

Gas Chromatograph Mass Spectrometer

GCMS-TQ NX Series

Instruction Manual

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

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Introduction

Read this Instruction Manual thoroughly before using the product.

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

This product includes the following instruction manuals.

1	Installation Manual	P/N S225-38064	Used by the Shimadzu service personnel to install the product.
2	Hydrogen Carrier Gas Safety	P/N S225-38068	Indicates important precautions for using hydrogen carrier gas safely.

Keep this manual for future reference.

This document assumes that the user has a working knowledge of Windows. There are references to functions and terminology specific to Windows; refer to a Windows user manual as necessary. Users who have never worked with Windows should read a Windows user manual before using this document.

PDF versions of this manual and the operation guide, etc. should have been placed in the folder "GCMSsolution\Manual" on your computer. Please refer to them as necessary.

IMPORTANT

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

Notice

- Information in this manual is subject to change without notice and does not represent a commitment on the part of the vendor.
- Any errors or omissions which may have occurred in this manual despite the utmost care taken in its production will be corrected as soon as possible, although not necessarily immediately after detection.
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- GCMS-TQ, GCMSsolution, and ClickTek are registered trademarks of Shimadzu Corporation in the United States and Europe (Office for Harmonization in the Internal Market).

Indications Used in This Manual

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



Warning

Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or possibly death.



Caution

Indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injury or equipment damage.



Note

Emphasizes additional information that is provided to ensure the proper use of this product.



Indicates items displayed on the screen, such as buttons, menu selections, settings, windows, and icons.
Example: Click [OK].

Safety Instructions

The gas chromatograph mass spectrometer is an analytical instrument used for qualitative and quantitative analyses.

To ensure safe product operation, read these important safety instructions carefully before use and follow all DANGER, WARNING and CAUTION instructions given in this section.

Product Applications



Warning

Safety regulations and standards

For notifications on installation and safety controls, follow the necessary procedures in compliance with the laws and regulations applicable in the country where the product is used.

Installation Site



Warning

- The solvents used with the gas chromatograph mass spectrometer are flammable and toxic. Install the instrument in a well-ventilated room. Otherwise, solvent vapors could cause poisoning, or ignite and cause a fire.
- Do not install this instrument in a location with flammable or explosive gases or liquids. Because this product is not designed to be explosion proof, doing so could cause a fire or explosion.



Warning

Do not place flammable materials near the column oven exhaust at the back of the instrument, as they could ignite and cause a fire.



Warning

The lab table or other surface on which this instrument is installed should be level, stable, and sufficiently strong to support the instrument's weight. Otherwise, the unit could tip over or fall off the surface.



Warning

- Do not install the instrument in a location with corrosive gases, gases containing organic solvents, halogen compounds, or siloxanes, oil mist, or high levels of debris/dust.
The instrument performance could be affected and its service life shortened.
- Do not operate the instrument in an environment where condensation may form.
Doing so could cause it to malfunction.



Caution

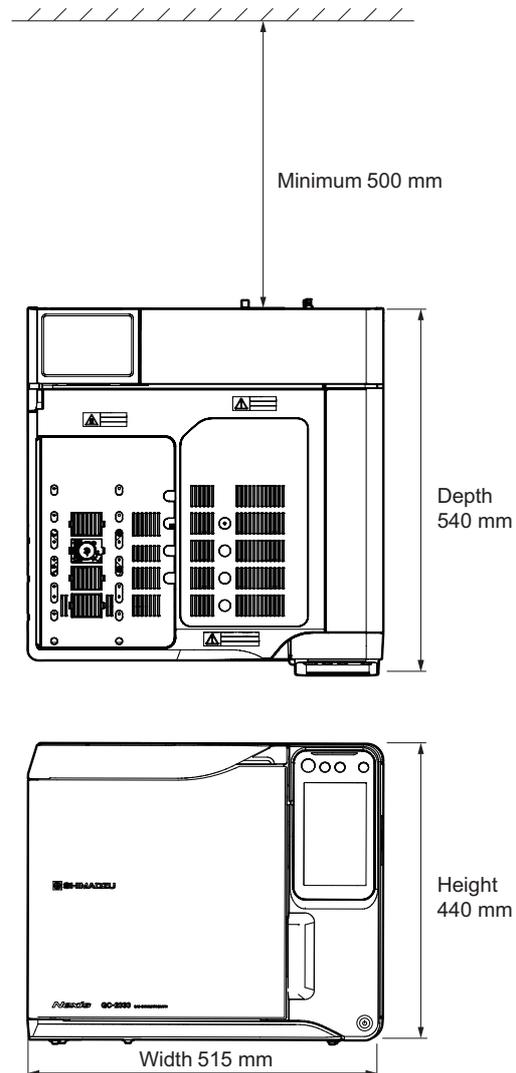
The power switches are located on the back of the instrument, toward the left, and on the right side of the instrument. If there is a wall or other obstruction to the left of the instrument, leave at least 30 cm of space between the wall and instrument to allow switching the power switch OFF. If there is a wall or other obstruction to the right of the instrument, leave at least 10 cm.

Installation clearances



Warning

Hot air is exhausted from the back vent. Do not place flammable materials near the exhaust.
Refer to [Appendix A.3.1 "Installation Examples"](#).



Rear clearance

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

- Do not place any flammable materials behind the unit.
- Allow a clearance of 50 cm or more between the back cover and the wall.*
- Reserve extra space for maintenance and inspection behind the unit.

* When the optional exhaust duct (S221-80955-41) is used, the clearance from the wall can be a minimum of 25 cm.

Installation



Warning

- To ensure safe operation, contact your Shimadzu representative if product installation, adjustment, or re-installation (after the product is moved) is required.
Otherwise, it could cause injury or instrument failure. It is also important for ensuring that the instrument functions in a stable manner.
- Implement measures to ensure that the instrument does not fall over in the event of an earthquake.
If the instrument falls over, it could cause injury.



Caution

The MS unit weighs about 70 kg. The GC unit weighs about 40 kg.
Use three people to lift and move the MS unit. Use two people to lift and move the GC unit.
Be careful not to pinch fingers when setting the instrument down.

Power Supply

Power Requirements

For 100 V - 115 V Type

AC Single Phase, Frequency 50/60 Hz

GC:	1800 VA
MS:	1000 VA
PC (including CRT):	See PC manual.
Printer:	See printer manual.
Installation Category:	Overvoltage Category II (IEC)
Protection Class:	Class I (IEC)

For 220 V - 240 V Type

AC Single Phase, Frequency 50/60 Hz

GC:	2600 VA
MS:	1000 VA
PC (including CRT):	See PC manual.
Printer:	See printer manual.
Installation Category:	Overvoltage Category II (IEC)
Protection Class:	Class I (IEC)

**Warning**

Use a power supply with a circuit breaker that is dedicated to this instrument. Avoid sharing a power supply with other instruments. Do not use power cords other than those supplied with the instrument, as this may cause fire or electric shock.

* Please note that additional options will increase the required current capacity.

**Warning**

- Ground the instrument. Grounding is necessary to prevent electric shock in the event of an accident or electrical short. It is also important for ensuring that the instrument functions in a stable manner.
- Earth resistance should be 100 Ω or less.
- Connect the GC, MS, computer, and optional power supply to an equipotential ground.

**Warning**

- Do not place heavy objects on the power cable, and avoid placing hot items near the cable.
- Do not excessively bend or pull on the power cable. It could be damaged, resulting in fire or electric shock. If the cable becomes damaged, contact your Shimadzu representative.

Ambient Environment

Although this instrument can operate within the temperature range from 15 °C to 35 °C, and humidity range from 5 % to 90 %, it is recommended to use the instrument within the ranges described below to maintain performance.

- Temperature range Constant temperature from 18 °C to 28 °C
- Humidity range 40 % to 70 %

(Be sure to avoid dew condensation)

Altitude: 2000 m max.

Pollution degree 2 (IEC)

Indoor use

**Note**

Choose an installation site with minimal detrimental factors such as dust, vibration, ambient noise, corrosive gas, and magnetic fields. To maintain good performance, note the following directions.

1. Minimize temperature fluctuation during use.
2. Avoid exposure to hot or cold air.
3. Avoid exposure to direct sunlight.



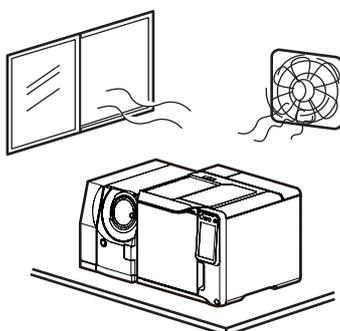
Note

This instrument can operate within the running warranty range, extensive operation beyond the specification warranty range may result in problems such as shortening the service life of the instrument.



Warning

Ventilate the room where the instrument is installed.
Make sure that the ventilation system is operating properly through daily inspections.



Gases

Carrier gas: Helium

Supply pressure: 300 - 980 kPa

Purity: 99.995 % or greater and oxygen O₂ < 3 ppmV

- Some optional accessories may require a gas other than the one specified above. Consult the user manual accompanying the accessory for more information.
- Some applications, such as agrochemical analysis, may require helium of a higher purity (99.999 - 99.9999 %).
- The pressure and flow rate setting range on the GC varies according to the supply pressure. Normally a supply pressure of 700 - 800 kPa is necessary.

CID gas: Argon

Supply pressure: 350 - 450 kPa

Purity: 99.99 % or greater

* When the supply pressure is unmaintainable to 450 kPa or less depending on the installation environment, add an optional regulator (S225-22680-41). The needed supply pressure range becomes 500 to 800 kPa.



Note

Helium of at least the purity indicated above must be supplied as the carrier gas through the supplied tubing.

Argon of at least the purity indicated above must be supplied as the CID gas through the supplied tubing.

If a carrier gas of lesser purity is used, performance may be compromised. Refer to [2.3 "Gas Requirements"](#) for more information.

Electro-magnetic fields and power supply noise

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

Do not use a cell phone near the unit.

Operation



Warning

Always wear clean gloves and safety glasses or goggles when handling solvents. If solvent gets into the eyes, blindness could result. Should solvent get into the eyes, immediately flush with large amounts of water and seek medical attention.



Warning

Do not place solvents near PCs, printers or other instruments, as fire or instrument damage could result.



Warning

Do not use flammable sprays (hair sprays, insecticide sprays, etc.) near this instrument, as they could ignite and cause a fire.



Warning

Safety glasses should be worn during sample injection to prevent the dangers associated with mechanical injury from the syringe or solvents splashing into the eyes. The injection port is typically under a pressure of a few hundred kPa to enable carrier gas to flow into the column. As a result, when a liquid sample is injected with a syringe, the plunger may be discharged from the syringe barrel, or the flow may be reversed and the sample ejected. Furthermore, when a large sample volumes are injected, the septum deteriorates more quickly and the sample may be ejected from the injection port.



Caution

If water, organic solvent, or other liquid is spilled on the instrument, wipe it off immediately.
Not doing so may result in instrument failure.

Inspection and Maintenance



Warning

To prevent injuries and instrument damage, do not disassemble or modify this instrument, or perform internal repairs.



Warning

Never remove the main unit cover.
Doing so could cause injury or instrument failure.
The main unit cover does not need to be removed for normal maintenance inspections or servicing. If repairs requiring the removal of the main unit cover are necessary, contact your Shimadzu representative.



Warning

If the power cable becomes dusty, remove the plug from the outlet and wipe away the dust with a dry cloth. Fire may result if dust is allowed to accumulate.



Warning

- Disconnect the power cord from the power outlet before inspecting or servicing the instrument or replacing parts.
Not doing so may result in an accident caused by electric shock or short circuit.
- Replace parts only with those specified in the instruction manual.
Using any other parts could result in part damage that prevents the instrument from functioning properly.

**Note**

To clean the surface of the instrument, use a soft cloth and water or neutral detergent. Wipe dry with a clean cloth.

**Note**

Periodic maintenance of the rotary pump and turbo molecular pump are recommended. Refer to respective manual for the interval.

**Note**

Perform analysis using a quality control (QC) sample periodically to check the performance of the system.

Repair, Disassembly and Modification

**Caution**

- Do not modify or disassemble the instrument without the express approval of an authorized Shimadzu representative.
- Doing so could cause an accident from electric shock or a short circuit. It could also cause injury or instrument failure.

**Caution**

For repairs, contact Shimadzu or your Shimadzu representative.
Not doing so could cause a fire, electrical shock, or injury.

Handling Emergencies

The following measures should be taken in the event of an emergency such as a malfunction of the gas chromatograph mass spectrometer.

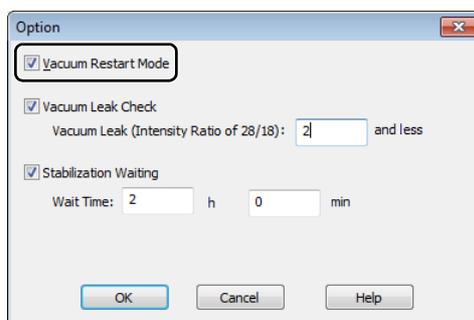
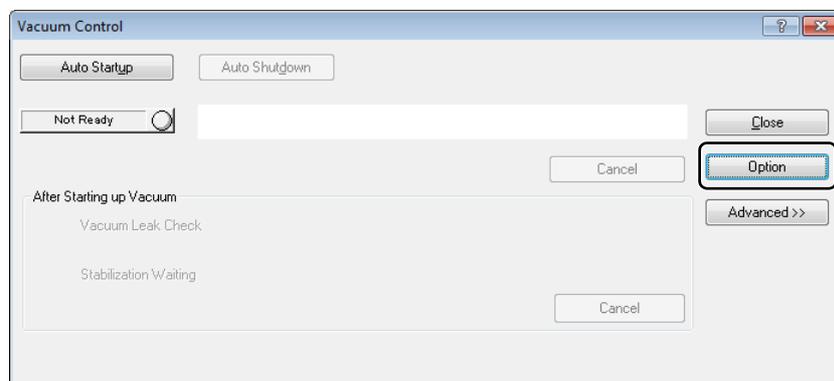
Take adequate precautions and contact your Shimadzu representative as necessary before resuming use of the instrument.

In the event of an emergency...

1. Turn off the gas chromatograph and mass spectrometer.
2. Turn off all accessories.
3. Close the valves in all carrier gas and air lines.
4. Turn off the power supply.
 - If the power cable is attached to a power board, turn off the power board.
 - If the power cable is plugged into an outlet, unplug the cable.

Measures during Power Outage

For power outages of 10 minutes or less, normally no particular procedure is required as long as the [Vacuum Restart Mode] checkbox is selected in the window opened by clicking [Option] in the [Vacuum Control] window. The instrument will automatically restart when the power comes back on.



For long-time power outages, perform the following procedure.

Shutdown Operation for Long-Time Power Outages

1. Turn off the gas chromatograph and mass spectrometer.
2. Turn off all accessories.
3. Close the valves in all carrier gas, CID gas and air lines.
4. Loosen the nut fastening the column on the interface to release the vacuum of the vacuum system.
5. Turn off the power supply.
 - If the power cable is attached to a power board, turn off the power board.
 - If the power cable is plugged into an outlet, unplug the cable.

For power outages while using hydrogen carrier gas, perform the following procedure.

Power Outage Operation While Using Hydrogen Carrier Gas

1. Immediately stop the supply of hydrogen gas.
2. Switch OFF power to the GC and the MS.
3. Open the windows and doors of the room where the instrument is installed to thoroughly ventilate.
4. Confirm that there is no ignition source in the room that could ignite the hydrogen gas.
5. Wait until the temperature of all components of this product has fallen to the ambient temperature (approximately 1 hour).
6. Open the front door of the GC and loosen the nut of the interface to return the interior of the MS to atmospheric pressure.
7. Confirm that the knob on the front door of the MS is completely loose.
8. Wait until all hydrogen gas is completely expelled (approximately 30 minutes).
9. After confirming the items in "Precautions in Installation" and "Precautions in Operation and Running of the Instrument", use the standard startup procedure to start the GC and MS.

Warning Labels



Indicates danger from high voltage.



Indicates danger from high temperature components.



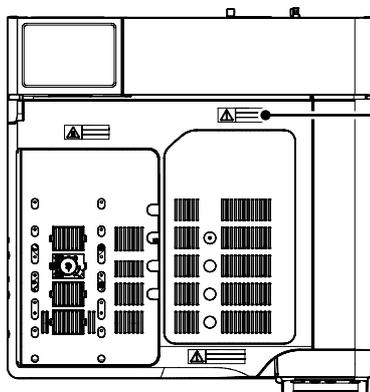
Refer to the user manual for details about handling or operation.



Caution

CAUTION FLAME PRESENT

Do NOT put objects on INJ/DET cover. May cause fire.



P/N: S221-81352



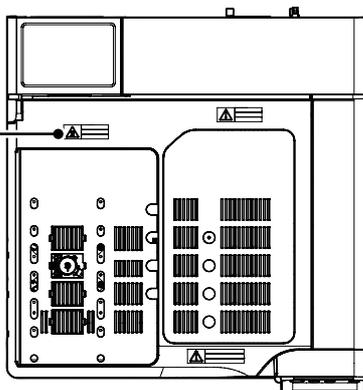


Warning

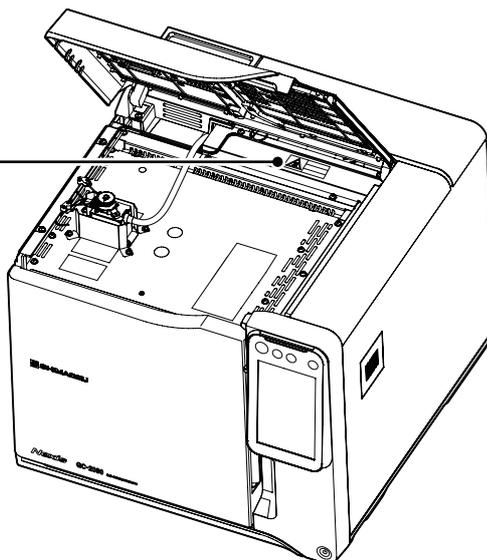
HIGH TEMPERATURE

Do NOT touch injection port, detector and INJ/DET cover during analysis.
May cause burn.

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P/N: S221-80981

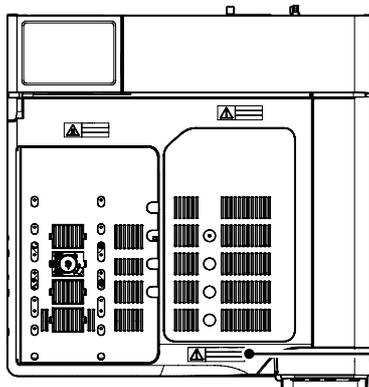




Warning

WARNING WHEN USING HYDROGEN

Close all unused valves for hydrogen pressure control and seal the column fittings. If hydrogen fills the oven, it may cause explosion.



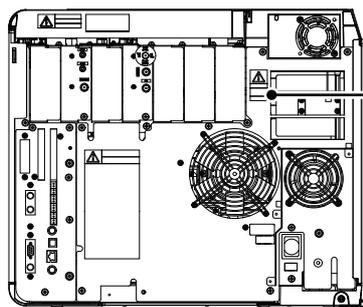
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Warning

HOT AIR EXHAUST

Hot air is exhausted from the openings and the rear. Hot air may cause burn and fire. If hot air blows directly on combustibles, that may cause ignition and fire.



P/N: S221-80982



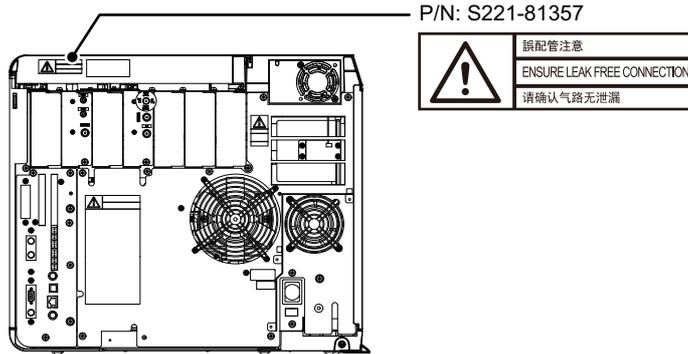
Allow a clearance of 50 cm or more between the back cover and the wall.



Warning

ENSURE LEAK FREE CONNECTION

Install the piping correctly. Wrong tubing may cause release of large amount of gases. We designed the joint of air inlet to be right-handed screw and the joint of hydrogen inlet to be left-handed screw to prevent incorrect piping.

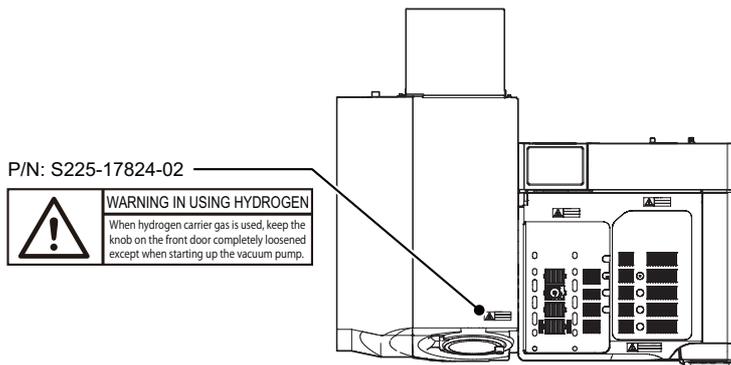


Warning

WARNING IN USING HYDROGEN

If hydrogen gas accumulates inside the vacuum chamber, it could potentially ignite.

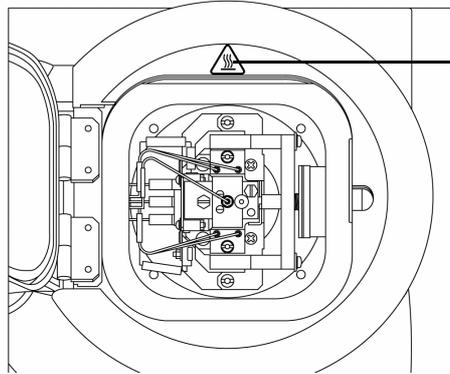
When hydrogen carrier gas is used, keep the knob on the front door completely loosened except when starting up the vacuum pump.





Caution

HIGH TEMPERATURE
Avoid contact ion source when hot.



P/N: S225-20199





Warning

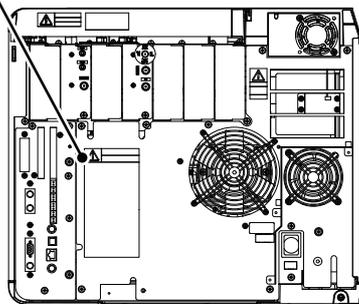
WARNINGS IN USING HYDROGEN

When hydrogen gas is in use, care should be exercised in order to prevent accident.

- Connect gas lines correctly.
- When the device is not in use, the main valve of the hydrogen gas cylinder or generator must be closed.
- The flow line for hydrogen gas should be checked for leakage whenever it is used.
- The room in which the device is used should be well ventilated. Do not use any spark producing instrument, except for analysis, near the device.
- If there is any abnormality, turn off the device and close the main valve of the hydrogen gas cylinder or generator.

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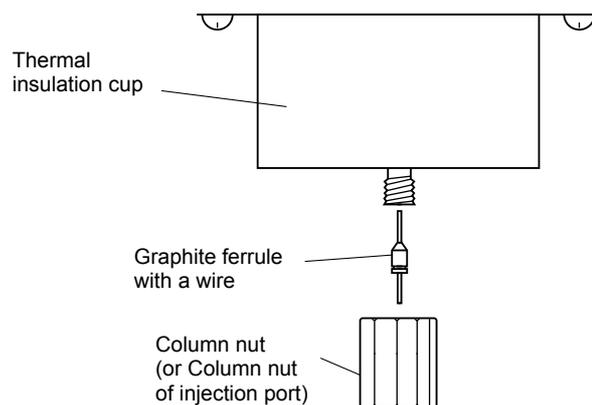
	水素ガス使用上の注意 WARNINGS IN USING HYDROGEN 谨慎使用氢气
	水素ガスが大量に漏れた場合、爆発する可能性があります。 ・配管を間違わないようにして接続してください。 ・使用しない時はガスの元栓を閉じてください。 ・使用の都度、ガス漏れがないことを点検してください。 ・換気を十分に行い、不必要に火気を使用しないでください。 ・異常を感じた場合、装置の電源を落として、ガスの元栓を閉めてください。
When hydrogen gas is in use, care should be exercised in order to prevent accident. ・ Connect gas lines correctly. ・ When the device is not in use, the main valve of the hydrogen gas cylinder or generator must be closed. ・ The flow line for hydrogen gas should be checked for leakage whenever it is used. ・ The room in which the device is used should be well ventilated. Do not use any spark producing instrument, except for analysis, near the device. ・ If there is any abnormality, turn off the device and close the main valve of the hydrogen gas cylinder or generator.	
氢气大量泄漏时，可能引发爆炸。 ・ 请正确连接氢气管路。 ・ 不使用仪器时，请关闭氢气瓶总阀门。 ・ 每次使用仪器前，请确认氢气是否泄漏。 ・ 保持实验室通风，禁止使用与分析操作无关的明火。 ・ 发现仪器有异常时，请立即关闭仪器电源，并关闭氢气瓶总阀门。	



**Caution****HYDROGEN GAS HANDLING PRECAUTIONS**

The accumulation of hydrogen gas inside the column oven can cause an explosion.

Close all hydrogen pressure regulator valves when not in use, and seal the column connection.



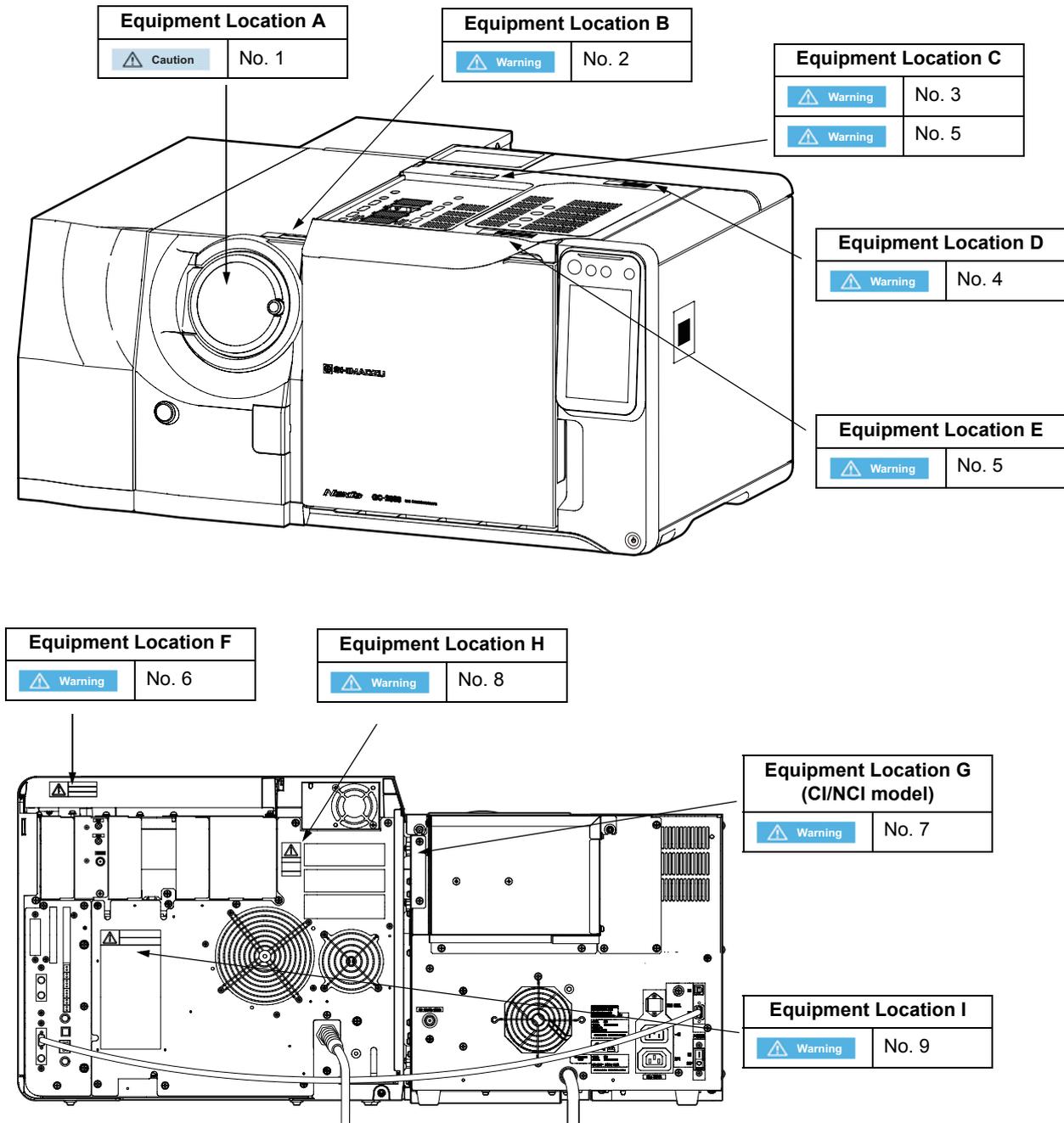
When the detector without any use of hydrogen gas is used.

Residual Risk Information

Residual risk is the risk that could not be eliminated or reduced at the design/manufacturing stage. Check the dangerous locations on the “Residual Risk Map” and implement the protective measures described on the “Residual Risk List”.

Residual Risk Map

The “Equipment Location” and “No.” shown below match those in the “Residual Risk List”. For details, see the “Residual Risk List”.



Residual Risk List

The “No.” and “Equipment Location” shown below match those in the “Residual Risk Map”.

Check the “Residual Risk Map” for the specific “Equipment Location”.

Also, be sure to carefully read and understand the details of the “Reference” section and implement the protective measures.

