Hitachi High-Tech
HITACHI

INSTRUCTION MANUAL

FOR

CHROMASTER 5440 FL DETECTOR

- Before using the instrument, read the safety instructions and precautions carefully.
- Be sure to observe the safety instructions in this manual and the WARNING/CAUTION labels on the instrument.
- Keep this manual in a safe place nearby so it can be referred to whenever needed.

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PREFACE

Thank you very much for purchasing Chromaster 5440 FL Detector.
The Chromaster 5440 FL Detector is specifically designed for fluorescence detection of sample components in a liquid chromatograph system.
Note that physiologically or biologically active samples are not applicable to the Chromaster 5440 FL Detector because of possible infection with bacteria or viruses.

This product is intended for use by persons having a basic knowledge of chemical analysis.
Remember that improper use of analytical instruments, chemicals or samples would result not only in wrong analytical data but also in consequences adverse to safety. Note that it is allowed only for persons having a basic knowledge of chemical analysis procedures to use this instrument.

Carefully read this instruction manual before attempting operation. For proper use of the software, please acquaint yourself with it.

The liquid chromatograph system comprises a pump unit for delivering mobile phases, a sample introduction unit for injecting samples (autosampler, manual injector), a column unit for separating components of each sample, a column oven unit for maintaining the column at a constant temperature, and a detector unit for detecting separated sample components as electric signals. Before using the liquid chromatograph system, read carefully the instruction manual accompanying each of these units so that you can carry out analysis properly.

ABOUT THIS MANUAL

This instruction manual describe how to use and maintein the Chromaster 5440 FL Detector.
This instruction manual. consists of the following sections.

IMPORTANT (Warranty, Installation, Relocation, After-sale Technical Service, etc)
SAFETY SUMMARY (collected and summarized)
Section 1 OVERVIEW (Basic Operation)
Section 2 FUNCTIONS (Name and Function of Each Part on FL detector)
Section 3 OPERATION (Basic Operation)
Section 4 MAINTENANCE & TROUBLESHOOTING (Operational Check)
Section 5 SPARE PARTS (Replacement Parts and Consumables)
Section 6 INDEX
APPENDIX1 INSTRATTION
APPENDIX2 DESCRIPTION ON CONTACT SIGNAL COMMUNICATION
APPENDIX3 GLOSSARY

First of all, read "IMPORTANT" and "SAFETY SUMMARY" at the beginning of this manual for ensuring safety in operation of pump and accessories.

IMPORTANT

Warranty on Product

Limited Warranty

The Chromaster 5440 FL Detector is warranted to be free from defects in material or workmanship under normal use within the product specifications indicated in this manual and under conditions given below. This warranty is void if the software is not used according to the instruction manual.
The manufacturer makes no warranties, either express or implied, except as provided herein, including without limitation thereof, warranties as to marketability, merchantability, for a particular purpose or use, or against infringement of any patent.
No oral or written information or advice given by the manufacturer, its dealers, distributors, agents or employees shall create a warranty or in any way increase the scope of this warranty.

Scope of Warranty

Any parts which prove to be defective in design or workmanship during the warranty period will be repaired, adjusted or replaced without charge. A substitute part may be used for repair, or replacement with an equivalent product may be made instead of repair. Such system components as a personal computer and printer to be updated frequently for improvement may not be available in original versions at the time of replacement.
Note that this warranty does not apply to the instrument after it is discarded, or if modified by the user or resold without permission from the manufacturer, consumable parts, and any failure of lifetime-expired parts.
The manufacturer assumes no liability for any damage to data or application software due to any possible fault or failure of this instrument.

Warranty Period

One year from the date of initial installation.
(In case a separate warranty document has been issued, the warranty period indicated in it takes precedence over the above period.)

Warranty Limitations and Exclusions

Disclaimer of Warranty

THE MANUFACTURER MAKES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, EXCEPT AS PROVIDED HEREIN, INCLUDING WITHOUT LIMITATION THEREOF, WARRANTIES AS TO MARKETABILITY, MERCHANTABILITY, FOR A PARTICULAR PURPOSE OR USE, OR AGAINST INFRINGEMENT OF ANY PATENT. IN NO EVENT SHALL THE MANUFACTURER BE LIABLE FOR ANY DIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OF ANY NATURE, OR LOSSES OR EXPENSES RESULTING FROM ANY DEFECTIVE PRODUCT OR THE USE OF ANY PRODUCT.
NO ORAL OR WRITTEN INFORMATION OR ADVICE GIVEN BY THE MANUFACTURER, ITS DEALERS, DISTRIBUTORS, AGENTS OR EMPLOYEES SHALL CREATE A WARRANTY OR IN ANY WAY INCREASE THE SCOPE OF THIS WARRANTY.

Note that the following cases are excluded from the scope of this warranty, i.e., these cases are beyond the coverage of free-of-charge repair even during the warranty period indicated above.

(a) Failure due to operation at a place not meeting the installation requirements specified by the manufacturer.

(b) Failure due to power supply voltage/frequency other than specified by the manufacturer or due to abnormality in power supply.

(c) Corrosion or deterioration of the tubing due to impurities contained in reagent, gas, air or cooling water supplied by the user.

(d) Corrosion of the electric circuits or deterioration of the optical elements due to highly corrosive atmospheric gas.

(e) Failure due to use of software, hardware or spare parts not supplied by the manufacturer.

(f) Failure due to use not described in the manual or improper repair not approved by the manufacturer.

(g) Failure due to maintenance or repair by other than service personnel qualified by the manufacturer.

(h) Failure due to relocation or transport conducted not under the supervision of the manufacturer after the initial installation of the instrument.

(i) Failure due to disassembly, modification or relocation not approved by the manufacturer.

(j) Failure due to acts of God, including fire, earthquake, storm, flood, lightning, social disturbance, riot, crime, insurrection, terrorism, war (declared or undeclared), radioactive pollution, contamination with harmful substance, etc.

(k) Failure of the hardware, or damage to the system software, application software, data or hard disk due to computer virus infection.

(l) After disposal of this instrument, after its resale without prior approval from the manufacturer, consumable parts, and failure of any part that have reached the end of its service life.

(m) Failure due to a life-limited part that has exceeded the end of its useful lifetime.

Limitations of Liability

Hitachi High-Technologies shall not be liable in contract or in tort (including, without limitation, negligence, strict liability or otherwise) for claims by third parties (other then for bodily injury or property damage), for economic losses of any kind or for any special, incidental, indirect, consequential, punitive or exemplary damages, arising in any way out of the performance of, or failure to perform, this instrument, even if Hitachi High-Technologies could foresee or has been advised of the possibility of such damages.

Disclaimer of Liability for Industrial Properties of a Third Party

Hitachi High-Technologies does not assume any liability for a third party's complaint regarding infringement of any patent rights or industrial properties with respect to products manufactured through use of the equipment supplied by Hitachi High-Technologies or its related companies or application of said instrument.

Installation, Relocation and After-sale Technical Service

Installation and Relocation

(a) Installation at delivery shall not be carried out by the user. It shall be carried out by our sales representative or the engineers who have been trained and qualified for this purpose by us in order to use the instrument safely and accurately.

(b) Before installation, the user shall make preparations for satisfying the installation requirements in accordance with this instruction manual.

(c) If relocation becomes necessary after initial installation (delivery), please contact the dealer from whom you purchased the instrument or our sales representative.

After-sales Service

(a) For after-sale technical service of this instrument, please notify our local sales representative or service office.

(b) A maintenance & service contract is available for servicing the instrument after the warranty period has ended (service available at charge).

(c) Maintenance parts and consumables will be supplied during the useful life of this instrument (7 years). And even though parts and/or units (when available) will continue to be supplied after the specified useful life has ended (for up to 10 years), they are not intended to extend the useful life of the instrument. Also, substitutes may be supplied in the event of discontinuance of manufacture of certain parts or units.

(d) Some main components of the instrument other than maintenance parts and consumables may not be available in the event of discontinuance of manufacture of the main unit. If repair cannot be provided in the case of instrument malfunction, we recommend that you consider discontinuing use and replacing the instrument.

Technical Seminars and Training Courses for Users

We offer technical seminars and training courses at either our or user's facilities to ensure proper and safe operation of the analytical instrument to its full performance. For further information, contact our sales representative. (Applicants will be charged.)

Estimated Life time of the Instrument

This instrument has a useful service life of seven (7) years after the date of initial use (installation), which is estimated under the condition that periodic maintenance, checkup, replacement of life-limited parts, and repair of worn parts are carried out as specified in the instruction manual.

Caution on Disposal of Instrument

Although at present the instrument does not use materials that would directly cause environmental disruption, the environmental protection laws and regulations may be revised or amended. When planning to dispose of the instrument, therefore, be sure to check the latest issues of the relevant laws and regulations or consult our sales representative.

Disposal of This Instrument and Its Parts

In the present design, this instrument does not use materials that would directly cause environmental harm. Note, however, that the environmental protection laws and regulations may be revised or amended. Therefore, be sure to consult with your local Hitachi High-Technologies sales or service representative when planning disposal of this instrument or its parts and accessories.
When discarding or recycling the used PC, it is the user's responsibility to delete all data from the hard drive.
When discarding the chargeable battery mounted on the PC, refer waste disposal treatment servicing to an authorized waste collection agent, or send the battery for recycling after providing insulation on its positive and negative terminals with adhesive vinyl tape or the like.

Precautions on CE Conformity Marking

In consideration of use in the European countries, this instrument bears the CE mark indicating the conformity to the requirements mentioned below.

Electromagnetic Compatibility Requirement

This instrument is designed to satisfy the European Norm EN61326-1 (2006) for the CE conformity marking through conformity to the EMC Directive 2004/108/EC.

This instrument is classified as Class A of EN61326-1. So, this instrument must not be used in domestic establishments nor in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purpose.

And this instrument is also designed to comply with table 1 "Basic immunity test requirements" in the above European Norms. If the instrument is used near an intense electromagnetic source, however, interfering noise may be given to the instrument to cause an adverse effect on its performance or functionality.

Safety Requirement

This instrument is also designed to satisfy the European Norm EN61010-1 (2001) for the CE conformity marking through conformity to the LVD Directive 2006/95/EC.
This instrument is requested to be used in a suitable environment and grounded appropriately.

Information for Users on WEEE (only for EU Countries)

This symbol is in compliance with the Waste Electrical and Electronic Equipment directive 2002/96/EC (WEEE).
This symbol on the product indicates the requirement NOT to dispose of the equipment as unsorted municipal waste, but use the return and collection systems available.

Information on Disposal for Users

1. In the European Union

If you need to discard this product or discard user serviceable parts:
Please contact your local sales representative or distributor who will inform you of the recycle of the product. You might be charged for the costs arising from take-back and recycling.

2. In other Countries outside the EU

If you wish to discard this product, please contact your local authorities and ask for the correct method of disposal.

Other Precautions

Handling of Chemicals and Samples

(a) The user is responsible for following relevant laws and regulations in handling, storage and disposal of chemicals and samples used in analytical operation with this instrument.

(b) Reagents, standard solutions and accuracy-control samples shall be handled, stored and discarded as instructed by the respective suppliers.

(c) Physiologically or biologically active samples are not applicable to this instrument because of possible infection with bacteria or viruses.

Disturbance by Electromagnetic Wave

This instrument conforms to Class A in the EN standards EN61326 (first edition 2002-02). Avoid installing this instrument near equipment whose data will be affected by electromagnetic noise within the permissible range of this standard.
Also, data of this instrument may be affected by electromagnetic noise or the instrument itself may malfunction. In the room where this instrument is installed, the following electric devices must not be brought: Devices which emit radio waves such as mobile phone, transceiver, wireless telephone and similar small-power device.

Trademark Acknowledgments

Empower™ are registered trademarks or trademarks of Waters Corporation USA.

SAFETY SUMMARY

Before using the Chromaster 5440 FL Detector, be sure to read the following safety instructions carefully.

The hazard warnings which appear on the warning labels on the product or in the manual have one of the following alert headings consisting of a safety alert symbol ⚠ and signal word WARNING or CAUTION.

	:	The alert symbol shown at left precedes every signal word for hazard warnings, and appears in safety-related descriptions in the manual. To prevent possible hazards or injury, be sure to follow the safety precautions preceded by this symbol.
⚠**WARNING**	:	Indicates a potentially hazardous situation which, if not avoided, will or can result in death or serious injury.
⚠**CAUTION**	:	Indicates a potentially hazardous situation which, if not avoided, will or can result in minor or moderate injury.

The following signal word *NOTICE* or NOTE is used to indicate precautionary instructions concerning possible property damage.

NOTICE	:	Used to indicate a potentially hazardous situation which, if not avoided, will or can result in damage to user's property, serious damage to the instrument, damage to data, or environmental pollution, though personal injury may not be incurred.
NOTE	:	Used to indicate explanatory information for ensuring proper instrument operation and accurate measurement while preventing any possible damage to the instrument.

- Be sure to observe the precautionary instructions in the manuals accompanying the instrument.
- Do not perform any operation or action other than described in these manuals.
- On occurrence of any trouble in the instrument, notify the nearest sales service representative of Hitachi High-Technologies.
- Keep in mind that the hazard warnings in the manuals or on the product cannot cover every possible case, as it is impossible to predict and evaluate all circumstances beforehand. Always be alert and use your common sense.

SAFETY SUMMARY

General Safety Precautions

Safety Precautions During Use

WARNING

- If an abnormal condition such as unusual noise, odor or fumes occurs during operation of the instrument, the power supply should be turned off immediately. Disconnect the power cord plug from the power outlet. Then, after providing proper safety measures as required, contact the nearest service representative of Hitachi High-Technologies.
  Using the instrument in such an abnormal condition could result in an electric shock or fire.

Radiation from the Laser Light Source

WARNING

- The internal CD-ROM or CD-R/W drive of the PC is provided with a laser beam source.
  In normal operation of the PC containing the laser beam source, no laser beam harmful to human health will be emitted outside. Note, however, that if a laser beam leaking out of the PC accidentally gets into the eye, eye injury could occur. When using the PC, carefully read the laser-related safety precautions described in the PC manual. Be sure to observe these instructions and the following precautions:

  (a) Do not open the panel of the laser device. There are no user-serviceable parts inside.

  (b) On any other laser device, do not attempt to operate or adjust.

SAFETY SUMMARY

WARNING precautions in the Manual

WARNING

Ignition of Flammable Chemicals

- This instrument is not explosion-proof. In unattended operation, do not use organic solvents having an ignition point below 70 °C

  (Section 3.6, 4.4)
- Beware of ignition hazard when using flammable chemicals such as organic solvents.

  (a) Do not bring a heat or flame source near the instrument.

  (b) Well-ventilate the laboratory room where the instrument is used.

  (c) Always check the following conditions. If an abnormality is found, stop operation immediately.
  ◊Leakage of solvent or waste solution.
  ◊Leakage of solvent inside the instrument.

  (Section 3.6, 4.4)
- When using flammable chemicals, be careful about possible ignition due to static electricity. To prevent the build-up of static electricity, use a conductive container for waste solution employ and provide proper grounding connection to it.

  (Section 3.6, 4.4)

Explosion of Vapor from Flammable Chemicals

If a flammable chemical such as organic solvent leaks from the flow path of the instrument and its vapor concentration reaches the explosion limit, it could cause spontaneous combustion with dangerously explosive results.
When using a flammable and readily volatile chemical, be sure to check for leakage from the instrument flow path and ventilate the laboratory room adequately.

(Section 3.6, 4.4)

SAFETY SUMMARY

WARNING precautions in the Manual(Continued)

WARNING

Electric Shock due to Contact with Inside of Instrument

When removing the pump cover for part replacement, etc., there is a risk of electric shock. Be sure to turn OFF the power switch and disconnect the power cord from the receptacle in advance.

(Section 5.2)

Electric Shock due to Improper Grounding

This instrument is designed in conformity with the specifications of Class I in Annex H of the IEC 61010-1 (International Electrotechnical Commission Standards) – Issue 1.
To prevent an electric shock hazard, provide a proper grounding connection.

(a) Be sure to use the grounded 3P power cable, which is supplied as a standard accessory for the instrument.
The use of a different type of power cable may result in an electric shock hazard.
Connect the 3P power cable to a grounded 3P power outlet.

(b) If a grounded 3P power outlet is not available, use a grounded 3P table tap or a 3P-2P adapter. In this case, be sure to provide proper grounding connection.
For grounding connection, use a screw having a diameter of M4 or higher and a turn count of 3 or more in threading, and a wire having a thickness of 1.25 mm.

(APPENDIX 1)

Inflammation or Injury due to Toxic, Corrosive or Stimulative Solvent

When using a toxic, corrosive or stimulative solvent, be careful not to incur a physical inflammation or injury. For details of the properties of each solvent and how to handle it, refer to the relevant Material Safety Data Sheets (MSDS). Be sure to handle each solvent properly.

(a) Wear proper protective clothes (e.g., safety goggles) so that a solvent will not come into direct with the skin.

(b) (b) Ventilate the laboratory room adequately to prevent accidental inhalation of harmful solvent vapor.

(Section 3.6, 4.4)

SAFETY SUMMARY

WARNING precautions in the Manual(Continued)

WARNING

Injury due to Xenon Lamp Explosion

[In use]

- When the cumulative turn-on time of the xenon lamp exceeds the guaranteed useful lifetime, the electrodes evaporate and the scattered matter sticks to the bulb wall, so its blackening progresses and heat dissipation is hindered. As a result, the internal bulb temperature (pressure) will rise abnormally to cause a danger of burst, etc. Replace the xenon lamp with a new one before its cumulative turn-on time exceeds the guaranteed useful lifetime.

P/N	Part Name	Useful Lifetime
J851152	150 W xenon lamp	500 hours
J851153	Long-life xenon lamp	1,000 hours

(Section 3.5)

[At replacement]

- Before removing the xenon lamp for replacement, turn off the xenon lamp (turn off power to the instrument) and then wait for at least one hour until the xenon lamp becomes sufficiently cool to reduce its internal pressure the normal safety level.

(Section 5.2)

- If a strong shock or impact is applied to the xenon lamp or if the surface of its quartz glass part is scratched, it may explode and scatter glass pieces, resulting in personal injury. Be sure to wear proper protective gear such as safety goggles, safety mask, thick long sleeves, and gloves when handling the xenon lamp.

(Section 5.2)

[At mounting]

- When loosening or tightening the retaining nut for the xenon lamp, be careful not to apply excessive force to its glass bulb part. Never hold and turn the glass bulb part for loosening/tightening.

(Section 5.2)

SAFETY SUMMARY

WARNING precautions in the Manual(Continued)

WARNING

Injury due to Xenon Lamp Explosion

[At mounting] (Continued)

- Do not touch the quartz glass part of the xenon lamp with bare hands. If the quartz glass part of the xenon lamp is contaminated with dust or fingerprints, wipe it using a gauze sheet or absorbent cotton cloth slightly moistened with high-quality alcohol. If the xenon lamp is turned on with dust or fingerprints left on the surface of the quartz glass part, it may cause contamination burn-in to decrease the mechanical strength of the glass part, resulting in explosion of the xenon lamp.

  (Section 5.2)

- Be sure to mount the xenon lamp in the specified direction.
  If the mounting direction (polarity) is wrong, the cathode will be consumed significantly to disable turn-on of the lamp.
  Mount the lamp so that the '+' (anode) mark on it will be positioned at the support metal of the lamp holder.
  If the lamp with its cathode consumed excessively is used continuously, pressure inside the lamp bulb may become too high, causing possible explosion. To prevent this, replace the lamp with a new one immediately if its cathode has been consumed substantially.

  (Section 5.2)

- If the nut on the lamp base and wiring part is loose, the contact resistance between them will increase due to poor contacting. This could generate a large amount of heat to make the lamp extremely hot, resulting in possible explosion. To prevent this, be sure to tighten the nut securely.

  (Section 5.2)

[At disposal]

- The xenon lamp is filled with high-pressure gas (approx. 1 MPa at room temperature, approx. 4 MPa under operating condition), and this high-pressure gas still remains in the xenon lamp after it is demounted for replacement.For disposal of the used xenon lamp, wrap it with a thick cloth (e.g., triple-folded cotton cloth) completely and crush its glass part with a hammer or the like. Then, discard the xenon lamp as a dangerous waste item properly. If the xenon lamp is discarded without being crushed, it could explode due to possible impact at the time of disposal, scattering glass pieces to cause personal injury.

  (Section 6.2)

SAFETY SUMMARY

CAUTION Precautions in the Manual

CAUTION

Touching Hot Part Could Result in Burns

The light source lamp and its cover become hot during operation and remain hot for a while even after power-off.
They can severely burn you if touched.
Before replacement of the lamp, turn power off and wait for about 30 minutes until it cools down sufficiently.

(Section 5.2)

Direct Gazing at Illuminating Xenon Lamp Could Cause Eye Damage

The xenon lamp radiates intense ultraviolet light when it is on.
If you look at the illuminating xenon lamp during coarse adjustment of its position, your eyes could be damaged. Do not look at the xenon lamp directly when it is lit. Be sure to wear tinted safety glasses to prevent possible eye damage.

(Section 5.2)

Heavy Instrument

This instrument weight as much as 23 kg.
When carrying this instrument, exercise care not to incur injury by dropping it accidentally.
Be sure to hold the right and left parts of the instrument securely when moving it.

(Section 2.1)

Prevention of Instrument Tipover

Personal injury could be incurred if the instrument tips over. When installing the instrument, provide a proper means for preventing the instrument from tipping over accidentally.

(APPENDIX 1)

Fatigue due to Long-Hour Operation

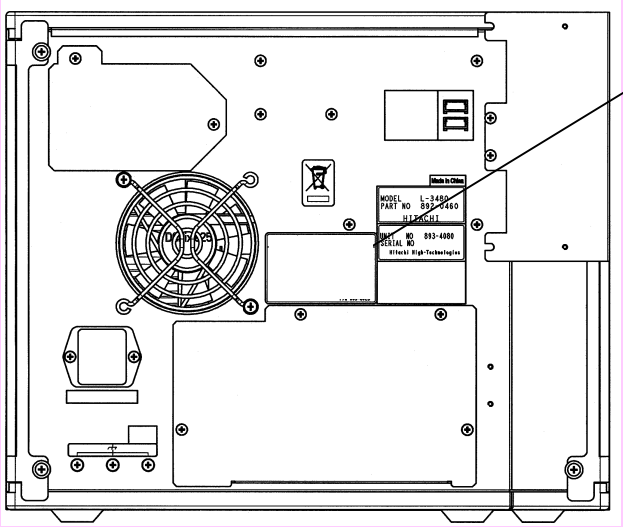
If you keep working with the display monitor and keyboard for long hours, your eyes and body will be fatigued to jeopardize your health. When working with the display monitor for a long time, take a break for 10 to 15 minutes per hour for health of your eyes and body.

(Chapter 3)

SAFETY SUMMARY

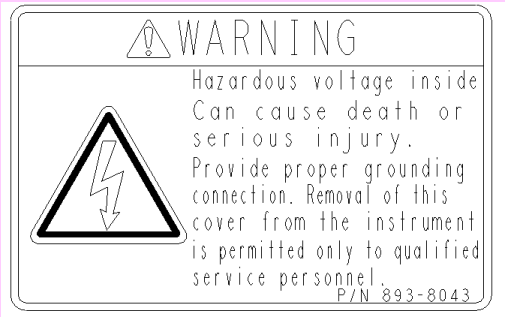
WARNING and CAUTION Labels on Instrument

The warning labels shown below are attached on the Chromaster 5440 FL Detector. Read the warning labels carefully, and check the instructions on them to attain a clear understanding with reference to actual parts. Periodically check the appearances of these warning labels to see if they are clean to allow easy reading over a safe distance. If any one of the warning labels becomes illegible due to deterioration, contact your local Hitachi High-Technologies Corporation sales representative or service office of Hitachi High-Technologies Corporation sales representative for replacement with a new one.



Rear panel

(1) Electric Shock due to Contact with Inside of Instrument

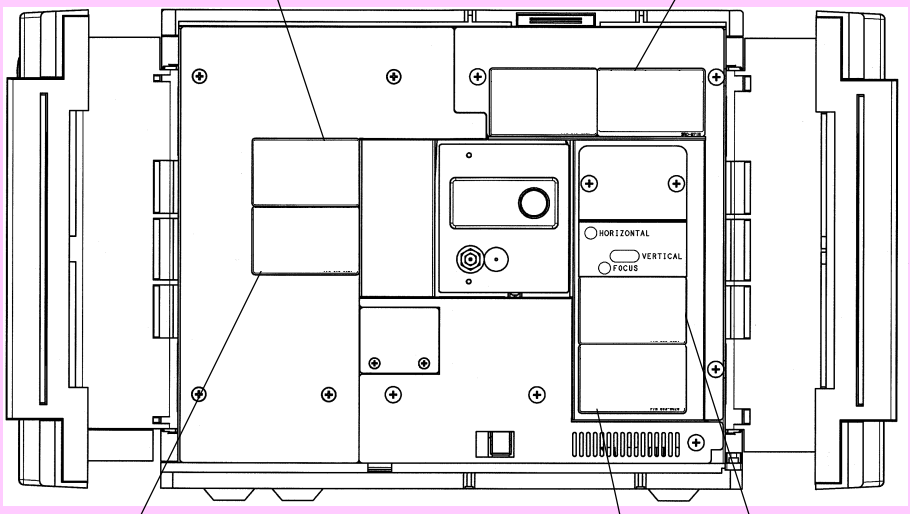


SAFETY SUMMARY

WARNING and CAUTION Labels on Instrument

(3) Explosion of Vapor from Flammable Chemicals

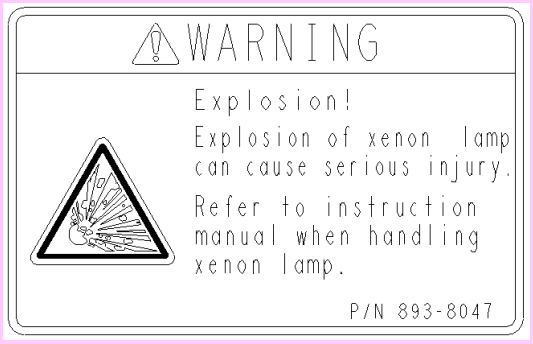
(4) Electric Shock due to Contact with Light Source Power Supply



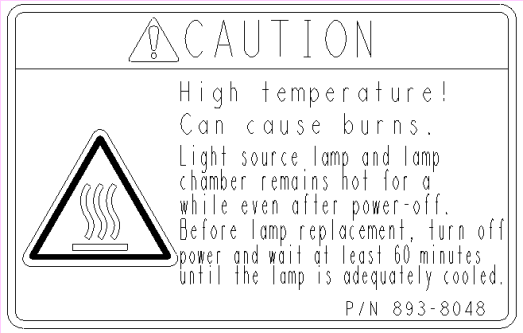
Front View

(4) Ignition of Flammable Chemicals

(5) Explosion of Xenon



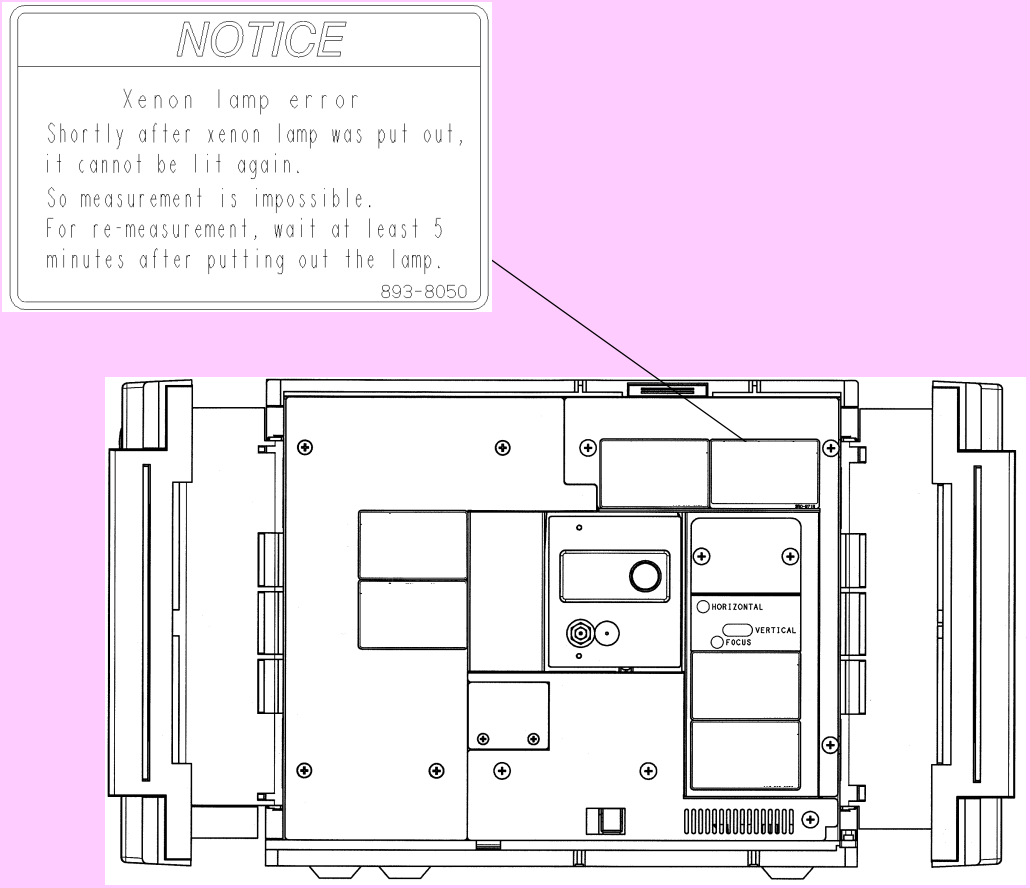
(6) Burns due to Contact with Hot Part



SAFETY SUMMARY

WARNING and CAUTION Labels on Instrument

(7) Before Turning on Xenon Lamp



SAFETY SUMMARY

NOTICE precautions

Precautions on Use of Solvents

- Fluororesin, PEEK, quartz and SUS316 materials are used for the wetted parts of the instrument. Never use solvents that would corrode these materials.

