-40	MF(2×1×400)GF
201-48560-50	MF(2×1×500)GF
201-48560-60	MF(2×1×600)GF
201-48560-70	MF(2×1×700)GF
201-48560-00	MF(2×1×1000)GF
201-48559-10	MM(2×1×100)MM
201-48559-20	MM(2×1×200)MM
201-48559-30	MM(2×1×300)MM
201-48559-50	MM(2×1×500)MM
201-48559-00	MM(2×1×1000)MM
201-48561-10	MM(2×1×100)GF
201-48561-30	MM(2×1×300)GF
201-48561-50	MM(2×1×500)GF
201-48561-75	MM(2×1×750)GF
201-48561-80	MM(2×1×800)GF
201-48561-00	MM(2×1×1000)GF
201-48564-05	MM(2×1×50)GM
201-48564-20	MM(2×1×200)GM
201-48564-30	MM(2×1×300)GM
201-48564-00	MM(2×1×1000)GM
201-48562-04	GF(2×1×40)GF
201-48562-06	GF(2×1×60)GF
201-48562-10	GF(2×1×100)GF
201-48562-20	GF(2×1×200)GF
201-48562-30	GF(2×1×300)GF
201-48562-40	GF(2×1×400)GF
201-48562-50	GF(2×1×500)GF
201-48562-70	GF(2×1×700)GF
201-48562-75	GF(2×1×750)GF
201-48562-00	GF(2×1×1000)GF
201-48565-10	GF(2×1×100)GM
201-48565-20	GF(2×1×200)GM
201-48565-30	GF(2×1×300)GM
201-48565-50	GF(2×1×500)GM
201-48565-00	GF(2×1×1000)GM
201-48566-10	GM(2×1×100)GM
201-48566-20	GM(2×1×200)GM
201-48566-30	GM(2×1×300)GM

1. Preparing Gas

1.5 Other Pipe Parts



No.	Part Name	P/N
(1)	Nut, M10	201-46833
(2)	Washer, M10	201-30211-02
(3)	For securing 2-way joint	201-30270
(4)	For securing 2-way joint (with nut, washer)	201-30270-91
(5)	Column coupling tube	201-35041-01
(6)	Parallel splitting branch pipe	201-35555
(7)	2-way joint	201-30219
(8)	3-way joint	221-15580-03
(9)	4-way joint	221-15580-04
(10)	Socket, MM-PT1/8	221-03106
(11)	Socket, MM-PT1/4	201-34675

ATTENTION

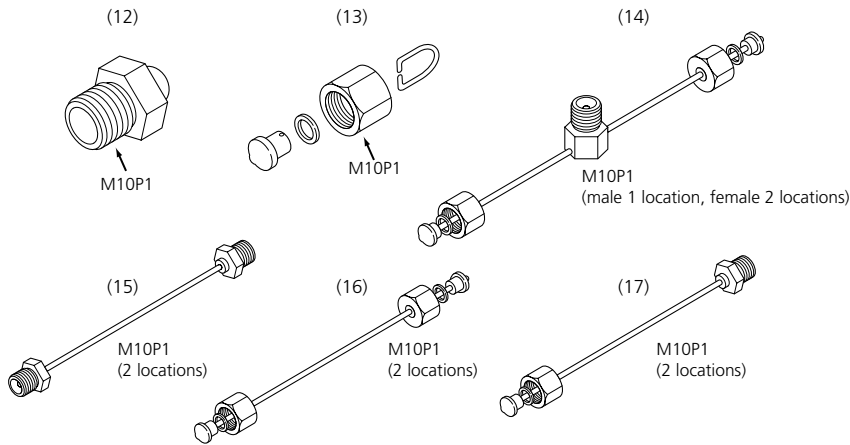
"M10P1" refers to a JIS standard thread shape with an O.D. of 10 mm and a pitch of 1 mm.

PT1/8 or PT1/4 refers to JIS standard taper threads. These are different from US-made NPT threads.

(7) is an M-type male/M-type male connection joint. (4) is also an M-type male/M-type male connection joint except that it is used for securing onto metal plates etc.

1. Preparing Gas

1.5 Other Pipe Parts



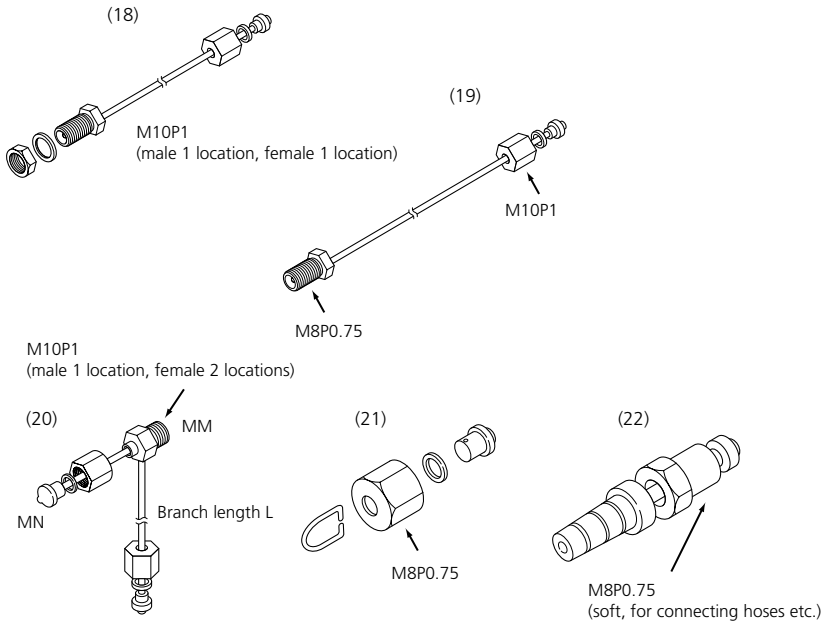
No.	Part Name	P/N	
(12)	Solid socket, MMO	201-30019	
(13)	M-type plug (pack of 2)	221-35566-91	
(14)	Branch pipe, MF-MM-MF	201-48386	
(15)	Pipe, MM-MM L-500	201-48559-50	
(16)	Pipe, MF-MF	201-48555-**	See pp. 23 and 24.
(17)	Pipe, MF-MM	201-48557-**	See pp. 23 and 24.

TIP

The pipe length of (16) and (17) can be selected.

1. Preparing Gas

1.5 Other Pipe Parts



ATTENTION

(20) and (14) are identical branch pipes except that (20) is used when the pitch of the male joint on the mating side is wider.

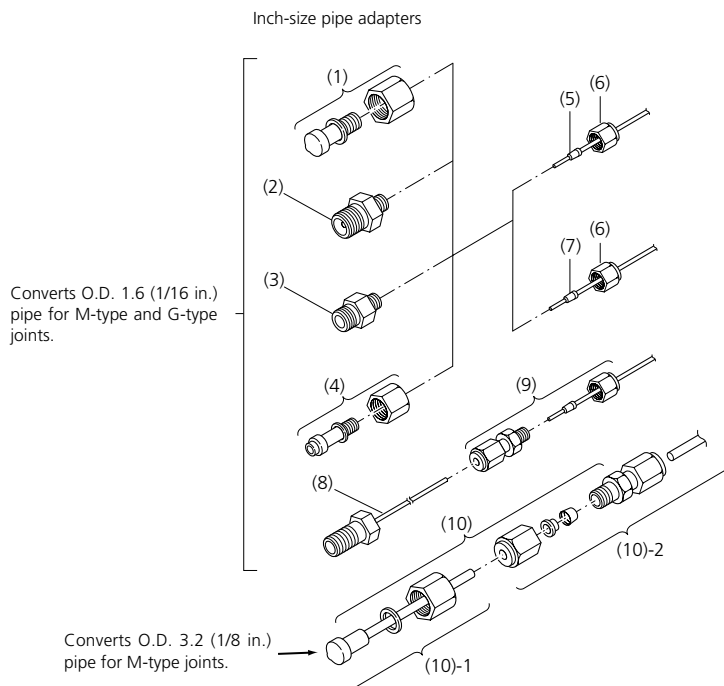
TIP

The pipe length of (18) and (19) can be selected.

No.	Part Name	P/N	
	Pipe, MF-GF	201-48560-**	See pp. 23 and 24.
(18)	Pipe, MF-MML L-400	201-48569-40	
(19)	Pipe, MM-GF	201-48561-**	See pp. 23 and 24.
	Pipe, MM-GF L-300	201-48561-30	
	Pipe, MM-GF L-500	201-48561-50	
(20)	Branch pipe, L-1 m	221-09688-91	
	Branch pipe, L-1.5 m	221-09688-94	
(21)	G-type plug (pack of 2)	221-35566-92	
(22)	Pipe insert G6	201-36364-01	

1. Preparing Gas

1.5 Other Pipe Parts



No.	Part Name	P/N
(1)	Adapter nipple MN-1.6L	221-35001-91
(2)	Union MN-1.6L	221-35002
(3)	Union GM-1.6L	221-35003
(4)	Adapter nipple MN-1.6L	221-35004-91
(5)	Ferrule	228-16000-84
(6)	Nut 1.6N	228-16002
(7)	Ferrule 1.6F fluoropolymer	228-16007-84
(8)	Pipe MML-1.6 L-150	221-26561-91
(9)	Union 1.6U	228-16053-91
(10)	Swage lock adapter (with union)	221-25975-92
(10)-1	Swage lock adapter 1/8	221-25975-91
(10)-2	Union B-200-6 1/8	035-60402
	SUS pipe 1.6 dia. × 0.5 dia. × 2 m	228-36995-94
	SUS pipe 1.6 dia. × 0.8 dia. × 2 m	228-36993-99
	SUS pipe 1.6 dia. × 1.0 dia. × 2 m	228-36993-98
	PTFE pipe 1.6 dia. × 0.25 dia.	016-37558
	SUS pipe 3.2 dia. × 2.1 dia.	670-10006-19

Names and Functions of Parts

1 Preparing Gas

2 Sample Injection

3 Installing the Column

4 Data Processing

5 Sample Injection Units

6 Detectors

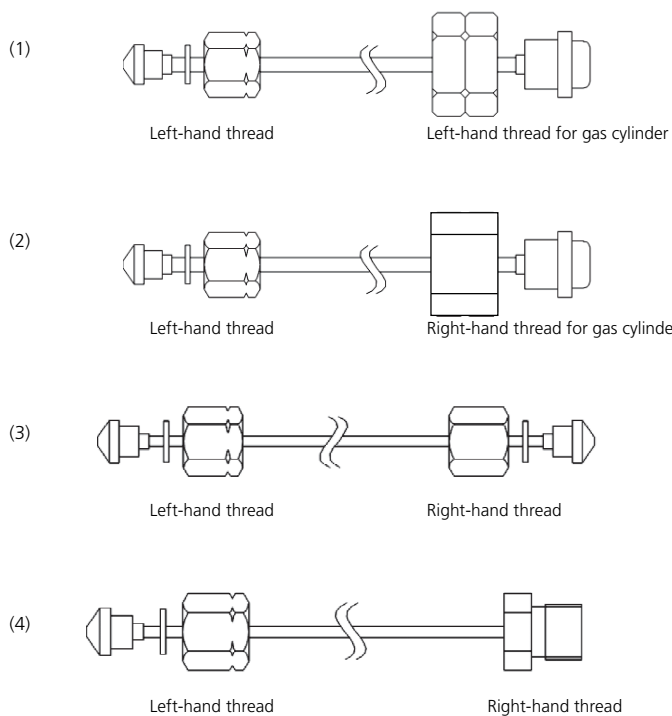
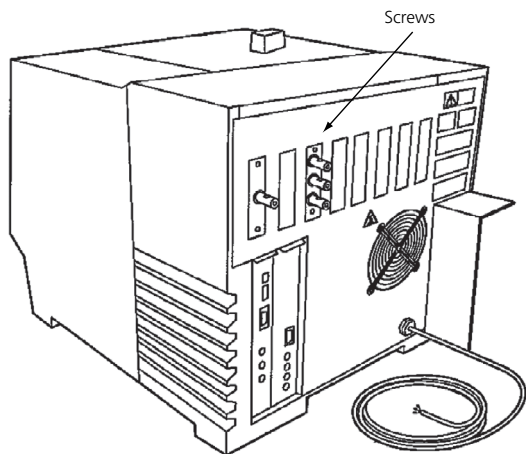
1. Preparing Gas

1.5 Other Pipe Parts

Left-hand-threaded pipes

On the GC-2010 Plus/GC-2025, the ferrules for the hydrogen piping are left-hand threaded (with reverse thread) as shown in the figures below. This is to eliminate erroneous piping between the hydrogen pipes and other pipes and to prevent accidents.

Ferrules (male screws) for the hydrogen piping are left-hand threaded.

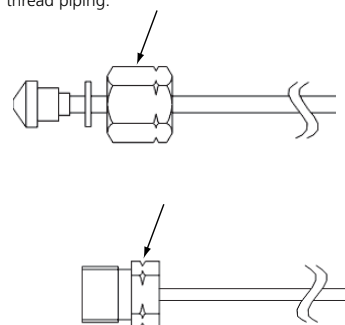


ATTENTION

Piping on the GC-2010 Plus/GC-2025 other than hydrogen piping uses regular right-hand threads.

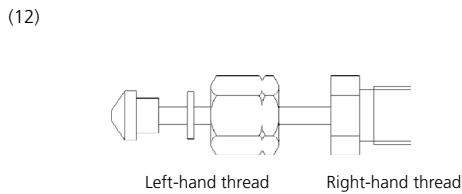
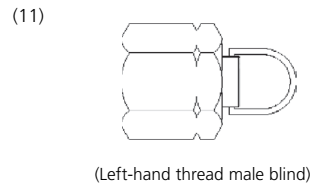
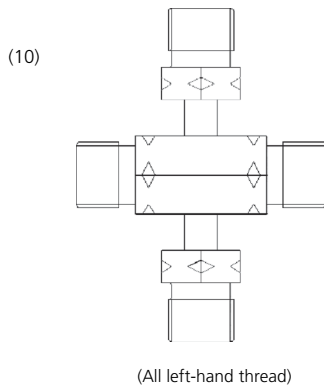
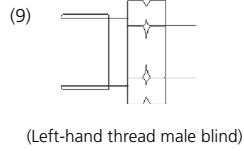
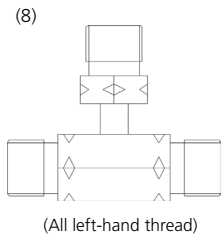
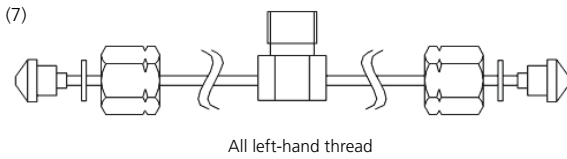
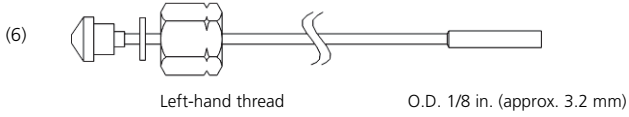
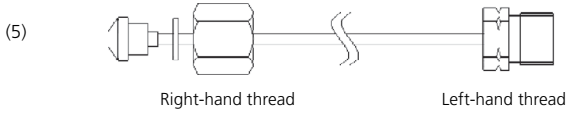
ATTENTION

The nuts and blocks of left-hand thread piping are provided with a slit to distinguish it from right-hand thread piping.



1. Preparing Gas

1.5 Other Pipe Parts



1. Preparing Gas

1.5 Other Pipe Parts

No.	Part Name	P/N
(1)	Reverse thread for H2 conduit, 2.5M	221-73474-25
	Reverse thread for H2 conduit, 5M	221-73474-50
	Reverse thread for H2 conduit, 10M	221-73474-00
(2)	H2 conduit, L-R, 2.5M	221-73626-25
	H2 conduit, L-R, 5M	221-73626-50
	H2 conduit, L-R, 10M	221-73626-00
(3)	Left-hand-threaded pipe, MF-LMF, 10 cm	221-73555-10
	Left-hand-threaded pipe, MF-LMF, 20 cm	221-73555-20
	Left-hand-threaded pipe, MF-LMF, 50 cm	221-73555-50
	Left-hand-threaded pipe, MF-LMF, 1 m	221-73555-00
(4)	Left-hand-threaded pipe, LMF-MM, 10 cm	221-73557-10
	Left-hand-threaded pipe, LMF-MM, 20 cm	221-73557-20
	Left-hand-threaded pipe, LMF-MM, 50 cm	221-73557-50
	Left-hand-threaded pipe, LMF-MM, 1 m	221-73557-00
(5)	Pipe, MF-LMM 10 cm	221-73670-10
	Pipe, MF-LMM 20 cm	221-73670-20
	Pipe, MF-LMM 50 cm	221-73670-50
	Pipe, MF-LMM 1 m	221-73670-00
(6)	Pipe, LMF-1/8 in. 15 cm	221-73576-15
	Pipe, LMF-1/8 in. 50 cm	221-73576-50
	Pipe, LMF-1/8 in. 1 m	221-73576-00
(7)	Branch pipe, reverse thread	221-73473-91
(8)	3-way block, L	221-75580-03
(9)	Socket, MMO, L	201-30019-01
(10)	4-way block, L	221-75580-04
(11)	Stop joint L, 2 pcs	221-35566-97
(12)	Hydrogen pipe adapter	221-73356-91

1. Preparing Gas

1.6 Gas and Pressure Setting Troubleshooting

Pressure or flowrate cannot be set, or control is not executed according to settings.

Cause	Countermeasures
Gas is not supplied.	Open the stop cock on the gas cylinder to supply gas.
Supply pressure is low.	Set the 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 is leaking.	Check for gas leaks, and re-tighten any leaking locations. (*) Replace the gaskets and septum.
Values are outside the allowable control ranges. Set values are inappropriate.	Set the pressure to appropriate values.
The split line trap is blocked. (Even if the overall flowrate is increased, the measured value of the split vent flowrate is small and pressure rises.)	Replace the trap assembly.

* Gas leak check

- Step1** Open the stop cock of the gas cylinder.
- Step2** Adjust the gas supply pressure to the specified value.
- Step3** Use the gas leak detection fluid (option) or leak detector at connections to check for leaks. When using the detection fluid, the fluid will bubble in the presence of a leak. When using the leak detector, the alarm buzzer will ring when a leak is detected.
- Step4** When a gas leak is found, perform the following measures to stop the leak:
 - Tighten connections more.
 - Re-tighten connections.
 - Replace seals.
- Step5** Wipe off the detection fluid with a cloth moistened with water.

Gas leaks do not stop.

Cause	Countermeasures
Parts are installed in the wrong way.	Install parts correctly.
Graphite ferrules and other packing parts are damaged.	Replace with new packing parts.

Third Party's Product Information

GLC Shimadzu GLC Handled Parts (parts made by third parties) (*)		
RESTEK Corporation	Gas leak detection fluid	P/N 670-11514
	Leak detector	

ATTENTION

The supply pressure decreases if there is a blockage between the gas cylinder and the gas chromatograph even if the regulator on the gas cylinder is set to a high pressure.

ATTENTION

Do not use gas leak detection fluid or soapy water at connections on the carrier and detector gas digital controller (AFC/APC). Fluid drips might damage the controller.

TIP

The leak detector can check for hydrogen and helium leaks. Nitrogen cannot be checked.



Gas leak detection fluid



RESTEK leak detector

(*) For details on the performance of parts made by third parties, contact the respective manufacturer. Please note the parts may not be available in some countries.

1. Preparing Gas

1.7 AFC/APC Control Ranges

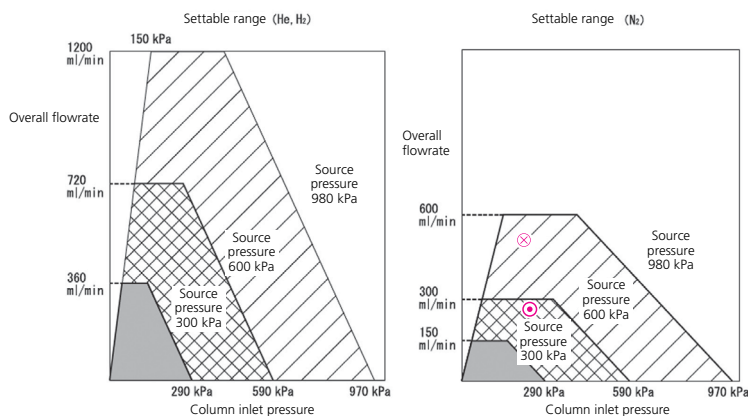
AFC (Advanced Flow Controller) and APC (Advanced Pressure Controller) are digital flow controllers for Shimadzu gas chromatographs.

The AFC digital flow controller is for carrier gas and the APC digital flow controller is for detector gas.

AFC control range

The inlet pressure setting range of the AFC digital flow controller for split analysis is 0 to 970 kPa, and the overall flowrate setting range is 0 to 1200 mL/min. Note, however, that this specification is for a source pressure of 980 kPa supplied to the GC-2010 Plus/GC-2010/GC-2014/GC-2025. The pressures and flowrates that can be set are limited depending on the source pressure, as follows. The pressure setting range is also limited by the column that is installed and the purge flowrate. (0 to 1 mL/min and 0 to 1 kPa cannot be set.)

If pressure and flowrate are not set within these ranges, a leak error or other messages might be displayed.

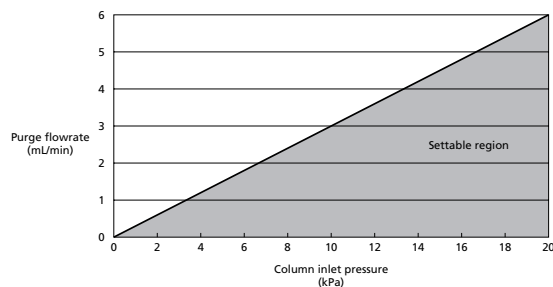


• How to view this chart

(Example) When N₂ is used for the carrier gas and the supply gas cylinder pressure (source pressure) is 600 kPa, a column inlet pressure of 300 kPa and an overall flowrate of 250 mL/min can be set. Indicated by ⊗ mark.

A column inlet pressure of 300 kPa and an overall flowrate of 500 mL/min are outside the setting range. Indicated by ⊗ mark.

The purge flowrate setting range changes according to the column inlet pressure.



• How to view this chart

(Example) A purge flowrate of 1 mL/min can be set when the column inlet pressure is 10 kPa. 1 mL/min cannot be set, however.

ATTENTION

Damaged pipes and joints must be replaced. Discontinue use of damaged piping, and contact your service representative.

ATTENTION

Control ranges are sometimes restricted if flow line resistors or buffers other than optional parts are added on.

TIP

A pressure drop of 13 kPa occurs when helium flows at a flowrate of 100 mL/min through 1 mm I.D. 10 m piping.

The pressure drop is proportional to flowrate and pipe length. It is also proportional to the inverse of the 4th power of the pipe diameter.

TIP

On the GC-2010 Plus/GC-2025, the supply gas cylinder pressure can be monitored.

TIP

Overall flowrate = column flowrate + split flowrate + purge flowrate

1. Preparing Gas

1.7 AFC/APC Control Ranges

APC control range

The following shows the APC setting ranges. In regions greater than the following flowrates, the deviation in the measured values increases and control is not executed in some cases. (When each of the supply pressures is 500 kPa or below, the maximum settable flowrate decreases proportionately.)

AIR (detector = FID)	0 to 1000 mL/min
H ₂ (detector = FID)	0 to 100 mL/min
Makeup gas (detector = FID)	0 to 100 mL/min
Makeup gas (detector = TCD)	0 to 20 mL/min

2.1 Before Injecting Samples	36	2.11 Insert Wool Packing Tool	53
2.2 Selecting the Vial Septum	36	2.12 O-Ring	53
2.3 Selecting the Vial	38	2.13 Sample Injection Units	54
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2.6 Replacing the Septum	44	2.17 Troubleshooting	64
2.7 Syringes	46	2.18 Accessories	67
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2.9 Inserts	48		
2.10 Replacing the Glass Insert	51		

Sample Injection

Daily maintenance is required on the sample injection unit of gas chromatographs. Peak shapes or reproducibility are greatly affected by how well the sample injection unit is maintained.



2. Sample Injection

2.1 Before Injecting Samples

Check the following points before injecting samples:

- Is the sample fresh?
- Is the vial septum new?
 - Septa that have been penetrated by a needle even once are more likely to produce ghost peaks originating from silicon.
- Is the vial septum correctly oriented?
 - At the correct orientation, the fluoropolymer face is in contact with the solution.
- Is there a sufficient amount of solution?

2.2 Selecting the Vial Septum

Genuine part for 1.5 mL vials

Septum

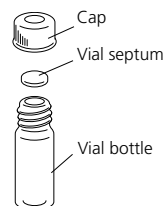
Silicon/fluoropolymer 2-layer

Deep light brown is the fluoropolymer layer.

Shimadzu	Vial septum, pack of 100	P/N 221-41239-91
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TIP

Names of parts



ATTENTION

A septum is a rubber stopper. On a gas chromatograph there are two types of septa, a septum for the vial and a septum for the sample injection unit.

2. Sample Injection

2.2 Selecting the Vial Septum

Third Party's Product Information

For 1.5 mL vial

TFE butyl rubber

Butyl rubber/fluoropolymer 2-layer

The glossier of the two surfaces is the fluoropolymer layer.

GLC Shimadzu GLC Handled Parts (parts made by third parties) (*)

System Inc. (former Alltech)	TFE butyl rubber 5/40 mil (1.1 mm thick) 100 pcs	P/N 98190
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Septum, white, TFE, 10 mil (0.25 mm thick)

Fluoropolymer; injection once only

Use of a gasket is recommended to improve sealing performance.

Use with gasket 228-15654-91 (pack of 100).

GLC Shimadzu GLC Handled Parts (parts made by third parties) (*)

System Inc. (former Alltech)	Septum, white, TFE, 10 mil (0.25 mm thick), 100 pcs	P/N 98094
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Top seal closure, white, formed polyliner, 10 mil (0.25 mm thick)

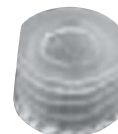
Integrated cap/septum type; made of resin; injection once only

GLC Shimadzu GLC Handled Parts (parts made by third parties) (*)

System Inc. (former Alltech)	Top seal closure, white, formed polyliner, 10 mil (0.25 mm thick), 100 pcs	P/N 98060
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Gasket (for gasket vial)



Top seal closure, white, formed polyliner, 10 mil (0.25 mm thick)

(*) For details on the performance of parts made by third parties, contact the respective manufacturer. Please note the parts may not be available in some countries.

2. Sample Injection

2.3 Selecting the Vial

Third Party's Product Information

1.5 mL target vial (wide-mouthed)

The overall size of this vial is the same as a standard-size vial, but its mouth is larger by 40 %. This makes it easier to put in and take out samples and to wash.



Shimadzu GLC Handled Parts (parts made by third parties) (*)

Target vial 1.5 mL (with septum and cap, pack of 100 sets), transparent	P/N C4010-17
Amber (brown bottle), 100 pcs	P/N C4010-17A
Transparent with label, 100 pcs	P/N C4010-17W
Amber with label (brown bottle), 100 pcs	P/N C4010-17AW

Transparent



Amber with label

Wide-mouthed bottle



Genuine bottle part

1.5 mL target vial (wide-mouthed)

Small-capacity insert (with polyspring)

Exclusively for 1.5 mL target vial (wide-mouthed)

Capacity 150 μ L. This is handy for injecting small amounts of sample. It comes with a polyspring for stabilizing the insert at the center.



Shimadzu GLC Handled Parts (parts made by third parties) (*)

Insert 150 μ L, pack of 100 pcs (exclusively for the target vial)	P/N C4010-630
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Small-capacity insert (with polyspring)
Exclusively for 1.5 mL target vial (wide-mouthed)

Trace-capacity insert (flat bottom)

Exclusively for 1.5 mL target vial (wide-mouthed)

Capacity 400 μ L. This is handy for injecting relatively small amounts of sample. Because the insert is slightly shorter than the depth inside the vial, solution might spill if the bottle is tipped over.



Shimadzu GLC Handled Parts (parts made by third parties) (*)

400 μ L flat bottom insert, non-glass, 500 pcs	P/N C4011-631
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Small-capacity insert (flat bottom)
Exclusively for 1.5 mL target vial (wide-mouthed)

ATTENTION

Use a vial with either a white or bright-colored cap. Black or other dark-colored caps sometimes cannot be recognized by the autosampler.

Inserts indicated with "Exclusively for" can be used only on the vial they are intended for.

(*) For details on the performance of parts made by third parties, contact the respective manufacturer. Please note the parts may not be available in some countries.

2. Sample Injection

2.3 Selecting the Vial

Third Party's Product Information

Small-capacity insert (with polyspring)

Exclusively for standard aperture vial C4013-58

Capacity 100 μ L. This is handy for injecting smaller amounts of sample. It comes with a polyspring for stabilizing the insert at the center.



Shimadzu GLC Handled Parts (parts made by third parties) (*)

1.5 mL standard aperture vial (with septum and cap, transparent, pack of 100)	P/N C4013-58
150 μ L insert (with polyspring, for standard aperture vial C4013-58)	P/N GLC4012-530



Small-capacity insert (with polyspring)
Exclusively for standard aperture vial C4013-58

(*) For details on the performance of parts made by third parties, contact the respective manufacturer. Please note the parts may not be available in some countries.

2. Sample Injection

2.3 Selecting the Vial

Third Party's Product Information

Small-capacity insert (flat bottom)
 Exclusively for standard aperture vial C4013-58

Capacity 400 µL. It is cheap and handy for injecting small amounts of sample.

GLC Shimadzu GLC Handled Parts (parts made by third parties) (*)			
Systech Inc. (former Alltech)	250 µL insert (flat bottom), pack of 100, 100 pcs		P/N 98028



Small-capacity insert (flat bottom)
 Exclusively for standard aperture vial C4013-58

Use the following vials and septa to use highly inflammable solvents such as carbon disulfide. The septa and caps are designed not to fall inside the bottle.

Carbon disulfide is a highly flammable solvent with a boiling point of 46.2 °C, a flash point of -30 °C and an ignition point of 90 °C, and is designated as a special inflammable material in Hazardous Substances Category IV of Japan's Fire Service Act.

Carbon disulfide is occasionally used as a solvent on gas chromatographs. Care is required in its use since it has low boiling and ignition points and is highly toxic.

GLC Shimadzu GLC Handled Parts (parts made by third parties) (*)			
Alltech shell vial 4 mL (15 × 45 mm) 100 pcs	Made of transparent glass	With transparent snap cap	98853
CHROMACOL 2-SVW 500pc	Made of transparent glass	1.5 mL vial	2-SVW
CHROMACOL 9-SC(Y)-BST1	Fluoropolymer sheet septum	Yellow cap	9-SC(Y)-BST1

(*) For details on the performance of parts made by third parties, contact the respective manufacturer. Please note the parts may not be available in some countries.

2. Sample Injection

2.4 Selecting the Vial (4 mL) and Vial Septum for Solvents

For 4 mL vial

Septum

Silicon/fluoropolymer 2-layer

If the septum is washed frequently, fragments of silicon are likely to fall off, and ghost peaks originating from silicon rubber might increase in number. So, septa must be replaced frequently.

Shimadzu	Pack of 50 septa	P/N 221-34266-92
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Septum for 4 mL vial

Third Party's Product Information

For 4 mL vial

Septum, TFE

Fluoropolymer

Blanks will not increase even if the septum is washed frequently. (The hole might become larger.)

Although solvents are likely to vaporize slightly, this does not affect regular analysis, and it is cheap.



Shimadzu GLC Handled Parts (parts made by third parties) (*)

TFE, 10 mil (0.25 mm thick),
pack of 100 pcs

P/N 73094



Septum for 4 mL vial, TFE

Third Party's Product Information

4 mL shell vial

Septum

4 mL vial for washing. This is used as a waste solution vial. Ghost peaks originating from silicon rubber will not increase in number even if the septum is washed frequently, and it is cheap.



Shimadzu GLC Handled Parts (parts made by third parties) (*)

Shell vial, 15 × 14 (with star-shaped slit cap),
pack of 100, 100 pcs

P/N 98853



4 mL shell vial

(*) For details on the performance of parts made by third parties, contact the respective manufacturer. Please note the parts may not be available in some countries.

2. Sample Injection

2.5 Selecting the Septum for the Sample Injection Unit

White (standard type)

Standard accessory silicon septum

Shimadzu	Standard type (pack of 20)	P/N 201-35584
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Blue (long-life (LL) septum)

Septum featuring both low bleed and long life

Shimadzu	LL long life (pack of 20)	P/N 221-48972-91
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Brown (high-temperature (HT) septum)

Bleed amount is less when used at high temperatures compared with LL septa.

Shimadzu	HT for high-temperature use (pack of 20)	P/N 221-48398-91
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Green (Thermogreen septum)

Least influence of plasticity but hard.

Shimadzu	Thermogreen LB-2 (pack of 10)	P/N 221-35507-01
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Standard type



Long-life septum



High-temperature septum



Thermogreen septum

ATTENTION

The type of bleeding differs with each septum and appears as a different pattern on chromatograms. For high-sensitivity analysis, be sure to select and use a septum that does not allow bleeding to appear at locations that will obstruct the peak of the target compound. After extraction for several hours by hexane etc., performing conditioning for several hours at a temperature between about 120 °C and 150 °C (up to about 200 °C for LL and HT septa) is sometimes effective in decreasing bleeding.

2. Sample Injection

2.5 Selecting the Septum for the Sample Injection Unit

Third Party's Product Information

Light green (GLC Komachi)

Low-bleed, for high-sensitivity analysis.



Shimadzu GLC Handled Parts (parts made by third parties) (*)

Light green (GLC Komachi), pack of 25, 25 pcs	P/N 514-200
Light green (GLC Komachi), pack of 50, 50 pcs	P/N 514-201
Light green (GLC Komachi), pack of 100, 100 pcs	P/N 514-202

Light blue (Euduro blue Septa)

Low-bleed, soft. For fine needle tipped syringes for OCI.



Shimadzu GLC Handled Parts (parts made by third parties) (*)

Light blue (Euduro blue Septa), pack of 50, 50 pcs	P/N 041890
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(*) For details on the performance of parts made by third parties, contact the respective manufacturer. Please note the parts may not be available in some countries.

2. Sample Injection

2.6 Replacing the Septum

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.

Tools Required: Tweezers

Procedure

Step1

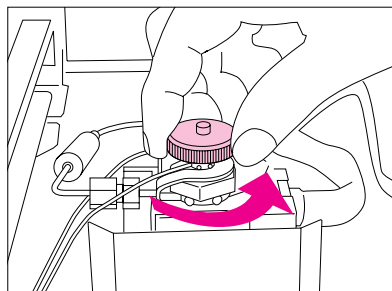
Press the [SYSTEM] key on the GC unit and select [INJ Maintenance] on the PF menu. The temperature of the sample injection port and the column oven will lower automatically, and the supply of carrier gas will stop when it goes below 50 °C.

Step2

Check that the message "Perform INJ maintenance" appears on the GC display.

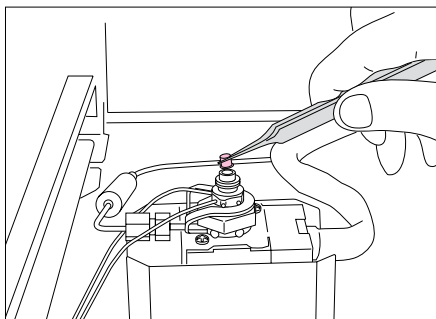
Step3

Loosen and remove the septum nut.



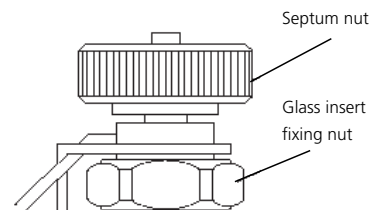
Step4

Remove the needle guide.



ATTENTION

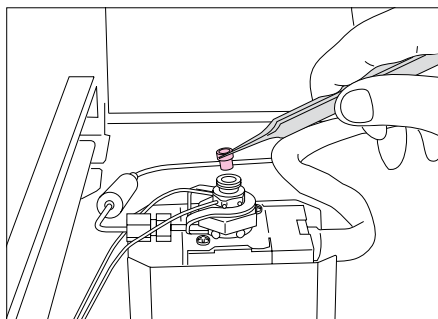
Performing maintenance work with each part still hot may cause burns or damage parts.



2. Sample Injection

2.6 Replacing the Septum

Step5 Remove the septum.



Step6 Types of injection port septum

White (standard type, pack of 20)	P/N 201-35584
Blue (LL long-life, pack of 20)	P/N 221-48972-91
Brown (HT for high-temperature use, pack of 20)	P/N 221-48398-91
Green (Thermogreen LB-2, pack of 10)	P/N 221-35507-01
Light green (GLC Komachi, pack of 25)	P/N 514-200
Light green (GLC Komachi, pack of 50)	P/N 514-201
Light green (GLC Komachi, pack of 100)	P/N 514-202
Light blue (Euduro blue Septa, pack of 50)	P/N 041890

Step7 Replace the septum.

Step8 Put back the needle guide.

Step9 Tighten the septum nut fully, and loosen it half a turn.

Step10 (Press the [SYSTEM] key.) Select [Analysis] on the PF menu. The GC will be readied automatically.

Step11 Select [3. Analysis Counter] on the screen where the [DIAG] key was pressed, place the cursor on [Counter for Septum], and then select [Reset] on the PF menu to reset the analysis count.

2. Sample Injection

2.7 Syringes

Generally, the injection amount in the case of liquid samples is 1 to 2 μL .

Select the appropriate syringe by referring to the following.

AOC-20i syringes (genuine parts)

Shimadzu	Standard syringe (needle O.D. 0.63 mm)	P/N 221-34618
	OCI syringe (needle O.D. 0.47/0.63 mm)	P/N 221-37282-02
	5 μL syringe	P/N 001988

Common to AOC-20i, 17, 14

Elastic syringe for AOC-20i

The syringe plunger is made of titanium. Because it is less likely to generate abrasive dust originating from metal, the syringe is less likely to seize, making it ideal for samples that contain water.

Shimadzu	AOC elastic syringe	P/N 221-49548
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Common to AOC-20i, 17, 14

Third Party's Product Information

Elastic syringe for AOC-20i-OCI

The syringe plunger is made of titanium. Because it is less likely to generate abrasive dust originating from metal, the syringe is less likely to seize, making it ideal for samples that contain water.


 Shimadzu GLC Handled Parts (parts made by third parties) (*)

 Ito Seisakusho	OCI syringe (needle O.D. 0.47/0.63 mm)	P/N MS-E10- AOC23G/26G
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Wire for cleaning needle

This wire is for cleaning the syringe needle.

 Shimadzu GLC Handled Parts (parts made by third parties) (*)

 SGE Analytical Science	Stylet wire (0.1 mm x 150 mm, pack of 5)	P/N 031745
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TIP

The state of discharge from the needle can be easily seen by comparing it with a new needle that is not clogged.

ATTENTION

Microsyringes are made to extremely high precision. So, be sure to use the original syringe body and plunger set. The syringe alone cannot be used as a replacement part.