Preparations

No.	Equipment Location	Details of Danger	Protective Measures Implemented by Equipment User	-	-
1	A	 Caution Burn from hot ion source	Perform maintenance after the temperature has sufficiently cooled	Reference	Warning Labels
				Work	Maintenance
				Qualifications and Training	Person who has taken the operation training lecture
2	B	 Warning Explosion due to hydrogen gas accumulation	Keep the knob on the front door loosened except when the vacuum pump operates	Reference	Warning Labels
				Work	When using hydrogen gas, when the pump is stopped
				Qualifications and Training	Person who has taken the operation training lecture
3	C	 Warning Burn from hot injection port	Do not touch the injection port or detector during analysis while the instrument's temperature is hot. Perform maintenance after the temperature has sufficiently cooled.	Reference	Warning Labels
				Work	Analysis Maintenance
				Qualifications and Training	Person who has taken the operation training lecture
4	D, unspecified	 Warning Fire from placing objects on the instrument	Do not place objects on the instrument	Reference	Warning Labels
				Work	Normal work
				Qualifications and Training	Person who has taken the operation training lecture
5	E	 Warning Explosion due to hydrogen gas accumulation	If not using hydrogen carrier, set AFC to OFF and close the main valve of the cylinder gas	Reference	Warning Labels
				Work	Normal work
				Qualifications and Training	Person who has taken the operation training lecture
6	F	 Warning Explosion due to filling with hydrogen gas	Avoid erroneous piping.	Reference	Warning Labels
				Operation Category	Usual
				Required Qualification/ Education	Qualified person received training to use the instrument
7	G	 Warning Ignition from reagent gas leak	If using reagent gas on the CI/NCI model, check for gas leaks.	Reference	CI/NCI instruction manual
				Work	Normal work
				Qualifications and Training	Person who has taken the operation training lecture

9	I	 Warning Explosion due to hydrogen gas accumulation	For details about the precautions when handling hydrogen gas, see the instruction manual	Reference	For Safe Use of Hydrogen Carrier Gas
				Work	Normal work
				Qualifications and Training	Person who has taken the operation training lecture

Operation

No.	Equipment Location	Details of Danger	Protective Measures Implemented by Equipment User	-	-
8	H	 Warning Combustion of flammable objects from hot air	Do not place flammable objects near the hot air exhaust	Reference	Warning Labels
				Work	Analysis
				Qualifications and Training	Person who has taken the operation training lecture

High-Pressure Gas Precautions



Warning

A high-pressure gas cylinder will be used to supply the carrier gas. When handling the gas cylinders, observe the following suggestions.

1. Keep gas cylinders in a well-ventilated area outside of the instrument installation site. Avoid exposure to direct sunlight. Use lines to transport the gas from the cylinders to the instrument. For flammable gases, this precaution is required by law.
2. Do not place the high-pressure gas cylinder in a location where the temperature can exceed 40 °C.
3. Choose an instrument installation site with sufficient ventilation, and include checking for gas leaks with leak detection solution in your daily inspection procedure. Do not smoke or use open flames within 5 m of the instrument when using highly combustible gases, such as acetylene and hydrogen, or potentially combustible gases, such as oxygen and nitrous oxide. Install and maintain effective fire extinguishers.
4. Secure the high-pressure gas cylinder with a cylinder stand or chain, etc., so that it does not fall over.
5. Be sure to use a pressure release valve specified as "not to be used with oil." Also, do not use a pressure release valve having piping, that is in contact with gas, whose inner surface is oily.
6. When finished using the gas, immediately close the main cylinder valve.
7. Verify that the pressure gauges are functional at least once every three months.
8. Warning signs (adhesive aluminum plates: P/N S221-44025-01) are available to indicate hydrogen gas use. Ask your Shimadzu representative for more details. Signs are supplied free of charge to sites in which they are mandatory.

Legal authorization is required to use cylinders with a capacity of 300 m³ or greater.

For Safety Use of Hydrogen Carrier Gas



Warning

Hydrogen gas, which is used as the carrier gas in gas chromatographs, is a dangerous gas that explodes easily. Read safety precautions in "Hydrogen Carrier Gas Safety" thoroughly before using the instrument, and use the product correctly. Be sure to observe the precautions described there. They are important for ensuring safety. Cautions related to hydrogen gas are also listed in the gas chromatograph user manual. Please read these as well.

Hydrogen Gas Properties

Hydrogen is a dangerous gas which can easily explode if handled improperly. When hydrogen is to be used as the carrier gas, be sure to understand the characteristics and proper handling of this gas.

- Colorless, odorless gas
- Wide combustion range, combustible within range of 4 vol% to 75 vol% when mixed with air.
- Ignites with extremely low energy.
- Easily accumulates near the ceiling, as it is lighter than air.
- Quickly mixes with air due to its high diffusion rate.
- Automatically ignites when rapidly expanding.
- The hydrogen flame is invisible, and easily carried by the wind.
- When mixed with a halogen gas such as chlorine, it explodes on direct exposure to sunlight.

Warranty

Shimadzu provides the following warranty for this instrument.

1. Period

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

2. Description

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

3. Limitation of Liability

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

4. Exceptions

Failures caused by the following are excluded from the warranty, even if they occur during the warranty period.

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

Note: Recording media such as floppy disks and CD-ROMs are considered consumable items.

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

After-Sales Service and Availability of Replacement Parts

After-Sales Service

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

Replacement Parts Availability

Replacement parts for this instrument will be available for a period of seven (7) years after the discontinuation of the product. Thereafter, such parts may cease to be available.

Please note that Shimadzu does not manufacture some parts of the instrument. For such parts, we will estimate the volume of part use within the aforementioned period after receiving notification of product discontinuation, and we will stock the part. However, due to incorrect estimates or circumstances under the control of the parts manufacturer, parts not manufactured by Shimadzu may not be available during the 7-year period after discontinuation of the product.

Maintenance Inspections and Service

Routine inspections and periodic inspections and calibrations are required to ensure the instrument performance levels are maintained and correct measurement data is acquired.

- For information regarding routine maintenance inspections and replacing parts, see 3. Maintenance in this manual.
- For periodic inspections and calibration, contact your Shimadzu representative.
- The indicated replacement frequency for regularly replaced parts is a guideline.
The actual replacement period may be shorter, depending on operating environment and frequency of use.

Disposal Precautions

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

Note also that the GC unit contains batteries (location: PCBs). Dispose of the unit appropriately and in accordance with the laws and regulations of the country or region.

Action for Environment (WEEE)

To all users of Shimadzu equipment in the European Union:



WEEE Mark

Equipment marked with this symbol indicates that it was sold on or after 13th August 2005, which means it should not be disposed of with general household waste. Note that our equipment is for industrial/professional use only.

Contact Shimadzu service representative when the equipment has reached the end of its life. They will advise you regarding the equipment take-back.

With your co-operation we are aiming to reduce contamination from waste electronic and electrical equipment and preserve natural resource through and recycling.

Do not hesitate to ask Shimadzu service representative, if you require further information.

Voltage Fluctuation

To all users of Shimadzu equipment in the European Union:

This equipment can only be connected to a supply with the impedance 0.1 ohm or lower. If necessary, determine the impedance in consultation with the supply authority.



Note

If the actual system impedance Z_{act} exceeds 0.1 ohm at the point of interface point on the user's premises, the supply authority may impose restrictions to connection on the use of the equipment.



Note

If the actual system impedance Z_{act} has been declared to, or measured by the user, the user can use the information to assess the equipment's suitability without reference to the supply authority.

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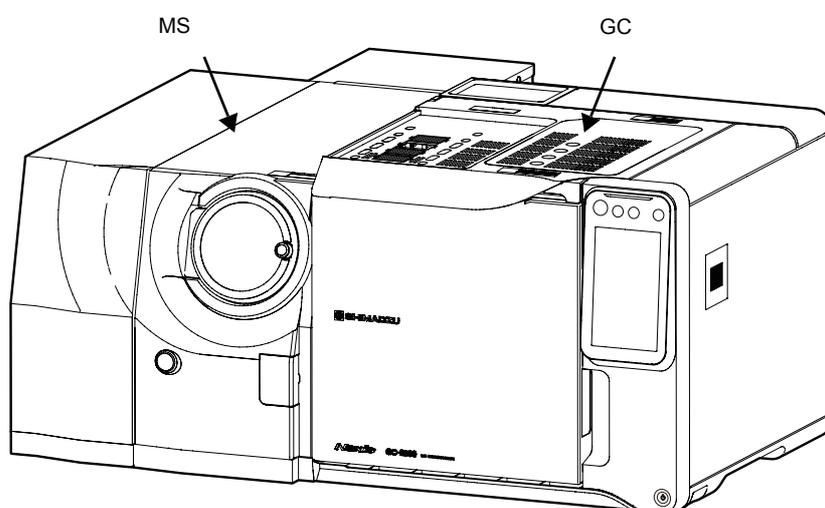
Overview

1.1 GCMS-TQ NX Series

1

This section presents an overview of this instrument.

The instrument is a bench-top type gas chromatograph/mass spectrometer intended for high-precision GC/MS analysis and GC/MS/MS analysis. The instrument enables mass spectrum measurement for qualitative analysis or identification of unknowns and Selected Ion Monitoring (SIM) and MRM measurement for quantitation of trace constituents.



The standard model includes the following components:

- GC-2030 high-performance gas chromatograph
- Vacuum system consisting of the differential turbo molecular pump and the rotary pump
- Vacuum gauge monitoring the pressure in the chamber
- Direct-coupled GC/MS interface
- Electron Impact (EI) ion source with independent temperature control
- Electron energy/current variable dual filament ion source
- Quadrupole mass filters with pre-rods
- Collision Cell
- Electron multiplier detector with conversion dynode
- Power source and instrument control circuit

1.6

GCMSsolution Ver. 4 software is used to control the GCMS-TQ NX series, acquire data and perform post-run analysis.

- Control of the GCMS-TQ NX series and peripherals such as the autosampler
- Automatic adjustment of the instrument by autotuning function
- Creation of analysis methods
- Scan, SIM, Precursor Ion Scan, Product Ion Scan, Neutral Loss Scan, MRM data acquisition
- Qualitative processing which includes the display and processing of mass spectrum as well as library searches
- Quantitative processing which includes the creation of compound tables, calibration curves and concentration calculations
- Customizable reports
- Sequential data acquisition/analysis by batch processing

1.2 Features

This section describes the functions and performance features of this product.

High Sensitivity

The GCMS-TQ NX series with the highest sensitivity in their class significantly broadens the range of applications for GC/MS.

High Throughput

The newly developed collision cell enables ultra fast MRM measurement, the transition speed of which is up to 800 trans/sec.

Maximum scan speed is 20,000 u/sec.

Compact

The GCMS-TQ NX series requires minimal space, even with the optional autosampler installed.

Intuitive Operation

Because the GCMSsolution software is intuitive, even novices to GC/MS can acquire and analyze data, as well as generate reports in the familiar Windows environment. QA/QC functions provide instrument status and data precision management.

Energy-Saving Product

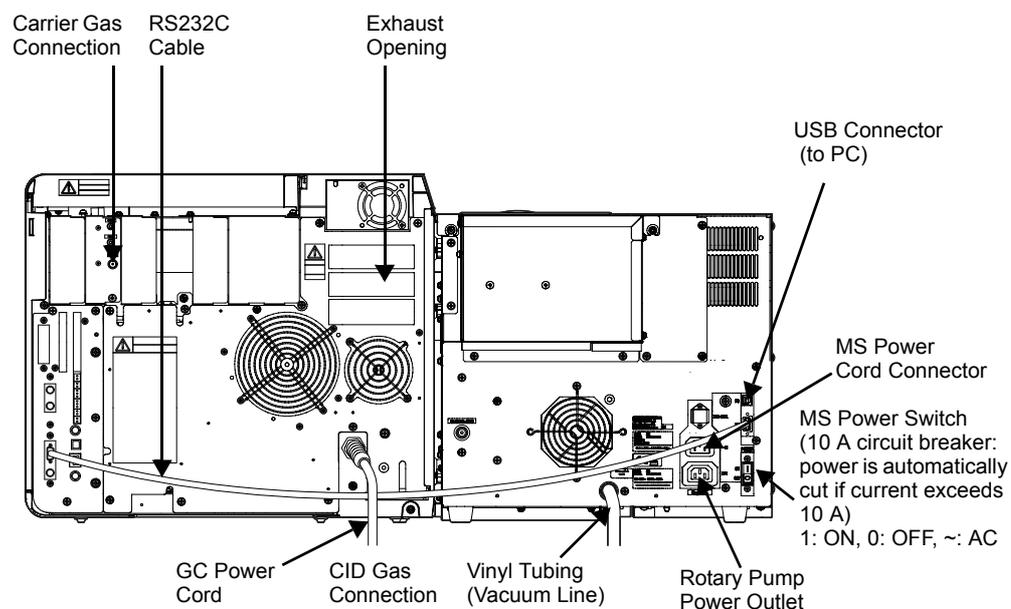
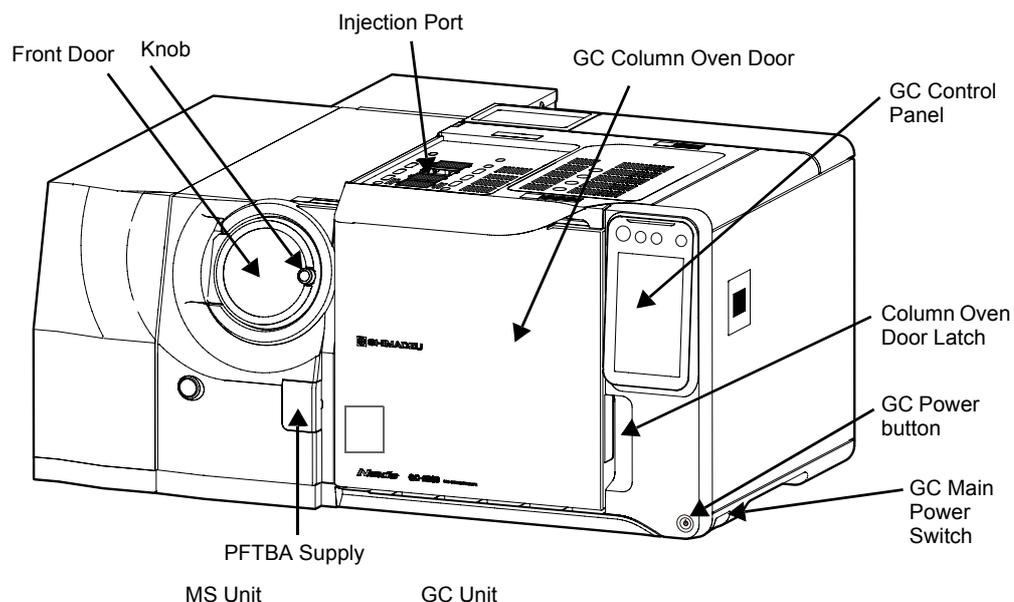
- 1.6.1 **The ecology mode** allows reducing energy consumption during standby operation by 26.2 %, compared to the normal mode. (Analysis days: 20 days/month, Analysis run: 6 hours/day, Standby mode: 18 hours/day. At standby mode, GC oven temperature 100 °C)

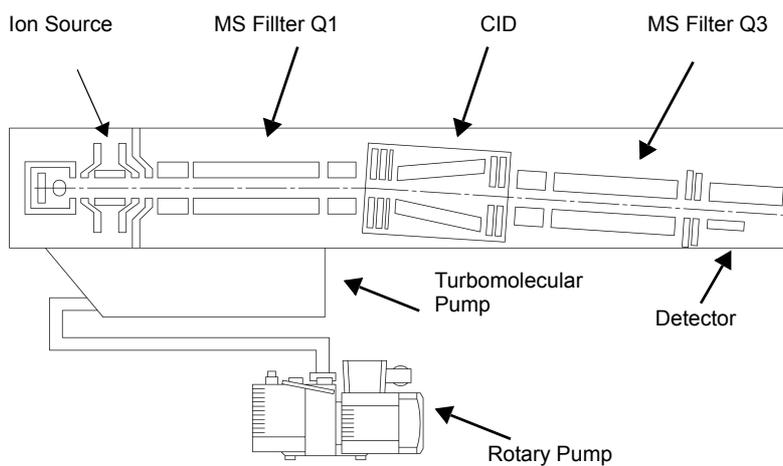
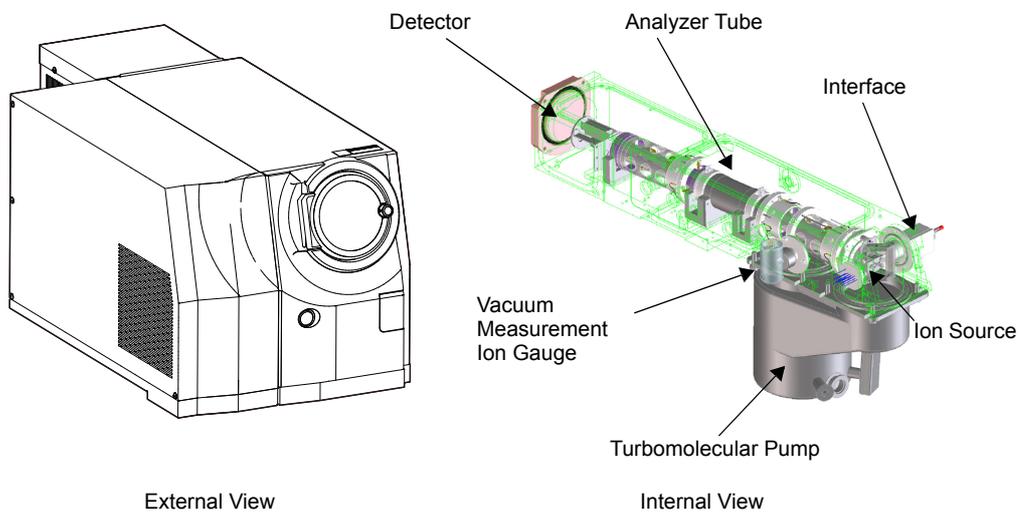


1.3 Component Names

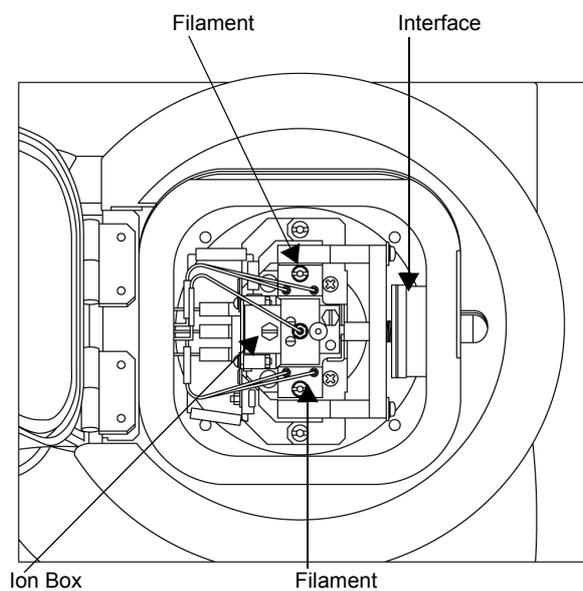
This instrument is composed of a gas chromatograph (GC), mass spectrometer (MS), rotary pump, personal computer system (PC) including monitor and printer, and other options. For the GC-2030 gas chromatography, refer to the GC-2030 instruction manual of included DVD.

1.3.1 GC/MS Analytical System



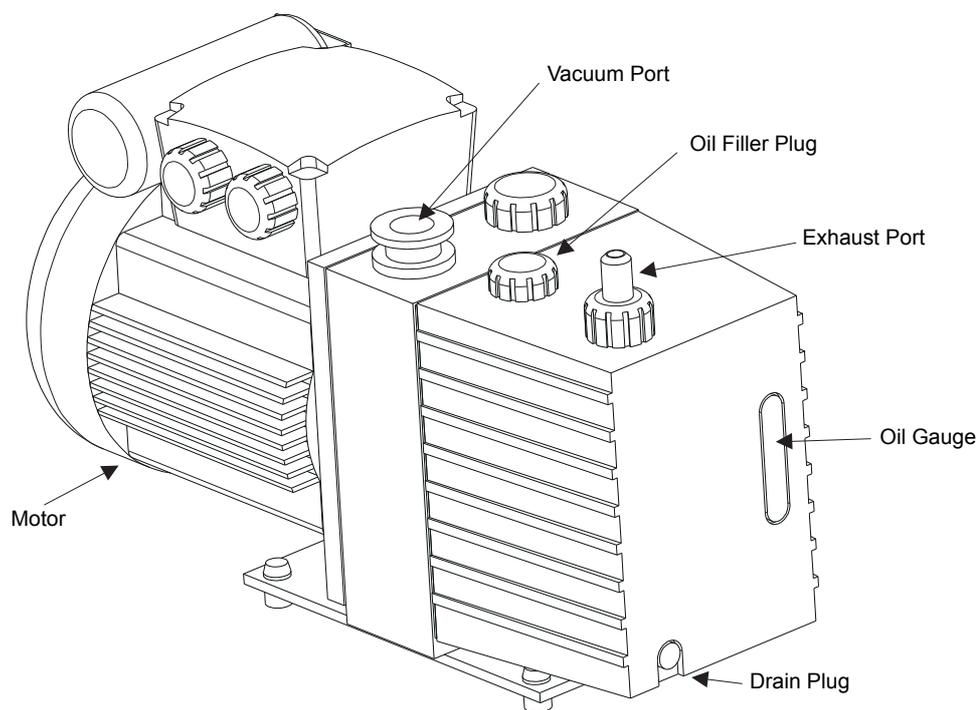


1.3.2 Ion Source



1

1.3.3 Rotary Pump



1.4 Standard Accessories

Gas chromatograph GC-2030 standard accessories are included in the package of the GC-2030 main unit or GC/MS main unit accessories as follows.

Part Name	Part Number	Qty
Cable, USB	S225-21270-41	2
Cable, RS232C	S088-50906-11	1
Interface cover	S225-11674	1
Vinyl tube	S016-31331	1
Hose clamp	S037-61019	2
INJ COVER	S221-43597-01	1
PIPE,AIR IN,CLEANING	S221-72658-91	1
Cover screw	S020-46547	1
Terminal board	S071-36136-01	3

Refer to ["Appendix B.1.3 GCMS Entry Kit \(Option\)"](#) for the consumable parts kit (option).

2

Basic Operation

2.1 Introduction

This section describes the following basic operational procedures of GCMSsolution:

- Instrument Startup and Shutdown
- Daily Startup and Shutdown
- Column Replacement
- System Configuration
- System Check and Tuning

Understanding of these topics is crucial for operating the GCMS-TQ NX series instrument and GCMSsolution software.

2.2 GC Basics

For specific information about the GC-2030 gas chromatograph, refer to the GC-2030 instruction manual. Note that the standard procedures for operating the GC-2030 may differ from those described below.

2.2.1 Instrument Parameters

The instrument parameters, including GC temperatures and pressure parameters, may be set from the PC. The parameters are saved in a file referred to as the "method file". Method files may be stored on the hard drive and the saved parameters loaded into the software. For more information about method files, refer to Section 3.3 "Setting Data Acquisition Methods" in the GCMSsolution Instruction Manual.

GC parameters may be set directly from the control panel or from a method file on the PC.

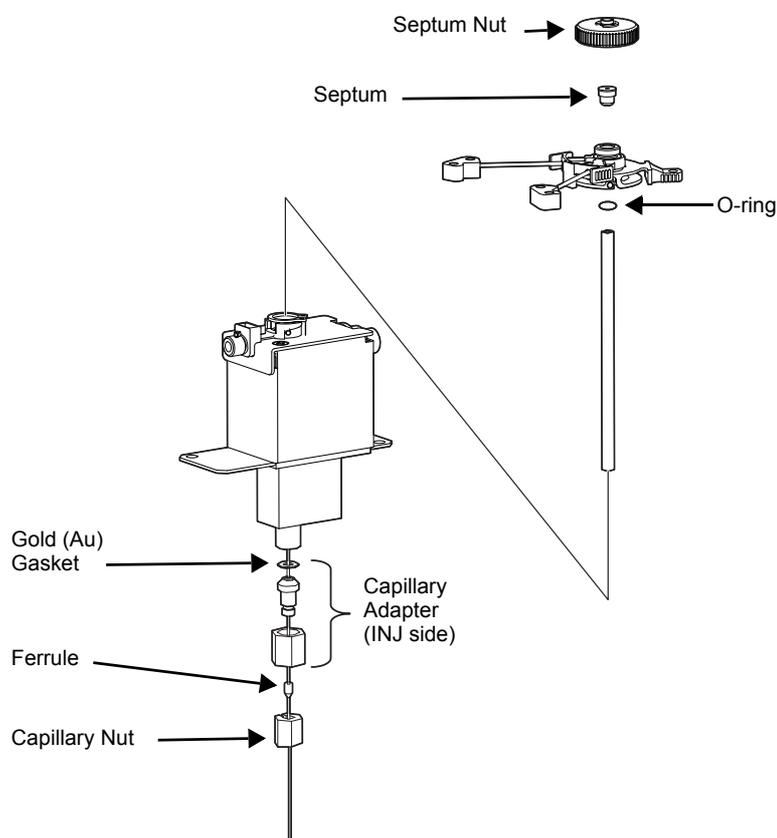
2.2.2 Injection Port Description

With a GC/MS system, air must be prevented from leaking into the carrier gas.

Ensuring carrier gas purity will:

1. Prevent capillary column deterioration.
2. Prolong the life of the MS filament and ion source.
3. Minimize the background noise in the analyzer.

To prevent air from leaking into the carrier gas, the product seals the standard injection port with a gold (Au) gasket, as shown in the diagram below.



2.3 Gas Requirements

This section describes the carrier gas and CID gas used by this system. The specifications presented below must be followed to promote safety and maintain instrument performance.

2.3.1 About Carrier gas

Helium (Supply Pressure: 300 - 980 kPa)

Purity: 99.995 % or greater and oxygen O₂ < 3 ppmV

Some optional accessories may require a gas other than the one specified above. Consult the user manual accompanying the accessory for more information.

- Some applications, such as pesticide analysis, may require helium of a higher purity (99.999 - 99.9999 %).
- The pressure and flow rate setting range on the GC varies according to the supply pressure. Normally a supply pressure of 700 - 800 kPa is necessary.



Note

Any air leakage into the gas supply lines will degrade the purity of the gas and may affect system performance. The helium supplied to the GC must meet or exceed the given purity specification. Using a gas of lesser purity may deteriorate system performance.

2.3.2 About CID gas

Specifications of argon gas

Argon gas is used for the CID gas. Use gas with the specifications indicated below.

Argon Supply pressure: 350 - 450 kPa

Purity: 99.99 % or greater

* When the supply pressure is unmaintainable to 450 kPa or less depending on the installation environment, add an optional regulator (S225-22680-41). The needed supply pressure range becomes 500 to 800 kPa.



Warning

Cautions on the use of high-pressure gas cylinders

If you use a high-pressure gas cylinder as the gas supply source, follow the guidance of the cylinder dealership and others and handle the cylinders in a way that will avoid accidents.

- High-pressure gas cylinders should be sited outdoors at a location where there is a good passage of air and no exposure to direct sunlight, and the gas should be fed indoors through tubing. In the case of liquefied gases in particular, these arrangements are obligatory under law.
- Take care to ensure that high-pressure gas cylinders never reach high temperatures of over 40 °C. Also ensure that there will be no naked flames within 2 m of the cylinders.
- Pay adequate attention to ventilation, and, as a start-of-work inspection, check for gas leakage using, for example, the soapy water test.
- Secure high-pressure gas cylinders, e.g. with rope, so that they cannot be made to fall over/fall off.
- Make sure that you use a pressure reducing valve of the oil prohibition type. In addition, do not use a valve that has oil adhering to the inside faces of the pipes that gas comes into contact with.
- When the use of gas has finished, turn off the main cock on the high-pressure gas cylinder immediately.
- Inspect the pressure gauge to check that it functions correctly at least once every three months.
- Note that permission is required under the law to store more than 300 m³ (standard status) of high-pressure gases like these.

Handle high-pressure gas cylinders correctly in compliance with regulations, the general high pressure gas preservation regulations and laws applicable in your country.

Supplying CID gas

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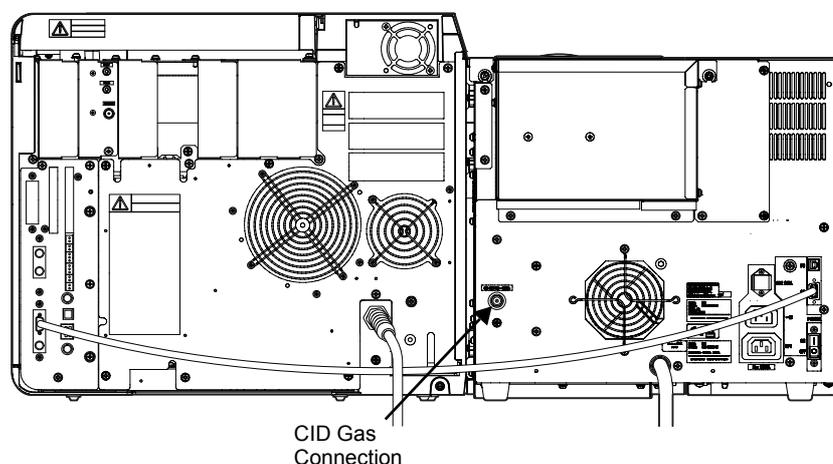
Connect the argon gas tubing to the rear of the instrument.

A Shimadzu M-shaped joint is attached to the rear of the instrument.

The following gas conductor has been prepared for connecting the argon gas cylinder to the GCMS-TQ NX series.

Part Name	Part Number
Pressure Regulator	S221-35999-01
Gas conductor (length: 2.5 m)	S201-48067
Gas conductor (length: 5 m)	S201-48067-05
Gas conductor (length:10 m)	S201-48067-10
Gas conductor (length: 15 m)	S201-48067-15
Extention Gas conductor (length: 2 m)	S221-26171-20

- 2** Open the argon gas main cock in order to supply CID gas.
Check that the supply pressure is 300 - 450 kPa.



2.4 Instrument Startup and Shutdown

This section explains how to start up and shut down an installed instrument.

2.4.1 Starting the Instrument

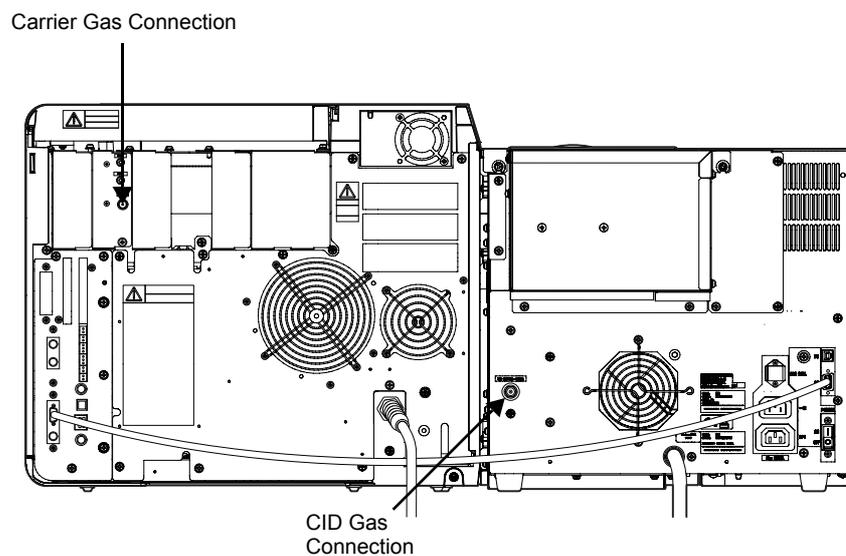
- 1** Turn on the carrier gas.
1.1 Carrier gas

- 1 After verifying that the carrier gas is helium with a purity of at least 99.995 %, make sure that the carrier gas lines are connected as shown in the diagram below.
- 2 Open the main valve of the carrier gas cylinder.
- 3 Ensure that the supply pressure, or the pressure at GC carrier gas inlet, is 300 - 980 kPa (about 3 - 9.8 kgf/cm²).