- This instrument has internal parts made of materials that could be corroded by strongly acidic solutions, strongly alkaline solutions or organic solvents. Take care not to spill these corrosive solutions or solvents into the inside of the instrument. If a corrosive solution or solvent spills inside, wipe it off immediately.

- For use of the liquid leak sensor, follow the instructions given below.

  (a) Turn on the leak sensor function when feeding a solvent.

  (b) The leak sensor function may remain inactive in cases where the amount of leakage is too small. Furthermore, leakage of a highly volatile solvent may not be detected. Be sure to check for liquid leakage regularly to prevent a possible serious accident regardless of whether the leak sensor is activated or not.

  (a) In routine inspection of the instrument, visually check for liquid leakage before attempting measurements.

  (b) In periodic inspection of the instrument, check that the leak sensor works normally.

  (Section 2.5)

- Referring to the instruction manual accompanying each module unit of the liquid chromatograph system, set up the automatic liquid feed stop function (such as the pressure limiter function of the pump unit) to prevent a possible trouble.

  (Section 4.3)

Disposal of Waste Solution

Be sure to collect waste solution and treat it for proper disposal in accordance with the relevant laws and regulations regarding water pollution control and sewage treatment. Improper treatment of waste solution may result in environmental pollution and could also lead to a penalty.

SAFETY SUMMARY

NOTICE precaution (Continued)

Accuracy and Precision of Measured Values

Carry out periodic inspection and check whether the system is operating normally.
If necessary, conduct measurement on a control sample.

Possible Carryover

When examining the results of measurements, take account of the possibility of occurrence of a carryover. Otherwise, a correct judgment may not be formed. Since fluororesin and quartz materials are used for the wetted parts of piping, particular attention should be paid when analyzing samples that are likely to be adsorbed by these materials.

Before Turning on Xenon Lamp Again

After the xenon lamp is turned off, it remains very hot for a while. Under this condition, it is not allowed to turn on the xenon lamp again for measurement.
Before turning on the xenon lamp again, wait for at least five minutes.

CONTENTS

1. OUTLINE

The liquid chromatograph system consists of a pump for feeding a mobile phase, a sample introducing section (autosampler, manual injector) for injecting a sample, a column for chromatographic separation of the injected sample, a column oven for maintaining the column at a constant temperature, and a detector section for detecting a signal of a separated component of the sample.
In addition, a degassing unit for deaerating an eluent, a gradient device for varying a mixing ratio of eluents with time, and other optional devices are incorporated in the system.

1.1 Isocratic System

The isocratic system has a simple configuration in which single-solvent analysis is performed.

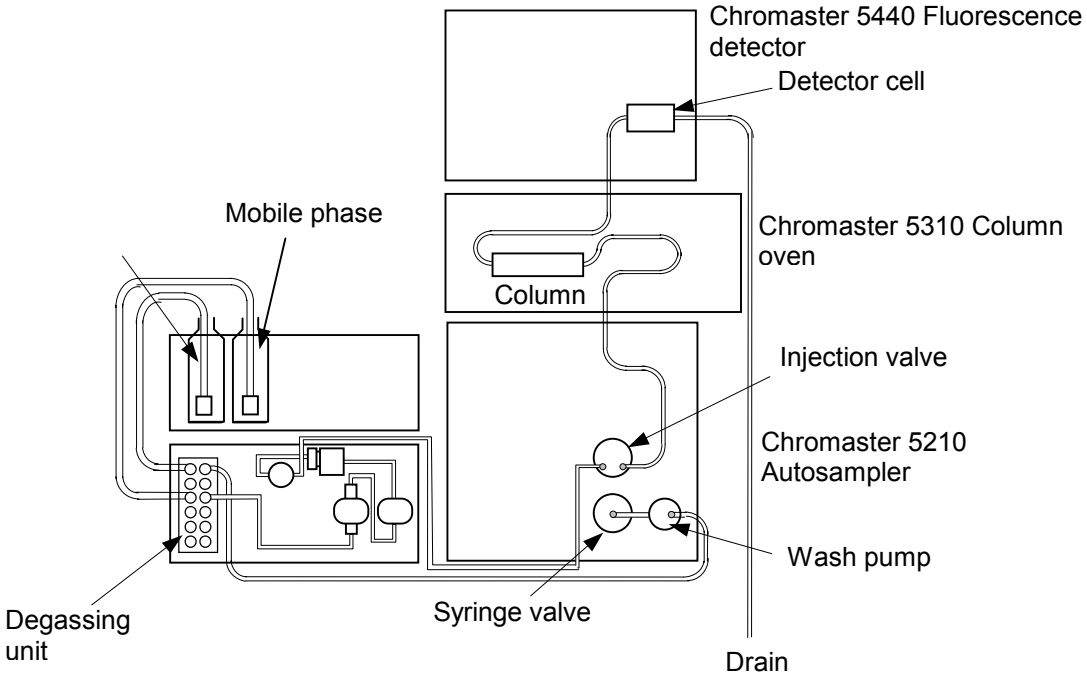


Fig. 1-1 Isocratic System

(1) An eluent is fed by the pump through the degassing unit.

(2) A sample is injected from the autosampler.

(3) The injected sample is separated through the column which is maintained at a constant temperature by the column oven.

(4) Each component separated from the sample is then detected as a signal by the detector.

1.2 Low-Pressure Gradient System

In the low-pressure gradient system, two or more solvents are mixed in its low-pressure section from which a liquid feed is performed by a single pump. The composition of an eluent is made to vary with time in chromatographic separation.

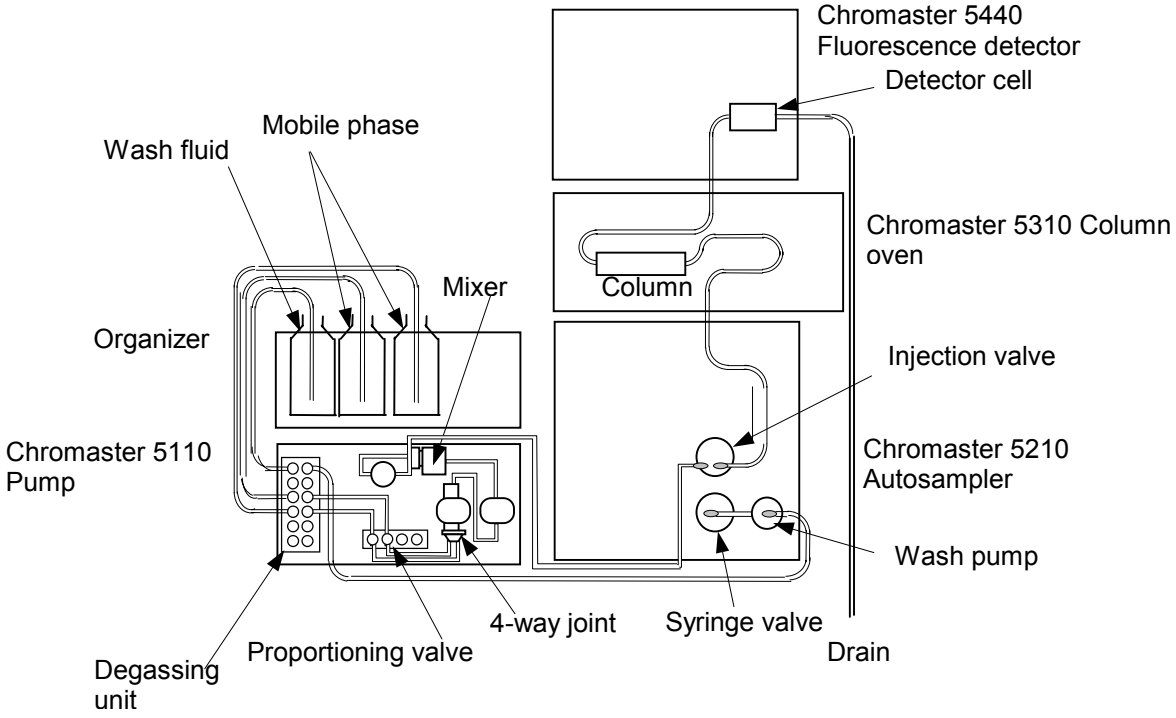


Fig. 1-2 Low Gradient System

(1) Each of plural eluents is fed from the degassing unit to the low-pressure unit.

(2) In the low-pressure unit, the eluents are mixed at a pre-specified ratio.

(3) Through the mixer, the mixture eluent is delivered.

(4) A sample is injected by the autosampler.

(5) The injected sample is separated through the column which is maintained at a constant temperature by the column oven.

(6) Each component separated from the sample is detected as a signal by the detector.

2. FUNCTIONS

2.1 Name and Function of Each Part on FL detector

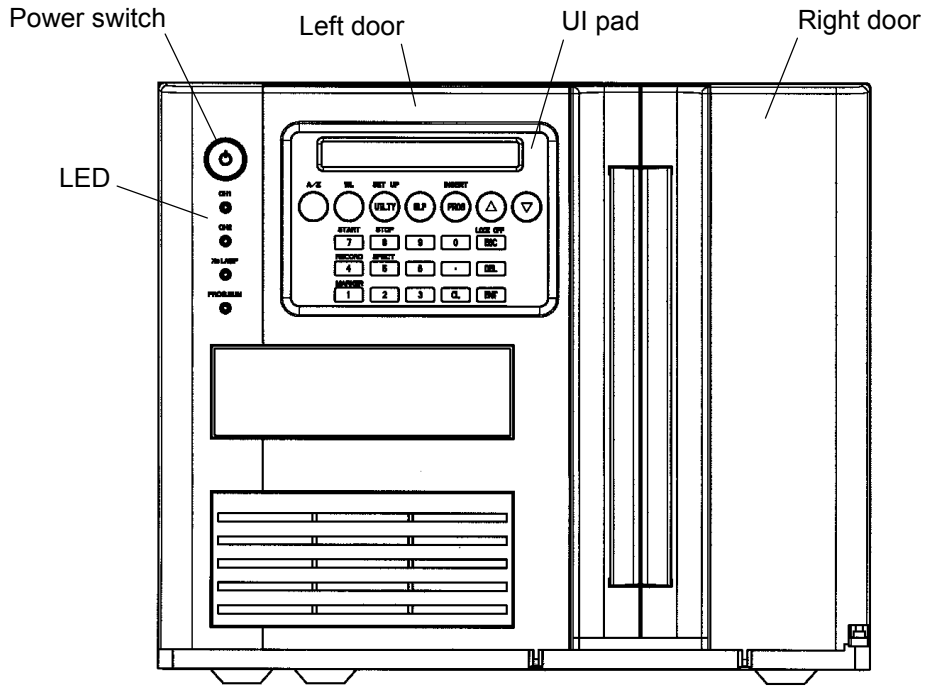


Fig. 2-1 Front Panel

Power switch	:	Turns power ON/OFF.
UI pad (option)	:	A keypad required for unit operation.
LEDs	:	Four LED indicators are provided for indicating the following states.
Doors (upper and lower right/left)	:	Three doors are provided.
Drain tray	:	A tray for liquid leakage

Designation (Color)	LED Indication
CH1 (blue, orange)	Blue : CH1 operation mode. Orange : An error has occurred in CH1 operation mode.
CH2 (blue, orange)	Blue : CH2 operation mode. Orange : An error has occurred in CH2 operation mode.
Xe LAMP (blue)	Blue : Xe lamp is lit.
PROG. RUN (blue)	Blue : Time program is in execution.

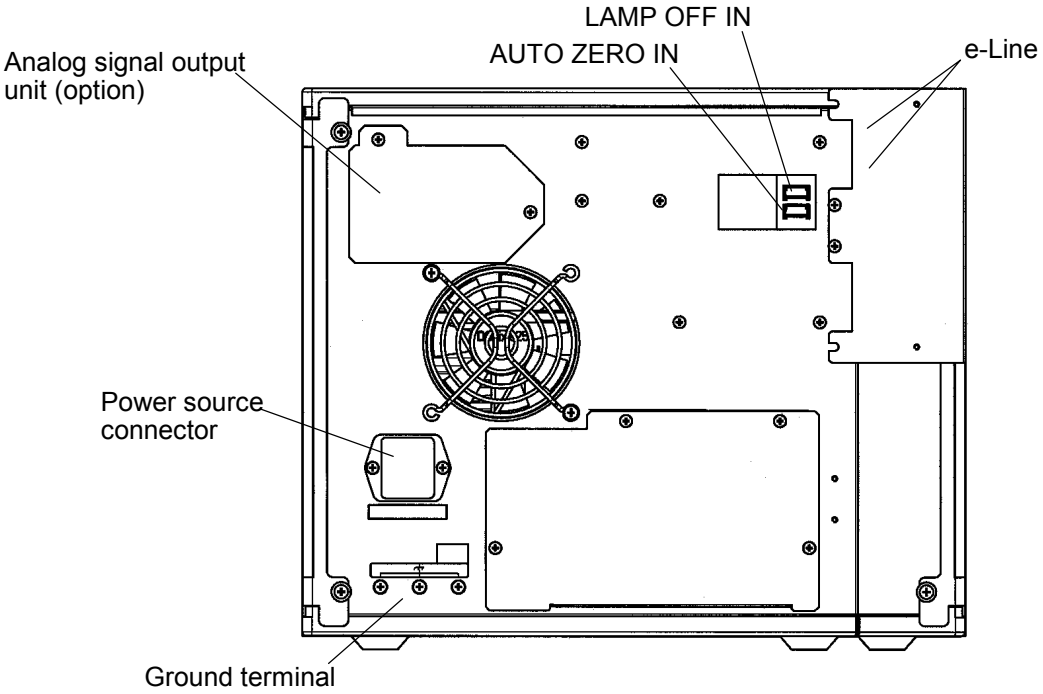


Fig. 2-2 Rear Panel

Analog signal output unit (Option)
:Provides PROCESSOR, RECORDER, MAKER IN terminal.
Ground terminal
:The terminals for grounding connection (three terminals).
Power source connector
:Connects the power supply cable.

Table 2-2 Input/Output terminal

No.	Indication	Function	Remarks
1	e-line	1. Used to transmit the acquired signal (or the acquired spectral data) to other units on the e-line. Also, used to send/receive the instrument parameter data via the e-line. 2. Used for input/output of each contact signal. • START IN • ERROR IN • ERROR OUT • BUSY OUT	1. The florescence intensity data is output. 2. • The program is initiated. • An error condition in another instrument is checked. • An error condition on this instrument is indicated. • The operational status of the instrument is indicated.
2	LAMP OFF IN	The lamp is turned off by means of a contact signal input.	
3	AUTO ZERO IN	The auto zero function is activated by means of contact signal input.	

4	MARKER IN (option)	The marker function is activated by means of contact signal input.	The marker function is started when the short-circuit signal of more than one second is input.
5	RECORDER (option)	Analog output for recorder 1. The florescence intensity value at each point of time 2. Stored spectral data	The florescence intensity value data is output.
6	PROCESSOR (option)	Analog output for data processor (integrator) 1. The florescence intensity value at each point of time 2. Stored spectral data	The florescence intensity value data is output.

2.2 Name and Function of Each Part on UI Pad (Option)

A UI pad will be used when a chromato data station or a GUI controller (option) won't be used for an instrument controlling. The UI pad will be invalid when the chromato data station or GUI controller (option) is connected.
Description is given for each key on the optional UI pad control panel.

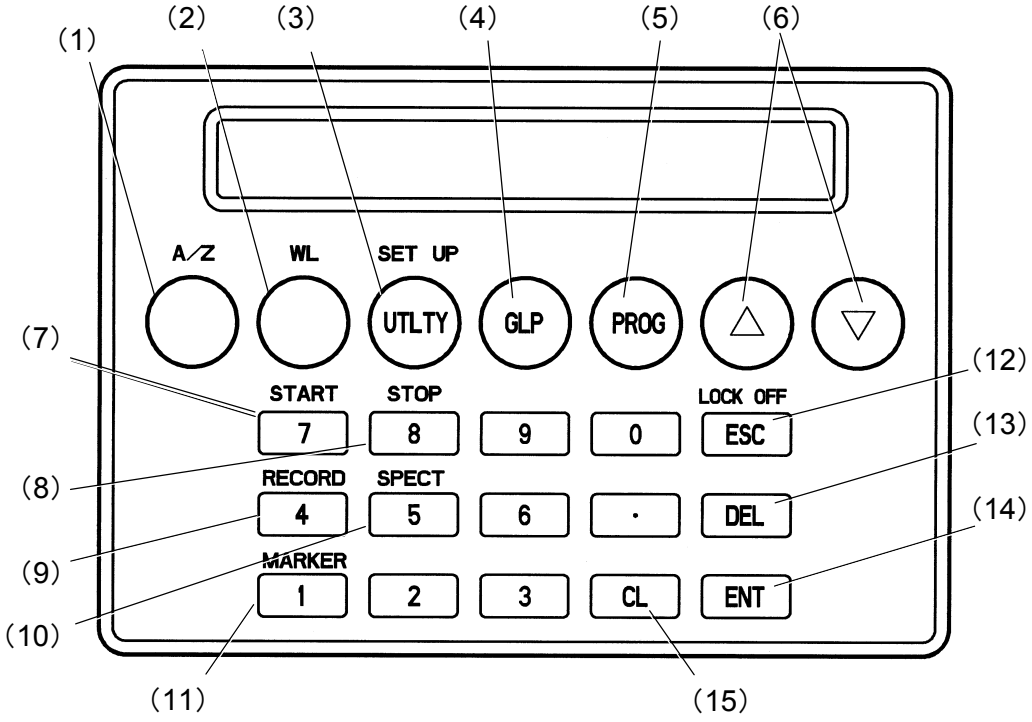


Fig. 2-2 Keyboard on the UI Pad

NOTE: Press the ESC key to return to the initial state when you made incorrect operation..

Table 2-3 Key Functions

No.	Indication	Function	Remarks
1	A/Z (Auto zero)	Sets display and output to zero at each measuring wavelength.	
2	WL (Wavelength)	Used to set each measuring wavelength.	
3	SET UP UTILTY (Utility, Set up)	(1) Sets offset value, time constant, etc (UTILTY). (2) Sets digital communication channel via the e-Line, LCD contrast, and constant temperature flow cell (SET UP)	(2) Keep pressing with ⏻ key simultaneously to change to the setup screen.
4	GLP (GLP)	Selects GLP information. (1) Checks for lamp energy and wavelength accuracy. Displays and resets lamp logbook. (2) Sets the key lock.	(2) Press the ESC key to release the key lock.
5	PROG (Set program)	Selects and sets the time program.	
6	△ ▽ (Arrow)	(1) The monitor screen △key: Accesses the previous screen. ▽key: Accesses the next screen. (2) Editing program △key: Displays the previous screen. Indicates the last line if it is the first line. ▽key: Displays the next screen. Indicates the first line if it is the last line.	
7	START 7 (Start)	(1) Starts the time program. (2) Starts analog output of the stored spectrum.	(2) Valid only when connect to the analog signal output unit.
8	STOP 8 (Stop)	(1) Stops the time program. (2) Stops analog output of the stored spectrum.	

No.	Indication	Function	Remarks
9	RECORD 4 (Record)	Used to specify the recorder full-scale range, recorder output speed, and output data.	
10	SPECT 5 (Spectrum)	Obtains spectrum over a specified wavelength range and stores the spectrum in memory.	
11	MARKER 1 (Marker)	Places a marker on the recording.	
12	LOCK OFF ESC (Escape, Lock off)	(1) Used to return from data input mode to the monitor screen. (2) Used to interrupt the recording of the spectrum. (3) Used to release the key lock when keys are locked.	
13	DEL (Delete)	Deletes the step which the cursor is pointed while editing a time program. ▪ Deletes the step which the cursor is pointed in the input part of TIME. ▪ Deletes the item when the cursor points a part other than the input part of TIME. ▪ When the ESC key is pressed while "-" is displayed on the screen, the screen returns to the monitor screen, and cancels the DEL key processing. "-" is displayed after pressing the DEL key, and the processing will be determined by pressing the ENT key.	
14	ENT (Enter)	Accepts entered information.	
15	CL (Clear)	(1) Used to remove the present data input on the display before the ENT key is pressed (e.g. to erase incorrect data). (2) Also used to reset system when an error condition is indicated.	

2.3 Description of Fluorometry

2.3.1 Principle of fluorometry

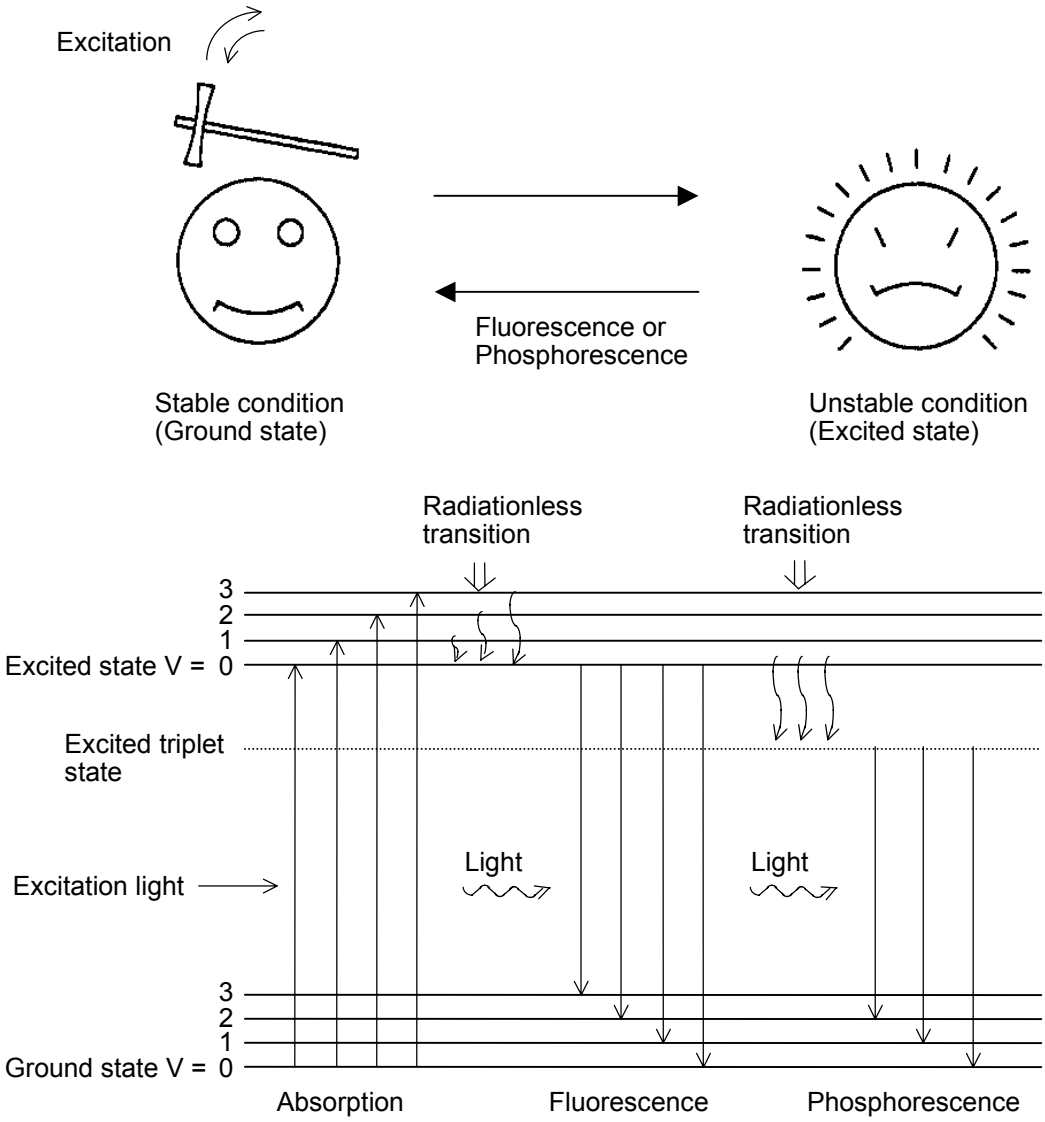


Fig. 2-4 Typical Organic Molecular Energy Level Diagram

Figure 3-4 shows the energy level transitions of an organic molecule for the various processes involved in absorption, fluorescence and phosphorescence.

When light strikes an organic molecule in the ground state, it absorbs radiation of specific wavelengths and several excited states are populated. A part of the excitation (absorbed) energy is lost in vibrational relaxation, i.e. radiationless transition to the lowest vibrational level in the excited state.

The molecule can return to the ground state by;

(1) Emitting radiation (Fluorescence)

(2) Undergoing a radiationless transition to populate the triplet state. The triplet state can emit radiation (Phosphorescence). Generally phosphorescence persists for 10^{-4} seconds or longer due to the selection rule imposed on the triplet-to-singlet transition. In contrast, fluorescence takes place over a period of 10^{-8} to 10^{-9} seconds.

(3) Going through a radiationless transition to return directly to the ground state.

Since a part of the radiation absorbed by the substance is lost as vibrational energy; the energy emitted by the excited state is less than that absorbed by the compound (i.e. the fluorescence wavelength is longer than the excitation wavelength, ***Stokes' Law**).

The ratio of the number of photons emitted during fluorescence to the number of photons absorbed is called the quantum efficiency of fluorescence (Fluorescence Yield). If two compounds absorb the same number of photons, the fluorescence intensity of the compound with the larger fluorescence quantum yield will be greater than that from a compound with a lower fluorescence quantum yield. Also, the intensity of the fluorescence emitted by a compound is proportional to the number of photons absorbed by it. Therefore, when a dilute sample is used, the intensity of fluorescence is expressed by:

$$\mathbf{F = KI_o c}\mathit{l}\varepsilon\varphi$$

F : Fluorescence intensity
K : Instrumental constant
I_o : Intensity of exciting radiation
c : Concentration of the compound of interest
l : Optical path length of cell
ε : Absorptivity of substance
φ : Quantum efficiency of substance

2.3.2 Advantages of fluorometry

For verifying the advantage of fluorometry, the limitation of absorbance measurement in its application to low-concentration samples is explained first.

In this discussion, we will consider the detection of a sample that has a transmittance of 99% (relative to the blank). If we assume that the inaccuracy of the % transmittance measurement is 0.1%, the reliability of the observed data is as follows:

Percent transmittance of blank	100.0 ± 0.1%
Percent transmittance of sample	99.0 ± 0.1%
Difference (proportional to concentration of sample)	1.0 ± 0.2%

In this example, the uncertainty in the concentration measurement is ±20%. In contrast, in fluorometry, a difference in the signal is directly proportional to the concentration of sample.

An analysis of the error in the measurement is as follows:

Output signal level at measurement of sample	100 ± 0.1
Value corresponding to blank	0 ± 0.1
Difference (proportional to concentration of sample)	100 ± 0.2

As is evident from this example, the error percentage by fluorometry is not dependent on sample concentration theoretically, so this method is very advantageous for low sample concentrations.
In actuality, some error factors will increase relatively as sample concentration falls extremely, but it can generally be said that fluorometry is capable of detecting concentrations at least 3 digits lower than by absorptiometry.

A graphical description of why fluorescence can provide better sensitivity than absorbance is presented in Fig. 3-5. In this figure, the signal I_S is used to represent the difference between the intensity of the incident beam I_o and the intensity of the transmitted beam I_t in absorptiometry. The detection limit is the point where the difference between I_t and I_o is equivalent to the noise level. In contrast, when fluorometry is used, the observed signal I_F is directly proportional to the concentration and the background has a fluorescence of zero. When a small signal is observed it is compared to a very small signal (since the blank does not fluoresce) and is readily amplified for detection.
In addition, since the fluorescence emission wavelength is different from the excitation wavelength (incident beam wavelength), scattering due to the excitation radiation is negligible.