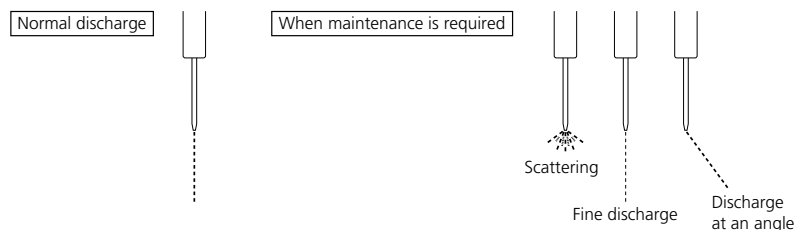
(*) For details on the performance of parts made by third parties, contact the respective manufacturer. Please note the parts may not be available in some countries.

2. Sample Injection

2.8 Syringe Maintenance

Be sure to wash the syringe with solvent etc. after use.

After checking that the plunger moves smoothly, make sure that the sample is discharged straight from the needle.



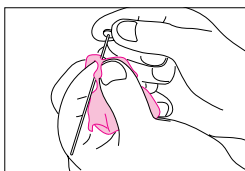
Maintenance Procedure

Step1

The interior of the microsyringe is cleaned through the repeated intake and discharge of organic solvent. Check that the plunger is moving smoothly when performing this action. Test the full stroke of the syringe, and make sure that there is no resistance to its motion, and that there is no catching in the motion.

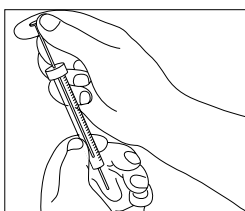
Step2

Pull the plunger out of the barrel if there is resistance to the plunger motion. It is recommended to wipe it with a soft cloth moistened in organic solvent.



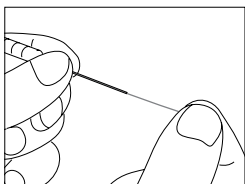
Step3

Pump repeatedly using organic solvent. Some fine dirt may still be present if resistance to the plunger motion increases quickly after several pumps. Repeat the cleaning procedure if this is the case.



Step4

Blockages in the needle tip can worsen analytical reproducibility; for this reason maintenance of the needle tip is necessary. Remove the blockage in the needle tip using, for example, a thin wire. Only use the needle after checking that the sample is discharged normally.



Suction by an aspirator etc. or use of a syringe cleaner is also effective for removing dirt inside the syringe or needle tip.

ATTENTION

Analytical reproducibility sometimes worsens if the sample is not discharged straight from the needle.

2. Sample Injection

2.9 Inserts

Check the following points for inserts in the injection port:

- Check the insert and silica wool for dirt.
 - Use deactivated silica wool.
 - As far as possible, also use deactivated inserts.
- Inserts Usable on GC-2010 Plus/GC-2010

Insert Name	Sample Injection Port	Capacity mL	P/N
For GC-2010 split	SPL	0.86	221-41444-01
For GC-2014/17 split	SPL	0.86	221-41444
For GC-2010/2014 splitless	SPL/WBI	0.67	221-48335-01
For GC-2010/2014 splitless (deactivated, wool at the bottom of aperture)	SPL/WBI	0.67	Pack of 5 221-48876-03
For GC-2010/2014 splitless (deactivated)	SPL/WBI	0.67	Pack of 5 221-48876-05
For GC-2010/2014 splitless (deactivated, wool at 25 mm)*	SPL/WBI	0.67	Pack of 5 221-48876-02
For GC-17 splitless	SPL/WBI	0.50	221-41544
For GC-2010/17 wide-bore	WBI	0.41	221-41599
Adapter for GC-2010 on-column	OCI	-	221-49298-91
For GC-2010 PTV (quartz)	PTV	0.17	221-49300
For GC-2010 simple on-column	OCI	-	221-49381-01
For GC-2010 simple on-column (deactivated)	OCI	-	221-49381-02

* Do not use on GC-2010 Plus (SPL-2010 Plus).

ATTENTION

Reactive residue and dirt remain on the silica wool. So, wash the silica wool with a small amount of solvent after pushing it into the insert.

TIP

The amount and position of the wool greatly influences reproducibility and sensitivity.

TIP

In the analysis of trace amounts, the inner wall of the insert is sometimes treated with acid or alkali to match the properties of components that are easily absorbed in addition to using deactivated inserts.

2. Sample Injection

2.9 Inserts

- Inserts usable on the GC-2014

Insert Name	Sample Injection Port	Capacity mL	P/N
For GC-2014/17 split	SPL	0.86	221-41444
For GC-2010 split	SPL	0.86	221-41444-01
For GC-2010/2014 splitless	SPL/WBI	0.67	221-48335-01
For GC-2010/2014 splitless (deactivated, wool at 25 mm)*	SPL/WBI	0.67	Pack of 5 221-48876-02
For GC-2010/2014 splitless (deactivated, wool at the bottom of aperture)	SPL/WBI	0.67	Pack of 5 221-48876-03
For GC-2010/2014 splitless (deactivated)	SPL/WBI	0.67	Pack of 5 221-48876-05
For GC-17 splitless	SPL/WBI	0.50	221-41544
For GC-17 wide-bore	WBI	0.41	221-41599

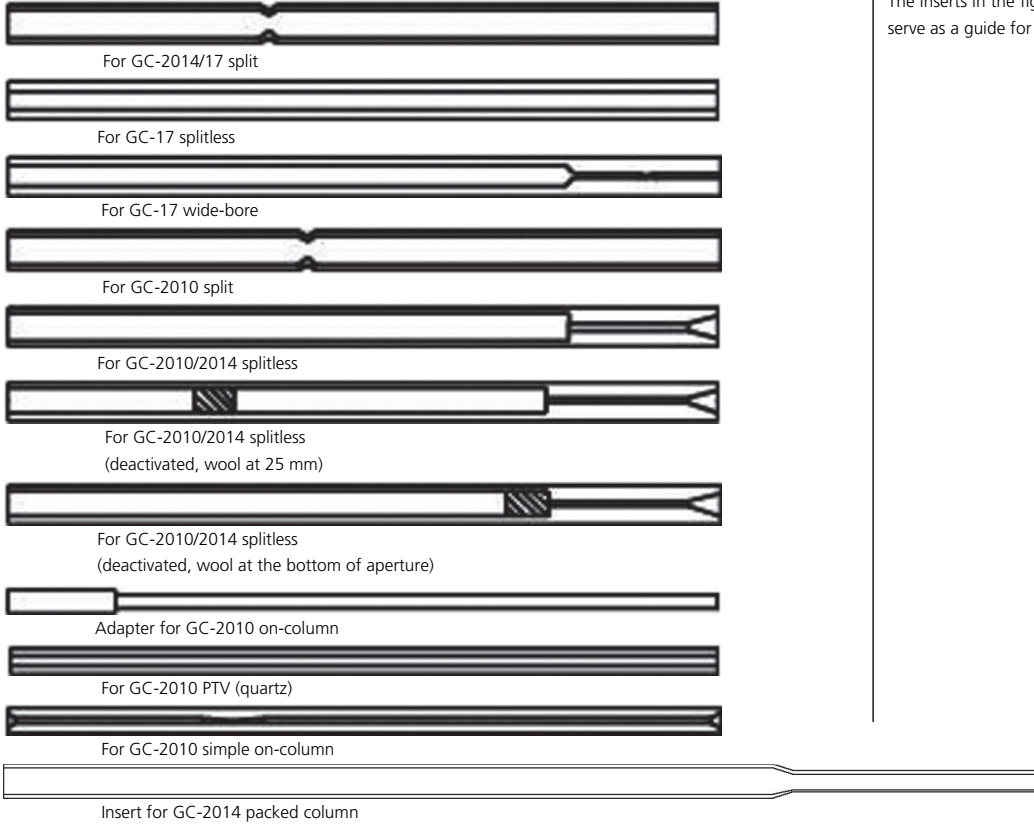
- Inserts usable on the GC-2025

Insert Name	Analytical Method	Capacity mL	P/N
For GC-2014/17 split	Split	0.86	221-41444
For GC-2010 split	Split	0.86	221-41444-01
For GC-2010/2014 splitless	Splitless	0.67	221-48335-01
For GC-2010/2014 splitless (deactivated, wool at 25 mm)*	Splitless	0.67	Pack of 5 221-48876-02
For GC-2010/2014 splitless (deactivated, wool at the bottom of aperture)	Splitless	0.67	Pack of 5 221-48876-03
For GC-2010/2014 splitless (deactivated)	Splitless	0.67	Pack of 5 221-48876-05
For GC-17 splitless	Splitless	0.50	221-41544

2. Sample Injection

2.9 Inserts

<Actual Size>



TIP

The inserts in the figure on the left are actual size and serve as a guide for P/Ns of actual glass inserts.

2. Sample Injection

2.10 Replacing the Glass Insert

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.

Tools Required: Glass insert wrench (standard accessory), tweezers

Procedure

Step1

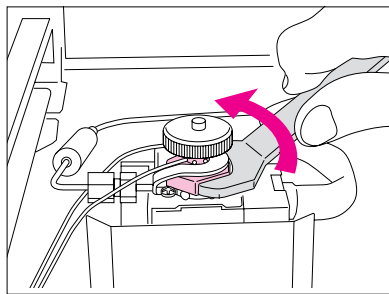
Press the [SYSTEM] key on the GC unit and select [INJ Maintenance] on the PF menu. The temperature of the sample injection port and the column oven will lower automatically, and the supply of carrier gas will stop when it goes below 50 °C.

Step2

Check that the message "Perform INJ maintenance" appears on the GC display.

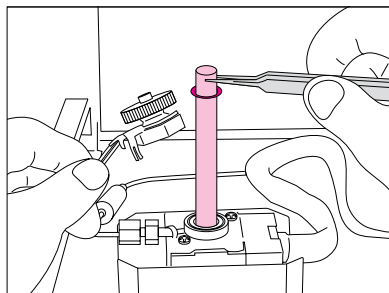
Step3

Remove the glass insert fixing nut using a glass insert wrench. (Glass insert wrench (standard accessory), P/N 221-46977)



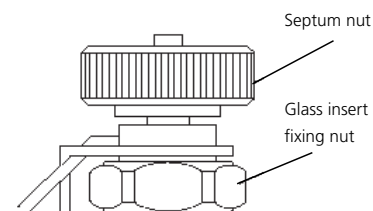
Step4

Pull out the glass insert using tweezers.



ATTENTION

Performing maintenance work with each part still hot may cause burns or damage parts.



ATTENTION

Pull out glass inserts vertically and straight upward. The glass insert might become damaged if it is pulled out at an angle.

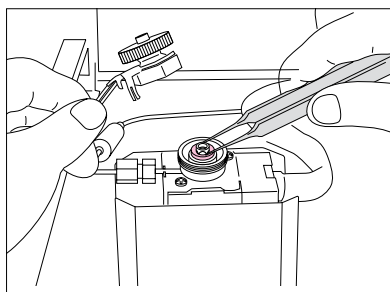
2. Sample Injection

2.10 Replacing the Glass Insert

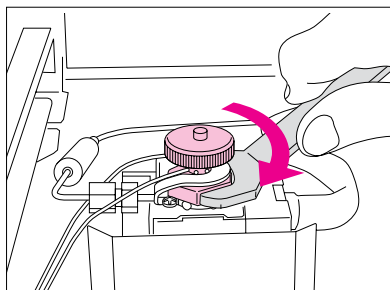
Step5 Fit an O-ring on the new glass insert and fill it with an appropriate amount of silica wool. For analysis with an injection port temperature of 400 °C or higher, it is recommended to use highly temperature-resistant graphite O-rings.

Fluoro rubber O-ring (pack of 5)	P/N 036-11203-84
Deactivated silica wool (2 g pack)	P/N 221-48600

Step6 Provisionally fit the O-ring at about 4 mm from the top of the glass insert, place it at the sample injection port, and push it down with tweezers until it touches the bottom.



Step7 Attach the glass insert fixing nut and fix it using the wrench.



Step8 (Press the [SYSTEM] key.) Select [Analysis] on the PF menu. The GC will be readied automatically.

Step9 Select [3. Analysis Counter] on the screen where the [DIAG] key was pressed, place the cursor on [Counter for Insert], and then select [Reset] on the PF menu to reset the analysis count.

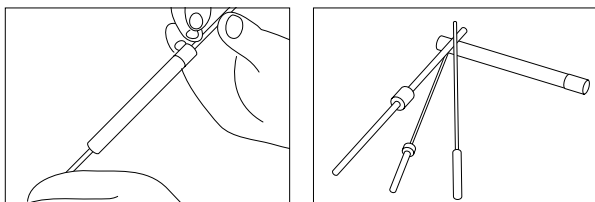
TIP
The analysis counter displays a message informing the user to replace the septum or insert when the analysis count exceeds the threshold value.

2. Sample Injection

2.11 Insert Wool Packing Tool

Third Party's Product Information

Shimadzu insert wool packing tool
(for GC-2010 Plus/GC-2010/GC-2014/GC-2025/GC-17)



- This tool is compatible with the GC-2010 Plus/GC-2010/GC-2014/GC-2025/GC-17.
- Wool can be easily packed to the optimum position in the insert on each type of GC instrument.
- The optimum wool position improves reproducibility and sensitivity.



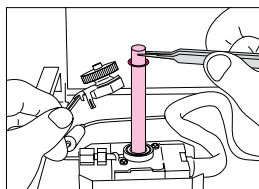
Shimadzu GLC Handled Parts (parts made by third parties) (*)

Shimadzu insert wool packing tool, 1 pc	P/N 092900
Deactivated silica wool, 2 g	P/N 501-320
Deactivated silica wool, 5 g	P/N 501-321

2.12 O-Ring

Fluoro rubber O-ring (pack of 5)

When setting the temperature of the sample injection unit to 350 °C or higher, it is recommended to use the perfluoro P5 O-ring (670-11518).



(*) For details on the performance of parts made by third parties, contact the respective manufacturer. Please note the parts may not be available in some countries.

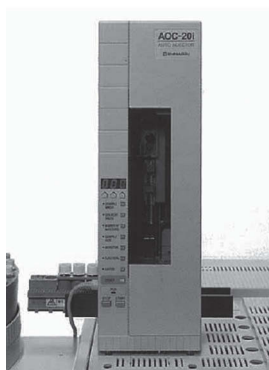
2. Sample Injection

2.13 Sample Injection Units

• AOC-20i Autoinjector

The autoinjector allows data with satisfactory reproducibility to be obtained by manual injection.

- Compact, lightweight, and can be installed easily.
- Use of a rigid frame and new needle guide achieves high reliability.
- Supports various injection modes including solvent flush, simultaneous injection of internal standard substances, and injection of large sample volumes.
- The sample suction position can be changed, which allows samples to be acquired from each of 2-phase lines and small-capacity samples to be sucked in.
- 1.5 mL and 4 mL vials can be used.



Product Name	P/N
For GC-2010 Plus/GC-2010	221-72315-XX
For GC-2014	221-72314-XX
For GC-2025	221-73957-XX



Long vial rack



Rack for 4 mL vials

Options

Product Name	P/N
Long vial rack (Up to 12 vials can be loaded.)	221-45622-91
Long vial rack + 1.5 mL vial case (Up to 15 vials can be loaded.)	221-45622-91 221-45609-91
Rack for 4 mL vials	221-32949-01
Sample cooling fan (for minimizing sample temperature rise)	221-44995-91
Microsyringe (10 μ L)	221-34618
Microsyringe (50 μ L)	221-45243
Microsyringe (250 μ L)	221-45244
1.5 mL vial (with septum and cap, pack of 100 sets)	221-34274-91
4 mL vial (with septum and cap, pack of 50 sets)	221-34269-91



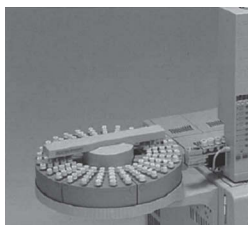
Microsyringe

2. Sample Injection

2.13 Sample Injection Units

• **AOC-20s Autosampler**

The AOC-20s allows up to 150 samples to be processed when 1.5 mL vials are used and up to 96 samples (separate rack is required) when 4 mL vials are used.



P/N
221-72300-31

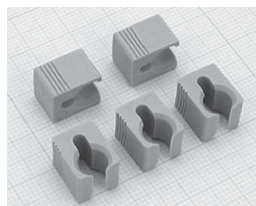
Options

Product Name	P/N
Rack for 1.5 mL vials (pack of 1, additional rack)	221-44709-91
Rack for 4 mL vials (pack of 6)	221-44878-91

Maintenance Parts

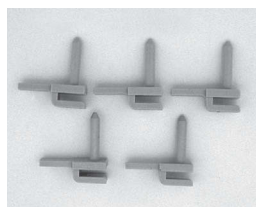
- (1) Barrel holder (pack of 5)

221-45178-91



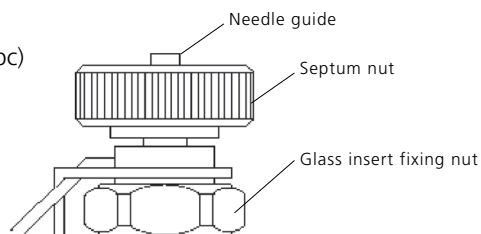
- (2) Plunger holder (pack of 5)

221-45177-91



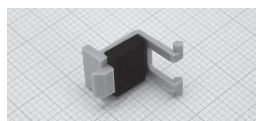
- (3) Needle guide (1 pc)

221-14773



- (4) Holder, syringe barrel (1 pc)

221-48989-91



Rack for 4 mL vials



Rack for 1.5 mL vials



Standard syringe



OCI syringe



Elastic syringe for AOC-20i

ATTENTION

When buying a new syringe, also replace the plunger holder with a new one.

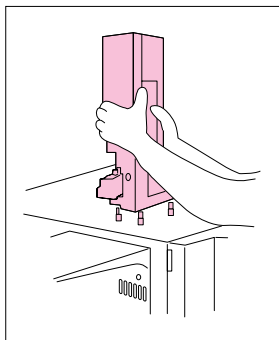
TIP

The autosampler is used with the autoinjector.

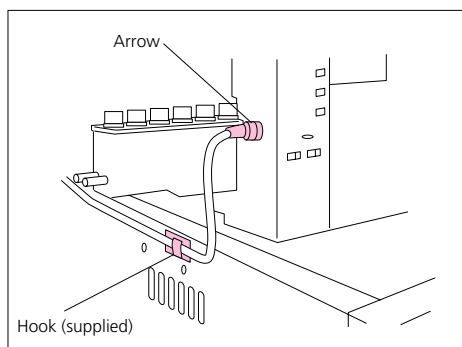
2. Sample Injection

2.14 Installing the AOC-20i

Step1 Fit in the unit firmly from above until there is no longer any play in the fitting.



Step2 Install and remove the AOC cable with the arrow on it facing upward. Also, fix the AOC cable using the hook (supplied) so that it does not interfere with vial rack operation.



ATTENTION

A wobbly AOC installation will adversely affect reproducibility.

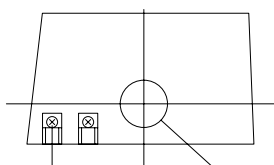
If the installation is insufficient, the error “-11” is displayed when the power is turned ON. Adjust the spacers so that the installation is not wobbly.

TIP

The AOC can be installed and removed with the cable connected.

Spacers on Injector Bottom

When the AOC is used on the GC-2014 and GC-14A/B, the plate springs, screws and spacers in the figure below are removed. When the autoinjector is used on the GC-2010 Plus/GC-2010/GC-2025/GC-17A, these parts will be needed, so store them in a safe place.



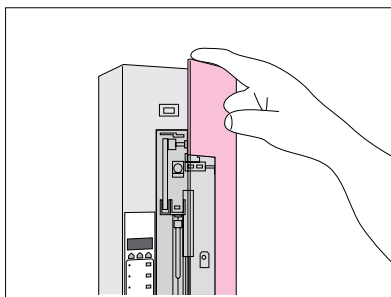
When the AOC is used on the GC-2014, for example, these plate springs, screws, and spacers are removed.

2. Sample Injection

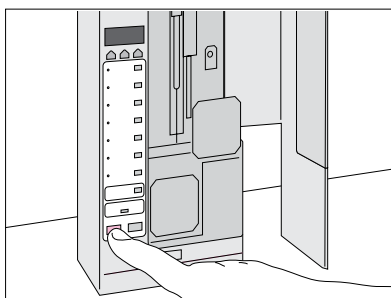
2.15 Replacing the Syringe

Replace the syringe with the AOC turned ON.

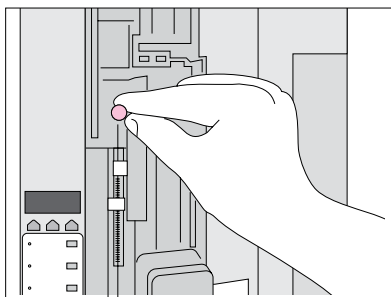
Step1 Open the front door of the AOC-20i.



Step2 Press the [STOP] key while the front door is open. The hold on the plunger motor will be disabled.



Step3 Loosen the plunger fixing knurled screw.



ATTENTION

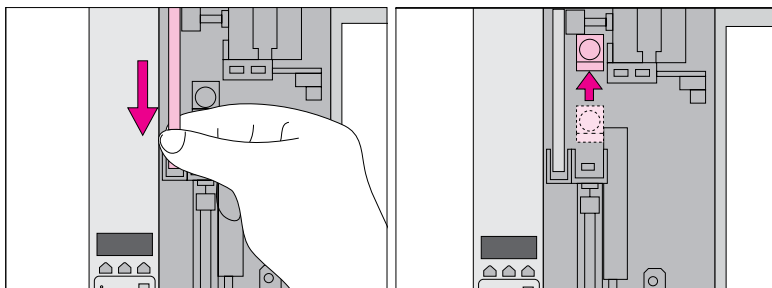
A wobbly AOC installation will adversely affect reproducibility.

If the installation is insufficient, the error "-11" is displayed when the power is turned ON. Adjust the spacers so that the installation is not wobbly.

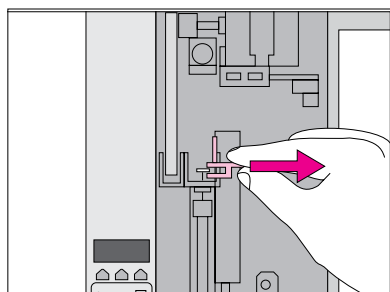
2. Sample Injection

2.15 Replacing the Syringe

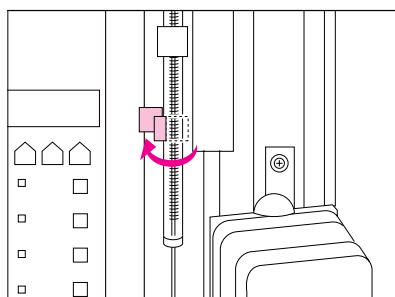
Step4 Holding the plunger driving belt, pull it down, and pull the plunger fixing section upward.



Step5 Pull it up until the top of the plunger holder comes out of the drive unit, and then remove the plunger holder.



Step6 Unfasten the syringe holder and remove the syringe.



2. Sample Injection

2.15 Replacing the Syringe

Step7

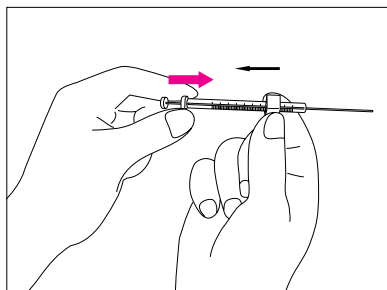
Check for blockages in the syringe and test the motion of the plunger. Either clean or replace these items if necessary.

TIP

See 2.8 Syringe Maintenance on page 47.

Step8

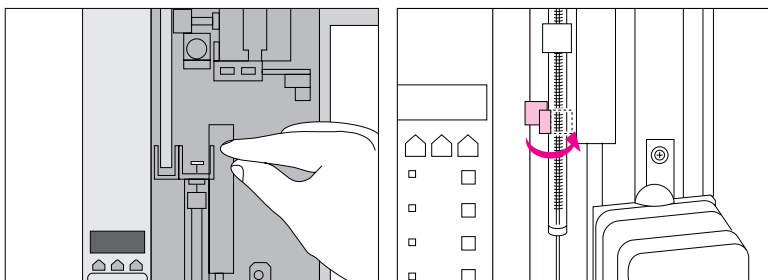
To fit a new syringe, attach a barrel holder onto the syringe.



Syringe for AOC-20i	P/N 221-34618
OCI syringe for AOC-20i	P/N 221-37282-02
Elastic syringe for AOC-20i	P/N 221-49548
Barrel holder (pack of 5)	P/N 221-45178-91

Step9

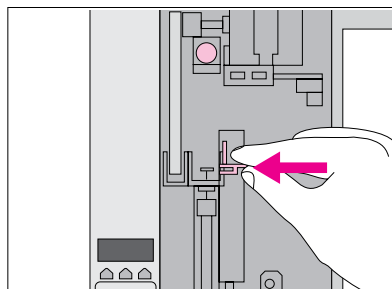
Place the syringe in the syringe drive unit and fix in place using the syringe holder.



2. Sample Injection

2.15 Replacing the Syringe

Step10 Set the plunger holder. For a new syringe, replace the plunger holder as well. Pull the plunger drive unit downward until the protrusion of the plunger holder is inserted into its hole.



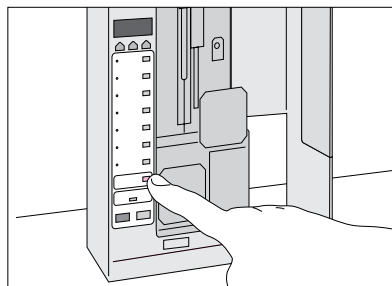
Plunger holder (pack of 5)

P/N 221-45177-91

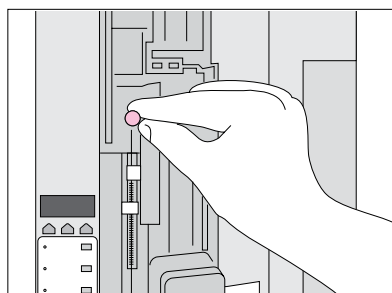


Plunger holder

Step11 Press the [RESET] key to move the plunger drive unit to the home position.



Step12 Press the plunger holder down lightly. After making sure that the plunger tip is at the zero-point, fix in place by tightening the plunger fixing knurled screw.



ATTENTION

Once the plunger holder is used, an indent appears due to the knurled screw. Analysis reproducibility may worsen if the plunger holder is used in this indented state.

When the syringe is replaced, it is recommended to replace the plunger holder as well.

ATTENTION

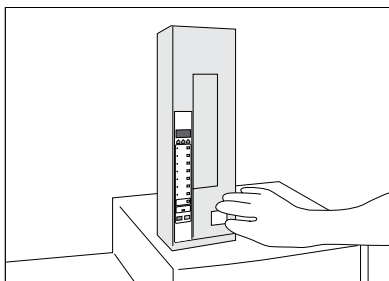
The home position cannot be moved to if the syringe is installed with power OFF. As a result, samples may not be sucked normally.

Install the syringe with the power turned ON.

2. Sample Injection

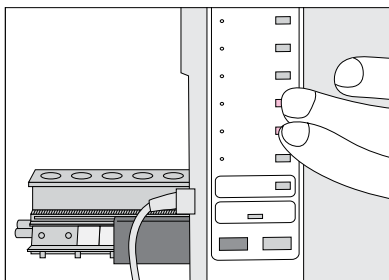
2.15 Replacing the Syringe

Step13 Close the front door and press the [RESET] key.

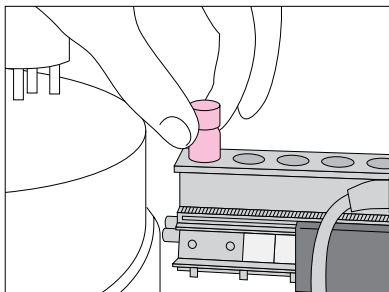


2.16 How to Adjust the Vial Gripping Position (when AOC-20s is used)

Step1 Turn the autoinjector ON while pressing both the [FUNCTION] and [MONITOR] keys.
For the GC-2010 Plus/GC-2010/GC-2014/GC-2025, set [AOC POWER] to [ON] in the [AOC Parameters] screen on the GC, and press the [ENTER] key.



Step2 After the initial processes of the autoinjector and autosampler have completed, place a vial (1.5 mL or 4 mL vial) on the left side of the autoinjector vial rack.



2. Sample Injection

2.16 How to Adjust the Vial Gripping Position (when AOC-20s is used)

Step3 Set the vial rack position for the autoinjector by the following procedure:

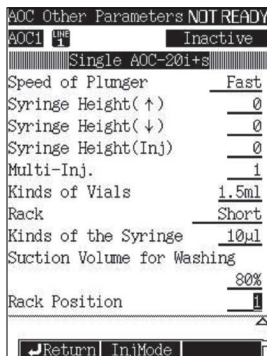
- 1) Press the [OPTION] key on the gas chromatograph to display the [AOC Parameters] screen.
- 2) Press [OtherPara] (PF3) of the PF menus to display the [AOC Other Parameters] screen.
- 3) Specify the vial rack position.

[0]: GC-2014

[1]: GC-2010 Front / GC-2010 Plus Front / GC-2025

[2]: GC-2010 Rear / GC-2010 Plus Rear = Standard Position

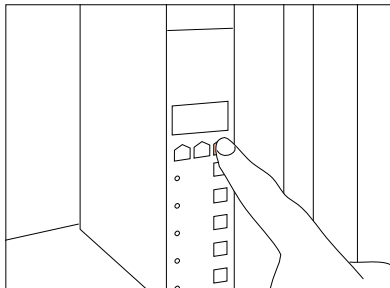
By factory default, the autosampler has been programmed so that the arm moves to the vial rack on the autoinjector mounted at each position above (far left for GC-2014). The desired arm destinations can be specified by using "teaching" procedures.



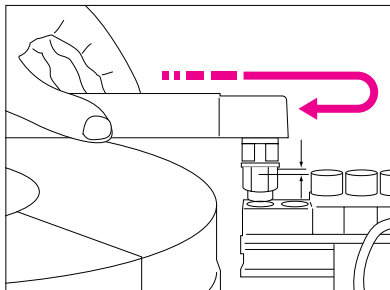
Screen display

Step4 Allow the FUNCTION 78 value ("000") to appear on the autoinjector display.

- 1: Press the [FUNCTION] key on the autoinjector.
- 2: Set "078" using the arrow keys.
- 3: Press the [ENTER] key.



Step5 Move the autosampler arm by hand to the vial in the vial rack. To position the arm in the horizontal plane, first extend the arm slightly beyond the amount required and then align it to the correct position.

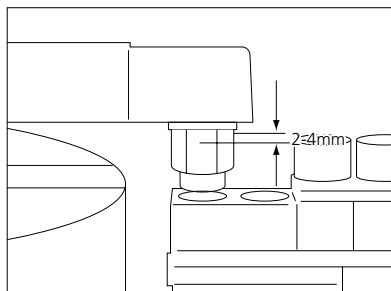


2. Sample Injection

2.16 How to Adjust the Vial Gripping Position (when AOC-20s is used)

Step6

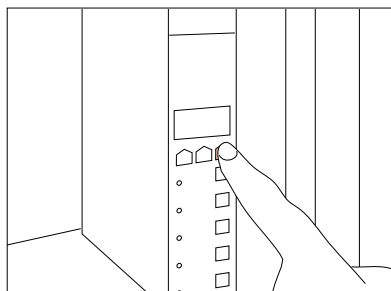
To position the arm in the vertical plane, use the [SAMPLE WASH], [SOLVENT WASH], and [NUMBER OF INJECTIONS] keys to move the arm to the position shown below.



Step7

After the position is aligned, adjust the function value to "001" using the arrow keys, and then press the [Enter] key.

The gripper at the end of the arm operates to grip the cap of the vial, and then returns to the home position.



ATTENTION

Never hold the end of the arm to move the arm up and down.

SAMPLE WASH: Up
SOLVENT WASH: Stop
NUMBER OF INJECTIONS: Down

2. Sample Injection

2.17 Troubleshooting

Autoinjector Error Codes

Error Code	Description and Remedy
-01	<p>Rack not in home position or not operating normally.</p> <ul style="list-style-type: none"> • Rack has not moved sufficiently to home position. <p style="text-align: center;">↓</p> <ul style="list-style-type: none"> • Remove the rack. Clean the rack gears and gear wheel thoroughly. Place the rack again and press the [RESET] key. • Rack not in place. <p style="text-align: center;">↓</p> <ul style="list-style-type: none"> • Install the rack and press the [RESET] key.
-02	<p>Syringe not in home position or not operating normally.</p> <ul style="list-style-type: none"> • Syringe has not moved sufficiently to home position. <p style="text-align: center;">↓</p> <p>Press the [RESET] key.</p>
-03	<p>Plunger not in home position or not operating normally.</p> <ul style="list-style-type: none"> • Plunger has not moved sufficiently to home position. <p style="text-align: center;">↓</p> <p>Press the [RESET] key.</p> <ul style="list-style-type: none"> • Plunger does not move smoothly. (See Note 1.) <p style="text-align: center;">↓</p> <p>Turn the power OFF, remove the syringe, and perform maintenance on or replace the plunger.</p>
-04	<p>Autoinjector is not ready to start.</p> <ul style="list-style-type: none"> • The [START] key was pressed after an error occurred on the autoinjector. <p style="text-align: center;">↓</p> <p>Press the [RESET] key to clear the error and then press the [START] key.</p>
-05	<p>Autoinjector memory error (RAM) and values initialized (See Note 2.)</p> <p style="text-align: center;">↓</p> <p>Re-enter the parameters.</p>

TIP

"01-" and "05E" are displayed when an error occurs on the sub side in a dual AOC configuration.

2. Sample Injection

2.17 Troubleshooting

Autoinjector Error Codes

Error Code	Description and Remedy
-06	Autoinjector memory error (ROM) (See Note 3.)
-08	CH2 error (transmission for the sub-injector or autosampler) ↓ Press the [RESET] key. (On the GC-2010/2014, check to see if the analytical line setting is correctly configured.)
-09	No priority sample for the No. specified by transmission ([PRIORITY SAMPLE]) (See Note 4.) Or, no sample for the No. specified by [INJECTION SAMPLE] ↓ Press the [RESET] key and restart after the sample has been placed in the rack.
-10	Memory (RAM) does not operate correctly. (See Note 3.)
-11	Autoinjector not correctly installed. ↓ Re-install the autoinjector.
-12	The CH2 transmission line connecting the host computer or the Chromatopac is not operating correctly. (See Note 3.)
-13	The CH2 transmission line connecting the sub-injector or autosampler is not operating correctly. (See Note 3.)
-14	The waste liquid vial is not in position. ↓ Place the waste liquid vial in position, and press the [RESET] key.

Note 1) If the plunger movement becomes slightly stiff, no error is generated, but a warning is displayed (the LED to the left of the [SAMPLE SIZE] key blinks while waiting for analysis) and operation continues.

Note 2) The error code "-05" is displayed when a RAM error occurs, and, in some cases, when parameters are initialized. If this error occurs every time the power is turned ON, the RAM back-up battery may be dead. For battery replacement, contact your Shimadzu representative.

Note 3) When the error "-06" or "-10" occurs, the autoinjector does not operate. When the error "-12" occurs, the autoinjector cannot be controlled externally. If these errors occur, the sub-injector or autosampler cannot be used. Contact your Shimadzu representative.

Note 4) When the [PRIORITY SAMPLE] setting is specified via the keypad, no error is generated when there is no sample in the position; the next number sample is injected. An error is generated only when the [PRIORITY SAMPLE] setting has been specified by transmission from an external device, and there is no vial in that position. When the [INJECTION SAMPLE] setting is specified, whether by the keypad or by transmission, an error is generated if no vial is found in the position specified.

Autosampler Error Codes

(For dual AOC, these error codes are displayed on the main injector.)

Error Code	Description and Remedy
E01	Arm does not rotate properly. ↓ Press the [RESET] key.
E02	Arm does not move properly along the x- or y-axis. ↓ Press the [RESET] key.
E03	Arm does not move up and down properly. ↓ Press the [RESET] key.
E04	Autosampler is not ready to start. • The [START] key was pressed after an error occurred on the autosampler. ↓ Press the [RESET] key to clear the error and then press the [START] key.
E05	An error occurred when the vial was placed in the rack. • A different vial is already at the position where the intended vial is to be placed. ↓ Remove the unwanted vial and press the [RESET] key. • A vial cannot be placed in the rack. ↓ Check the rack, replace the vial in the autosampler, and press the [RESET] key. Or, perform teaching.

2. Sample Injection

2.17 Troubleshooting

Autosampler Error Codes

(For dual AOC, these error codes are displayed on the main injector.)

Error Code	Description and Remedy
E06	An error occurred when the vial was returned to the autosampler. <ul style="list-style-type: none"> A different vial is already on the autosampler tray at the position where the intended vial is to be returned. ↓ Remove the unwanted vial and press the [RESET] key.
E07	An error occurred when gripping or releasing a vial. <ul style="list-style-type: none"> The grip motor did not operate properly. ↓ Replace the vial in the autosampler, and press the [RESET] key. <ul style="list-style-type: none"> The vial could not be gripped or released. ↓ Replace the vial in the autosampler, and press the [RESET] key. <ul style="list-style-type: none"> The vial remains gripped when the [RESET] key was pressed. ↓ Remove the vial from the grip, place the vial again and press the [RESET] key.
E08	The vial came loose during vial transfer. ↓ Replace the vial in position, and press the [RESET] key.
E09	No priority sample for the No. specified by transmission ([PRIORITY SAMPLE]) ^{Note 1)} Or, no sample for the No. specified by [INJECTION SAMPLE] ↓ Press the [RESET] key and restart after the sample has been placed in the rack.

Note 1) This error is generated only when the [PRIORITY SAMPLE] setting was specified by transmission before start.
When it has been specified after start, an error is generated whether the priority sample was specified by the keypad or by transmission.

Other Error Codes

Message	Description
OP	The door is open. (Opening the door during operation causes the autosampler to stop.) ↓ Close the door. (The display returns to normal.) To restart operation, press the [START] key.
LEI	A CH1 transmission line error has occurred (transmission line connecting the host computer or Chromatopac). ↓ Redo the cable connections, and re-enter the OPEN command for the autoinjector port.
LE2	A CH2 transmission line error has occurred (transmission line connecting the sub-injector or autosampler). ↓ Redo the cable connections, and press the [RESET] key. (On the GC-2010 Plus/GC-2010, check to see if the analytical line setting is correctly configured.)

2. Sample Injection

2.18 Accessories

Autoinjector/Autosampler Standard Accessories

Name	P/N	Qty
AOC cable (for AOC-20i)	221-49794-91	1
AOC cable (for AOC-20s)	221-49794-92	1
Short vial rack (for AOC-20i)	221-45608-91	1
4 mL vial case (for AOC-20i)	221-32949-01	1
1.5 mL vial case (for AOC-20i)	221-45609-92	1
1.5 mL vial rack (for AOC-20s)	221-44709-91	6
1.5 mL vial case (for AOC-20s)	221-45181	1
Microsyringe (10 µL)	221-34618	1
Cable clamp	072-60330-01	1
Needle guide	221-44584	2
Plunger holder	221-45177-91	5
Barrel holder	221-45178-91	2
Knurled screw (for plunger)	037-02820	1
Vial, large (for 4 mL)	221-34267-92(*)	1 pack (50 pcs.)
Large cap (for 4 mL)	221-34268-92(*)	1 pack (50 pcs.)
Septum, large (for 4 mL)	221-34266-92(*)	1 pack (50 pcs.)
Vial, small (for 1.5 mL)	221-34272-92(*)	1 pack (100 pcs.)
Small cap (for 1.5 mL)	221-34273-92(*)	1 pack (100 pcs.)
Septum, small (1.5 mL)	221-41239-91	1 pack (100 pcs.)
Holder, syringe barrel	221-48989-91	1
PAC START cable	221-35975-91	1

(*) Dashed number "-92" is a P/N for ordering.