Note

When changing gas cylinders, make sure that there are no leaks from the connection at the gas cylinder.



1.2 CID gas

- 1 After verifying that the CID gas is argon with a purity of at least 99.99 %, make sure that the CID gas lines are connected as shown in the diagram below.
- 2 Open the main valve of the CID gas cylinder.
- 3 Ensure that the supply pressure is 350 - 450 kPa (about 3.5 - 4.5 kgf/cm²).



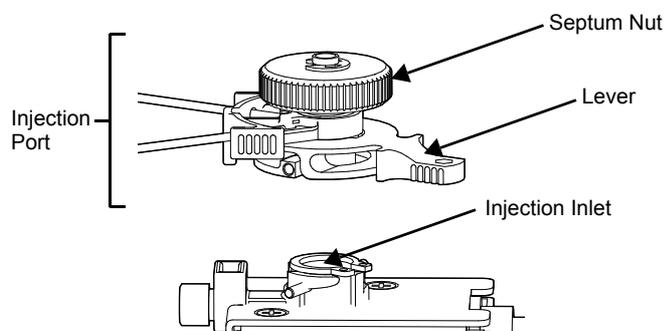
Note

When changing gas cylinders, make sure that there are no leaks from the connection at the gas cylinder.

2 Confirm the insert.

Inspect the injection port glass insert using the following procedure to determine whether the glass insert is appropriate for the application.

- 1 Turn the lever counterclockwise while holding the injection port. Raise the injection port slowly.



Caution

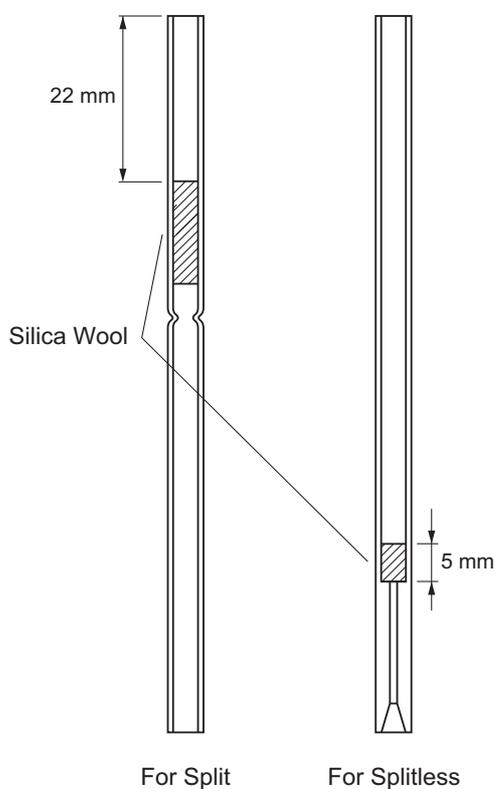
Raise the injection port slowly by left hand to prevent damage of glass insert.



Caution

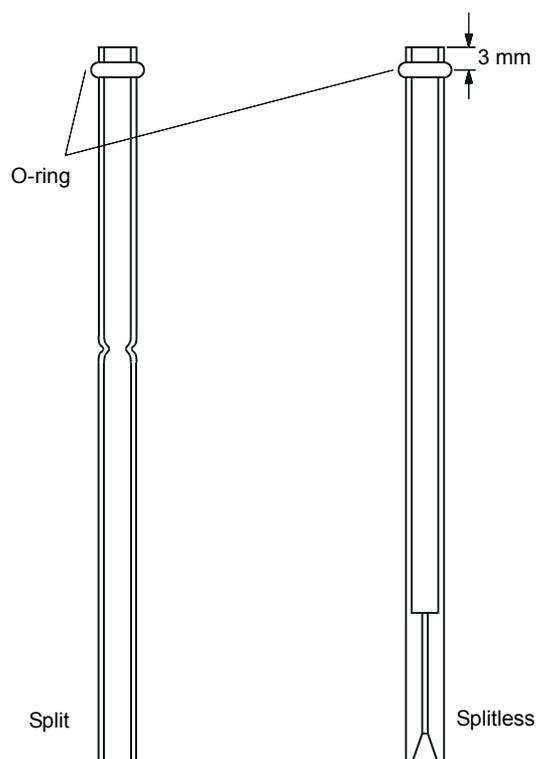
Pay attention not to damage the installation surface of O-ring on the injection inlet.

- 2 Remove the glass insert with forceps, and verify that it is appropriate for the application. Refer to the figure below. Check the silica wool to make sure that it is clean and positioned properly.



- 3 If the silica wool is contaminated, remove the wool, and clean or replace it. Pack an appropriate amount of clean silica wool at the specified location. For split injection this is about 10 mg and for splitless about 4 mg.

- 4 Install the glass insert and O-ring as described below. Refer to the figure of the upper injection port assembly as necessary.
- 1) Temporarily slide the O-ring onto the glass insert so that it is about 4 mm from the top, as shown in the diagram below. Guide the glass insert into the injection port until it touches the bottom. The O-ring will be about 3 mm from the top of the insert when properly positioned.
 - 2) Install the injection port fitting into the groove.
 - 3) Turn the lever clockwise while holding the injection port.



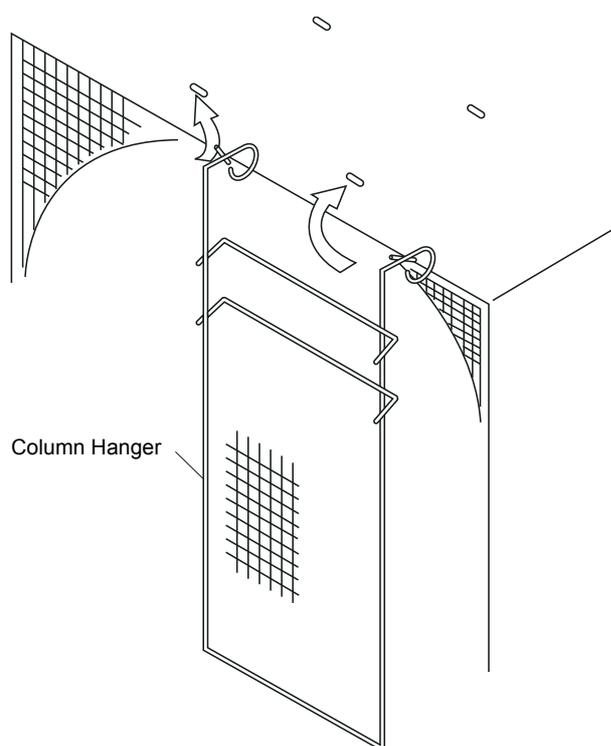
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3 Install the column holder and capillary column.

Attaching the Column Hanger

Attach the column hanger to the connecting holes as follows:

- 1 Squeeze the tabs at the top of the hanger so the ends of the hanger can be inserted into the connecting holes. The standard column mounting position is on the back side of the hanger. When connecting two columns, mount one in front and the other in back.



Connecting the Capillary Column to the Injection Port

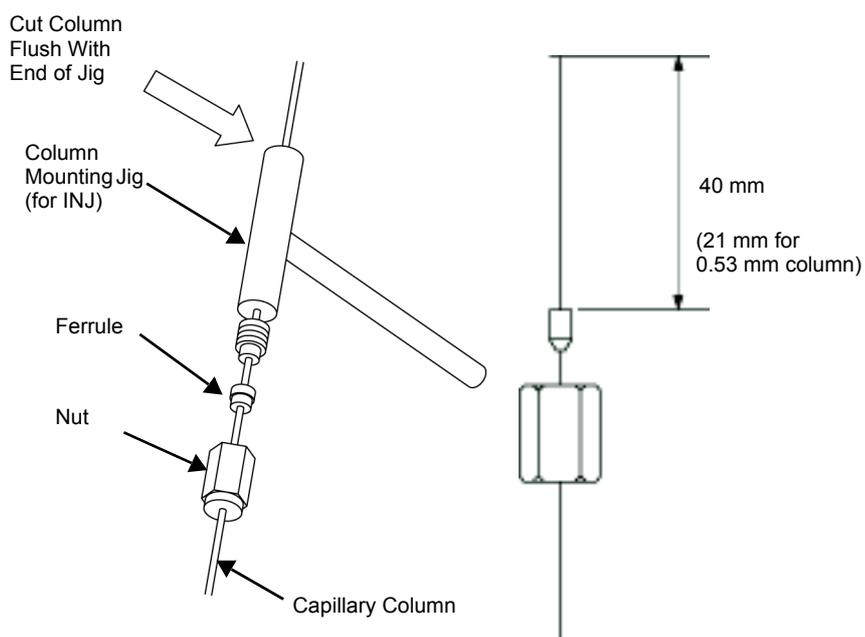


Note

The ClickTek connector, one of the GC-2030 optional parts, cannot be used for the GCMS NX series.

- 1 Push the capillary column through the Vespel ferrule and nut. Refer to Figure "Using the Column Fitting Jig".
- 2 Insert the end of the capillary column into the column fitting jig (P/N S225-01453-95) of Tool Kit (option), so that the capillary column protrudes about 1 cm from the end of the jig as indicated in Figure "Using the Column Fitting Jig". Secure it by tightening the nut. Cut the protruding end of capillary column.
- 3 Mark the capillary column beneath the tightened nut with tape as shown in Figure "Making the Column with Tape".
- 4 Remove the capillary column from the jig without moving the tape, and wipe the capillary column with acetone. Insert the column into the injection port and secure it by hand tightening the nut. If the ferrule is new, use the wrench to turn the nut an additional full turn. If the ferrule has been previously used, use the wrench to tighten the nut by turning it 20 to 40 degrees.
- 5 Remove the tape used to mark the column.

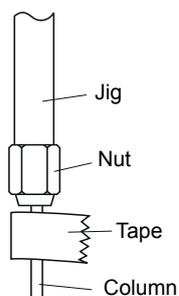
Part Name	Part Number
Vespel ferrule	S670-15003-03 (for 0.25 mm column) (option)
	S670-15003-04 (for 0.32 mm column) (option)
	S670-15003-07 (for 0.53 mm column) (option)
Column mounting jig	S225-01453-95 (option)
Nut	S670-11009 (option)
Capillary column cutter	S221-50595-91 (option)



Using the Column Fitting Jig

Note

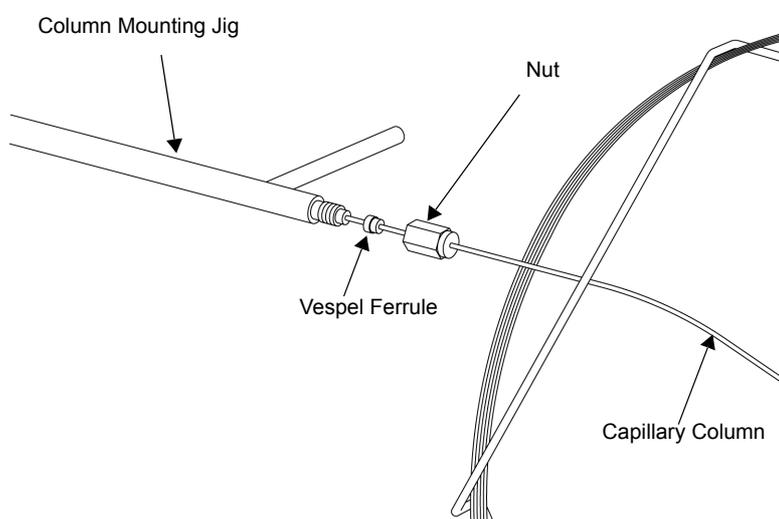
A graphite ferrule is crimped by the jig, so that it is attached to the column, whereas a Vespel ferrule is not crimped and will slide on the column. To ensure proper positioning of the column, mark the column beneath the Vespel ferrule and nut with tape. Ensure that the tape is removed after installation.



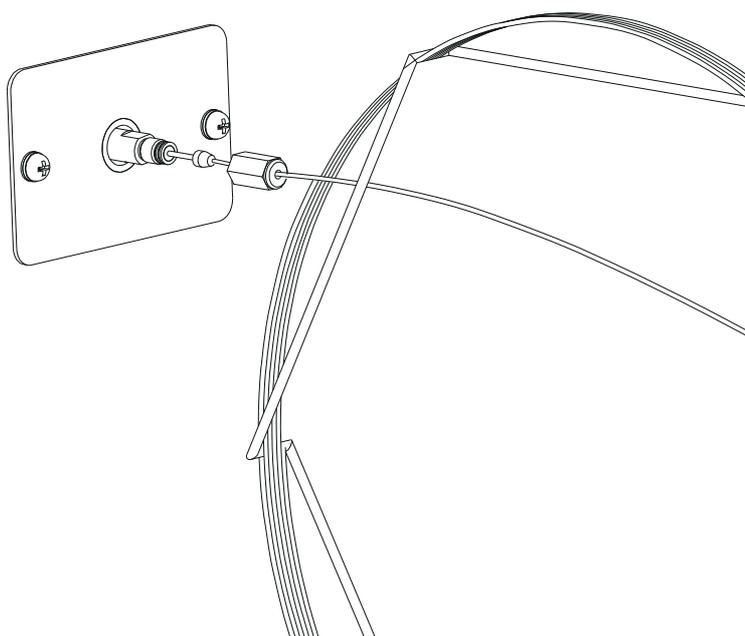
Marking the Column with Tape

Connecting the capillary column to the MS

- 1 Push the capillary column through the Vespel ferrule and nut. Refer to Figure "Using the Column Mounting Jig".
- 2 Insert the end of the capillary column into the column fitting jig (P/N S225-01453-94) of Tool Kit (option), so that the capillary column protrudes about 1 cm from the end of the jig as indicated in Figure "Using the Column Mounting". Secure it by tightening the nut. Cut the protruding end of capillary column.
- 3 Mark the capillary column beneath the tightened nut with tape as shown in Note.
- 4 Remove the capillary column from the jig without moving the tape, and wipe the capillary column with acetone. Insert the column into the MS interface and secure it by hand tightening the nut. If the ferrule is new, use the wrench to turn the nut an additional full turn. If the ferrule has been previously used, use the wrench to tighten the nut by turning it 20 to 40 degrees.
- 5 Remove the tape used to mark the column.



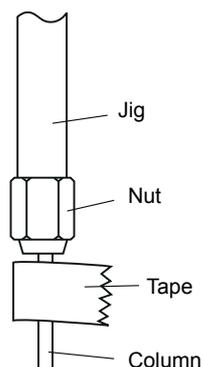
Using the Column Mounting Jig



Connecting the Capillary Column to the MS

 **Note**

To prevent background noise, always use a Vespel ferrule to connect the column to the MS. A graphite ferrule is crimped by the jig, so that it is attached to the column, whereas the Vespel ferrule is not crimped and will slide on the column. To ensure proper positioning of the column, mark the column beneath the Vespel ferrule and nut with tape. Ensure that the tape is removed after installation.

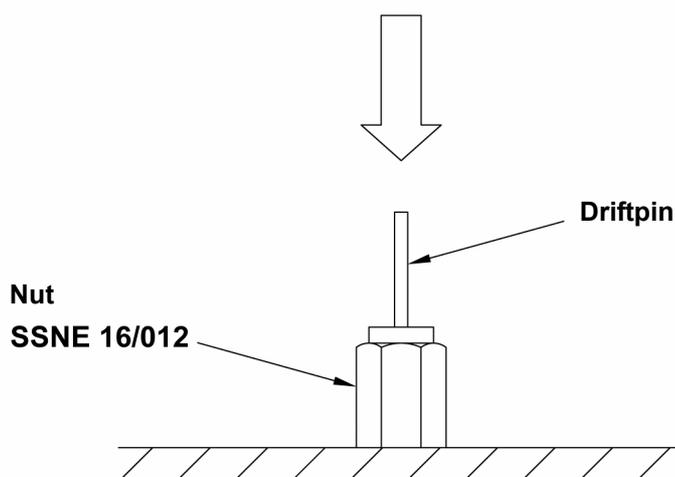


2

 **Note**

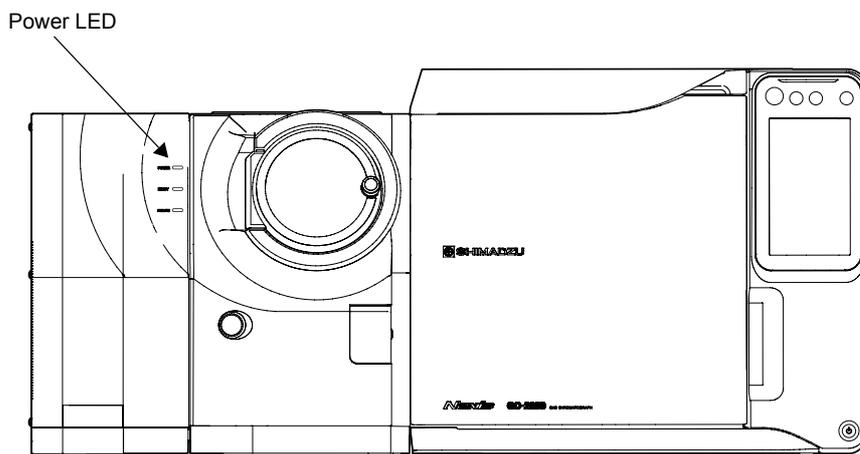
A driftpin is provided in the tool kit (optional) to maintain nuts (SSNE 16/012) used to mount capillary columns.

A driftpin is provided to remove the ferrule lodged inside the mounting nut (SSNE16/012) when the nut is re-used. In order to reduce wear on the interface screw, only reuse it two or three times..

Tap with a Hammer

4 Turn on the instrument.

- 1 Ensure that breaker controlling the instrument power supply is on, and turn on the GC main power switch.
- 2 Turn on the computer, monitor and printer, and start Windows.
- 3 Turn on the MS. The power LED in the upper left corner of the MS will illuminate.

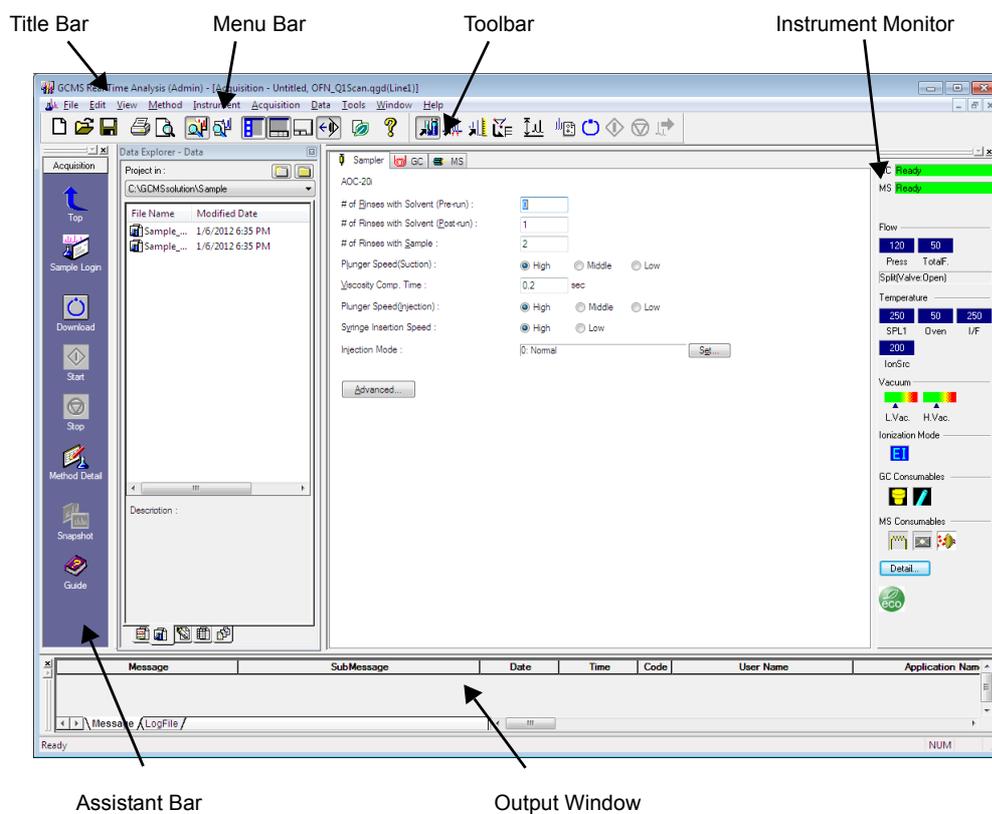


5 Start GCMSsolution.

- 1 Double-click the [GCMS Real Time Analysis] icon. The [Login] dialog box is displayed.



- 2 Enter your user name and password. The first time that the software is accessed, use the default user name "Admin" and leave the password blank.
After entering the necessary information, click the [OK] button.
The [GCMS Real Time Analysis] program starts.



2

6 Start the vacuum system



Caution

If the instrument has been shut down for an extended period of time and the ambient temperature is low, the rotary pump oil may become very viscous. When the oil viscosity is too high and the rotary pump is operated, an excessive load is placed on the rotary pump motor. The breaker for the main power supply (on back of the instrument, see ["1.3.1 GC/MS Analytical System"](#)) may trip, shutting down the instrument.

When the instrument has been turned off and maintained in a cold environment, increase the ambient temperature and start up the instrument after the rotary pump temperature is at least as high as the minimum temperature specification (18 °C).



Caution

Verify that the knob on the MS front panel door is tight before starting the vacuum system.

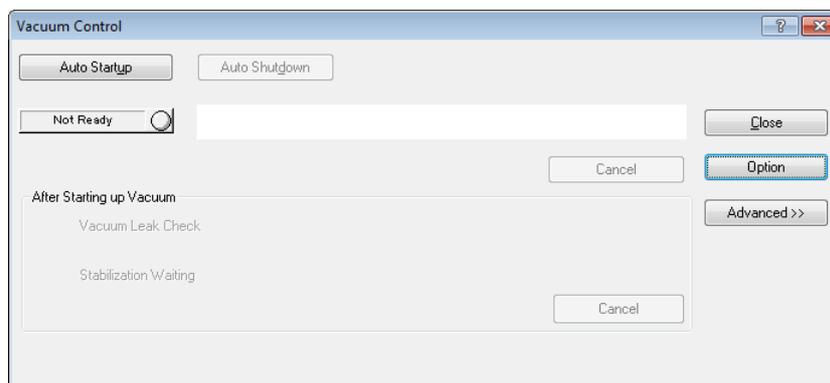
**Caution**

Do not tighten the knob on the MS front panel door after starting the vacuum system. Otherwise, it may be impossible to loosen the knob after the instrument is shut down.

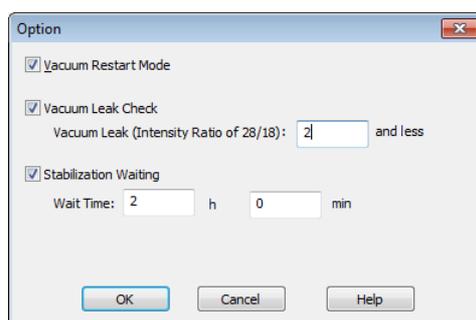
**Caution**

When replacing a column with one of a larger internal diameter, a large volume of carrier gas may flow into the MS and prevent the vacuum system from starting. Before starting the vacuum system, adjust the pressure for the carrier gas and make sure that the flow into the column is less than 15 mL/min (less than 5 mL/min for CI/NCI).

- 1 Click the [Vacuum Control] icon in the Assistant Bar. The [Vacuum Control] dialog box is displayed



- 2 Click [Option].
The [Option] sub-window is displayed.



- 3 Set the items to execute.
See below for details of each item.

Parameter	Description
Vacuum Restart Mode	Specifies whether or not to automatically start the vacuum system when the power distribution recovers after temporary system shutdown caused by power outage, etc. Note, however, that the vacuum system will not start regardless of the setting, if the vacuum system has already stopped before instrument shutdown due to power outage.
Vacuum Leak Check (*1)	<p>Allows for checking vacuum leakage by comparing the intensities of nitrogen (m/z 28) and water (m/z 18), after automatic start of the vacuum system is completed. The guideline value for the intensity ratio varies depending on the accessory/peripheral equipment. Set the value using the following guideline.</p> <ul style="list-style-type: none"> AOC-20, AOC-5000/6000: Intensity ratio of 2 Other accessory/peripheral equipment: Intensity ratio of 5 <p>Note When using the advanced flow technology system (such as detector splitting system or backflush), the intensity for m/z 28 may be larger than when using the standard system. Therefore, it is not recommended to use this function for leak check.</p>
Stabilization Waiting	Auto-tuning is usually executed to stabilize the vacuum degree of MS for about two hours for qualitative analysis and four hours for quantitative analysis after the vacuum system start. This item allows for setting the waiting time for stabilization.

(*1) The setting is available only when the ion source is EI and the carrier gas is He. In other cases, see "3.6.3 Vacuum Leak Check Using Peak Monitor" to check for vacuum leakage.

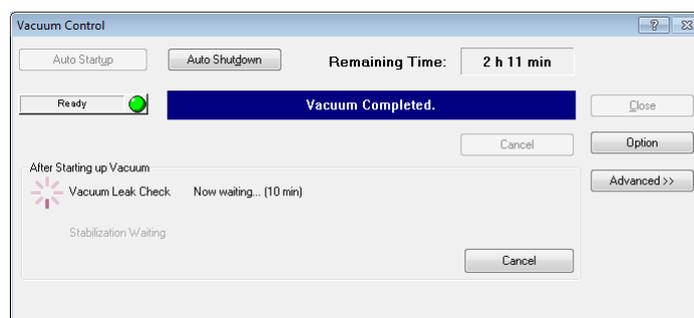
4 Click [OK].

The [Option] window is closed.

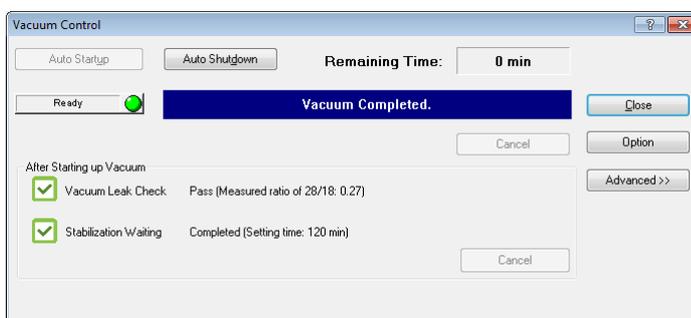
5 Click the [Auto Startup] button. 1.6.1

The Startup indicator flashes, the progress bar is displayed, and the vacuum system startup sequence initiates. The various components start up in sequence, as noted in the progress bar, and when the vacuum system is ready for operation, "Vacuum Completed." is displayed.

When the vacuum leakage check or stabilization waiting is set, the operation is automatically executed upon completion of the automatic start of the vacuum system.



6 Check the result.

**Note**

When the result of vacuum leakage check fails, it is possible that there is an air leak. Search for the location of the leak, referring to ["3.6 Checking for Leaks"](#).

**Note**

After the vacuum system starts operating, the degree of vacuum may temporarily be insufficient, so a "Vacuum level deterioration. Ion gauge is immediately switched off." message may be displayed. In this case, wait about 1 hour. Then open the [Monitor

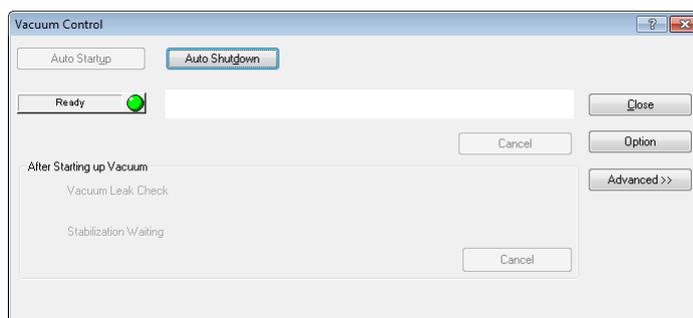
Settings] window, and in the [Higher Vacuum] area, click  (ion gauge). If no error message is displayed, you may use the system as is.

7 Close the [Vacuum Control] dialog box.

2.4.2 Shutting Down the Instrument

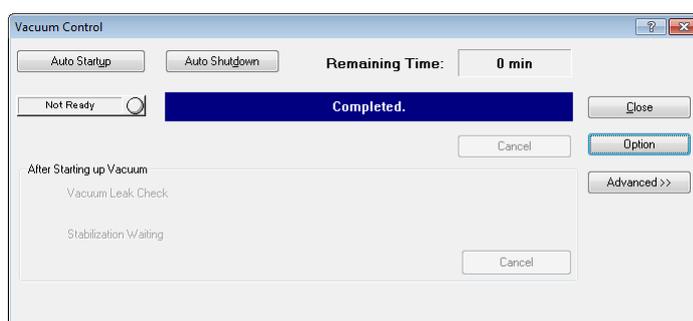
1 Shut down the vacuum system.

- 1 Click the Assistant Bar [Vacuum Control] icon to open the [Vacuum Control] dialog box.



- 2 Click the [Auto Shutdown] button.

The Shutdown indicator flashes, the progress bar is displayed, and the vacuum system shutdown sequence initiates. The various components shut down in sequence, as noted in the progress bar, and when the vacuum system shutdown is completed, "Completed." is displayed.



- 3 Click the [Close] button to close the [Vacuum Control] dialog box.



Caution

If the front door of the vacuum housing will be opened after the vacuum system is shut down, loosen the knob on the front door with one turn to the left.

2 Exit GCMSsolution.

- 1 Select Exit from the File menu.
[GCMS Real Time Analysis] program is closed.

3 Turn off the power supply and carrier gas.

- 1 Turn off the computer, monitor and printer.
- 2 Turn off the GC main power switch.
- 3 Turn off the MS power switch.
- 4 Close the main valve of the carrier gas cylinder.
- 5 Close the main valve of the CID gas cylinder.

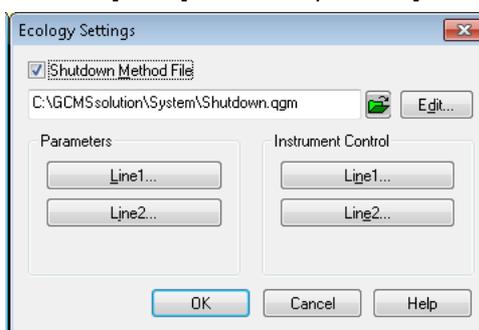
2.5 Daily Startup and Shutdown

When the instrument is used daily, the vacuum system should be left running after each use rather than shutting down and restarting it so that the proper analysis conditions can be met more quickly. This section describes how to set the shutdown parameters when the instrument is standing by for analysis and how to execute a shutdown.