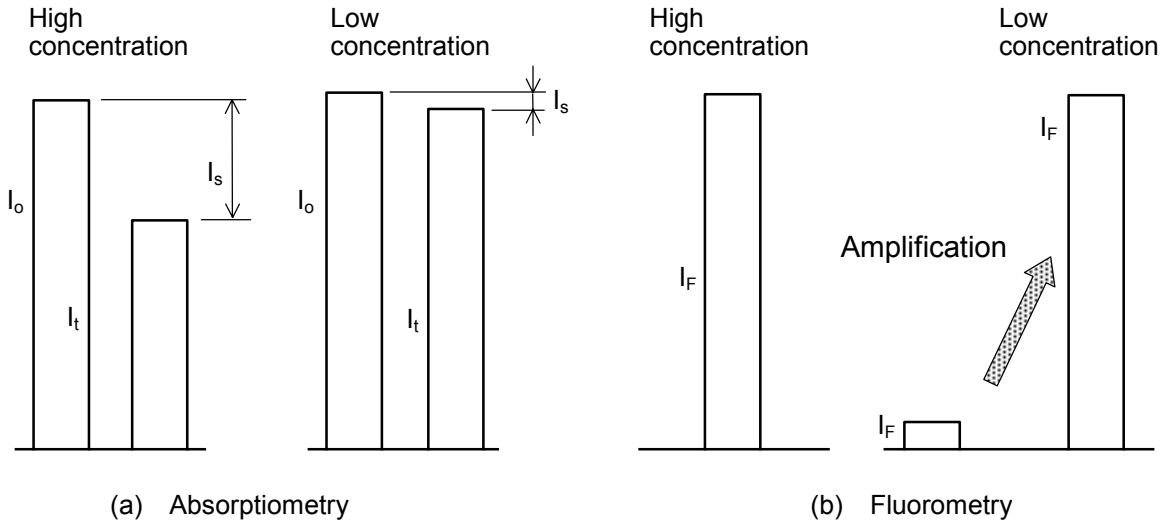
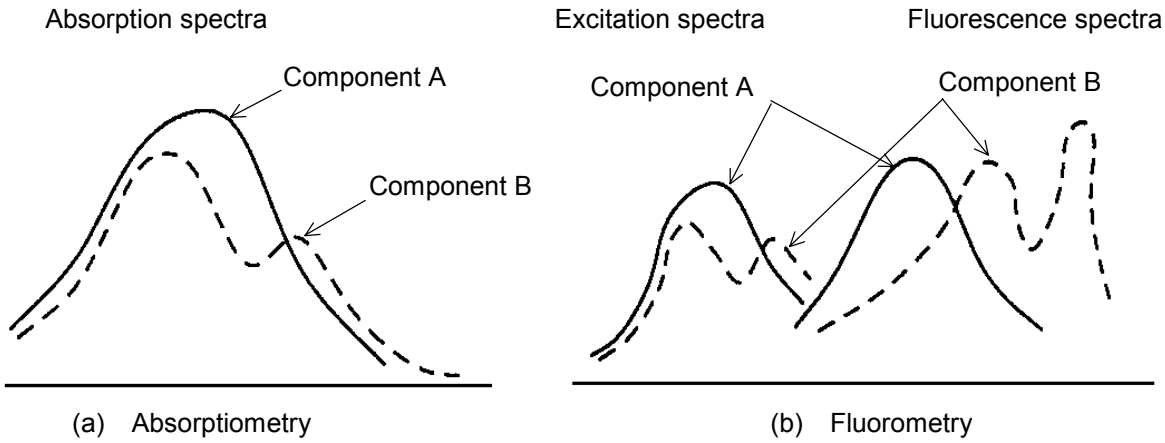


Fig. 2-5 Comparison of Absorptiometry and Fluorometry

In addition to providing high sensitivity, fluorescence detection can provide a fluorescence spectrum and an excitation spectrum (which is very similar to the absorbance spectrum).
If the sample contains two compounds, selection of the appropriate excitation and emission wavelengths may be used to provide qualitative and quantitative information about the components in the mixture. This point is described in Fig. 3-6. An attempt to quantitate compound B in a mixture of A and B using absorbance will not be successful because the absorbance spectra of the two compounds overlap at all wavelengths (Fig. 3-6 (a)).

In contrast, if the fluorescence spectra do not overlap (Fig. 3-6 (b)), quantitative analysis of each compound can be made by selecting the appropriate fluorescence emission wavelength (even if the absorption wavelengths of two components are the same).



(a) Absorptiometry (b) Fluorometry

Fig. 2-6 Spectroscopic Measurement of a Sample Containing Two Components

Table 3-1 compares the analytical information obtained via absorptiometry and fluorometry.

Table 2-4 Comparison of Analytical Information Attainable with Absorptiometry and Fluorometry

Absorptiometry	Fluorometry
Absorption spectra only (corresponding to excitation spectra)	• Excitation spectra • Fluorescence spectra

2.3.3 Notes on fluorescence analysis

(1) Raman Scattering

When fluorescence is measured, two additional peaks may appear in the spectrum. The Rayleigh peak appears at the excitation wavelength and is due to scattered light, while the Raman peak appears at longer wavelength than the excitation. The position of the Raman band is dependent on the excitation wavelength, while the position of the fluorescence is independent of the excitation wavelength though its peak height changes. Both Rayleigh and Raman scatterings occur due to a solvent. Take care not to mistake them for fluorescence peaks.
Table 3-2 presents the position of the Raman peak for a variety of excitation wavelengths.
In liquid chromatography, the Raman scattering appears as a background rise. This means that baseline noise increases to disturb high-sensitivity measurement.

Table 2-5 Raman Spectral Peak Position at Each Excitation Wavelength

(Excitation Wavelength)	Water	Ethanol	Cyclohexane	Carbon Tetrachloride	Chloroform
248	271	267	267	—	—
313	350	344	344	320	346
365	416	405	408	375	410
405	469	459	458	418	461
436	511	500	499	450	502

Excitation wavelength, and Raman peak position (nm)

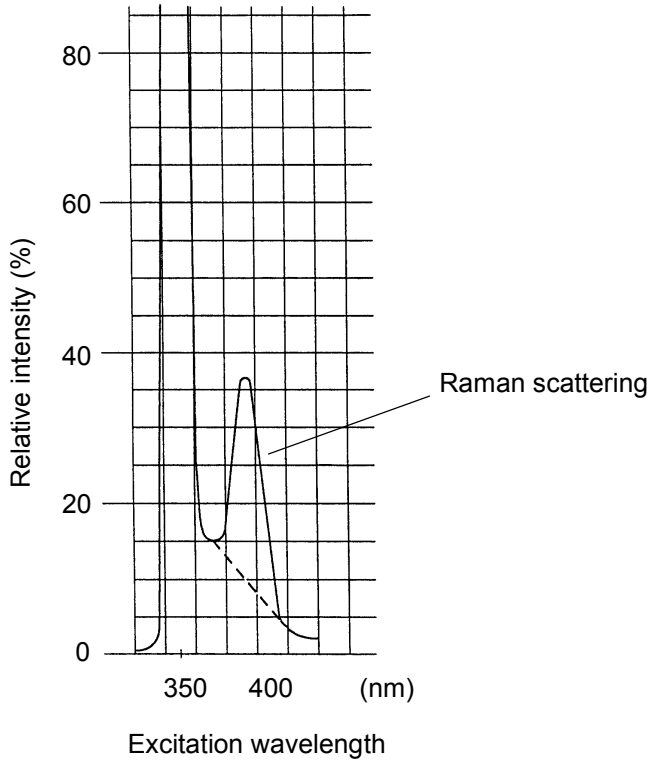


Fig. 2-7 Raman Spectrum of Water

(2) Notes on Handling Samples that Contain a High Concentration of the Compound of Interest

When the concentration of the compound of interest is relatively high, various error factors will arise.
The greatest factor is that the excitation beam is substantially absorbed near the entrance slit of a cell and it cannot reach the cell center adequately.
An extreme situation is shown in Fig. 3-8. Fluorescence is emitted near the entrance slit of a cell, but it will not be taken into the emission monochromator.

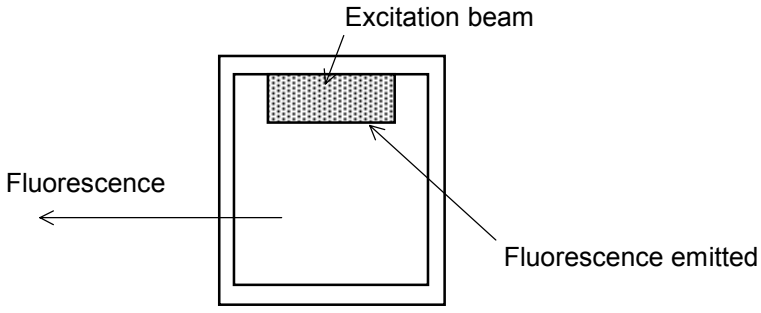


Fig. 2-8 Sample Having Extremely High Concentration

If emission occurs only in the entrance area for excitation beam, such a sample needs to be diluted with an appropriate factor before measurement.
The second factor is called “concentration quenching” where activity is disturbed by interaction of molecules.
Another potential error that may occur when fluorescence detection is used is the re-absorption of fluorescence (self-absorption of fluorescence). An example of this phenomenon is shown in Fig. 3-9. Re-absorption of fluorescence occurs when the tail of the shorter-wavelength side of fluorescence spectrum overlaps the tail of the long-wavelength side of the excitation spectrum. When this phenomenon occurs, the fluorescence spectrum appears to be somewhat shifted toward the longer-wavelength.
This phenomenon will very rarely cause a substantial error in quantitation when fluorescence detection is used, and should not be a cause for concern.

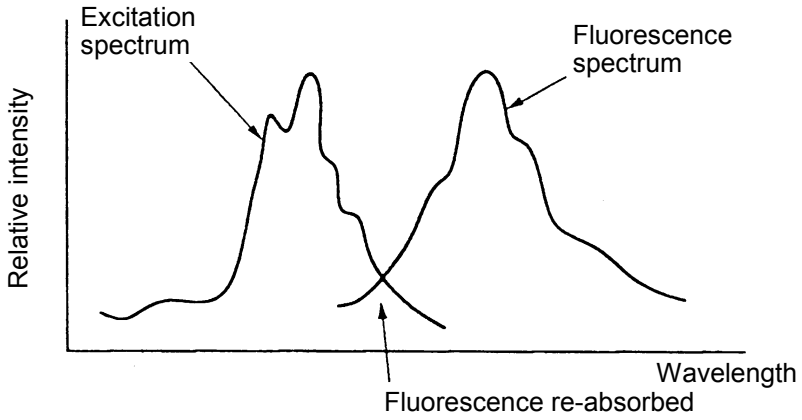


Fig. 2-9 Re-absorption of Fluorescence

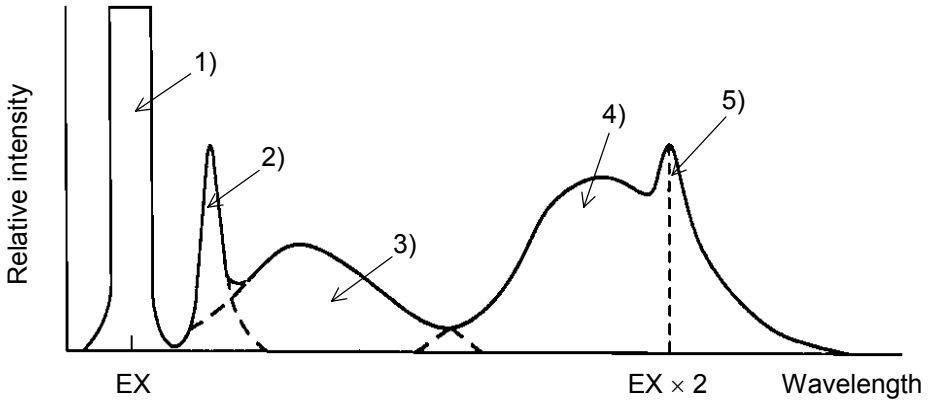
Anyway if a high concentration may have caused a measurement error, dilution with an appropriate factor is necessary.

(3) Second-order and Third-order Radiation

The Raman peak is described as a cautionary item when the excitation and emission wavelengths are comparatively close to each other. Conversely, when these wavelengths are comparatively distant from each other, the analyst should be aware of the second and third-order radiation phenomenon.
The second-order radiation occurs at a double wavelength of the excitation beam and the third-order radiation arises at a triple wavelength.
For instance, if the excitation wavelength is 240 nm, the second-order and third-order excitation occur at 480 and 720 nm, respectively. To eliminate second and third order radiation, it is simply necessary to place a short-wavelength cutoff filter in the path of fluorescing radiation.
When the second and/or third-order radiation poses a particular problem, it is recommended to use the optional filter set accessory.
In measurement with a chromatograph, the second and third-order radiation appears as a background rise. Therefore, baseline noise will increase to disturb high-sensitivity measurement.

(4) An Example of a Fluorescence Spectrum

Figure 3-10 provides an example of a fluorescence spectrum.



1) Scattering of excitation beam
2) Raman scattering due to mobile phase
3) Fluorescence of impurity
4) Fluorescence of compound of interest
5) Second-order scattering of excitation beam

Fig. 2-10 Measurement Example of Fluorescence Spectrum

In measurement of a fluorescence spectrum, many peaks appear besides that of sample fluorescence. It is necessary to find the correct sample peak according to the explanation given above.

(5) Temperature Dependency of Fluorescence Intensity

In most cases, the fluorescence intensity decreases by 1 to 2% as the temperature of sample increases by 1 °C.
It should be noted, however, that in some biochemical samples, the fluorescence intensity decreases by approx. 10% as the temperature of sample increases by 1 °C.

2.3.4 Principle of operation

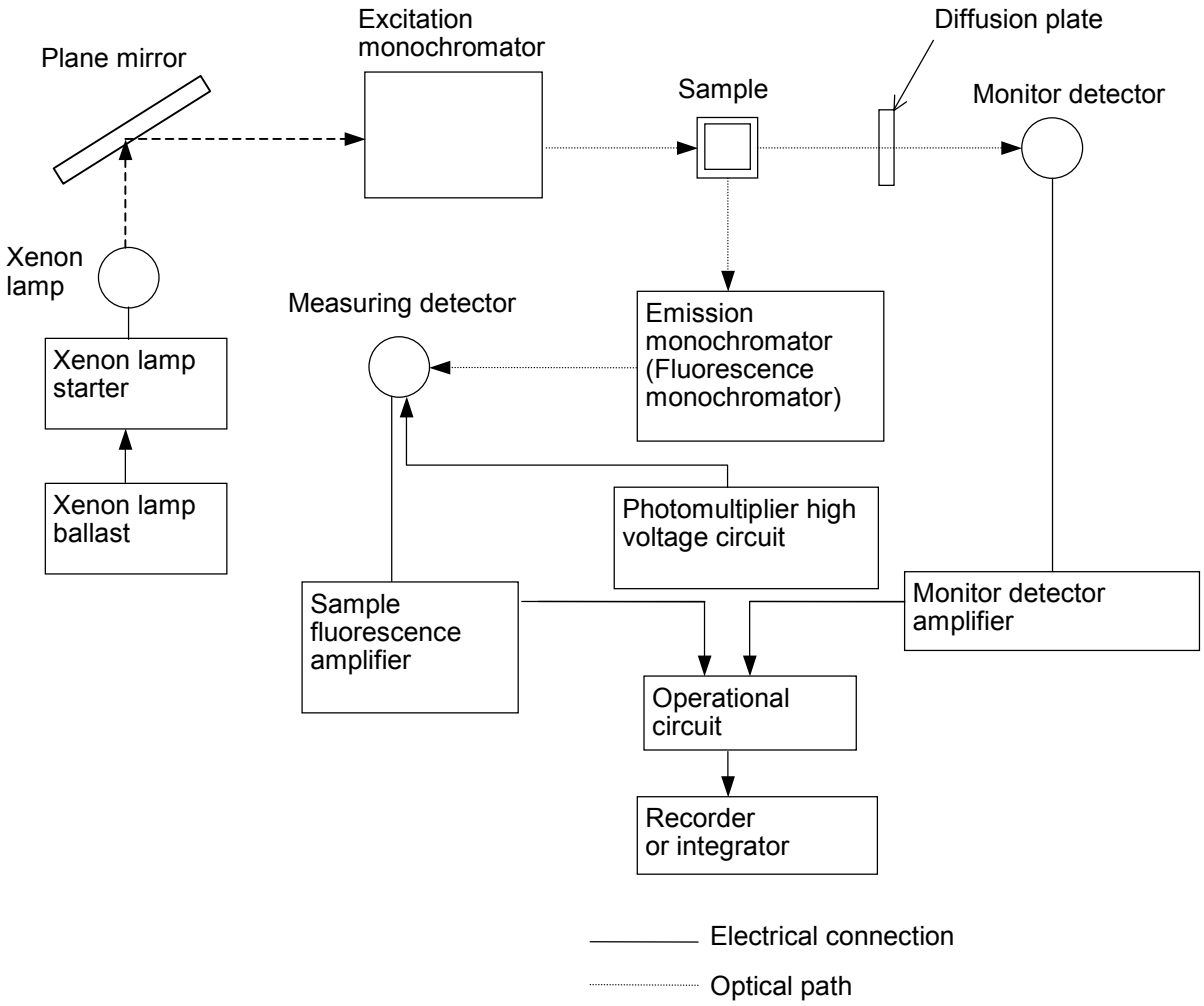


Fig. 2-11 Functional Block Diagram

The beam from the xenon lamp strikes the excitation monochromator that disperses the radiation. Only radiation of the specified wavelength is allowed to pass through the exit slit. After the exit slit, the excitation radiation strikes the sample. The fluorescence (emitted radiation) enters the emission monochromator, where it is dispersed by the monochromator. The selected radiation strikes the measuring detector.
On the other hand, the excitation beam which passed through the sample enters the monitor detector via the diffusion plate.

2.3.5 Features of light source

The light source thermally dissociates ozone via the heat generated by the xenon lamp itself. This allows the use of a quartz-bulb xenon lamp that produces intense radiation even in the short wavelength region.
As a safety measure against failure or stoppage of the cooling fan, a thermal sensor works to extinguish the xenon lamp in about 15 minutes if the fan stops during analysis at a room temperature of 27 °C, or in about 20 minutes if the fan was stopped from the beginning, in order to prevent failure or damage of the instrument.

2.4 Specifications

(1) Optical system:
Ratio photometry;
intensity of transmitted beam is monitored.

(2) Light source:
Xe lamp (150 W)
Hg lamp (for checking wavelength)

(3) Excitation wavelength range: 200 to 850 nm/Zero order

(4) Emission wavelength range:
250 to 900 nm/Zero order
Photomultiplier must be changed at emission wavelength greater than 731 nm.

(5) Spectral bandwidth on excitation side: 15 nm

(6) Spectral bandwidth on emission side: 15 nm, 30 nm (variable)
With this instrument, spectrum bandwidth is defined by half-value width. Therefore, in order to separate a spectrum completely, a wavelength interval of 30 nm or more is required.

(7) Wavelength setting: By communication (e-line) or keyboard

(8) Wavelength accuracy: ±3 nm

(9) Wavelength repeatability: ±0.5 nm

(10) Recorder output (Option):
10 mV Full scale. Full scale 1 to 1000 FLU (settable in steps of 1).

(11) Processor output (Option):
1 V Full scale, digital by e-Line.
-40 (-40 mV) to 1000(1000 mV)

(12) Response:
Changeable in 7 steps corresponding to time constants of 0.01 / 0.02 / 0.05 / 0.1 / 0.5 / 1.0 / 2.0 seconds.

(13) Sensitivity:

(a) With emission-side spectral bandwidth set at 15 nm
S/N ratio for Raman peak of water
..... 700 or more (Baseline method)
S/N ratio for Raman peak of water
..... 525 or more (Tangent method)

(b) With emission-side spectral bandwidth set at 30 nm
S/N ratio for Raman peak of water
..... 900 or more (Baseline method)
Wavelength: 350 nm, Time constant: 2.0 s

(14) Auto Zero range: 0 to 1000 FLU

(15) Offset range: 0 to 1000 FLU (settable in steps of 1)

(16) Spectrum memory:

Memorized contents.....	Excitation and fluorescence spectra
Number of spectra memorized.....	4
Measuring wavelength range.....	Changeable in measurement condition setting

(17) Marker (Option): Place a marker (0.6 mV) on the recording.

(18) Instrumental conditions setup:
Following conditions are set and saved in the memory.
- Full scale range
- Spectrum measurement range
- Photo multiplier applied voltage
- Offset value

(19) Time program

Number of programs	9
Settable time	Up to 600 minutes in increments of 0.1 minute
Number of steps storable	100 steps for a total of 9 files
Programmable parameters	Measurement wavelength (Ex and Em) Baseline processing PMT gain

(20) GLP support function:
Lamp energy check
Wavelength accuracy check
Lamp lighting time and replacement record

(21) Communication facility: e-Line communication

(22) External output terminal (Option):
- Processor: 1 V Full scale
- Recorder: 10 mV Full scale

(23) External I/O contact terminals:
Time Program Start
Error Input/Output
Busy Output
(Above contacts are incorporated in
e-Line connector, and effective with analog connection.)
Auto Zero Input
Lamp Off Input

(24) Flow cell: Standard, Constant temperature flow cell (Option)

(25) Flow cell capacity: Standard 12 μL (irradiated capacity)

(26) Flow cell withstand pressure: 1.0 MPa

(27) Operating temperature range: 4 to 35 °C (non-condensing)

(28) Operating humidity range: 25 to 85% RH

(29) Power requirement: 100-115/220-240 V AC/50 or 60 Hz

(30) Power consumption: 330 VA

(31) Dimensions: 340(W) mm × 440(D) mm × 280(H) mm

(32) Weight: Approx. 25 kg

NOTE: Please contact your local Hitachi High-Technologies Corporation sales representative about a purchas of the Thermo cell.

3. OPERATION

The method of FL detector operation using the optional UI pad is described here.

⚠ CAUTION

Fatigue due to Long-Hour Operation

If you keep working with the display monitor and keyboard for long hours, your eyes and body will be fatigued to jeopardize your health. When working with the display monitor for a long time, take a break for 10 to 15 minutes per hour for health of your eyes and body.

3.1 Basic Operation

First, turn on the power supply to display the 1st LCD monitor screen.

- Spend one hour or more for warming up time to stabilize the xenon lamp.
- The numerical value indicated before input is default values or currently set values.

3.1.1 Power supply

The power activation operation of autosampler is described here.

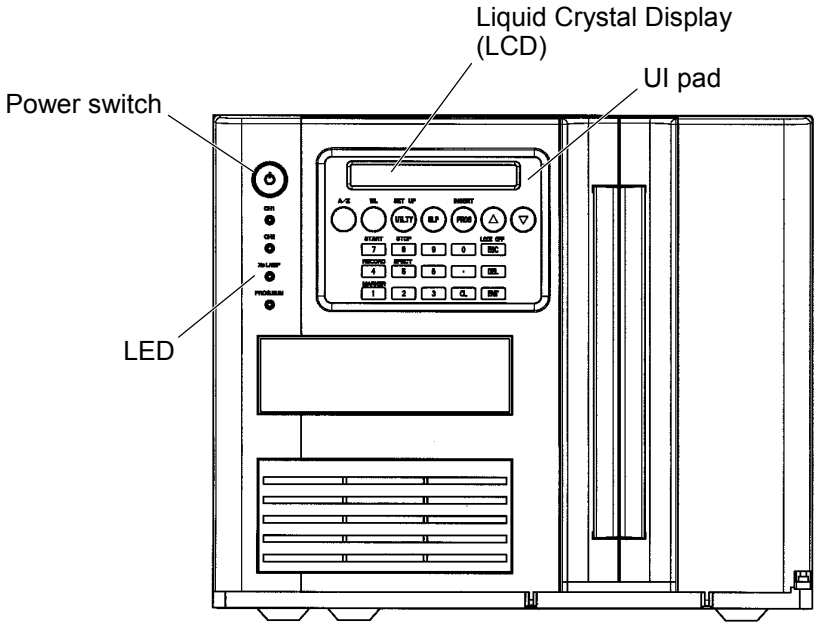


Fig. 3-1 Front Panel

NOTE: If the monitor display screen does not appear on the LCD within 3 minutes after turning on the power, or if an error message appears on the LCD, refer to “5.6 Troubleshooting” or “5.7 Error Messages”.

1) Turn on the power switch of the detector.

2) Liquid Crystal Display (LCD) presents the initial screen, which changes to the initializing screen after a few seconds. At the same time, a test for self-diagnosis (initialization) is carried out.

   * The current channel setting LED and the Xe LAMP LED will light in blue.

<Initial screen>

FL Detector 8928148-00 © Hitachi High-Technologies Corp.2010

↓

<Initializing screen>

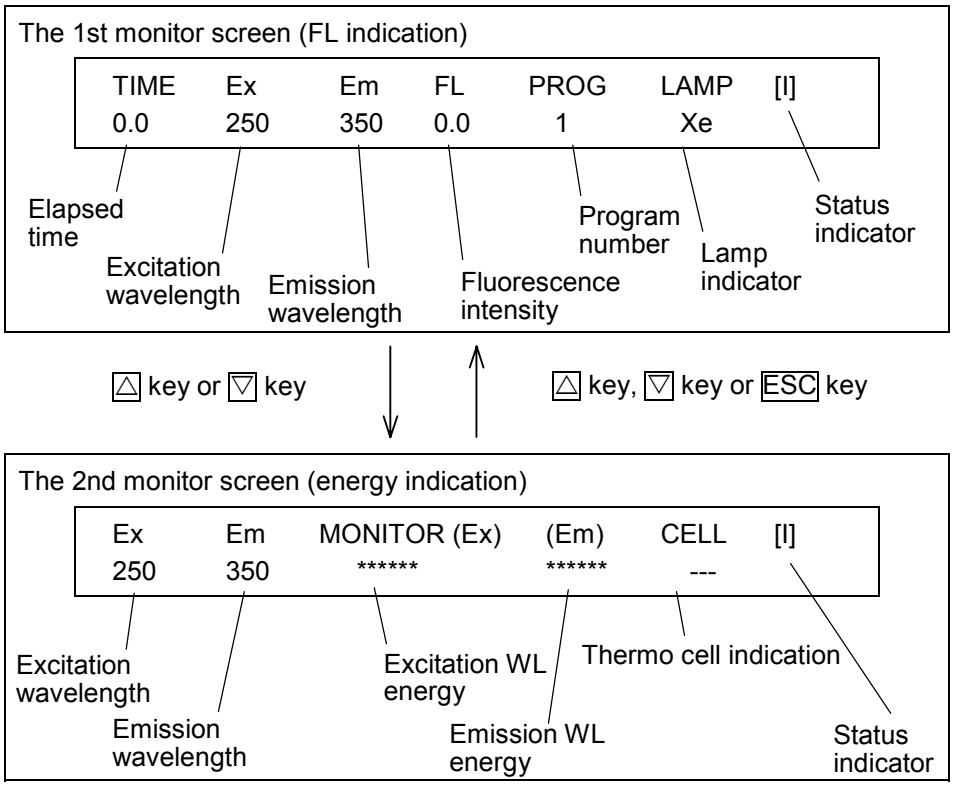
WL DRIVE & LAMP INITIALIZING

The sequence of wavelength drive (check of reference point for drive), lighting of the lamp and auto zeroing is performed.

3) The first monitor screen will be indicated after initialize-processing is completed normally.

Press [△] [▽] key to indicate the second and the third monitor screen.
Press [△] [▽] [ESC] key to return to the first monitor screen.

   * An error message will be presented if an abnormality occurs during initializing. **Check Section 4.6.**



a) The indicated values are the default values or currently set values.

b) The indicated program number is the currently selected one. However, when the time program is not used, "-"is indicated.

c) In lamp indication, Xe stands for the lit status of the xenon lamp and OFF stands for the extinguished status.

d) Fluorescence intensity (FL) is indicated within a range from -1000.0 to 1000.0. If the intensity is outside this range, "******" is indicated.

e) The thermo cell indication is as follows.
ON : The thermo cell (option) is running.
OFF : The thermo cell is suspended.
"----" : The thermo cell is disconnected.

f) Status indicators should be read as follows.
[I] : Initial status.
[R] : Time program running status
[B] : Busy status

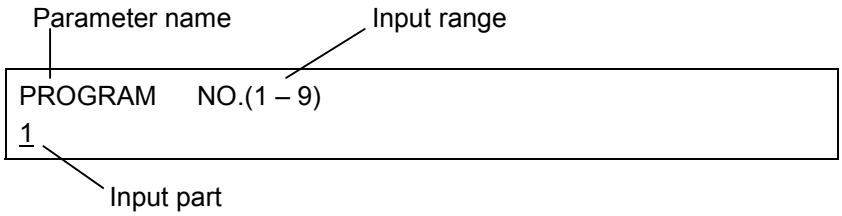
[L] : Key-locked status

4) Turn off the power switch of the detector.