3.1	Selecting the Column	70
3.2	Cutting the Column	72
3.3	Installing the Column	73
3.4	When Coupling Capillary Columns Together	76

Installing the Column

Gas Chromatograph Parts and Maintenance Brochure

The cross-section of the capillary column tip and the insertion depth of the various units affect peak shape and sensitivity.



3. Installing the Column

3.1 Selecting the Column

The following is the basic procedure for selecting the column.

(1) Check the structure of the target components.

Investigate the structure (functional group), boiling point, nature, stability, and other properties of the target component.

(2) Select the stationary phase.

Selecting a stationary phase of chemical properties close to those of the target component helps increase retention force and prevent drops in separation caused by defective peak shape.

(3) Determine the column size.

Determine the column size according to the sample amount to inject while referring to the following table:

0.10mm ID 0.18mm ID	<p>Has extremely high resolution but its sample load is small.</p> <ul style="list-style-type: none"> • Samples having a complex mixed system • Suited to split injection
0.25mm ID 0.32mm ID	<p>Has high resolution and a moderate sample load</p> <ul style="list-style-type: none"> • Supports samples having a complex mixed system • Suited to split/splitless injection
0.53mm ID	<p>Has satisfactory resolution and a large sample load</p> <ul style="list-style-type: none"> • Suited to purity measurement and analysis of trace components • Used in direct injection, on-column injection, and large-volume injection • Can be easily replaced from packed column

TIP

When twice as long (for fixed-temperature analysis)

- 2× the analysis time
- 1.4× the degree of separation
- 2× the price

TIP

Membrane Thickness and Separation

Thick-membrane column

- Good separation of high-concentration components
- Suited to purity analysis

Thin-membrane column

- Fast elution of high boiling point compounds
- Suited to the analysis of medium to high boiling point compounds

3. Installing the Column

3.1 Selecting the Column

Types of Stationary Phases

(1) Stationary phase name: 100 % dimethyl polysiloxane

Polarity: Non-polar

Separation properties: Elution in boiling point order

Applications: Gasoline and solvent related

Operating temperature range:

-60 °C to 360 °C (up to 430 °C in special applications)

(2) Stationary phase name: ** % diphenyl ** % dimethyl polysiloxane

Polarity: Slight to medium

Separation properties:

Aromatic compounds are retained by phenyl group content

Applications: Perfumes, environmental related, aromatic compounds

Operating temperature range: -60 °C to 340 °C

(3) Stationary phase name: ** % cyanopropyl phenyl ** % dimethyl polysiloxane

Polarity: Medium to strong

Separation properties:

Effective for separation of oxygenated compounds, isomers, etc.

Applications: Agrichemicals, PCBs, oxygenated compounds

Operating temperature range: -20 °C to 280 °C

(4) Stationary phase name: ** % trifluoropropyl ** % methyl polysiloxane

Polarity: Medium to strong

Separation properties: Uniquely retains compounds containing halogens

Applications: Halogenated compounds, polar compounds, solvents

Operating temperature range: -20 °C to 340 °C

(5) Stationary phase name: Polyethylene glycol

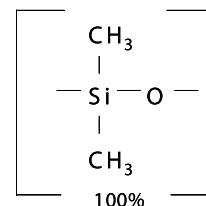
Polarity: Strong

Separation properties: Strong retention of polar compounds

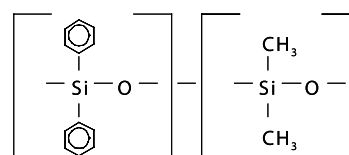
Applications: Polar compounds, solvents, perfumes, fatty acid methyl ester

Operating temperature range: 40 °C to 250 °C

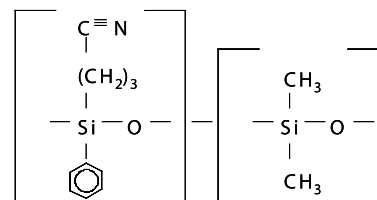
(1) Methyl silicons



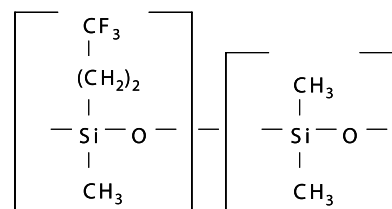
(2) Phenyl methyls



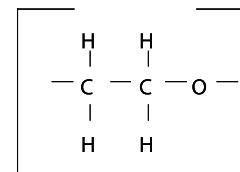
(3) Cyanopropyl phenyls



(4) Trifluoropropyls



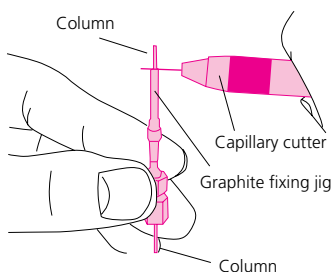
(5) Polyethylene glycols



3. Installing the Column

3.2 Cutting the Column

Incorrect connection of the capillary column might cause trouble. The length from the tip of the column to the graphite ferrule differs with the instrument and various units, and the column must be cut to the correct length.



- **Capillary cutter**

Capillary cutter (with 1 spare blade)	P/N 221-50595-91
---------------------------------------	------------------

- **Capillary accessory set**

Capillary accessory set	P/N 221-38652-91
-------------------------	------------------

This comprises the capillary cutter and the following accessories required for capillary-column analysis.

- List of Accessories

Capillary nut, graphite ferrule, O-rings, soap membrane flow meter, 6 × 7 wrench, tweezers, magnifying glass, adapter socket, pin vice, 0.4 mm drill, 0.5 mm drill, 0.8 mm drill, stainless steel ruler, vice, press-tight connector, polyimide adhesive for press-tight connector, magnet, stand



Capillary cutter

Third Party's Product Information

Ceramic cutter

A handy fused silica capillary cutter with all four usable sides

GLC Shimadzu GLC Handled Parts (parts made by third parties) (*)	
Shimadzu GLC	P/N 98853
RESTEK Corporaiton	P/N 20116 5pc

Ceramic cutter

Obtains clean, straight cross-sections.

GLC Shimadzu GLC Handled Parts (parts made by third parties) (*)	
Shortix capillary GC column cutter	P/N 0010
Maintenance kit	P/N 0011



Pack of 5 ceramic cutters



Shortix capillary GC column cutter

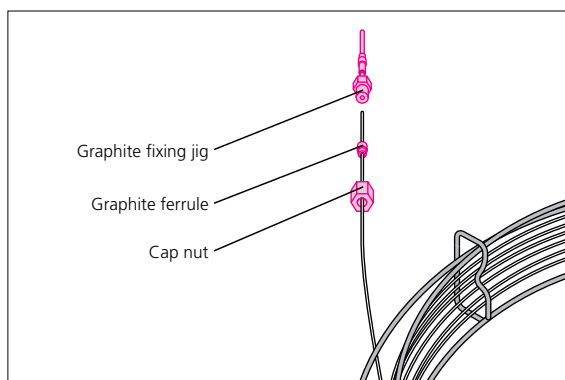
(*) For details on the performance of parts made by third parties, contact the respective manufacturer. Please note the parts may not be available in some countries.

Names and Functions of Parts
 1 Preparing Gas
 2 Sample Injection
 3 Installing the Column
 4 Data Processing
 5 Sample Injection Units
 6 Detectors

3. Installing the Column

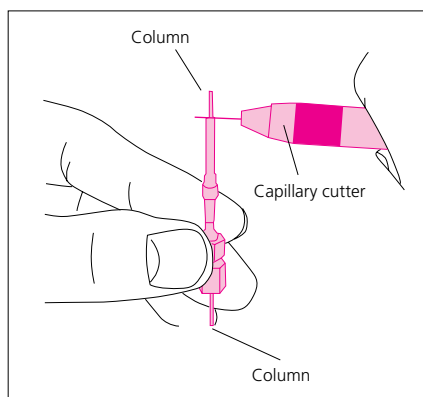
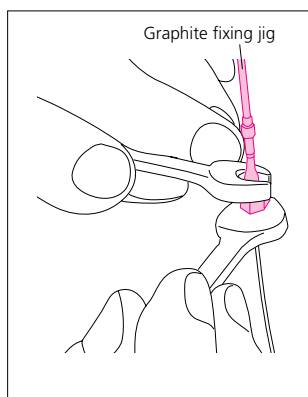
3.3 Installing the Column

Step1 Pass the capillary column inlet side through a hexagon cap nut and graphite ferrule.



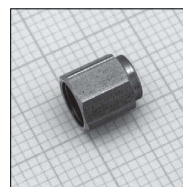
Cap nut (1 pc)	P/N 221-16325-01
Cap nut, split (1 pc)	P/N 221-32705
Graphite ferrule 0.5 mm (pack of 10)	P/N 221-32126-05
Graphite ferrule 0.8 mm (pack of 10)	P/N 221-32126-08

Step2 Fix the graphite ferrule on the sample injection unit side provisionally using the graphite fixing jig. When doing so, let the capillary column protrude about 10 mm from the graphite fixing jig, and cut the column using a capillary cutter etc. at the tip of the fixing jig. If the fixing jig for the SPL is used, the position will be fixed at 34 mm from the column tip.

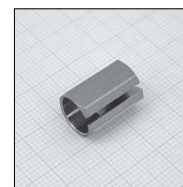


ATTENTION

Use of cap nut 221-16325-01 for fixing the column on the sample injection unit provides sharper peaks. Note, however, that cap nut 221-32705 is easier to handle.



221-16325-01



221-32705

ATTENTION

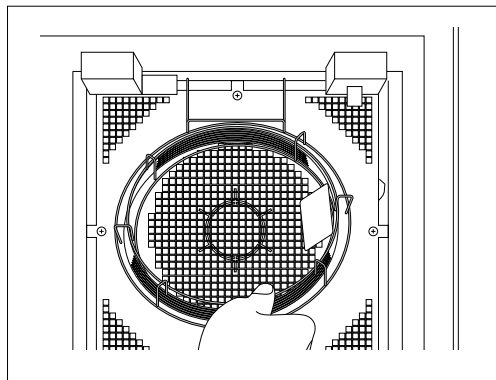
Change the graphite fixing position to 15 mm when performing splitless analysis with a wide-bore column of 0.53 mm inner diameter.

3. Installing the Column

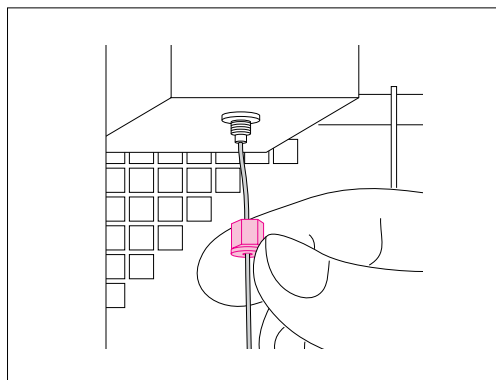
3.3 Installing the Column

Step3 Using the graphite fixing jig, fix the graphite ferrule on the detector side of the capillary column as well. Since, normally, a split nut (221-32705) is used, a cap nut need not be used ahead of the graphite ferrule. (If analyses are performed at column temperatures over 350 °C, it may be better to reduce the thermal capacity by using a small cap nut as on the inlet side).

Step4 Remove the fixing jig once the position of the graphite ferrule is set, and then hang the column on the column hanger.



Step5 Insert the column into the sample injection port.



ATTENTION

The column insertion length differs according to the injection unit and detector.

• GC-2010 Plus/GC-2010

SPL	34mm	TCD	50mm
WBI 34 mm (15 mm only for splitless analysis using wide-bore column)		FPD	82mm
FID(FTD)	69mm*1	ECD	37mm

*1 Shorten by 2 to 3 mm when using a metal capillary column.

• GC-2014

SPL	34mm	FTD-2014c	69mm*2
WBI 34 mm (15 mm only for splitless analysis using wide-bore column)		FPD	120mm
FID/FTD-2014	99mm*2	ECD	75mm

*2 Shorten by 2 to 3 mm when using a metal capillary column.

• GC-2025

SPL	34mm
FID	69mm*3

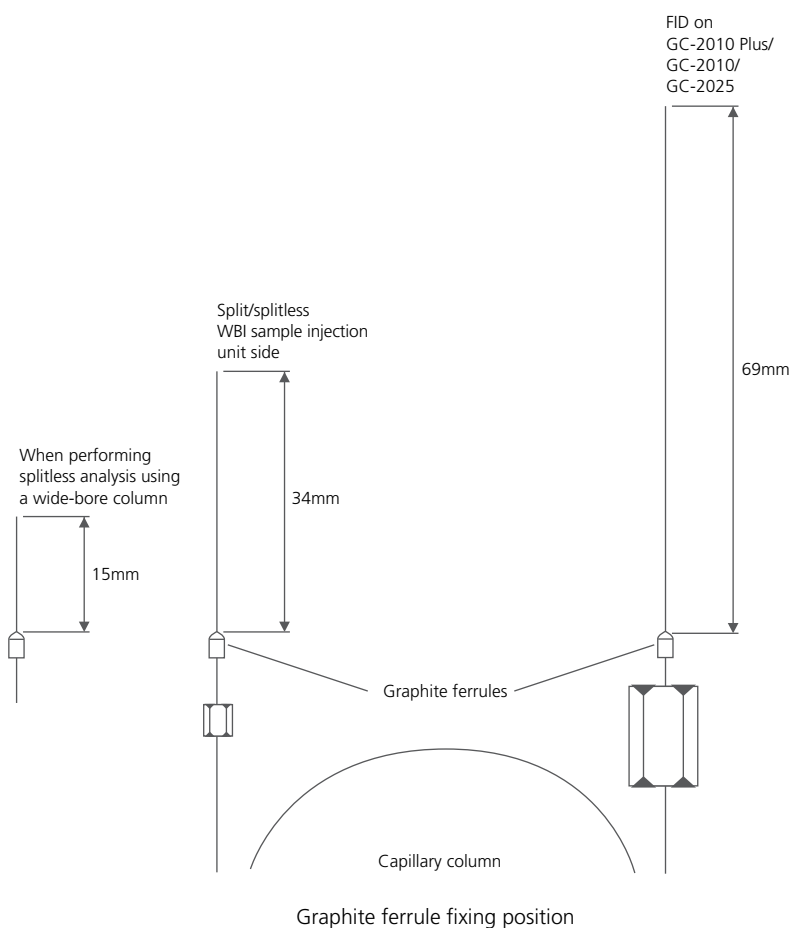
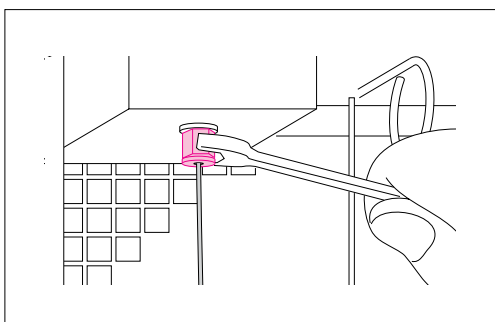
*3 Shorten by 2 to 3 mm when using a metal capillary column.

3. Installing the Column

3.3 Installing the Column

Step6

After tightening the nut by hand, fix in place by turning the nut another half-turn using the wrench.



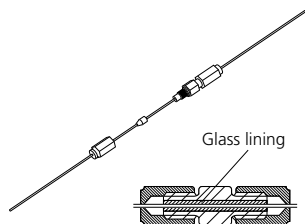
TIP
Figure on left shows actual size.

3. Installing the Column

3.4 When Coupling Capillary Columns Together

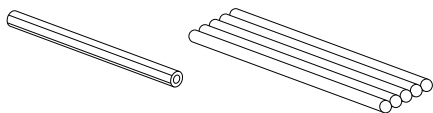
• Metal joints

Part Name	P/N	Compatible Capillary O.D. (mm)
Mini union (graphite ferrule, pack of 5)	670-11424-11	0.4
	670-11424-12	0.5
	670-11424-13	0.8
Graphite ferrule (pack of 10)	670-11424-21	0.4 to 0.5
	670-11424-22	0.8



• Quartz glass joint

Part Name	P/N
Press-tight connector (pack of 5)	221-38102-91
5 connectors and 5 g liquid polyimide resin	221-38102-92



ATTENTION

Although the mini union can be installed with ease, components might stick to the glass lining. The press-tight connector is made of quartz and few components stick to it, which means that it is suited to high-sensitivity analysis.

4.1	GC Workstation GCsolution Ver. 2	78
4.2	Chromatography Integrated Workstation LabSolutions LC/GC Ver. 5	79
4.3	Chromatopac C-R7A plus	80
4.4	Chromatopac C-R8A	81
4.5	Analog Cable	82

Data Processing

Gas Chromatograph Parts and Maintenance Brochure

The GC workstation and Chromatopac series are available as data processors. The GC workstation is capable of high-grade operations and data analysis, while Chromatopac series features easy operation.

4

4. Data Processing

4.1 GC Workstation GCsolution Ver. 2

- Features Assistant Bar, Data Explorer, and other navigational aids common with LabSolutions software.

Features both operator ease and high performance and high productivity.

- Handles control and data processing for up to four GC systems. Simultaneous chromatographic analysis is supported on up to eight flow lines in a dual injection system environment.
- Use of the GC-LAN connection option enables the GC instrument to be connected to a PC via a LAN (Local Area Network) using a LAN adapter.
- Supports control of the GC-2010 Plus, GC-2010, GC-2014, GC-2025, GC-14A/B, GC-17A, and GC-1700.*

Analog signals from the detector can also be loaded on other GC instrument types for data acquisition and analysis by using the CBM-102.

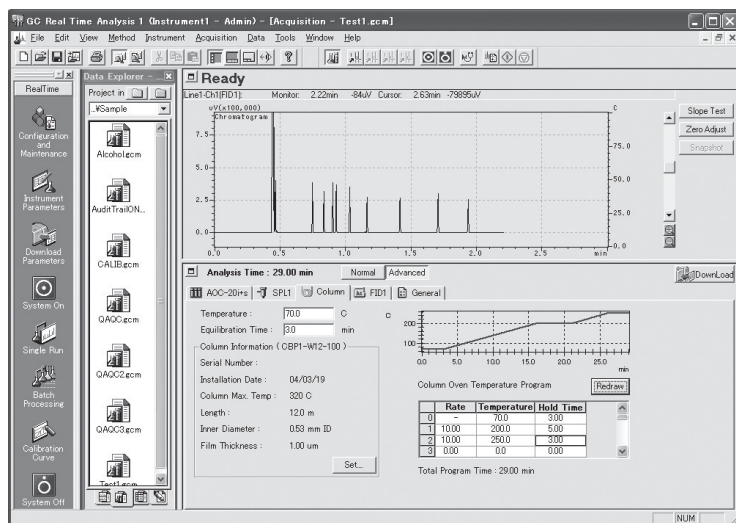
* GC-2010 Plus control is supported from Ver. 2.32 onward.

* GC-2025 control is supported from Ver. 2.40 onward.

* For control of the GC-14A/B, GC-17A, and GC-1700, data acquisition from these models, and acquisition of other analog signal data, the CBM-102 is required.

For the GC-14A, some control functions cannot be used.

The GC main unit of the GC-14A/B may need to be modified.



Display example

4. Data Processing

4.2 Chromatography Integrated Workstation

LabSolutions LC/GC Ver. 5

The LabSolutions series next-generation workstation is designed to integrate GC and LC control and enhance network functions. It features a Quantitation Browser for verifying multiple analytical results, enhanced automation functions from startup to shutdown, and improved operator ease and analysis productivity. It also comes with a PDF output function as standard to support the use of fewer paper resources. It can control the GC-2010 (Plus) and GC-2014.

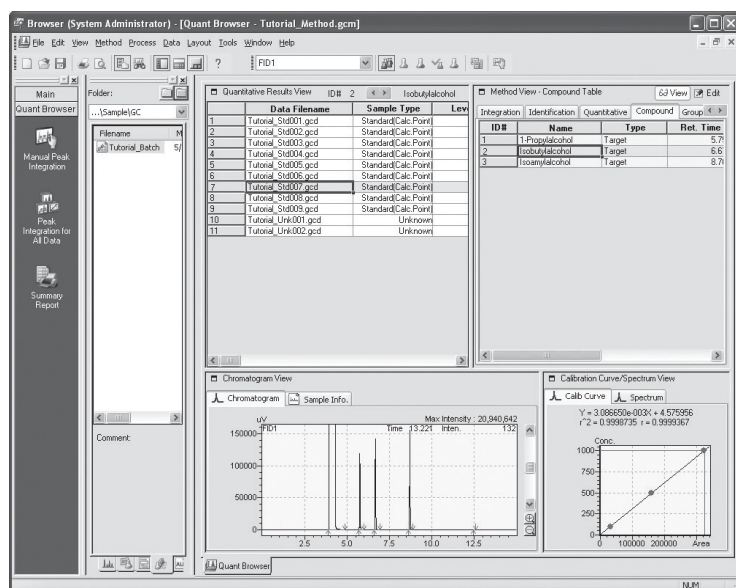
LabSolutions GC workstation (single: 1 unit control)

LabSolutions GC workstation (multi: 4 unit control)

* Windows XP, LabSolutions LC/GC, and CLASS-Agent Manager are already installed.

Note) Distillation GC software, PONA solution, and MDGC solution are not yet supported. So, use GC solution.

(For details, refer to the brochure C191-E015.)



Display example

4. Data Processing

4.3 Chromatopac C-R7A plus

P/N 223-04220-XX (* This model is currently discontinued and not available in sales.)

This multi-function and high-performance data processor is equipped with a high-speed parallel printer and multi-task and multi-window functions as standard.

Since the Chromatopac C-R7A plus incorporates a large, easy-to-view, slidable monitor, it can be installed under the instrument to save space. It also has a quick operation board for routine use, which can be operated by just ten keys.

Inputs from two channels are processed and output simultaneously on screen. Either of these outputs can also be switched and displayed on screen.

Anti-fade paper that can be stored for 20 years* is provided for GLP and GMP.

* When stored in a dark place at a constant temperature and humidity

Roll paper (general thermal chart paper), 50 m, 10 rolls	P/N 223-04230-81
Roll paper (for long storage), 50 m, 10 rolls	P/N 223-04231-81
Z-fold paper (general thermal chart paper), 1 set	P/N 223-04232
Z-fold paper (long-storage anti-fade paper), 1 set	P/N 223-04233

Recording paper is common with C-R8A.



Chromatopac C-R7A plus

4. Data Processing

4.4 Chromatopac C-R8A

P/N 223-04500-XX

The C-R8A is provided as standard with the numerous peak integration functions and quantitative calculation functionality from the well-established Chromatopac line with its superior data processor algorithms.

It has also been designed focusing on routine work such as quality control. Anyone can easily make full use of its functions.

VP features for automating its various validation functions powerfully support GLP/GMP compliance.

The standard high-speed RS-232C port (19,200 bps) ensures that PC network systems are supported by CLASS-Agent and Chromatopac manager software programs, for example.

Adding on a 2-channel board allows analog signals on two channels to be processed.

2-channel board	P/N 223-04202-91
Roll paper (general thermal chart paper), 50 m, 10 rolls	P/N 223-04230-81
Roll paper (for long storage), 50 m, 10 rolls	P/N 223-04231-81
Z-fold paper (general thermal chart paper), 1 set	P/N 223-04232
Z-fold paper (long-storage anti-fade paper), 1 set	P/N 223-04233
RS-232C cable, 2 m	P/N 228-35397-92
RS-232C cable, 3 m	P/N 228-35397-93
RS-232C cable, 5 m	P/N 228-35397-95

Recording paper is common with C-R7A Plus.



Chromatopac C-R8A

4. Data Processing

4.5 Analog Cable

Use the following cable included with the GC as a standard accessory to connect the GC-2010 Plus/GC-2010/GC-2014/GC-2025 to the C-R7A Plus and C-R8A. (Exclusively for a wide-range connection)

221-47251-41	Signal cable for Chromatopac
--------------	------------------------------

Also, set the analog signal type in the detector setting on the GC instrument side to [Wide] as follows.

Detector DET #1		NOT READY
FID 1	LINE 1	On
Temp(C)	0.0	300.0
Flame		Off
Filter Time Constant		4ms

Signal Output Port		Ch1
Background sig save		Off
Background sig comp.		Off
Det sig subtraction		Off
Signal Attenuation		x1
Analog Signal Type	◀	Wide

Screen display

When former Chromatopac models C-R3A, 5A, 6A are connected by the above cable, only linear range signal processing can be performed. So, set the analog signal type to [Linear].

When the GC-2010 Plus/GC-2010/GC-2014/GC-2025 is connected to the C-R7A Plus or C-R8A and signal processing is performed in the linear range, the linear range cable below is required separately.

221-47251-42	Chromatopac signal cable (for linear)
--------------	---------------------------------------



Signal cable for Chromatopac

ATTENTION

Wrong signals will be output unless the analog signal type is set correctly.

5.1	SPL-2010 Plus/SPL-2010/SPL-2014/SPL-2025	84
5.2	WBI-2010 Plus/WBI-2010/WBI-2014	84
5.3	OCI/PTV-2010	85
5.4	DINJ-2014	86
5.5	SINJ-2014	86

Sample Injection Units

Gas Chromatograph Parts and Maintenance Brochure

In gas chromatography, of the sample that is injected, only the component that is vaporized in the sample injection unit is introduced into the column by the carrier gas. A variety of sample injection units are available: for split/splitless, wide-bore-column, on-column/PTV, and packed-column injections.

5

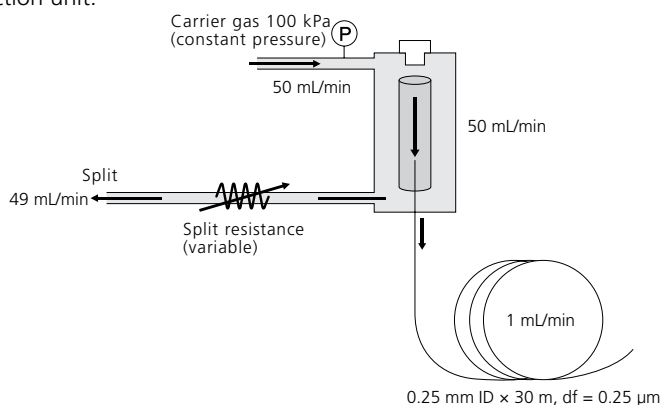
5. Sample Injection Units

5.1 SPL-2010 Plus/SPL-2010/SPL-2014/SPL-2025

“SPL” refers to the split sample injection unit. SPL-2010 is for the GC-2010, and SPL-2014 is for the GC-2014.

A split sample injection unit is an injection unit for split analysis.

“Split analysis” is an analysis method where the moving speed inside the injection port is increased to set to a column flowrate (linear speed) that is ideal for separation. This is achieved by providing a sample discharge port in the sample injection unit.



ATTENTION

The “split ratio” refers to the ratio of the split flowrate when the column flowrate is taken to be 1.

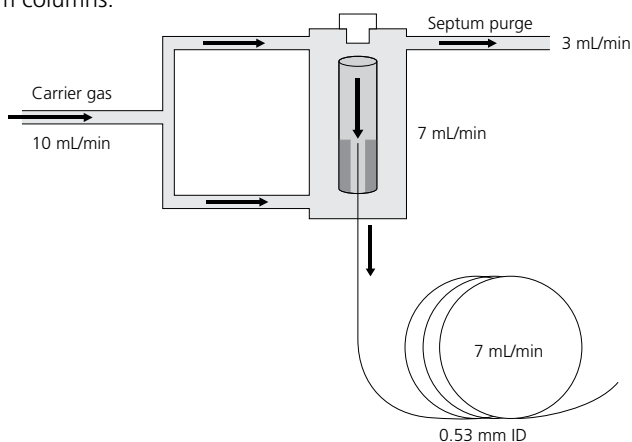
In the example on the left, the split ratio is 49.

The definition of split ratio differs with each manufacturer.

5.2 WBI-2010 Plus/WBI-2010/WBI-2014

“WBI” refers to a sample injection unit for a wide-bore column. WBI-2010 is for the GC-2010, and WBI-2014 is for the GC-2014. There is no WBI lineup for the GC-2025.

The analysis of trace amounts is supported since larger amounts of sample can be introduced into wide-bore columns (I.D. 0.53 mm) compared with 0.25 mm or 0.32 mm columns.

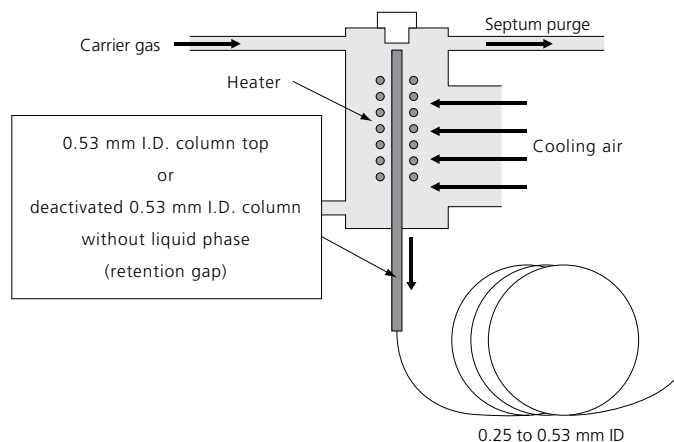


5. Sample Injection Units

5.3 OCI/PTV-2010

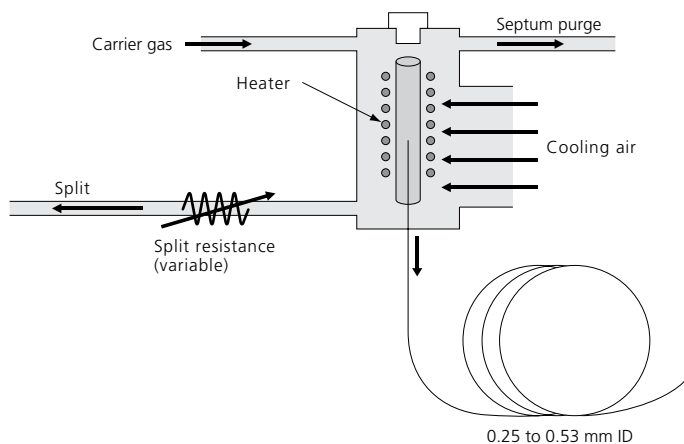
“OCI/PTV” refers to a sample injection unit equipped with functions for both on-column injection and programmed temperature vaporization injection. There is no OCI/PTV lineup for the GC-2014 and GC-2025.

The on-column sample injection unit is suitable for compounds which easily cause thermal decomposition. The liquid sample is injected directly into the column via an exclusive syringe, and heated rapidly to be vaporized and analyzed.



If the OCI adapter is replaced with the quartz insert provided, this injection unit can be used as a programmed temperature vaporization injection unit with a split function. (Rearrangement of split piping is required for switching between OCI and PTV.) The injection unit causes no changes in chemical composition (discrimination), making it suitable for compounds which easily cause thermal decomposition.

Column contamination can be reduced since an insert is used.



ATTENTION

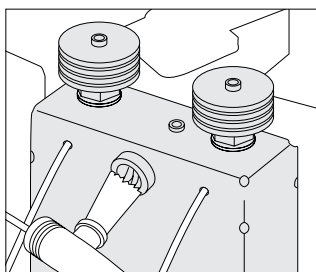
On-column analysis is suitable for compounds which easily cause thermal decomposition.

However, note that the column is more likely to be contaminated because the sample is introduced directly into the column.

5. Sample Injection Units

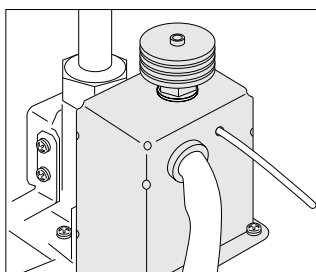
5.4 DINJ-2014

“DINJ” refers to a sample injection unit for dual-packed-column analysis. Packed columns can be used on only the GC-2014 and not on other models. This injection unit supports FID and TCD dual analysis. The cell design used in the sample injection unit is the same as that for the GC-14 series and allows joint use of the glass insert for packed columns.



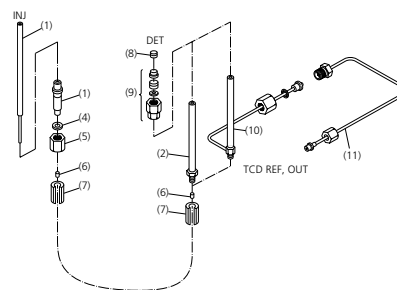
5.5 SINJ-2014

“SNJ” refers to a sample injection unit for single-packed-column analysis. Packed columns can be used on only the GC-2014 and not on other models. When an ECD or other high-sensitivity detector is used, provide the exclusive sample injection unit to prevent ghost peaks or contamination.



TIP One-Point Attachment

This attachment is used on gas chromatographs for packed column analysis when a wide-bore capillary column with an I.D. of 0.53 mm is used by the direct injection method. (Common with the GC-14 series)



221-29992-91 WBC Attachment (Option)

No.	P/N	Name	Qty
(1)	221-29676	WBC adapter, INJ	1
(2)	221-29757	WBC adapter, DET	1
(3)	221-14093	Glass insert, 3.0 mm	1
(4)	201-30051-84	Washer, WM (pack of 10)	1
(5)	201-30008	Nut, MF	1
(6)	201-30008-84	Nut, MF (pack of 10)	1
(7)	221-32126-08	Graphite ferrule 0.8 (pack of 10)	1
(8)	221-32705	Capillary connector nut (with split)	2
(9)	221-15563-91	Graphite ferrule, 5 mm (pack of 4)	1
(10)	221-15561-91	Glass column joint	1

6.1	FID	88	6.7	FTD Troubleshooting	190
6.2	FTD	101	6.8	FPD Troubleshooting	193
6.3	FPD	123	6.9	TCD Troubleshooting	196
6.4	TCD	183	6.10	ECD Troubleshooting	198
6.5	ECD	185	6.11	General Detector Troubleshooting	201
6.6	FID Troubleshooting	188			

Detectors

Detectors convert the amount of component separated and eluted by the column to electrical signals.

Five types of detectors (FID, FTD, FPD, TCD, and ECD) are available, and these are selected according to the target component and sensitivity.



6. Detectors

6.1 FID

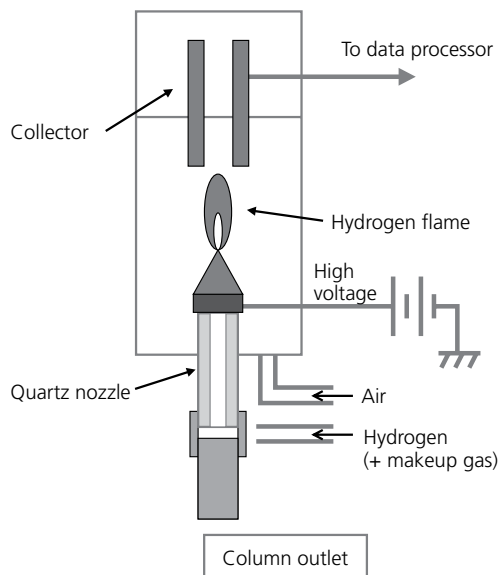
FID Principle of Operation

FID stands for Flame Ionization Detector. This type of detector is most widely used on gas chromatographs.

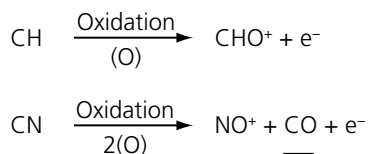
Although it responds to almost all organic compounds, it is not sensitive to carbon-free compounds.

On this detector, hydrogen is burned at the top of a metal-tipped quartz nozzle. Organic matter burns to produce carbon dioxide and water. In a hydrogen flame, however, several ppm of organic matter causes the ionization reaction shown below, and the resulting ions are collected in a collector and converted to electrical signals.

- FID (Flame Ionization Detector)



Organic matter burns in the hydrogen flame and several ppm becomes ions as shown in the following equations:



When ions are collected in a collector, an electrical current flows.

6. Detectors

6.1 FID

6.1.1 Inspecting the Collector and Replacing the Nozzle (FID-2010 Plus/FID-2010/FID-2025)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.

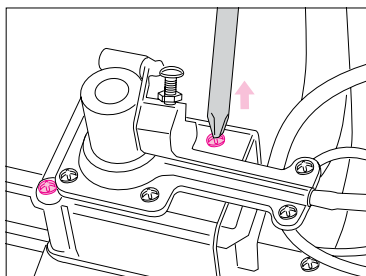
Tools Required:

Phillips screwdriver, tweezers, hex nut screwdriver (option, P/N 670-18800)

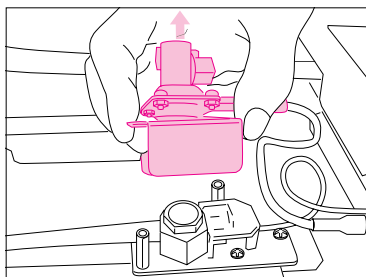
Procedure

Step1 Shut down the system.

Step2 Remove the screws of the collector holding bracket.



Step3 Remove the collector unit together with the collector holding bracket.



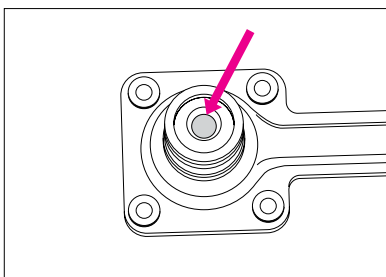
6. Detectors

6.1 FID

6.1.1 Inspecting the Collector and Replacing the Nozzle (FID-2010 Plus/FID-2010/FID-2025)

Step4

Check for dirt inside the collector. If dirty, wipe the dirt away using cotton buds soaked in solvent. If using an item like a brush, use a soft one. Damage caused by using a wire brush etc. can result in noise.

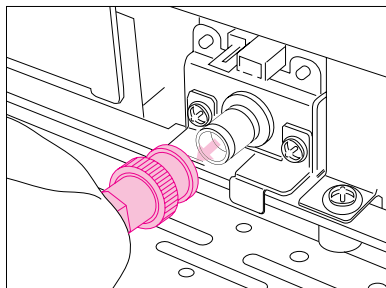


Collector ASSY, FID

P/N 221-72322-91

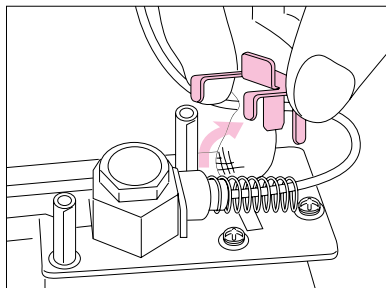
Step5

Disconnect the signal cable.



Step6

Pull out the high-voltage-cable holding plate upward.