2.5.1 Daily Shutdown

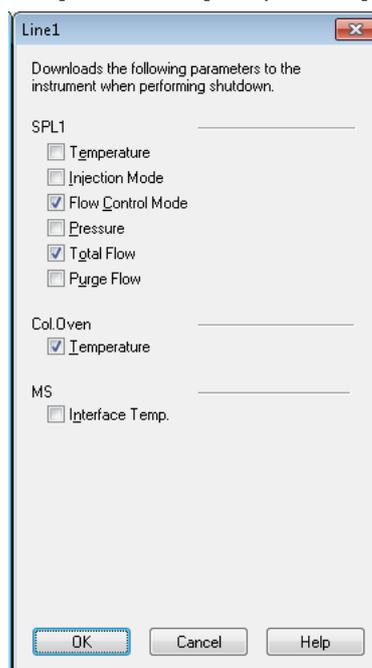
Set Shutdown Parameters

- 1 Select [Shutdown] from the [Tools] menu to open the [Ecology Settings] dialog box.

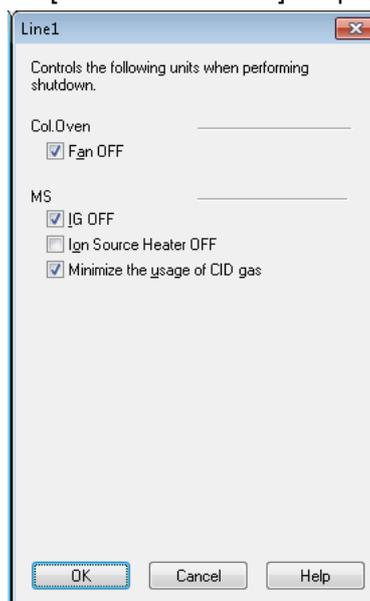


- 2 In the [Shutdown Method File] text box, enter the name of the method file to download to the instrument when performing a shutdown. To change the method settings, click the [Edit] button and make the new settings in the [GCMS Analysis Editor] program that opens.

- 3 Click [Line 1] button in the [Parameters] to open the [Line 1] dialog box.



- 4 Select which parameters of the shutdown method file are to be downloaded to the instrument, and click the [OK] button. Only parameters whose checkboxes are selected are downloaded to the instrument at shutdown.
- 5 Enter the desired settings for the equipment in use on the [Line 2] dialog box and [Additional Heater / Flow] dialog box.
- 6 Click [Line 1] button in the [Instrument Control] to open the [Line 1] dialog box.

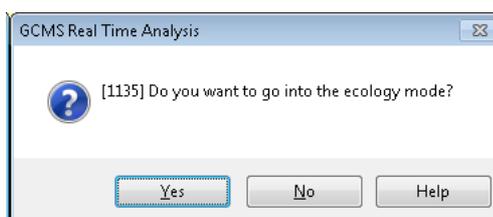


- 7 Select the parameters to turn off at shutdown, and click the [OK] button. Only parameters whose checkboxes are selected are turned off at shutdown.
- 8 Likewise, make the required settings in the [Line 2] dialog box.
- 9 Click OK in the [Ecology Settings] dialog box.

Execute Shutdown

1.6.1

- 1 Click the Ecology Mode icon on [Instrument Monitor] in the [GCMS Real Time Analysis] program. A message prompting whether or not to enter the Ecology mode is displayed.



- Click [Yes]. The [Ecology Settings] dialog box settings are downloaded to the instrument, and the instrument enters the Ecology mode. While the Ecology mode is executing, the [Ecology Mode] dialog box opens. Other operations can be performed in the [GCMS Real Time Analysis] program only when the Ecology mode is canceled.



Note

If the front door of the vacuum housing will be opened after the vacuum system is shut down, loosen the knob on the front door with one turn to the left.

- The instrument will not automatically switch to the power save mode while the instrument is running. The instrument will switch to the power save mode after the current process is finished and a specified amount of time elapses.
- The power save mode can be activated manually, depending on power option settings. However, do not manually switch to the power save mode while the instrument is running. Doing so will cause an error communicating with the instrument.
- This feature is not compatible with pretreatment units other than HS-20 or AOC-20.

For information about power save mode settings, refer to the instruction manual or help menu for Windows.

2.5.2 Daily Startup

Follow the procedure below when the vacuum system is already running, as when the daily shutdown procedure has been performed.

- 1

Click Cancel in the [Ecology Mode] dialog box.

The instrument automatically returns to the state before the Ecology mode was entered.



Note

When the PC is in the Power Save mode, first cancel the Power Save mode and then cancel the Ecology mode.

For information about power save mode settings, refer to the instruction manual or help menu for Windows.



Note

Do not connect or disconnect devices connected via USB (such as USB memory or printers) or switch the power OFF/ON while the [GCMS Real Time Analysis] program is running. Doing so could interfere with communications.

2.6 Column Replacement

This section explains column replacement when column performance has deteriorated or with a column more appropriate for the application. If the column is not replaced correctly, a vacuum leak may result.

2.6.1 Shutting Down the Vacuum System

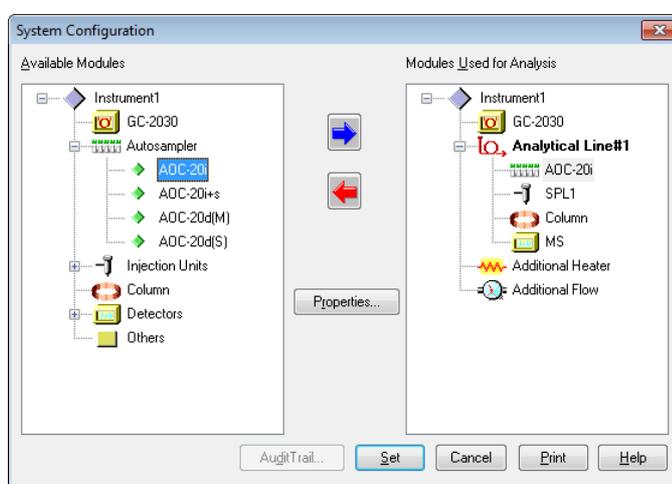
- 1** Shut down the vacuum system.
Refer to [2.4.2 "Shutting Down the Instrument"](#).
- 2** Change the column.
 - 1** Remove the column that is currently installed.
 - 2** Loosen the nuts at the injector and MS connections, and remove the capillary column. If the Vespel ferrule and nut from the MS end are still on the capillary column, the column may be stored with the ferrule and nut attached.
The Vespel ferrules and nuts required to install the capillary column are considered consumable parts and should be stocked in sufficient quantities. Refer to ["Appendix B.1 Consumable Parts and Maintenance Parts List"](#).
 - 3** Connect the Capillary Column to the Injection Port.
Refer to "Connecting the Capillary Column to the Injection Port" in [2.4.1 "Starting the Instrument"](#).
 - 4** Connect the Capillary Column to the Injection Port.
Refer to "Connecting the capillary Column to the MS" in [2.4.1 "Starting the Instrument"](#).
 - 5** Turn on the instrument.
Refer to "Turn on the instrument" in [2.4.1 "Starting the Instrument"](#).
 - 6** Start GCMSsolution.
Refer to "Start GCMSsolution" in [2.4.1 "Starting the Instrument"](#).
 - 7** Start the vacuum system.
Refer to "Start the vacuum system" in [2.4.1 "Starting the Instrument"](#).

2.7 System Configuration

This section explains system configuration. Procedures are described for entering the properties for the autosampler, injection port, column, detector, additional temperature control, additional flow, and other installed components.

2.7.1 System Configuration

- 1 Click the Assistant Bar System Configuration icon to open the [System Configuration] dialog box.



The components that can be included in the configuration are listed in the Available Modules box on the left. The tree structure includes the various GC, autosampler, injection port, detector, and additional options. To view the options that are available for a particular component, click the plus symbol (+) to the left of the respective icon.

- 2 To include a component in the configuration, select its icon in the Available Modules box and click the right arrow button. Alternatively, double-click the icon, or drag the icon from the left window and drop it in the right.

The current system configuration is displayed in the Modules Used for Analysis box on the right.

Available GCMS Modules

Module	Options
GC	GC-2030
Autosamplers	AOC-20i AOC-20i+s AOC-20d(M) AOC-20d(S)
Injection Ports	SPL OCI WBI PTV
Column	Column
Detectors	FID FPD FTD ECD TCD MS OTHER
Other Units	Other Units
Additional Heater*	
Additional Flow*	

* Units connected to the main unit are displayed automatically.

- 3 Double-click each component listed in the Modules Used for Analysis box to open the [Properties] dialog box and enter the necessary parameters. Default settings may be used for most parameters. For column properties, selecting the type of column in use automatically enters its specifications. Ensure that the MS ion source is correctly selected. Change any other parameters according to the application and configuration. For more information about the parameters for each GC/MS system component, consult the online GCMS Help.
To print the configuration and properties, click the [Print] button in the [System Configuration] dialog box.
- 4 After all of the components included in the configuration are listed in the Modules Used for Analysis box and their properties are entered, click the Set button and exit the [System Configuration] dialog box.

2.7.2 CID Gas Pressure

Parameter Name	Default Value [kPa]	Maximum [kPa]	Minimum [kPa]	Remarks
CID Gas	200	230	17	Indicates 0 when [Use CID Gas] is unchecked on the [MS] tab page in the system configuration window

The screenshot shows the 'Detectors' configuration window with the 'MS' tab selected. The 'CID Gas (Initial value of tuning)' field is highlighted with a red box and contains the value 200 kPa. The 'Use CID Gas' checkbox is checked. Other fields include Name (MS), Detector Type (MS), Serial # (O21505500222AE), ROM Version (1.14), Model (Dual Stage TMP (TQ8050)), and Manufactured Year-Month (2017-11). The 'Interface' section shows Heat Port (DET1) and Max Temp (350 °C). The 'Ion Source' section shows Type (EI), Temperature (200 °C), and Perform GCI (unchecked). The 'Reagent Gas' section shows Port1 and Port2 (both None). The 'Vacuum Unit' section shows Turbo Molecular Pump 1 and 2 (both 200), Pirani Gauge (Lower Vacuum) (Present), Ion Gauge (Higher Vacuum) (Present), and Rotary Pump 2 (None). The 'Jet Separator' is set to None, and Vacuum Units are set to Pa. The 'DI Type' is set to None. A 'Test Values of System Check/Auto Tuning...' button is visible at the bottom right.



Note

If CID gas is used, all measurement modes can be used for analysis. If CID gas is not used, analysis is possible as a single GCMS system using Q3 scan or Q3 SIM measurement modes.

2.7.3 Judging Auto-Tuning Results Automatically

When the ion source of the MS detector is EI, auto-tuning results can be judged automatically. Configure the settings using the procedure below.

- 1 To automatically judge auto-tuning results, select [Check Auto Tuning Result].

The screenshot shows the 'Detectors' configuration window for an MS detector. The 'Check Auto Tuning Result' checkbox is highlighted with a red box. Other settings include Name: MSJ, Detector Type: MS, Serial #: Q21505500222AE, ROM Version: 1.14, Model: Dual Stage TMP (TQ8050), Manufactured Year-Month: 2017-11, Ion Source Type: EI, Temperature: 200 °C, and Vacuum Unit settings.

- 2 Click the [Test Values of System Check/Auto Tuning] button and open the [Auto Tuning] tab page.

Set the criteria for judging auto-tuning results.

The screenshot shows the 'Test Value' configuration window, Auto Tuning tab. The window shows settings for FWHM, Detector Gain, and Vacuum Leak/Intensity Ratio of 69/28. The 'Default' button is highlighted with a red box.

Item	Description	Default
FWHM	Specifies the upper limit of the shift of the FWHM of spectrum peaks at m/z 69, 219, and 502 from the set value.	0.1
Detector Gain	Specifies the upper limit of the detector voltage set by auto-tuning. Note Although the detector voltage on the actual instrument is a negative value, the software handles the parameter as a positive value.	2
Vacuum Leak (Intensity Ratio of 69/28)	Specifies the lower limit of the intensity ratio between m/z 69 (PFTBA) and m/z 28 (Nitrogen). Note <ul style="list-style-type: none"> The reference value of the criteria differs depending on the pretreatment unit. Set the criteria in accordance with the pretreatment unit by following the values below. <ul style="list-style-type: none"> Pyrolyzer, OPTIC-4: intensity ratio 1 Other pretreatment units: intensity ratio 2 When using the advanced flow technology system (such as detector splitting system or backflush), the intensity for m/z 28 may be larger than when using the standard system. Therefore, it is not recommended to select [Vacuum Leak (Intensity Ratio of 69/28)] for check. 	2
Maximum Mass Shift	Specifies the upper limit of the mass axis shift.	0.1
Relative Intensity Ratio for High m/z (502)	Specifies the lower limit of the relative intensity for m/z 69 in the high mass range (m/z 502).	2

3

Click [OK] to close the [System Configuration] sub-window.

See "2.8 System Check and Tuning" to execute auto-tuning.

2.8 System Check and Tuning

This section explains how to perform a system check and tune the GC/MS system. The system check is a diagnostic check that should be run before analysis to verify proper instrument operation. The system is tuned by selecting the appropriate items within the [Tuning] window.

2.8.1 Tuning

In the [Tuning] window, the parameters controlling the MS can be adjusted so that the desired mass spectrum peaks are obtained.

There are two tuning methods: autotuning and manual tuning. Autotuning automatically adjusts the various instrument control parameters as specified in the Autotuning Conditions. In manual tuning, various control parameters are used to manually adjust the mass peaks. When the [Tuning] window is opened, the tuning file that was last saved or used for data acquisition is displayed. Unless otherwise specified, the file that opens automatically in the [Tuning] window is used during system checks or data acquisition.

Operations associated with creating or accessing a tuning file are described below.



Note

When the ion source of the MS detector is EI, auto-tuning results can be judged automatically.

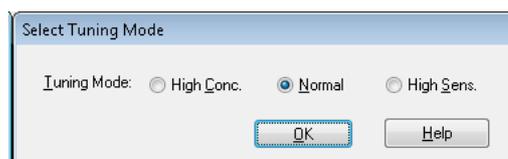
See ["2.7.3 Judging Auto-Tuning Results Automatically"](#).

1

Click the Assistant Bar Tuning icon in the [GCMS Real Time Analysis] program. The [Tuning] window is displayed.



To create a new tuning file, select [New Tuning File] from the [File] menu. When the type of ion source is EI, the [Select Tuning Mode] dialog box opens. Select one of High Concentration, Normal or High Sensitivity, and proceed to Step 2 (Normally, select [Normal]).



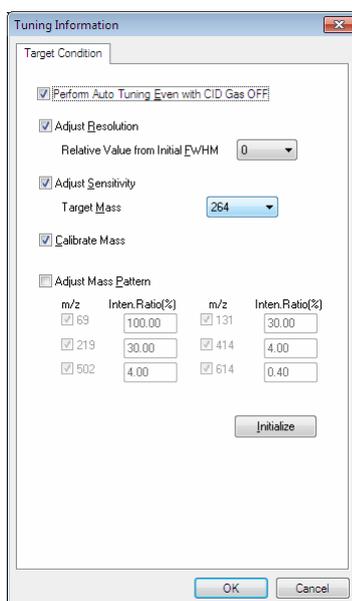
Parameter	Description
Tuning Mode	When [High Conc.] is selected, 20 μ A is set to the emission current. When [Normal] is selected, 60 μ A is set to the emission current. When [High Sens.] is selected, 150 μ A is set to the emission current.

To perform tuning with an existing file, select [File] > [Open Tuning File] to display the [Open Tuning File] dialog box. Select the appropriate tuning file, and click [Open]. Proceed to Step 3.

2

Click the [Assistant Bar Autotuning Condition] icon, or select [Tuning] > [Condition of Autotuning], to open the [Tuning Information] dialog box.





Tuning Condition

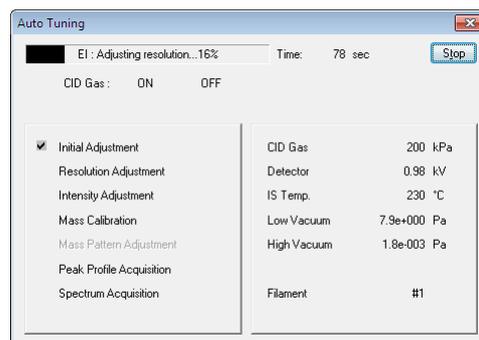
Select which parameters to apply during autotuning, and enter those parameters. The parameters include Adjust Resolution, Adjust Sensitivity, Calibrate Mass and Adjust Mass Pattern. Select the parameters to include during autotuning. When the tuning conditions are changed, the MS system check or autotuning results may vary.

Instrument Parameter	Description
Perform Auto Tuning Even with CID Gas OFF	Select whether or not to perform autotuning without using CID gas in addition to autotuning using CID gas
Adjust Resolution	Adjust the resolution so that the peak width at half-height value obtained with the standard (PFTBA) is near the value entered for [Relative Value from Initial FWHM].
Relative Value from Initial FWHM	-0.2u, -0.1u, 0u, 0.1u (where "u" denotes atomic mass unit) Adjust this setting so that the FWHM value for the peak profile obtained using a standard sample (PFTBA) approaches the sum of the default FWHM value plus the [Relative Value from Initial FWHM] value. Note: Although resolution increases as the width at half-height value decreases, the signal intensity tends to decrease.
Adjust Sensitivity	Perform target ion adjustment, which adjusts the lens system to maximize the sensitivity of specific target ions in Q3 scan peak profiles.
Calibrate Mass(*1)	A spectrum produced from a standard (PFTBA) is used to correct for mass axis misalignment.
Adjust Mass Pattern	Adjust the lens system to maximize the peak profile signal in Q3 scans and correct intensity levels so that the intensity pattern in the standard sample spectrum measured using a magnetic field type MS unit matches the intensity pattern measured using this instrument. Pattern calibration sets the intensity correction parameter to correspond to the specified intensity ratio.

(*1) If CID gas is used, both Q1 and Q3 are adjusted.
If CID gas is not used, only Q3 is adjusted.

After selecting the appropriate parameters and entering values as necessary, click the [OK] button and close the [Tuning Information] dialog box.

- 3** Click the Assistant Bar [Start Autotuning] icon or the Start Tuning button on the toolbar to tune the instrument automatically. Autotuning can also be started with the [Tuning] > [Start Autotuning] command.



After autotuning is completed, save the file. Select [File] > [Save Tuning File As] the first time the file is saved or to save the file with a new name. Select [File] > [Save Tuning File] to overwrite the existing tuning file.

- 4** Click the Assistant Bar [Tuning Result View] icon to view the tuning results.



The peak profile corresponding to each m/z is displayed

Peak profiles are measured using Q1 and Q3 scans. (If CID gas is not used, they are only measured using Q3 scans.)

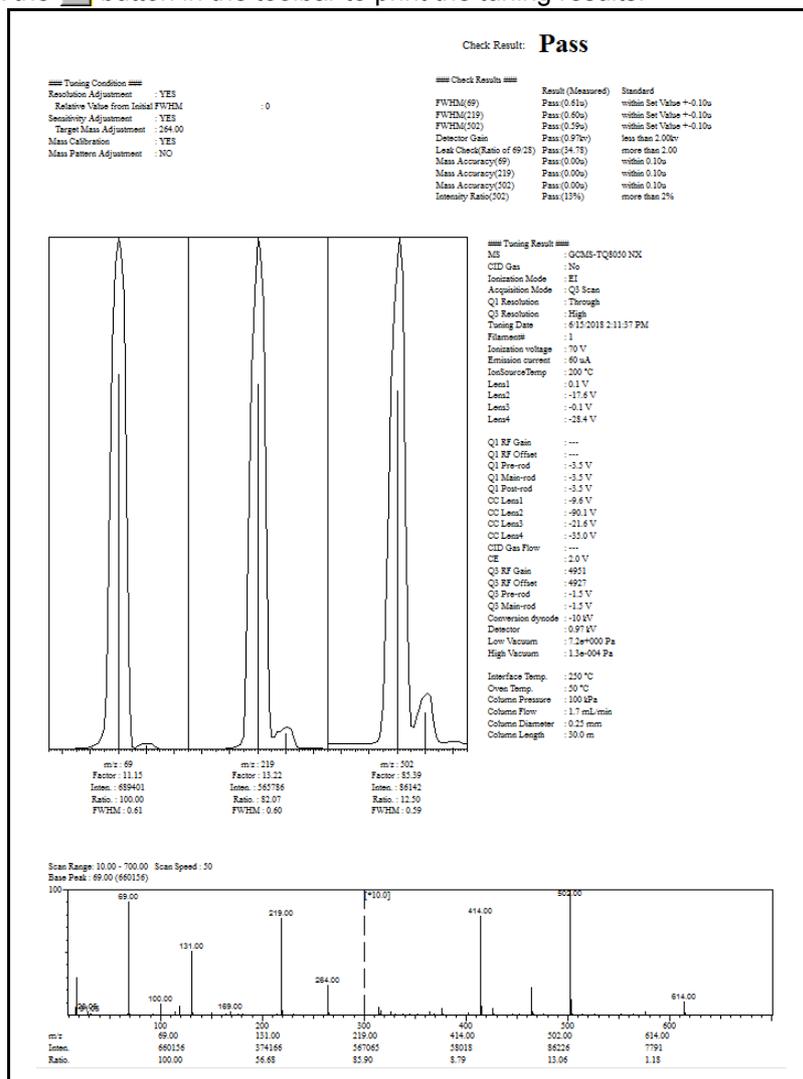
Tuning results to be displayed can be switched between "results for tuning in which CID gas was used" and "results for tuning in which CID gas was not used" in the [CID Gas] drop-down list.



Note

Displays the result of auto-tuning judgment at the Q3 scan with CID gas set OFF when auto-tuning results are set to be judged in the System Configuration.

5

Click the  button in the toolbar to print the tuning results.

Note

The [Peak Monitor] window displayed by clicking the Assistant Bar [Peak Monitor View] icon is the same as the screen displayed during the Vacuum Leak Check and other operations.



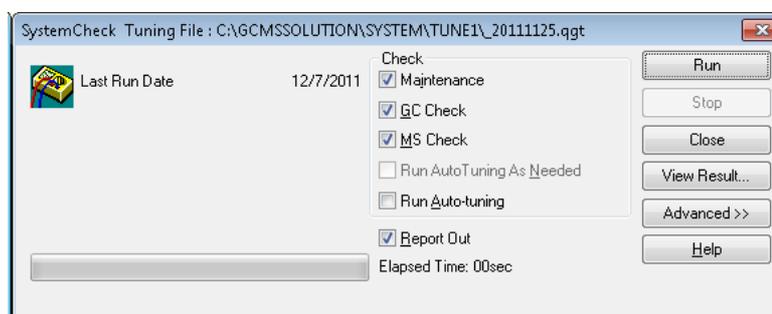
For more information about checking for vacuum leaks, refer to 3.6 "Checking for Leaks".

2.8.2 System Check

Overview

Parameter	Description	Action if System Check fails
Maintenance	Verifies how long and how many times a GC/MS consumable part has been used.	Replace the part and reset its amount of use.
↓		
GC Check	Verifies system status of GC.	If adjustment or repairs are recommended, discuss them with your Shimadzu representative. If a part replacement is necessary, replace the part as recommended.
↓		
MS Check	Verifies various values related to MS analysis precision.	If adjustment or repairs are recommended, discuss them with your Shimadzu representative. If a part replacement or tuning is necessary, replace the part or tune as recommended.
↓		
Run Autotuning as Needed	Performs autotuning, when System Check fails.	
OR		
Run Autotuning	Performs autotuning regardless of System Check results.	
↓		
Report Out	Prints the System Check results.	

- 1 Click the Assistant Bar [System Check] icon to open the [System Check] dialog box.



Note

The standards entered in System Check are the criteria used for the test, and do not reflect the manufacturer's specifications.

When autotuning is performed, the current tuning file is overwritten. Depending on the items being tuned, some previously obtained calibration curves can no longer be used.

[System Check] Dialog Box

The following items are displayed in the [System Check] dialog box.

Item	Description
Last Run Date	Displays the date on which the last system check was performed.
Result messages	Displays Pass, Fail and other messages.
Elapsed Time	Displays the time elapsed during the system check.

System Check

The system check is performed according to the items selected in the [System Check] dialog box.

Item	Description
Maintenance	Verifies how long and how many times a GC/MS consumable or maintenance part has been used.
GC Check	Verifies system status of GC.
MS Check	Verifies various values related to MS analysis precision.
Run Autotuning As Needed	If the [Signal intensity fluctuation], [Mass axis misalignment], or [Spectrum peak half-width fail] message is displayed, run autotuning.
Run Autotuning	Performs autotuning regardless of System Check results.
Report Out	Prints the System Check results.

To display the detailed settings for each item, click the [Advanced>>] button.

 **Note**

Some checks may only be performed with an EI ion source. There are also some checks that may only be performed after the MS has completed operation. Checks that cannot be performed are disabled. For more information, please refer to GCMS Help.

Autotuning should usually be performed with the default parameters:

- [Resolution adjustment] selected
- [Relative Value from Initial FWHM] = "0"
- [Sensitivity adjustment] selected
- [Mass Calibration] selected

Autotuning parameters may be changed by clicking the [Tuning] icon in the Assistant Bar. Select the Tuning file to be used in the advanced MS parameters tab.

The system is tuned according to the parameters entered in the Tuning file. Note that depending on the items being tuned, some previously obtained calibration curves can no longer be used.

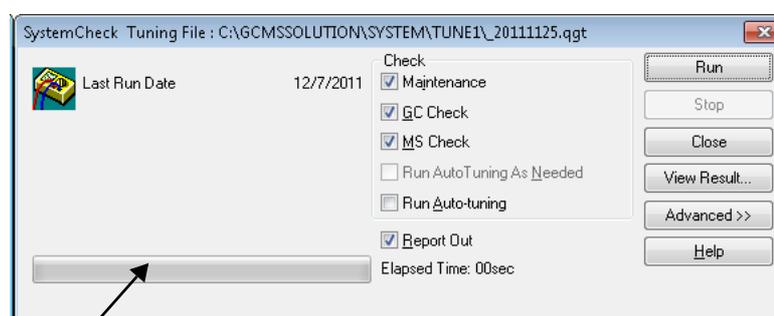
2

Buttons

The following buttons are displayed in the [System Check] dialog box.

Button	Description
Run	Starts the system check.
Stop	Stops the system check. Only enabled while System Check is performed.
Close	Closes the [System Check] dialog box.
View result	Displays the results of the System Check. The results may be printed from the [System Check Result] dialog box.
Help	Opens the help file.
Advanced	Displays the advanced parameters. Only users authorized for [Changing System Check settings] can access these parameters.

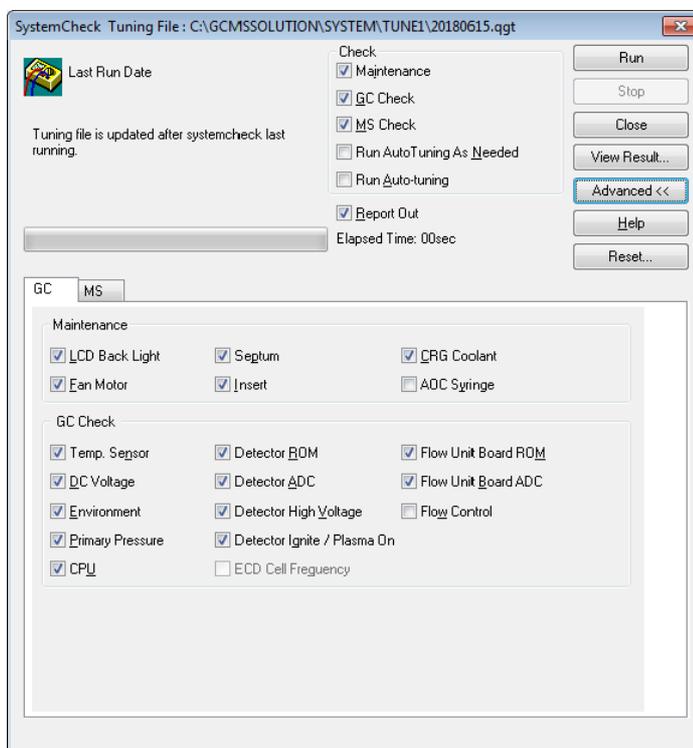
The system check is initiated when Run is clicked. The time elapsed during the system check is displayed, and the progress bar tracks the system check progress.



Progress bar

If the system check is completed without detecting any problems, "Pass" is displayed above the progress bar. If problems are detected, "Fail" is displayed.

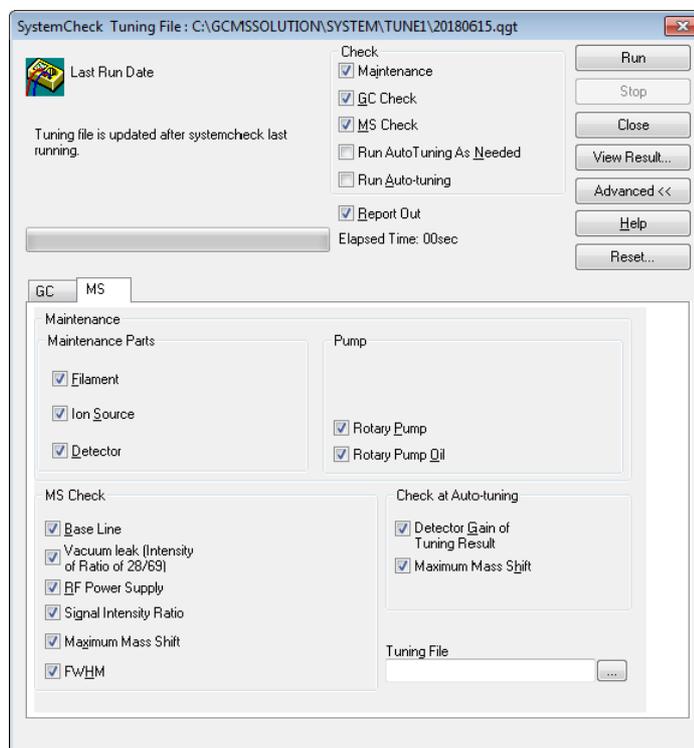
- 2 Click the [Advanced>>] button to display the GC and MS advanced tabs. Select the [GC] tab to select the maintenance items and consumable parts to be checked during system check.



GC Maintenance Items

Item	Description
LCD Back Light	Checks how long the back light has been active.
Fan Motor	Checks how long the fan motor has operated.
CRG Coolant	Checks the counter for CRG refrigerant depletion.
Septum	Checks how many times the currently installed septum has been used. For more information, refer to GCMS Help.
Insert	Checks how many times the currently installed glass insert has been used. For more information, refer to GCMS Help.
AOC Syringe	Checks how many times the currently installed AOC syringe has been used. For more information, refer to GCMS Help.