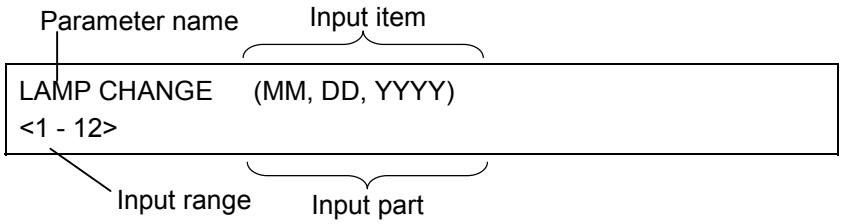
3.1.2 Parameter setting

(1) For entering a value, press numeric key, then ENT (enter) key.

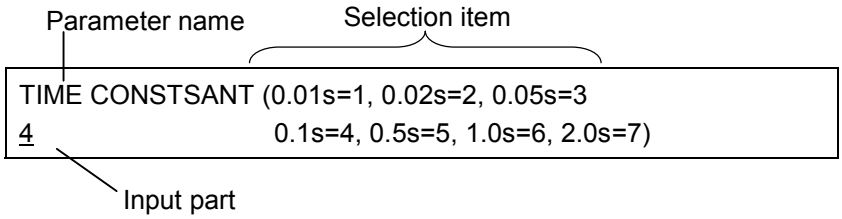
(a) Single numeric input



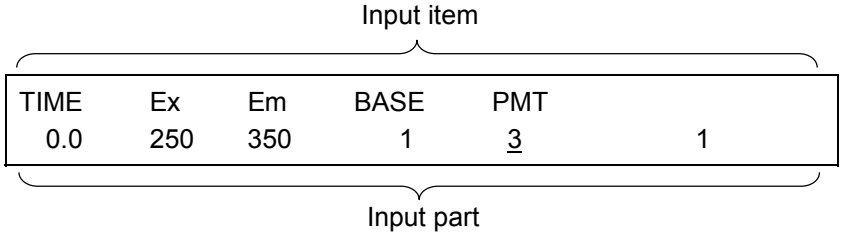
(b) Plural numeric input



(c) Numericl value selection



(d) Program setup screen



Input procedure

(i) The cursor is indicated on the front line of the input part. Currently set values are indicated in the input part.

(ii) Numeric keys and decimal points (.) are accepted by the upper limit.

(iii) Numeric inputs are accepted by the ENT key, and moves to the next item. When an input error has occurred, the cursor is set to the front line in the input part while displaying inputs, and then waits for retype.
Press the ESC key to return to the initial screen (monitor screen). Even if the ESC key is pressed while inputting parameters, it won't be updated (the previous value is set).

NOTE: When the power supply is turned on, defaults will be indicated in the item selection number.

(2) Deleting the Present Data Entry

(a) If you made an error in entering data, but have NOT pressed the ENT key, press the CL key, then re-edit the value.

(b) If you made an error in entering data and HAVE pressed the ENT key, press the ESC key for return to the 1st monitor screen then re-edit the value.

(c) Press the DEL key to delete the item in the input part while editing the program.
When the ESC key is pressed while setting plural parameters, the item, which the ESC key has pressed, will be updated.

(3) For canceling the setup conditions, press the ESC key for return to the 1st monitor screen followed by re-setup.

(4) For accessing the next window without changing or entering values, press the ENT key, or ▽ key.
For accessing the previous or next window, press △ key, or ▽ key.

(5) If the time program is not in use, spectral output can be performed at any time.
If spectral output is started during data acquisition, the data is automatically directed to the integrator.

(6) The UI pad operation is disabled when connecting with the chromato data station or the GUI controller (option).

3.1.3 Auto Zero adjustment

The output value should be zeroed when zero point adjustment is required or when the data baseline deviates from the recorder zero point.

(1) Press the A/Z key.

(2) The FL indication on the 1st monitor screen is reset to zero and output signal becomes zero.

<The 1st monitor screen>

TIME	Ex	Em	FL	PROG	LAMP	[I]
0.0	250	350	0.0	1	Xe	

* Setting value range: 0 to 1000
  If the range is exceeded, an error message is displayed

3.1.4 Wavelength setting

Specify Ex (Excitation wavelength) and Em (Emission wavelength).

(1) Press the WL key.

(2) The following display will be presented. Set an excitation wavelength (Ex) (cursor appears under Ex).

<Ex wavelength setting screen>

Ex	Em	(200 - 850.0) nm
250	350	

Press numeric keys (2 0 0 to 8 5 0) and then the ENT key.

* This wavelength is settable within a range from 200 to 850 nm in increments of 1 nm.
* Default value: 250 nm
* Press the ESC key or △ key to cancel the input excitation wavelength value. The 1st monitor screen returns.
* Pressing the ▽ key enables you to advance to the emission wavelength setting without changing the excitation wavelength.

Then, the cursor moves to Em.

(3) Set an emission wavelength (Em).

<Em wavelength setting screen>

Ex	Em	(250 - 900.0) nm
250	350	

Press numeric keys ((2 5 0 to 9 0 0)) and then the ENT key.

* This wavelength is settable within a range from 250 to 900 nm in increments of 1 nm.
* Default value: 350 nm
* Press the ESC key or ▽ key to cancel the input emission wavelength value. It returns to the 1st monitor screen.
* Pressing the △ key enables you to return to the excitation wavelength setting without changing the emission wavelength.

(4) Wavelength setting is now completed and the 1st monitor screen returns.
At Ex and Em, the set values are indicated.

<1st monitor screen>

TIME	Ex	Em	FL	PROG	LAMP	[I]
0.0	250	350	0.0	1	Xe	

3.1.5 Shutdown procedure

Turn the power supply of the detector off to shut it down.
The set measurement conditions are retained by the memory even when the power is switched off. When power is turned on again, the conditions that were in place when power was turned off will be restored.

3.1.6 Flushing the flow cell after use

Make sure to flush the flow cell with distilled water after using any buffers or salts in the mobile phase. Failure to carry out flushing may lead to clogging and/or breakage of the flow cell.

3.2 UTLTY Setting

The UTILITY key sets the following conditions.

- OFFSET
- TIME CONSTANT
- USE PROG (whether to use time program or not)
- PMT VOLT (photomultiplier voltage)
- OTHERS

3.2.1 Offset setting

The OFFSET is a set input signal amount that is added to the actually measured value for output.

(1) Press the SET UP / UTLTY key.

(2) The following display will be presented.

<Utility initial screen>

```
UTILITY  (OFFSET=1, TIME CONSTANT=2,
_1          USE PROG=3, PMT VOLT=4, OTHERS=5)
```

Select OFFSET.
Press numeric key 1 and then the ENT key.

(3) The following display will be presented.

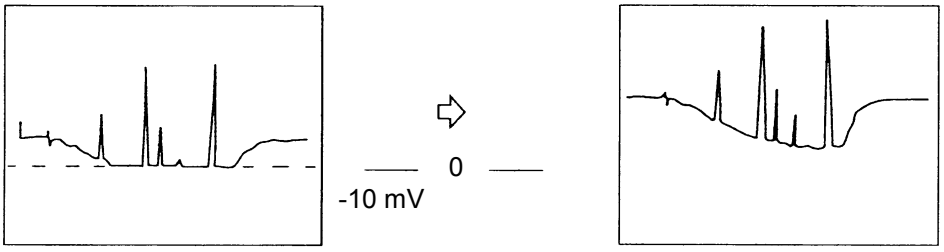
<Offset setting screen>

```
OFFSET (0 - 1000)
_  0
```

Set an offset value.
Press numeric key (0 to 1 0 0 0, usually input 0) and then the ENT key.

* An offset value is settable within a range from 0 to 1000 in increments of 1 step.
* Default value: 0

♦ Typically, the negative input limit for an integrator or data processor is approximately -10 mV.
If the baseline decreases below this level, it becomes impossible to integrate the peaks in the chromatogram (see Fig. 3-2 (a)).
In such a case, the offset function is used to adjust the shifted baseline to the allowable input signal range of the data processor (see Fig. 3-2 (b)).



(a) Offset is not used (b) Offset is used

Fig. 3-2 Example of Offsetting

(4) Offset setting is now completed and the 1st monitor screen returns.
Though no value is indicated for FL, "+*" will be displayed when selecting a value other than 0.

<1st monitor screen>

TIME	Ex	Em	FL	PROG	LAMP	[I]
0.0	250	350	0.0+*	1	Xe	

3.2.2 Time constant setting

Specify electrical response time.

(1) Press the SET UP UTLTY key.

(2) The following display will be presented.

<Utility initial screen>

```
UTILITY  (OFFSET=1, TIME CONSTANT=2,
_2          USE PROG=3, PMT VOLT=4, OTHERS=5)
```

Select TIME CONSTANT.
Press numeric key 2 and then the ENT key.

(3) The following display will be presented.

<Time constant setting screen>

TIME CONSTANT (0.01s=1, 0.02s=2, 0.05s=3, 4 0.1s=4, 0.5s=5, 1.0s=6, 2.0s=7)

Set a time constant value.
Press numeric key (1 to 7, usually input 4) and then the ENT key.

* Default value: 4

(4) Constant setting is now completed and the 1st monitor screen returns.

3.2.3 Use time progrum setting

It is selectable whether or not to use automatic change of measurement parameters in response to measurement time (time program).

(1) Press the SET UP / UTLTY key.

(2) The following display will be presented.

<Utility initial screen>

UTILITY (OFFSET=1, TIME CONSTANT=2, _3 USE PROG=3, PMT VOLT=4, OTHERS=5)

Select USE PROG.
Press numeric key 3 and then the ENT key.

(3) The following display will be presented.

<Time program setting screen>

USE TIME PROGRAM (YES=1, NO=0) 1

Select use (YES=1) or non-use (NO=0) of a time program.
Press a numeric key (1 or 0) and then the ENT key.

* 1: Time program starts by start input.
  0: Time program does not start despite start input.
* Default value: 1

(4) Selection or avoidance of a time program is now completed and the 1st monitor screen returns.
When use of a time program is avoided, "-" is indicated for PROG.

<1st monitor screen>

TIME	Ex	Em	FL	PROG	LAMP	[I]
0.0	250	350	0.0	—	Xe	

3.2.4 PMT voltage setting

Set photomultiplier voltage for fluorescence detection.

(1) Press the SET UP UTLTY key.

(2) The following display will be presented.

<Utility initial screen>

```
UTILITY  (OFFSET=1, TIME CONSTANT=2,
_4          USE PROG=3, PMT VOLT=4, OTHERS=5)
```

Select PMT VOLT.
Press numeric key 4 and then the ENT key.

(3) The following display will be presented.

<PMT voltage setting screen>

```
PMT VOLT  (SUPER HIGH=1, HIGH=2, MID=3,
3              LOW=4, SUPER LOW=5)
```

Set a photomultiplier voltage.
Press numeric key (1 to 5, usually input 3) and then the ENT key.

* Default value: 3

(4) Photomultiplier voltage setting is now completed and the 1st monitor screen returns.

3.2.5 Other settings

Set the following items.

- Em BANDWIDTH
- ERROR OUT
- LEAK SENSOR
- LAMP

(1) Em BANDWIDTH setting
A bandwidth value of the emission monochromator is settable. Standard is 15 nm and wide setting is 30 nm.

(a) Press the SET UP UTLTY key.

(b) The following display will be presented.

<Utility initial screen>

```
UTILITY  (OFFSET=1, TIME CONSTANT=2,
_5          USE PROG=3, PMT VOLT=4, OTHERS=5)
```

Select OTHERS.
Press numeric key 5 and then the ENT key.

(c) The following display will be presented.

<Others setting screen>

```
OTHERS   (Em BANDWIDTH=1, ERROR OUT=2,
1             LEAK SENSOR=3, LAMP=4)
```

Select Em BANDWIDTH.
Press numeric key 1 and then the ENT key.

(d) The following display will be presented.

<Em bandwidth selecting screen>

```
Em BANDWIDTH (STANDARD=1, WIDE=2)
1
```

Set an Em bandwidth value.
Press numeric key (1 or 2, usually input 1) and then the ENT key.

* Default value: 1

(e) Em bandwidth setting is now completed and the 1st monitor screen returns.

(2) ERROR OUT setting

It is selectable whether to enable or disable the error signal output.
When enabled, the following errors can be indicated.

Xenon lamp error
Thermo cell error
Thermo cell connection error
ADC error
DAC error
Data buffer overflow (CDS system)
Overheat (Refer to Section 4.7)

(a) Press the SET UP / UTLTY key.

(b) The following display will be presented.

<Utility initial screen>

```
UTILITY  (OFFSET=1, TIME CONSTANT=2,
_5         USE PROG=3, PMT VOLT=4, OTHERS=5)
```

Select OTHERS.
Press numeric key 5 and then the ENT key.

(c) The following display will be presented.

<Others setting screen>

```
OTHERS   (Em BANDWIDTH=1, ERROR OUT=2,
2              LEAK SENSOR=3, LAMP=4)
```

Select ERROR OUT.
Press numeric key 2 and then the ENT key.

(d) The following display will be presented.

<Error out signal selecting screen>

```
ERROR OUT SIGNAL (DISABLE=0, ENABLE=1)
1
```

Invalid (0) or valid (1) status of error out signal output is settable.
Press numeric key (0 or 1) and then the ENT key.

* Default value: 1

(e) Error out setting is now completed and the 1st monitor screen returns.

(3) LEAK SENSOR setting
Whether to use the liquid leak sensor or not is settable.

(a) Press the SET UP UTLTY key.

(b) The following display will be presented.

<Utility initial screen>

```
UTILITY  (OFFSET=1, TIME CONSTANT=2,
_5             USE PROG=3, PMT VOLT=4, OTHERS=5)
```

Select OTHERS.
Press numeric key 5 and then the ENT key.

(c) The following display will be presented.

<Others setting screen>

```
OTHERS   (Em BANDWIDTH=1, ERROR OUT=2,
3              LEAK SENSOR=3, LAMP=4)
```

Select LEAK SENSOR.
Press numeric key 3 and then the ENT key.

(d) The following display will be presented.

<Leak sensor selecting screen>

```
LEAK SENSOR (OFF=0, ON=1)
1
```

Select use (ON=1) or non-use (OFF=0) of the leak sensor.
Press a numeric key (0 or 1, usually input 1) and then the ENT key.

* Default value: 0
* When use (ON=1) of the leak sensor is selected, an error message will be indicated upon detection of liquid leakage (Refer to Section 4.6).
* When power supply is restored, setting will be use (ON=1) of the leak sensor.

(e) Selection or avoidance of the leak sensor is now completed and the 1st monitor screen returns.

(4) LAMP setting

ON or OFF status of the xenon lamp is selectable in the following procedure.

(a) Press the SET UP / UTLTY key.

(b) The following display will be presented.

<Utility initial screen>

```
UTILITY  (OFFSET=1, TIME CONSTANT=2,
_5             USE PROG=3, PMT VOLT=4, OTHERS=5)
```

Select OTHERS.
Press numeric key 5 and then the ENT key.

(c) The following display will be presented.

<Others setting screen>

OTHERS (Em BANDWIDTH=1, ERROR OUT=2, 4 LEAK SENSOR=3, LAMP=4)

Select LAMP.
Press numeric key 4 and then the ENT key.

(d) The following display will be presented.

<Xe lamp selecting screen>

Xe LAMP ON/OFF (OFF=0, ON=1) 1

Select ON (1) or OFF (0) status of the xenon lamp.
Press numeric key (0 or 1, usually input 1) and then the ENT key.

* Default value: 1

(e) Xenon lamp setting is now completed and the 1st monitor screen returns.
When the xenon lamp is lit, Xe is displayed for LAMP.
And when the lamp is extinguished, OFF is displayed for LAMP.

<1st monitor screen>

TIME	Ex	Em	FL	PROG	LAMP	[I]
0.0	250	350	0.0	1	OFF	

* The Xe lamp will light up when this unit is powered on.

NOTE: A xenon lamp shortly after turning off the lights can't be lit because of high temperature.
For re-measurement, wait at least 5 minutes or more after turning off the lamp.

3.3 GLP Functions

For this function, the following items are settable.

- Xe lamp LOGBOOK data display and resetting
- Hg lamp LOGBOOK data display and resetting
- KEY LOCK setting
- WL CHECK (wavelength accuracy check) by using Hg lamp
- CHECK (Xe lamp energy check)

NOTE: The logbook data entry is reset when a numeric value representing “year” is input followed by pressing the ENT key.
Even when the same year as desired is already indicated, it must be reentered without fail.

3.3.1 Xe lamp logbook data display

Total on period of the Xe lamp and its standard lifetime (in parentheses under Xe LAMP), the number of switching-on times and the date of the last lamp change can be indicated.

(1) Press the GLP key.

(2) The following display will be presented.

<GLP initial screen>

```
GLP   (LOGBOOK=1, KEY LOCK=2,
1        WL CHECK=3, Xe CHECK=4)
```

Select LOGBOOK.
Press numeric key 1 and then the ENT key.

(3) The following display will be presented.

<Lamp selecting screen>

```
LAMP SELECT (Xe=1, Hg=2)
1
```

Select Xe.
Press numeric key 1 and then ENT key.

(4) The following display will be presented.

<Logbook selecting screen>

LOGBOOK (REPORT=1, RESET=2) 1

Select Report.
Press numeric key 1 and then the ENT key.

(5) On the logbook report screen, the total on period of the Xe lamp and its standard lifetime (in parentheses under Xe LAMP), the number of switching-on times and the date of the last lamp change will be indicated.

<Logbook report screen>

Xe LAMP	SWITCHING	LAST CHANGED DATE
123h (500)	23 times	9/ 1/2010

Press the ENT or ESC key.

(6) Logbook display is now completed and the 1st monitor screen returns.

3.3.2 Xe lamp logbook data resetting

Total on period of the Xe lamp, the number of switching-on times and the date of the last lamp change are reset.

(1) Press the GLP key.

(2) The following display will be presented.

<GLP initial screen>

GLP (LOGBOOK=1, KEY LOCK=2, 1 WL CHECK=3, Xe CHECK=4)

Select LOGBOOK.
Press numeric key 1 and then the ENT key.

(3) The following display will be presented.

<Lamp selecting screen>

```
LAMP SELECT (Xe=1, Hg=2)
1
```

Select Xe.
Press numeric key 1 and then the ENT key.

(4) The following display will be presented.

<Logbook selecting screen>

```
LOGBOOK (REPORT=1, RESET=2)
2
```

Select RESET.
Press numeric key 2 and then the ENT key.
Next, advance to the Xe lamp change date setting screen for setting the date of xenon lamp change.

(5) Set the date of xenon lamp change in the following procedure.

(a) Input a month for MM (cursor appears under MM).

<Xe lamp change date setting screen (month)>

```
Xe LAMP CHANGE   (MM    DD    YYYY)
<1-12>             9     1    2010
```

Press numeric key (1 to 1 2) and then the ENT key.
The cursor moves to DD.

(b) Input a day for DD.

<Xe lamp change date setting screen (day)>

```
Xe LAMP CHANGE   (MM    DD    YYYY)
<1-31>             9    _1    2010
```

Press numeric key (1 to 3 1) and then the ENT key.
The cursor moves to YYYY.

(c) Input a year for YYYY.

<Xe lamp change date setting screen (year)>

```
Xe LAMP CHANGE   (MM    DD    YYYY)
<1-31>                9     1   2010
```

Press numeric keys (2 0 0 0 to 2 1 0 0) and then the ENT key.

* Even when the same year as desired is indicated, its numeral must be input again without fail.

(6) Logbook setting is now completed and the 1st monitor screen returns.

* When a xenon lamp change date is set, the total on period of the Xe lamp and the number of switching-on times will be automatically reset accordingly.

3.3.3 Hg lamp logbook data display

Total on period of the Hg lamp, the number of switching-on times and the date of the last lamp change can be indicated.

(1) Press the GLP key.

(2) The following display will be presented.

<GLP initial screen>

```
GLP   (LOGBOOK=1, KEY LOCK=2,
1       WL CHECK=3, Xe CHECK=4)
```

Select LOGBOOK.
Press numeric key 1 and then the ENT key.

(3) The following display will be presented.

<Lamp selecting screen>

```
LAMP SELECT (Xe=1, Hg=2)
2
```

Select Hg.
Press numeric key 2 and then the ENT key.

(4) The following display will be presented.

<Logbook selecting screen>

```
LOGBOOK（REPORT=1, RESET=2）
1
```

Select Report.
Press numeric key [1] and then [ENT] key.

(5) On the logbook report screen, the total ON period of the Hg lamp, the number of switching-on times and the date of the last lamp change will be indicated.

<Logbook report screen>

Hg LAMP	SWITCHING	LAST CHANGED DATE
12h	56 times	9/ 1/2010

Press the [ENT] or [ESC] key.

(6) Logbook display is now completed and the 1st monitor screen returns.

3.3.4 Hg lamp logbook data resetting

Total on period of the Hg lamp, the number of switching-on times and the date of the last lamp change are reset.

(1) Press the (GLP) key.

(2) The following display will be presented.

<GLP initial screen>

```
GLP    (LOGBOOK=1, KEY LOCK=2,
1       WL CHECK=3, Xe CHECK=4)
```

Select LOGBOOK.
Press numeric key [1] and then the [ENT] key.

(3) The following display will be presented.

<Lamp selecting screen>

```
LAMP SELECT (Xe=1, Hg=2)
2
```

Select Hg.
Press numeric key 2 and then ENT key.

(4) The following display will be presented.

<Logbook selecting screen>

```
LOGBOOK（REPORT=1, RESET=2）
2
```

Select RESET.
Press numeric key 2 and then ENT key.
Next, advance to the Hg lamp change date setting screen for setting the date of mercury lamp change.

(5) Set the date of mercury lamp change in the following procedure.

(a) Input a month for MM (cursor appears under MM).

<Hg lamp change date setting screen (month)>

```
Hg LAMP CHANGE     (MM   DD   YYYY)
<1-12>              _9    1    2010
```

Press numeric key (1 to 1 2) and then the ENT key.
The cursor moves to DD.

(b) Input a day for DD.

<Hg lamp change date setting screen (day)>

```
Xe LAMP CHANGE     (MM   DD   YYYY)
<1-31>              9    _1    2010
```

Press numeric key (1 to 3 1) and then the ENT key.
The cursor moves to YYYY.

(c) Input a year for YYYY.

<Hg lamp change date setting screen (year)>

```
Xe LAMP CHANGE     (MM   DD   YYYY)
<2000-2100>         9    1    2010
```

Press numeric keys (2 0 0 0 to 2 1 0 0) and then the ENT key.

* Even when the same year as desired is indicated, its numeral must be input again without fail.

(6) Logbook setting is now completed and the 1st monitor screen returns.

* When a mercury lamp change date is set, the total ON period of the Hg lamp and the number of switching-on times will be automatically reset accordingly.

3.3.5 Key lock setting

Lock the keyboard to prevent incorrect operation.

(1) Press the GLP key.

(2) The following display will be presented.

<GLP initial screen>

```
GLP     (LOGBOOK=1, KEY LOCK=2,
2         WL CHECK=3, Xe CHECK=4)
```

Select KEY LOCK.
Press numeric key 2 and then the ENT key.

(3) The following display will be presented.

<Key lock selecting screen>

```
KEY LOCK (YES=1, NO=0)
1
```

Set selection 1 or avoidance 0 of KEY LOCK.
Press numeric key (1 or 0, usually input 1) and then the ENT key.

* Default value: 0
* Even with the keys locked, the monitor screen can be changed with △ and ▽ keys.
Key lock can be released by pressing LOCK OFF / ESC key. It is also released when power is turned on again or when an error occurs.

(4) Key lock setting is now completed and the 1st monitor screen returns.

3.3.6 Wavelength accuracy check by using Hg lamp

Whether wavelength is normal or not can be checked by using the 254 nm bright line of mercury lamp.

(1) Press the GLP key.

(2) The following display will be presented.

<GLP initial screen>

```
GLP      (LOGBOOK=1, KEY LOCK=2,
3          WL CHECK=3, Xe CHECK=4)
```

Select WL CHECK.
Press numeric key 3 and then the ENT key.

(3) The WL accuracy checking screen appears and it is checked whether wavelength is normal or not.

<WL accuracy checking screen (running)>

```
CHECKING WL ACCURACY
```

* If an Hg lamp lighting error occurs, the error message shown below will appear. Return to the 1st monitor screen by pressing the CL key.

<Hg lamp error screen>

```
Hg LAMP ERROR
PRESS “CL” KEY TO CLEAR MESSAGE
```

(4) The result of excitation wavelength (Ex) check will be displayed automatically.

<Ex side check result>

```
Ex SIDE ACCURACY (254 nm)
      GOOD -1nm
```

Press the ENT key.

* If the error is within ±3 nm, “GOOD” will appear, and if the error exceeds ±3 nm, “FAIL” will appear on the display.

* If ESC key is pressed prior to ENT key, or if this status continues for 5 minutes or longer, the system will return automatically to the 1st monitor screen.

(5) The result of emission wavelength (Em) check will now be displayed.

<Em side check result>

Em SIDE ACCURACY (254 nm) GOOD -1nm

Press the ENT or ESC key.

* If the error is within ±3 nm, “GOOD” will appear, and if the error exceeds ±3 nm, “FAIL” will appear on the display.
* If 5 minutes or more elapses without pressing the ENT or ESC key, the system will return automatically to the 1st monitor screen.

(6) When the wavelength accuracy check is finished, the system returns to the 1st monitor screen.

3.3.7 Xe lamp energy check

Energy level of the xenon lamp can be checked using the xenon lamp beam at 254 nm.

(1) Press the GLP key.

(2) The following display will be presented.

<GLP initial screen>

GLP (LOGBOOK=1, KEY LOCK=2, 4 WL CHECK=3, Xe CHECK=4)

Select Xe CHECK.
Press numeric key 4 and then the ENT key.

* If the Xe lamp is turned off, the system will return to the 1st monitor screen without performing an energy check.

(3) The Xe lamp energy check screen appears and an energy check will be performed.

<Xe lamp energy check screen> (energy check is in progress)

```
CHECKING LAMP ENERGY
                                        (Xe)
```

(4) The result of Xe lamp energy check will be displayed automatically.

<Xe lamp energy check result>

```
Xe ENERGY
    1200
```

Press the ENT or ESC key.

* If 5 minutes or more elapses without pressing ENT or ESC key, the system will return automatically to the 1st monitor screen.

(5) When the Xe lamp energy check is finished, the system returns to the 1st monitor screen.

NOTE: When the temperature of the Xe lamp is high, the sealed gas pressure will fluctuate and the lamp may be difficult to ignite. Before restarting the instrument or re-lighting the lamp, wait at least five minutes for the lamp to cool down after turning it off.

3.4 Operating Instructions

3.4.1 Time program setting

A time program is used for automatic change of the chromatograph measurement conditions with time. The time program takes priority over other settings.
The following items can be set.

- Measurement time (TIME)
- Excitation wavelength (Ex)
- Emission wavelength (Em)
- Baseline processing (BASE)
- Photomultiplier voltage (PMT)

* Up to 9 programs can be registered as a time program, and a total of 100 steps can be registered for the 9 programs.
  The registered time program is retained by battery backup even when the power switch is turned OFF.

* Use the CL key to correct entered numerics. And use the DEL key to delete registered values. Use the △ key to go back to the preceding step, or the ▽ key to advance to the next step.
  When the setting at each step is finished, press the ESC key to return to the 1st monitor screen, and the time program is registered.

NOTE: When setting the time program, be sure to set the TIME for the first step at 0.0. This cannot be changed or deleted. And for the final step of the program, be sure to set the measurement completion time.
The time program will thus be executed up to the time entered for the final step.

NOTE: Set an interval of at least 0.3 minute between steps of the time program.

NOTE: It is recommended that the wavelength set here for 0.0 minute be identical to the measurement wavelength set in section 3.1.4. For instance, if 500 is set here for Ex with 250 set for Ex of the measurement wavelength, then a time loss will occur when Ex shifts from 250 to 500 at the start of the time program.

(1) Press the PROG key.

(2) The time program No. setting screen appears.

<Time program No. setting screen>

```
SET PROGRAM NO. (1-9)
1
```

Press a numeric key 1 to 9 and then the ENT key to create or change the program No., or select the existing program No.

* Initial (default) value: 1
* If the setting will not be changed, press the ESC key to return to the 1st monitor screen.

(3) The mode setting screen appears. "0" is always indicated here.