ATTENTION

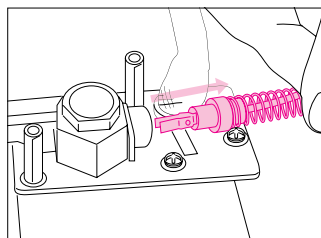
Replace the collector if it becomes too dirty to clean or rusting or other abnormalities appear.

6. Detectors

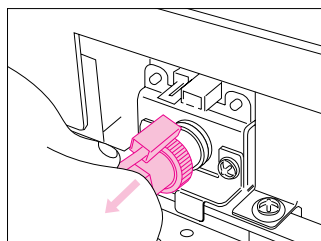
6.1 FID

6.1.1 Inspecting the Collector and Replacing the Nozzle (FID-2010 Plus/FID-2010/FID-2025)

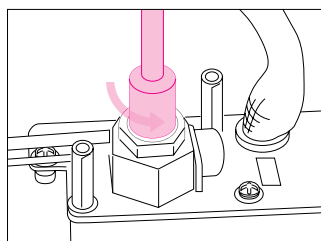
Step7 Pull out the high voltage brush together with the spring.



Step8 Disconnect the high voltage cable.

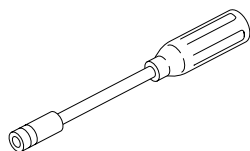


Step9 Loosen the FID nozzle with a hex nut screwdriver.



Hex nut screwdriver

P/N 670-18800



Hex nut screwdriver

ATTENTION

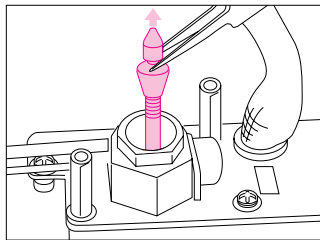
The hex nut screwdriver is not a standard accessory.

6. Detectors

6.1 FID

6.1.1 Inspecting the Collector and Replacing the Nozzle (FID-2010 Plus/FID-2010/FID-2025)

Step10 Detach the FID nozzle with tweezers.



Step11 Check the jet section at the tip of the FID nozzle for dirt or blockages. If dirty, wipe the dirt away using a cotton bud soaked in solvent. Replace it with a new one if it has blockages.

FID Nozzles for GC-2010 Plus/GC-2010/GC-2025



FID nozzle (0.3 dia. standard)	P/N 221-48258-91
FID nozzle (0.8 dia. for water analysis)	P/N 221-49373-91
FID nozzle (0.8 dia., for packed columns and water analysis) * Used for analysis of aqueous solution etc. using a packed column when the flame easily goes out	P/N 221-70162-96

ATTENTION

Do not jolt the nozzle as this may break the quartz tube.

ATTENTION

Use the dedicated 0.8 mm I.D. nozzle if performing water analysis.
When using the general-purpose nozzle with the standard 0.3 mm I.D. for capillary columns, water may cause the FID flame to go out.

6. Detectors

6.1 FID

6.1.2 Replacing the Igniter (FID-2010 Plus/FID-2010/FID-2025)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.

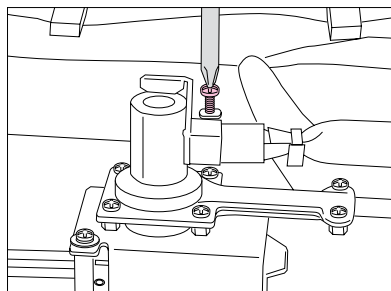
Tools Required:

Phillips screwdriver

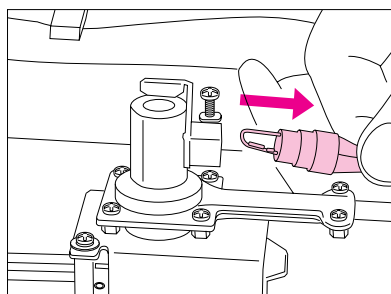
Procedure

Step1 Shut down the system.

Step2 Loosen the igniter fixing screw.



Step3 Pull out the igniter filament.
Check that the filament is not broken.

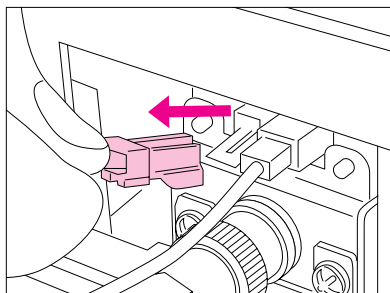


6. Detectors

6.1 FID

6.1.2 Replacing the Igniter (FID-2010 Plus/FID-2010/FID-2025)

Step4 Disconnect the connector at the FID amplifier end if replacing the igniter.



Step5 Attach the new igniter.

FID igniter

P/N 221-41847-93

Step6 Loosely tighten the igniter fixing screw to fix it. Be careful as tightening it too hard may damage the insulator.

6. Detectors

6.1 FID

6.1.3 Inspecting the Collector and Replacing the Nozzle (FID-2014)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.

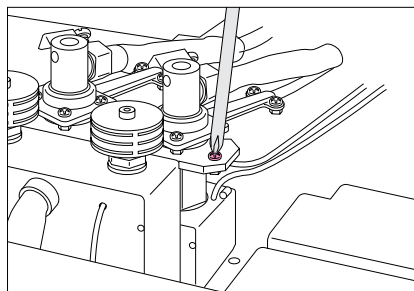
Tools Required:

Phillips screwdriver, tweezers, hex nut screwdriver (option, P/N 670-18800)

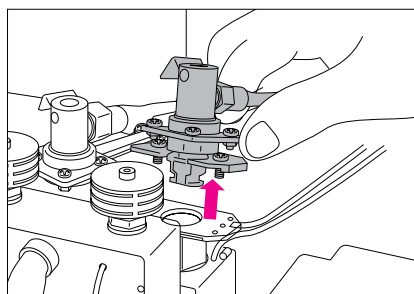
Procedure

Step1 Shut down the system and stop the gas supply for detectors.

Step2 Remove the two screws of the collector holding bracket.



Step3 Remove the collector unit.

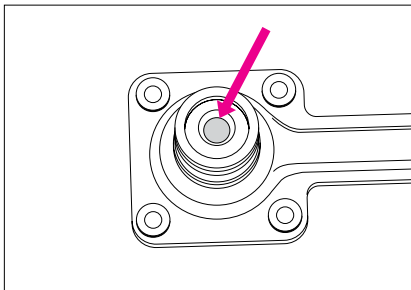


6. Detectors

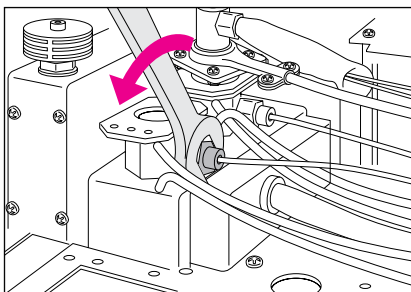
6.1 FID

6.1.3 Inspecting the Collector and Replacing the Nozzle (FID-2014)

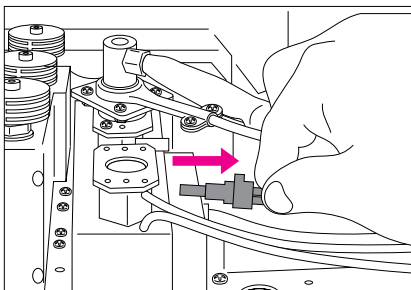
Step4 Check for dirt inside the collector. If dirty, wipe the dirt away using cotton buds soaked in solvent. If using an item like a brush, use a soft one. Damage caused by using a wire brush etc. can result in noise.



Step5 Loosen the high voltage unit fixing nut.



Step6 Pull out the high voltage brush.

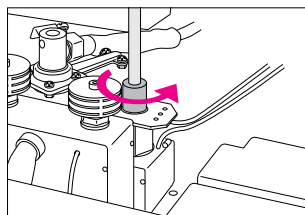


6. Detectors

6.1 FID

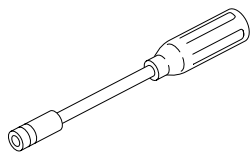
6.1.3 Inspecting the Collector and Replacing the Nozzle (FID-2014)

Step7 Loosen the FID nozzle with a hex nut screwdriver.



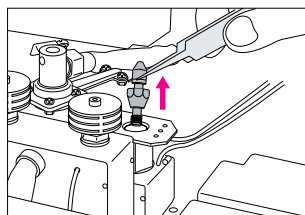
Hex nut screwdriver

P/N 670-18800



Hex nut screwdriver

Step8 Detach the FID nozzle with tweezers.



ATTENTION

Do not jolt the nozzle as this may break the quartz tube.

6. Detectors

6.1 FID

6.1.3 Inspecting the Collector and Replacing the Nozzle (FID-2014)

Step9 Check the jet section at the tip of the FID nozzle for dirt or blockages.

FID Nozzles for GC-2014



FID nozzle (0.5 dia., for packed columns) * Nozzle included as standard, for packed columns	P/N 221-70162-95
FID nozzle (0.3 dia., for capillary columns) * For obtaining sharp peaks	P/N 221-70162-93
FID nozzle (0.8 dia., for capillary columns and water analysis) * Used for analysis of aqueous solution etc. using a capillary column when the flame easily goes out	P/N 221-70162-94
FID nozzle (0.8 dia., for packed columns and water analysis) * Used for analysis of aqueous solution etc. using a packed column when the flame easily goes out	P/N 221-70162-96
FID nozzle (0.5 dia., for capillary columns) * Used when a capillary column is used and the flame easily goes out	P/N 221-70162-92

Step10 Attach the FID nozzle and use the hex nut screwdriver to turn it until it comes to a full stop.

Step11 Put back the high voltage unit and collector unit by following the removal procedure in reverse.

Step12 Start up the system.

ATTENTION

The FID flame may go out when analyzing aqueous solution etc. However, it will be less likely to go out if a nozzle with a large I.D. is used. Also, the nozzle may more likely become blocked when analyzing high boiling point components. Blockages can be reduced by using a nozzle with a large I.D.

ATTENTION

Be careful as tightening the high voltage unit fixing nut too hard may damage the insulator.

6. Detectors

6.1 FID

6.1.4 Replacing the Igniter (FID-2014)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.

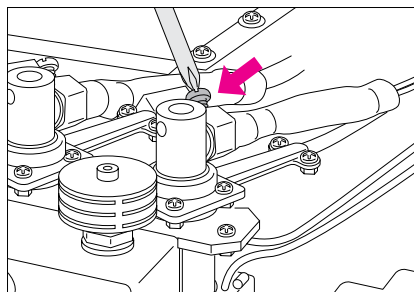
Tools Required:

Phillips screwdriver

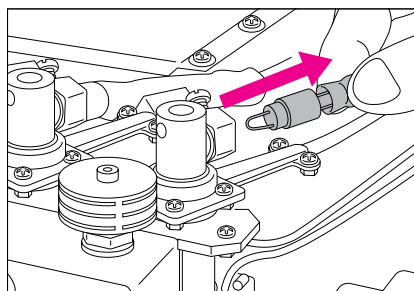
Procedure

Step1 Shut down the system and stop the gas supply for detectors.

Step2 Loosen the igniter fixing screw.



Step3 Pull out the igniter filament.
Check that the filament is not broken.

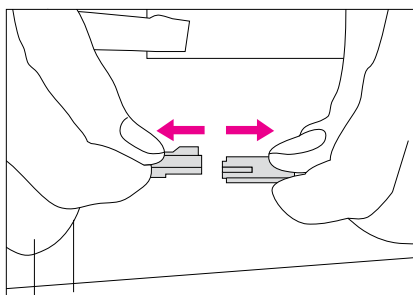


6. Detectors

6.1 FID

6.1.4 Replacing the Igniter (FID-2014)

Step4 Disconnect the connector on the igniter cable if replacing the igniter.



Step5 Attach the new igniter.

FID igniter

P/N 221-41847-93

Step6 Loosely tighten the igniter fixing screw to fix it. Be careful as tightening it too hard may damage the insulator.

Step7 Connect the connector on the igniter cable.

6. Detectors

6.2 FTD

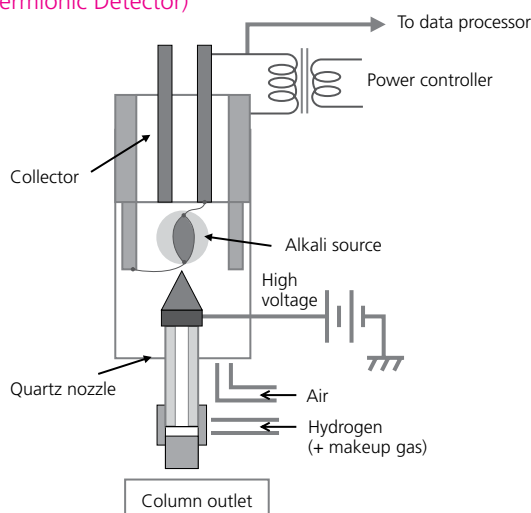
FTD Principle of Operation

FTD stands for Flame Thermionic Detector.

This type of detector demonstrates high sensitivity to organic nitrogen compounds and phosphorous compounds. For phosphorous compounds, FPD detectors demonstrate better selectivity. In the figure below, current is passed through a platinum coil with an alkali source (rubidium sulfate) attached to heat the coil.

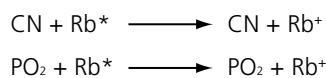
Carrier gas and hydrogen are passed through the nozzle. FTD detectors do not form a hydrogen flame like FID detectors; they form a plasma-like atmosphere. Here, nitrogen compounds and phosphorous compounds selectively cause ionization as shown below, and the resulting ions are collected in a collector where they are converted to electrical signals.

• FTD (Flame Thermionic Detector)



When current is passed through a platinum coil with an alkali source (rubidium salt) attached, a plasma-like atmosphere is formed around the alkali source.

Rb^* (rubidium radical) is formed in this atmosphere, and $-\text{CN}$ and $-\text{PO}_2$, which is formed by oxidation of organophosphorus compounds, react with Rb^* as follows to produce ions.



When ions are collected in a collector, an electrical current flows.

6. Detectors

6.2 FTD

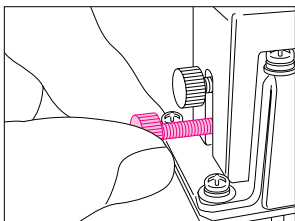
6.2.1 Replacing the Collector (FTD-2010 Plus/FTD-2010/FTD-2014C)

- Perform maintenance work only after the temperature of each part has fallen to 50°C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts. Perform maintenance work using the appropriate tools.
- Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.

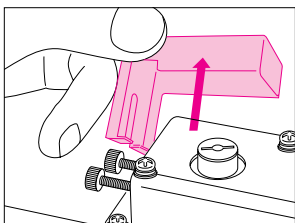
Procedure

Step1 Shut down the system.

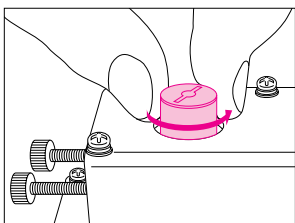
Step2 Loosen the two collector fixing knurled screws.



Step3 Detach the collector cover.



Step4 Turn the FTD collector by hand to loosen it.



ATTENTION

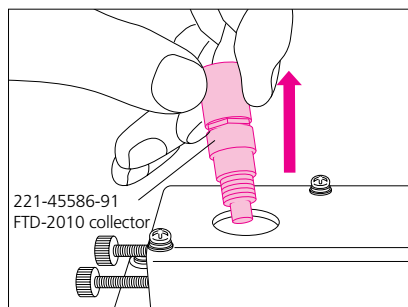
Check whether any silica originating from the alkali source has deposited on the inside of the collector cover, blocking the exhaust hole. Increased levels of noise and reductions in sensitivity can result if a lot of silica has been deposited. Wipe away using tissue paper etc.

6. Detectors

6.2 FTD

6.2.1 Replacing the Collector (FTD-2010 Plus/FTD-2010/FTD-2014C)

Step5 Detach the FTD collector.

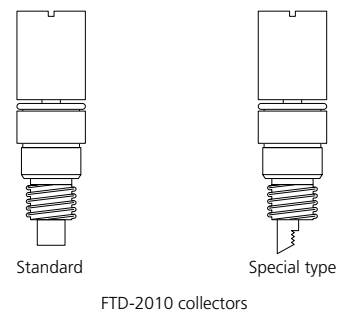
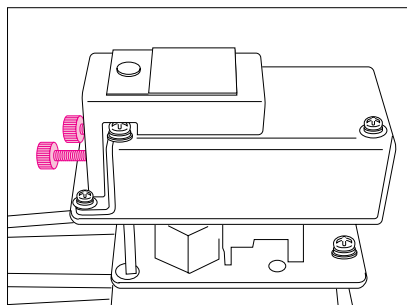


Step6 Attach the new FTD collector by turning it until it touches.

FTD-2010/FTD-2014C collector (standard)	P/N 221-45586-91
FTD-2010 Plus collector (special type)	P/N 221-71513-91

On the FTD-2010 Plus, the special-type collector (P/N 221-71513-91 [for high-matrix samples]) is provided as standard.

Step7 Put back the collector cover. Tighten the collector fixing knurled screws several times, alternating between the top and bottom screws.



ATTENTION

Overtightening the screws might break the filament. So, do not use a screwdriver or similar tool; tighten the screws by hand to install the collector.

ATTENTION

The screws must be tightened several times, as tightening one screw may loosen the other. Ensure that the collector cover has been properly fixed. If these screws are loose, the alkali source will not glow as hot, possibly resulting in reduced sensitivity.

6. Detectors

6.2 FTD

6.2.2 Replacing the Nozzle (FTD-2010 Plus/FTD-2010/FTD-2014C)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.

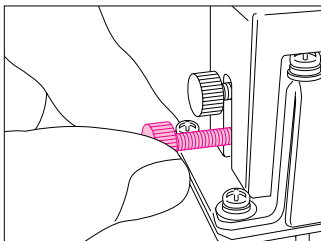
Tools Required:

Phillips screwdriver, tweezers, hex nut screwdriver (option, P/N 670-18800)

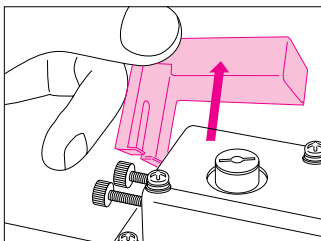
Procedure

Step1 Shut down the system.

Step2 Loosen the two collector fixing knurled screws.



Step3 Detach the collector cover.

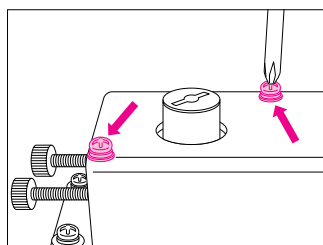


6. Detectors

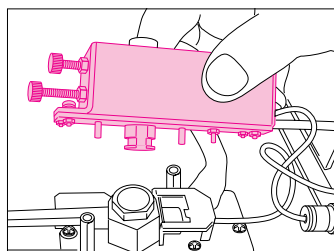
6.2 FTD

6.2.2 Replacing the Nozzle (FTD-2010 Plus/FTD-2010/FTD-2014C)

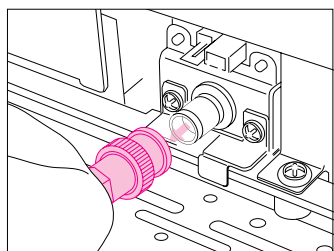
Step4 Remove the FTD unit fixing screws.



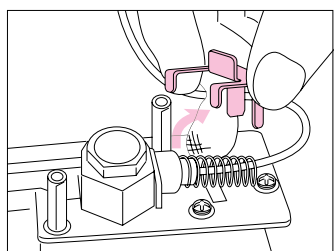
Step5 Detach the FTD unit.



Step6 Disconnect the signal cable.



Step7 Pull out the high-voltage-cable holding plate upward.

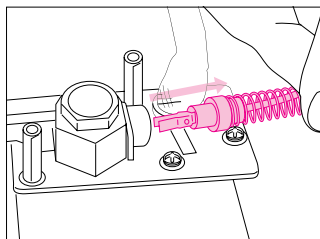


6. Detectors

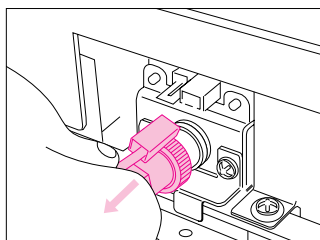
6.2 FTD

6.2.2 Replacing the Nozzle (FTD-2010 Plus/FTD-2010/FTD-2014C)

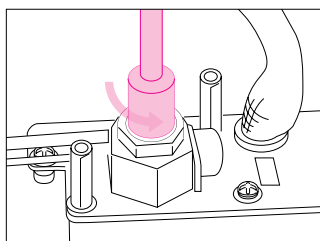
Step8 Pull out the high voltage brush together with the spring.



Step9 Disconnect the high voltage cable.

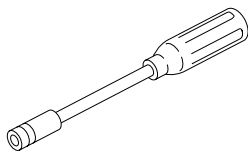


Step10 Loosen the FID nozzle with a hex nut screwdriver.



Hex nut screwdriver

P/N 670-18800



Hex nut screwdriver

ATTENTION

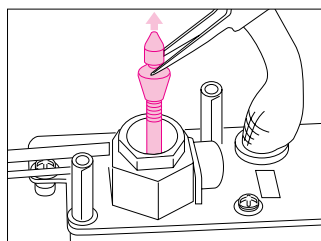
The hex nut screwdriver is not a standard accessory.

6. Detectors

6.2 FTD

6.2.2 Replacing the Nozzle (FTD-2010 Plus/FTD-2010/FTD-2014C)

Step11 Detach the FID nozzle with tweezers.



Step12 Check the jet section at the tip of the FID nozzle for dirt or blockages. If dirty, wipe the dirt away using a cotton bud soaked in solvent. Replace it with a new one if it has blockages.

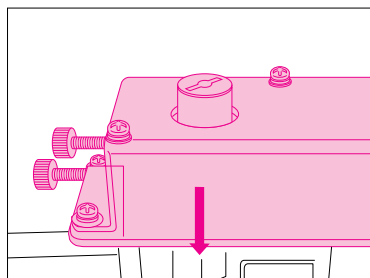
FID Nozzle



FID nozzle (0.3 dia., standard)

P/N 221-48258-91

Step13 Attach the FTD unit.



ATTENTION

Do not jolt the nozzle as this may break the quartz tube.

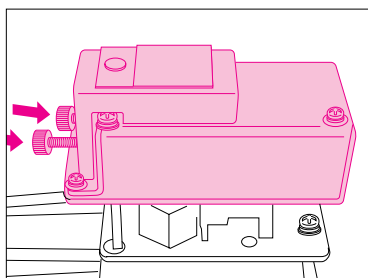
6. Detectors

6.2 FTD

6.2.2 Replacing the Nozzle (FTD-2010 Plus/FTD-2010/FTD-2014C)

Step 14

Put back the collector cover. Tighten the collector fixing knurled screws several times, alternating between the top and bottom screws.

**ATTENTION**

The screws must be tightened several times, as tightening one screw may loosen the other. Ensure that the collector cover has been properly fixed. If these screws are loose, the alkali source will not glow as hot, possibly resulting in reduced sensitivity.

6. Detectors

6.2 FTD

6.2.3 Replenishing the Alkali Source

(FTD-2010 Plus/FTD-2010/FTD-2014C)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.

Tools Required:

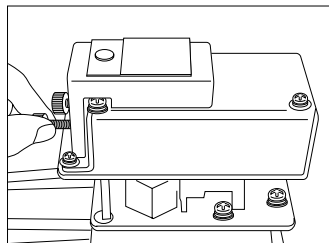
Tweezers, hex wrench (accessory of regeneration adapter)

Procedure

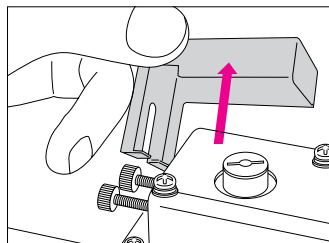
Step1 Prepare the FTD-2010 collector regeneration kit (221-49079-91) and the collector regeneration adapter (221-70846-91).

Step2 Press the [DET] key to display the FTD screen. Lower the FTD temperature to below 50 °C and stop the supply of detector gas. Turn OFF the FTD power controller.

Step3 Loosen the two collector fixing knurled screws.



Step4 Detach the collector cover.

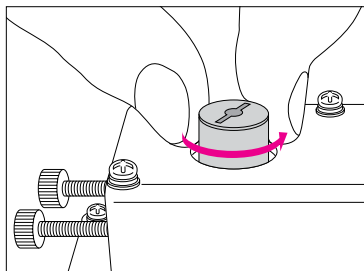


6. Detectors

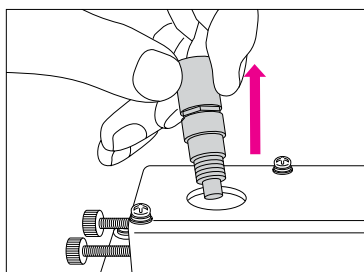
6.2 FTD

6.2.3 Replenishing the Alkali Source (FTD-2010 Plus/FTD-2010/FTD-2014C)

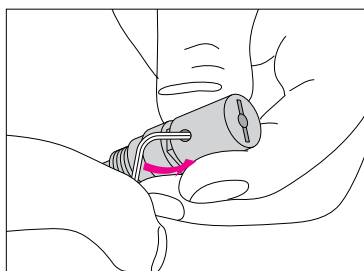
Step5 Turn the FTD collector by hand to loosen it.



Step6 Detach the FTD collector.



Step7 Loosen the screw with the hex wrench provided with the collector regeneration adapter, and remove the collector knob.



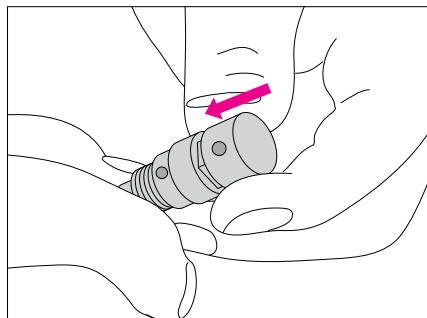
6. Detectors

6.2 FTD

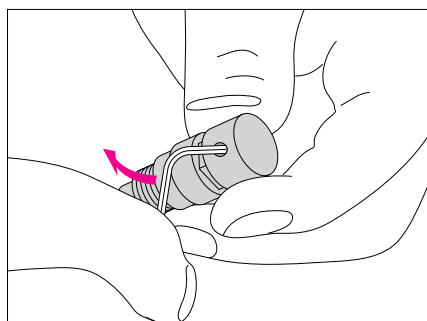
6.2.3 Replenishing the Alkali Source

(FTD-2010 Plus/FTD-2010/FTD-2014C)

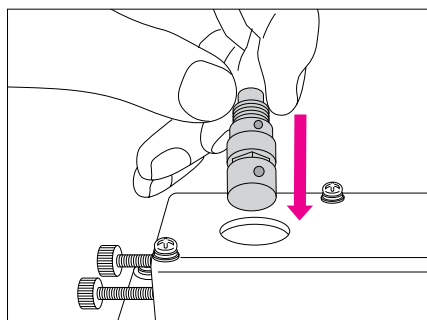
Step8 Attach the collector regeneration adapter.



Step9 Tighten the setscrew with the hex wrench to fix the collector regeneration adapter in place.



Step10 Attach the collector upside down.

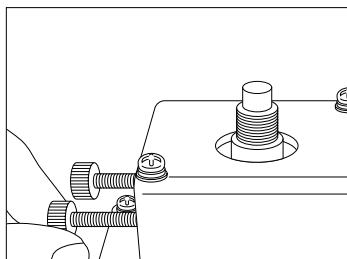


6. Detectors

6.2 FTD

6.2.3 Replenishing the Alkali Source (FTD-2010 Plus/FTD-2010/FTD-2014C)

Step 11 Tighten the collector fixing knurled screws several times, alternating between the top and bottom screws.



Step 12

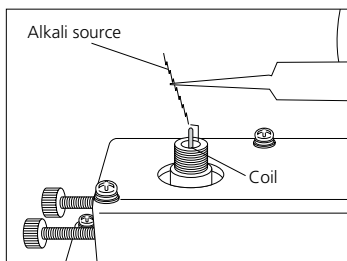
Detector: DET #2 NOT READY	
FTD #1	On
Temp (C)	0.0 280.0
Current (pA)	1.00
Control Mode	Current
Filter Time Constant	4ms
Power controller	On
Ad'ust	Complete
Ad'ust time	0.00 1.00
Power (%)	0
Signal Output Port Ch1	
Background sig save Off	
Background sig comp. Off	



Detector: DET #2 NOT READY	
FTD #1	On
Temp (C)	0.0 280.0
Voltage (%)	60
Control Mode	Voltage
Filter Time Constant	4ms
Power controller	On
Ad'ust	Complete
Ad'ust time	0.00 1.00
Power (%)	0
Signal Output Port Ch1	
Background sig save Off	
Background sig comp. Off	

Press the [DET] key to display the FTD screen, and after setting the control mode to [Voltage], and the power to [0 %], turn ON the FTD power controller.

Step 13 Increase the power little by little while checking the glow of the filament of the alkali source. When it becomes a pale orange, use tweezers to bring the rod-shaped, top-up alkali source to lightly touch the coil. Melt it little by little to add the alkali source onto the coil. Raise the voltage about 5 % to 10 % if the thermal capacity increases, the coil becomes dark, and the top-up alkali source gets stuck on the coil. This will make it glow red again, so take away the excess. Adding too much of the alkali source will result in reduced sensitivity during analysis. So, as a guide, add enough to cover the coil thinly (O.D. 1.8 to 2 mm).



6. Detectors

6.2 FTD

6.2.3 Replenishing the Alkali Source

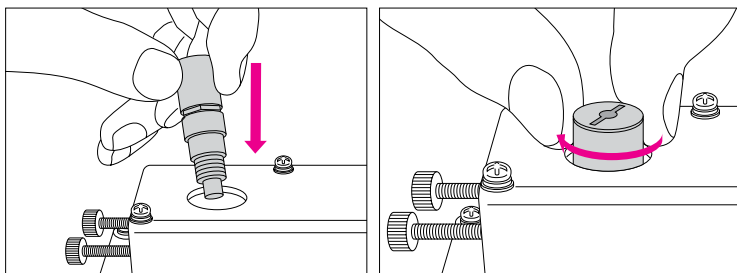
(FTD-2010 Plus/FTD-2010/FTD-2014C)

Step14 Once the alkali source has been added, increase the voltage further by 5 % to 10 % to smooth out the alkali source on the coil. When the coil is coated evenly, set the voltage to [0 %], and turn the power controller OFF. Change the control mode to [Current].

Step15 Loosen the two collector fixing knurled screws and detach the collector.

Step16 Replace the collector regeneration adapter and the collector knob following the installation procedure in reverse.

Step17 Attach the new FTD collector by turning it until it touches. Tightening it too hard may cause the filament to break, so fix it by hand instead of using a screwdriver.

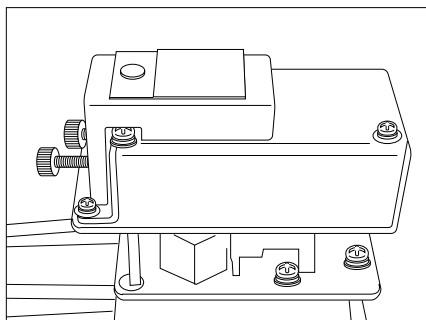


6. Detectors

6.2 FTD

6.2.3 Replenishing the Alkali Source (FTD-2010 Plus/FTD-2010/FTD-2014C)

Step 18 Put back the collector cover.



Step 19 Tighten the collector fixing knurled screws several times, alternating between the top and bottom screws.

The screws must be tightened several times, as tightening one screw may loosen the other. Ensure that the collector cover has been properly fixed. If these screws are loose, the alkali source will not glow as hot, possibly resulting in reduced sensitivity.

Step 20 In order to let the alkali source settle, and to reduce the contaminants that result in noise, set the current to about 1.00 pA and condition the system in the adjustment mode for about 3 to 5 hours, using the same flowrates of hydrogen, air, and make-up gas as the analytical conditions.

6. Detectors

6.2 FTD

6.2.4 Replacing the Collector (FTD-2014)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.

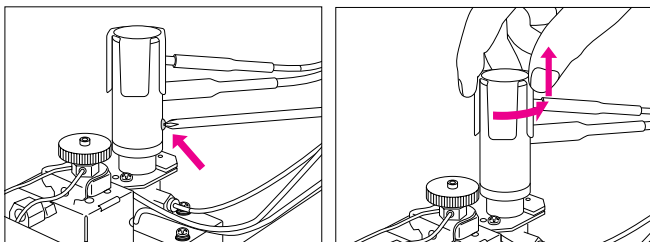
Tools Required:

Phillips screwdriver, flat screwdriver, 5.5×7 wrench (standard FTD accessory),
1.5 mm Hex wrench (standard FTD accessory)

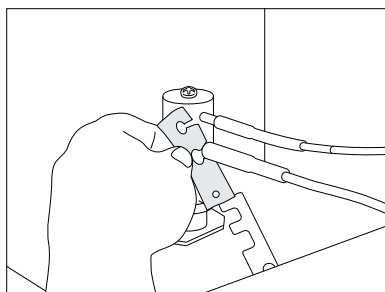
Procedure

Step1 Shut down the system and stop the gas supply for detectors.

Step2 Remove the collector cover fixing screw, and turn the collector and pull it out upward.



Step3 Remove the fluoropolymer sheet. If the sheet is damaged, replace it.



Fluoropolymer sheet

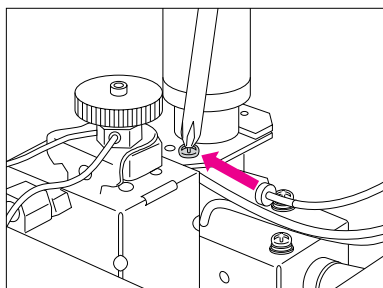
P/N 221-70662

6. Detectors

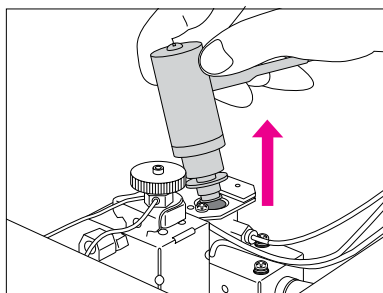
6.2 FTD

6.2.4 Replacing the Collector (FTD-2014)

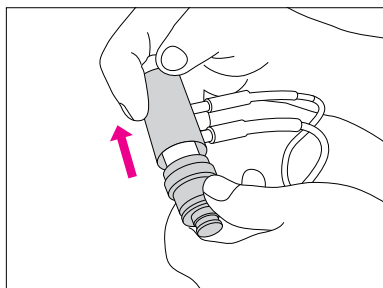
Step4 Loosen the FTD electrode fixing screw and remove the fixing plate.



Step5 Pull out the FTD electrode upward.



Step6 Pull out the collector cover.

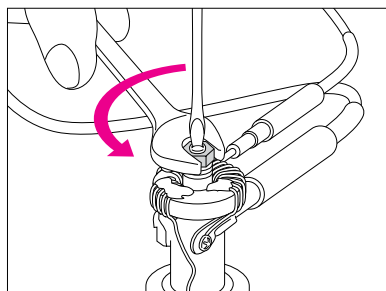


6. Detectors

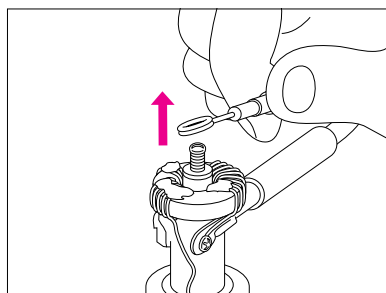
6.2 FTD

6.2.4 Replacing the Collector (FTD-2014)

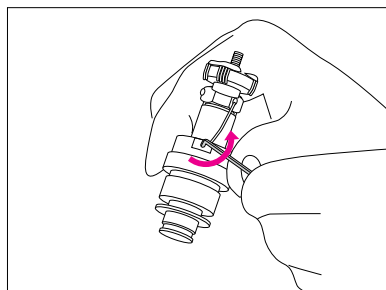
Step7 Loosen the signal cable fixing nut with a wrench and remove the fixing nut and washer.



Step8 Disconnect the signal cable.



Step9 Loosen the collector fixing nut with the hex wrench.

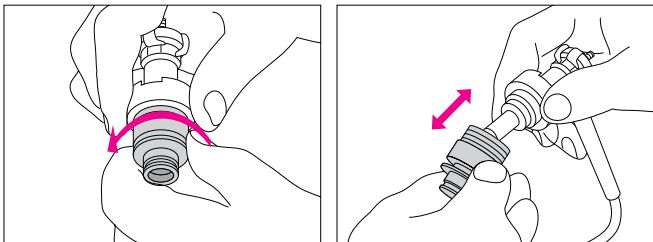


6. Detectors

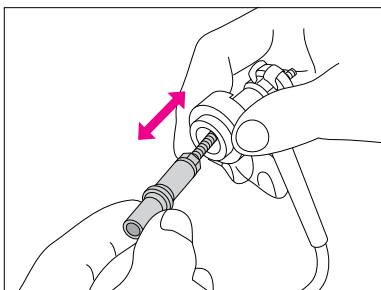
6.2 FTD

6.2.4 Replacing the Collector (FTD-2014)

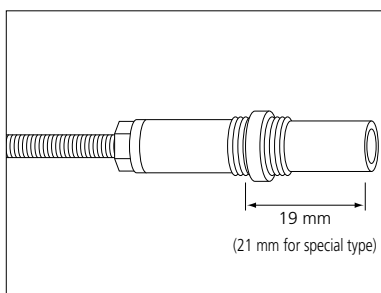
Step10 Rotate the collector holder to detach it.



Step11 Detach the FTD collector.



Step12 Set the flange of the new FTD collector to 19 mm (21 mm for the special type).



FTD collector	P/N 221-18704-91
Special-type FTD collector (for pesticide analysis etc.)	P/N 221-42512-91

6. Detectors

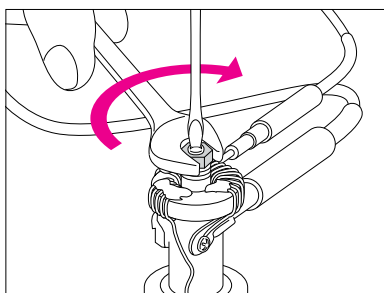
6.2 FTD

6.2.4 Replacing the Collector (FTD-2014)

Step13 Attach the new collector to the FTD electrode and tighten the collector fixing nut with the hex wrench.

Step14 Put back the collector holder.

Step15 Fit the signal cable, followed by the signal cable fixing nut and washer. Tighten it with the wrench. When doing so, be sure to secure the top of the collector using a flat screwdriver in order to prevent the filament from breaking.



Step16 Put back the collector cover.

Step17 Attach the fluoropolymer sheet to the signal and power cables.

Step18 Install the shield cover following the removal procedure in reverse, taking care to prevent the fluoropolymer sheet from moving.

Step19 Tighten the fixing screw.

Step20 Start up the system.