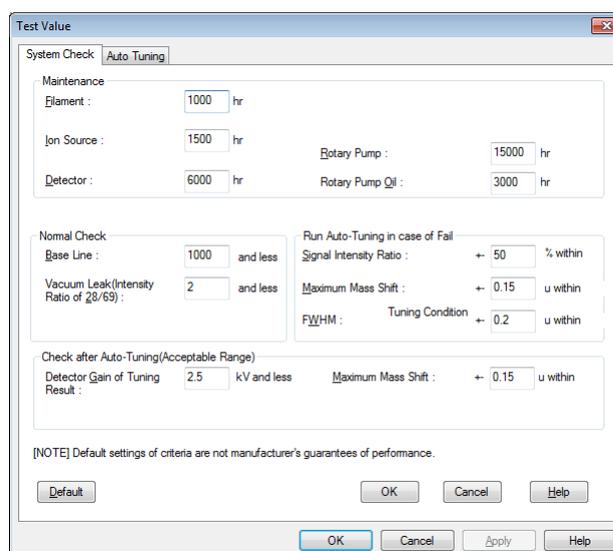
- 3** Select the [MS] tab to select the maintenance items and consumable parts to be checked during system check.



2

Note

Standard values for system checks are set in the [Test Value] dialog box in the [System Configuration] dialog box.



For more details, refer to Help.

MS Maintenance Items

Item	Description
Filament	Checks how long the filament has been used. For more information, refer to GCMS Help.
Ion Source	Checks how long the ion source has been used. For more information, refer to GCMS Help.
Detector	Checks how long the detector has been on and in use. For more information, refer to GCMS Help.
Turbo Molecular Pump	Checks how long the turbomolecular pump has been running and in use. For more information, refer to GCMS Help.
Rotary Pump	Checks how long the rotary pump has been running and in use. For more information, refer to GCMS Help.
Rotary Pump Oil	Checks how long the rotary pump oil has been used. For more information, refer to GCMS Help.
Reset	Opens the dialog box to set the use time or number of uses for maintenance parts. Note: Only a Shimadzu representative can reset the turbomolecular pump use time.

- 4** When the [Reset] button is clicked, the [Reset Consumables] dialog box is displayed. Reset the use time or number of uses any time a consumable part is replaced.

**Note**

Only users authorized for [Changing System Check Settings] can reset the time or number of uses.

- "0" is entered when the [Clear] button is clicked.
- If the part was changed earlier, enter the appropriate value.
- The value is changed when [OK] is clicked.
- The value displayed is the same value as when the [Reset Consumables] dialog box was last displayed. The values do not update automatically.

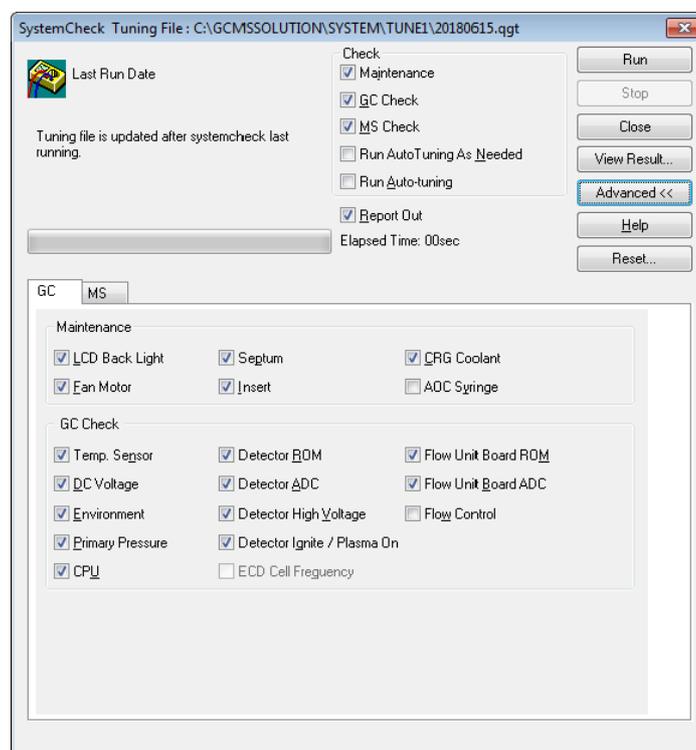
Reset Items

	Item	Description
GC	Septum	Reset the number of uses to 0 by clicking the [Clear] button. The number is not user definable.
	Glass Insert	
	CRG Refrigerant (Column Oven)	
	CRG Refrigerant (INJ#2)	
MS	Filament #1	When these parts are changed, enter "0" and the time if it was used for some time.
	Filament #2	
	Ion Source	
	Rotary pump 1 Oil	
	Rotary pump 2 Oil	This is only displayed if a second rotary pump is installed. When these parts are changed, enter "0" and the time if it was used for some time.

2

5

Click the [GC] tab and select the desired GC Check items.

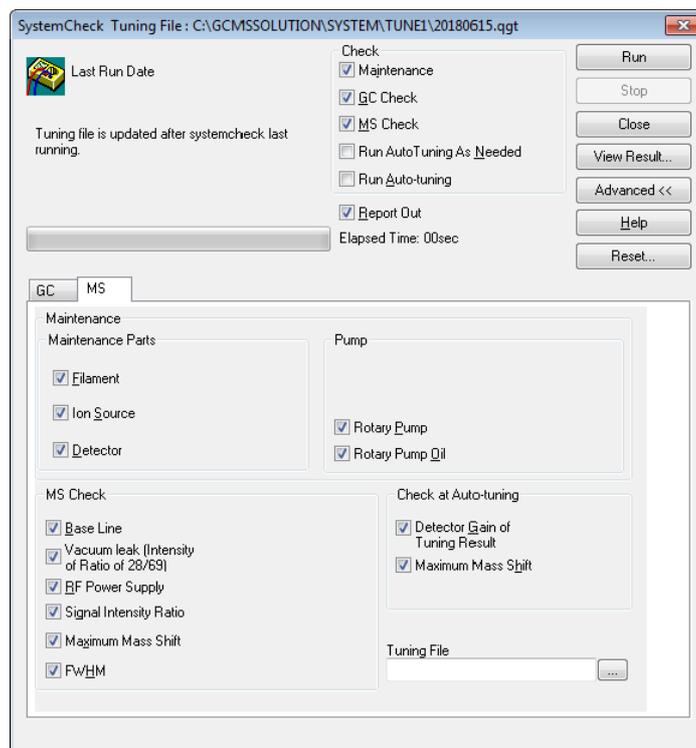


GC Check Items

Item	Description
Temp. Sensor	Checks how long the temperature sensor is used at 300 °C or above. Refer to GCMS Help for more information.
DC Voltage	Measures the DC voltage and checks if the error is within the standard range. Refer to GCMS Help for more information.
Environment	Measures the room temperature and air pressure, and checks if they are within the warranted operating conditions. Refer to GCMS Help for more information.
Primary Pressure	Measures the primary pressure of the carrier gas and checks if it is above the following standard value. If [350 - 500 kPa] is selected, the standard value is 150 kPa. If [500 - 900 kPa] is selected, it is 350 kPa.

Item	Description
CPU	Checks the CPU Register and Real-time Clock. Refer to GCMS Help for more information.
Detector ROM	Checks the detector ROM for each detector. Refer to GCMS Help for more information.
Detector ADC	Checks the detector ADC for each detector. Refer to GCMS Help for more information.
Detector High Voltage	Checks the high voltage of detectors respectively. Performed only when FID, FTD, or FPD is mounted. Refer to GCMS Help for more information.
Detector Ignite / Plasma On	Checks the Ignition Pulse and ignition procedure of each detector. Performed only when FID, FTD, or FPD is mounted. Refer to GCMS Help for more information.
ECD Cell Frequency	Measures the pulse voltage band for each detector ECD and compares dirtiness of cells with the threshold. Refer to GCMS Help for more information.
Flow Unit Board ROM	Checks ROM for each Flow Control Circuit (SLOT). Refer to GCMS Help for more information.
Flow Unit Board ADC	Checks ADC for each Flow Control Circuit (SLOT). Refer to GCMS Help for more information.
Flow Control	Checks if the flow is controlled properly for each Flow Port. Refer to GCMS Help for more information.

6 Click the [MS] tab and select the desired MS Check items.

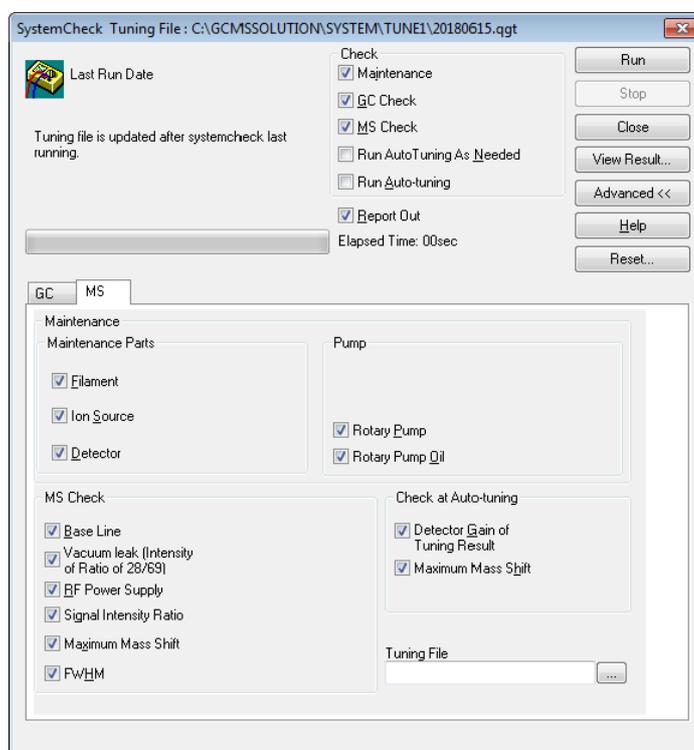


MS Check Items

Item	Description
Base Line	Determines the baseline fluctuation value (RMS). Refer to GCMS Help for more information.
Vacuum leak (Intensity of Ratio of 28/69)	Evaluates the ratio obtained from measuring $m/z=28$ (nitrogen) and $m/z=69$ (PFTBA). The ratio is used in determining if there is a leak. Refer to GCMS Help for more information.
RF Power Supply	Confirms that the high-frequency power is operating normally. Refer to GCMS Help for more information.
Signal Intensity Ratio	Compares the PFTBA signal intensity with the previous autotuning results. Refer to GCMS Help for more information.
Maximum Mass Shift	Determines if the mass axis has shifted. For this parameter to be corrected during autotuning, [Calibrate Mass] must be selected in the Autotuning Conditions. Refer to GCMS Help for more information.
FWHM	Determines the spectrum peak width at half-height shift from the mass peak width at half-height values entered for $m/z = 69, 219, \text{ and } 502$. For this parameter to be corrected during autotuning, [Adjust Resolution] must be selected in the Autotuning Conditions. Refer to GCMS Help for more information.

(*1) If CID gas is used, both Q1 and Q3 are judged.
If CID gas is not used, only Q3 is judged.

- 7 Select the desired items to be checked during autotuning in the [Check at Autotuning] section of the [MS] tab.



When [Run Autotuning As Needed] or [Run Auto-tuning] are selected, these items are checked after autotuning is performed.

Checks after Autotuning

Item	Description
Detector Gain of Tuning Result	Determines the detector voltage setting that resulted from autotuning. Refer to GCMS Help for more information.
Maximum Mass Shift	Determines the mass axis shift. Note that [Calibrate Mass] must be selected in the Autotuning Conditions. Refer to GCMS Help for more information.

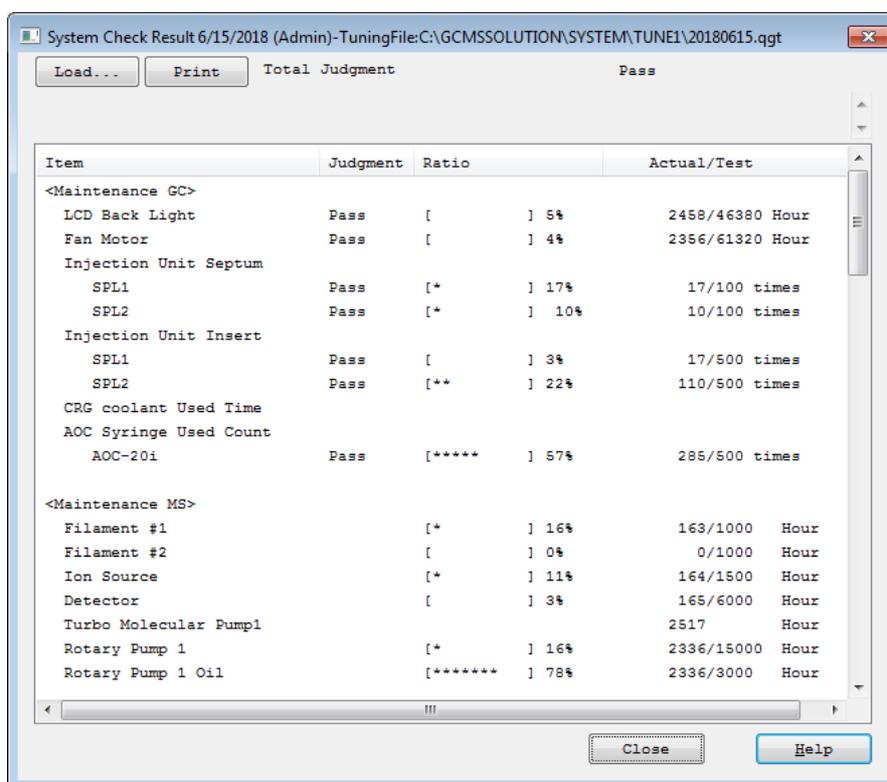
- 8 Select the [Tuning file] to use for autotuning during the system check.

Tuning File

Item	Description
Tuning	The file displayed in Tuning is used to autotune the instrument during the system check. To select or change the file, either enter the full file path directly or open the [Select Tuning File] dialog box by clicking the [...] button to the right. From the [Select Tuning File] dialog box, select the appropriate file and click [OK]. The file name is now displayed in Tuning.

- 9 Click the [Run] button to run the system check.

10 Select [View Result...] to display the [System Check Result] dialog box. This displays the results of the last system check.



Note

After performing a check, the results are displayed automatically. Current and previous system check results can be printed. It is not necessary to run the system check to display or print previous results.

System Check Table

Columns	Descriptions
Item	The check item that was performed.
Judge	Whether the item passed or failed the test, and suggested actions.
Ratio	The ratio of the measured value to the standard value. Allows quick examination of system condition.
Actual/Standard	Measured and standard values for the item.

2

Buttons in the [System Check Result] Dialog Box

Button	Description
Load	Open past results that were saved in the log folder. The files are saved and named automatically. A 14-character name is assigned. The first character is the system number. The second is an underscore (_). The third through sixth are the year. The seventh and eighth are the month. The ninth and tenth are the day. Characters 11 and 12 are the hour time, and 13 and 14 are the minutes. Thus, if a system check is performed on System 1 on January 1, 2000, at 13:00, the name is 1_200001011300.qgc.
Print	Print the currently displayed results.

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Click the [Print] button to print the currently displayed system check results.

The maintenance, GS, MS and post-tuning check items and their results are printed, followed by specific GC and MS information.

Text Printed with System Check Results

Text	Description
Header	Prints the user name, date and time of system check, and time of printing.
Footer	Prints the page number and number of pages in the center.

2.8.3 Adjustment for High Masses

This instrument incorporates an auto-tuning function that conducts mass calibration for molecular weight up to m/z 614. Mass displacement is rare in the normal range of operation (up to approximately m/z 700.) However, displacement from the calibration for the m/z is possible in the high mass range above m/z 700. To ensure accurate calibration in the range above m/z 700 requires manual calibration by the following procedure.

Analysis Conditions (Column: DB-5 ms, Inner diameter 0.25 mm, Length 30 m, Thickness 0.25 μ m)

Sample1: Tris (perfluoroheptyl) -S-triazine 1 % solution (acetone)

Sample2: Tris (perfluorononyl) -S-triazine 1 % solution (acetone)

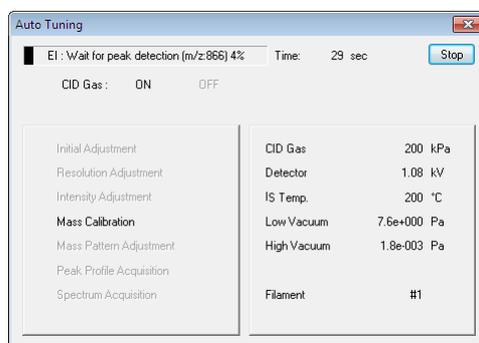
GC: INJ 250 °C, Column head pressure 100 kPa, Total flow rate 30 mL/min, Splitless injection (1 min. sampling)

COL 50 °C (1 min) _ 5 °C /min_ 100 °C (1 min)_ 30 °C /min_ 250 °C (10 min)

MS: I/F 250 °C, Ion source 200 °C

2

- 1 Execute the autotuning command.
- 2 When auto-tuning is finished, select [Auto High Mass Calibration] - [m/z : 866] on the [Tuning] menu.
- 3 After initialization is finished and the instrument is waiting to detect peaks (at m/z 866), inject 1 μ L of the sample (1) indicated in the above analytical conditions and start the GC unit.



- 4 After about 10 minutes, eluted peaks for m/z 866 are detected and mass is calibrated automatically.
- 5 After mass calibration is finished, results are displayed next to the tuning date/time as [High Mass Calibration: Done(m/z 866)].

6 Select [Auto High Mass Calibration] - [m/z : 1066] on the [Tuning] menu in the same manner as in Step 2.

7 After initialization is finished and the instrument is waiting to detect peaks (at m/z 1066), inject 1 μL of the sample (2) indicated in the above analytical conditions and start the GC unit.

**Note**

Before starting the GC unit, confirm that the GC injection mode is set to splitless. If the injection mode is accidentally set to split mode, triazine will not be detected.

8 After about 10 minutes, eluted peaks for m/z 1066 are detected and mass is calibrated automatically.

9 After mass calibration is finished, results are displayed next to the tuning date/time as [High Mass Calibration:Done].

10 Save the tuning file.

**Note**

Traces of the injected triazine may remain in the INJ, column, etc. and hinder subsequent analysis after calibration. In that case, set the column temperature to 250 °C and proceed with aging. Although a sample of about 1 ppm can be analyzed for about 1 hour by aging, changing the insert or aging for several hours are recommended to conduct ultra-microanalysis.

2.9 Resolution and Collision Energy

2.9.1 Changing the Resolution

For analysis modes using SIM (see C.1 Analysis Modes), the resolution for Q1 or Q3 can be changed. There are three resolution levels - (1) Unit, (2) High, and (3) Low, where High results in narrower peaks and Low broader peaks than with Unit. Low increases signal intensity, but provides poorer resolution.

If there is interference from contaminant components, set resolution to Unit or High.

2.9.2 Changing the Collision Energy 1.5

Changing the collision energy changes the fragmentation results using CID. Optimal collision energy varies depending on the compound, so refer to the GCMS Operating Manual Method Development, before setting collision energy.

3

Maintenance

3.1 Precautions

Read and follow the following MS maintenance precautions to ensure optimal MS performance and prevent accidents.

Before performing GC maintenance, first shut down the MS vacuum system, and shut down all modules. Then perform GC maintenance as described in the GC instruction manual and Maintenance Help.



WARNING

1. Follow all relevant precautions when performing a maintenance operation.
2. Wear clean gloves when working on any instrument parts other than the exterior covering. For details, refer to GCMSsolution Maintenance Help.
3. Use clean tools to disassemble parts. Contaminants from dirty tools or gloves can generate background noise. Clean any tools used inside the mass spectrometer with a lint-free cloth and acetone.
4. Place parts on a clean cloth as they are removed, to ensure that they remain clean.
5. Take note of how the parts are assembled to ensure correct re-assembly.
6. Operations that require opening the power unit or moving the MS should be performed by a Shimadzu representative. Only changing columns and minor ion source box maintenance should be performed by the user.

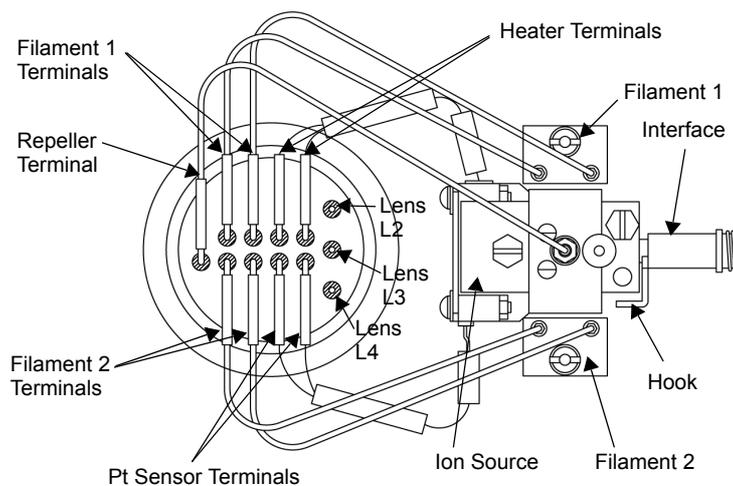
3.2 Filament Replacement

The filament can burn out after extended use or by a decrease in vacuum level. This section describes changing the filament. Follow these precautions when performing this procedure.



WARNING

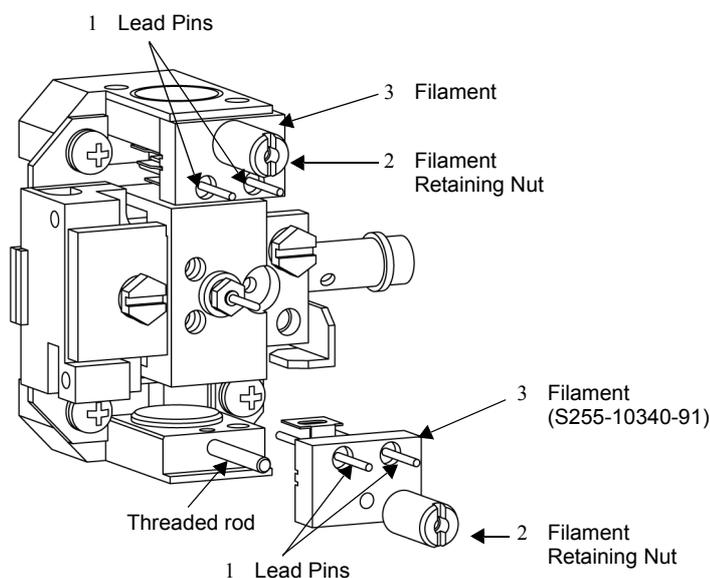
The ion source and interface are usually heated during operation. Before maintenance, allow the instrument to cool for at least 10 minutes once it has been turned off.



3.2.1 Filament Replacement Procedure

- 1 Turn off the instrument as described in ["2.4.2 Shutting Down the Instrument"](#).
- 2 Rotate the knob and open the front panel.
- 3 Disconnect the filament by pulling the lead connectors from the lead pins (1).

- 4** Loosen the retaining nut (2) and pull out the filament (3).



3

- 5** Completely insert the new filaments and tighten the nut.

- 6** Reconnect the filament leads by pushing the lead connectors onto the lead pins.



Note

Precautions during filament installation:

1. Insert the filament completely.
2. Do not allow the filament leads to contact any other part when the filament is seated.
3. If the connection of the lead wire socket and lead pin (1) is not good, request a replacement from a Shimadzu representative.

- 7** After completing the filament replacement, start up the instrument and set the usage time of the filament to "0" according to the procedure described in [3.7 "Reset Usage Frequencies/Usage Times of Consumables"](#).

3.3 Cleaning the Ion Source Box and Repeller Electrode

The function of the ion source is to bombard a sample with electrons, causing ionization and therefore the production of ions. Consequently, the source parts become contaminated over time. When the ion source box or repeller electrode are contaminated, the generated ions are not produced effectively, decreasing sensitivity. Remove and clean the ion source box periodically.



WARNING

Exercise caution when handling the organic solvent used to clean the ion source box. Provide proper ventilation in areas where organic solvent is used.

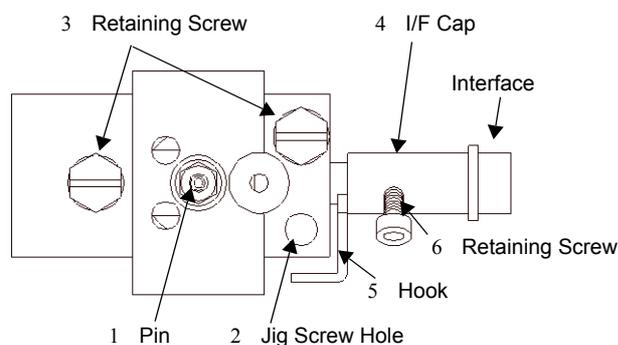
**WARNING**

The ion source and interface are usually heated during operation. Before maintenance, allow the instrument to cool for at least 10 minutes once it has been turned off.

**WARNING**

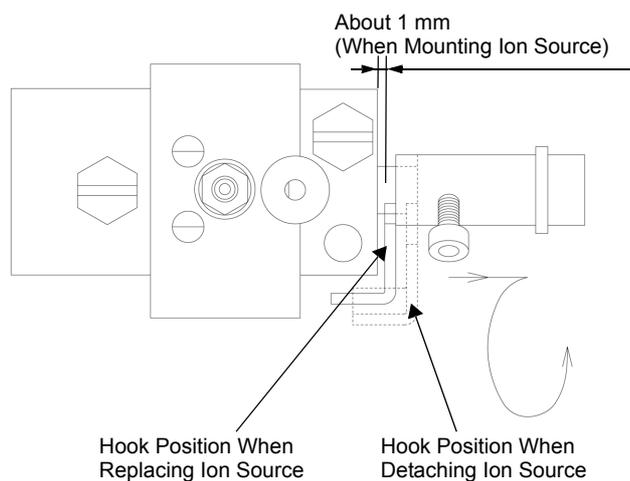
There is a risk of burns because the ion source box and repeller electrode are still hot after drying/baking. Make sure that parts cool sufficiently before maintenance.

3.3.1 Removing the Ion Source Box and Detaching the Repeller Electrode



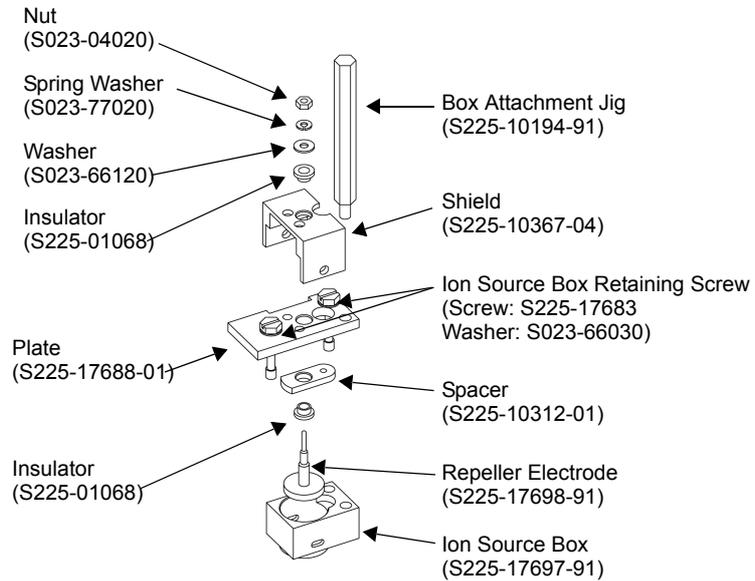
- 1** Shut down the instrument according to ["2.4.2 Shutting Down the Instrument"](#).
- 2** Rotate the knob and open the front panel.
- 3** Carefully pull the lead connector from the pin of the repeller electrode in the figure above with forceps.

- 4 Screw the jig for attaching/detaching the ion source box into the threaded hole on the box.
- 5 Loosen the retaining screws (3) that supports the ion source box by a half turn.
- 6 Loosen the retaining screws (6).
- 7 Push the interface cap (4) to the right, and rotate the hook (5) downward.

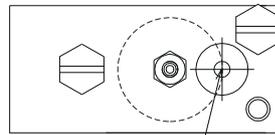


- 8 Loosen the retaining screws (3) and detach the box.
- 9 Detach the jig and separate the box and repeller.
- 10 Loosen the nut using the supplied nut driver and remove the repeller electrode.
- 11 Clean according to ["3.3.3 Cleaning the Ion Source Box and Repeller Electrode"](#).

3.3.2 Re-Assembling the Ion Source Box and Repeller Electrode



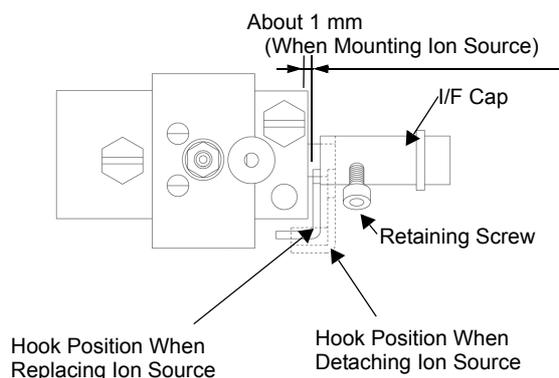
- 1 Place the repeller electrode in the ion source box and adjust so that the repeller is positioned in the center of the ion source box.



The smaller circle is centered inside the larger circle.

- 2 Install the parts in the ion source box. Use the two retaining screws to temporarily hold the parts in place.
- 3 Attach the installation jig to the ion source box.

- 4** Push up the hook on the interface cap, and attach it onto the box.



- 5** Adjust the jig vertically so that the interface cap is completely inserted into the box.

- 6** Detach the jig and tighten the two retaining screws used to hold the parts in place. The left screw should be tightened first.

- 7** Loosen the retaining screws (6).

- 8** Attach the repeller lead connector.



Note

1. Verify that the cap at the end of the interface is seated firmly in the hole on the ion source.
2. Ensure that the repeller electrode lead connector is attached.
3. Verify that the ion source is seated straight.



Note

Precautions for reassembly of the ion source box and lens 1.

1. Do not use excessive force to tighten the screws; this could bend the lens or break the insulating parts.
2. Use a circuit tester to ensure that the repeller electrode and the ion source box are insulated.
3. Do not clean the insulator parts. New parts can be purchased if the parts are contaminated.

- 9** After completing the assembly, start up the instrument and set the usage time of the ion source to "0" according to the procedure described in ["3.7 Reset Usage Frequencies/Usage Times of Consumables"](#).

3.3.3 Cleaning the Ion Source Box and Repeller Electrode

- 1 Polish parts with abrasive paper. Refer to ["3.3.4 Required Materials"](#).