<Mode setting screen>

```
EDIT MODE (MODIFY=0, NEW=1)
1
```

Press a numeric key 0 or 1 and then the ENT key to either use (MODIFY=0) or delete (NEW=1) the conditions in the time program No. selected above.

* 0 : Conditions in the time program No. selected above are used; additions or changes can be made in the program.
  1 : Conditions in the time program No. selected above are deleted, and new conditions can be set.

The system now advances to the step setting screen for setting the time program, and setting is allowed for the first step (the cursor moves to TIME).

(4) Setting of first step (start conditions) of time program:

(a) Set the TIME.

<Step setting screen (TIME indicated)>

TIME	Ex	Em	BASE	PMT	
_ 0.0					1

Press numeric keys 0.0 and then the ENT key.

* Be sure to enter “0.0” for TIME.
* Initial (default) value: 0.0
* The program No. currently set is indicated at the bottom right of the screen.

The cursor now moves to Ex.

(b) Set an Ex (excitation) wavelength.

<Step setting screen (Ex indicated)>

TIME	Ex	Em	BASE	PMT	
0.0	250				1

Press numeric keys 2 0 0 to 8 5 0 and then the ENT key.

* Setting range: 200 to 850 nm
  It is recommended to set the same wavelength as was set for Ex of the measuring wavelengths.
* Initial (default) value: blank

The cursor next moves to Em.

(c) Set an Em (emission) wavelength.

<Step setting screen (Em indicated)>

TIME	Ex	Em	BASE	PMT	
0.0	250	350			1

Press numeric keys 2 5 0 to 9 0 0 and then the ENT key.

* Setting range: 250 to 900 nm
  It is recommended to set the same wavelength as was set for Em of the measuring wavelengths.
* Initial (default) value: blank

The cursor next moves to BASE.

(d) Set the BASE (baseline processing).

<Step setting screen (BASE indicated)>

TIME	Ex	Em	BASE	PMT	
0.0	250	350	1		1

Press a numeric key (1 or 2; usually 1) and then the ENT key.

* **1** : AUTO ZERO is executed. Data baseline is set to the zero point of the recorder.
  2 : HOLD is executed. Baseline is held so that it doesn't fluctuate. HOLD function is released by executing AUTO ZERO.
* Initial (default) value: 1

(e) Set the PMT (photomultiplier voltage).

<Step setting screen (PMT indicated)>

TIME	Ex	Em	BASE	PMT	
0.0	250	350	1	3	1

Press a numeric key 1 to 5 and then the ENT key.

(f) When the setting for the first step is completed, return to the TIME setting on step setting screen.

* If some parameters will be changed, advance to the second and subsequent steps.
  If parameters will not be changed, advance to the final step setting.

(5) Setting of second and subsequent steps of time program:

(a) Set the TIME to be changed.

<Step setting screen (TIME indicated)>

TIME	Ex	Em	BASE	PMT
_ 10.0			1	1

Press numeric keys 0 to 6 0 0 and then the ENT key.

* Setting range: 0 to 600 minutes, in increments of 0.1 minute

The cursor now moves to Ex.

(b) Set an Ex (excitation) wavelength to be changed.

<Step setting screen (Ex indicated)>

TIME	Ex	Em	BASE	PMT
10.0	400		1	1

Press numeric keys 2 0 0 to 8 5 0 and then the ENT key.
The cursor next moves to Em.

(c) Set an Em (emission) wavelength to be changed.

<Step setting screen (Em indicated)>

TIME	Ex	Em	BASE	PMT
10.0	400	500		1

Press numeric keys 2 5 0 to 9 0 0 and then the ENT key.
The cursor next moves to BASE.

(d) Set the BASE (baseline processing) to be changed.

<Step setting screen (BASE indicated)>

TIME	Ex	Em	BASE	PMT	
10.0	400	500	2		1

Press a numeric key (1 or 2; usually 2) and then ENT key.

* Enter 2 so as to match the baseline in the present step with the one in the previous step.

(e) Set the PMT (photomultiplier voltage) to be changed.

<Step setting screen (PMT indicated)>

TIME	Ex	Em	BASE	PMT	
10.0	400	500	2	4	1

Press a numeric key 1 to 5 and then the ENT key.

(f) When the setting for the second step is completed, return to the TIME setting on step setting screen.

* If more parameters will be changed, then repeat the operation in this subsection.
  If parameters will not be changed, advance to the final step setting.

(6) Setting of final step of time program:

(a) Set the measurement end TIME.

<Step setting screen (TIME indicated)>

TIME	Ex	Em	BASE	PMT	
_ 20.0			1		1

Press numeric keys followed by the ENT and then the ESC key.

* Setting range: 0 to 600 minutes, in increments of 0.1 minute
* Items other than TIME need not be set.

(b) When the time program settings are completed, the 1st monitor screen reappears.

(7) Addition of steps

Press the INSERT key to add a step to the program during step input. The step setting screen will appear, so make the addition in the same procedure as described above. However, the addition must be made within the time entered at the final step.

3.4.2 Time program starting

Press the START key to start the time program.
Status indication on the 1st monitor screen becomes R (time program is running), and the elapsed time is indicated at TIME. The PROG. RUN LED lights up in blue.

<1st monitor screen>

TIME	Ex	Em	FL	PROG	LAMP	[R]
***	250	350	0.0	1	Xe	

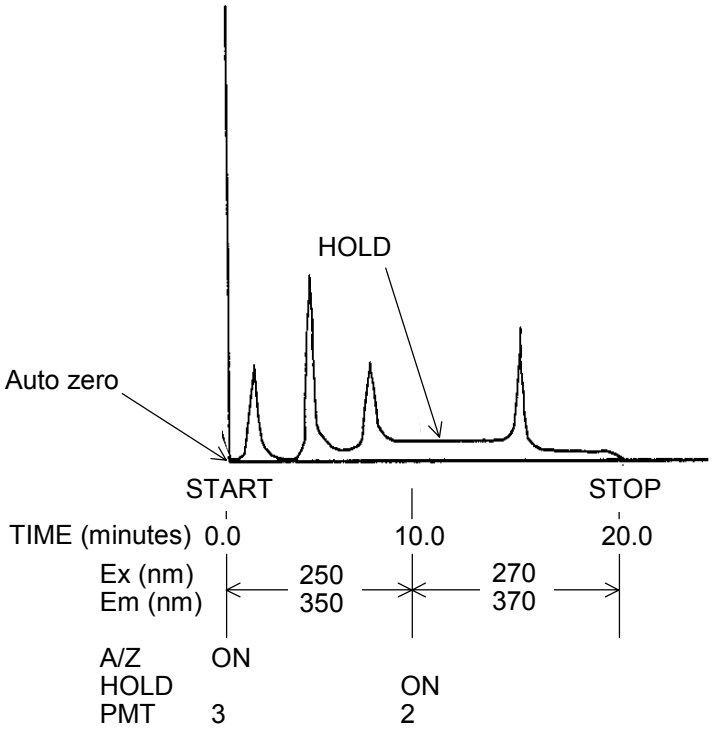
3.4.3 Time program stopping

Press the STOP key, then the time program under execution stops and the 1st monitor screen returns.

3.4.4 Time program operation examples

(1) Setting of time program

Described next is the procedure for newly creating a time program shown in the figure.



Described here is an example of newly setting a time program at program No. 1. Ten minutes after the start (1), photomultiplier voltage is changed from MID to LOW, excitation wavelength from 250 to 270 nm, emission wavelength from 350 to 370 nm, and hold function is applied, then measurement is completed after 20 minutes (2).

Press PROG key.

↓

```
SET PROGE NO. (1 - 9)
1
```

Press 1 key and then the ENT key.

↓

```
EDIT MODE (MODIFY=0, NEW=1)
0
```

Press 1 key and then the ENT key.

↓

```
TIME      Ex        Em        BASE      PMT
0.0                           1                   1
```

Press 0 key and then the ENT key.
Press 2 5 0 keys and then the ENT key.
Press 3 5 0 keys and then the ENT key.
Press 1 key and then the ENT key.
Press 3 key and then the ENT key.

↓

```
TIME      Ex        Em        BASE      PMT
0.0       250       350       1         3         1
```

Press 1 0 keys and then the ENT key.
Press 2 7 0 keys and then the ENT key.
Press 3 7 0 keys and then the ENT key.
Press 2 key and then the ENT key.
Press 2 key and then the ENT key.

↓

```
TIME      Ex        Em        BASE      PMT
10.0      270       370       2         2         1
```

Press 2 0 keys and then the ENT key.

↓

```
TIME      Ex        Em        BASE      PMT
20.0                                              1
```

Press the ESC key.
Time program setting is now finished.

↓

```
TIME      Ex        Em        FL        PROG      LAMP      [I]
0.0       250       350       0.0       1         Xe
```

Press the START key.
The time program starts and measurement is initiated.

(2) Check of time program

Take the following procedure for checking the program that was set in the above.

Press the GLP key.

↓

```
SET PROGE NO. (1 - 9)
1
```

Press 1 key and then the ENT key.

↓

```
EDIT MODE (MODIFY=0, NEW=1)
0
```

Press 0 key and then the ENT key.
Step at startup is indicated.

↓

```
TIME    Ex      Em      BASE    PMT
0.0     250     350       1       3          1
```

Press ▽ key to access the next step.

↓

```
TIME    Ex      Em      BASE    PMT
10.0    270     370       2       2          1
```

Press ▽ key to access the next step.

↓

```
TIME    Ex      Em      BASE    PMT
20.0                                       1
```

Press the ESC key, and the 1st monitor screen returns.

↓

```
TIME    Ex      Em      FL      PROG    LAMP      [I]
0.0     250     350     0.0       1       Xe
```

3.4.5 Spectrum measurement

Set the wavelength scan range (maximum and minimum values) for excitation (Ex) and emission (Em), then measure and record the spectral data for each.

* Carry out recording of spectral data with sample contained in the cell (sample not flowing, but stationary in cell).

NOTE: The spectral bandwidth is 15 nm on both excitation and emission sides (bottom width of peak is about 30 nm). A component with a difference between excitation and emission wavelengths of less than 30 nm cannot be accurately measured. Excitation and emission wavelengths should be kept more than 30 nm apart for measurement.

NOTE: The maximum wavelength scan range (from end to start wavelength) for both excitation and emission is 400 nm.
For spectrum acquisition in a range greater than 400 nm, the range should be divided into two for measurement.

NOTE: Saved spectral data will not be retained when the power is turned OFF.

(1) Measurement and Recording of Spectrum for Excitation (Ex) Scan Range:

(a) Press the SPECT key.

(b) The scan mode setting screen will appear.

<Scan mode setting screen>

```
SPECTRUM MODE (FL (Ex)=1, FL (Em)=2)
1
```

Press numeric key 1 and then the ENT to select FL (Ex).
Now proceed to the scan range setting screen for setting a scan range, and enter a start wavelength (a cursor will appear at WL1).

(c) Enter a start wavelength (minimum value) at WL1 of the scan range.

<Scan range setting screen (indicate WL1)>

```
SCANNING WL RANG (WL1   WL2) nm FL (Ex)
<200-800>          200 - 600
```

Press numeric keys [2] [0] [0] to [8] [0] [0] and then the [ENT] key.

* Setting range : 200 to 800 nm
* Initial (default) value: 200
* If setting will not be changed, press [▽] key to proceed to WL2 setting.

The cursor now moves to WL2.

(d) Now enter an end wavelength (maximum value) at WL2.

<Scan range setting screen (indicate WL2)>

```
SCANNING WL RANG        (WL1   WL2) nm FL (Ex)
<250-850>                200 - 600
```

Press numeric keys [2] [5] [0] to [8] [5] [0] and then the [ENT] key.

* Input value : Value of less than 850 within WL1 + 50 to WL1 + 400.
* Setting range : 250 to 850 nm
* Initial (default) value: 600
* Pressing [△] key prior to the [ENT] key will return to WL1.

(e) A memorize spectrum setting screen will now appear.

<Memorize spectrum setting screen>

```
MEMORIZE SPECTRUM NO. (1 - 4)
1
```

Set a memorize spectrum number for the spectral data.
Press a numeric key [1] to 4 and then the [ENT] key.

* Initial (default) value: blank
* Upon entering a memorize spectrum No., the previous spectral data will be deleted and the new data will be memorized.

(f) The scan monitor screen appears, and spectral acquisition within the set range is carried out.

<Scan monitor screen (spectral acquisition under way)>

```
SCANNING SPECTRUM NO.: 1              MODE: FL (Ex)
Ex: ***nm   Em: 350 nm
```

* Pressing the ESC key during spectral acquisition will cancel the process. Spectral data will not be memorized.
* The memorize spectrum No. set in the preceding step will be indicated at SCANNING SPECTRUM NO.
* Ex is effective within the scan range set above.

(g) When the spectral data memorization is completed, the system returns to the 1st monitor screen automatically.

(2) Measurement and Recording of Spectrum for Emission(Em) Scan Range:

(a) Press the SPECT key.

(b) The scan mode setting screen will appear.

<Scan mode setting screen>

```
SPECTRUM MODE (FL (Ex)=1, FL (Em)=2)
2
```

Press numeric key 2 and then the ENT key to select FL (Em).
Now proceed to the scan range setting screen for setting a scan range, and enter a start wavelength (a cursor will appear at WL1).

(c) Enter a start wavelength (minimum value) at WL1 of the scan range.

<Scan range setting screen (indicate WL1)>

```
SCANNING WL RANG (WL1   WL2) nm FL (Em)
<250-850>              250 - 700
```

Press numeric keys 2 5 0 to 8 5 0 and then the ENT key.

* Setting range : 250 to 850 nm
* Initial (default) value: 250
* If setting will not be changed, press ▽ key to proceed to WL2 setting.

The cursor now moves to WL2.

(d) Now enter an end wavelength (maximum value) at WL2.

<Scan range setting screen (indicate WL2)>

```
SCANNING WL RANG (WL1   WL2) nm FL (Em)
<300-900>              250 - 700
```

Press numeric keys 3 0 0 to 9 0 0 and then the ENT key.

* Input value : Value of less than 900 within WL1 + 50 to WL1 + 400.
* Setting range : 300 to 900 nm
* Initial (default) value: 700
* Pressing △ key prior to the ENT key will return to WL1.

(e) A memorize spectrum setting screen will now appear.

<Memorize spectrum setting screen>

```
MEMORIZE SPECTRUM NO. (1 - 4)
1
```

Set a memorize spectrum No. for the spectral data.
Press a numeric key 1 to 4 and then the ENT key.

* Initial (default) value: blank
* Upon entering a memorize spectrum No., the previous spectral data will be deleted and the new data will be memorized.

(f) The scan monitor screen appears, and spectral acquisition within the set range is carried out.

<Scan monitor screen (spectral acquisition under way)>

```
SCANNING SPECTRUM NO.: 1   MODE: FL (Em)
Ex: 250 nm   Em: *** nm
```

* Pressing the ESC key during spectral acquisition will cancel the process. Spectral data will not be memorized.
* The memorize spectrum No. set in the preceding step will be indicated at SCANNING SPECTRUM NO.
* Em is effective within the scan range set above.

(g) When the spectral data memorization is completed, the system returns to the 1st monitor screen automatically.

3.4.6 Recorder and spectrum output factors setting

The following items are settable as factors used in recorder and/or spectrum output.

- Full scale range of recorder
- Output speed of recorder
- Output spectrum data

NOTE: With an emission spectrum, scattered excitation light, Raman scattering due to solvent, emission due to solvent or impurities in it, and second (or third) order emission may be superimposed on the emission of the analyte element. Similarly, an excitation spectrum may be affected by scattered light at the emission wavelength, by Raman scattering due to solvent, by emission due to solvent or impurities contained in it, and by second (or third) order scattered light of the excitation beam. These factors must be taken into consideration when selecting the optimum excitation and emission wavelengths for spectrum acquisition. Refer to section 2.4 for details.

NOTE: The excitation and emission spectra output are not corrected for the wavelength-dependent sensitivity of the photomultiplier.
The obtained spectra therefore differ from the true excitation and emission spectra of the analyte element. This difference is especially noticeable at wavelengths below 300 nm.

(1) Full Scale Range of Recorder

(a) Press the RECORD key.

(b) The recorder setting screen appears.

<Recorder setting screen>

```
RECORD  (RCD RANGE=1, RCD SPEED=2,
1               SPECT RCD=3)
```

Press numeric key 1 and then the ENT key to select RCD RANGE (recorder range).

(c) The recorder full scale range setting screen appears.

<Recorder full scale range setting screen>

```
RCD RANGE (1 - 1000)
1000
```

Press numeric keys 1 to 1 0 0 0 and then the ENT key to set a recorder full scale range.

* Initial (default) value: 1000

(d) When the setting of recorder full scale range is finished, the system returns to the 1st monitor screen.

(2) Setting of Recorder Output Speed

(a) Press the RECORD key.

(b) The recorder setting screen appears.

<Recorder setting screen>

```
RECORD  (RCD RANGE=1, RCD SPEED=2,
2               SPECT RCD=3)
```

Press numeric key 2 and then the ENT key to select RCD SPEED (recorder speed).

(c) The recorder speed setting screen appears.

<Recorder speed setting screen>

```
RCD SPEED (40 nm/min=1, 60 nm/min=2)
2
```

Press numeric key 1 or 2 and then the ENT key to set a recorder speed.
* Initial (default) value: 2

(d) When the setting of recorder output speed is finished, the system returns to the 1st monitor screen.

(3) Setting of Output Spectral Data

(a) Press the RECORD key.

(b) The recorder setting screen appears.

<Recorder setting screen>

```
RECORD  (RCD RANGE=1, RCD SPEED=2,
3               SPECT RCD=3)
```

Press numeric key 3 and then the ENT key to select SPECT RCD (spectral recording).

(c) The output data spectrum No. setting screen appears.

<Output data spectrum No. setting screen>

```
RECORD SPECTRUM NO. (1 - 4)
1
```

Press a numeric key 1 to 4 and then the ENT key to set a spectrum No. to be output.
* Initial (default) value: 1

(d) The background spectrum No. setting screen now appears.
The background spectrum is used to compensate for absorption by the solvent or cell. To ensure that an appropriately corrected spectrum is used in analysis, a new background spectrum should be acquired whenever the solvent or wavelength scan range is changed.

<Background spectrum No. setting screen>

BACKGROUND SPECTRUM NO. (0 ~ 4) 0

Press a numeric key 0 to 4 and then the ENT key to select whether or not to correct the output spectrum.

* 0 : Spectrum selected at RECORD SPECTRUM NO. will be output as it is.
  1 - 4 : Spectral data obtained by subtracting the specified background data from the spectrum selected at RECORD SPECTRUM NO. will be output.
* Initial (default) value: 0
* When the energy spectrum and spectrum type are mismatched, the error message indicated below will appear. Press the CL key and the 1st monitor screen will return.

<Error display>

SPECTRA ARE MISMATCHED PRESS “CL” KEY TO CLEAR MESSAGE

(e) The “ready for output” monitor screen will appear.

<“Ready for output” monitor screen>

RCD NO.	SPEED	WL-RANGE (Em)	WIDTH:STD
1	60	200-600 PRESS	“START”

Press the START key.

* Pressing the ESC key prior to the START key will cancel the process.
* The output spectrum No. set before will be indicated at RCD NO.

(f) The output monitor screen appears, and a spectrum is output.

<Output monitor screen (spectrum output under way)>

RCD NO.	Ex	Em	FL	SPEED	MODE
1	250	350	0.0	60	Em

* Pressing the STOP key during spectrum output will cancel the process.

* The output spectrum No. set before will be indicated at RCD NO.

(g) When the spectrum output is finished, the 1st monitor screen will return automatically.

3.4.7 Marker operation

A marker line is indicated only on the recorder. It is usable as an event marker to indicate, for example, the start of measurement or the point where set conditions were changed during measurement.

* Press the MARKER [1] key to indicate a marker line on the recorder data.

3.5 Set Up Setting

Before analytical operation, communication channel (CH) and liquid crystal display contrast (LCD CONTRAST) need to be set.

- This setting is not required every time. When unnecessary, skip this setting.
- The default value or currently set value is indicated before your input.

3.5.1 Communication channel (CH) setting

Set a communication channel via the e-Line in the following way.

(1) Turn on the power switch with the SET UP / UTLTY key held down.

(2) The following display will be presented.

<Setup initial screen>

SETUP:	DETECT	THERMO	CONTRAST	S. NO.
	CH1	NO USE	4	02AB-111

Press the ENT key.

(3) The following display will be presented.

<Setup items selecting screen>

```
SETUP ITEMS (DETECTOR=1, THERMO CELL=2
1                CONTRAST=3, EXCHANGE STANDARD=4)
```

Select DETECTOR.
Press numeric key 1 and then the ENT key.

(4) The following display will be presented.

<Channel selecting screen>

```
DETECTOR (CH1=1, CH2=2)
1
```

Select a channel (CH).
Press numeric key 1 or 2 and then the ENT key.

* Default value: 1
* Two channels can be selected for two detectors.

(5) Channel setting is now completed and the setup initial screen appears.
Under DETECTOR, the selected channel setting is indicated.

<Setup initial screen>

SETUP:	DETECT	THERMO	CONTRAST	S. NO.
	CH1	NO USE	4	02AB-111

* When you press the ENT key here, the setup items selecting screen is presented to allow reentry.
  Or you can advance to LCD contrast setting.
* The selected setting will be fetched upon turning on power supply at the next time.

(6) Turn off the power switch.

3.5.2 Thermo cell setting

It is selectable whether or not to use the optional thermo cell

(1) Turn on the power switch with the SET UP / UTLTY key held down.

(2) The following display will be presented.

<Setup initial screen>

SETUP:	DETECT	THERMO	CONTRAST	S. NO.
	CH1	NO USE	4	02AB-111

Press the ENT key.

(3) The following display will be presented.

<Setup items selecting screen>

SETUP ITEMS (DETECTOR=1, THERMO CELL=2
2 CONTRAST=3, EXCHANGE STANDARD=4)

Select THERMO CELL.
Press numeric key 2 and then the ENT key.

(4) The following display will be presented.

<Thermo cell selecting screen>

THERMO CELL (NO USE=0, USE=1) 1

Select use (USE=1) or non-use (NO USE=0) of the thermo cell.
Press a numeric key (0 or 1) and then the ENT key.

* Default value: 1
* Two channels can be selected for two detectors.

(5) Selection or avoidance of the thermo cell is now completed and the setup initial screen appears.
Under THERMO, the selected channel setting is indicated.

<Setup initial screen>

SETUP:	DETECT	THERMO	CONTRAST	S. NO.
	CH1	USE	4	02AB-111

* When you press the ENT key here, the setup items selecting screen is presented to allow reentry.
  Or you can advance to LCD contrast setting.
* The selected setting will be fetched upon turning on power supply at the next time.

(6) Turn off the power switch.

3.5.3 Liquid crystal display contrast setting

Set a contrast (brightness) level of the LCD screen.

1) Turn on the power switch with the SET UP / UTLTY key held down.

2) The following display will be presented.

<Setup initial screen>

SETUP:	DETECT	THERMO	CONTRAST	S. NO.
	CH1	USE	4	02AB-111

Press the ENT key.

(3) The following display will be presented.

<Setup items selecting screen>

SETUP ITEMS (DETECTOR=1, CONTRAST=2
3 CONTRAST=3, EXCHANGE STANDARD=3)

Select CONTRAST.
Press numeric key 2 and then the ENT key.

(4) The following display will be presented.

<LCD contrast setting screen>

LCD CONTRAST (1 - 7)
3

Set a LCD CONTRAST value.
Press a numeric key (1 to 7, usually input 3) and then the ENT key.
* 1:Dark → 7:Bright
* Default value: 4

(5) LCD contrast setting is now completed and the setup initial screen appears.
Under CONTRAST, the selected contrast value is indicated.

<Setup initial screen>

SETUP:	DETECT	THERMO	CONTRAST	S. NO.
	CH1	USE	3	02AB-111

* When you press the ENT key here, the setup items selecting screen is presented to allow reentry.
* The selected setting will be fetched upon turning on power supply at the next time.

6) Turn OFF the power switch.

3.5.4 Standard xenon lamp lifetime setting

WARNING

Injury due to Xenon Lamp Explosion

When the cumulative turn-on time of the xenon lamp exceeds the guaranteed useful lifetime, the electrodes evaporate and the scattered matter sticks to the bulb wall, so its blackening progresses and heat dissipation is hindered. As a result, the internal bulb temperature (pressure) will rise abnormally to cause a danger of burst, etc.
Replace the xenon lamp with a new one before its cumulative turn-on time exceeds the guaranteed useful lifetime.

The standard life time of the xenon lamp is settable.
This setting activates the following function. If the total operation time of the Xe lamp is longer than the standard lifetime upon turning on the lamp, an error message is indicated to notify that the time point of lamp replacement is reached.

(1) Turn on the power switch with the SET UP / UTLTY key held down.

(2) The following display will be presented.

<Setup initial screen>

SETUP:	DETECT	THERMO	CONTRAST	S. NO.
	CH1	USE	4	02AB-111

Press the ENT key.

(3) The following display will be presented.

<Setup items selecting screen>

SETUP ITEMS (DETECTOR=1, CONTRAST=2
4 CONTRAST=3, EXCHANGE STANDARD=3)

Select EXCHANGE STANDARD.
Press numeric key 4 and then ENT key.

(4) The following display will be presented.

<Standard Xe lamp lifetime setting screen>

XE LAMP EXCHANGE STANDARD (1 - 2500) H _500

The standard lifetime of the Xe lamp is settable here.
Press numeric key (to input 1 to 2 5 0 0) and then the ENT key.

* Check the part number of your Xe lamp and input the correct value listed below.

Part No.	Part Name	Guaranteed Life	Limit	Allowable Input
J851152	150 W Xe lamp	150 hours	500 hours	500 or less
J851153	Long-life Xe lamp	500 hours	1,000 hours	1000 or less

* Default value: 500 hours
(J851152 Xe lamp is attached with shipment.)

(5) The setting of a standard Xe lamp lifetime is now completed and the following display will be presented.

<Setup initial screen>

SETUP:	DETECT	THERMO	CONTRAST	S. NO.
	CH1	USE	3	02AB-111

* When you press the ENT key here, the setup items selecting screen is presented to allow reentry.
* The selected setting will be fetched upon turning on power supply at the next time.

6) Turn OFF the power switch.

3.6 Before Performing Analysis

This chapter describes the basic items to be careful about before starting analysis.

WARNING

Ignition of Flammable Chemicals

- This instrument is not explosion-proof. In unattended operation, do not use organic solvents having an ignition point below 70 °C.
- Beware of ignition hazard when using flammable chemicals such as organic solvents.
  (a) Do not bring a heat or flame source near the instrument.
  (b) Well-ventilate the laboratory room where the instrument is used.
  (c) Always check the following conditions. If an abnormality is found, stop operation immediately.
    ◊ Leakage of solvent or waste solution.
    ◊ Leakage of solvent inside the instrument.
- When using flammable chemicals, be careful about possible ignition due to static electricity. To prevent the build-up of static electricity, use a conductive container for waste solution and provide proper grounding connection to it.

WARNING

Explosion of Vapor from Flammable Chemicals

If a flammable chemical such as organic solvent leaks from the flow path of the instrument and its vapor concentration reaches the explosion limit, it could cause spontaneous combustion with dangerously explosive results.
When using a flammable and readily volatile chemical, be sure to check for leakage from the instrument flow path and ventilate the laboratory room adequately.

⚠ WARNING

Inflammation or Injury due to Toxic, Corrosive or Stimulative Solvent

When using a toxic, corrosive or stimulative solvent, be careful not to incur a physical inflammation or injury.
For details of the properties of each solvent and how to handle it, refer to the relevant Material Safety Data Sheets (MSDS). Be sure to handle each solvent properly.

(a) Wear proper protective clothes (e.g., safety goggles) so that a solvent will not come into direct contact with the skin.

(b) Ventilate the laboratory room adequately to prevent accidental inhalation of harmful solvent vapor.

3.6.1 Selection of mobile phase and cautions on handling

(1) Be careful about restriction on use due to characteristics and temperature of mobile phase to be used. (See Table 3-2 Characteristics of Organic Solvents.)

(2) When performing high sensitivity analysis with a UV detector, use solvents whose UV absorption characteristics are especially small. Use solvents for liquid chromatograph commercially available.
Absorption characteristics of special grade reagents such as methanol, ethanol and acetonitrile generally and widely used are greatly different in the short wavelength range, depending on the manufacturing lot and the manufacturer. Be careful especially when performing high sensitivity analysis.

(3) Degas the mobile phase before use without fail.

(a) It is recommended to use a degassing unit because organic solvents have a specially high content of air, and the baselines may be fluctuated by bubbles. Malfunction of check valve and loss of column efficiency may also be caused. Degassing unit is especially required for mixing solvents for gradient use. Degas the solvents before use with reference to 4.8.2 Degassing Mobile Phase.