6. Detectors

6.2 FTD

6.2.5 Replacing the Nozzle (FTD-2014)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.

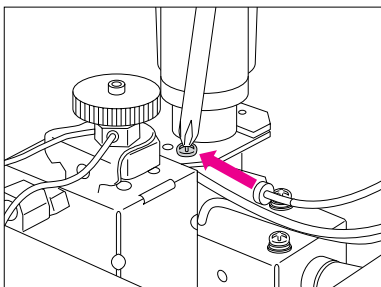
Tools Required:

Tweezers, hex nut screwdriver (option, P/N 670-18800)

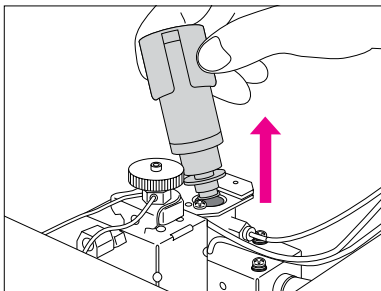
Procedure

Step1 Shut down the system and stop the gas supply for detectors.

Step2 Loosen the FTD electrode fixing screw and remove the fixing plate.



Step3 Pull out the FTD electrode.

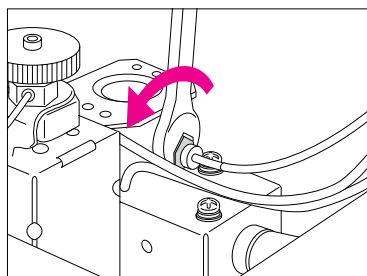


6. Detectors

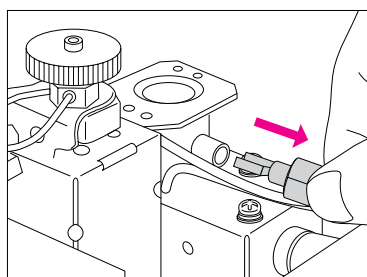
6.2 FTD

6.2.5 Replacing the Nozzle (FTD-2014)

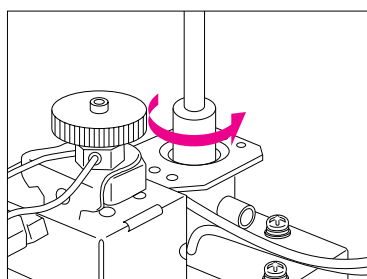
Step4 Loosen the high voltage unit fixing nut.



Step5 Pull out the high voltage brush.

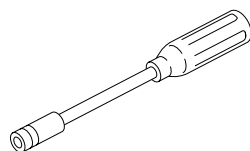


Step6 Loosen the FID nozzle with a hex nut screwdriver.



Hex nut screwdriver

P/N 670-18800



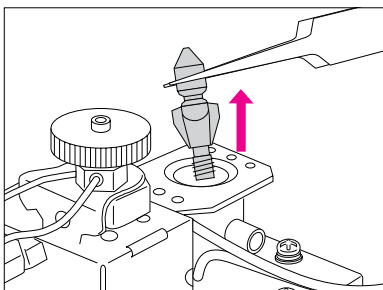
Hex nut screwdriver

6. Detectors

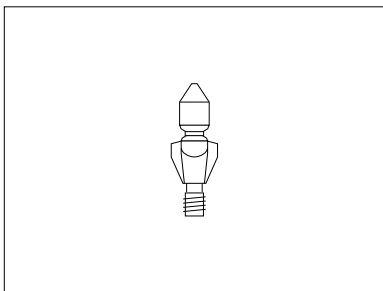
6.2 FTD

6.2.5 Replacing the Nozzle (FTD-2014)

Step7 Detach the FID nozzle with tweezers.



Step8 Check the jet section at the tip of the FID nozzle for dirt or blockages.



Step9 Attach the FID nozzle and use the hex nut screwdriver to turn it until it comes to a full stop.

Step10 Put back the high voltage unit and FTD electrode by following the removal procedure in reverse.

Step11 Start up the system.

ATTENTION

Do not jolt the nozzle as this may break the quartz tube.

ATTENTION

If dirty, wipe the dirt away using a cotton bud soaked in solvent. Replace it with a new one if it has blockages.

FID nozzle assemblies:

0.5 dia., for general-purpose packed columns: 221-70162-95

0.3 dia., for capillary columns: 221-70162-93

The 0.5 dia. nozzle for general-purpose packed columns is marked "P" on its side.

6. Detectors

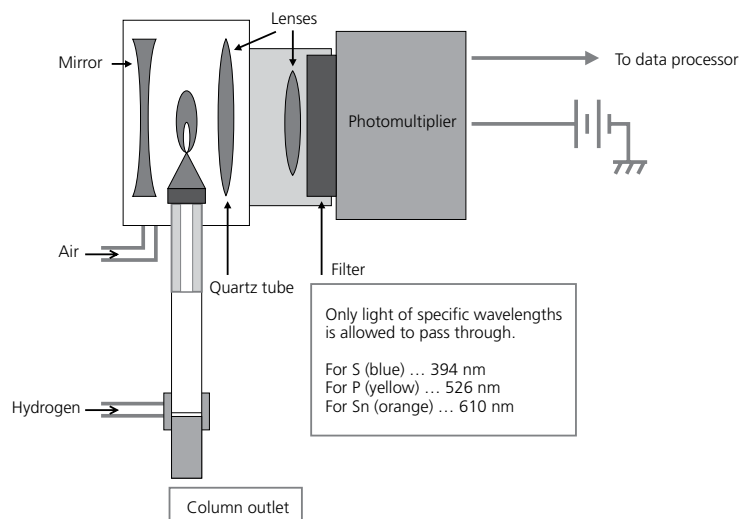
6.3 FPD

FPD Principle of Operation

FPD stands for Flame Photometric Detector.

This detector detects light unique to elements that emit light in a hydrogen flame. FPD detectors resemble FID detectors in that the hydrogen flame is located at the top of the nozzle, but the hydrogen flame of the FPD is a reducing flame containing a large amount of hydrogen and has a lower temperature. This type of detector demonstrates high sensitivity to sulfur, phosphorous, and tin compounds. Luminescence in the hydrogen flame allows light of wavelengths unique to elements to be obtained. The optimum hydrogen to air ratio differs according to the target element. A filter removes light other than the target wavelength which is then detected by a photomultiplier. FPD detectors are said to have the highest selectivity since they detect only light of wavelength pertaining to the target element.

- FPD (Flame Photometric Detector)



Each of the S, P, and Sn compounds emits light of a unique wavelength when they are burned in a reducing flame. Respective filters allow only the light of the target wavelength to reach the photomultiplier where light intensity is converted to electrical signals.

6. Detectors

6.3 FPD

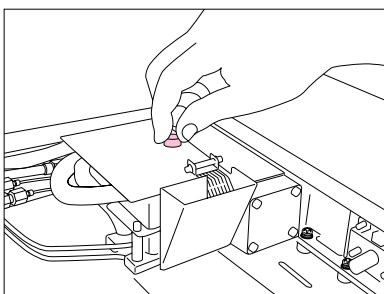
6.3.1 Replacing the Interference Filter (FPD-2010 Plus/FPD-2010)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

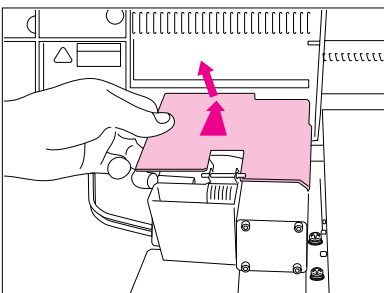
Procedure

Step1 Shut down the system.

Step2 Remove the knurled screw on the FPD top cover.



Step3 Slide the FPD top cover backward and remove it.

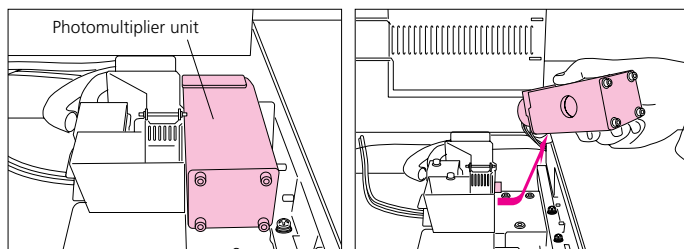


6. Detectors

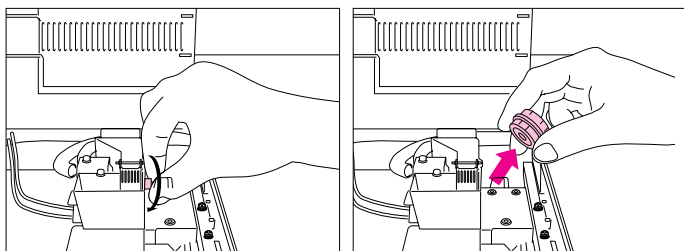
6.3 FPD

6.3.1 Replacing the Interference Filter (FPD-2010 Plus/FPD-2010)

Step4 Slowly pull out the photomultiplier unit horizontally to remove it.
Cover the photomultiplier receiver with aluminum foil etc. to avoid exposure to intense light.



Step5 Turn the interference filter by hand and remove it.
If it is difficult to remove the interference filter, use the rubber finger (provided). This will make it easier to remove the filter.



Step6 Wipe away any dirt on the filter surface using a soft cloth.

Filter Assemblies for FPD-2010 Plus

Filter assembly for S (sulfur)	P/N 221-73354-01
Filter assembly for P (phosphorus)	P/N 221-73354-02
Filter assembly for Sn (tin)	P/N 221-73354-03

* The filter assembly for FPD-2010/FPD-2014 cannot be used on the FPD-2010 Plus. Since the filter is common to the FPD-2010/FPD-2014, it is possible to exchange them with each other.

Filter Assemblies for FPD-2010/FPD-2014

Filter assembly for S (sulfur)	P/N 221-46310-01
Filter assembly for P (phosphorus)	P/N 221-46310-02
Filter assembly for Sn (tin)	P/N 221-46310-03

TIP

The colors of each interference filter are as follows.
For sulfur: Blue; For phosphorus: Yellow; For tin: Orange

6. Detectors

6.3 FPD

6.3.1 Replacing the Interference Filter (FPD-2010 Plus/FPD-2010)

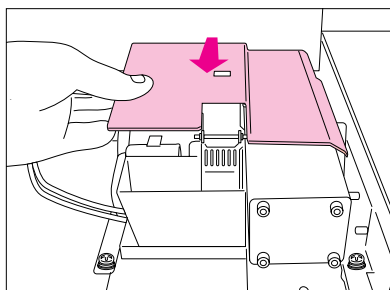
Step7 Check the O-ring of the interference filter and replace it if it shows signs of deterioration.

O-ring, for outside the filter	P/N 036-19006-17
O-ring, for inside the filter	P/N 036-19006-14

Step8 Turn the interference filter by hand to attach it.

Step9 Attach the photomultiplier unit slowly.

Step10 Put back the FPD top cover, and slide it forward so that it fits into the protrusion on the duct fixing screw section.



O-ring, for outside the filter



O-ring, for inside the filter

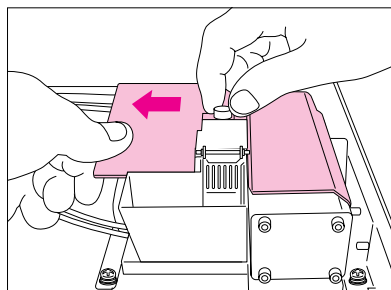
6. Detectors

6.3 FPD

6.3.1 Replacing the Interference Filter (FPD-2010 Plus/FPD-2010)

Step11

Tighten the knurled screw while pulling the top cover to the left so that it fits on the photomultiplier unit.

**Step12**

Start up the system.

ATTENTION

On FPD-2010s shipped from April 2006 onward, the shape of the FPD top cover has been modified. This is to limit tilting of the photomultiplier unit caused by deterioration of O-rings and to reduce stray light. Those who are still using the FPD-2010 with the old shape cover (flat board shape) and who want the new shape cover should order FPD Top Cover Assembly (P/N 221-71795-91).

6. Detectors

6.3 FPD

6.3.2 Exchanging Interference Filters (FPD-2010 Plus)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

Tools Required:

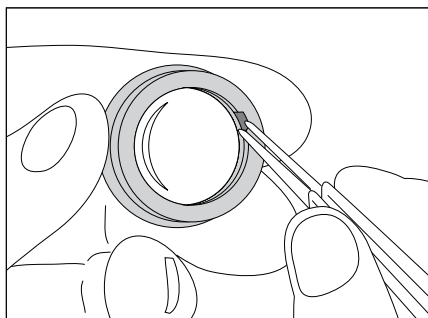
Tweezers

Procedure

Step 1

The interference filter assembly for FPD-2010 Plus contains a filter. The filter alone can be exchanged to reduce costs. Since the filters for FPD-2010 Plus are common to the FPD-2010, it is possible to exchange them with each other.

Insert tweezers into the notch on the filter holder, and remove the O-ring for inside the filter.



6. Detectors

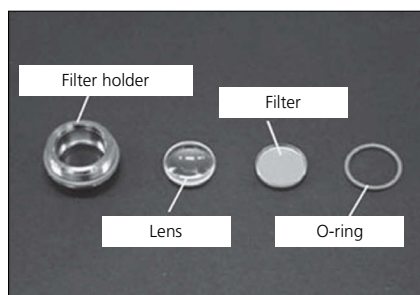
6.3 FPD

6.3.2 Exchanging Interference Filters (FPD-2010 Plus)

Step2 The filter assembly consists of a filter holder, a lens, a filter, and an O-ring.

Filter holder * Set of a filter holder, a lens, and two types of O-rings)	P/N 221-73354-91
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Lens * Set of a lens and an O-ring for inside the filter	P/N 221-73354-10
---	------------------



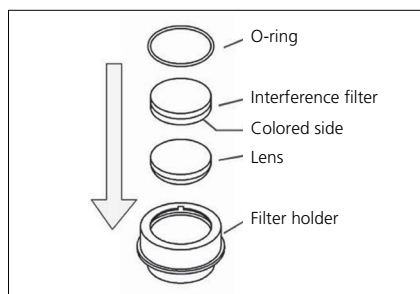
Step3 Since the filters are common to the FPD-2010, it is possible to exchange them. Each filter comes with an O-ring for inside the filter.

Filter for S (sulfur) * Filter color: Blue	P/N 221-73354-11
---	------------------

Filter for P (phosphorus) * Filter color: Yellow	P/N 221-73354-12
---	------------------

Filter for Sn (tin) * Filter color: Orange	P/N 221-73354-13
---	------------------

Step4 Place the lens (convex side down) and the filter (colored side down) in this order in the filter holder, and then fix the filter assembly with the O-ring for inside the filter.



ATTENTION

The filter assembly for FPD-2010/FPD-2014 cannot be used on the FPD-2010 Plus.

6. Detectors

6.3 FPD

6.3.3 Replacing the Photomultiplier (FPD-2010 Plus/FPD-2010)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

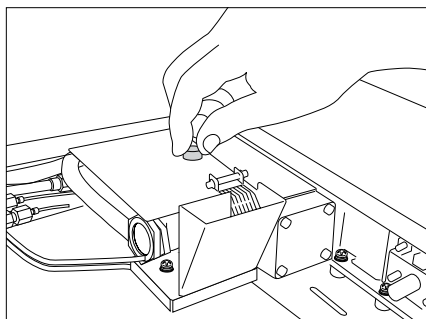
Tools Required:

Phillips screwdriver

Procedure

Step1 Shut down the system.

Step2 Remove the knurled screw on the FPD top cover.

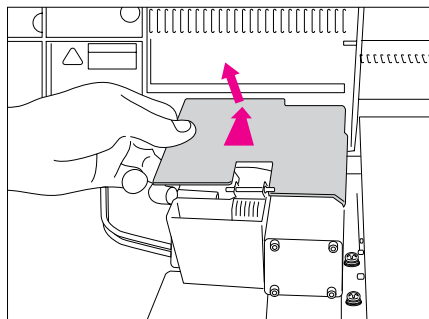


6. Detectors

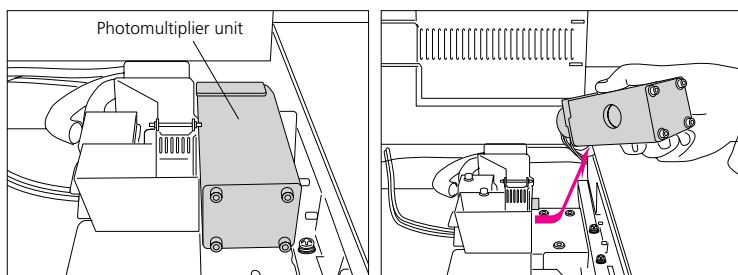
6.3 FPD

6.3.3 Replacing the Photomultiplier (FPD-2010 Plus/FPD-2010)

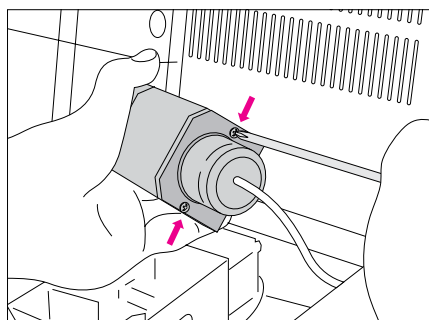
Step3 Slide the FPD top cover backward and remove it.



Step4 Slowly pull out the photomultiplier unit horizontally to remove it.
Cover the photomultiplier receiver with aluminum foil etc. to avoid exposure to intense light.



Step5 Remove the two fixing screws of the photomultiplier socket.

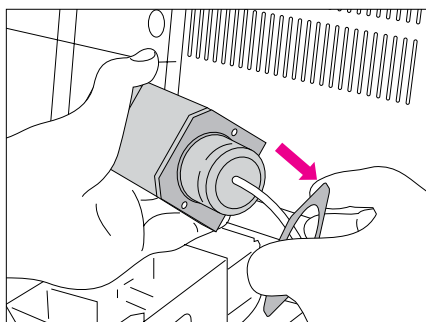


6. Detectors

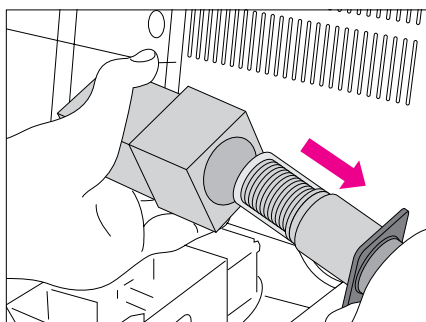
6.3 FPD

6.3.3 Replacing the Photomultiplier (FPD-2010 Plus/FPD-2010)

Step6 Detach the photomultiplier socket fixing plate.

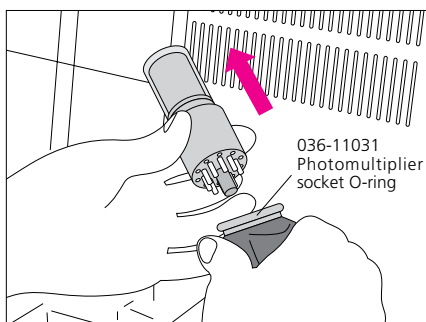


Step7 Hold the photomultiplier socket and pull the photomultiplier out slowly.



Photomultiplier (for FPD-2010 Plus)	P/N 221-73413
Photomultiplier (for FPD-2010)	P/N 221-48578

Step8 Holding the base of the photomultiplier, pull it out slowly from the socket. Replace the O-ring of the socket if it shows signs of deterioration.



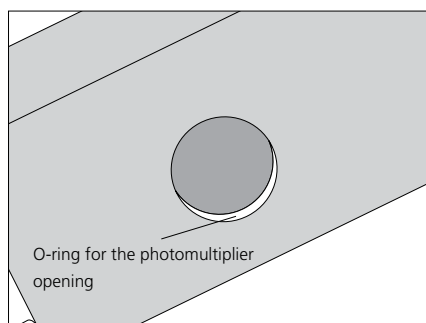
Photomultiplier socket O-ring	P/N 036-11031
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6. Detectors

6.3 FPD

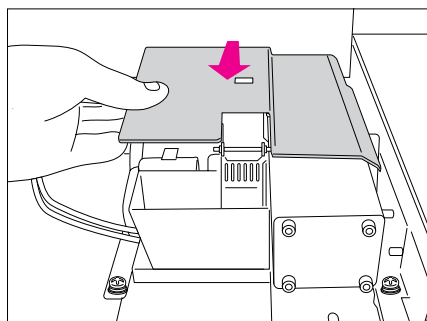
6.3.3 Replacing the Photomultiplier (FPD-2010 Plus/FPD-2010)

- Step9** Check that the O-ring in the opening (filter attachment section) of the photomultiplier case is not deteriorated.
Replace it if deteriorated.



O-ring for the photomultiplier opening (for FPD-2010 Plus)	P/N 036-11019
O-ring for the photomultiplier opening (for FPD-2010)	P/N 036-11018

- Step10** Insert the new photomultiplier into the socket.
- Step11** Insert the photomultiplier slowly into the photomultiplier case.
- Step12** Attach the photomultiplier socket fixing plate and fix in place using the two screws.
- Step13** Put back the photomultiplier unit slowly.
- Step14** Put back the FPD top cover, and slide it forward so that it fits into the protrusion on the duct fixing screw section.

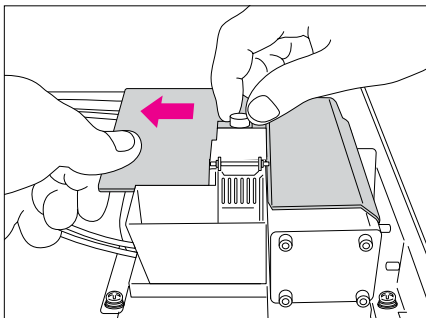


6. Detectors

6.3 FPD

6.3.3 Replacing the Photomultiplier (FPD-2010 Plus/FPD-2010)

Step15 Tighten the knurled screw while pulling the top cover to the left so that it fits on the photomultiplier unit.



Step16 Start up the system.

ATTENTION

On FPD-2010s shipped from April 2006 onward, the shape of the FPD top cover has been modified. This is to limit tilting of the photomultiplier unit caused by deterioration of O-rings and to reduce stray light. Those who are still using the FPD-2010 with the old shape cover (flat board shape) and who want the new shape cover should order FPD Top Cover Assembly (P/N 221-71795-91).

6. Detectors

6.3 FPD

6.3.4 Inspecting and Replacing the Igniter Filament (FPD-2010 Plus/FPD-2010)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

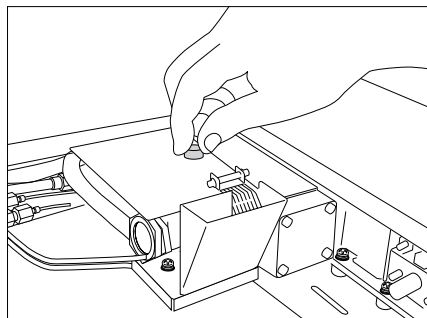
Tools Required:

Phillips screwdriver

Procedure

Step1 Shut down the system.

Step2 Remove the knurled screw on the FPD top cover.

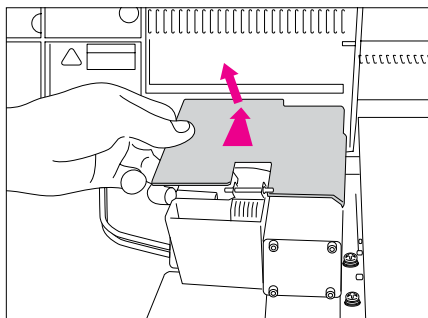


6. Detectors

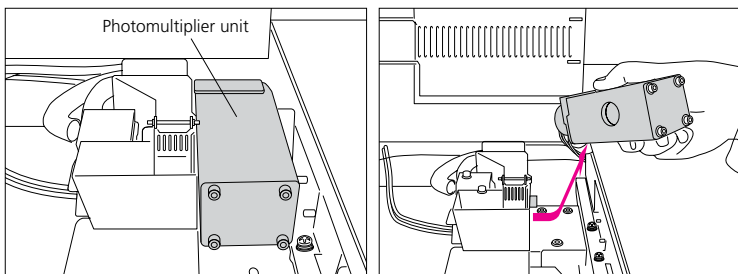
6.3 FPD

6.3.4 Inspecting and Replacing the Igniter Filament (FPD-2010 Plus/FPD-2010)

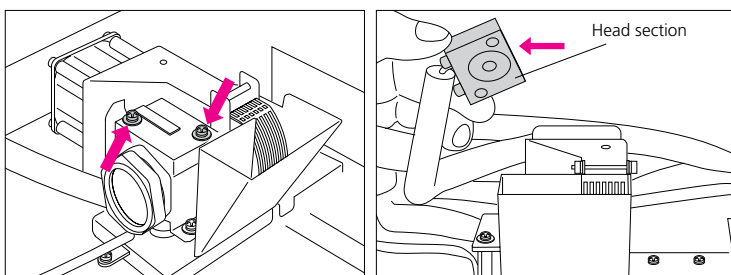
Step3 Slide the FPD top cover backward and remove it.



Step4 Slowly pull out the photomultiplier unit horizontally to remove it. Cover the photomultiplier receiver with aluminum foil etc. to avoid exposure to intense light.



Step5 Remove the two screws and detach the head section.

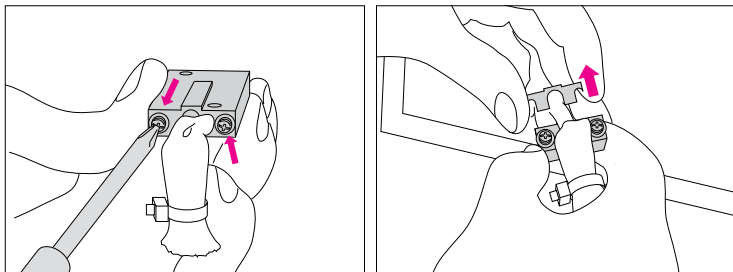


6. Detectors

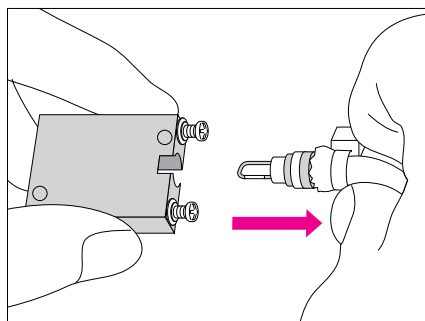
6.3 FPD

6.3.4 Inspecting and Replacing the Igniter Filament (FPD-2010 Plus/FPD-2010)

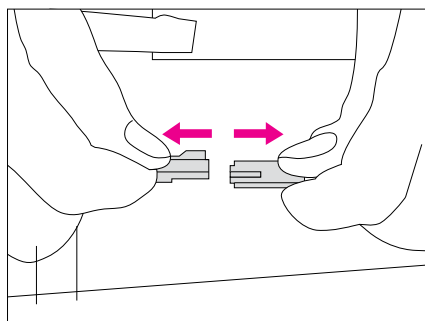
Step6 Remove the two igniter fixing screws and detach the igniter holder.



Step7 Slowly pull the igniter filament out of the head section.



Step8 The filament needs to be replaced if it is deteriorated or the wire is broken. Disconnect the connector and replace the filament with a new one.



Igniter filament (for FPD-2010 Plus)

P/N 221-73430-91

Igniter filament (for FPD-2010)

P/N 221-45647-91

6. Detectors

6.3 FPD

6.3.4 Inspecting and Replacing the Igniter Filament (FPD-2010 Plus/FPD-2010)

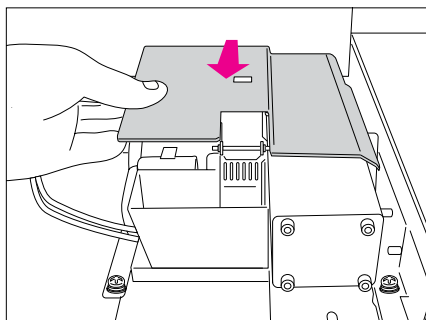
Step9 Insert the igniter filament into the head section.

Step10 Attach the igniter holder and fix in place using the two screws.

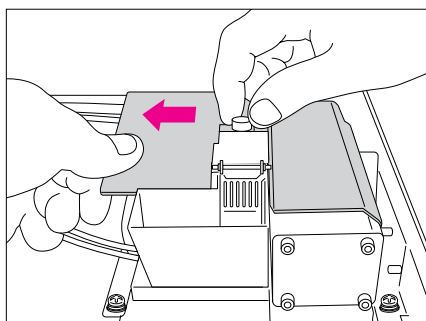
Step11 Attach the head section and fix in place using the two screws.

Step12 Put back the photomultiplier unit slowly.

Step13 Put back the FPD top cover, and slide it forward so that it fits into the protrusion on the duct fixing screw section.



Step14 Tighten the knurled screw while pulling the top cover to the left so that it fits on the photomultiplier unit.



Step15 Start up the system.

ATTENTION

On FPD-2010s shipped from April 2006 onward, the shape of the FPD top cover has been modified. This is to limit tilting of the photomultiplier unit caused by deterioration of O-rings and to reduce stray light. Those who are still using the FPD-2010 with the old shape cover (flat board shape) and who want the new shape cover should order FPD Top Cover Assembly (P/N 221-71795-91).

6. Detectors

6.3 FPD

6.3.5 Replacing the Quartz Tube (FPD-2010 Plus/FPD-2010)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

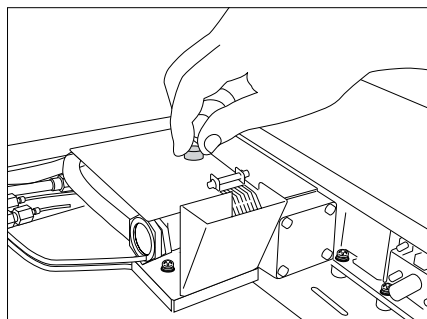
Tools Required:

Phillips screwdriver, tweezers

Procedure

Step1 Shut down the system.

Step2 Remove the knurled screw on the FPD top cover.

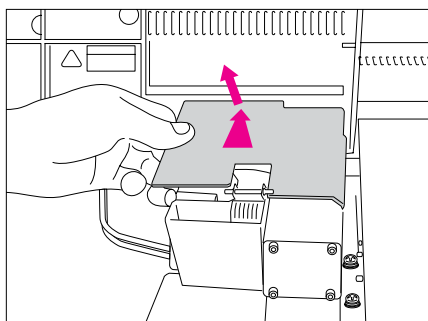


6. Detectors

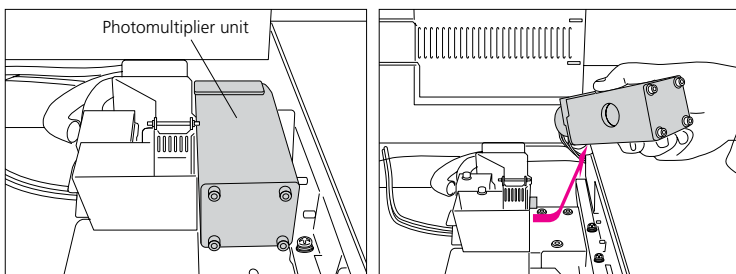
6.3 FPD

6.3.5 Replacing the Quartz Tube (FPD-2010 Plus/FPD-2010)

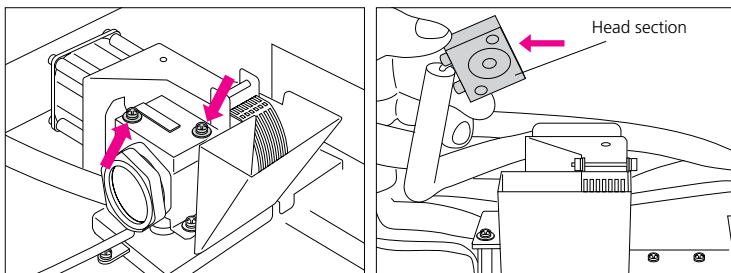
Step3 Slide the FPD top cover backward and remove it.



Step4 Slowly pull out the photomultiplier unit horizontally to remove it. Cover the photomultiplier receiver with aluminum foil etc. to avoid exposure to intense light.



Step5 Remove the two screws and detach the head section.

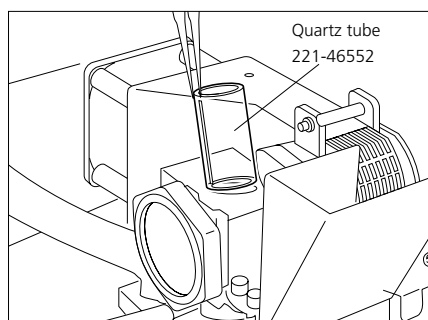


6. Detectors

6.3 FPD

6.3.5 Replacing the Quartz Tube (FPD-2010 Plus/FPD-2010)

Step6 Pull out the quartz tube using tweezers. If dirty, it needs to be cleaned or replaced.

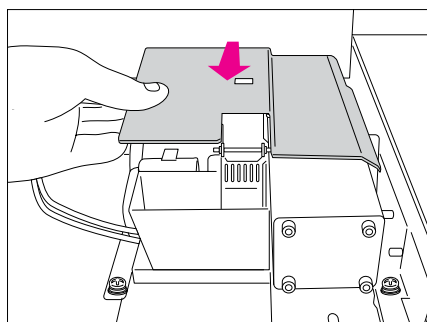


Step7 Set either the new or cleaned quartz tube in place.

Step8 Attach the head section and fix in place using the two screws.

Step9 Put back the photomultiplier unit slowly.

Step10 Put back the FPD top cover, and slide it forward so that it fits into the protrusion on the duct fixing screw section.

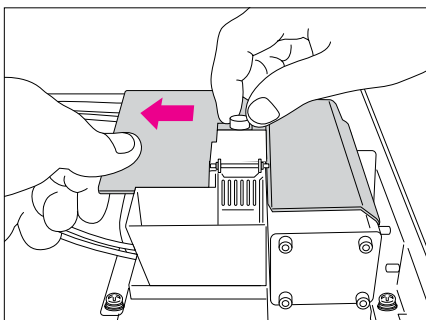


6. Detectors

6.3 FPD

6.3.5 Replacing the Quartz Tube (FPD-2010 Plus/FPD-2010)

Step11 Tighten the knurled screw while pulling the top cover to the left so that it fits on the photomultiplier unit.



Step12 Start up the system.

ATTENTION

On FPD-2010s shipped from April 2006 onward, the shape of the FPD top cover has been modified. This is to limit tilting of the photomultiplier unit caused by deterioration of O-rings and to reduce stray light. Those who are still using the FPD-2010 with the old shape cover (flat board shape) and who want the new shape cover should order FPD Top Cover Assembly (P/N 221-71795-91).

6. Detectors

6.3 FPD

6.3.6 Replacing the Lens (FPD-2010 Plus/FPD-2010)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

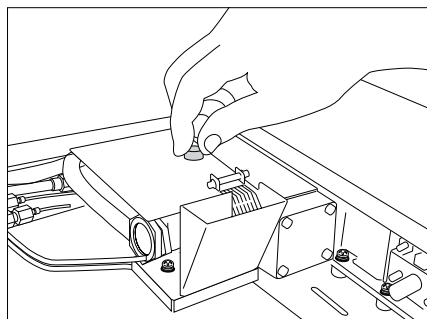
Tools Required:

Phillips screwdriver, tweezers

Procedure

Step1 Shut down the system.

Step2 Remove the knurled screw on the FPD top cover.

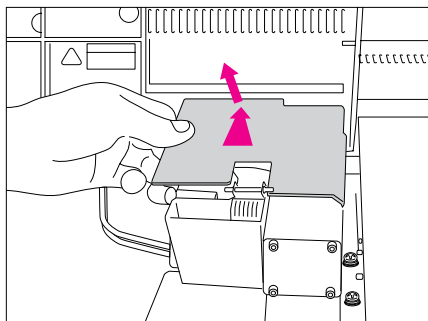


6. Detectors

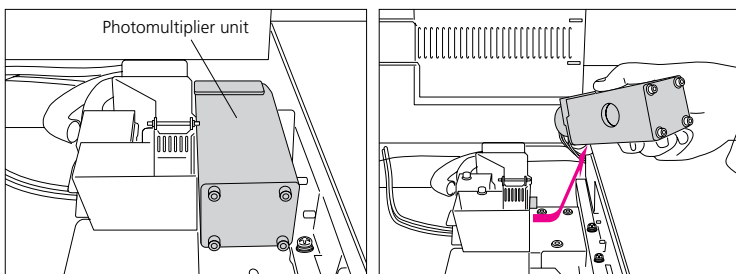
6.3 FPD

6.3.6 Replacing the Lens (FPD-2010 Plus/FPD-2010)

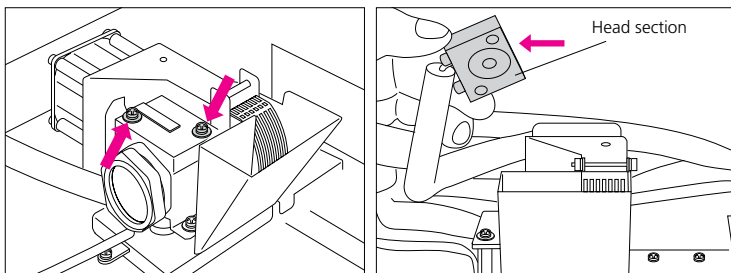
Step3 Slide the FPD top cover backward and remove it.



Step4 Slowly pull out the photomultiplier unit horizontally to remove it. Cover the photomultiplier receiver with aluminum foil etc. to avoid exposure to intense light.



Step5 Remove the two screws and detach the head section.



6. Detectors

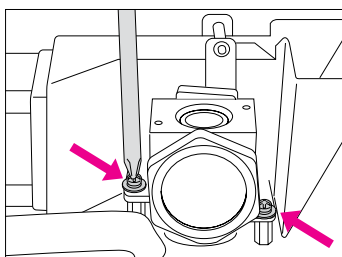
6.3 FPD

6.3.6 Replacing the Lens (FPD-2010 Plus/FPD-2010)

Step6

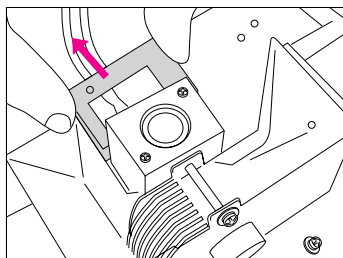
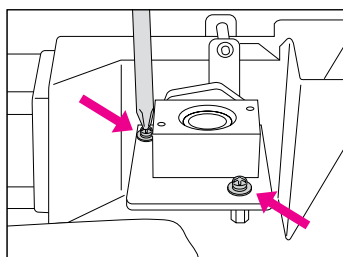
FPD-2010 Plus

Remove the two body section fixing screws.



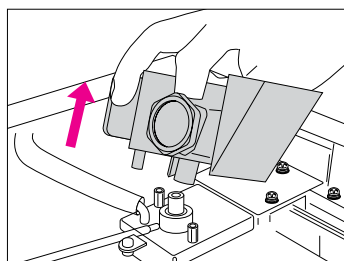
FPD-2010

Remove the two body section fixing screws and detach the fixing plate.



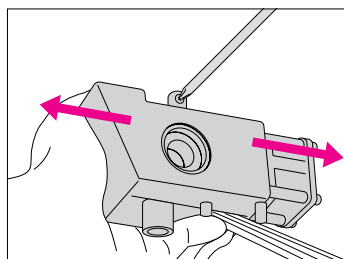
Step7

Pull out the body section upward.