Note

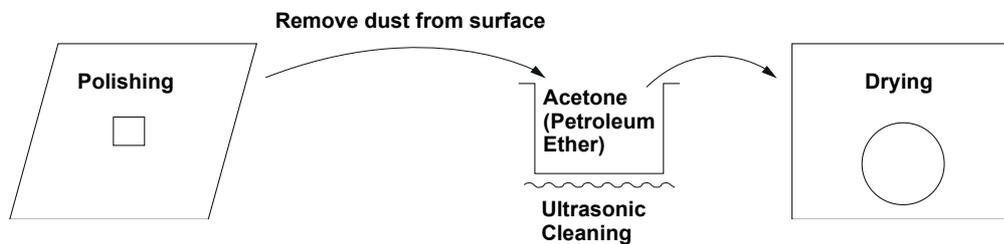
Precautions for polishing the ion source box and repeller electrode:
1. Be careful not to bend the electrode when polishing it.

- 2 Remove dust from the surface with a clean compressed air source.
- 3 Perform ultrasonic cleaning in acetone or petroleum ether.
- 4 Dry the ion source and repeller electrode for about 60 min at 400 °C. .
- 5 Store the dry ion source box and repeller in a clean box.



Note

Do not clean the insulator. Replace a dirty insulator with a new one. (INSULATOR: P/N S225-01068)



3.3.4 Required Materials

1. Abrasive paper
 - P/N S085-35124-02 (general finishing, 20 sheets)
 - P/N S085-35124-03 (extra-fine finishing, 20 sheets)

If parts are extremely contaminated, polish with general finishing paper followed by extra-fine finishing paper. If parts are only slightly contaminated, polish with extra-fine finishing paper only.

3.4 Vacuum Pump Maintenance

This section describes how to change the rotary pump oil and replace the lubricant for the main turbomolecular pump. The rotary pump oil is still hot after shutting down the system. Wait at least 10 minutes before performing maintenance.

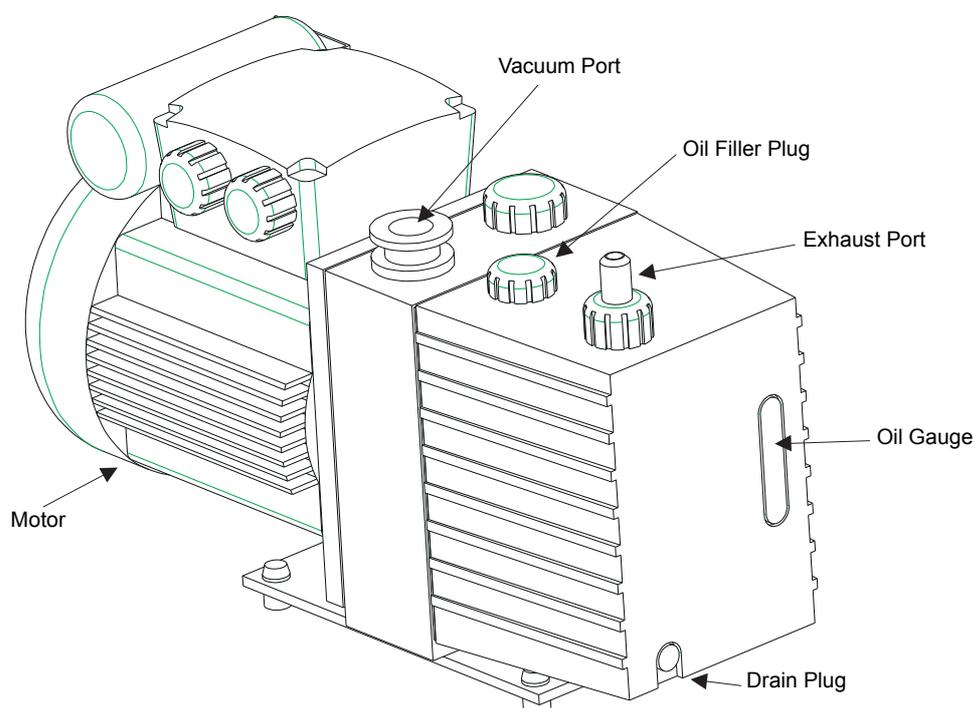
3.4.1 Changing the Rotary Pump Oil

The rotary pump requires an oil change every 3000 hours. The oil must be changed to prevent vacuum level deterioration, oil leaks and excessive noise.

The oil must have the proper characteristics for the pump. Use only pure oil of the specification.

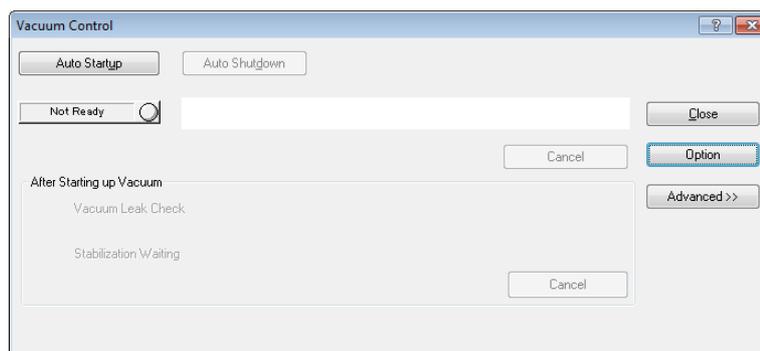
Oil Change Procedure

3

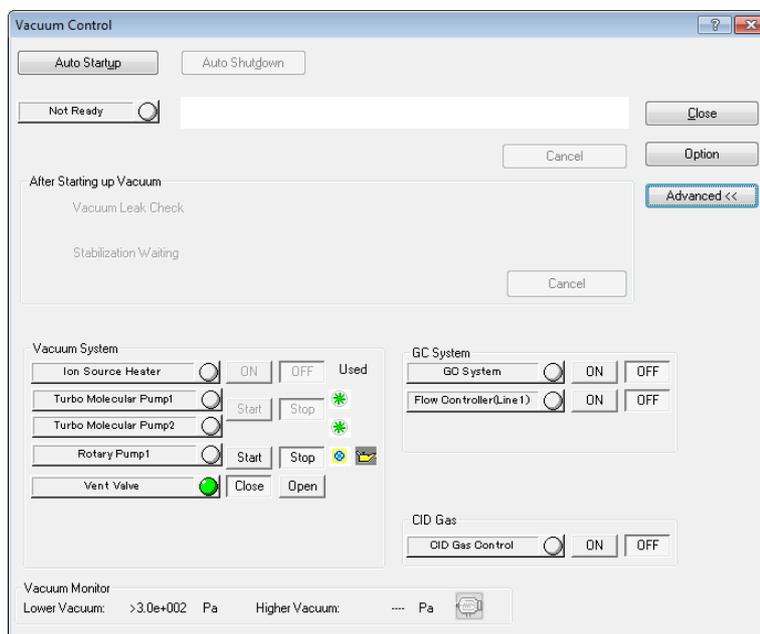


- 1** Shut down the instrument according to [2.4.2 "Shutting Down the Instrument"](#).
- 2** Wait at least 10 min.

- 3 While using an appropriate container and wearing rubber gloves remove the drain plug and drain the oil. Use caution: Oil will be discharged when the drain plug is removed.
- 4 When the oil has finished draining, replace the drain plug temporarily and turn the motor switch on.
- 5 Click the Assistant Bar Vacuum Control icon to open the [Vacuum Control] dialog box.



- 6 Click the Advanced button in the lower part of the dialog box to access the manual operation system.



Click the [Start] button of the rotary pump adjacent to the Rotary Pump oil replacement item in the [Vacuum System] group.
 Leave the rotary pump on for 5 - 10 sec. The pump will operate, discharging the remaining oil inside the pump.

- 7 Click the rotary pump [Stop] button in the [Vacuum Control] dialog box.

- 8 Remove the drain plug, and drain the remaining oil.
- 9 Close the drain plug, and remove the oil filler plug. Add fresh oil until the oil reaches the MAX mark on the oil gauge (about 0.28 L).
- 10 Replace the oil filler plug.
- 11 Set the usage time of the rotary pump oil to "0" according to the procedure described in ["3.7 Reset Usage Frequencies/Usage Times of Consumables"](#).

**Note**

In addition to the oil changing procedure, pump overhaul should be performed every 1500 hours. Refer to the User's Manual for rotary pump.

3

3.4.2 Maintenance for the Turbomolecular Pump

When running continuously in conjunction with the Instrument, no special maintenance is required. However, the rotating parts have a limited working life and should be replaced every 3 years to prevent accidents.

If the equipment will not be used for a long period, it should be operated for 8 hours at least one every 6 months. If it is left unused for more than 6 months, malfunctions may occur.

3.5 Cleaning the Fan

The fan and fan guard must be periodically cleaned.

**Note**

Do not use the instrument if dust has accumulated on the fan or fan guard. Insufficient cooling could compromise performance.

3.5.1 Cleaning the Fan

- 1 Shut down the instrument according to the procedure described in [2.4.2 "Shutting Down the Instrument"](#). Ensure that all of the power switches are off.
- 2 Vacuum dust from the vents of the MS.
- 3 Vacuum dust from the fan and fan guard on the back of the gas chromatograph (GC).
- 4 Vacuum dust from the vents of the personal computer (PC) system and any other instrument modules, such as the autosampler.

**WARNING**

To prevent injuries or accidents when cleaning the fan and fan guard, ensure that instrument is shut down and verify that all power switches are off.

3.6 Checking for Leaks

This section describes how to check the instrument for leaks. If an air leak is clearly present, locate the leak as described in ["3.6.2 MS Vacuum Leak Check"](#), and take corrective measures.

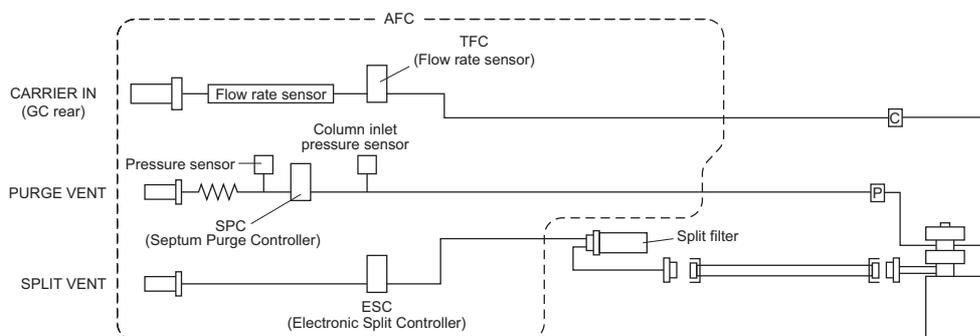
Operating an instrument with an air leak can cause a decrease in sensitivity, an increase in noise, filament burnout or other problems. Always check for leaks after performing maintenance.

A GC leak will have different symptoms than an MS leak. Normally, carrier gas will leak from the system if there is a GC leak, while air will be drawn into the system when there is an MS leak. To check for GC leaks, refer to ["3.6.1 GC Carrier Gas Leak Check"](#). To check for MS leaks, refer to ["3.6.2 MS Vacuum Leak Check"](#) and ["3.6.3 Vacuum Leak Check Using Peak Monitor"](#).

3.6.1 GC Carrier Gas Leak Check

To check for GC carrier gas leaks, a blank plug is installed in the injection port column connection, and the split and purge vents are sealed with a blank nut. This seals the carrier gas in the injection port flow line, the carrier gas flow line, and the split and purge gas flow lines. Leaks are detected by observing the change in pressure of the sealed carrier gas over time. Changes in carrier gas pressure are observed by monitoring the window displayed by selecting [HOME] - [Injection Port] on the GC-2030 Touch Panel.

- 1** Shut down the instrument according to ["2.4.2 Shutting Down the Instrument"](#). Turn the MS power source off, but leave the GC-2030 power source on.
- 2** Open the GC column oven door, and remove the column on the injection side.
- 3** Install the blank plug in place of the column in the injection port.
- 4** Install G-type blank nuts in the vents for the split and purge gas, respectively.



- 5** Ensure that the carrier gas supply pressure (cylinder pressure) exceeds 350 kPa.

6 Select [HOME] - [Injection Port], and set the items as follows.

- Injection Mode : Split
- Flow Control Mode : Press
- Inlet Press : 350 kPa
- Total Flow : 100 mL/min

7 Turn [On] the flow controller control, and turn [On] the AFC control.

8 Wait 5 minutes and verify that the injection pressure is between 300 and 400 kPa. If the pressure is above 400 kPa, loosen the column nut slightly and let the pressure decrease. If the pressure is below 300 kPa, increase the injection pressure slightly.

9 Verify that the total flow is below 2 mL/min. A total flow greater than 2 mL/min indicates a carrier gas leak.

10 Turn [Off] the flow controller control.

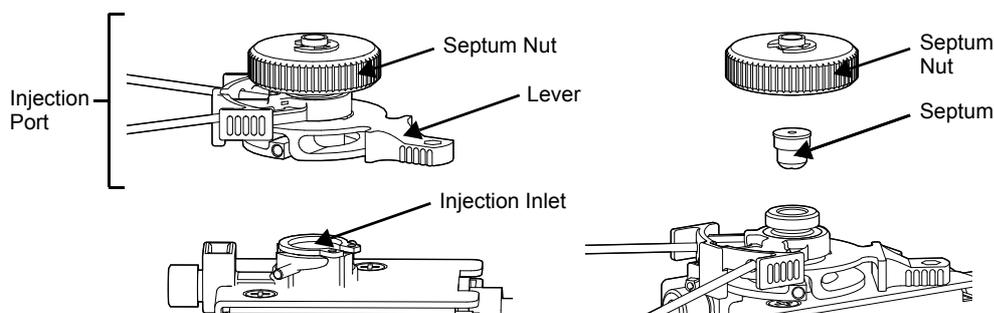
11 Allow pressure to stabilize after turning off the AFC Control.

12 Verify that the pressure does not decrease by more than 5 kPa per 10 minutes. A pressure decrease exceeding 5 kPa per 10 minutes indicates a leak.

13 While the carrier gas is sealed under pressure, possible leaks can be checked by using an electronic gas leak detector (available commercially) at the connections, such as the G-type nuts and injection port nuts.

14 When a leak is detected, tighten the part or remove it and inspect for problems. Replace the three aluminum spacers when a G-type nut is removed.

15 If a leak was detected because of a pressure decrease after step 14, replace the injection port septum, and verify that the O-ring is properly installed on the glass insert in the injection port. Repeat the pressure leak test described in steps 8 - 12.



16 If a leak continues to be detected, the leak is probably located in the flow lines of the split vents. Tighten the G-type nut on the split line, or remove the nut and check for problems. Replace the three aluminum spacers when a G-type nut is removed.

17 Repeat the pressure leak test described in steps 8 - 12.



Note

Precautions for sealing GC carrier gas under pressure:

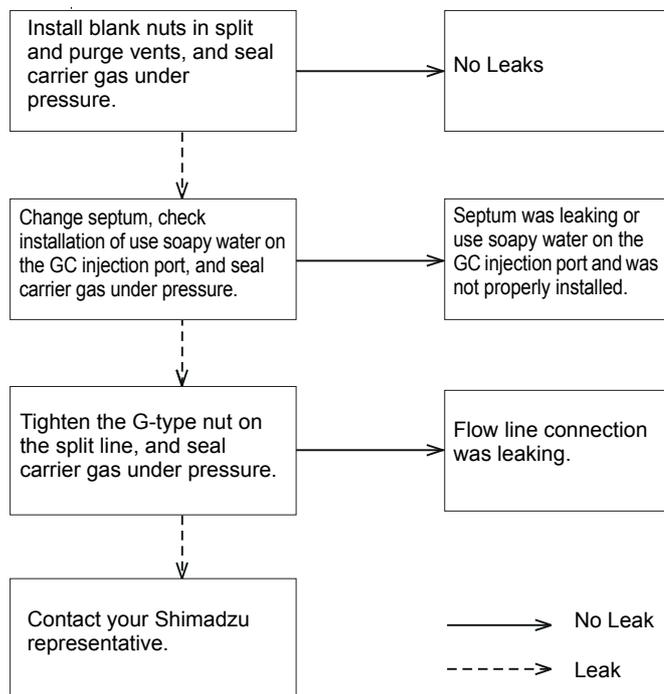
1. Ensure that there are no leaks after disassembling and reconnecting a G-type nut.
2. Replace the three aluminum spacers when a G-type nut is removed.
3. Do not touch any GC parts other than the G-type nut on the split line. Contact your Shimadzu Service Representative for maintenance in other areas.



Note

Do not use soapy water on the GC injection port and AFC piping.

Procedure for Pressure-Sealing Carrier Gas



3.6.2 MS Vacuum Leak Check

This section describes MS vacuum leak check procedures. Leaks can be large enough to take the rotary pump off-line, or small enough to allow the turbomolecular pump to function almost normally.

Ensure that the O-ring is properly installed on the MS door. The O-ring seals the connection between two surfaces, preventing vacuum leaks and maintaining the proper vacuum in the MS.

When the MS door is opened to perform maintenance, observe the following precautions to avoid leaks.



Note

Observe the following precautions to prevent vacuum leaks:

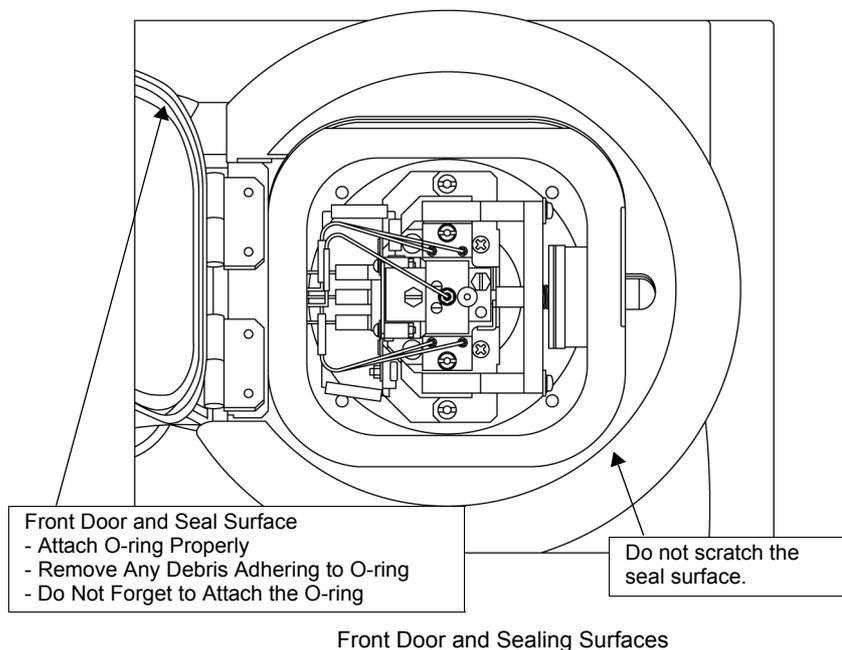
- Do not forget to install the O-ring.
- Install the O-ring properly.
- Remove any foreign material from the O-ring.
- Remove foreign material, including pieces of O-ring, from sealing surfaces.
- Do not scratch sealing surfaces.
- Do not forget to install the Vespel ferrule where the column connects to the interface.
- Firmly tighten the column interface nut.
- Change the GC septum on a regular basis (around 80 to 100 injections).

3

If the rotary or turbomolecular pumps are not functioning properly:

1. The sound of air exhausting from the rotary pump does not diminish after a few minutes.
2. The turbomolecular pump operates, but the vacuum system power shuts down after about 5 minutes.

If the situation in step 2 occurs, a vacuum leak is indicated. Wait for the MS to vent, then check the front door and the connection between the column and interface according to the above precautions for preventing vacuum leaks. If a vacuum leak occurs in a location other than the front door or connection between the column and interface, contact your Shimadzu Service Representative.



3.6.3 Vacuum Leak Check Using Peak Monitor

Vacuum leaks too small to prevent proper operation of the instrument can still affect the instrument performance. This section describes the procedure for checking for those leaks. The operations described in this section can be used provided that the instrument and turbomolecular pump are functioning properly and the Turbo Pump light is green in the [Vacuum Control] dialog box.

This method monitors the water (m/z 18) and nitrogen (m/z 28) peaks from the [Peak Monitor] window. The height of these two peaks is compared to check for small vacuum leaks.

1 Click the GCMS Real Time Analysis Assistant Bar Tuning icon. The [Tuning] window opens.



2 Click the Assistant Bar [Peak Monitor View] icon. This opens the [Peak Monitor] window.

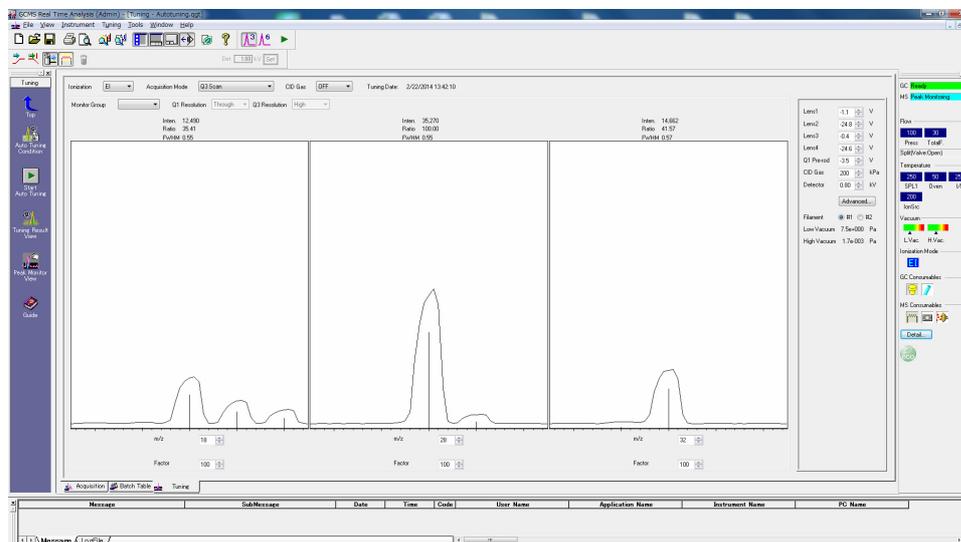


3 In the [Peak Monitor] window, set [Acquisition Mode] to [Q3 Scan] and set the m/z of ions to monitor to 18 (water) and 28 (nitrogen), or choose the [Water, Air] in [Monitor Group].

4 Set the detector voltage to about 0.60 - 1.50 kV so that the peaks for m/z 18 and m/z 28 are visible.

5 Turn on the filament.

- 6** Compare the peak heights for m/z 18 and m/z 28. If the height of m/z 28 is more than twice that of m/z 18, a vacuum leak is indicated.



Note

In some cases, the peak at m/z 19 can be bigger than that at m/z 18 immediately after pulling a vacuum.



Note

If it contains CID gas (argon), a peak will appear at m/z 20 for divalent argon ions (Ar^{2+}).

- 7** When a vacuum leak is detected, shut down the instrument according to "[2.4.2 Shutting Down the Instrument](#)". Turn off the main instrument switch.

- 8** Follow the precautions for vacuum leak prevention described in "[3.6.2 MS Vacuum Leak Check](#)".



Note

If an optional accessory for sample introduction is connected, the vacuum leak check may not meet standards, even if there is not leakage in the GC/MS.

Insufficient purging may result in a high 28 m/z to 18 m/z ratio. When this occurs, increase the total flow of the GC to around 200 mL/min to purge.

3.6.4 Vacuum Check using Petroleum Ether



Note

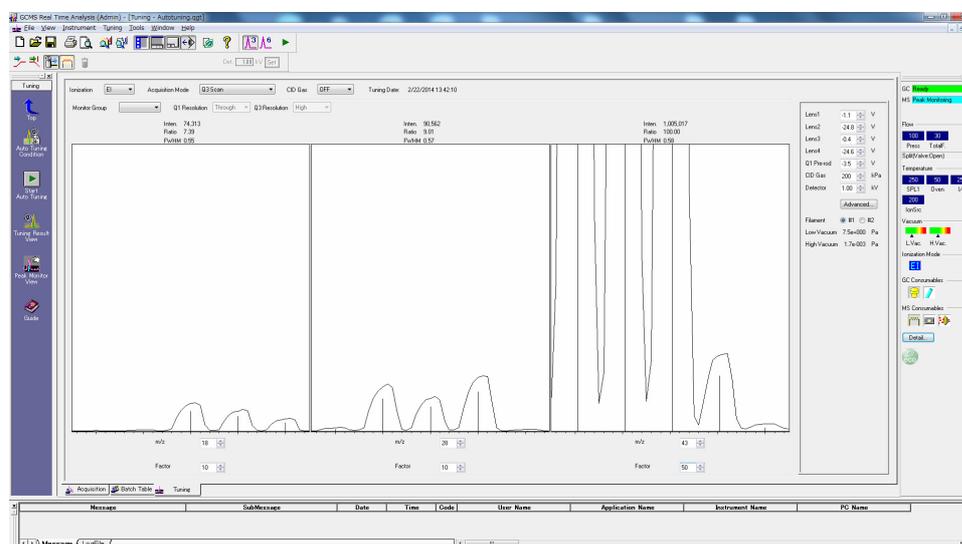
Precautions when Performing Vacuum Leak Check with Petroleum Ether

1. Use only petroleum ether.
2. Do not spill petroleum ether on any electronics.
3. Do not allow petroleum ether to contact any site other than contact surface between the interface and column.

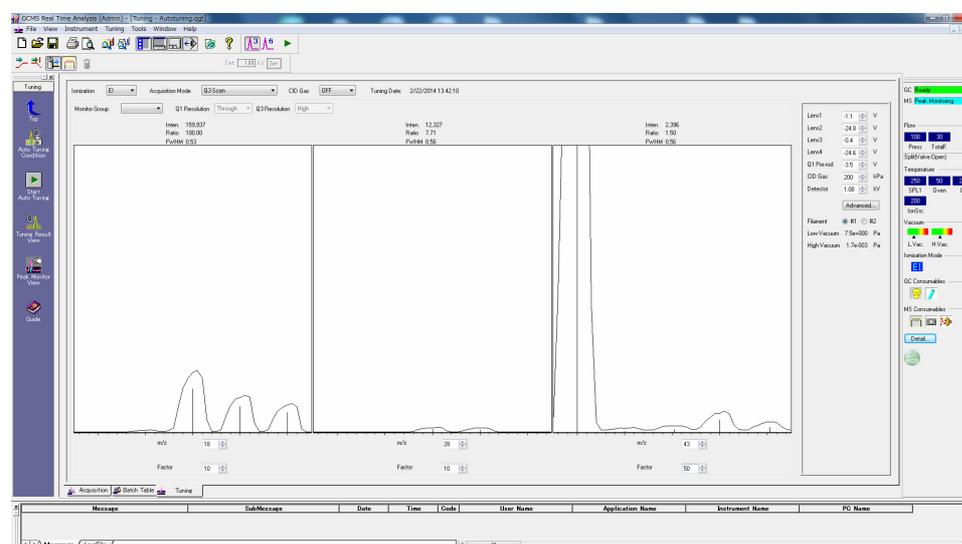
This procedure is based on the suction produced when a vacuum leak occurs in the MS. If there is a leak, the petroleum ether applied to the contact surface between the column and the interface will be detected at that time in the "Peak Monitor" window, by the m/z 43 peak. The vacuum check is performed by monitoring the fluctuations of this m/z 43 peak.

- 1** Click on the Tuning icon in the GCMS analysis assistant bar. The "Tuning" window opens. 
- 2** Click on the Peak Monitor View icon in the Assistant bar to open the "Peak Monitor" window. 
- 3** Set the m/z for the ion to be monitored in the "Peak Monitor" window to 43 (fragment ion of petroleum ether). Set the magnification factor to 50 - 100.
- 4** Select "Q3 Scan" at "Acquisition Mode".
- 5** Set the detector voltage to 0.60 - 1.00 kV.
- 6** Turn on the filament.
- 7** Fill a syringe with petroleum ether.
- 8** Apply petroleum ether to the contact surfaces of the front door and between the column and interface.

- 9 Observe the m/z 43 peak in the "Peak Monitor" window. If the m/z 43 peak fluctuates greatly (increases), there is vacuum leak at the petroleum ether application site.



- 10 Repeat the procedures described in steps 7 and 8. If there is no change in the m/z 43 peak, there is no leak.



- 11 If a vacuum leak has been detected, follow the precautions for vacuum leak prevention described in "3.6.2 MS Vacuum Leak Check".

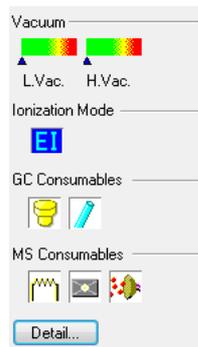
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3.7 Reset Usage Frequencies/Usage Times of Consumables

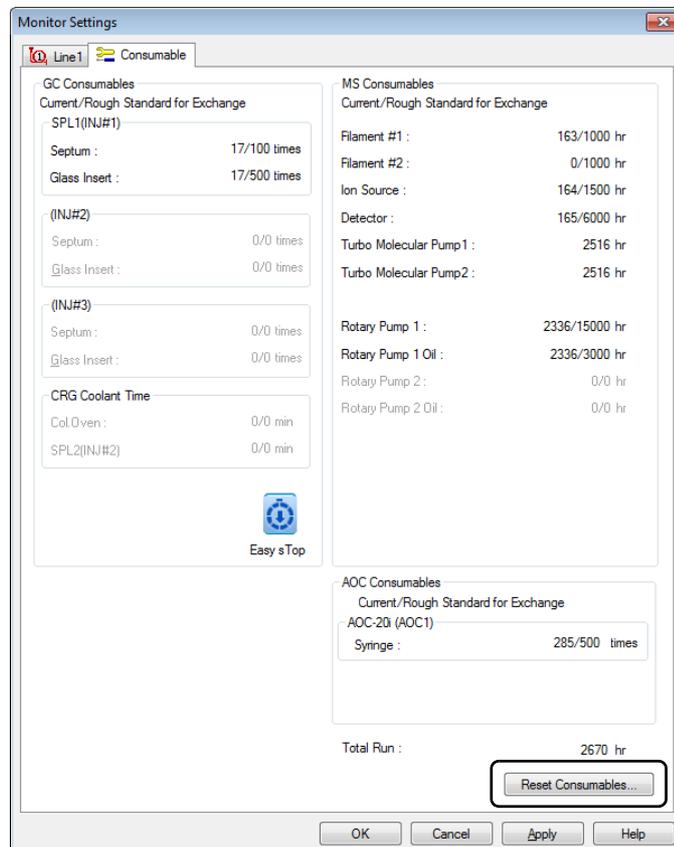
The usage frequencies and usage times of each consumable are recorded in the GCMSsolution Instrument Monitor.

This section describes the procedure for resetting the usage frequencies and usage times of each consumable. After replacing consumables or cleaning the ion source, be sure to reset the usage frequencies and usage times by following the procedure described below.

- 1 Click the Detail button on the [Instrument Monitor] in the [GCMS Real Time Analysis] program.



- 2 Click the Consumable tab in the [Monitor Settings] window. Then, click the [Reset Consumables] button.