(b) When performing analysis with a UV detector in the short wavelength range or highly sensitive analysis with an RI detector, degassing the mobile phase before use is not enough, and the baselines may be fluctuated by the bubbles. In such a case, use degassing unit which can degas mobile phase on-line.

(4) Mobile Phase

When using mobile phase for liquid chromatograph, since the connections of pipings of pump and separation column use stainless steel (SUS316), solvents or reagents that may corrode stainless steel may be restricted.
Especially, solvents or solutions which contain halogen ions such as HCl, KCl, NaCl, NH_4Cl are typical reagents.
Reagents which may be restricted are shown in Table 4-1; use the table as a rough standard.

NOTE: When unsuitable reagents absolutely necessary for ingredient separation or reaction of a constituent have been used, or when mobile phase which deposits salt has been used, wash all the flow paths with distilled water after completing analysis without fail. If not, the plunger may wear down.
Pour water into the plunger wash mechanism in the rear part of the pump head and wash to prevent the plunger and the plunger seal from salt deposition.
Connect an accessory cylinder to the connector on the wash mechanism and pour water.
Run the plunger wash pump when the optional plunger wash pump is connected.

Table 3-1 Reagents for Mobile Phase that may be Restricted

Use is Possible	Use is Possible if 50% or Lower	Use is Possible if 10% or Lower	Reagents Unsuitable for SUS316
Phosphoric acid Sodium phosphate	Acetic acid Ammonium citrate Ammonium nitrate Citric acid Butyric acid Sodium nitrate	Disodium phosphate Ammonium formate Ammonium perchlorate Ammonium phosphate Boric acid Formic acid (up to pH3) Hydrochloric acid (up to pH3) Potassium nitrate Sodium hydrogencarbonate Sodium carbonate	Ammonium chloride Potassium chloride Sodium chloride Tolufluoroacetic acid Note 1: Max. concentration of above reagents should be 5-6%. Note 2: When the above reagents have been used necessarily, wash all the flow paths with distilled water completely without fail.

Do not use reagents that corrode SUS316 though they are not shown in the table above. If viscosity of solvent is high, pumping is impossible.

3.6.2 Characteristics of organic solvents

Characteristics of organic solvents as mobile phase for liquid chromatograph are shown in Table 4-2. Use it for reference.

WARNING

Ignition of Flammable Chemicals

This instrument is not explosion-proof. In unattended operation, do not use organic solvents having an ignition point below 70 °C.

Beware of ignition hazard when using flammable chemicals such as organic solvents.

(a) Do not bring a heat or flame source near the instrument.

(b) Well-ventilate the laboratory room where the instrument is used.

(c) Always check the following conditions. If an abnormality is found, stop operation immediately.
- ◊ Leakage of solvent or waste solution.
- ◊ Leakage of solvent inside the instrument.

When using flammable chemicals, be careful about possible ignition due to static electricity. To prevent the build-up of static electricity, use a conductive container for waste solution and provide proper grounding connection to it.

WARNING

Explosion of Vapor from Flammable Chemicals

If a flammable chemical such as organic solvent leaks from the flow path of the instrument and its vapor concentration reaches the explosion limit, it could cause spontaneous combustion with dangerously explosive results.
When using a flammable and readily volatile chemical, be sure to check for leakage from the instrument flow path and ventilate the laboratory room adequately.

⚠ WARNING

Inflammation or Injury due to Toxic, Corrosive or Stimulative Solvent

When using a toxic, corrosive or stimulative solvent, be careful not to incur a physical inflammation or injury.
For details of the properties of each solvent and how to handle it, refer to the relevant Material Safety Data Sheets (MSDS). Be sure to handle each solvent properly.

(a) Wear proper protective clothes (e.g., safety goggles) so that a solvent will not come into direct contact with the skin.

(b) Ventilate the laboratory room adequately to prevent accidental inhalation of harmful solvent vapor.

Table 3-2 Characteristics of Organic Solvents

	Polarity E^2 (Al_2O_3)	Viscosity (cP20 °C)	Refractive Index	UV Cut off (nm)	Flash Point (°C)	Ignition Point			Vapor Density (Air: 1)	Boiling Point (°C)	Specific Gravity (Water: 1)
						°C	Lower Limit	Upper Limit			
Fluoroalkanes	-0.25		1.25								
n-Pentane	0.00	0.23	1.358	210	< -40	308.9	1.5	7.8	2.5	36.1	0.6
Hexane	0.00		1.375	210	-21.7	233.9	1.2	7.5	3.0	68.9	0.7
Isooctane	0.01		1.404	210							
Petroleum ether	0.01	0.3		210							
n-Decane	0.04	0.92	1.412		46.1	207.8	0.8	5.4	4.9	173.9	0.7
Cyclohexane	0.04	1.00	1.427	210	-20	260	1.3	8	2.9	81.7	0.8
Cyclopentane	0.05	0.47	1.406	210							
Diisobutylene	0.06		1.411	210							
i-Pentene	0.08		1.371		-17.8	272.8	1.5	8.7	2.4	30	0.7
Carbon disulfide	0.15	0.37	1.626	380	-30	100	1.3	44	2.6	46.1	1.3
Carbon tetrachloride	0.18	0.97	1.466	265							
Amyl chloride	0.26	0.43	1.413	225	12.8	343.3	1.6	8.6	3.7	106.1	0.9
Butyl chloride	0.26		1.436	220	-9.4	460	1.8	10.1	3.2		0.9
		0.81†			o-17.2	463.9	1.0	6.0		144.4	
Xylene	0.26	0.61†	~ 1.50	290	m-25	527.8	1.1	7.0	3.7	138.9	0.9
		0.64†			p-25	528.9	1.1	7.0		138.3	
i-Propyl ether	0.28		1.368	220	-27.8	443.3	1.4	21	3.5	68.9	0.7
i-Propyl chloride	0.29	0.37	1.378	225	-32.2	593.3	2.8	10.7	2.7	35	0.9
Toluene	0.29	0.33	1.496	285	4.4	536.1	1.4	6.7	3.1	110.6	0.9
n-Propyl chloride	0.30	0.59	1.389	225	< -17.8		2.6	11.1	2.7	46.1	0.9
Chlorobenzene	0.30	0.35	1.525		32.2	637.8	1.3	7.1	3.9	132.2	1.1
Benzene	0.32	0.80	1.501	280	-11.1	562.2	1.4	7.1	2.8	80	0.9
Ethyl bromide	0.37	0.65	1.424			511.1	6.7	11.3	3.8	37.8	1.4
Ethyl ether	0.38		1.353	220	-45	180	1.9	48	2.6	35	0.7
Ethyl sulfide	0.38	0.23	1.442	290							
Chloroform	0.40	0.45	1.443	245							
Methylene chloride	0.42	0.57	1.424	245	-50	518.9	3.8	15.4	2.2	38.5	0.9
Methyl i-butyl ketone	0.43	0.44	1.394	330							
Tetrahydrofurane	0.45		1.408	220	-14.4	321.1	2	11.8	2.5	66.1	0.9
Ethylene dichloride	0.49		1.445	230	13.3	412.3	6.2	16	3.4	83.9	1.3
Methyl ethyl ketone	0.51	0.79	1.381	330	-6.1	515.6	1.8	10	2.5	80	0.8
i-Nitropropane	0.53		1.400	380	48.9	420.6	2.6		3.1	131.1	1.0
Acetone	0.56		1.359	220	-17.8	537.8	2.6	12.8	2.0	56.7	0.8
Dioxane	0.56	0.32	1.422	260	12.2	180	2.0	22	3.0	101.1	1.0
Ethyl acetate	0.58	1.54	1.370	260	4.4	460	1.8	8	3.5	90	0.9
Methyl acetate	0.60	0.45	1.362	210	-10	501.7	3.1	16	2.6	60	0.9
Amyl alcohol	0.61	0.37	1.410		32.8	300	1.2	10.0	3.0	137.8	0.8
Dimethyl sulfoxide	0.62	4.1									
Aniline	0.62	2.24	1.586		70	617.2	1.3		3.2	184.4	1.0
Dimethyl amine	0.63	4.4	1.387	275	< -17.8	312.2	1.8	10.1	2.5	56.7	0.7
Nitromethane	0.64	0.38	1.394	380	35	418.3	7.3		2.1	101.1	1.1
Acetonitrile	0.65	0.67	1.344	210	5.6				1.4	81.7	0.8
Pyridine	0.71	0.37	1.510	305	20		1.8	12.4	2.7	115	1.0
Butyl cellosolve	0.74	0.94		220							
i-Propanol n-Propanol	0.82		1.38	210	11.7	398.9	2.0	12	2.1	82.8	0.8
Ethanol	0.88	2.3	1.361	210	12.8	422.8	4.3	19	1.6	78.3	0.8
Methanol	0.95	1.20	1.329	210	11.1	463.9	7.3	36	1.1	63.9	0.8
Ethylene glycol	1.11	0.60	1.427	210	111.1	412.8	3.2			197.2	1.1
Acetic acid	Large	19.9	1.372								
Water	Large	1.26	1.333								
Salts & buffer	Larger										

* L.R.Snydar, Dekker. "Principles of Adsorption Chromatography"

† The Handbook of Chemistry, 2nd ed., The Chemical Society of Japan

Solvent with low boiling point as shown in ☐ cannot be used.

Notes for Using Organic Solvents as Mobile Phase

(1) When using organic solvents, be careful about UV cut off wavelength.
- UV cut off wavelength
  Light cannot be transmitted in the range shorter than this wavelength.
  For example:
  Cut off wavelength of chloroform is 245 nm. Chloroform cannot be used in the range shorter than 245 nm (e.g. 210 nm).

(2) Boiling point of mobile phase
Solvents of low boiling point cannot be used as mobile phase. Use solvents whose boiling point is 55 °C or higher.
Solvents of low boiling point are not only dangerous but also generate bubbles when sucked by pump so that normal pumping will be impossible.

(3) When performing high sensitivity analysis with UV detector, use solvents which absorb especially small amount of UV light.
Since special grade reagents such as methanol and acetonitrile generally used absorb the shorter wavelengths a lot, use reagents for liquid chromatograph commercially available.

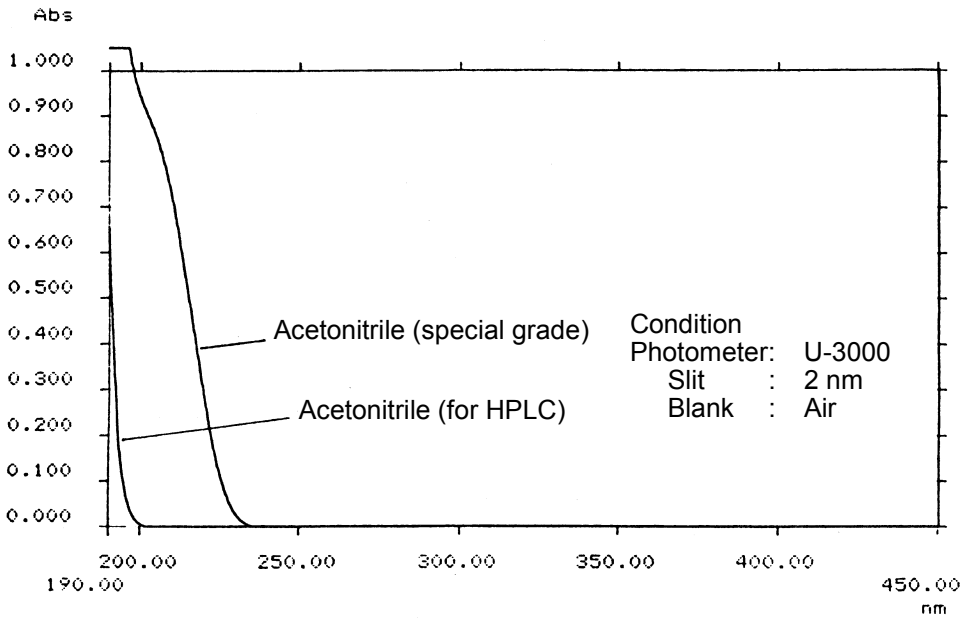


Fig. 3-3 Absorption Spectra of Organic Solvents

3.6.3 Cautions on static electricity

WARNING

Ignition of Flammable Chemicals by Static Electricity

When using flammable chemicals, be careful about possible ignition due to static electricity. To prevent the build-up of static electricity, use a conductive container for waste solution and provide proper grounding connection to it.

Since flammable organic solvents are used for the high speed liquid chromatograph, be careful about heat and fire.
Since thin tubings are used for the liquid chromatograph, static electricity is easily generated. If charged liquid is collected into an insulated waste container, for example, and an electric discharge occurs, so flammable material if present may catch fire.

3.7 Preparation

NOTE: When using an ultrasonic cleaner etc., follow the instruction manual for it.

3.7.1 Degassing and removing dust from mobile phase

(1) Degas mobile phase before use without fail.
Oxygen gas and nitrogen gas contained in mobile phase cause the following when used under high pressure.

(a) Change in quality of mobile phase sample
(b) Loss of column efficiency caused by bubbles
(c) Noise of detector caused by bubbles
(d) Variation of pump pressure
(e) Reduced precision of gradient mixing ratio

(2) For degassing mobile phase, two methods are available, Degassing unit and Manual. Degassing method is explained in 3.7.2.

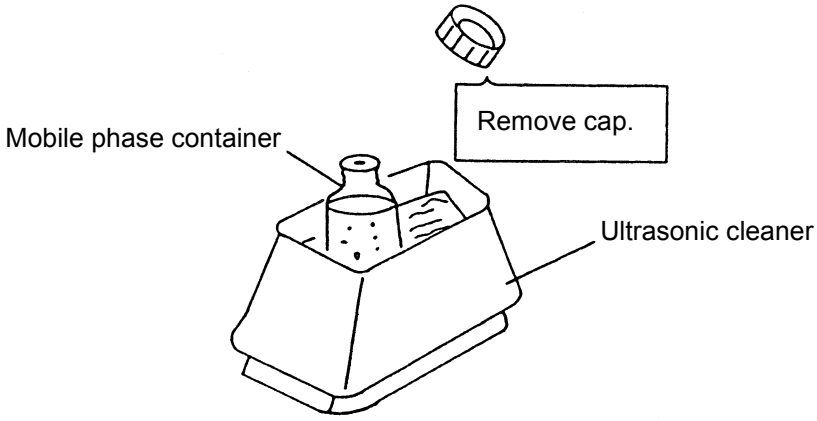
(3) Use mobile phase without dust.
Dust in mobile phase causes trouble in pumping and the pressure may vary.

3.7.2 Degassing mobile phase

There are various ways of degassing.
Perform degassing suitable for the purpose of use.

(1) Example of Degassing by Ultrasonic Waves (when mobile phase is organic solvent)

Example : Methanol 100%
Mixture of methanol 80% and acetonitrile 20%
Preparation : Ultrasonic cleaner (put water in the bath without fail)



(a) Set mobile phase container well stirred into ultrasonic cleaner.

* When using a mixed mobile phase, stir it completely by using a stirrer, or else low repeatability or baseline drift may be caused.

NOTE: Degas mobile phase of organic solvent by using ultrasonic cleaner with water.

(b) Turn on the power of ultrasonic cleaner.

(c) When degassing, small bubbles are generated first, then gradually larger bubbles are generated. Continue degassing until bubbles are not generated anymore.
It takes 5 to 10 minutes to finish.

(d) When bubble generation finishes, turn off the power of ultrasonic cleaner.

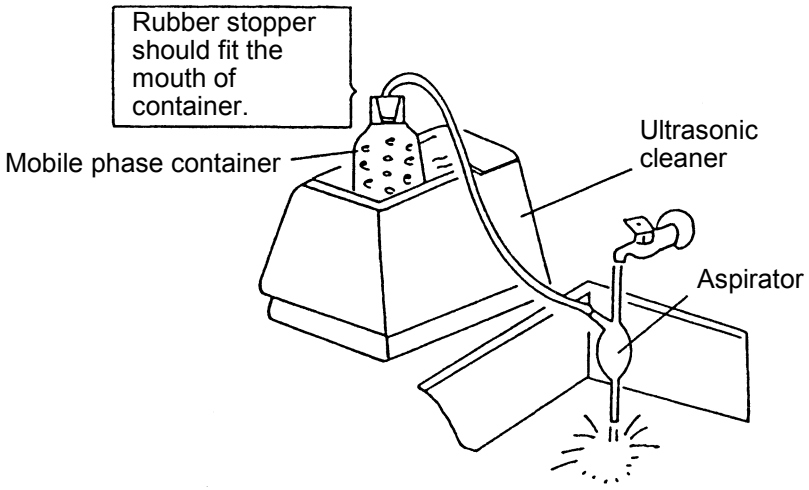
(e) Take out mobile phase container from ultrasonic cleaner, wipe the water from the container, and set the container to liquid chromatograph.

(2) Example of Degassing by Reducing Pressure (mobile phase is aqueous solution)

Example: Ethanol 20% + water 80%, 0.2% citric acid aqueous solution

Devices to be prepared

- Ultrasonic cleaner
  (Put water in the bath without fail.)
- Aspirator with rubber stopper which fits the mouth of mobile phase container



(a) Set mobile phase container in ultrasonic cleaner after sufficient stirring.

* When using a mixed mobile phase, stir it completely by using a stirrer, or else poor repeatability or drift of baseline may be caused.

NOTE: Degas mobile phase of aqueous solution by using both ultrasonic cleaner with water and aspirator to decrease pressure. Fix the degassing time.

(b) Insert rubber tube of aspirator into mouth of reagent bottle.

(c) Turn on the power of ultrasonic cleaner.

(d) Open the faucet of city water for aspirator to decrease pressure.

(e) When degassing, small bubbles are generated first, then gradually larger bubbles are generated. Continue degassing until bubble generation finishes. It takes about 5 minutes. (See NOTE.)

(f) When bubble generation finishes, remove rubber tube of aspirator from the reagent bottle.

(g) Shut off the city water.

(h) Turn off the power of ultrasonic cleaner.

(i) Take mobile phase container out of ultrasonic cleaner, wipe the water from the container, and set it to liquid chromatograph.

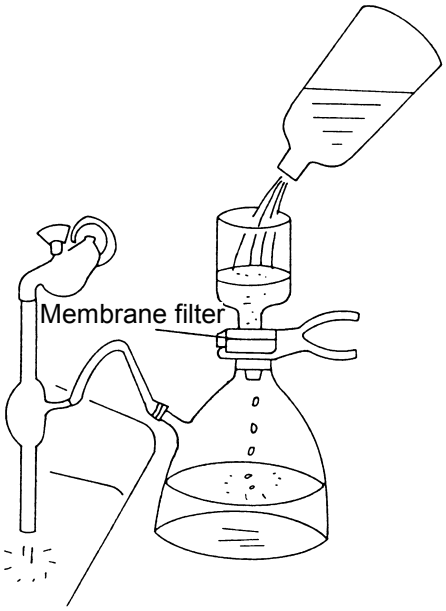
NOTE: Bubble generation depends on constitution of mobile phase.
When mobile phase is a mixture with organic solvent (e.g. methanol 20% + water 80%), fix degassing time because constitution ratio of mobile phase may be varied by degassing time (boiling point of mobile phase would vary with a reduced pressure).

3.7.3 Removing dust from mobile phase

There are various ways to remove dust from mobile phase. Remove dust in the way suitable for the purpose of use.

(1) Example of Filtering of Mobile Phase by Using Membrane Filter

Removing dust and degassing can be performed simultaneously by filtration with a 0.45 μm membrane filter.



NOTE: Remove dust from mobile phase by using a 0.45 μm membrane filter. (Do not use filter paper because it generates dust.)

3.7.4 Sample pretreatment

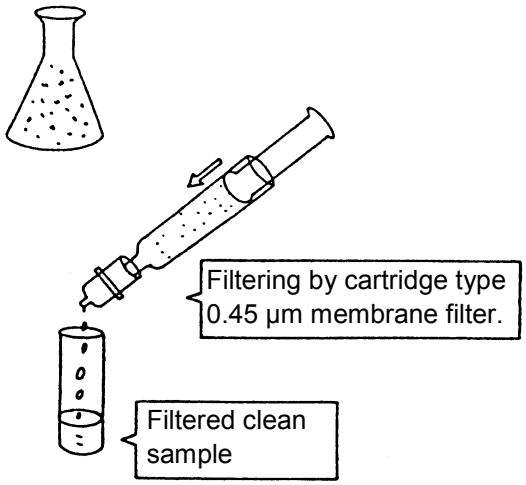
(1) Filter samples without fail if they may contain fine dust. Dust can clog column and deteriorate it.

(2) Remove foreign matter from samples without fail. Foreign matter can lower the reliability of data, e.g. generating abnormal peaks etc.

(a) Example of filtering samples

Dust in sample can be removed easily as follows. Take sample in Syringe, attach cartridge type 0.45 µm membrane filter, and perform filtering. See the figure left.

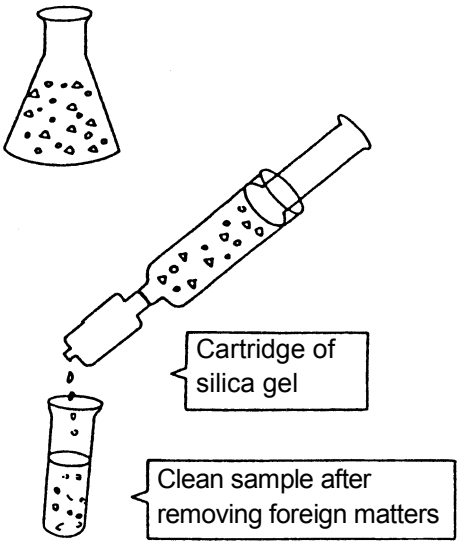
NOTE: There are various ways for filtering sample.
Filtering sample in the way suitable for the sample amount.



(b) Example of Removing foreign matters in sample

For example, when analysis is performed with Reversed Phase Column (e.g. ODS Column), foreign matters can be removed as follows.
Take sample in Syringe, attach Normal Phase cartridge, and perform filtering. See the figure left.

NOTE: There are various ways for removing foreign matters in sample.
Remove in the way suitable for the purpose of analysis.



4. MAINTENANCE AND TROUBLESHOOTING

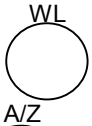
4.1 Operational Check

Check the operation when the instrument has been installed.

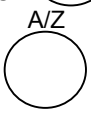
(1) Prepare the instrument for operation as instructed in this manual.

(2) Turn on the power switch of the detector.

(3) Check that measurement conditions (time constant, output range, etc.) can be properly set.

(4) Check the wavelength operation by pressing 

key.

(5) Check the auto zero operation by pressing 

key.

4.2 Performance Checks

Check the performance when the instrument has been installed.

NOTE: First adjust the xenon lamp position (see 5.2.1 (3)) and then check the performance. Positional adjustment of the lamp is necessary for an accurate performance check.

NOTE: When this detector unit is used in combination with EZChrom Elite Client/Server for Hitachi, the lamp energy, wavelength accuracy and sensitivity can be automatically calculated. For details, refer to the instruction manual of Hitachi LaChrom Elite control option.

4.2.1 Xe lamp energy check

Check the energy value of the Xe lamp at a wavelength of 254 nm (see section 3.3.7).

NOTE: When the energy value of the Xe lamp has decreased by 50% or more in comparison with the value at the start of use, the useful life of the lamp is considered to have expired. Use the decrease in energy value plus baseline fluctuation (data variation or noise) in judging the lifetime of the lamp.

4.2.2 Wavelength accuracy check by using Hg lamp

Check the wavelength accuracy by using the bright line at 254 nm of the Hg lamp (see section 3.3.6). "GOOD" will appear on the display when the wavelength error is within ±3 nm, or "FAIL" will appear when the error exceeds ±3 nm.

NOTE: Wavelength calibration is necessary when "FAIL" appears. See section 4.2.4 (2) for the calibration.

4.2.3 Sensitivity check

The S/N ratio of the Raman spectrum of water is used to measure the sensitivity of the fluorescence detector.
The following items must be prepared for the measurement.
The following items are required.

- Pump
- Recorder or D-2500 chromato-data processor
- Distilled water

(1) Injection of Distilled Water

Connect tubing as shown in Fig. 4-1, supply distilled water at a flow rate of 1 mL/min for 3 minutes with the Chromaster 5110 Pump in Manual mode, then set the flow rate to 0 and stop the supply of water. Remove the flow cell unit and check for any bubbles in the flow cell.

NOTE: If the flow cell has been left empty for awhile (including when the instrument is installed), first inject methanol or acetonitrile into the flow cell in order to wet the interior in advance, then inject distilled water. Injection of water without first injecting an organic solvent may cause a reduction of sensitivity.

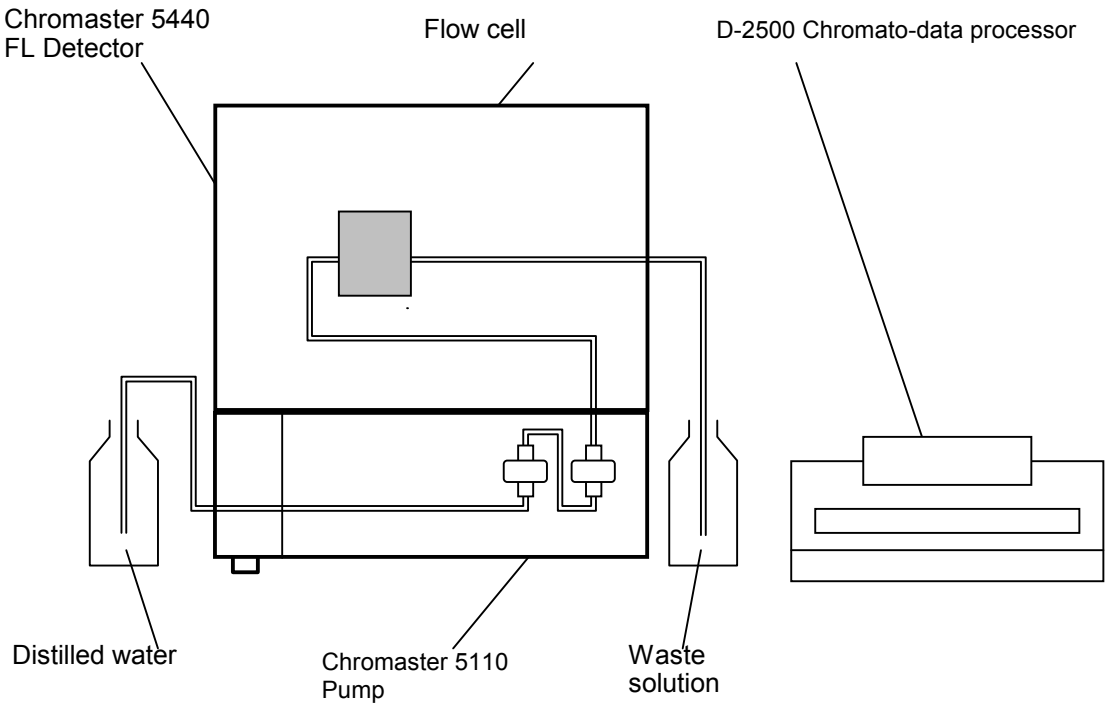


Fig. 4-1 Tubing Diagram

(2) Measurement of Raman Spectrum of Water

Set the flow cell unit in place, measure the Raman spectrum of water under the conditions given below, and record the results (see sections 3.4.2, 3.4.3, 3.4.5 and 3.4.6). Measure in the following sequence.

- Excitation (Ex) wavelength : 350 nm
- Time constant (response) : 2 seconds
- Photomultiplier voltage : MID
- Emission spectrum bandwidth : STANDARD (15 nm) or WIDE (30 nm)
- Emission spectrum measuring wavelength : 350 to 450 nm
- Spectrum No. : Any of 1 to 4

(a) Turn ON the power switch and the 1st monitor screen appears.

(b) Set an excitation wavelength.

(i) Press the WL key and the wavelength setting screen appears. Set an excitation (Ex) wavelength.

<Wavelength setting screen (Ex indicated)>

Ex	Em	(200 - 850.0)
350	350	

Press numeric keys 3 5 0 and then the ENT key.

(ii) An emission (Em) wavelength will not be set here. Leave the present setting as it is.

<Wavelength setting screen (Em indicated)>

Ex	Em	（250 - 900.0）
350	350	

Press the ENT key.

(iii) The 1st monitor screen appears again.

(c) Set a time constant, a photomultiplier voltage and an emission spectrum bandwidth.

(i) Press the SET UP UTLTY key, and the utility setting screen appears.

<Utility setting screen>

UTILITY	(OFFSET=1, TIME CONSTANT=2,
_2	USE PROG=3, PMT VOLT=4, OTHERS=5)

Press numeric key 2 and then the ENT key.

(ii) The time constant setting screen appears.