Step8

Remove the cooling duct fixing screw and detach the duct by pulling it apart.

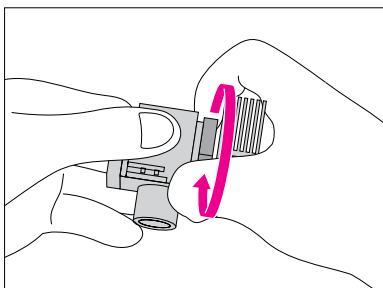


6. Detectors

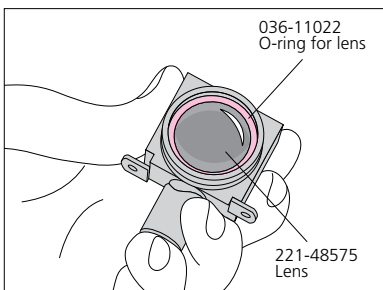
6.3 FPD

6.3.6 Replacing the Lens (FPD-2010 Plus/FPD-2010)

Step9 Loosen the cooling fin fixing nut and detach the lens unit.



Step10 Check the lens unit visually and, if dirty, either clean or replace it. Also replace the O-ring of the lens unit if it is deteriorated.



Lens	P/N 221-48575
O-ring for lens	P/N 036-11022

Step11 Once the lens and O-ring have been set in place, tighten the nut by hand to attach the cooling fin.

Step12 Fit the duct from the front and back of the cooling fin and fix in place using the fixing screw.

Step13 FPD-2010 Plus
 Insert the body section into the nozzle base and fix in place using the two screws.
FPD-2010
 After inserting the body section into the nozzle base, insert the body section fixing plate and fix in place using the two screws.

Step14 Attach the head section and fix in place using the two screws.

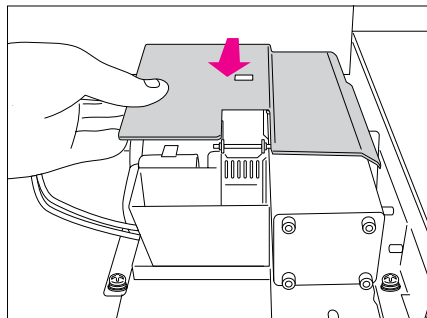
6. Detectors

6.3 FPD

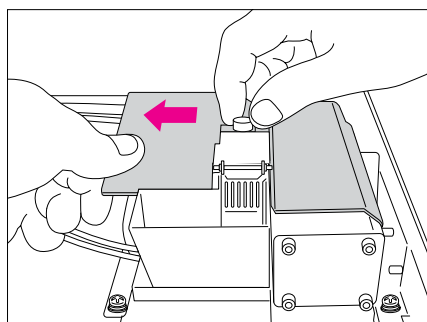
6.3.6 Replacing the Lens (FPD-2010 Plus/FPD-2010)

Step15 Put back the photomultiplier unit slowly.

Step16 Put back the FPD top cover, and slide it forward so that it fits into the protrusion on the duct fixing screw section.



Step17 Tighten the knurled screw while pulling the top cover to the left so that it fits on the photomultiplier unit.



Step18 Start up the system.

ATTENTION

On FPD-2010s shipped from April 2006 onward, the shape of the FPD top cover has been modified. This is to limit tilting of the photomultiplier unit caused by deterioration of O-rings and to reduce stray light. Those who are still using the FPD-2010 with the old shape cover (flat board shape) and who want the new shape cover should order FPD Top Cover Assembly (P/N 221-71795-91).

6. Detectors

6.3 FPD

6.3.7 Replacing the O-Ring in the Mirror Unit (FPD-2010 Plus)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

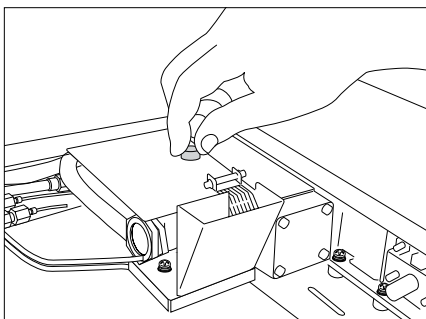
Tools Required:

Phillips screwdriver

Procedure

Step1 Shut down the system.

Step2 Remove the knurled screw on the FPD top cover.

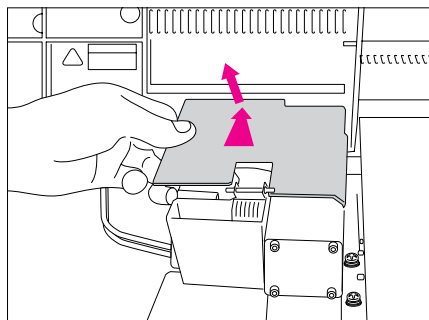


6. Detectors

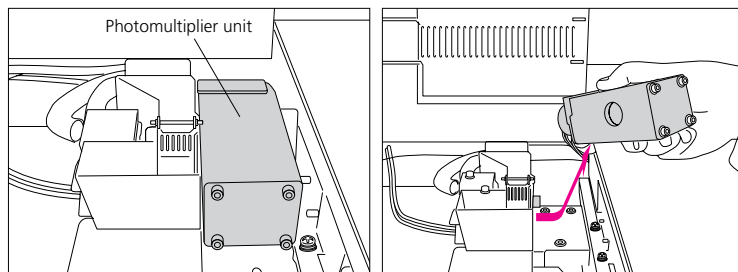
6.3 FPD

6.3.7 Replacing the O-Ring in the Mirror Unit (FPD-2010 Plus)

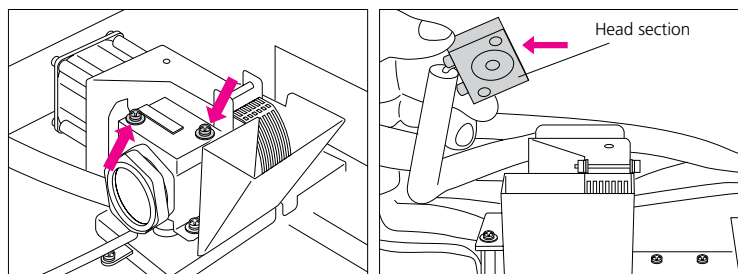
Step3 Slide the FPD top cover backward and remove it.



Step4 Slowly pull out the photomultiplier unit horizontally to remove it.
Cover the photomultiplier receiver with aluminum foil etc. to avoid exposure to intense light.



Step5 Remove the two screws and detach the head section.

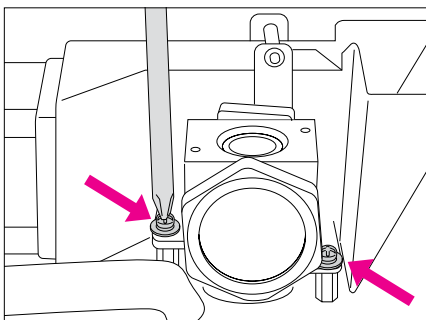


6. Detectors

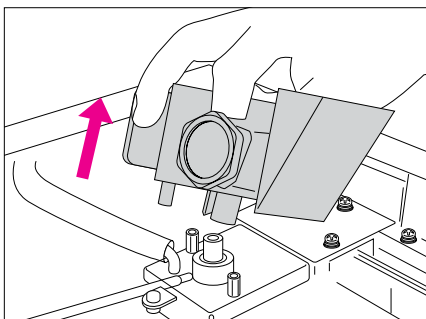
6.3 FPD

6.3.7 Replacing the O-Ring in the Mirror Unit (FPD-2010 Plus)

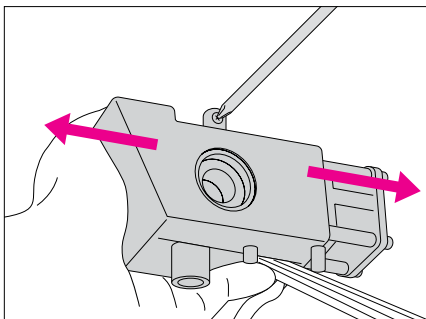
Step6 Remove the two body section fixing screws.



Step7 Pull out the body section upward.



Step8 Remove the cooling duct fixing screw and detach the duct by pulling it apart.

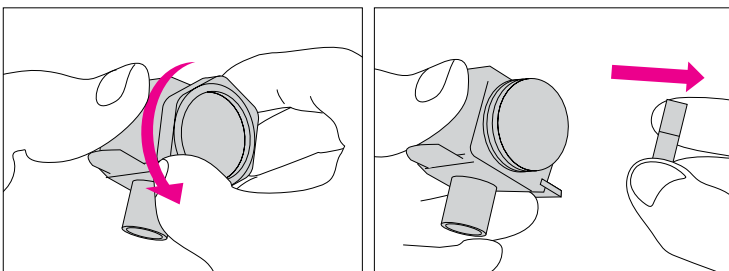


6. Detectors

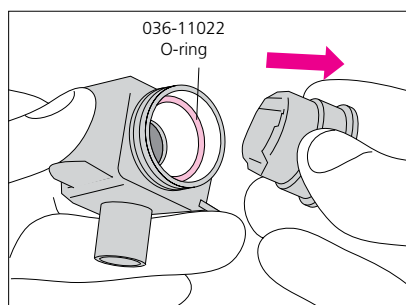
6.3 FPD

6.3.7 Replacing the O-Ring in the Mirror Unit (FPD-2010 Plus)

Step9 Loosen the mirror unit fixing nut and remove it.



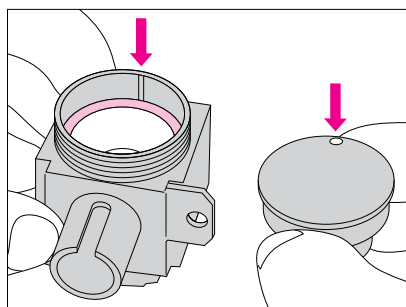
Step10 Pull out the mirror unit. Wipe away any dirt on the surface using a soft cloth. Also replace the O-ring if it is deteriorated.



O-ring

P/N 036-11022

Step11 Place O-rings both in the mirror unit and in the FPD body, and then attach the mirror unit. Align the protrusion on the mirror unit with the notch on the body, and insert it.



Step12 Tighten the mirror unit fixing nut by hand.

6. Detectors

6.3 FPD

6.3.7 Replacing the O-Ring in the Mirror Unit (FPD-2010 Plus)

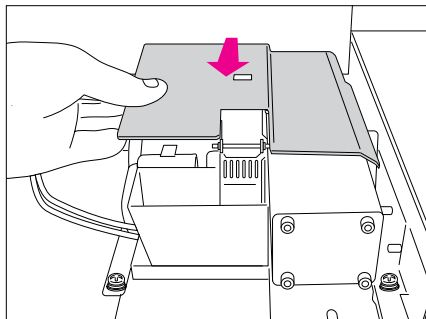
Step13 Fit the duct from the front and back of the cooling fin and fix in place using the fixing screw.

Step14 Insert the body section into the nozzle base and fix in place using the two screws.

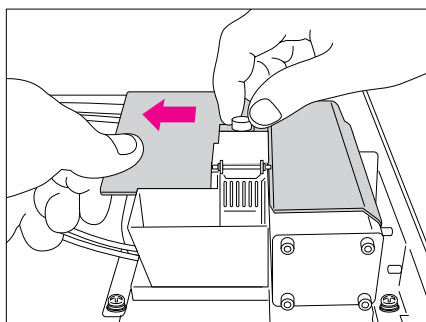
Step15 Attach the head section and fix in place using the two screws.

Step16 Put back the photomultiplier unit slowly.

Step17 Put back the FPD top cover, and slide it forward so that it fits into the protrusion on the duct fixing screw section.



Step18 Tighten the knurled screw while pulling the top cover to the left so that it fits on the photomultiplier unit.



Step19 Start up the system.

6. Detectors

6.3 FPD

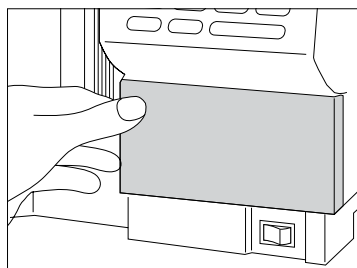
6.3.8 Replacing the Cooling Fan Backup Batteries (FPD-2010 Plus/FPD-2010)

To protect the filter, the FPD-2010 Plus and FPD-2010 use a fan to cool the filter unit while the power is ON. Backup batteries have been incorporated which keep the fan powered until the temperature of the filter unit drops sufficiently in the event of a power failure, or if the GC has been turned OFF without lowering the detector temperature. An error will occur when these batteries are depleted, and the temperature control function of the FPD unit will stop. When this happens, replace the batteries.

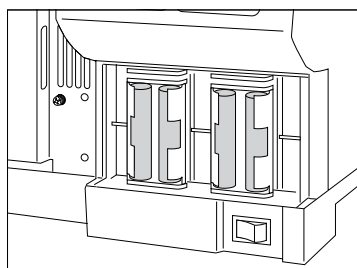
Procedure

Step1 Shut down the system.

Step2 Detach the cover below the LCD and keypad of the GC-2010 Plus.



Step3 Replace the batteries.



Step4 Put back the cover.

Step5 Start up the system.

6. Detectors

6.3 FPD

6.3.9 Adjusting the Shield Ring (FPD-2010)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

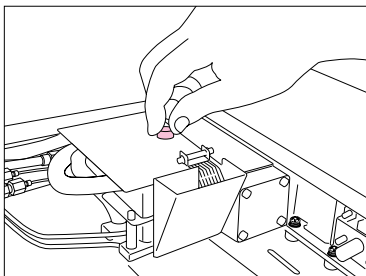
Tools Required:

Phillips screwdriver

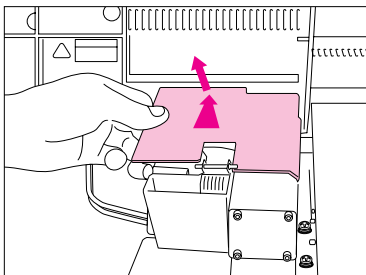
Procedure

Step1 Shut down the system.

Step2 Remove the knurled screw on the FPD top cover.



Step3 Slide the FPD top cover backward and remove it.



ATTENTION

This adjustment is not necessary on the FPD-2010 Plus since it has no shield ring.

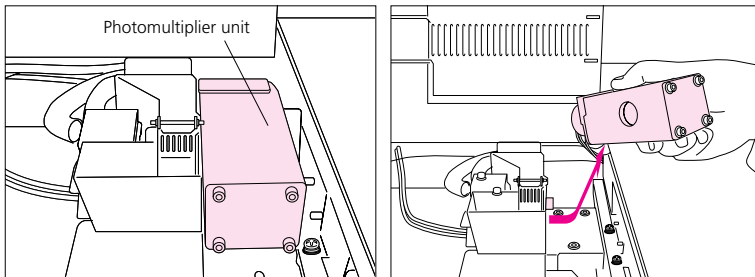
6. Detectors

6.3 FPD

6.3.9 Adjusting the Shield Ring (FPD-2010)

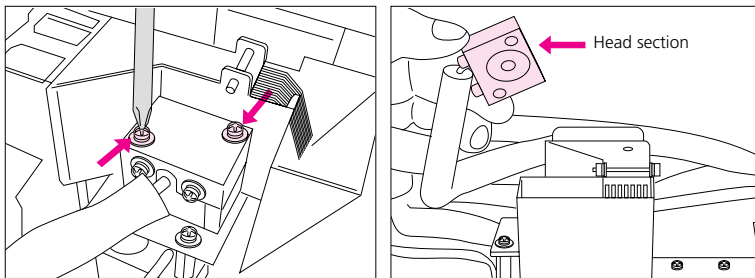
Step4

Slowly pull out the photomultiplier unit horizontally to remove it.
Cover the photomultiplier receiver with aluminum foil etc. to avoid exposure to intense light.



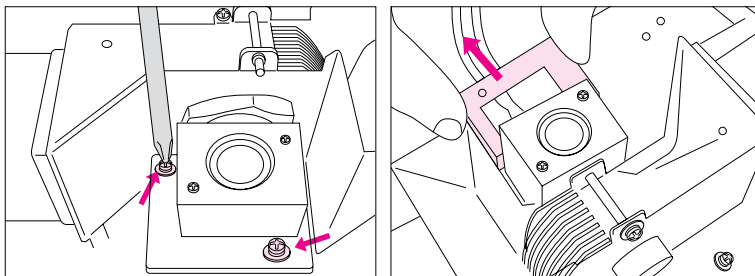
Step5

Remove the two screws and detach the head section.



Step6

Remove the two body section fixing screws and detach the fixing plate.

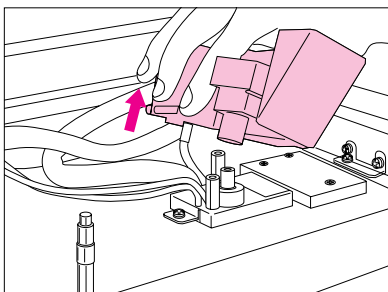


6. Detectors

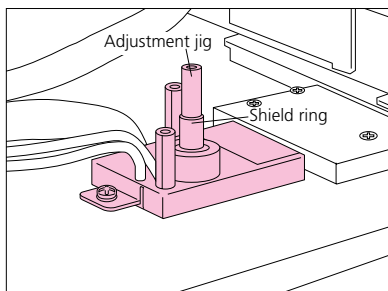
6.3 FPD

6.3.9 Adjusting the Shield Ring (FPD-2010)

Step7 Pull out the body section upward.



Step8 Fit the shield ring adjustment jig into the shield ring. Rotate the shield ring to adjust its height. The height will be 2.0 mm if the top of the shield ring is aligned with the groove on the bottom (the spacing between grooves is 1 mm). Adjust to 2 mm when using the SPL injection port, and to 4 mm for the WBI injection port.



Step9 Remove the shield ring adjustment jig and insert the body section.

Step10 Insert the body section fixing plate and fix in place using the two screws.

Step11 Attach the head section and fix in place using the two screws.

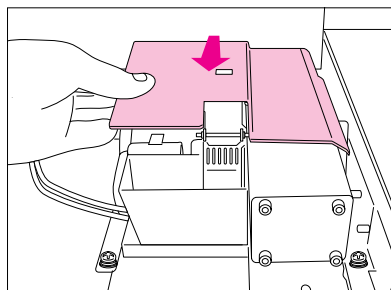
Step12 Put back the photomultiplier unit slowly.

6. Detectors

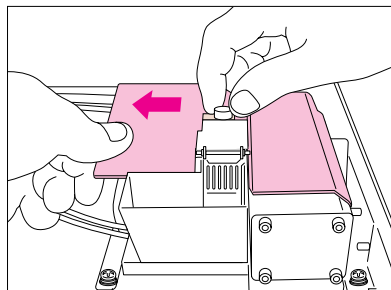
6.3 FPD

6.3.9 Adjusting the Shield Ring (FPD-2010)

Step13 Put back the FPD top cover, and slide it forward so that it fits into the protrusion on the duct fixing screw section.



Step14 Tighten the knurled screw while pulling the top cover to the left so that it fits on the photomultiplier unit.



Step15 Start up the system.

ATTENTION

On FPD-2010s shipped from April 2006 onward, the shape of the FPD top cover has been modified. This is to limit tilting of the photomultiplier unit caused by deterioration of O-rings and to reduce stray light. Those who are still using the FPD-2010 with the old shape cover (flat board shape) and who want the new shape cover should order FPD Top Cover Assembly (P/N 221-71795-91).

6. Detectors

6.3 FPD

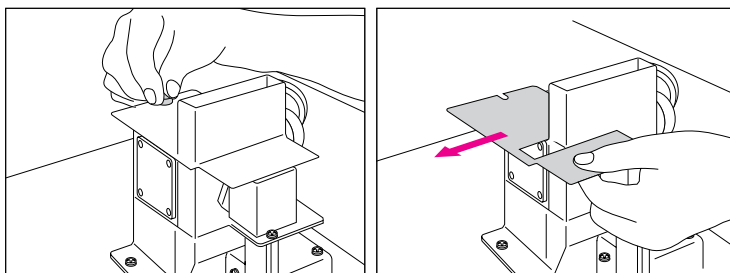
6.3.10 Replacing the Interference Filter (FPD-2014)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

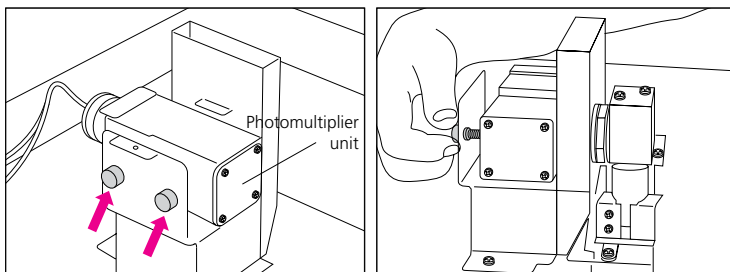
Procedure

Step1 Shut down the system and stop the gas supply for detectors.

Step2 Remove the knurled screw and detach the FPD top cover.



Step3 Loosen the two photomultiplier unit fixing knurled screws.

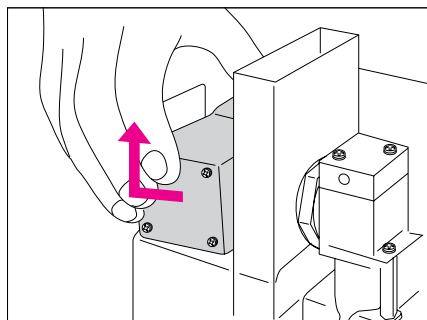


6. Detectors

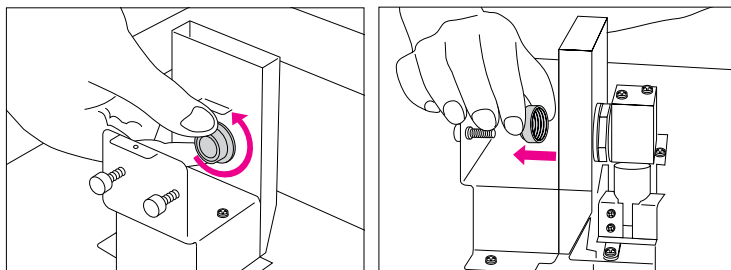
6.3 FPD

6.3.10 Replacing the Interference Filter (FPD-2014)

- Step4** Slowly pull out the photomultiplier unit horizontally to remove it.
Cover the photomultiplier receiver with aluminum foil etc. to avoid exposure to intense light.



- Step5** Turn the interference filter by hand and remove it.



- Step6** Wipe away any dirt on the filter surface using a soft cloth.

Filter Assemblies for FPD-2014/FPD-2010

Filter assembly for S (sulfur)	P/N 221-46310-01
Filter assembly for P (phosphorus)	P/N 221-46310-02
Filter assembly for Sn (tin)	P/N 221-46310-03

TIP

The colors of each interference filter are as follows.
For sulfur: Blue; For phosphorus: Yellow; For tin: Orange

6. Detectors

6.3 FPD

6.3.10 Replacing the Interference Filter (FPD-2014)

Step7 Check the O-ring of the interference filter and replace it if it shows signs of deterioration.

O-ring, for outside the filter	P/N 036-19006-17
O-ring, for inside the filter	P/N 036-19006-14

Step8 Turn the interference filter by hand to attach it.

Step9 Put back the photomultiplier unit slowly.

Step10 Tighten the photomultiplier unit fixing knurled screws to fix the photomultiplier unit. Make sure that the photomultiplier unit and interference filter have been fixed in place.

Step11 Put back the FPD top cover and tighten the knurled screw.

Step12 Start up the system.

O-ring, for inside the filter 036-19006-14



O-ring, for outside the filter 036-19006-17

6. Detectors

6.3 FPD

6.3.11 Adjusting the Shield Ring (FPD-2014)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

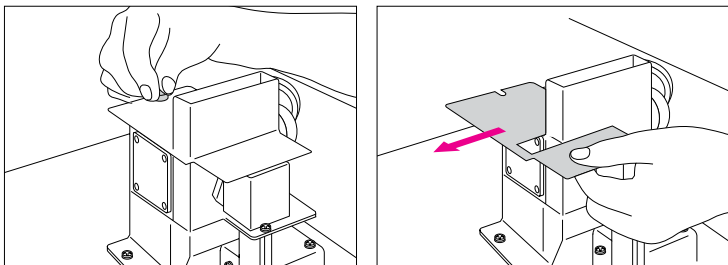
Tools Required:

Phillips screwdriver

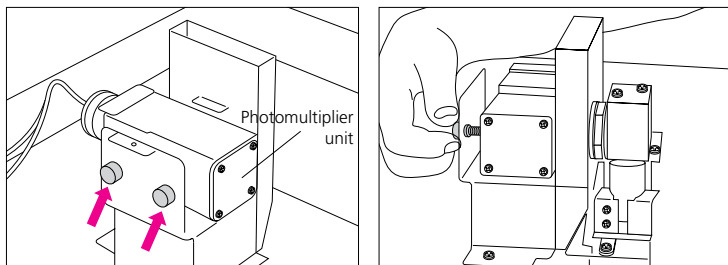
Procedure

Step1 Shut down the system and stop the gas supply for detectors.

Step2 Remove the knurled screw and detach the FPD top cover.



Step3 Loosen the two photomultiplier unit fixing knurled screws.

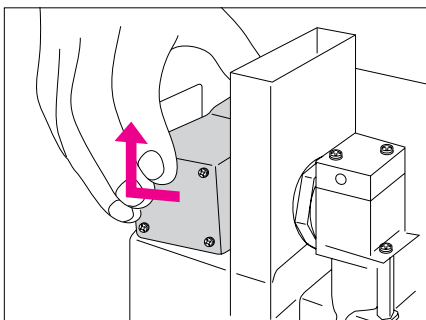


6. Detectors

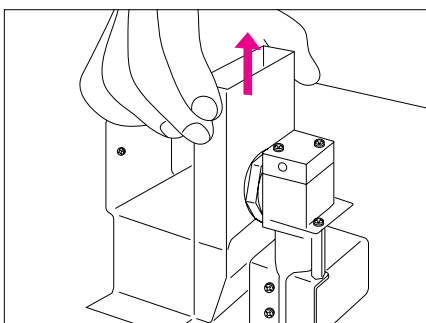
6.3 FPD

6.3.11 Adjusting the Shield Ring (FPD-2014)

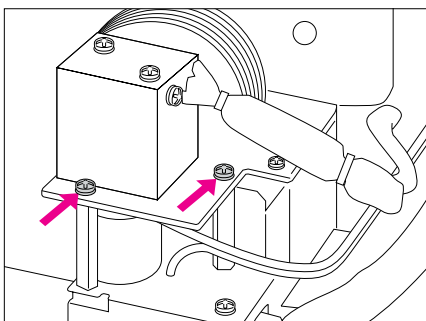
Step4 Slowly pull out the photomultiplier unit horizontally to remove it.
Cover the photomultiplier receiver with aluminum foil etc. to avoid exposure to intense light.



Step5 Pull out the cooling fin duct.



Step6 Remove the two body section fixing screws.

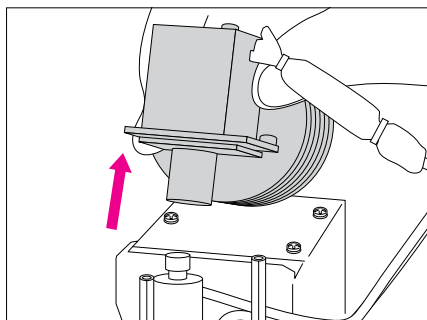


6. Detectors

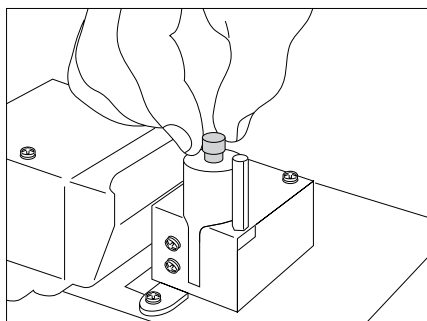
6.3 FPD

6.3.11 Adjusting the Shield Ring (FPD-2014)

Step7 Pull out the body section upward together with its fixing plate.

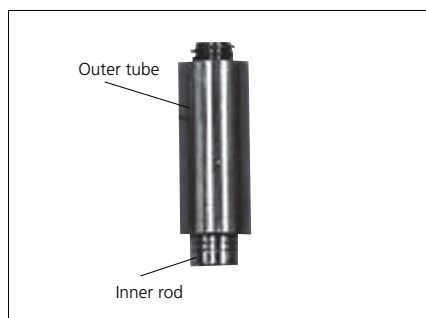


Step8 Temporarily lower the shield ring to the bottom.



Step9 Adjust the shield ring adjustment jig to the desired thread level of the inner rod by turning the outer tube.

The bottom thread adjusts the nozzle tip and the shield ring at the same height. Normally adjust it to the lowest thread level. The thread pitch is 1 mm.

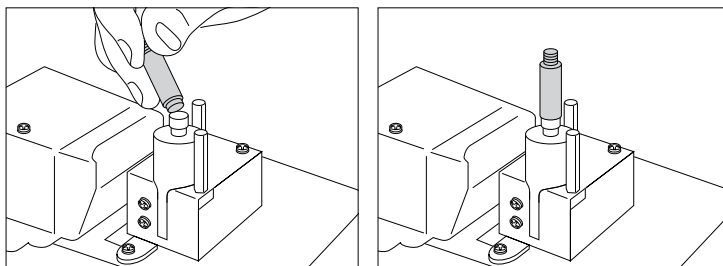


6. Detectors

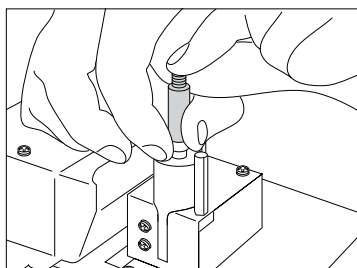
6.3 FPD

6.3.11 Adjusting the Shield Ring (FPD-2014)

Step10 Place the adjustment jig on the nozzle so that the nozzle tip is seated in the concavity of the inner rod.



Step11 Raise the shield ring to the outer tube level by turning it.



Step12 Remove the shield ring adjustment jig and insert the body section together with its fixing plate.

Step13 Tighten the two screws to fix the body section.

Step14 Insert the cooling fin duct.

Step15 Put back the photomultiplier unit slowly.

Step16 Tighten the photomultiplier unit fixing knurled screws to fix the photomultiplier unit. Make sure that the photomultiplier unit and interference filter have been fixed in place.

Step17 Put back the FPD top cover and tighten the knurled screw.

Step18 Start up the system.

6. Detectors

6.3 FPD

6.3.12 Replacing the Photomultiplier (FPD-2014)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

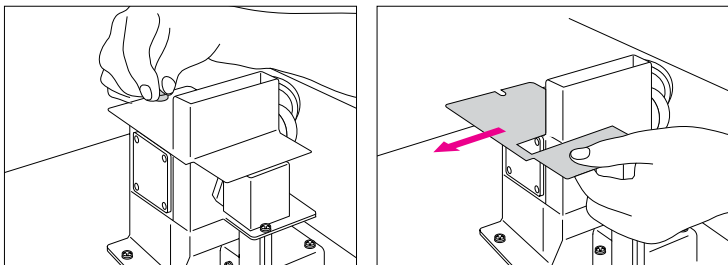
Tools Required:

Phillips screwdriver

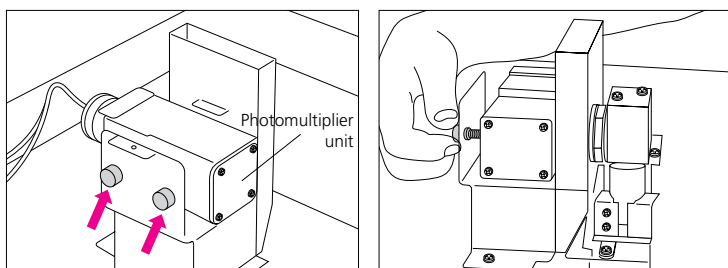
Procedure

Step1 Shut down the system and stop the gas supply for detectors.

Step2 Remove the knurled screw and detach the FPD top cover.



Step3 Loosen the two photomultiplier unit fixing knurled screws.

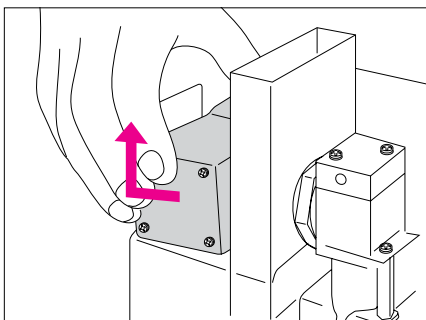


6. Detectors

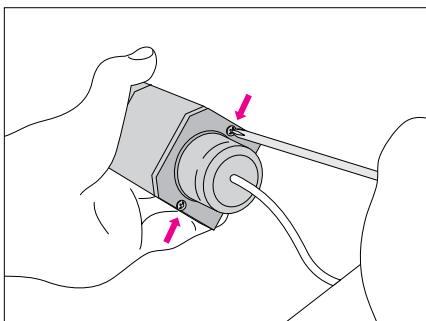
6.3 FPD

6.3.12 Replacing the Photomultiplier (FPD-2014)

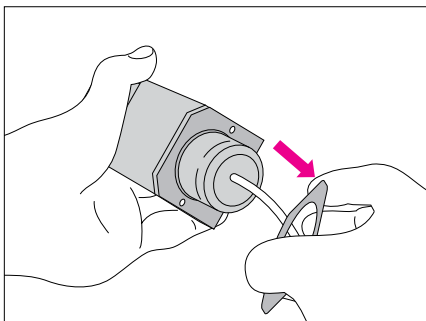
Step4 Slowly pull out the photomultiplier unit horizontally to remove it.



Step5 Remove the two fixing screws of the photomultiplier socket.



Step6 Detach the photomultiplier socket fixing plate.

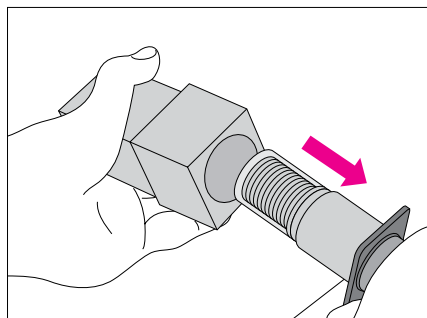


6. Detectors

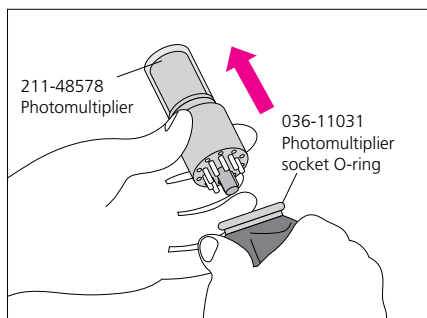
6.3 FPD

6.3.12 Replacing the Photomultiplier (FPD-2014)

Step7 Hold the photomultiplier socket and pull the photomultiplier out slowly.

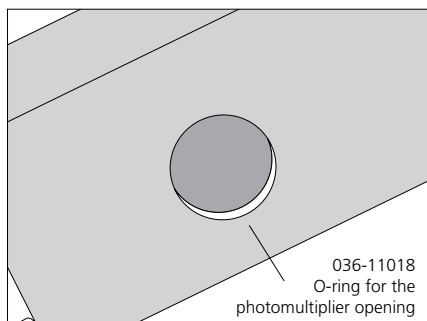


Step8 Holding the base of the photomultiplier, pull it out slowly from the socket. Replace the O-ring of the socket if it shows signs of deterioration.



Photomultiplier	P/N 221-48578
Photomultiplier socket O-ring	P/N 036-11031

Step9 Check that the O-ring in the opening (filter attachment section) of the photomultiplier case is not deteriorated. Replace it if deteriorated.



O-ring for the photomultiplier opening	P/N 036-11018
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6. Detectors

6.3 FPD

6.3.12 Replacing the Photomultiplier (FPD-2014)

Step10 Insert the new photomultiplier into the socket.

Step11 Insert the photomultiplier slowly into the photomultiplier case.

Step12 Attach the photomultiplier socket fixing plate and fix in place using the two screws.

Step13 Put back the photomultiplier unit slowly.

Step14 Tighten the photomultiplier unit fixing knurled screws to fix the photomultiplier unit. Make sure that the photomultiplier unit and interference filter have been fixed in place.

Step15 Put back the FPD top cover and tighten the knurled screw.

Step16 Start up the system.

6. Detectors

6.3 FPD

6.3.13 Replacing the Igniter Filament (FPD-2014)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

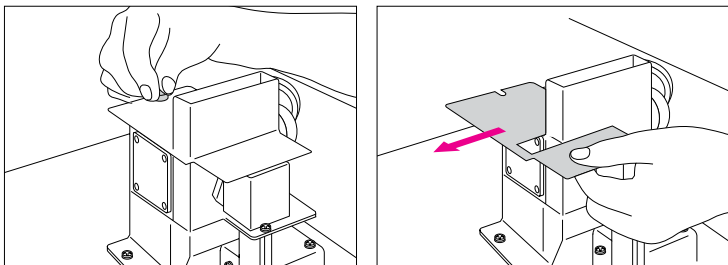
Tools Required:

Phillips screwdriver

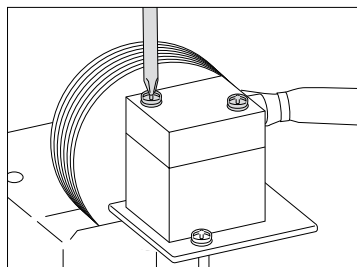
Procedure

Step1 Shut down the system and stop the gas supply for detectors.

Step2 Remove the knurled screw and detach the FPD top cover.



Step3 Remove the two screws and detach the head section.

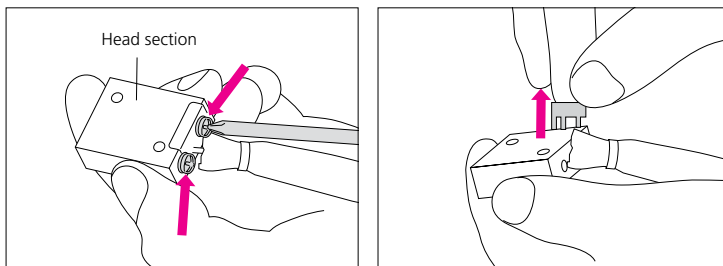


6. Detectors

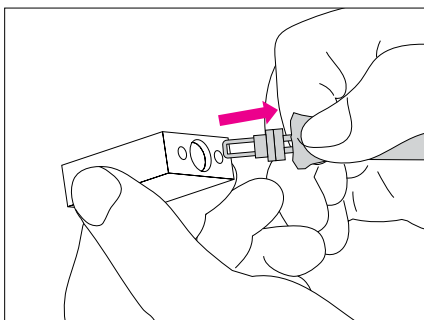
6.3 FPD

6.3.13 Replacing the Igniter Filament (FPD-2014)

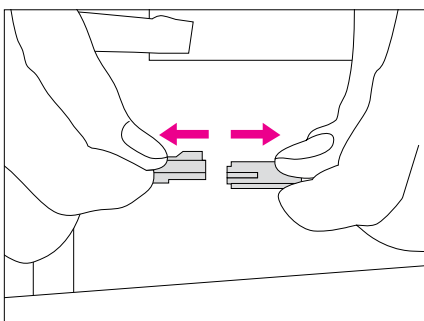
Step4 Remove the two igniter fixing screws and detach the igniter holder.