- 3** Click the [Clear] button or enter "0" in the usage times cell for the consumable you have just replaced or cleaned. Click the [OK] button. You will return to the previous window.

Reset Consumables

GC

SPL1(INJ#1)

Septum: 17 times

Glass Insert: 17 times

(INJ#2)

Septum: 0 times

Glass Insert: 0 times

(INJ#3)

Septum: 0 times

Glass Insert: 0 times

CRG Coolant Used Time

Column Oven: 0 min

SPL2(INJ#2): 0 min

MS

Filament #1: 163 Hour

Filament #2: 0 Hour

Ion Source: 164 Hour

Rotary Pump 1 Oil: 2336 Hour

AOC-20 Syringe Used Count

AOC-20i: 285

- 4** Click the [OK] button in the [Monitor Settings] dialog box to close it.

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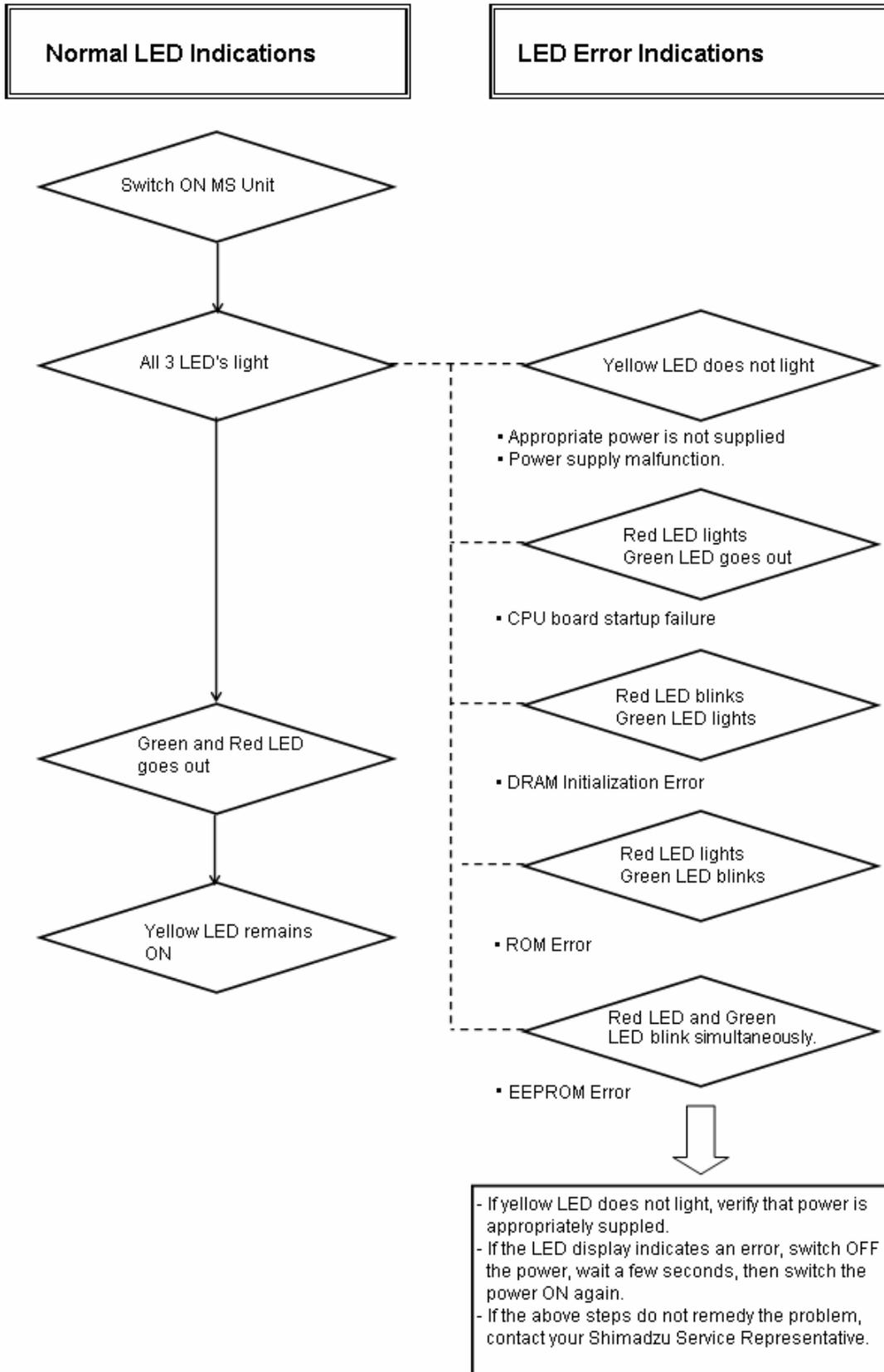
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Troubleshooting

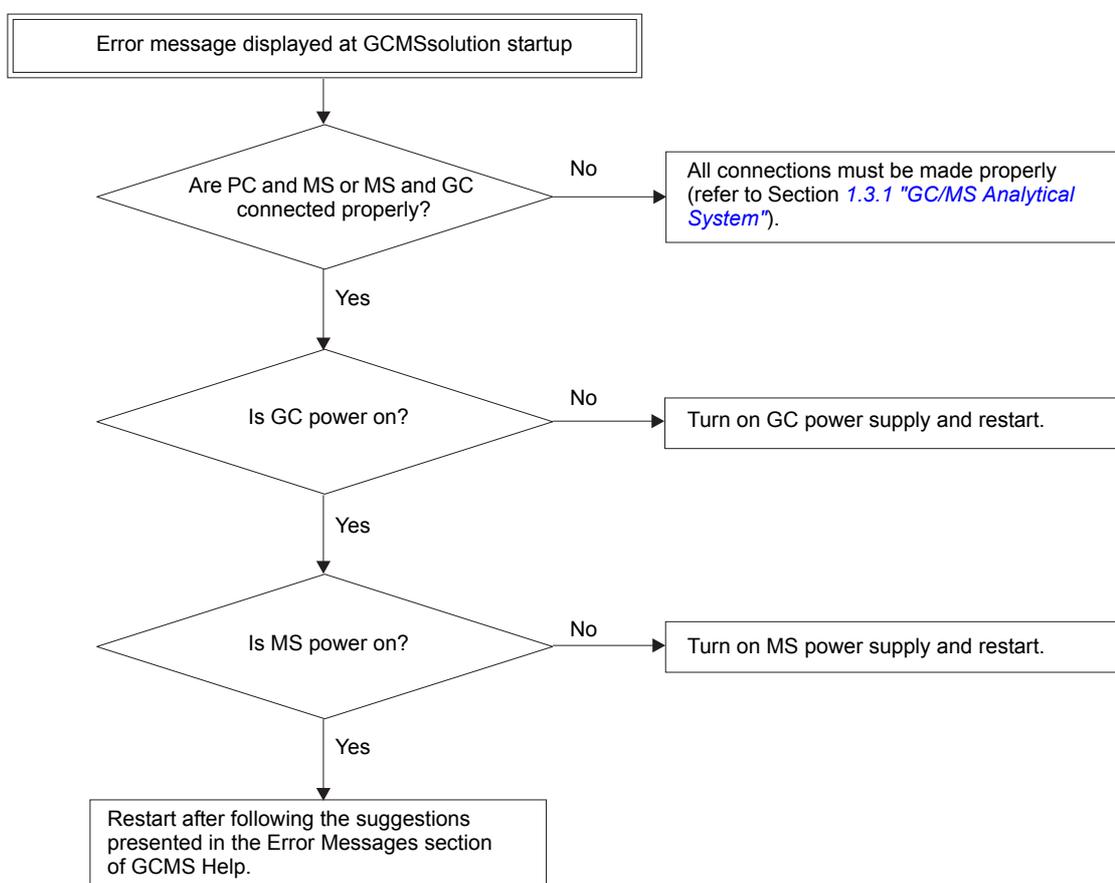
4.1 Operational Problems and Remedial Measures

This section describes operational problems that can occur during an analysis, the causes of these problems and recommended solutions. Contact your Shimadzu Service Representative if symptoms persist after remedial action, or if other problems arise.

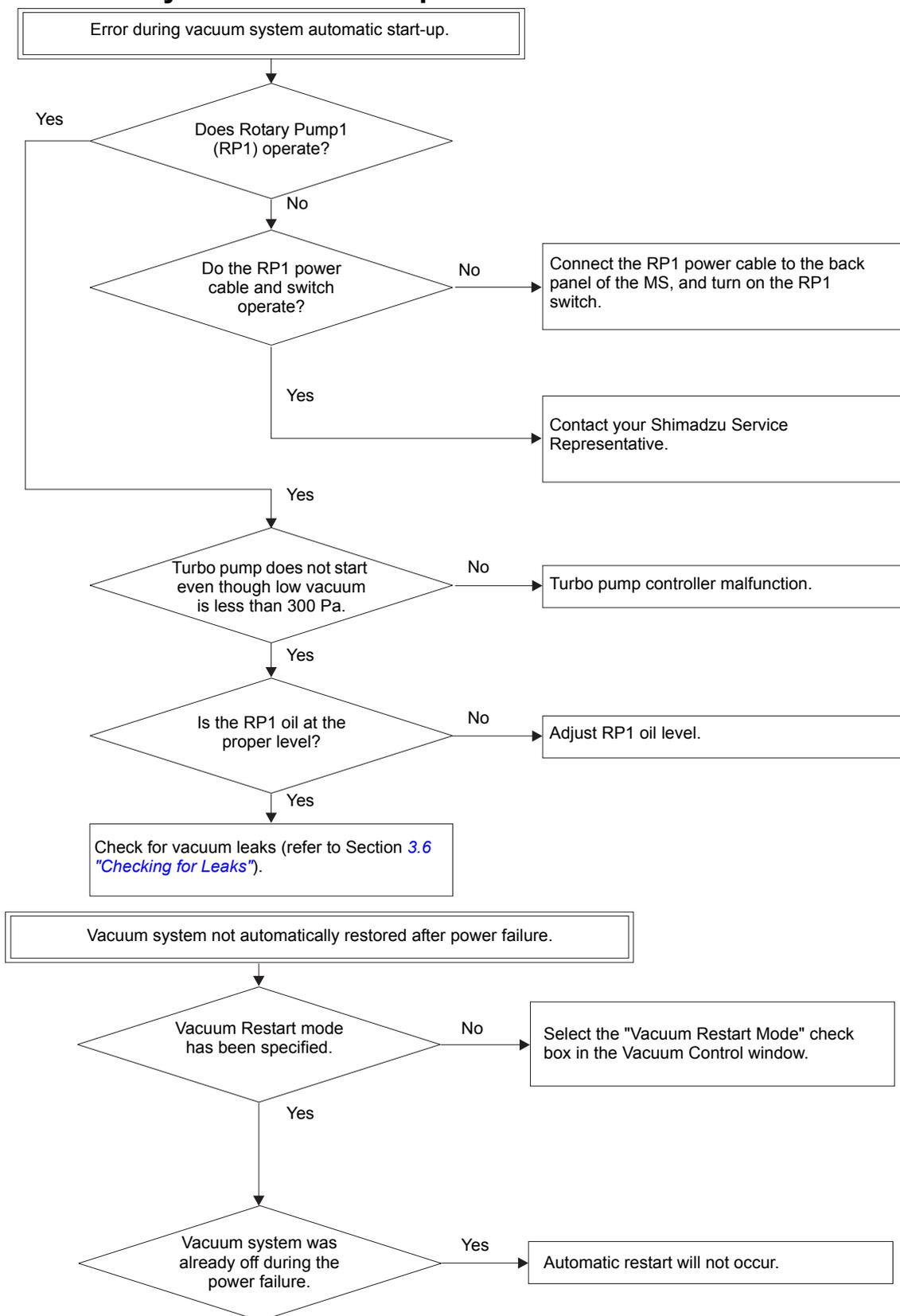
4.1.1 Error status indicated by LED on MS



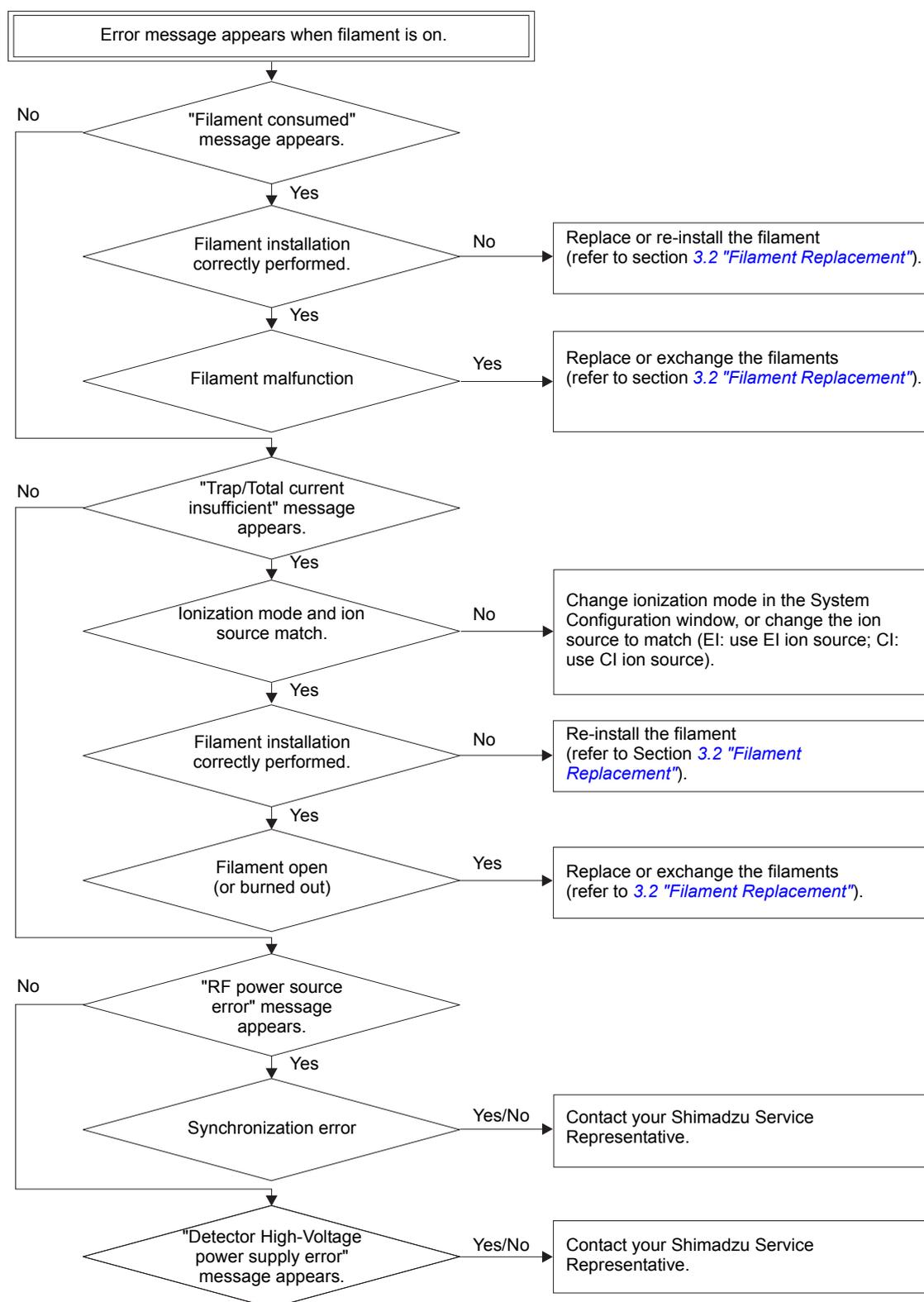
4.1.2 GCMSsolution Software Startup Errors



4.1.3 Vacuum System Auto Startup Errors



4.1.4 MS Filament ON Errors



4.1.5 Autotuning and Analysis Errors

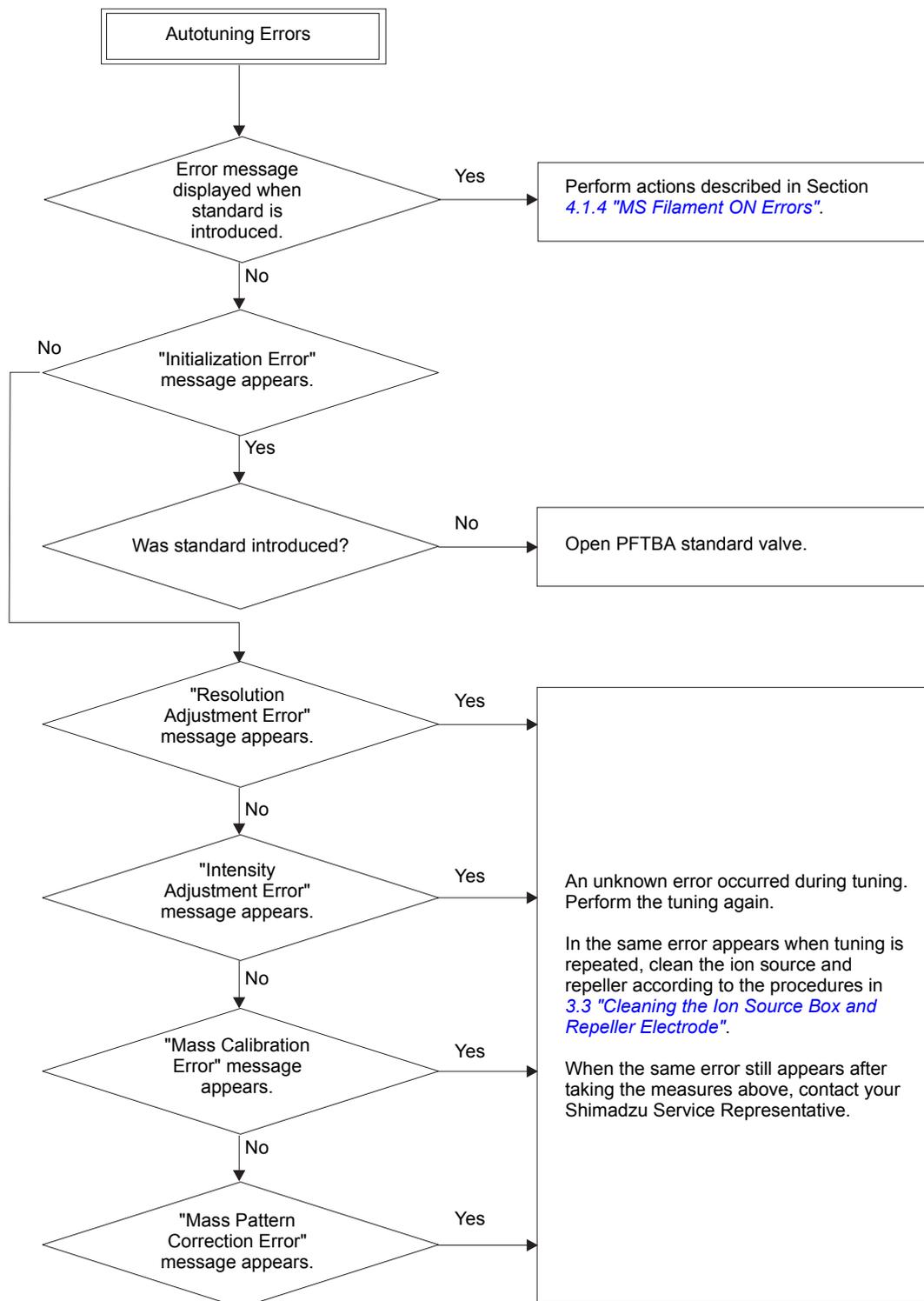
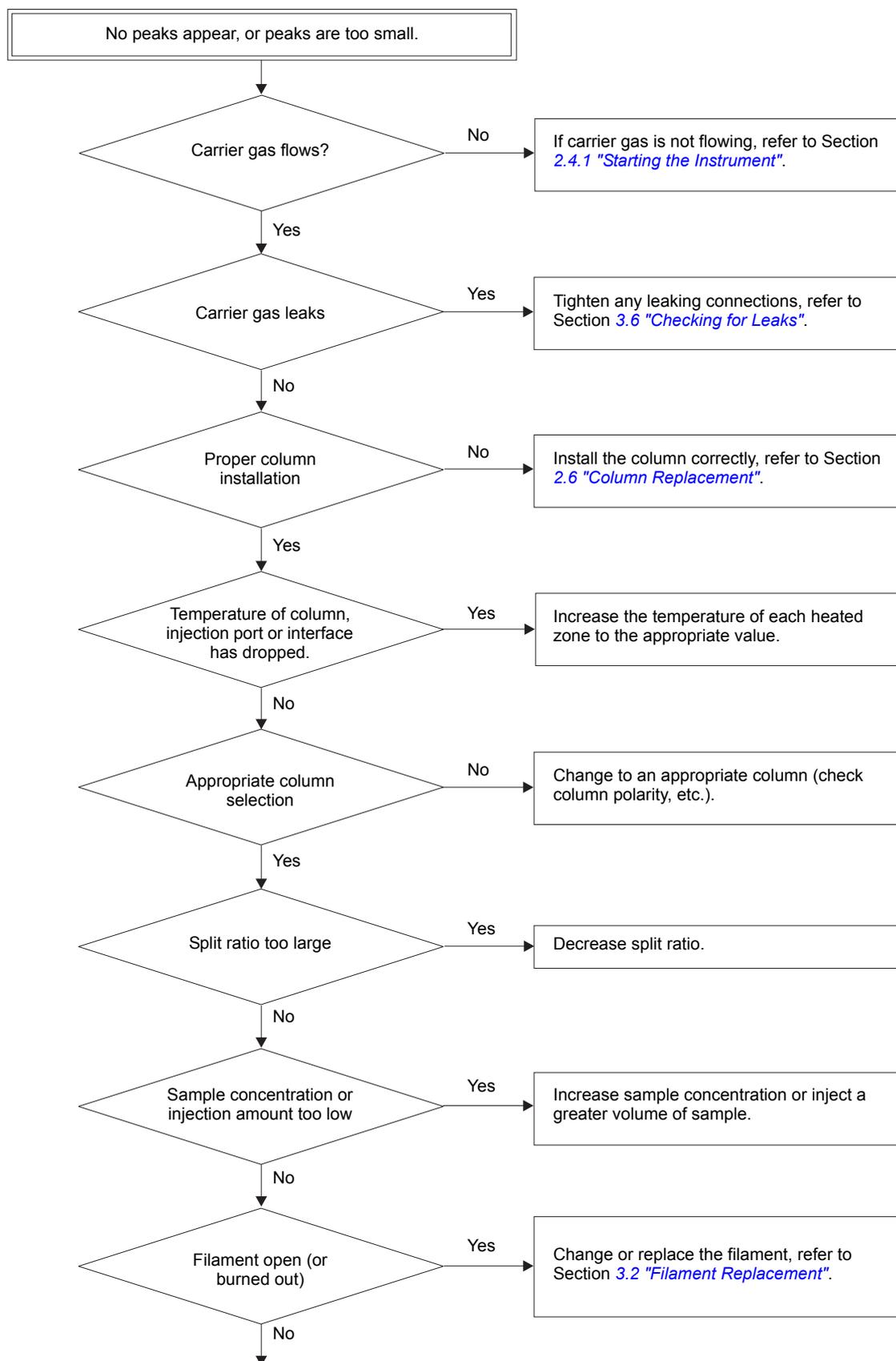
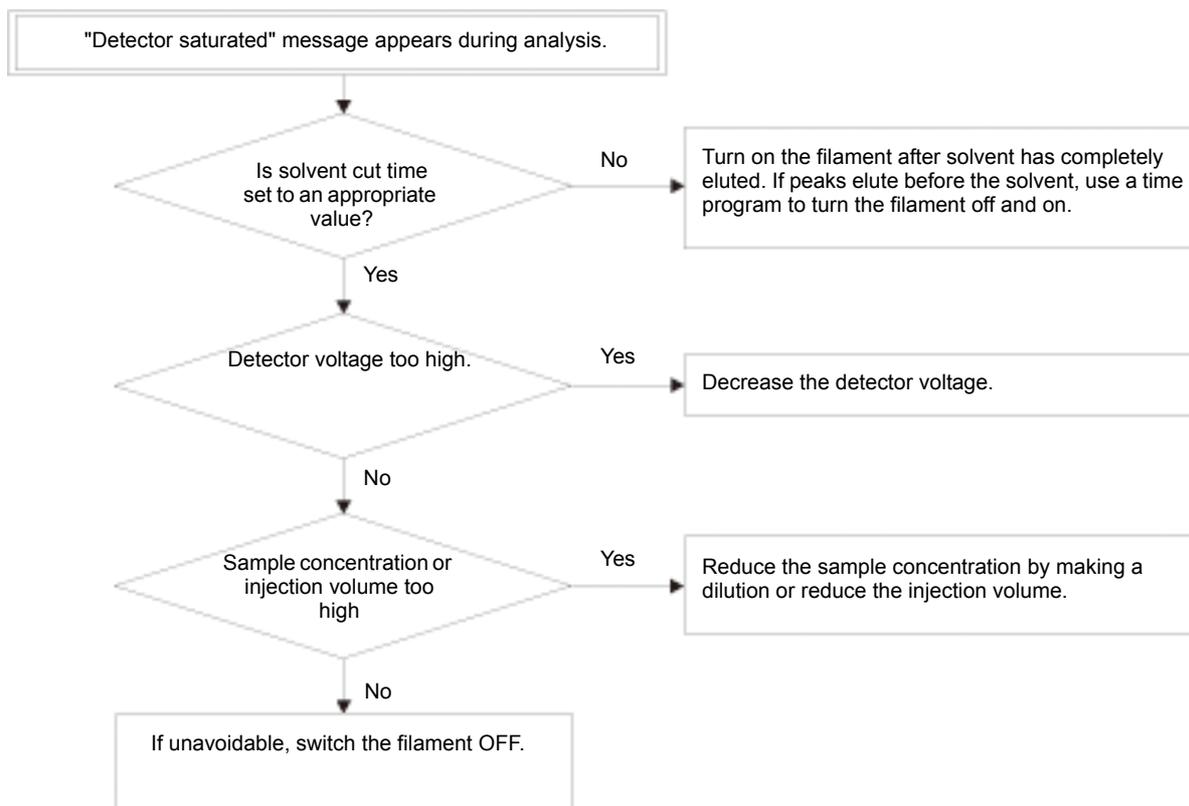
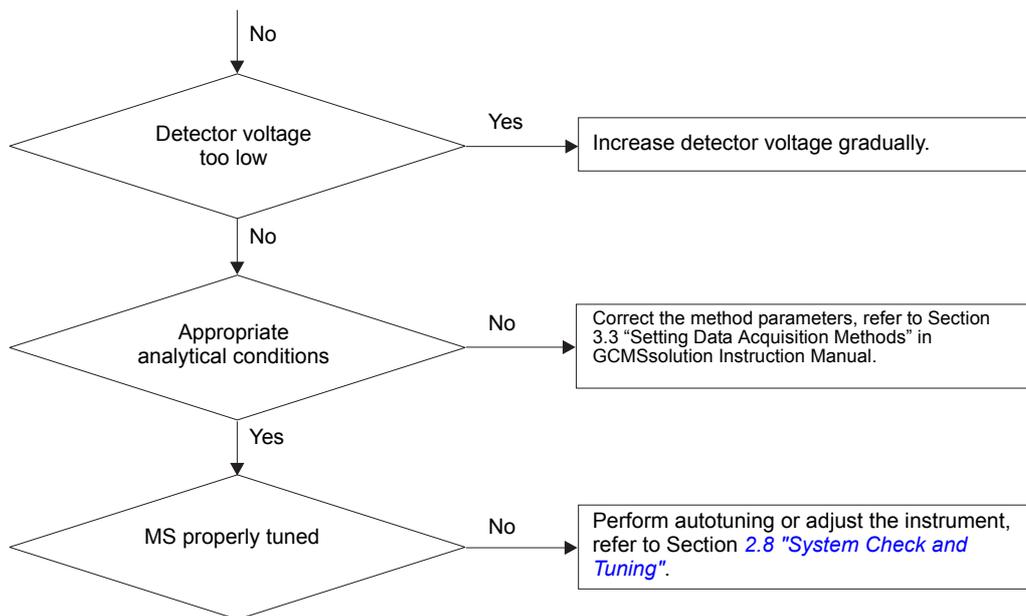
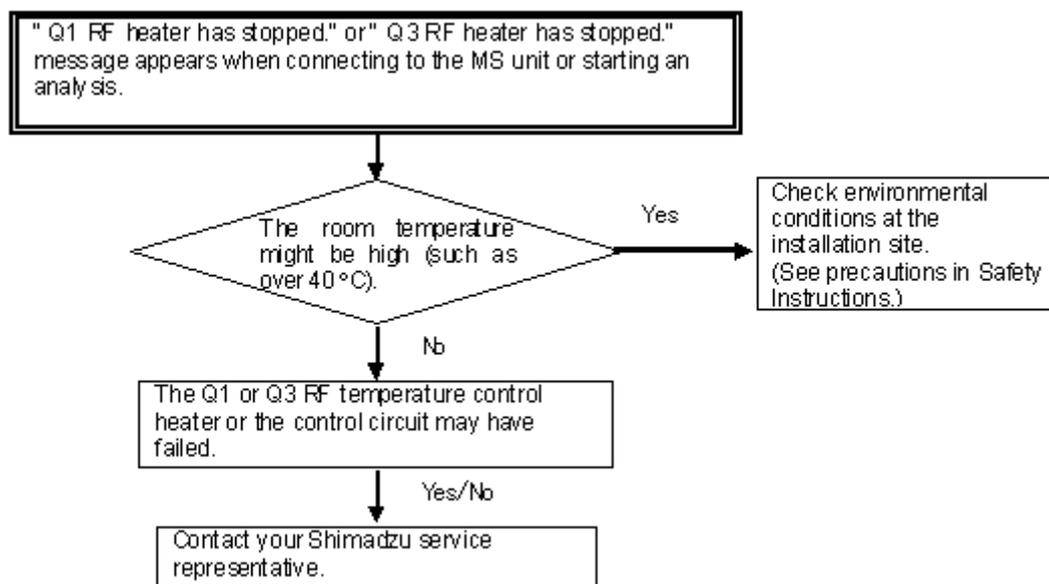


Figure 4.1 Autotuning Errors





4.1.6 RF Temperature Control Error



4

Note

The RF heater shuts OFF if an RF temperature control error occurs. Analysis is still possible in that state, but a shift in the mass axis may occur. To avoid such shifts in the mass axis, perform auto-tuning with RF temperature control switched OFF before acquiring data.

4.2 Vacuum System Protection Functions

This section describes the protection functions when something abnormal is detected in the vacuum system.

4.2.1 Overview

Three items are monitored during evacuation in the instrument. System protection occurs when something abnormal is detected.

- Status of the turbomolecular pump.
 - Back pressure of the turbomolecular pump. (Low vacuum in "Instrument Monitor" shows the backpressure)
 - Vacuum of analyzer housing. (High vacuum in "Instrument Monitor" shows the vacuum)
- When the Ion Gauge is set to "None" in the System Configuration window, high vacuum is not displayed.