<Time constant setting screen>

TIME CONSTANT	(0.01s=1, 0.02s=2, 0.05s=3,
7	0.1s=4, 0.5s=5, 1.0s=6, 2.0s=7)

Press numeric key 7 and then the ENT key.

(iii) The 1st monitor screen appears.

(iv) Press SET UP UTLTY key. And the utility setting screen reappears.

<Utility setting screen>

UTILITY (OFFSET=1, TIME CONSTANT=2, 4 USE PROG=3, PMT VOLT=4, OTHERS=5)

Press numeric key 4 and then the ENT key.

(v) The pmt voltage setting screen appears.

<Pmt voltage setting screen>

PMT VOLTAGE (SUPER HIGH=1, HIGH=2, MID=3, 3 LOW=4, SUPER LOW=5)

Press numeric key 3 and then the ENT key.

(vi) The 1st monitor screen reappears.

(vii) Press SET UP UTLTY key, and the utility setting screen reappears.

<Utility setting screen>

UTILITY (OFFSET=1, TIME CONSTANT=2, 5 USE PROG=3, PMT VOLT=4, OTHERS=5)

Press numeric key 5 and then the ENT key.

(viii) The others setting screen appears.

<Others setting screen>

OTHERS (Em BANDWIDTH=1, ERROR OUT=2, 1 LEAK SENSOR=3, LAMP=4)

Press numeric key 1 and then the ENT key.

(ix) The Em bandwidth setting screen appears.

<Em bandwidth setting screen>

Em BANDWIDTH (STANDARD=1, WIDE=2) 1

Press numeric key 1 or 2 and then the ENT key.

*1: STANDARD = emission spectrum bandwidth 15 nm
2: WIDE = emission spectrum bandwidth 30 nm

(x) The 1st monitor screen returns.

(d) Setting of spectrum measurement:

(i) Press the SPECT key. The scan mode setting screen appears.

<Scan mode setting screen>

SPECTRUM MODE (FL (Ex)=1, FL (Em)=2)
2

Press numeric key 2 and then the ENT key.

(ii) Set a scanning range.

① Enter a starting wavelength (minimum value) for WL1.

<Scan range setting screen>

SCANNING WL RANGE (WL1 WL2) nm FL (Em)	
<250 – 850>	350 - 700

Press numeric keys 3 5 0 and the ENT key.

② Enter an end wavelength (maximum value) for WL2.

<Scan range setting screen>

SCANNING WL RANGE (WL1 WL2) nm FL (Em)	
＜400 - 750＞	350 - 450

Press numeric keys 4 5 0 and the ENT key.

(iii) The memorize spectrum No. setting screen appears.

<Memorize spectrum No. setting screen>

MEMORIZE SPECTRUM NO. (1 - 4)
1

Press a numeric key (1 to 4) and the ENT key.

(iv) The scan monitor screen appears, and spectrum acquisition begins.

<Scan monitor screen (spectrum acquisition under way)>

SCANNING SPECTRUM NO.: 1 MODE: FL (Em) Ex: 350 nm Em: *** nm

(v) When the recording of spectral data finishes, the 1st monitor screen returns automatically.

(e) Setting of recorder full scale range, speed and memory No.:

(i) Press the RECORD key and the recorder setting screen appears.

<Recorder setting screen>

RECORD (RCD RANGE=1, RCD SPEED=2, 1 SPECT RCD=3)

Press numeric key 1 and then the ENT key.

(ii) The recorder full scale setting screen appears.

<Recorder full scale setting screen>

RCD RANGE (1 - 1000) 1000

Press numeric keys 1 0 0 0 and then the ENT key.

(iii) The 1st monitor screen returns.

(iv) Press the RECORD key. And the recorder setting screen appears.

<Recorder setting screen>

RECORD (RCD RANGE=1, RCD SPEED=2, 2 SPECT RCD=3)

Press numeric key 2 and then the ENT key.

(v) The recorder speed setting screen will appear.

<Recorder speed setting screen>

RCD SPEED (40 mm/min=1, 60 mm/min=2) 2

Press numeric key 2 and then the ENT key.

(vi) The 1st monitor screen returns.

(vii) Press the RECORD key. The recorder setting screen reappears.

<Recorder setting screen>

RECORD (RCD RANGE=1, RCD SPEED=2, 3 SPECT RCD=3)

Press numeric key 3 and then the ENT key.

(viii) The output data spectrum No. setting screen appears.

<Output data spectrum No. setting screen>

RECORD SPECTRUM NO. (1 - 4) 1

Press a numeric key 1 to 4 and then the ENT key.

* Set the same number as was entered when making the setting for spectrum measurement.

(ix) The background spectrum No. setting screen appears.

<Background spectrum No. setting screen>

BACKGROUND SPECTRUM NO. (0 - 4) 0

Press numeric key 0 and then the ENT key.

(x) The output ready monitor screen appears.

<Output ready monitor screen>

RCD NO.	SPEED	WL-RANGE (Em)	WIDTH: STD
1	60	350-450	PRESS “START”

Press the START key.

* A spectrum is recorded by starting the recorder or chromato-data processor simultaneously with pressing the START key.

(xi) The spectrum output screen appears, and spectrum output begins.

<Spectrum output screen>

RCD NO.	Ex	Em	FL	SPEED	MODE
1	350	350	1000.0	60	Em

(xii) When the spectrum output is completed, the 1st monitor screen returns automatically.

NOTE: Set the following conditions for the D-2500 chromato-data processor.
ATT : 5
CHART SPEED : 60 mm/min

NOTE: If the detector and data processor are connected via E-Line (digital), start the output by pressing the ALL START key of the data processor.

(3) Determination of Raman Signal Intensity

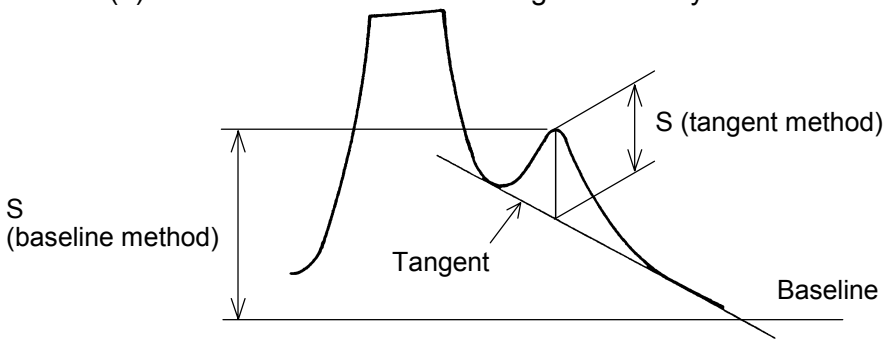


Fig. 4-2 Measuring the Raman Signal Intensity

Determine the voltage value corresponding to S in the figure. When using the D-2500 chromato-data processor, calculation can be made using the length (L in mm) of S on the chart.

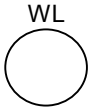
$$S = \frac{L}{162} \times 2^x \text{ mV}$$

L: Length of S (mm)
x: ATT setting of data processor used in measurement

NOTE: When the instrument is combined with Empower™2 Software, Hitachi Chromaster driver for Empower™2, and Chromaster System Manager for Hitachi, the Raman signal intensity can be obtained automatically by means of the furnished maintenance software. For details refer to the instruction manual on the maintenance software.

(4) Measurement of Noise

With the excitation wavelength left at 350 nm, set the emission wavelength at 397 nm (other conditions may be the same as in preceding subsection (2)), and check the FL indication.

Press the 

key to drive the emission wavelength, and set at the Em wavelength where the FL indication is maximum. Start the recorder or D-2500 chromato-data processor and record the baseline.
A suitable attenuator setting is ATT=0 when using the D-2500.

* Drift can also be measured if the measurement is continued for 15 minutes or longer.

NOTE: In measurement with the emission spectrum bandwidth set at WIDE (30 nm), the peak emission wavelength is shifted toward the shorter wavelength side from 397 nm. Due to the WIDE setting, the spectrum bandwidth widens for the scattered light of excitation beam and the Raman line of water. Therefore, the wavelength of Raman peak is shifted toward the wavelength of the scattered light. For details, refer to 3.4.

(5) Noise Calculation

Calculate the noise level on the chart by the method given in Fig. 4-3. The noise level in the case of using the D-2500 data processor is obtained from the noise width (in mm) as follows.

$$N = \frac{\text{Noise width}}{162} \times 2^{x}\ \text{mV}$$

X: ATT setting of data processor used in measurement

(6) S/N Ratio Calculation for Raman Spectrum of Water

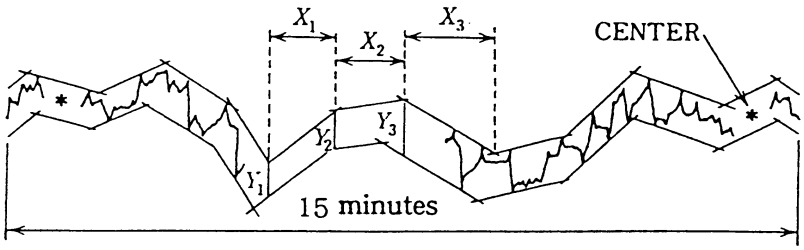
Perform calculation according to the S and N obtained in the preceding subsections (3) and (5).

(a) Excitation spectrum bandwidth: 15 nm

S/N ratio = S/N (baseline method, S/N ratio ≥ 700)
S/N ratio = S/N (tangent method, S/N ratio ≥ 525)

(b) Emission spectrum bandwidth: 30 nm

S/N ratio = S/N (baseline method, S/N ratio ≥ 900)



Noise value = $\sum_{R=1}^{R=n} Y_{R/n}$ (Xn shall be determined for intervals of 0.5 minute)

Fig. 4-3 Noise Calculation (extracted from JAIMAS 0005-1984)

NOTE: The Raman spectrum of water and the noise level may be affected by the purity of the water used and/or the presence of air bubbles.

(7) Measurement of Raman Spectrum of Water Using a Time Program (when Raman signal intensity obtained in the preceding subsection (2) is low)

If the sensitivity (S/N ratio of Raman peak of water) is low, recheck the following items.

(a) When noise is high

(i) Check the distilled water.
* Distilled water should be used soon after its purification. If left for a long time in a container made of resin or the like, fluorescent substance may mix in with the distilled water.

(ii) Check the position and useful life of the xenon lamp.

(b) When peak separation is not good

(i) Check the distilled water.

* Distilled water should be used soon after its purification. If left for a long time in a container made of resin or the like, fluorescent substance may mix in with the distilled water.

(ii) Check for bubbles

If water is directly injected into an empty flow cell, small bubbles may remain in the cell. To prevent this, first inject ethanol or the like and then water.

(iii) Change the method of spectrum measurement (via time program).

Measure the Raman spectrum of water using a time program. But first check the fluctuation of FL value via wavelength shift.

Set the excitation(Ex) wavelength at 350 nm and emission(Em) wavelength at 450 nm using the WL key.

Then zero the FL value with the A/Z key.

Next, with the WL key, check the Em wavelength near 397 nm where the FL value is maximum, and the Em wavelength near 380 nm where the FL value is minimum.

The minimum FL value should be less than half the maximum FL value.

Create a time program as indicated below for measuring the Raman spectrum of water.

TIME	Ex	Em	BASE (A/Z=1, HOLD=2)
0.0	350	450	1
0.5		360	
0.6		370	
0.7		375	
0.8		380	
0.9		385	
1.0		390	
1.1		395	
1.2		400	
1.3		405	
1.4		410	
1.5		415	
1.6		430	
1.8		450	
2.0			

NOTE: The above time program shows an example where the minimum FL value was obtained at 380 nm and the maximum at 400 nm. For the top Em of the program, set a wavelength that includes the wavelengths where the maximum and minimum FL values were obtained. (For instance, if the maximum FL value was obtained at a wavelength of 397 nm, then the wavelength at 1.1 minutes should be set at 397 nm.)

Read out the value corresponding to “S” from the spectrum obtained with the time program.

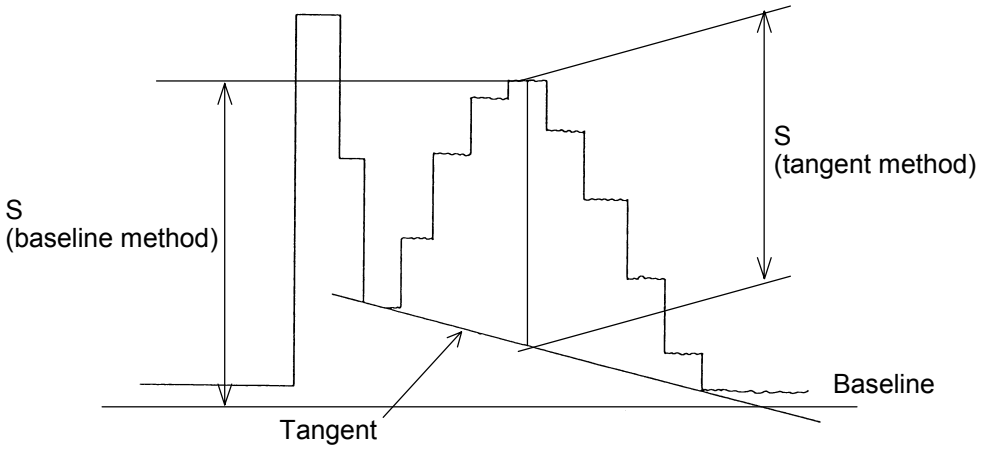


Fig. 4-4 Calculate the Raman Peak of Water

When using the D-2500 chromato-data processor, calculation can be made using the length (L in mm) of S on the chart.

$$S = \frac{L}{162} \times 2^{x} \text{ (mV)}$$

L: length of S (mm)
X: ATT setting of data processor used in measurement

Refer to previous subsections (4) through (6) for measurement and calculation of noise and calculation of S/N ratio.

(8) Measurement of Drift

Drift is measured by using the data and baseline obtained from the Raman spectrum of water (measurement conditions are the same as in preceding subsection (4); but measuring time is 15 minutes).
For the sake of simplicity, calculation can be performed on the assumption that the output signal is zero at the emission wavelength of 450 nm.

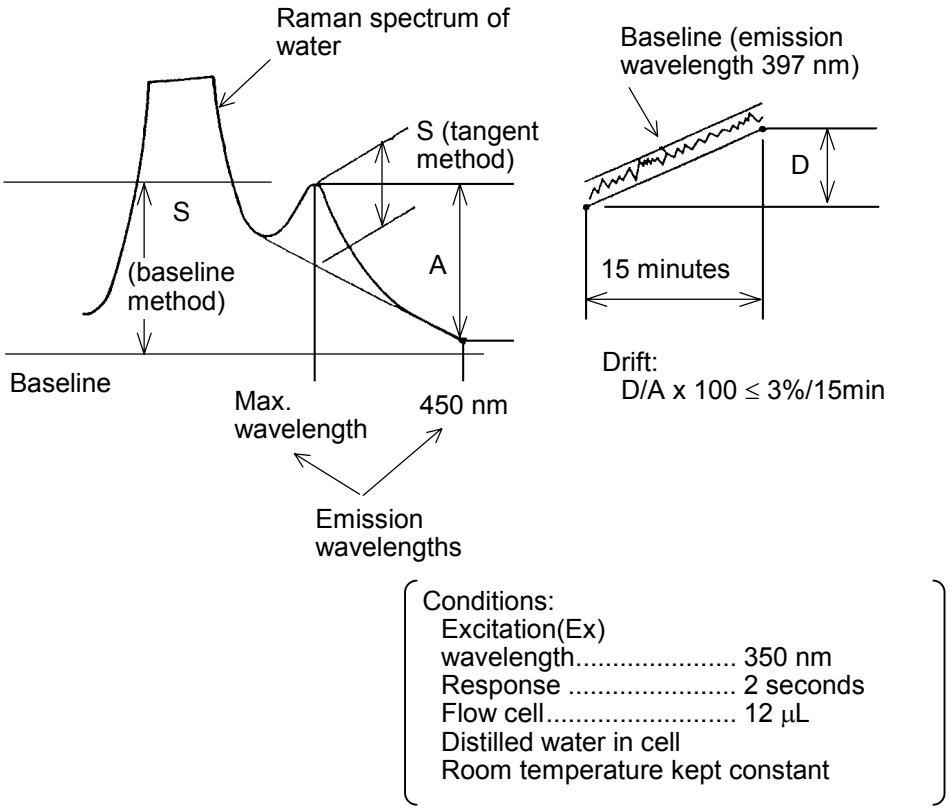


Fig. 4-5 Drift Measurement

NOTE: Carry out the drift measurement after the xenon lamp has stabilized (at least one hour after the lamp is turned on).

4.2.4 Wavelength accuracy check and calibration

(1) Check of Wavelength Accuracy

(a) Principle of measurement

Wavelength accuracy of the emission side monochromator is checked by using the bright line at 254 nm of the builtin Hg lamp.
As for the wavelength accuracy of the excitation side monochromator, the Em side is fixed at the wavelength position where the abovementioned bright line was detected, then the Ex wavelength where a Rayleigh scattering peak of 254 nm is produced is measured.

(b) Check of wavelength accuracy

Check the wavelength accuracy by using the bright line at 254 nm of the Hg lamp (see section 4.4.4 (6)). "GOOD" will be indicated if the wavelength error is within ±3 nm, or "FAIL" will be indicated if the error exceeds ±3 nm.

NOTE: First adjust the xenon lamp position (see 5.2.1 (3)) and then check the wavelength accuracy. An accurate wavelength check cannot be made unless the lamp position is adjusted.

NOTE: If "FAIL" is indicated, wavelength calibration is required. Refer to paragraph (2) below for the calibration.

(2) Calibration of Wavelength Accuracy

If there is a wavelength deviation, then adjust the wavelength in the wavelength calibration mode (special mode).

(a) Calibration of excitation wavelength

(i) Press the SET UP / UTLTY key, and the utility setting screen appears.

<Utility setting screen>

```
UTILITY  (OFFSET=1, TIME CONSTANT=2,
99          USE PROG=3, PMT VOLT=4, OTHERS=5)
```

Press numeric keys 9 9 and then the ENT key.

(ii) The excitation wavelength calibration mode screen appears.

<Excitation wavelength calibration mode screen>

```
Ex WL ADJUST (1 - 20)
10      (ONLY FOR FACTORY USE)      (-2)
```

The present offset value is indicated at Ex WL ADJUST. Indicated at the bottom right of the screen is the wavelength check result (deviation of wavelength; indication range of –10 to 10).

Wavelength calibration is conducted by entering a new offset value (value to which the deviation is added).
Press numeric keys (from 1 to 2 0) and then the ENT key.

* Input range for offset value: 1 to 20
* Calculation of new offset value:
  New offset value = present offset value – wavelength deviation
  Example: 12 = 10 – (-2)

(iii) The 1st monitor screen appears.

(b) Calibration of emission wavelength

(i) Press the UTLTY key, and the utility setting screen appears.

<Utility setting screen>

```
UTILITY  (OFFSET=1, TIME CONSTANT=2,
98          USE PROG=3, PMT VOLT=4, OTHERS=5)
```

Press numeric keys 9 8 and then the ENT key.

(ii) The emission wavelength calibration mode screen appears.

<Emission wavelength calibration mode screen>

```
Em WL ADJUST (1 - 20)
10      (ONLY FOR FACTORY USE)      (-2)
```

The present offset value is indicated at Em WL ADJUST. Indicated at the bottom right of the screen is the wavelength check result (deviation of wavelength; indication range of –10 to 10).
Wavelength calibration is conducted by entering a new offset value (value to which the deviation is added).
Press numeric keys (from 1 to 2 0) and then the ENT key.

* Input range for offset value: 1 to 20
* Calculation of new offset value:
  New offset value = present offset value – wavelength deviation
  Example: 12 = 10 – (-2)

(iii) The 1st monitor screen appears.

4.2.5 Leak sensor check

(1) Operational Check of Leak Sensor

(a) Drip water onto the leak sensor.

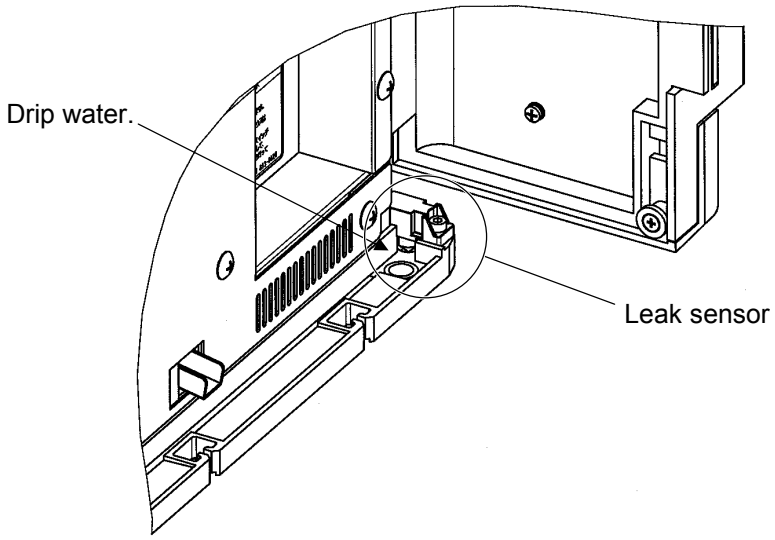


Fig. 4-6 Leak Sensor Check

(b) Confirm that a leak error is detected.

Specification: A leak error must be detected.

NOTE: Observe the following precautions before using the leak sensor which detects a liquid leak.

1. While a solvent is used, the leak sensor function should be kept active.
2. The leak sensor function of this instrument may not work when liquid leaks in a small amount.
   Leakage of a highly volatile solvent may not be detectable either.
   Even when the leak sensor function is activated, you should be careful not to overlook liquid leakage for avoiding a serious situation.
3. As a routine checkup, visually check for any liquid leak before measurement.
4. As a periodic checkup, make sure the leak sensor works normally.

(2) Cleaning of Liquid Leak Sensor

<Item to be prepared>

- Hexagonal wrench (P/N: N315003, size: B2.5)

(a) Separate the liquid leak sensor from the drain tray by removing the liquid leak sensor fastening screw with the furnished hexagonal wrench.

(b) Wipe off the water adhering to the liquid leak sensor and drain tray, and then fasten the sensor to the drain tray again.

NOTE: While cleaning the liquid leak sensor, be careful not to damage its tip. If damaged, the liquid leak sensor may not work properly or an error may occur.

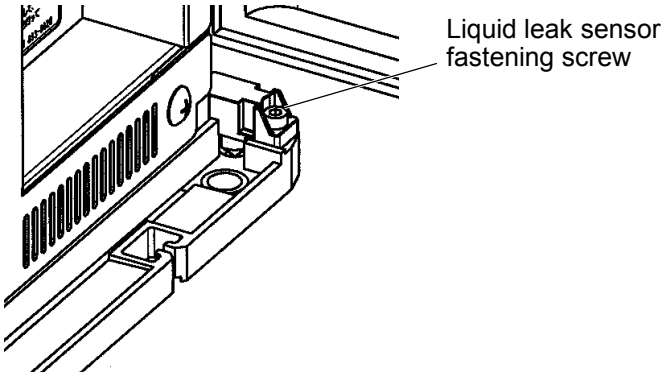


Fig. 4-7 Liquid Leak Sensor Fastening Screw

NOTE: Mount the leak sensor at the correct position. If the sensor is mounted at a wrong position, it may not work properly or an error may occur.

4.2.6 Drain tray check

⚠ WARNING

Inflammation or Injury due to Toxic, Corrosive or Stimulative Solvent

When using a toxic, corrosive or stimulative solvent, be careful not to incur a physical inflammation or injury. For details of the properties of each solvent and how to handle it, refer to the relevant Material Safety Data Sheets (MSDS). Be sure to handle each solvent properly.

(a) Wear proper protective clothes (e.g., safety goggles) so that a solvent will not come into direct contact with the skin.

(b) Ventilate the laboratory room adequately to prevent accidental inhalation of harmful solvent vapor.

Refer to the following procedure for the drain tray check.

(1) Remove retaining screws to detach the drain tray.

NOTE: Avoid breakage of the detached leak sensor to prevent malfunction.

(2) Pull out the drain tray from the unit.

(3) Wipe up the drain tray with a soft gauze. Wash it with flowing water if it is filthy.

(4) Dry the train tray well. Put and install it into the unit.

(5) Wipe up the tip of the leak sensor with a soft gauze.

(6) Fix the leak sensor on the drain tray with retaining screws.

4.3 Periodic Checks

No.	Check Item	Frequency of Check	Check Procedure	Remarks
1	Drain tray	Daily	Check the drain tray, and wash it when needed.	
2	Lighting of lamp	Daily	Check that “Xe” is indicated on LEDs.	
3	Liquid leakage	Daily	Visually check that liquid is not leaking from the mobile phase bottle, tubing and waste bottle.	
4	Fluorescence intensity check	Daily	Press A/Z key, and check if FL indication is zeroed.	
5	Lifetime of lamp	Monthly	1) Check lamp for service life by energy check, or by cumulative lamp turn-on time. 2) Check if baseline drifts considerably (or if baseline fluctuates or noise becomes high).	See 3.3
6	Leak sensor	Monthly	1) Drip water onto the leak sensor and confirm the occurrence of an error. 2) After confirmation, wipe off water.	See 4.2.5
7	Wavelength accuracy	Yearly	Check wavelength by using bright line of Hg lamp at 254 nm.	See 4.2.4

NOTE: First adjust the xenon lamp position (see 6.2.1 (3)), then make an energy check of the xenon lamp and a wavelength accuracy check using the Hg lamp. Correct measurement results will not be obtained unless the lamp position is adjusted.

4.3.1 Xe lamp energy check

Check the energy level of the Xe lamp at a wavelength of 254 nm (see section 3.3.7).

NOTE: When the energy level of the Xe lamp has decreased by 50% or more in comparison with the level at initial use, the useful life of the lamp is considered to have ended. The lamp life can be judged by the energy level, or by baseline fluctuation (fluctuation of data and/or noise).

4.3.2 Wavelength accuracy check using Hg lamp

Check the wavelength accuracy by means of the bright line of the Hg lamp at 254 nm (see section 3.3.6).
“GOOD” will be indicated on the display when wavelength error is within ±3 nm; “FAIL” will be indicated if the error exceeds ±3 nm.

NOTE: If “FAIL” is indicated, wavelength calibration is required. Refer to section 4.2.4 (2) for the calibration.

4.3.3 Lamp logbook check

The cumulative turn-on time, number of lightings, and last replacement date for the Xe and Hg lamps can be checked via the GLP function (see 3.3).

4.4 Flow Cell Unit Checks

WARNING

Ignition of Flammable Chemicals

- This instrument is not explosion-proof. In unattended operation, do not use organic solvents having an ignition point below 70 °C.
- Beware of ignition hazard when using flammable chemicals such as organic solvents.
  (a) Do not bring a heat or flame source near the instrument.
  (b) Well-ventilate the laboratory room where the instrument is used.
  (c) Always check the following conditions. If an abnormality is found, stop operation immediately.
    ◊ Leakage of solvent or waste solution.
    ◊ Leakage of solvent inside the instrument.
- When using flammable chemicals, be careful about possible ignition due to static electricity. To prevent the build-up of static electricity, use a conductive container for waste solution and provide proper grounding connection to it.

WARNING

Explosion of Vapor from Flammable Chemicals

If a flammable chemical such as organic solvent leaks from the flow path of the instrument and its vapor concentration reaches the explosion limit, it could cause spontaneous combustion with dangerously explosive results.
When using a flammable and readily volatile chemical, be sure to check for leakage from the instrument flow path and ventilate the laboratory room adequately.

4.4.1 Check and washing of flow cell

If the inside of the flow cell is contaminated, it must be cleaned.

Prepare the following items for the cleaning.