Step5 Slowly pull the igniter filament out of the head section.



Step6 The filament needs to be replaced if it is deteriorated or the wire is broken. Disconnect the connector on the igniter cable if replacing the igniter.



Igniter filament (for FPD-2014)

P/N 221-45647-92

Step7 Insert the igniter filament into the head section.

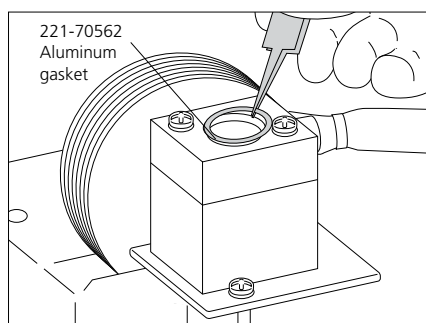
6. Detectors

6.3 FPD

6.3.13 Replacing the Igniter Filament (FPD-2014)

Step8 Attach the igniter holder and fix in place using the two screws.

Step9 Put an aluminum gasket and attach the head section on it. Tighten the two screws.



Aluminum gasket

P/N 221-70562

Step10 Put back the FPD top cover and tighten the knurled screw.

Step11 Start up the system.

6. Detectors

6.3 FPD

6.3.14 Replacing the Quartz Tube (FPD-2014)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

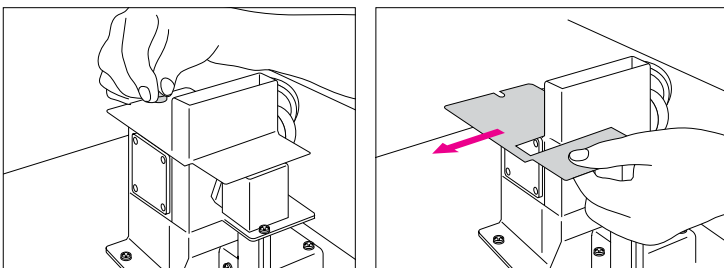
Tools Required:

Phillips screwdriver, tweezers

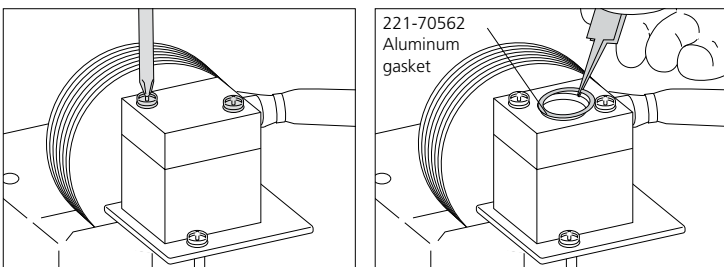
Procedure

Step1 Shut down the system and stop the gas supply for detectors.

Step2 Remove the knurled screw and detach the FPD top cover.



Step3 Remove the two screws and detach the head section.
The aluminum gasket needs to be replaced if damaged or deteriorated.



Aluminum gasket

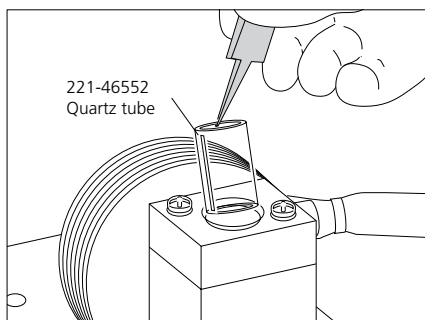
P/N 221-70562

6. Detectors

6.3 FPD

6.3.14 Replacing the Quartz Tube (FPD-2014)

- Step4** Pull out the quartz tube using tweezers.
If dirty, it needs to be cleaned or replaced.



Quartz tube

P/N 221-46552

- Step5** Set either the new or cleaned quartz tube in place.
- Step6** Put an aluminum gasket and attach the head section on it. Tighten the two screws.
- Step7** Put back the FPD top cover and tighten the knurled screw.
- Step8** Start up the system.

6. Detectors

6.3 FPD

6.3.15 Replacing the Lens (FPD-2014)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.
- Do not remove the photomultiplier unit while the system is operating or the FPD is ON as this may damage the photomultiplier.

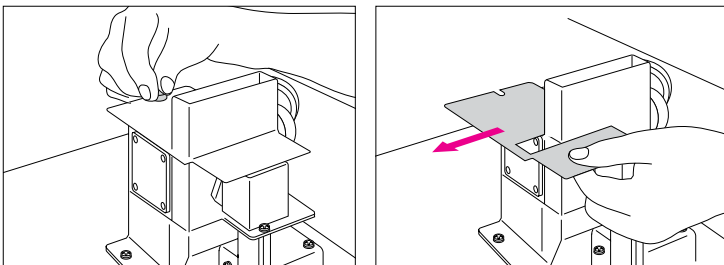
Tools Required:

Phillips screwdriver

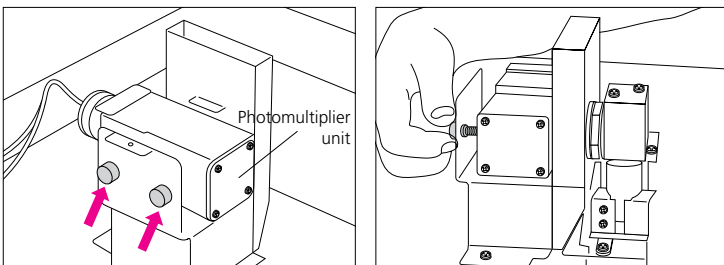
Procedure

Step1 Shut down the system and stop the gas supply for detectors.

Step2 Remove the knurled screw and detach the FPD top cover.



Step3 Loosen the two photomultiplier unit fixing knurled screws.

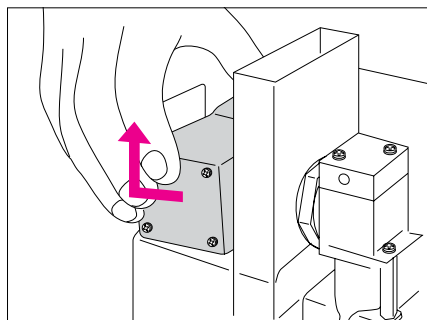


6. Detectors

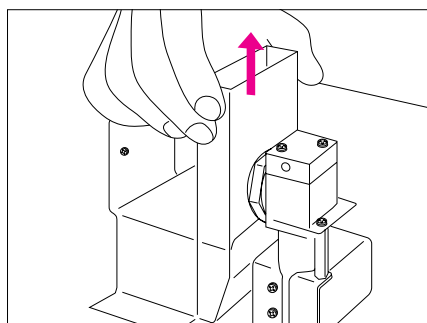
6.3 FPD

6.3.15 Replacing the Lens (FPD-2014)

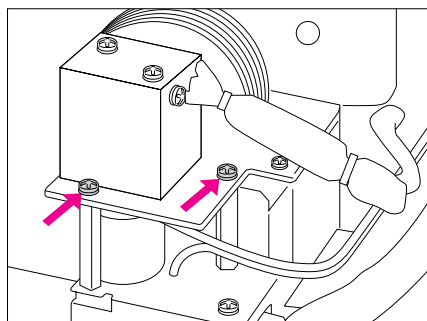
Step4 Slowly pull out the photomultiplier unit horizontally to remove it.
Cover the photomultiplier receiver with aluminum foil etc. to avoid exposure to intense light.



Step5 Pull out the cooling fin duct.



Step6 Remove the two body section fixing screws.

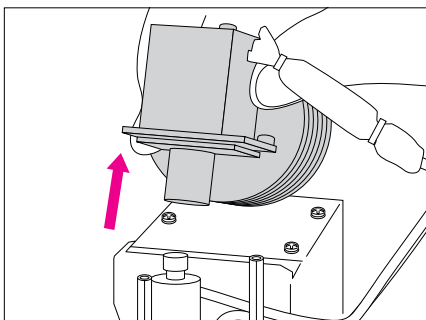


6. Detectors

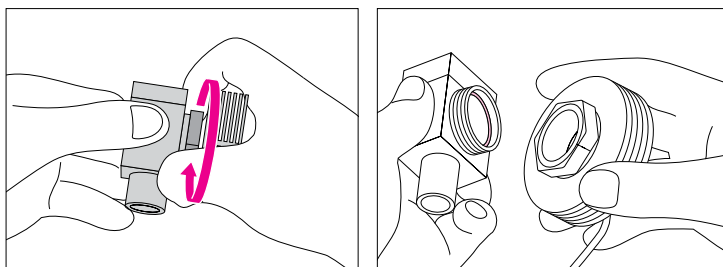
6.3 FPD

6.3.15 Replacing the Lens (FPD-2014)

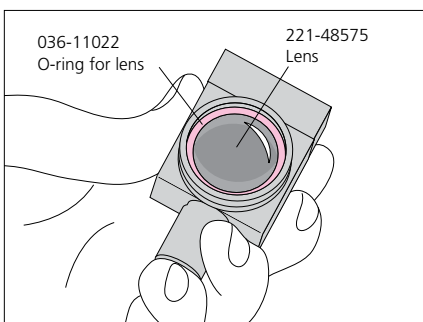
Step7 Pull out the body section upward together with its fixing plate.



Step8 Loosen the cooling fin fixing nut and detach the lens unit.



Step9 Check the lens unit visually and, if dirty, either clean or replace it. Also replace the O-ring of the lens unit if it is deteriorated.



Lens	P/N 221-48575
O-ring for lens	P/N 036-11022

Names and Functions of Parts

1 Preparing Gas

2 Sample Injection

3 Installing the Column

4 Data Processing

5 Sample Injection Units

6 Detectors

6. Detectors

6.3 FPD

6.3.15 Replacing the Lens (FPD-2014)

Step10 Once the lens and O-ring have been set in place, tighten the nut by hand to attach the cooling fin.

Step11 Insert the body section with the body section fixing plate into the nozzle base.

Step12 Tighten the two screws to fix the body section.

Step13 Attach the cooling fin duct.

Step14 Put back the photomultiplier unit slowly.

Step15 Tighten the photomultiplier unit fixing knurled screws to fix the photomultiplier unit.
Make sure that the photomultiplier unit and interference filter have been fixed in place.

Step16 Put back the FPD top cover and tighten the knurled screw.

Step17 Start up the system.

6. Detectors

6.3 FPD

6.3.16 Replacing the Nozzle (An example of replacing the capillary-column nozzle with the packed-column nozzle) (FPD-2014)

- Perform maintenance work only after the temperature of each part has fallen to 50 °C or less.
- Place any detached parts on a clean sheet or tray. Do not lose or contaminate these parts.
- Perform maintenance work using the appropriate tools. Wipe off any dirt on the tools in advance using gauze etc. dipped in acetone.

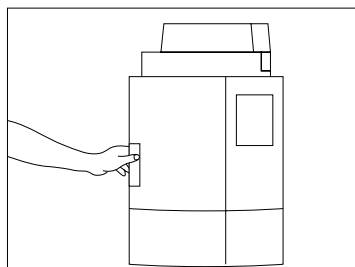
Tools Required:

Phillips screwdriver, flat screwdriver (standard FPD accessory),
10×12 wrench (standard accessory)

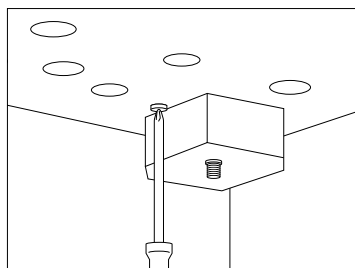
Procedure

Step1 Shut down the system and stop the gas supply for detectors.

Step2 Pull the lever on the left side of the door to open the column oven.



Step3 After removing the column, loosen two screws and detach the heat insulating cup on the FPD.



When using a packed column, the heat insulating cup is not required. Be sure to attach the heat insulating cup when it is returned to the capillary-column nozzle.

TIP

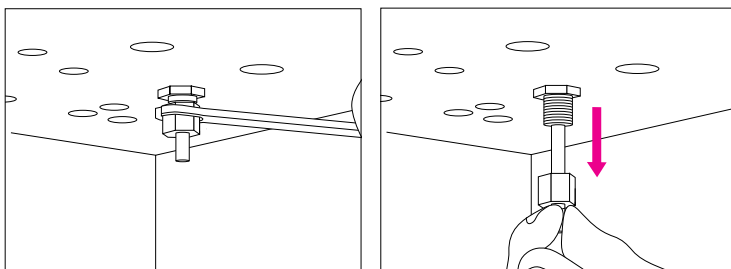
The FPD-2014 supports both packed and capillary columns by simple replacement of the nozzle from the column oven side.

6. Detectors

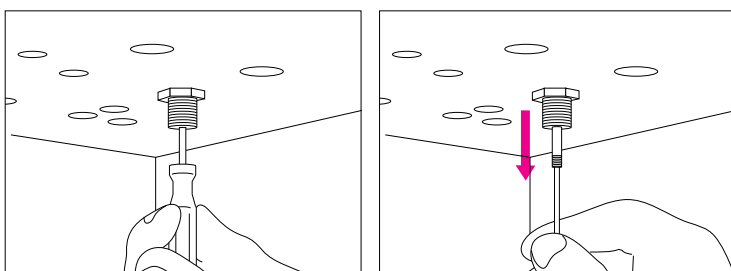
6.3 FPD

6.3.16 Replacing the Nozzle (An example of replacing the capillary-column nozzle with the packed-column nozzle) (FPD-2014)

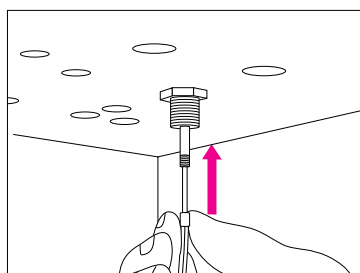
Step4 Loosen the capillary adapter with the wrench and pull it down to remove.



Step5 Use the accessory flat screwdriver to slowly lower the nozzle and then remove it. (Be careful not to drop it.)



Step6 Slowly insert the replacement nozzle into the FPD cell while holding the screwdriver at the setscrew on the replacement nozzle, and then tighten it.
After the PDF nozzle has been replaced, the nozzle level may change. It is recommended that the shield ring level be adjusted again.
(See Adjusting the Shield Ring on page 161.)



SUS nozzle (for capillary-column analysis)	P/N 221-70735-91
Quartz nozzle (for packed-column analysis)	P/N 221-70348-91

ATTENTION

Because the quartz nozzle for packed columns is easily broken, take extra care not to drop it.

6. Detectors

6.3 FPD

6.3.17 Replacing the Cooling Fan Backup Batteries (FPD-2014)

To protect the filter, the FPD-2014 uses a fan to cool the filter unit while the power is ON. Backup batteries have been incorporated which keep the fan powered until the temperature of the filter unit drops sufficiently in the event of a power failure, or if the GC has been turned OFF without lowering the detector temperature. An error will occur when these batteries are depleted, and the temperature control function of the FPD unit will stop. When this happens, replace the batteries.

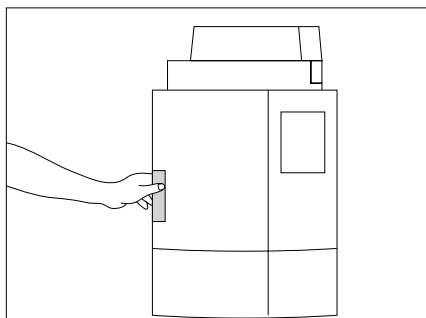
Tools Required:

Phillips screwdriver

Procedure

Step1 Shut down the system.

Step2 Pull the lever on the left side of the door to open the column oven.

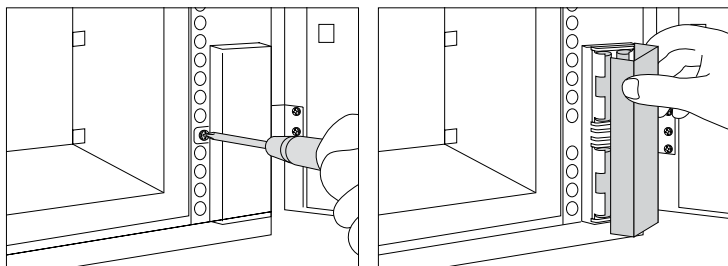


6. Detectors

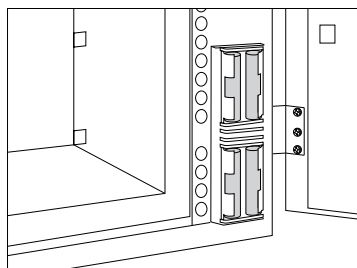
6.3 FPD

6.3.17 Replacing the Cooling Fan Backup Batteries (FPD-2014)

Step3 Remove the FPD battery cover fixing screw at the bottom right of the column oven and detach the battery cover.



Replace the batteries.



Step4 Put back the cover and tighten it with the fixing screw.

Step5 Close the column oven door and start up the system.

6. Detectors

6.3 FPD

6.3.18 Photomultiplier Purge Kit (FPD-2010 Plus/FPD-2010/FPD-2014)

Since the inside of the photomultiplier is a vacuum, its life is sometimes shortened by the intrusion of gases such as helium that have a small molecular mass. The photomultiplier purge kit can keep the pressure inside the photomultiplier case slightly higher than atmospheric pressure to reduce the risk of helium or other gases getting inside the photomultiplier. Be sure to use this kit when mounting an FPD and a detector (FID, FTD) that uses helium as the makeup gas at the same time.

Photomultiplier purge kit for FPD-2010 Plus	P/N 221-72652-41
Photomultiplier purge kit for FPD-2010	P/N 221-72652-91
Photomultiplier purge kit for FPD-2014	P/N 221-72652-92

ATTENTION

Nitrogen or air is supplied to the photomultiplier purge kit. Do not supply helium.

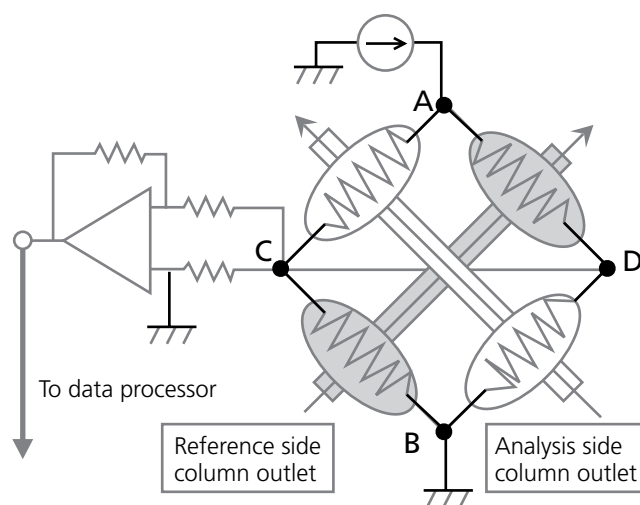
6. Detectors

6.4 TCD

TCD Principle of Operation

TCD stands for Thermal Conductivity Detector. It detects all compounds other than the carrier gas. Although helium is often used as the carrier gas, nitrogen and argon are sometimes used for the analysis of helium or hydrogen. A TCD comprises four tungsten-rhenium filaments. As shown in the TCD-2014 schematic below, the filaments are heated by a current applied between A and B. When helium, which has a high thermal conductivity (i.e. more likely for heat to dissipate), is used for the carrier gas, the filament temperature rises when components eluted from the column reach the detector since these components normally have a thermal conductivity lower than that of helium. As a result, filament resistance increases and the resulting voltage change between C and D is detected as a chromatogram.

- TCD (Thermal Conductivity Detector)



DC voltage is applied between A and B.

While only the carrier gas is flowing at a fixed flowrate, each of the filaments is kept at a fixed temperature and a fixed voltage is indicated between C and D.

Components elute from the column on the analysis side. → As a result, the filament temperature rises.

(Since the thermal conductivity is smaller than that of the carrier gas) → Resistance value changes. → Voltage between C and D changes.

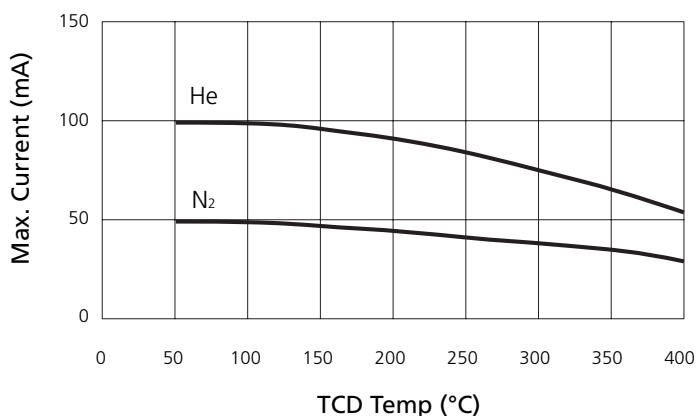
6. Detectors

6.4 TCD

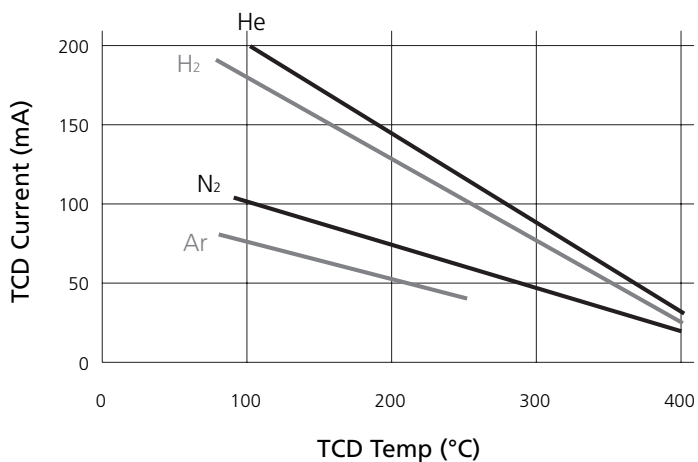
6.4.1 Setting the Current Value

The upper limit value of the TCD current differs according to the type of carrier gas used and detector temperature. Be sure to use TCD detectors at their current upper limit value or lower. Setting a large TCD current value increases sensitivity (proportionately to about the 3rd power of the current value). However, the service life of the filaments is shortened as this current value becomes larger. It is recommended to avoid unnecessarily setting the current to above the value where the required sensitivity can be obtained.

TCD-2010 Plus/TCD-2010



TCD-2014



ATTENTION

The service life of the filaments decreases when strong acids or corrosive gases are analyzed.

ATTENTION

The filaments sometimes deteriorate or break if current is allowed to pass without gas flowing around the filaments. Before setting the TCD current value, make sure that gas is flowing from the TCD vent (TCD outlet).

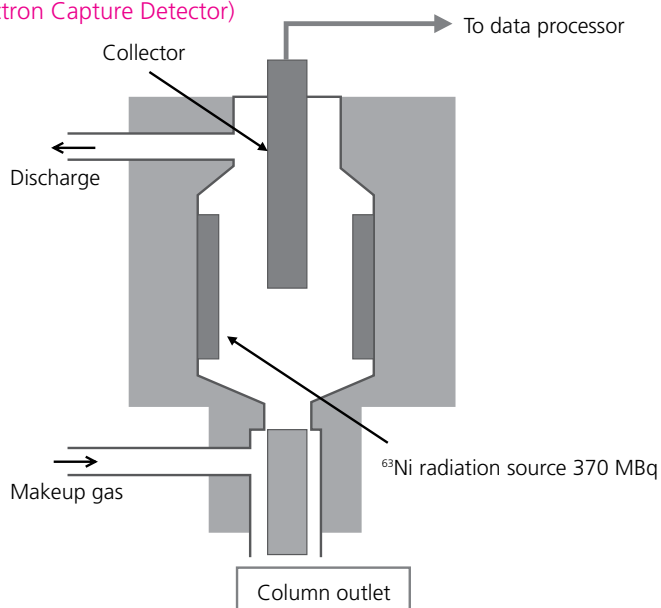
6. Detectors

6.5 ECD

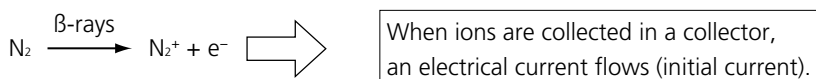
ECD Principle of Operation

ECD stands for Electron Capture Detector. This detector shows extremely high sensitivity to chlorine compounds such as PCBs and agrichemicals, and is widely used for the analysis of environmental pollutants. The ECD detector is filled with radioisotopes (nickel 63) that emit β -rays. Ultrapure nitrogen not containing oxygen is used as the makeup gas. As shown in the figure below, nitrogen is ionized by β -rays to form electrons and cause an ion current to flow. This ion current decreases when electrophilic compounds enter here from the column. This decrease in ion current is inverted to be detected as a chromatogram.

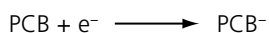
- ECD (Electron Capture Detector)



The N_2 used as the carrier gas (makeup gas) is ionized by β -rays emitted from the ^{63}Ni radiation source.



When electrophilic compounds enter here



Since PCB^- is extremely bigger and heavier than e^- , it takes time for the ions to reach the collector. \rightarrow Ion current decreases.

ATTENTION

ECD detectors cannot be disassembled or maintenance performed on them like other detectors since they use a radioactive source.

6. Detectors

6.5 ECD

6.5.1 ECD Pipe Parts

Of detectors used on GC instruments, ECD detectors are the most sensitive. They are even sensitive to oxygen. So, air (oxygen) entering these detectors might cause noise. Be sure to connect the oxygen trap shown below to the nitrogen gas line.

1. Oxygen Trap

The oxygen trap removes oxygen in the line. Maintenance must be performed on this oxygen trap before oxygen removal performance drops. Also, when a gas other than nitrogen (e.g. helium) is used as the carrier gas, the noise level can be further reduced by connecting the oxygen trap to the carrier gas line.



Oxygen trap

P/N 221-46985-91

2. Gas Filter

The modular sieve in this filter prevents the entry of organic substances. The noise level can be further reduced by using the gas filter together with the oxygen trap.



Gas filter

P/N 221-05619-01

TIP

When using the gas filter together with the oxygen trap, connect the gas filter on the upstream side of the oxygen trap.

6. Detectors

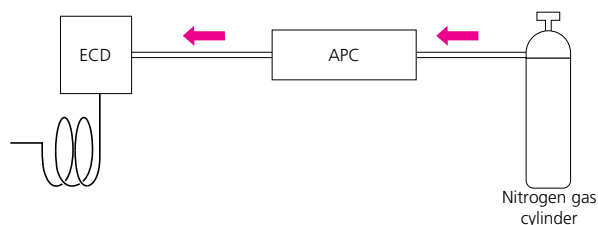
6.5 ECD

6.5.2 ECD Bypass Kit (for ECD-2010 Plus/ECD-2010)

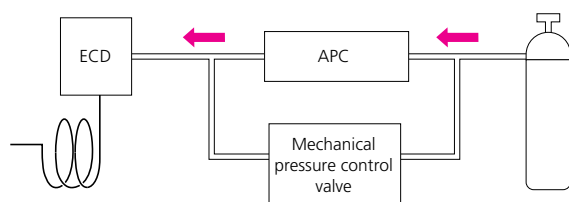
ECD Bypass Kit (for GC-2010)

The supply of all gases on the GC-2010 Plus/GC-2010 stops when the GC main power is turned OFF since all gases are electronically controlled. The ECD is a highly sensitive detector, and a long time is required for it to stabilize in the high-sensitivity region after detector gas supply is stopped. Supplying nitrogen gas to the ECD even with the GC main power turned OFF is effective in shortening the time required for the ECD to stabilize after the GC is started up. Installation of the following parts is recommended to reduce the stabilization time after the GC is started up and to quickly restore the ECD after a power outage.

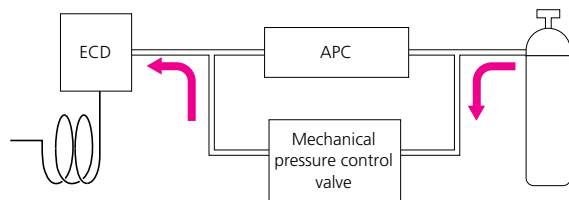
Regular ECD (gas supply stopped by GC power OFF)



When ECD bypass kit is attached (GC powered OFF)



When ECD bypass kit is attached (GC powered OFF, power outage)



ECD Bypass Kit

P/N 221-49664-91

ATTENTION

For the ECD-2014, makeup gas is supplied from the manual flow controller as standard. This allows purge gas to be supplied to the ECD even with the GC main power turned OFF (if the nitrogen line stop cock is fully open and is not fully closed by the flow controller knob).

6. Detectors

6.6 FID Troubleshooting

Cannot ignite the flame.

Cause	Countermeasures
The column is not connected.	Connect the column.
Hydrogen gas is not supplied. Or, the flowrate is not appropriate.	Supply hydrogen gas at an appropriate flowrate.
The hydrogen line is not completely purged.	Purge the hydrogen line to remove air.
Air is not supplied. Or, the flowrate is not appropriate.	Supply air at an appropriate flowrate.
Detector temperature is low.	Increase the detector temperature.

Fluctuating baseline

Cause	Countermeasures
Carrier gas is leaking.	Check for gas leaks, and re-tighten any leaking locations. Replace the pipes and septum.
Purity of carrier gas is low.	Replace the carrier gas with high-purity gas. Insert a molecular sieve filter into the carrier gas flow line.
The molecular sieve filter is contaminated.	Condition the molecular sieve filter.
The sample injection unit and column are contaminated.	Inspect the glass insert, and wash or replace. Condition the column.
There are many impurities in the air being supplied from the air compressor. (Adjust the compressor pressure to check if the baseline fluctuates in sync with pressure fluctuations.)	Attach the silica gel, pressure regulator, and silica gel to the flow line in this order. Change the flow line to gas cylinder air.
The hydrogen line is not completely purged.	Leave for 30 minutes to 1 hour to completely purge the line.
The room temperature is not within the recommended temperature range. Or, the room temperature of the site where the instrument is installed is fluctuating greatly.	Keep the room temperature within the recommended temperature range and decrease room temperature fluctuations.

Significant amount of noise

Cause	Countermeasures
Purity of carrier gas is low.	Replace the carrier gas with high-purity gas. Insert a molecular sieve filter into the carrier gas flow line.
Purity of hydrogen gas is low.	Replace with high-purity hydrogen gas.
Gas is leaking.	Check the sample injection unit and column connections for leaks.
Dust is building up at the bottom of the quartz nozzle.	Spray this section with air to remove the dust.

ATTENTION

Remove any blockages from the nozzle.

ATTENTION

The igniter filament must be replaced if it is burned out.

⇒ How to Regenerate the Molecular Sieve Filter (p.189)

ATTENTION

The nozzle must be replaced if it is damaged. Also, the collector must be washed if white powder is adhering to it. Contact your sales representative.

6. Detectors

6.6 FID Troubleshooting

Peaks not detected or extremely small (FID)

Cause	Countermeasures
Carrier gas is not flowing.	Allow the carrier gas to flow.
Carrier gas is leaking.	Re-tighten any leaking locations.
The split ratio is large. (in split analysis)	Decrease the split ratio.
The sample concentration is too low or the sample injection amount is too small.	Increase the sample concentration, or increase the sample injection amount.
An inappropriate column is in use.	Replace with an appropriate column while taking into consideration factors such as polarity.
The column temperature is too low.	Increase the column temperature.
There is a faulty connection on the detector's signal cable.	Correct the signal cable connection.
The detector is OFF.	Turn the detector ON.
Detector sensitivity is low.	Increase the sensitivity of the range and attenuation.
The hydrogen flame is not lit.	Inspect the hydrogen and air flowrates, and ignite the hydrogen flame again.
The ZERO LEVEL has fallen too far on the minus side.	Press the [MONIT] key to check the signal level, and then press [ZERO calibration] on the PF menu to perform zero calibration.
Other analytical conditions (e.g. temperature at each part, column flowrate) are inappropriate.	Review the analytical conditions.

• How to Regenerate the Molecular Sieve Filter

Step1 Stop carrier gas flow.

Step2 Remove the INJ/DET section cover.

Step3 Remove the molecular sieve filter.

Step4 Regenerate the molecular sieve filter under the following conditions:

- Gas used Clean N₂ or He
- Gas flow direction Opposite to that at GC piping work
- Gas flowrate 10 to 20 mL/min
- Temperature 300 °C
- Time 3 to 4 hours

Step5 After regeneration, do not leave the filter off the gas chromatograph for a long time. Attach it immediately.

ATTENTION

A significant amount of noise sometimes prevents peaks from being detected. See the item "Significant amount of noise."

ATTENTION

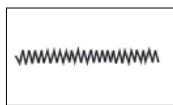
The nozzle and cable must be replaced if they are damaged. Contact your sales representative.

6. Detectors

6.7 FTD Troubleshooting

1. Abnormal baseline

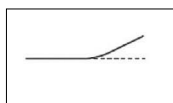
■ Significant amount of noise in baseline



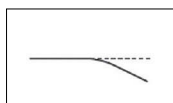
Noise

Cause	Countermeasures
The metal plate on the collector cover is not covering the small hole.	Turn the metal plate to cover the small hole.
Connectors on the electrical system are not firmly connected.	Check the connectors and connect firmly.
The carrier gas and makeup gas contain a large amount of impurities.	Replace the filter (molecular sieve filter, gas filter, oxygen trap, etc.). Replace piping parts. Replace the gases with higher purity gases.
Gas is leaking.	Check the sample injection unit and column connections for leaks.
The pressure regulator is malfunctioning.	Replace the pressure regulator.
The alkali source contains impurities.	Condition the alkali source.
The nozzle and alkali source are too close to each other.	Shorten the distance between the nozzle and alkali source. (possible only on FTD-2014)
Inappropriate column is used.	In particular, avoid using cyanopropyl-type liquid phase columns (e.g. XE-60, OV-25, OV-1701, OV-1301).

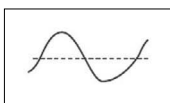
■ Baseline drift, meander, etc.



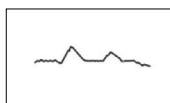
(Positive drift)



(Negative drift)



Meandering



Other

Cause	Countermeasures
The carrier gas and makeup gas contain a large amount of impurities.	Replace the filter (molecular sieve filter, gas filter, oxygen trap, etc.). Replace piping parts. Replace the gases with higher purity gases.
Gas is leaking.	Check the sample injection unit and column connections for leaks.
The pressure regulator is malfunctioning.	Replace the pressure regulator.
The sample injection unit (glass insert) and column are contaminated.	Wash or replace the glass insert. Sufficiently age the column.
The alkali source contains impurities.	Condition the alkali source.
The nozzle is contaminated.	Clean or replace the nozzle.
Temperature of each section is unstable.	Monitor the temperature of each section on the monitor screen ([MONIT] key).
The flowrate is unstable.	Monitor the flowrate of each section on the monitor screen ([MONIT] and [FLOW MON] keys).

6. Detectors

6.7 FTD Troubleshooting

- Shock peaks appear on the minus side due to spike noise.

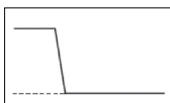


Cause	Countermeasures
The alkali source is exhausted.	If the given sensitivity cannot be obtained, regenerate or replace the collector using the alkali source regeneration kit.

- Alkali source is not heated red.

Cause	Countermeasures
The collector fixing screws are not fully tightened. The filament is burned out.	Firmly tighten the collector fixing screws. Replace the collector.

- Baseline exceeds the limit on the minus side when the sample is injected.

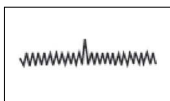


Cause	Countermeasures
The alkali source contains impurities.	Condition the alkali source.
A sample containing a large amount of halogen compounds was injected.	Evaluate the sample by pretreatment and remove the compounds. Change the solvent if the sample is used as a solvent.

6. Detectors

6.7 FTD Troubleshooting

Sensitivity is too low or peaks are extremely small.



Cause	Countermeasures
Carrier gas is leaking.	Check the sample injection unit and column connections for leaks.
The split ratio is large. (in split analysis)	Decrease the split ratio.
The sample injection amount is too small, or the sample concentration is too low.	Increase the quantity (normally 2 μL max.) or the concentration of the injected sample.
The detector range/attenuation are set to inappropriate values.	Change the detector range/attenuation to appropriate values.
The column is installed at the wrong location.	Check the column insertion length and install it at the correct location.
An inappropriate column is in use.	Replace with an appropriate column, taking into consideration polarity matching with the target compound, thickness of the liquid phase film and other factors.
The carrier gas and makeup gas contain a large amount of impurities.	Replace the filter (molecular sieve filter, gas filter, oxygen trap, etc.). Replace piping parts. Replace the gas cylinder. (Replace the gases with higher purity gases.)
The background current is set to too small a value.	Set a larger background current value.
The column is contaminated.	Sufficiently age the column.
The alkali source contains impurities.	Condition the alkali source.
The background current was adjusted while liquid phase vapor from the column (bleeding) was excessive.	Sufficiently age the column, and re-adjust the background current. Set the column oven temperature to a lower value, and re-adjust the background current.
The detector temperature and makeup gas flowrate were altered after the background current adjustment was completed.	Re-adjust the background current.
The nozzle is contaminated.	Clean or replace the nozzle.
The alkali source is exhausted, preventing the given sensitivity from being obtained.	Regenerate the collector using the FTD collector regeneration kit (P/N 221-49079-91). Or, replace the collector.

6. Detectors

6.8 FPD Troubleshooting

1. Cannot ignite the flame, or flame goes out.

Cause	Countermeasures
The column is not connected.	Connect the column.
Hydrogen gas is not supplied, or the flowrate is inappropriate.	Supply hydrogen gas at an appropriate flowrate.
Air is not supplied, or the flowrate is inappropriate.	Supply air at an appropriate flowrate.
The igniter filament is burned out.	Replace the igniter filament.
The detector temperature is low.	Increase the detector temperature.
The shield ring position is inappropriate.	Set the shield ring to the appropriate height. (excluding FPD-2010 Plus)
The APC is malfunctioning.	Contact your sales representative.

2. Abnormal baseline

■ Significant amount of noise in baseline

Cause	Countermeasures
Connectors on the electrical system are not firmly connected.	Check the connectors and connect firmly.
The carrier gas and detector gas contain a large amount of impurities.	Replace the filter (molecular sieve filter, gas filter, oxygen trap, etc.). Replace piping parts. Replace the gas cylinder. (Replace the gases with higher purity gases.)
Gas is leaking.	Check for gas leaks, and repair leaking piping connections.
Light is leaking into the detector.	Place a blackout curtain over the detector, and repair leaking piping connections.
The detector (quartz tube, filter, photomultiplier) is contaminated.	Wash or replace.
The shield ring position is inappropriate.	Set the shield ring to the appropriate height.
Water drops are produced around the exhaust vent.	Completely purge the exhaust vent to remove the water drops.
The APC is malfunctioning.	Contact your sales representative.

■ Baseline drift, meander, etc.

Cause	Countermeasures
The carrier gas and detector gas contain a large amount of impurities.	Replace the filter (molecular sieve filter, gas filter, oxygen trap, etc.). Replace piping parts. Replace the gas cylinder. (Replace the gases with higher purity gases.)
Gas is leaking.	Check for gas leaks, and repair leaking piping connections.
The sample injection unit (glass insert) and column are contaminated.	Wash or replace the glass insert. Condition the column.
Light is leaking into the detector.	Place a blackout curtain over the detector, and find and repair leaking piping connections.
Temperature of each section is unstable.	Check the temperature of each section, and, if the temperature does not stabilize, contact your sales representative.
The flowrate is unstable.	Check the pressure and flowrate of the AFC, and, if the flowrate does not stabilize, contact your sales representative.