4.2.2 Protection Functionality

1. The filament, detector high voltage and RF power supply are turned off when the following occur:

- (1) Low vacuum (monitored by Pirani gauge) is greater than 100.0 Pa.
- (2) Turbomolecular pump is not in "Ready" condition.
- 1.5.8 (3) High vacuum (monitored by ionization gauge) is larger than 1.0E-2 Pa.

Filament, detector high voltage and RF voltage are turned on again when the following conditions are satisfied.

- (1) Low vacuum (monitored by Pirani gauge) is smaller than 80.0 Pa.
- (2) Turbomolecular pump is in "Ready" condition.
- (3) High vacuum (monitored by ionization gauge) is smaller than 0.8E-2 Pa.

2. The vacuum system is automatically stopped when one or more of the following condition continue for more than 5 minutes.

- (1) Low vacuum (monitored by pirani gauge) is larger than 100.0 Pa.
- (2) Turbomolecular pump is not in "Ready" condition.

The vacuum system LED is red and blinks when the vacuum system is stopped.

A.1 Performance

See the specifications sheet.

A.2 Hardware

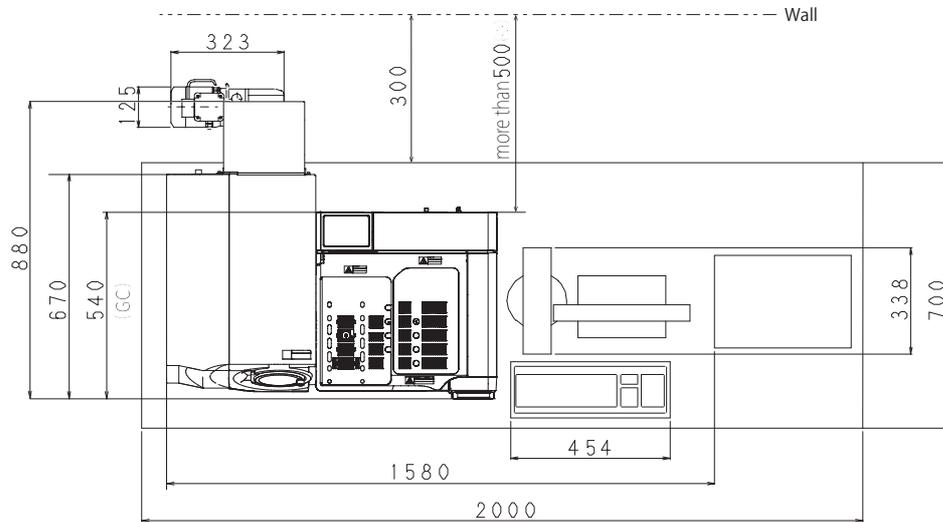
Gas chromatograph	Model	GC-2030
	Oven temperature	Maximum 450 °C
	Injection port temperature	Maximum 450 °C
GC/MS interface	Model	Capillary column direct interface
	Temperature	Room temperature - 350 °C
Ion source	Ionization type	EI
	Temperature	Temperature control: 140 - 300 °C
	Filament	Dual filament (automatic switching)
	Electron voltage setting range	10 - 200 V
	Electron current setting range	5 - 250 µA
Analysis part	Cylindrical quadrupole with pre-rod	
	Collision Cell	Octopole type ultra fast collision cell
Detector	Secondary electron multiplier with conversion dynode	
Vacuum system	Main pump (TMP) 1.5.8	Differential vacuum system Ion source side: 190 L/sec (He) Rod/Detector side: 170 L/sec (He)
	Backing pump (RP)	30 L/min (60 Hz) oil rotary pump

A.3 Installation Requirements

Power supply	Frequency	50/60 Hz
	For GC	Single phase 100 V AC, 115 V AC 1800 VA
		Single phase 230 V AC 2600 VA (for high-powered oven)
	For MS	Single phase 100 V AC to 240 V AC 1000 VA
	Voltage fluctuation	Operating power voltage range $\pm 10\%$
		Specification power voltage range $\pm 5\%$
	Installation Category	Overvoltage Category II (IEC)
	Protection Class	Class I (IEC)
	Short-circuit Current Rating	1000 A
	*A dedicated power source with a circuit breaker should be provided for the unit. Do not share power supply with another device.	
*With regards to voltage fluctuations, the device is designed to work in a range $\pm 10\%$ including fluctuations caused by high frequency noise, but it is recommended that it be kept within $\pm 5\%$ including noise to ensure the best efficiency. The current frequency fluctuation should be kept within ± 0.5 Hz.		
*Power supplies for PC, monitor and printer are also required.		
Environmental requirements	Ground resistance	100 Ω or less Connect the GC, MS, computer, and optional power supply to an equipotential ground.
	Although this instrument can operate within the temperature range from 15 °C to 35 °C, and humidity range from 5 % to 90 %, it is recommended to use the instrument within the ranges described below to maintain performance. <ul style="list-style-type: none"> • Temperature range Constant temperature from 18 °C to 28 °C • Humidity range 40 % to 70 % (Be sure to avoid dew condensation)	
	*An exhaust duct must be installed. The pump exhaust must be connected to the exhaust duct to avoid oil mists and injected solvents and samples from being directly vented into the room. If this is not possible, the oil mist filter below should be installed. Injected solvents and samples are vented directly into the room with the oil mist filter.	
	*Dust, vibrations, spatial noise and corrosive gases should be also avoided.	
	Altitude	2000 m max.
Pollution degree	Pollution degree 2 (IEC)	

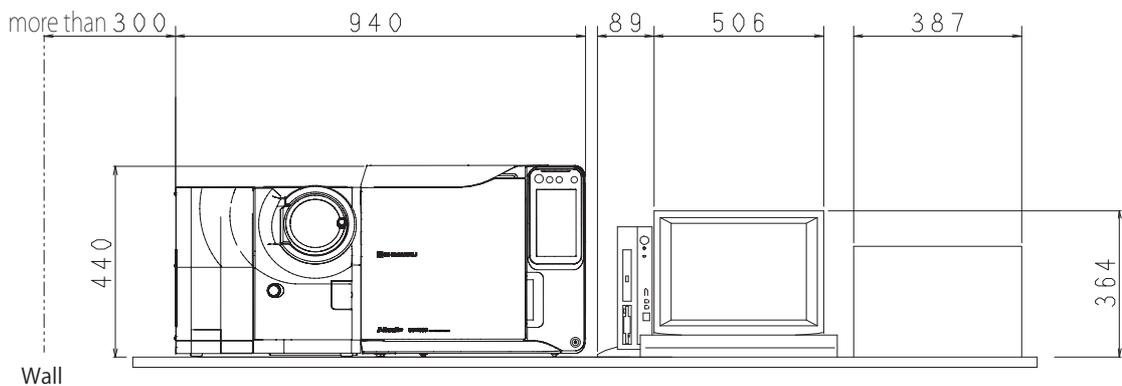
A.3.1 Installation Examples

Installation Example (dimension will vary depending on the PC and printer used.)



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

- Do not place any flammable materials behind the unit.
- Allow a clearance of 50 cm or more between the back cover and the wall.*
- Reserve extra space for maintenance and inspection behind the unit.
- When the optional exhaust duct (S225-80955-41) is used, the clearance from the wall can be a minimum of 25 cm.



Tubing and cable lengths are as follows.

MS rotary pump	Vacuum tubing	1.5 m approx.
	Exhaust tubing	4 m approx.
	Power cord	1.5 m approx.
PC-MS	Cable	2 m approx.
PC-GC	Cable	2 m approx.

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Appendix **B**

Consumable parts and Maintenance parts

B.1 Consumable Parts and Maintenance Parts List

This section presents the consumable parts list and maintenance parts list for a standard the instrument configuration. Parts for optional units are found in their accompanying user manuals. Most of the consumable and maintenance parts for the GC component (GC-2030) are shown in the list, but for additional details, refer to the GC-2030 instruction manual and Maintenance Help of included DVD. If there are questions concerning parts on this list, please ask your Shimadzu representative.

For consumable parts without a replacement period in Remarks column indicated, replace them on an as-needed basis.

B.1.1 GCMS-TQ NX Series

For the maintenance parts of the GC-2030, contact your Shimadzu representative.

For the maintenance parts of the GCMS-TQ NX series other than the parts described below, contact your Shimadzu representative.

Consumable Parts List

Unit Name	Part No.	Part Name	Remarks
GC	S227-35004-01	SEPTUM, LOW-BLEED , 50/PKT	
	S227-35005-01	O-RING, 4D P5, 10/PKT	For glass insert attachment
	S221-48600	DEACTIVATED SILICA WOOL	
	S227-35007-01	DEACTIVATED GLASS INSERT, SPLIT	5/PKT
	S227-35008-01	DEACTIVATED GLASS INSERT, SLESS	5/PKT
	23336	Topaz Liner Splitless Single Taper Gooseneck w/Wool	For inquiries, contact Restek Corporation
	S201-35183-84	GASKET, AL, COLUMN PACKING, 500PC	For line connections
DIRECT INTERFACE	S670-15003-03	FERRULE, GVF/004, 10/PKT	For less than 0.25 mm bore capillary column
	S670-15003-04	FERRULE, GVF/005, 10/PKT	For 0.32 mm bore capillary column
	S670-15003-07	FERRULE, GVF/008, 10/PKT	For 0.53 mm bore capillary column
	S670-11009	NUT, SSNE16/012, 5 PCS	
ION SOURCE	S225-10340-91	FILAMENT	
	S225-17659-91	REPELLER ASSY	
	S225-17697-91	BOX (HEAT TREATED)	
	S225-17698-91	REPRLLER (HEAT TREATED)	
	S225-01068	INSULATOR	
CI/NCI	S202-75101	PIPE ASSY	
	S225-17705-91	BOX ASSY, CI+ (HEAT TREATED)	for CI
	S225-17705-92	BOX ASSY, NCI+ (HEAT TREATED)	for NCI
	S225-17710-91	REPRLLER ASSY, CI+	for CI/NCI
	S016-37575-03	PTFT, 7040AMS3653#16	for CI/NCI PTFE tube (10 m)

B

Unit Name	Part No.	Part Name	Remarks
DI	S200-33168	SEAL	
	S036-15550-12	O-RING, AS568A-012-AD	
	S225-09344	SAMPLE POT (100 pcs)	
	S225-04209	CAP	
	S225-10627-91	DI PROBE ASSY	
	S225-17711-91	REPELLER2, CI+DI(C)	for CI Analysis with DI
CALIBRATION GAS	S225-09493-03	STANDARD SAMPLE, PFTBA (5 g)	
	S225-09493-01	STANDARD SAMPLE, TRIS (0.5 g)	For <i>m/z</i> 866 calibration
	S225-09493-05	Tris (perfluorononyl)-S-triazene (1 g)	For <i>m/z</i> 1066 calibration
VACUUM	S017-30163-11	ROTARY PUMP OIL ULTRAGRADE15 1 L	
JIG, TOOLS	S085-35124-03	ABRASIVE CLOTH, ULTRA FINE, 20/PKT	
	S225-10194-91	JIG, IS	
	S225-01453-94	JIG FOR COLUMN CONNECTION (FOR I/F)	
	S225-01453-95	JIG FOR COLUMN CONNECTION (FOR INJ)	
DETECTOR	S225-09340-11	DETECTOR, FOR TQ8040	Must be replaced by service personnel Consumable part
	S225-20823-01	DETECTOR, FOR TQ8050	Must be replaced by service personnel Consumable part

B.1.2 Tool Kit (Option)

Unit Name	Part No.	Part Name	Remarks
Tool Kit (Option) S225-20051-92	S086-03047-02	SPANNER,DOUBLE OPEN END 10X12-R	2 pcs
	S086-03047-01	SPANNER,DOUBLE OPEN END 6X8-R	2 pcs
	S016-16111-01	TWEEZERS	1 pc
	S086-11002	SCREWDRIVER,TORQUE #2 100MM	1 pc
	S086-12011	NUTDRIVER,4.0	1 pc
	S086-10403	SCREW-DRIVER, MINUS 100MM	1 pc
	S225-20801-01	SPANNER 3/16X1/4 AF	1 pc
	S225-10194-91	JIG,IS	1 pc
	S225-01453-94	JIG FOR COLUMN CONNECTION(I/F)	1 pc
	S225-01453-95	JIG FOR COLUMN CONNECTION(INJ)	1 pc
	S221-50595-91	CUTTER,CAPILLARY TUBE	1 pc
	S086-10530-01	SCREWDRIVER,HEXAGON 006-1.5MM	1 pc
	S026-11007-02	PARALLEL PIN, SUS304 1X12	1 pc
	S221-35566-92	G-TYPE BLANK NUT (WITH 2pcs)	1 pc
	S018-20211-11	TAPE, YELLOW	1 pc

B.1.3 GCMS Entry Kit (Option)

Unit Name	Part No.	Part Name	Remarks
GCMS Entry Kit (Option) S227-37171-01	221-34618 10 µl, SSOT-221- 34618	SYRINGE, FOR AOC-20	1 pc
	227-35004-01	PREMIUM GREEN SEPTUM (50/PKT)	1 pc
	670-15003-03	VESPEL FERRULE 0.4 (10/PKT)	1 pc
	670-15003-04	VESPEL FERRULE 0.5 (10/PKT)	1 pc
	227-35005-01	O-RING, INSERT (10/PKT)	1 pc
	227-35007-01	DEACTIVATED GLASS INSERT, SPLIT (5/ PKT)	1 pc
	227-35008-01	DEACTIVATED GLASS INSERT, SLESS (5/ PKT)	1 pc
	670-11009	NUT, 5 PCS	1 pc

B.1.4 Maintenance Kit for NX (Option)

Unit Name	Part No.	Part Name	Remarks
Maintenance Kit for NX (Option) S225-38070-91	221-77580-42	SPLIT FILTER, FOR GC-2030	1 pc
	221-48990	AU GASKET (1/PKT)	1 pc
	225-10340-91	FILAMENT	2 pcs
	201-35183	AI GASKET (100/PKT)	1 pc
	225-20804-91	ABRASIVE CLOTH, WITH CUT (for polishing the ion source)	1 pc

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C.1 Analysis Modes

The GCMS-TQ series is an analysis instrument for obtaining various types of mass spectra by combining two quadrupole mass filters.

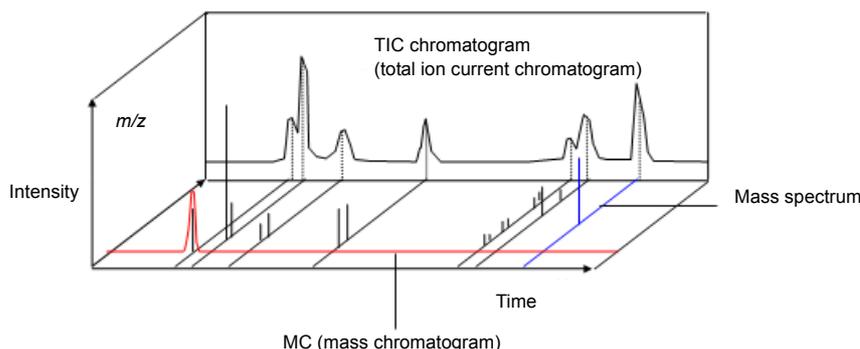
Conventional MS analysis, not to mention MS/MS analysis, is available by selecting the appropriate analysis mode. 1.5.10

C.1.1 MS Analysis

In the GCMS-TQ series, only Q3 MS analysis is available when CID gas is OFF, meanwhile, either Q1 and Q3 analysis available when CID gas is ON. Both scan analysis and SIM analysis are possible like usual GCMS instrument such as GCMS-QP2020 NX. High speed scanning at 20,000 u/sec, which is one of the main features of the GCMS-QP2020 NX, can be performed in only Q3 MS mode.

Analysis Mode	Q1	Collision Cell	Q3
Q1 MS	Selection mode	Transmission mode	
Q3 MS	Transmission mode		Selection mode

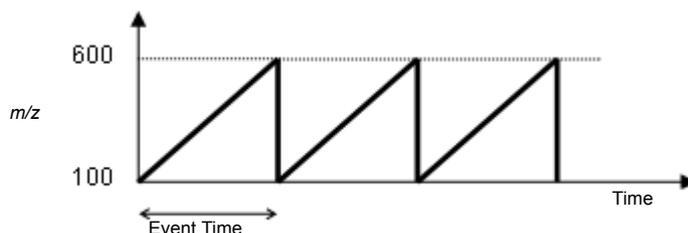
C.1.2 MS Scan Mode



Scan measurement is a method in which data is acquired by repeatedly scanning the mass range in the fixed time interval (at the fixed sampling rate). (I.e., one mass spectrum is obtained once every fixed interval.)

This method is mainly used for qualitative analysis.

As an example, the figure below shows the case that the m/z range from 100 to 500 is scanned.



If we set the scan time 1 second, the range from m/z 100 to 600, which corresponds to mass range 500, is scanned in 1 second.

This is called a scan speed of 500 u/sec.

1.5.10

The GCMS-TQ series is capable of scan measurement at a maximum speed of 20,000 u/sec in Q3 MS mode. The high speed scan measurement is available only for Q3 MS mode, not for Q1 MS mode.

TIC chromatogram (total ion current chromatogram)

A TIC chromatogram is a chromatogram produced by summing up all of the detected ions.

MC (mass chromatogram)

This is a chromatogram that shows the time change of intensity of ion with a specific mass obtained from scan data.

C.1.3 SIM Mode

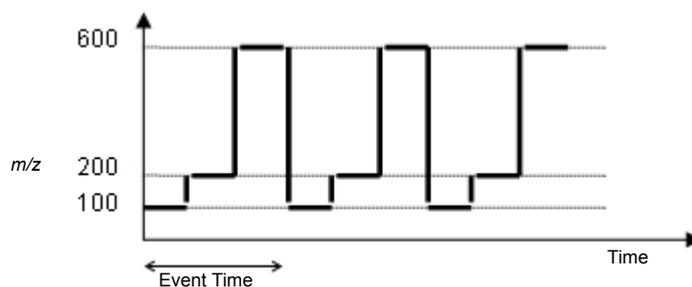
While in scan measurement a mass spectrum is obtained continually, SIM is a method in which only ions with the target mass are selectively detected. Compared with scan measurement, SIM enables highly sensitive analysis without wasting time on detecting unnecessary ions.

Since the peak height and area are stable in addition, SIM is normally used for quantitative analysis.

An example where m/z 100, 200 and 600 are analyzed using SIM is shown below.

Up to 16 channels can be set for a single event. Up to 64 events can be set for each group.

The maximum number of settable events is 2048 in total. (3 channels are set in the example below.)



C.1.4 MS/MS Analysis Mode

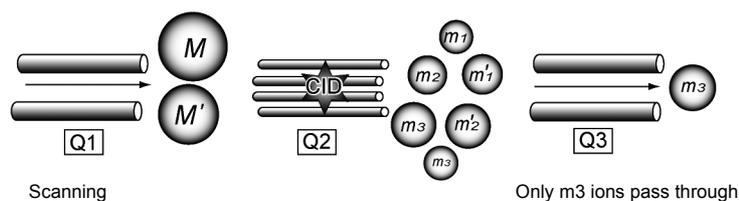
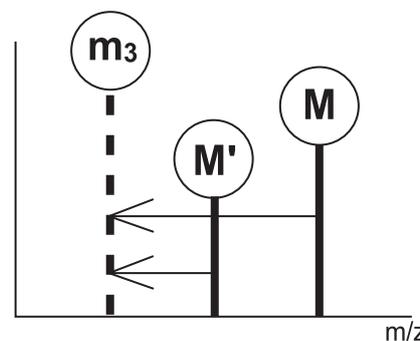
In MS/MS analysis mode the first quadrupole mass filter (Q1) selects specific ions, called precursor ions. The precursor ions are collided with inert gas in the collision cell (collision-induced dissociation, CID) to generate product ions. By measuring the product ions in the second quadrupole mass filter (Q3), we can obtain information regarding the structure of the precursor ions. This analysis method is referred to as MS/MS. Four types of analysis are possible by configuring either scan analysis or SIM analysis for Q1 and Q3.

Analysis Mode	Q1	Collision Cell	Q3
Precursor ion scan	Scan	Transmission mode	SIM
Product ion scan	SIM		Scan
Neutral loss scan	Scan		Scan
MRM	SIM		SIM

C.1.5 Precursor Ion Scan Mode

The analysis method in this mode involves performing scanning in Q1, fixing Q3 to a specific m/z , and selectively analyzing the ions generated in the CID. This allows the examination of precursor ions with common product ions. This mode is suitable for screening ions with common substructures.

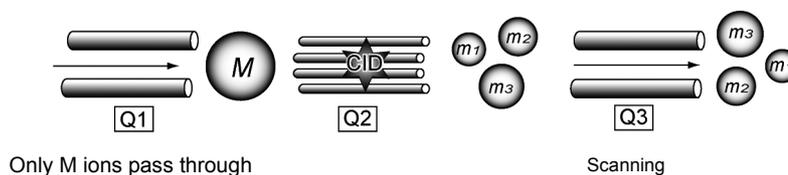
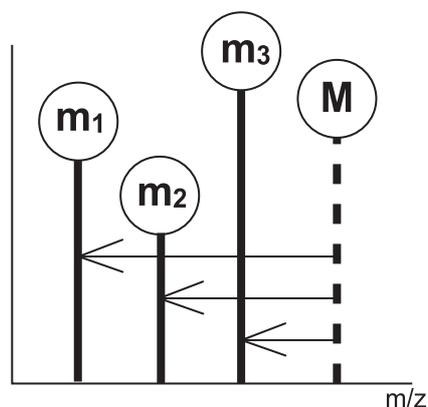
The horizontal axis of the displayed mass spectrum indicates the scale of Q1 and the vertical axis indicates the intensity of the product ions.



C.1.6 Product Ion Scan Mode

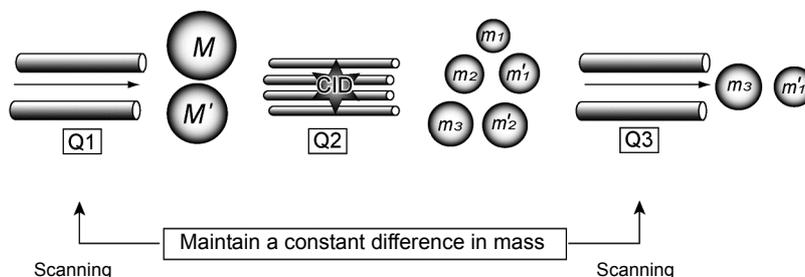
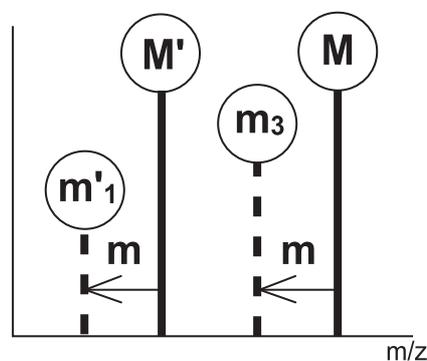
The analysis method in this mode involves fixing Q1 to a specific m/z and performing scan analysis in Q3 on the generated ions by CID of selected precursor ions. This mode is suitable for examining the structure of ions selected in Q1 based on product ion spectra. The horizontal axis denotes m/z in the Q3 scale.

Example of usage: Determination of MRM analysis condition
identification of product ion



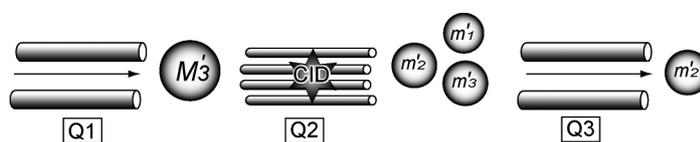
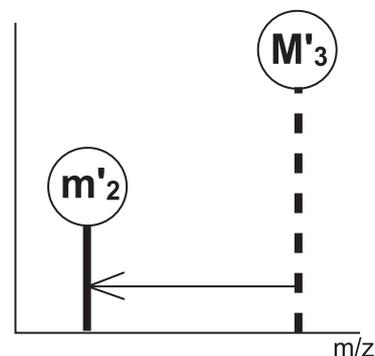
C.1.7 Neutral Loss Scan Mode

The analysis method in this mode involves performing simultaneously Q1 scan and Q3 scan with keeping the m/z difference constant between the two mass filters. This allows the scanning of ions from which common neutral fragments are detached by dissociation. As with the precursor ion scan mode, this mode is suitable for screening ions with common substructures (neutral fragments). Generally, the horizontal axis of the displayed spectrum indicates the scale of Q1 and the vertical axis indicates the intensity of the product ions.



C.1.8 MRM Mode

The analysis method in this mode involves fixing both Q1 and Q3 to a specific m/z and selectively analyzing ions. Product ions, which are generated in CID and subsequently selected in Q3, contain structural information of precursor ions. Highly selective quantitative analysis almost free from unwanted substances can be achieved compared to SIM measurement because both precursor ions and product ions are specified and monitored. This means this mode is effective in determining the quantities of trace analysis of samples including large matrix. It is not mass spectra that can be obtained in MRM mode, but chromatograms, because scanning is not performed.



MRM (selective reaction monitoring)

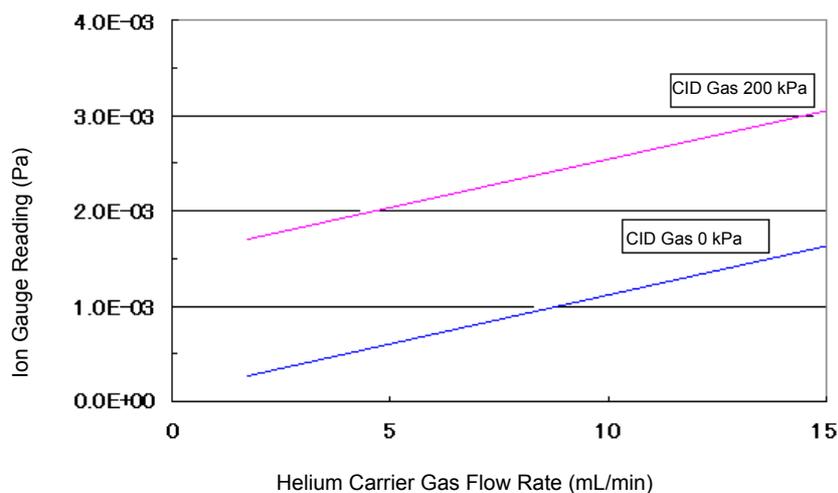
C.2 Vacuum Characteristics

The graph below shows the vacuum dependence on carrier gas flow rate. A variation of roughly $\pm 20\%$ in the vacuum may be observed depending on the ionization interval.

Outgassing from vacuum components may affect the vacuum, especially at low flow rates or when monitored in a short time after starting evacuation.

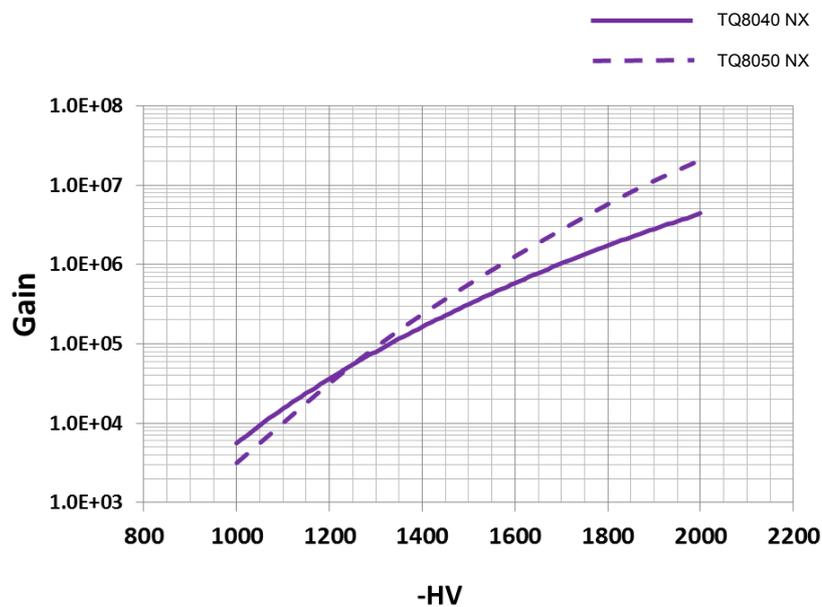
The maximum column flow rate at which data acquisition is possible is 10 mL/min (5 mL/min when CI/NCI ion source). If the internal diameter of the column is 0.53 mm.

Carrier Gas Flow Rate and Vacuum Pressure



C.3 Detector Amplification

The characteristic graph shown in the figure below indicates average values. There will be slight variations depending on the detector.



Note

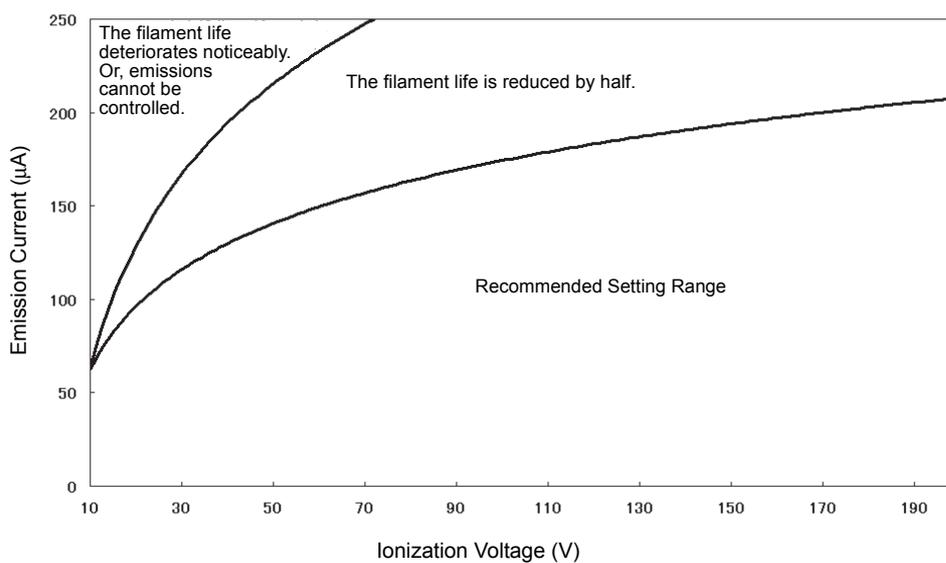
The life of the detector may be shortened if it is used for a long period of time at the detector voltage of 2.0 kV or greater in MRM analysis, etc.

C

C.4 Ionization Voltage/Emission Current and Filament Life

Ionization voltage and emission current can be changed; however, parameter setting may affect the life of the filament. Refer to the graph below when changing these parameters.

Ionization Voltage/Emission Current and Filament Life



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