6. Detectors

6.8 FPD Troubleshooting

3. Zero adjustment is not possible.

Cause	Countermeasures
Light is leaking into the detector.	Place a blackout curtain over the detector, and find and repair leaking piping connections.

4. Peaks do not appear.

Cause	Countermeasures
The hydrogen flame is out.	Re-ignite the flame.
The position of the hydrogen flame is inappropriate.	Check that the flowrate conditions are correct, and re-ignite the flame.
Quenching is occurring.	Review the analytical conditions.
A wrong filter is used.	Check the filter.
The detector is not turned ON.	Turn the detector ON.
The shield ring position is inappropriate.	Set the shield ring to the appropriate height. (excluding FPD-2010 Plus)

5. Peaks are extremely small (or sensitivity is low).

Cause	Countermeasures
Carrier gas is leaking.	Check for gas leaks, and repair leaking piping connections.
The split ratio is large. (in split analysis)	Decrease the split ratio.
The sample injection amount is too small, or the sample concentration is too low.	Increase the sample injection amount or its concentration.
The range/attenuation are set to inappropriate values.	Set a larger range or raise the attenuation.
The capillary column is installed at the wrong location.	Install the column at the correct location.
An inappropriate column is in use.	Replace with an appropriate column while taking into consideration factors such as polarity.
The carrier gas and detector gas contain a large amount of impurities.	Completely purge the air inside the flow line. Replace the filter (molecular sieve filter, gas filter, oxygen trap, etc.). Replace piping parts. Replace the gas cylinder. (Replace the gases with higher purity gases.)
Light is leaking into the detector.	Place a blackout curtain over the detector, and find and repair leaking piping connections.
The flowrates of H ₂ and air are inappropriate.	Set appropriate flowrates.
The detector (quartz tube, filter, photomultiplier) is contaminated.	Wash or replace.
Sample is sticking to the column and detector.	Review the analytical conditions.
The shield ring position is inappropriate.	Set the shield ring to the appropriate height. (excluding FPD-2010 Plus)

6. Abnormal peak shape

Cause	Countermeasures
Quenching is occurring.	Remove the impurities in the air. Review the analytical conditions.

6. Detectors

6.8 FPD Troubleshooting

FPD Error Messages

- **DET#n FPD battery voltage error**

This error indicates that the voltage of the cooling fan backup batteries have dropped. When this error occurs, temperature control of the FPD is stopped to protect the filter from unexpected power outages.

Replace the batteries with new ones according to 6.3.8 Replacing the Cooling Fan Backup Batteries (FPD-2010 Plus/FPD-2010) or 6.3.17 Replacing the Cooling Fan Backup Batteries (FPD-2014).

If this error message appears even after replacing the batteries, check the following points:

- Are the batteries inserted in the correct orientation?
- Are the batteries making contact with the electrodes in the battery compartment?
- Are the connections between the battery compartment and the connector properly connected?

If no problem is found with the above, a probable cause is a hardware failure. The FPD cannot be used in this state. Turn the instrument OFF, and contact your sales representative.

- **DET#n FPD radiator temperature error**

This error indicates that the temperature of the filter radiator is abnormally hot.

Check around the cooling fan to see that the cooling fan is operating normally and that the flow of the cooling air is not blocked.

If no problem is found with the above, a probable cause is a hardware failure. The FPD cannot be used in this state. Turn the instrument OFF, and contact your sales representative.

- **DET#n FPD cooling fan error**

This error indicates that the cooling fan is not installed or its cable is not connected properly. If no problem is found with the connection, a probable cause is a fan failure. The FPD cannot be used in this state.

Turn the instrument OFF, and contact your sales representative.

- **DET#n FPD current error**

This error indicates that the current flowing to the photomultiplier is abnormal. Check the connections to see if strong light is entering the photomultiplier.

If the FPD does not return to a normal state by shutting off outside light by covering it with a blackout curtain, a probable cause is a hardware failure. The FPD cannot be used in this state. Turn the instrument OFF, and contact your sales representative.

6. Detectors

6.9 TCD Troubleshooting

Zero adjustment not possible

Cause	Countermeasures
The gas chromatograph is not connected to the data processor.	Make the proper connections.
Current is not flowing to the filament.	Make sure that current flows.
The current value is set too high.	Set a smaller current value.

Fluctuating baseline

Cause	Countermeasures
Carrier gas and makeup gas are leaking.	Check for gas leaks, and re-tighten any leaking locations. Replace the pipes and septum.
Purity of carrier gas and makeup gas is low.	Replace the carrier gas with high-purity gas. Insert a molecular sieve filter into the carrier gas flow line.
The molecular sieve filter is contaminated.	Condition the molecular sieve filter.
The current value is set too high.	Set a smaller current value.
The sample injection unit (glass insert/silica wool) and column are contaminated.	Inspect the glass insert, and wash or replace. Condition the column.
The cell is contaminated.	Condition the cell. Inject solvent several times.
The room temperature is not within the recommended temperature range, or the room temperature of the site where the instrument is installed is fluctuating greatly.	Keep the room temperature within the recommended temperature range and decrease room temperature fluctuations.

Significant amount of noise

Cause	Countermeasures
The carrier gas and makeup gas contain a large amount of impurities.	Completely purge the air inside the flow line. Replace piping parts. Replace the gas cylinders to supply gases with higher purity. Insert a molecular sieve filter into the flow line.
Gas is leaking.	Check the sample injection unit and column connections for leaks.
The current value is set too high.	Set a smaller current value.
The flowrate of the makeup gas is too small.	Increase the flowrate.

ATTENTION

If current is allowed to pass with air still remaining inside the TCD cell, the filament may oxidize or become burned out, and prevent zero adjustment from being performed. If the filament is burned out, the cell must be replaced. Contact your sales representative.

⇒ How to Regenerate the Molecular Sieve Filter (p.189)

⇒ How to Condition the Cell (p.197)

ATTENTION

Allowing an excessive current to flow might damage the filament and cause noise to increase. If this happens, the cell must be replaced. Contact your service representative.

6. Detectors

6.9 TCD Troubleshooting

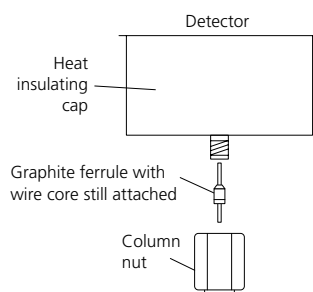
• How to Condition the Cell (TCD-2010/TCD-2010 Plus)

Step1 To prevent makeup gas from leaking, plug the column connector of the detector by fixing the graphite ferrule wire core to it with the nut.

Step2 Set the current value to 0 mA.

Step3 Allow makeup gas to pass. (The flowrate is the same as during analysis.)

Step4 Set the detector temperature to 30 °C higher than during analysis.
(Note, however, that the detector temperature must not exceed the maximum operating temperature of 400 °C.)



Allow 1 to 12 hours for the conditioning. This, however, depends on how contaminated the cell is.

Peaks not detected or extremely small (TCD)

Cause	Countermeasures
Detector sensitivity is low.	Set the range to $\times 1$. Or, set attenuation to $\times 1$.
The current is set to too small a value.	Increase the current value. (Lower the TCD temperature to increase the maximum operating current value.)
The flowrate of the makeup gas is too high.	Set an appropriate flowrate: He: approx. 7.5 mL/min; N ₂ : approx. 8.0 mL/min
The split ratio is large. (in split analysis)	Decrease the split ratio.
Carrier gas is leaking.	Re-tighten any leaking locations.
The capillary column insertion length is incorrect.	Install the column properly.
The column is contaminated.	Condition the column.
The sample concentration is too low or the sample injection amount is too small.	Increase the sample concentration, or increase the sample injection amount.
An inappropriate column is in use.	Replace with an appropriate column while taking into consideration factors such as polarity.
Other analytical conditions (e.g. temperature at each part, column flowrate) are inappropriate.	Review the analytical conditions.

ATTENTION

The baseline sometimes fluctuates when the temperature of each part or the flowrate is not stabilized. Check the monitor display. If this kind of symptom occurs, contact your sales representative.

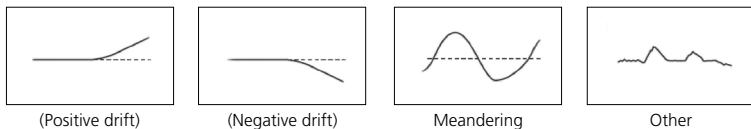
ATTENTION

A significant amount of noise sometimes prevents peaks from being detected. See the item "Significant amount of noise."

6. Detectors

6.10 ECD Troubleshooting

1. Baseline drift, meander, etc.

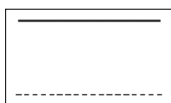


Cause	Countermeasures
Air is trapped inside the flow line.	Completely purge the air.
The carrier gas or makeup gas is not flowing, and air is present in the flow line.	Allow carrier gas or makeup gas to flow to completely purge the flow line.
The sample injection unit (glass insert) and column are contaminated.	<ul style="list-style-type: none"> • Wash or replace the glass insert. • Condition the column.
Temperature of each section is unstable.	Monitor the temperature of each section on the monitor screen ([MONIT] key).
The flowrate is unstable.	Monitor the flowrate on the monitor screen ([MONIT] key).
The cell is contaminated.	Check the cell for contamination, and send the ECD to Shimadzu for cleaning if necessary.

6. Detectors

6.10 ECD Troubleshooting

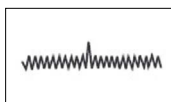
2. Zero adjustment is not possible.



Upper limit is exceeded.

Cause	Countermeasures
Air is trapped inside the flow line.	Completely purge the air.
The carrier gas or makeup gas is not flowing, and air is present in the flow line.	Allow carrier gas or makeup gas to flow to completely purge the flow line.
The cell is contaminated.	Check the cell for contamination, and send the ECD to Shimadzu for cleaning if necessary.
The current value is set too high.	Set a smaller current value.

3. Detector sensitivity is low.



Cause	Countermeasures
Carrier gas is leaking.	Check for gas leaks and re-tighten any leaking locations.
The split ratio is large. (in split analysis)	Decrease the split ratio.
The sample injection amount is too small, or the sample concentration is too low.	Increase the sample concentration, or increase the sample injection amount.
The range, attenuation, and current are set to inappropriate values.	Set larger range, attenuation, and current values.
The capillary column is installed at the wrong location.	Install the column at the correct location.
An inappropriate column is in use and tailing is occurring on peaks.	Replace with an appropriate column while taking into consideration factors such as polarity.
The carrier gas and makeup gas contain a large amount of impurities.	<ul style="list-style-type: none"> • Completely purge the air inside the flow line. • Replace the filter (molecular sieve filter, gas filter, oxygen trap, etc.). • Replace piping parts. • Replace the gas cylinder to supply gases with higher purity.
The cell is contaminated.	Check the cell for contamination, and send the ECD to Shimadzu for cleaning if necessary.
Components are sticking to the glass insert.	Change the glass insert to a deactivated insert (option). Change to a glass insert treated with acid or alkali depending on the component.

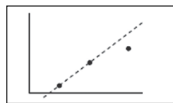
ATTENTION

1. Injecting an excessive amount of sample might contaminate the sample injection unit.
2. High-concentration samples might contaminate the detector.

6. Detectors

6.10 ECD Troubleshooting

4. The linearity of the calibration curve has worsened significantly. In particular, the high-concentration side is saturated.



Calibration curve

Cause	Countermeasures
The carrier gas and makeup gas contain a large amount of impurities.	<ul style="list-style-type: none"> • Completely purge the air inside the flow line. • Replace the filter (molecular sieve filter, gas filter, oxygen trap, etc.). • Replace piping parts. • Replace the gas cylinder to supply gases with higher purity.
The column is contaminated.	Condition the column.
The cell is contaminated.	Check the cell for contamination, and send the ECD to Shimadzu for cleaning if necessary.
The current value is set too high.	Set a smaller current value. Note, however, that this will cause the detector sensitivity to drop.
The flowrate of the makeup gas is too low.	Increase the makeup gas flowrate. Note, however, that this will cause the detector sensitivity to drop.

Error Message

The DET temperature has exceeded the upper limit.

If the detector temperature exceeds the maximum operating temperature specified on the temperature control unit, the error cancellation confirmation screen appears and the above message is displayed.

The maximum operating temperature of the ECD is set to 350 °C to comply with legislative restrictions.

When the detector temperature exceeds 350 °C, the safety function operates automatically to generate this error.

When this error occurs, first move the cursor to [Ignore Error] and press the [ENTER] key. Next, change the setting to remove the cause of the error. Several tens of seconds after pressing the [ENTER] key, the confirmation screen appears. Move the cursor to [Reset Error] and press the [ENTER] key. If this confirmation screen appears while the settings are being changed, select [Ignore Error] again and change the settings again.

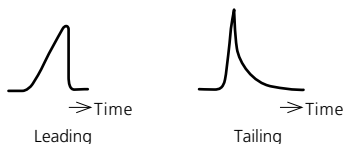
6. Detectors

6.11 General Detector Troubleshooting

Ghost peaks appear.

Cause	Countermeasures
Septum purge is not being supplied.	Supply septum purge.
Peaks that did not elute in previous analysis are eluting.	Raise the column oven temperature to the analysis maximum temperature to elute the component still inside the column.
The sample is contaminated.	Prepare a new sample.
The microsyringe is contaminated.	Wash or replace the microsyringe.
Purity of carrier gas is low.	Replace the carrier gas with one of higher purity. Insert a molecular sieve filter into the carrier gas flow line.
Substances having a high boiling point accumulating at the column inlet end are flowing out.	Condition the column. Or, cut the tip of the capillary column.
The sample injection unit is contaminated.	Wash or replace the glass insert.
Piping and pressure regulator are contaminated with oil etc.	Replace with clean flow line parts.
Fragments of the septum are inside the glass insert or column.	Remove the septum fragments. Wash or replace the glass insert. Cut the tip of the capillary column.

Abnormal peak shape



Leading: The peak rises slowly.

Tailing: It takes an extremely long time for the peak to return to the baseline after elution.

Cause	Countermeasures
<ul style="list-style-type: none"> Leading The column is overloaded.	Decrease the injection amount. Dilute the sample. Increase the split ratio. Replace the column with one having a thick liquid phase film.
<ul style="list-style-type: none"> Divided peak top, leading, or tailing Multiple peaks are not completely separated and are merged into one peak.	Change the various conditions to improve separation. Or, replace the column.
<ul style="list-style-type: none"> Leading or tailing The temperature of the sample injection unit is low.	Raise the temperature of the sample injection unit.
<ul style="list-style-type: none"> Tailing The column is contaminated.	Condition the column.
<ul style="list-style-type: none"> Tailing The glass insert is damaged.	Replace the glass insert.
<ul style="list-style-type: none"> Tailing Septum purge is not being supplied, or its flowrate is too low.	Supply septum purge. Increase the septum purge flowrate.
<ul style="list-style-type: none"> Tailing Fragments of the septum are inside the glass insert or column.	Remove the septum fragments. Wash or replace the glass insert. Cut the tip of the capillary column.

6. Detectors

6.11 General Detector Troubleshooting

Poor retention time reproducibility

Cause	Countermeasures
The carrier gas cylinder is almost empty, and its supply pressure changes greatly over time.	Replace the gas cylinder with one that has at least 3 MPa of pressure indicated on its gauge.
The carrier gas flowrate is fluctuating due to a gas leak.	Re-tighten any leaking locations. Replace the pipes and septum.
The column is overloaded.	Decrease the injection amount. Dilute the sample. Increase the split ratio. Replace the column with one having a thick liquid phase film.
The room temperature is not within the recommended temperature range. Or, the room temperature of the site where the instrument is installed is fluctuating greatly.	Keep the room temperature within the recommended temperature range and decrease room temperature fluctuations.
The syringe tip is blocked, preventing the sample solution from being injected straight.	Wash or replace the syringe.

Poor peak area reproducibility

Cause	Countermeasures
The carrier gas cylinder is almost empty, and its supply pressure changes greatly over time.	Replace the gas cylinder with one that has at least 3 MPa of pressure indicated on its gauge.
The carrier gas flowrate is fluctuating due to a gas leak.	Re-tighten any leaking locations. Replace the pipes and septum.
The sample is not being injected or collected completely.	Inject the sample accurately. Replace with a new microsyringe.
The column is overloaded.	Decrease the injection amount. Dilute the sample. Increase the split ratio. Replace the column with one having a thick liquid phase film.
The room temperature is not within the recommended temperature range. Or, the room temperature of the site where the instrument is installed is fluctuating greatly.	Keep the room temperature within the recommended temperature range and decrease room temperature fluctuations.
The syringe tip is blocked, preventing the sample solution from being injected straight, or the sample solution is not being sucked up successfully.	Wash or replace the syringe.
The syringe plunger does not move smoothly.	Wash the syringe barrel and plunger. Wash or replace the syringe.
Silica wool inside the insert is fuzzy.	Re-pack the insert with the silica wool.

ATTENTION

The detector must be repaired or replaced if a malfunctioning gas cylinder pressure regulator, for example, is causing the gas supply pressure to fluctuate. Contact your sales representative.

7.1	Possible Detector Combinations (by GC-2010 Plus model)	204
7.2	Possible Detector Combinations (by GC-2014 model)	207

Possible Detector Combinations

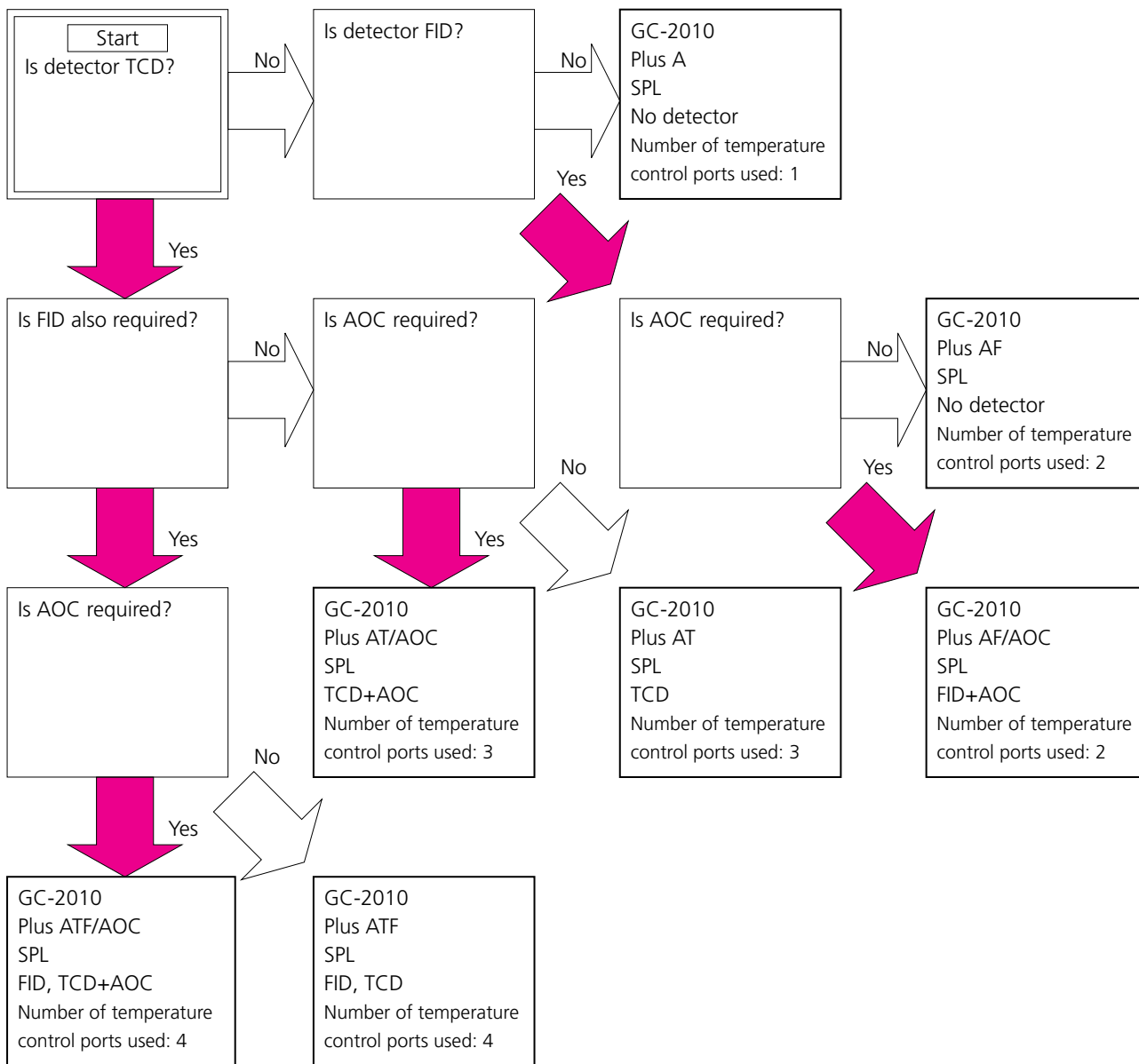
Gas Chromatograph Parts and Maintenance Brochure

7.1 Possible Detector Combinations (by GC-2010 Plus model)

Procedure for checking the number of additional mounted detectors (GC-2010 Plus)

1) Select the base GC model by following the GC-2010 Plus Main Unit Selection Guide below.

GC-2010 Plus Main Unit Selection Guide



2) After determining the base GC model, select the additional detector and number to mount from the GC-2010 Plus Detector Selection Table.

(Example)

When adding an ECD and FTD onto the GC-2010 Plus AT, this is indicated by the arrow in the table below. In the table, it can be seen that this combination is possible. Also, the column to the right of this combination indicates that additional temperature control is "required." So, the additional temperature control unit (221-48458-41) must be procured. Other combinations not listed in this table are not possible or are custom orders.

3) Study the type of additional sample injection unit.

In the case of an additional sample injection unit (SPL, WBI, or OCI/PTV), use one temperature control port. Accordingly, when adding on one sample injection unit, add "1" to the temperature control port in the table below, and when the number of temperature control ports has reached or exceeded five, the additional temperature control unit (221-48458-41) must be procured. The maximum number of sample injection units that can be mounted on the GC is two.

GC-2010 Plus Detector Selection Table

GC-2010 Plus AF,GC-2010 Plus AF/AOC

FID	ECD	FPD	FTD	Temperature Control Port	Additional Temperature Control (*)	
3	0	0	0	5	Required	
2	1	0	0	5	Required	
	0	0	0	4		
1	2	0	0	5	Required	
	1	0	0	4		
	0	1	0	0	4	
		0	1	0	4	
0	3	0	0	5	Required	
		0	0	3		
	2	0	0	4		
		1	1	0	4	
	1	0	0	1	4	
			0	0	3	
		0	1	1	4	
			0	1	0	3
0	0	1	3			

GC-2010 Plus AT,GC-2010 Plus AT/AOC

FID	ECD	FPD	FTD	Temperature Control Port	Additional Temperature Control (*)
2	0	0	0	5	Required
1	1	0	0	5	Required
	0	0	1	5	Required
0			4		
0	2	0	0	5	Required
	1	0	1	5	Required
			0	4	
0	0	0	1	4	

GC-2010 Plus ATF,GC-2010 Plus ATF/AOC

FID	ECD	FPD	FTD	Temperature Control Port	Additional Temperature Control (*)
1	0	0	0	5	Required
0	1	0	0	5	Required
	0	0	1	5	Required

(*) The upper limit value of the temperature control port in a standard specification is "4." When "5" or higher, an additional temperature control unit (221-48458-41) must be procured.

GC-2010 Plus A

FID	ECD	FPD	FTD	Temperature Control Port	Additional Temperature Control (*)	
4	0	0	0	5	Required	
3	1	0	0	5	Required	
	0	0	0	4		
2	2	0	0	5	Required	
	1	0	0	4		
	0	1	0	0	4	
		0	0	1	4	
1	3	0	0	5	Required	
	2	0	0	4		
	1	1	1	0	4	
		0	0	1	4	
	0	1	1	0	3	
		0	1	1	4	
			0	0	1	3
		0	0	1	3	
	0	4	0	0	5	Required
		3	0	0	4	
2		1	1	0	4	
		0	0	1	4	
		0	0	0	3	
1		1	1	1	4	
		0	0	1	3	
			0	0	1	3
		0	0	1	1	3
0				0	2	
0			1	1	3	
			0	0	2	
0	0	2	3			
		1	2			

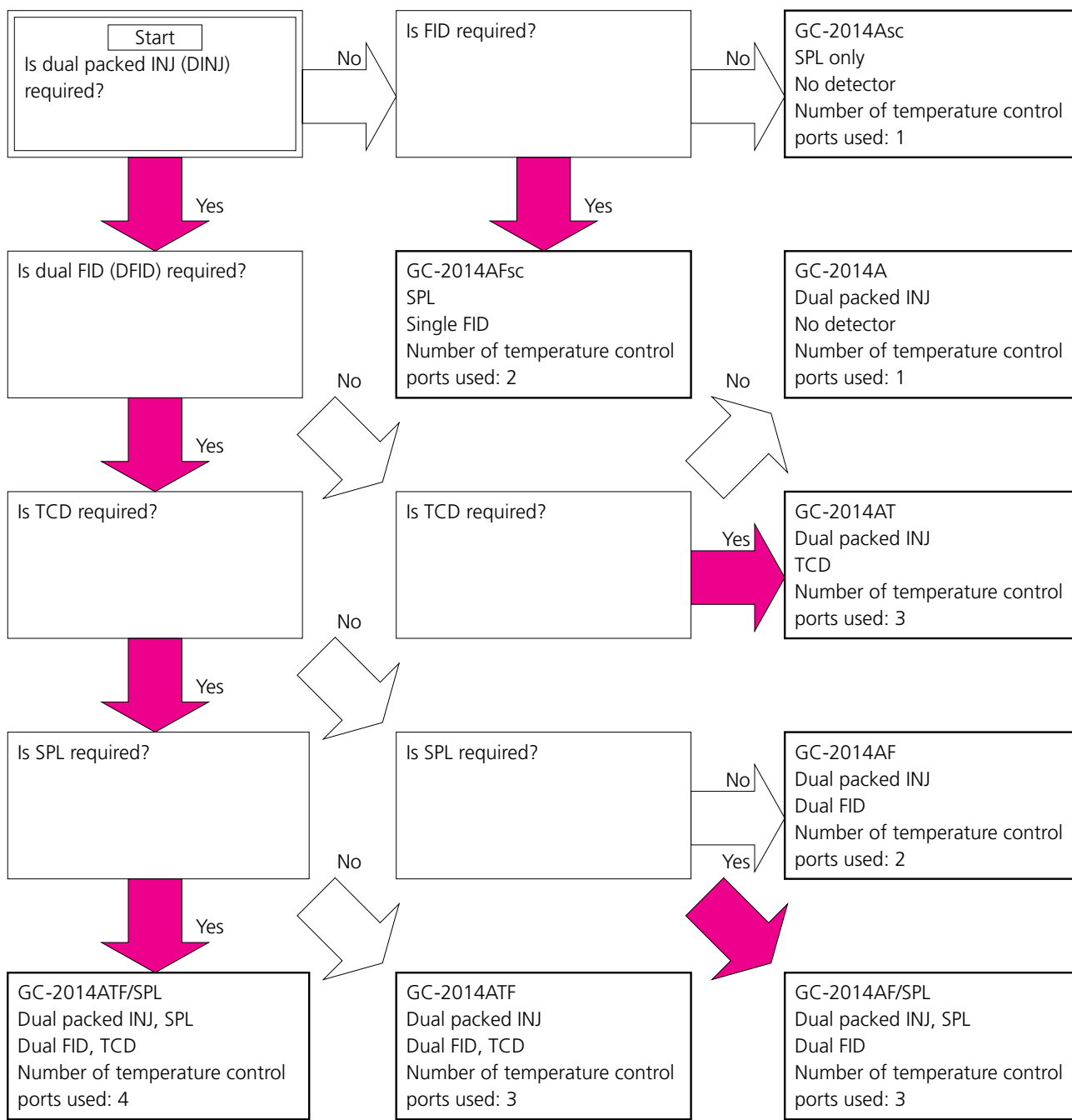
(*) The upper limit value of the temperature control port in a standard specification is "4." When "5" or higher, an additional temperature control unit (221-48458-41) must be procured.

7.2 Possible Detector Combinations (by GC-2014 model)

Procedure for checking the number of additional mounted detectors (GC-2014)

1) Select the base GC model by following the GC-2014 Main Unit Selection Guide below.

GC-2014 Main Unit Selection Guide



2) After determining the base GC model, select the additional detector and number to mount from the GC-2014 Detector Selection Table.

(Example)

When adding an ECD and FPD onto the GC-2014AF/SPL, this is indicated by the arrow in the table below. In the table, it can be seen that this combination is possible. Also, the column to the right of this combination indicates that additional temperature control is "required." So, the additional temperature control unit (221-48458-41) must be procured. Other combinations not listed in this table are not possible or are custom orders.

3) Determine the sample injection unit to add on from the GC-2014 Additional Sample Injection Unit Selection Guide on pages 213 and 214.

GC-2014 Detector Selection Table

GC-2014AF Standard attachments: Dual INJ, dual FID

Single FID	ECD	FPD	FTD-2014c	FTD-2014	Temperature Control Port (*)	Additional Temperature Control		
2	0	0	0	0	4	-		
1	1	0	0	0	4	-		
	0	1	0	0	4	-		
		0	1	0	0	4	-	
			0	1	0	4	-	
0	2	0	0	0	4	-		
	1	1	0	0	4	-		
		0	1	0	0	4	-	
			0	1	0	0	4	-
				0	1	0	4	-
		0	2	0	0	4	-	
		0	1	1	0	0	4	-
	0			1	0	0	4	-
				0	1	0	4	-
	0		1	0	0	4	-	
			0	1	0	3	-	
			0	1	0	3	-	
		0	1	3	-			

GC-2014AF/SPL Standard attachments: Dual INJ, SPL-INJ, dual FID

Single FID	ECD	FPD	FTD-2014c	FTD-2014	Temperature Control Port (*)	Additional Temperature Control		
2	0	0	0	0	5	Required		
1	1	0	0	0	5	Required		
	0	1	0	0	5	Required		
		0	1	0	0	5	Required	
			0	1	0	5	Required	
0	2	0	0	0	5	Required		
	1	1	0	0	5	Required		
		0	1	0	0	5	Required	
			0	1	0	0	5	Required
				0	1	0	5	Required
		0	2	0	0	5	Required	
		0	1	1	0	0	5	Required
	0			1	0	0	5	Required
				0	1	0	5	Required
	0		1	0	0	5	Required	
			0	1	0	5	Required	
			0	1	0	5	Required	
		0	1	4	-			



(*) The upper limit value of the temperature control port in a standard specification is "4." When "5" or higher, an additional temperature control unit (221-48458-41) must be procured.

GC-2014ATF Standard attachments: Dual INJ, dual FID, TCD

Single FID	ECD	FPD	FTD-2014c	FTD-2014	Temperature Control Port (*)	Additional Temperature Control
2	0	0	0	0	5	Required
1	1	0	0	0	5	Required
	0	1	0	0	5	Required
			0	0	4	-
0	2	0	0	0	5	Required
	1	1	0	0	5	Required
			0	0	0	4
	0	1	0	0	4	-
			0	1	0	4
		0	0	1	4	-

GC-2014ATF/SPL Standard attachments: Dual INJ, SPL-INJ, dual FID, TCD

Single FID	ECD	FPD	FTD-2014c	FTD-2014	Temperature Control Port (*)	Additional Temperature Control	
2	0	0	0	0	6	Required	
1	1	0	0	0	6	Required	
	0	1	0	0	6	Required	
			0	0	5	Required	
0	2	0	0	0	6	Required	
	1	1	0	0	6	Required	
			0	0	0	5	Required
	0	1	0	0	0	5	Required
			0	1	0	5	Required
		0	0	1	5	Required	

GC-2014AT Standard attachments: Dual INJ, TCD

Single FID	ECD	FPD	FTD-2014c	FTD-2014	Temperature Control Port (*)	Additional Temperature Control	
2	0	0	0	0	5	Required	
1	1	0	0	0	5	Required	
	0	1	0	0	5	Required	
			0	1	0	5	Required
				0	1	5	Required
				0	4	-	
0	2	0	0	0	5	Required	
	1	1	0	0	5	Required	
			0	1	0	5	Required
				0	1	5	Required
	0				0	4	-
			1	0	1	5	Required
					0	4	-
		0	1	0	4	-	
			0	1	4	-	

(*) The upper limit value of the temperature control port in a standard specification is "4." When "5" or higher, an additional temperature control unit (221-48458-41) must be procured.

GC-2014A Standard attachment: Dual INJ

Single FID	ECD	FPD	FTD-2014c	FTD-2014	Temperature Control Port (*)	Additional Temperature Control		
4	0	0	0	0	5	Required		
3	1	0	0	0	5	Required		
	0	0	0	0	4	-		
2	2	0	0	0	5	Required		
	1	0	0	0	4	-		
	0	1	0	0	0	4	-	
		0	1	0	0	4	-	
	0	0	1	0	1	4	-	
1	3	0	0	0	5	Required		
	2	0	0	0	4	-		
	1	1	1	0	0	4	-	
		0	0	1	0	4	-	
	0	0	1	0	1	4	-	
				0	0	1	4	-
		0	0	1	0	3	-	
				0	1	0	3	-
		0	4	0	0	0	5	Required
			3	0	0	0	4	-
	2		1	0	0	0	4	-
			0	1	0	0	4	-
1	0		1	0	1	4	-	
				0	0	1	4	-
	0		0	1	0	3	-	
				0	1	0	3	-
	0		2	0	0	0	3	-
1				1	0	3	-	
0		0	1	1	3	-		
			0	0	1	2	-	
0		0	1	0	2	-		

(*) The upper limit value of the temperature control port in a standard specification is "4." When "5" or higher, an additional temperature control unit (221-48458-41) must be procured.

GC-2014AFsc

Standard attachments: SPL, single FID

Single FID	ECD	FPD	FTD-2014c	FTD-2014	Temperature Control Port (*)	Additional Temperature Control						
3	0	0	0	0	5	Required						
2	1	0	0	0	5	Required						
	0	0	0	0	4	-						
1	2	0	0	0	5	Required						
	1	0	0	0	4	-						
	0	1	0	0	0	4	-					
		0	1	0	0	4	-					
		0	0	1	0	4	-					
0	3	0	0	0	5	Required						
							2	0	0	0	4	-
	0	1	1	0	4	-						
							0	1	0	0	4	-
	0	1	1	0	4	-						
							0	1	0	1	4	-
	0	0	1	0	3	-						
							0	1	1	0	3	-
	0	0	1	1	3	-						

(*) The upper limit value of the temperature control port in a standard specification is "4." When "5" or higher, an additional temperature control unit (221-48458-41) must be procured.

GC-2014Asc

Standard attachment: SPL

Single FID	ECD	FPD	FTD-2014c	FTD-2014	Temperature Control Port (*)	Additional Temperature Control		
4	0	0	0	0	5	Required		
3	1	0	0	0	5	Required		
	0	0	0	0	4	-		
2	2	0	0	0	5	Required		
	1	0	0	0	4	-		
	0	1	0	0	0	4	-	
		0	1	0	0	4	-	
	0	0	1	0	0	4	-	
1	3	0	0	0	5	Required		
	2	0	0	0	4	-		
	1	1	1	0	0	4	-	
		0	0	1	0	4	-	
	0	0	1	0	1	4	-	
				0	0	1	4	-
		0	0	1	0	0	4	-
		0	0	1	0	1	4	-
		0	0	0	0	0	3	-
		0	0	0	0	0	3	-
	0	4	0	0	0	5	Required	
3		0	0	0	4	-		
2		1	1	0	0	4	-	
			0	1	0	4	-	
		0	0	1	0	1	4	-
1		0	1	1	0	4	-	
				0	1	4	-	
		0	0	0	0	3	-	
		0	0	1	0	3	-	
		0	0	0	1	3	-	
0		2	2	0	0	3	-	
			1	1	0	3	-	
		0	1	0	1	1	3	-
	0		1	0	0	2	-	
	0		1	0	0	2	-	
0	0	0	1	2	-			

(*) The upper limit value of the temperature control port in a standard specification is "4." When "5" or higher, an additional temperature control unit (221-48458-41) must be procured.

GC-2014 Additional Sample Injection Unit Selection Guide

When a sample injection unit is added on, the number of temperature control ports used increases by one.

- Additional sample injection units for the GC-2014ATF/SPL
WBI-2014(AMC)
Single packed INJ
Direct INJ (for TurboMatrix HS): Installed on left side (SPL must be moved to right side.)

1 of above units

Note: Units that use an AFC (i.e. SPL-2014 or WBI-2014) cannot be added on.

- Additional sample injection units for the GC-2014ATF
Single packed INJ
Direct INJ (for TurboMatrix HS): Installed on left side

For possible combinations of two units, see Table 1 at the bottom of the next page.

Note: When an SPL is added on, conditioning is required after installation. It is recommended to choose a GC model with the SPL mounted at the time of purchase. Before shipment from the factory, the GC-2014ATF/SPL is already mounted with the SPL and has already undergone noise and other inspections.

- Additional sample injection units for the GC-2014AF/SPL
Single packed INJ
Direct INJ (for TurboMatrix HS): Installed on left side (SPL must be moved to right side.)

One of above units

Note: Units that use an AFC (i.e. SPL-2014 or WBI-2014) cannot be added on.

- Additional sample injection units for the GC-2014AF
Single packed INJ
Direct INJ (for TurboMatrix HS): Installed on left side

For possible combinations of two units, see Table 1 at the bottom of the next page.

Note: When an SPL is added on, conditioning is required after installation. It is recommended to choose a GC model with the SPL mounted at the time of purchase. Before shipment from the factory, the GC-2014AF/SPL is already mounted with the SPL and has already undergone noise and other inspections.

GC-2014 Additional Sample Injection Unit Selection Guide

- Additional sample injection units for the GC-2014AT and GC-2014A

Single packed INJ

Direct INJ (for TurboMatrix HS): Installed on left side

For possible combinations of two units, see Table 1 at the bottom of the page.

- Additional sample injection units for the GC-2014AFsc and GC-2014Asc

WBI-2014 (AMC): Can be installed but WBI-2010 is recommended.

Single packed INJ

Direct INJ (for TurboMatrix HS): Installed on left side

One of above units

Note: The dual packed INJ cannot be added on.

Table 1: Possible Combinations of Two Units on GC-2014A/AT/AF/ATF

	SPL	WBI	WBI (AMC)	SINJ
SPL	×	×	○	○
WBI	×	×	○	○
WBI (AMC)	○	○	○	○
SINJ	○	○	○	○
INJ,HS	○	○	○	○

SPL: SPL-2014

WBI: WBI-2014

WBI(AMC): WBI-2014(AMC)

SINJ: Single packed INJ

INJ, HS: Direct INJ (for TurboMatrix HS)

Note) Only one INJ or HS unit can be added on to the left side of a dual packed INJ.

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