- Glass syringe with capacity of about 10 mL
- Wash fluid

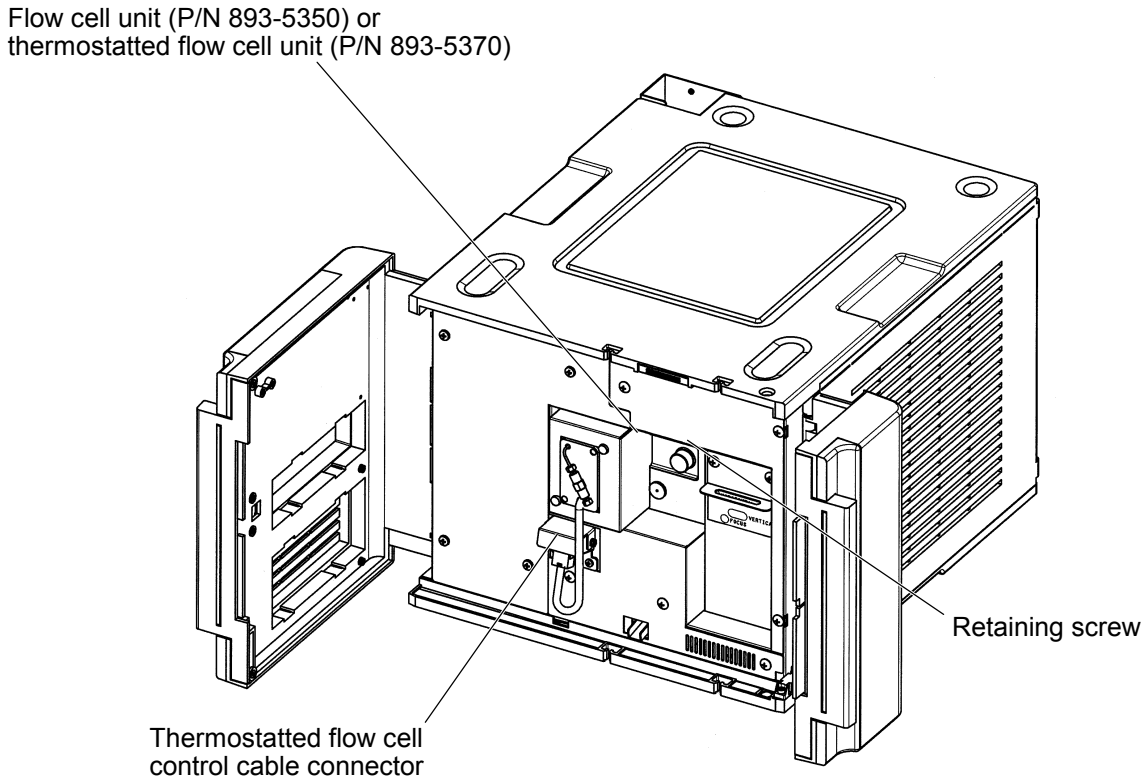


Fig. 4-8 Check of Flow Cell

(1) Loosen the retaining screw of the flow cell unit (see Fig. 4-8).

(2) Pull the flow cell unit straight out.

(3) Check the inside of the cell visually to see if it is contaminated with any foreign substance (crystallized substance, etc.).

(4) Check the outside of the cell for any leakage.

(5) If contamination is observed inside the cell, it must be cleaned with an appropriate solution. If an aqueous solvent has been used, distilled water should be used for washing. And if an organic solvent has been used, then ethanol (or acetone) should be used for washing.

Connect the syringe to the tip of the drain tube, and inject the wash fluid into the cell for cleaning (Fig. 5-7).

NOTE: This flow cell unit (P/N 890-2967) uses a part similar to the one used in the Chromaster 5440 FL Detector. Be careful not to mount the part of the flow cell unit to the detector and vice versa.

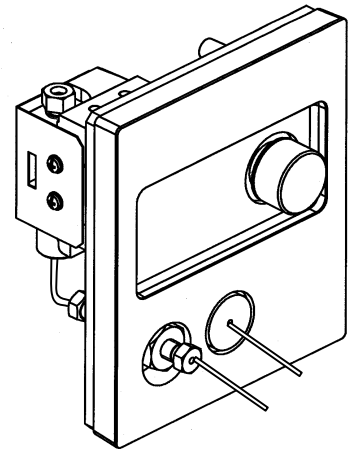


Fig. 4-9 Flow Cell Unit

(6) Replace the wash fluid with the mobile phase that is used for separation, and repeat the procedure in step (5).

(7) If air bubbles are observed in the flow cell, supply solution into the cell with the pump at a flow rate within 1.0 mL/min and a pressure within 1.0 MPa. While the solution is being supplied into the flow cell, pinch the end of the drain tube with your fingers for a few seconds to increase the pressure inside the cell, then release your fingers quickly. Repeat this procedure a few more times until all the air bubbles have been removed.

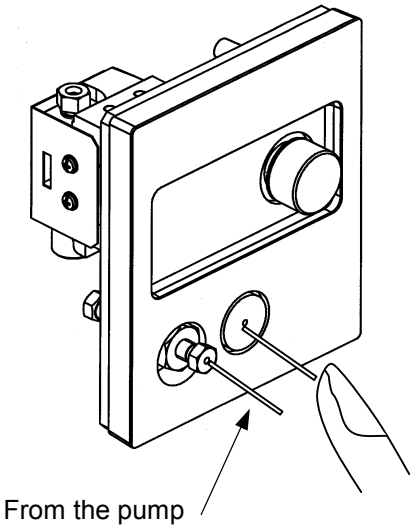


Fig. 4-10 Removing Air Bubbles

NOTE: Applying too much pressure may damage the flow cell. Set the pressure limiter of the pump at 1.0 MPa max. before removing air bubbles.

4.4.2 Disassembly and cleaning of flow cell

(1) Disassembly of Flow Cell

If contamination is not removed by just flushing the interior of the flow cell, then disassemble and clean the cell in the procedure below.

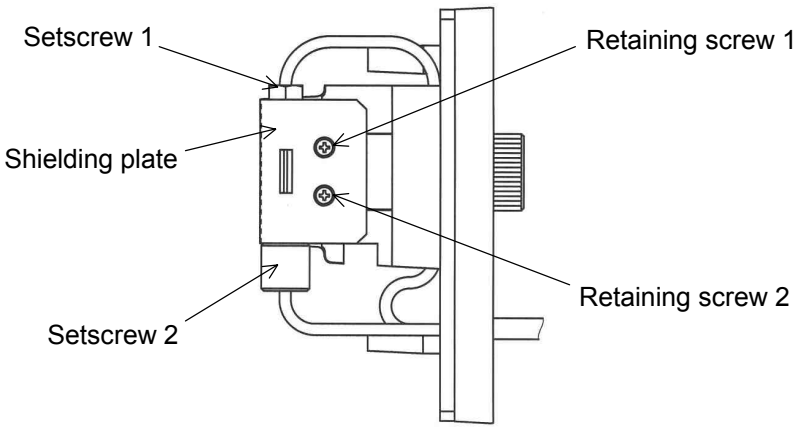


Fig. 4-11 Flow Cell Unit

(a) Loosen retaining screws 1 and 2 and detach the shielding plate.

(b) Detach the cell window.

(c) Remove the cell clamp.

(d) Loosen setscrews.

(e) Take out the flow cell.

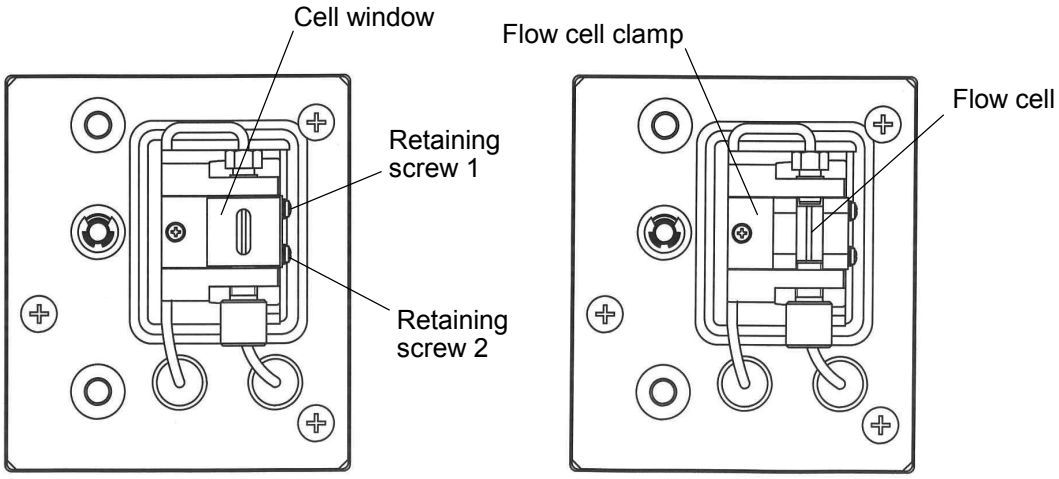


Fig. 4-12 Disassembly of Flow Cell Unit

(2) Washing of Flow Cell

(a) Wash the flow cell in running water.
If the contamination cannot be removed with running water, then use an ultrasonic cleaner. In this case be sure to put the flow cell in a paper or plastic container and then place it in the ultrasonic cleaner, so as to avoid scratching the cell.

(b) Wipe the surface of the flow cell with gauze that is moistened with acetone or ethanol.

NOTE: Be careful not to scratch the flow cell surface when disassembling it.

NOTE: Make sure to put the flow cell in a paper or plastic container when cleaning it.
The use of a glass container may scratch the cell or preclude obtaining the desired performance from the instrument.

(3) Assembly of Flow Cell

(a) Assemble the flow cell into the cell holder in the orientation shown in Fig. 4-11 and fix it with the cell clamp.

(b) Tighten the upper and lower retaining screws 1 and 2.

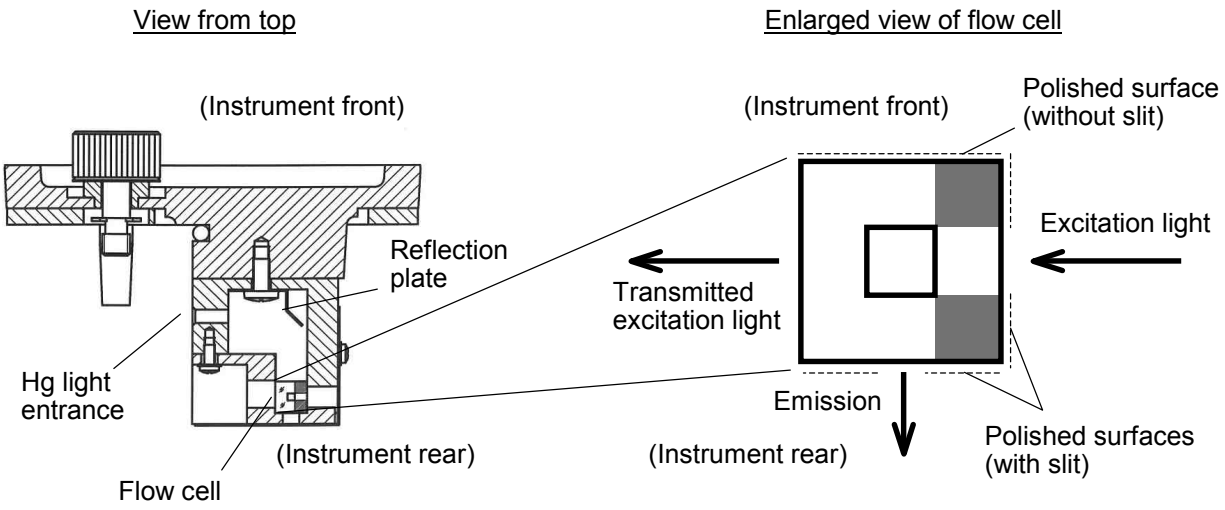


Fig. 4-13 Assembly of Flow Cell Unit

(c) Attach the cell window and shielding plate.

(d) After assembling the flow cell in the order reverse to disassembly, flow a liquid through the unit and make sure there is no leakage.

NOTE: Be careful not to scratch the flow cell surface when assembling it.

NOTE: Take care about the orientation of the polished surfaces of the flow cell when putting it into the cell holder (see Fig. 4-11). A mistake in the orientation may preclude obtaining the proper performance from the instrument.

NOTE: Tighten setscrew 1 fully with hand, and then tighten setscrew 2 about 30° manually or tighten setscrew 1 further 30° with a wrench.

4.4.3 Leakage from the flow cell

It is important to check for any liquid leakage from the flow cell unit prior to analysis. If a leak is found, stop the pump immediately and remove the flow cell unit. Take the following procedure to remedy the leak.

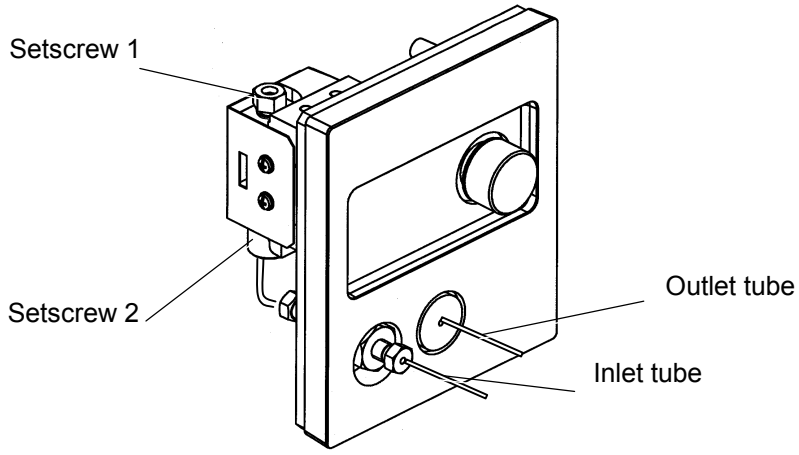


Fig. 4-14 Inlet and Outlet Tube

(1) Supply liquid using the pump, and check that liquid comes out of the outlet tube of the flow cell.

(2) If liquid does not come out of the tube, it indicates the tube is clogged. Replace the outlet tube with a new one.

(3) If a leakage occurs though liquid comes out of the tube normally, setscrew tightening may be slightly inadequate. Retighten setscrew 1 lightly (about 10 to 20°) with a wrench or setscrew 2 lightly (about 10 to 20°) manually.

(4) Wipe up any liquid spilt on the outside of the flow cell.

(5) Before returning the flow cell unit into position, supply liquid with the pump and make sure there is no more leakage.

NOTE: It is important that the OUTLET tube of the flow cell be checked first for clogging. If the upper setscrew is judged to be loose and is retightened with the wrench without checking the OUTLET tube, then the flow cell may be damaged or broken.

NOTE: If leakage is found in the sample compartment, wipe up the liquid thoroughly and then clean with a cloth moistened with water.

4.4.4 Cautions on storage of the flow cell

If the flow cell will be left unused for more than a few days, clean the flow cell interior thoroughly by pumping distilled water or alcohol through it and then store it in a safe place.
If the period of nonuse is less than a few days, the inside of the cell may be filled completely with a solvent such as ethanol or acetonitrile and then stored.

4.5 Troubleshooting

Symptom	Cause	Judgment/Check	Remedy
Self-diagnosis (initialization) is not performed when the POWER switch is turned on.	The power cord plug is not securely plugged in.	Visual check	Plug in the power cord securely.
	The fuse is blown.	Check the fuse for continuity.	Replace the fuse with a new one. (Refer to Section 6.3.)
	The light source cover is not properly attached. (The cover activates a safety interlock switch.)	Visual check	Retighten the retaining screws of the light source cover.
The keyboard does not work.	The instrument is not ready for operation.	Check the monitor screen.	Press the ESC key. The READY status will be presented.
The A/Z key does not work.	The display does not present the 1st monitor screen (FL indication).	Check the monitor screen.	Return to the 1st monitor screen (FL indication). (Refer to Section 4.1.)
The time program does not start.	The instrument is not ready to operate.	Check the monitor screen.	Press the ESC key. The READY status will be presented.
The xenon lamp does not light.	The xenon lamp is still hot.	Turn on the lamp again.	For turning on the lamp again, wait at least 5 minutes after the Xe lamp went out.
	The Xe lamp has reached the end of its useful life.	Check the cumulative turn-on time of Xe lamp.	Replace the Xe lamp with a new one.
Excessive noise	The flow cell is contaminated.	Visual check	Clean the flow cell. (Refer to Section 4.4)
	The mobile phase is not sufficiently degassed.	Spike noise occurs.	Degas the mobile phase thoroughly.
	The mobile phase contains impurities.	Check the mobile phase.	Purify the mobile phase, or replace it with mobile phase of a higher quality.
	The gain level of the recorder is too high.	Check the gain level of the recorder.	Adjust the gain level of the recorder.
	The pump is faulty.	Check to ensure the operation of the pump is smooth.	Check the pump.
		Check for noise when the pump is stopped.	
	The xenon lamp has reached the end of its useful life.	Check the cumulative turn-on time of Xe lamp.	Replace the xenon lamp with a new one. (Refer to Section 5.2.1.)

Symptom	Cause	Judgment/Check	Remedy
Excessive drift	The warm-up period is not sufficient.	—	Wait until the instrument becomes stable (at least 10 minutes).
	Mobile phase is leaking from a fitting.	Check each fitting.	Retighten the offending fitting.
	An impurity is eluting from the column.	Stop feeding liquid from the pump.	Wait until elution is completed, or replace the column with a new one.
	There is a significant change in the ambient temperature. Or low purity solvent is used.	Check solvent.	Control the temperature variation. Purify the solvent or replace it with one of a higher quality.
Poor S/N ratio	Flow cell contaminated	Visual check	Clean the flow cell (see 4.4).
	Xenon lamp off-position	Check lamp energy level	Adjust lamp position (5.2.1).
	Error in flow cell mounting	Visual check	Correctly mount flow cell (4.4).
	Flow cell surface scratched	Visual check	Replace flow cell (4.4).
Poor wavelength accuracy	Water is not injected in the flow cell.	—	Inject water into the flow cell.
	Bubbles have entered the flow cell.	Visual check	Remove bubbles (4.4).
	Poor adjustment of xenon lamp position	Check lamp energy level.	Adjust Xe lamp position properly.
	Error in flow cell mounting	Visual check	Correctly mount the flow cell (4.4).
	Monochromator off-position	Check wavelength accuracy.	Perform wavelength accuracy (4.3).
Leak error occurs	Liquid has leaked.	Visual check	Wipe off the liquid which has leaked to the drain receptacle. Also wipe off the liquid stuck to the leak sensor (4.2.5).
	Contaminant has stuck to the leak sensor.	Visual check	Wipe off the contaminant stuck to the leak sensor (4.2.5).

4.6 Error Messages

Message	Description	Remedy
ROM ERROR PRESS “CL” KEY TO CLEAR MESSAGE.	ROM is faulty.	1) Press CL key, and 1st monitor screen returns. 2) Contact your nearest service office of Hitachi High-Technologies sales representative.
RAM ERROR PRESS “CL” KEY TO CLEAR MESSAGE.	RAM is faulty.	1) Press CL key, and 1st monitor screen returns. 2) Contact your nearest service office of Hitachi High-Technologies sales representative.
PARAMETER ERROR PARAMETERS ARE SET TO DEFAULT VALUE.	Analytical parameters are inadequate.	1) Press CL key, and 1st monitor screen returns. 2) Turn on power again. 3) Contact your nearest service office of Hitachi High-Technologies sales representative.
LOG INFORMATION ERROR LOG INFORMATION IS INITIALIZED.	Log information is inadequate.	1) Press CL key, and 1st monitor screen returns. 2) Turn on power again. 3) Contact your nearest service office of Hitachi High-Technologies sales representative.
EEPROM ERROR INSTRUMENT INFO. IS INITIALIZED.	Instrument parameters are inadequate.	1) Press CL key, and 1st monitor screen returns. 2) Turn on power again. 3) Contact your nearest service office of Hitachi High-Technologies sales representative.
Ex (Em) SIDE OF WL DRIVE MECHANISM ERROR	Failure in detecting Ex or Em wavelength origin during self-diagnosis test (initialization).	1) Cannot be released by key operation. 2) Turn on power again. 3) Contact your nearest service office of Hitachi High-Technologies sales representative.
Ex (Em) SIDE ACCURACY (254 nm) NOT DETECTED	Wavelength error exceeds ±10 nm during wavelength accuracy check.	1) Carry out troubleshooting (4.5). 2) Contact your nearest service office of Hitachi High-Technologies sales representative.
LAMP OFF BY OVERHEAT! PRESS “CL” KEY TO CLEAR MESSAGE.	Abnormal temperature detected	1) Press CL key, and 1st monitor screen returns. 2) Contact your nearest service office of Hitachi High-Technologies sales representative.
	Xe lamp turned off to prevent its overheating.	1) Press CL key, and 1st monitor screen returns. 2) Use UTLTY key to light up the lamp again.
LAMP OFF BY EXTERNAL INPUT PRESS “CL” KEY TO TURN ON.	Lamp has been turned off due to an external contact input. Busy status is assumed.	1) Release the key lock if it has been activated. 2) Press CL key and light up the lamp again.

Message	Description	Remedy
LAMP OFF BY EXTERNAL ERROR PRESS “CL” KEY TO TURN ON.	Lamp has been turned off due to an external error. Busy status is assumed.	1) Release the key lock if it has been activated. 2) Press CL key and light up the lamp again.
LAMP OFF BY LEAKAGE PRESS “CL” KEY TO CLEAR MESSAGE.	Liquid leakage has occurred. Xe and Hg lamps have been turned off. Busy status is assumed.	1) Press CL key, and 1st monitor screen returns. 2) Use UTLTY key to light up the lamp again.
Xe LAMP ERROR PRESS “CL” KEY TO CLEAR MESSAGE.	Xe lamp fails to come on or go off. Temperature upper limiter of Xe lamp power source is activated.	1) Press CL key, and 1st monitor screen returns. 2) Wait at least 5 minutes after turning off lamp for the lamp to cool down, then turn on power again or re-light the lamp. 3) Replace lamp with a new one.
Hg LAMP ERROR PRESS “CL” KEY TO CLEAR MESSAGE.	Hg lamp fails to come on or go off.	1) Press CL key, and 1st monitor screen returns. 2) Replace the lamp with a new one.
XE LAMP EXCEEDED EXCHANGE STANDARD TIME PRESS “CL” KEY TO CLEAR MESSAGA	The cumulative turn-on time of xenon lamp has exceeded its standard exchange time.	1) Press CL key, and 1st monitor screen returns. 2) Replace the lamp with a new one.
A/Z OVER RANGE PRESS “CL” KEY TO CLEAR MESSAGE.	Allowable auto zero range has been exceeded.	1) Press CL key, and 1st monitor screen returns. 2) Change the wavelength. 3) Replace the solvent with another one. 4) Clean the flow cell.
NO SPECTRA PRESS “CL” KEY TO CLEAR MESSAGE.	Spectrum of specified No. is not found.	1) Press CL key, and 1st monitor screen returns. 2) Enter a number corresponding to an existing spectrum. 3) Perform spectrum acquisition.
SPECTRA ARE MISMATCHED PRESS “CL” KEY TO CLEAR MESSAGE.	Scan mode incorrect, Em bandpass incorrect, fixed wavelength incorrect, background WL range doesn’t include entire spectrum WL range, background spectrum mode incorrect, or energy spectrum incorrect.	1) Press CL key, and 1st monitor screen returns. 2) Select correct parameters.
DATA BUFFER OVERFLOW PRESS “CL” KEY TO CLEAR MESSAGE.	During data acquisition, data transfer to the interface board has been disabled, causing an overflow of the data buffer.	1) Press CL key, and 1st monitor screen returns. 2) Check the connection with the interface board.
THERMO CELL IS NOT CONNECTED	A thermo cell is not connected even though the thermo cell setting is in ON state.	1) Press CL key, and 1st monitor screen returns. 2) Check the thermo cell connection.

Message	Description	Remedy
ADC INITIALIZE ERROR	An error has occurred during ADC initialization.	1) Cannot be released by key operation. 2) Turn on power again. 3) Contact your nearest service office of Hitachi High-Technologies sales representative.
ADC ERROR	Data transfer from ADC has been interrupted.	1) Cannot be released by key operation. 2) Turn on power again. 3) Contact your nearest service office of Hitachi High-Technologies sales representative.
DAC ERROR	Data transfer to DAC has been interrupted.	1) Cannot be released by key operation. 2) Turn on power again. 3) Contact your nearest service office of Hitachi High-Technologies sales representative.
THERMO CELL ERROR	An error has occurred at the thermo cell.	1) Cannot be released by key operation. 2) Turn on power again. 3) Contact your nearest service office of Hitachi High-Technologies sales representative.

An error message will be displayed together with the alarm buzzer sounding.

NOTE: An input value stored in this instrument may be deleted if a certain error message appears. In this case enter the relevant value again. Especially in the event of a PARAMETER ERROR, the wavelength calibration value will be deleted, so it is necessary to perform the wavelength calibration again (refer to 4.2.4 for the procedure).

5. SPARE PARTS

5.1 Replacement Parts and Consumables

Table 5-1 lists the replacement parts and consumables for this instrument. It is suggested that a suitable quantity of each item be stocked in the laboratory to minimize down time. For many of these items (e.g. lamps), the quantity is dependent on the level of use of the instrument.
The estimated service life of each part is based on the assumption that the instrument is operated 160 hours/month (8 hours/day), 1920 hours/year (240 days).

Table 5-1 Replacement Parts and Consumables

Part Number	Part Name	Estimated Service Life	Remarks
650-1500 (J851152)	150 W Xenon lamp	Guaranteed life : 150 hours Limit : 500 hours Warranty period: 6 months after delivery to customer	
250-1600 (J851153)	Long-life xenon lamp (Special accessory)	Guaranteed life : 500 hours Limit : 1000 hours Warranty period: 6 months after delivery to customer	
890-2662	Mercury lamp	Guaranteed life: 100 hours/ 2 years	
J821349	Time-lag fuse	5 A	
890-2932	Flow cell (12 μL)	9600 hours/5 years	
890-2684	Drain tube ID 0.33 × 0.62 T	9600 hours/5 years	Length: 2 m Outside diameter: 1.57 mm
893-0833	Inlet tube ID 0.25 × 0.66 T	9600 hours/5 years	Length: 55 mm Outside diameter: 1.57 mm (inlet ferrule included)
L369053	Ferrule front	9600 hours/5 years	Part for connecting column and inlet tube Material: Daiflon
893-0827	Inlet tube (SUS, with coating) ID 0.25	9600 hours/5 years	Length: 350 mm Outside diameter: 1.57 mm (for standard cell)
893-0826	Inlet tube (SUS) ID 0.25	9600 hours/5 years	Length: 350 mm Outside diameter: 1.57 mm (for thermostatted flow cell)
893-0825	Fitting (PEEK)	—	SUS tube (1.57 mm, for column outlet)

Part Number	Part Name	Estimated Service Life	Remarks
M790019	Setscrew S (SUS)	—	SUS tube (1.57 mm, for flow cell)
L329109	Ferrule (SUS)	—	SUS tube (1.57 mm, for flow cell)

5.2 Lamp Replacement

5.2.1 Xe lamp replacement

⚠ WARNING

Injury due to Xenon Lamp Explosion

Before removing the xenon lamp for replacement, turn off the xenon lamp (turn off power to the instrument) and then wait for at least one hour until the xenon lamp becomes sufficiently cool to reduce its internal pressure the normal safety level.

⚠ CAUTION

Touching Hot Part Could Result in Burns

The xenon lamp and its housing becomes very hot during operation and remains hot for a while after operation. Touching the hot xenon lamp or its housing could result in severe burns. Before proceeding to lamp replacement, turn off the power switch and then wait for at least one hour until the lamp and its housing cool down sufficiently.

For replacing the xenon lamp immediately after the use, the lamp must be cooled first of all, because it is still hot.
Once the Xe lamp has been cooled adequately, you can proceed to its replacement.

(1) Cooling Down the Xenon Lamp

Take the following procedure to turn off the lamp and let it cool down (see section 3.2.5).

(a) Press the UTLTY key and the utility setting screen will appear.

<Utility setting screen>

```
UTILITY  (OFFSET=1, TIME CONSTANT=2,
_5          USE PROG=3, PMT VOLT=4, OTHERS=5)
```

Press numeric key 5 and then the ENT key.

(b) The others setting screen appears.

<Others setting screen>

OTHERS (Em BANDWIDTH=1, ERROR OUT=2, 4 LEAK SENSOR=3, LAMP=4)

Press numeric key 4 and then the ENT key.

(c) The Xe lamp setting screen appears.

<Xe lamp setting screen>

Xe LAMP ON/OFF (OFF=0, ON=1) 0

Press numeric key 0 and then the ENT key.

(d) The 1st monitor screen appears, and OFF is indicated at LAMP.

<1st monitor screen>

TIME	Ex	Em	FL	PROG	LAMP	[I]
0.0	250	350	0.0	1	OFF	

(e) The xenon lamp is thus turned off. Although the lamp is off, the fan continues rotating so as to cool down the lamp. Wait for at least 30 minutes in this status without turning off the power supply.

(2) Replacement of the Xe Lamp

⚠ WARNING

Electric Shock due to Contact with Inside of Instrument

The xenon lamp is supplied with high voltage of 30 kV, which could cause an electric shock to result in serious or fatal injury.
Before removing the light source cover for replacement of the light source lamp, be sure to turn off the power switch.

⚠ WARNING

Injury due to Xenon Lamp Explosion

If a strong shock or impact is applied to the xenon lamp or if the surface of its quartz glass part is scratched, it may explode and scatter glass pieces, resulting in personal injury. Be sure to wear proper protective gear such as safety goggles, safety mask, thick long sleeves, and gloves when handling the xenon lamp.

(a) Turn OFF the power switch and unplug the power cord.

(b) Loosen six retaining screws of the light source cover, and detach the cover (see Fig. 5-1).

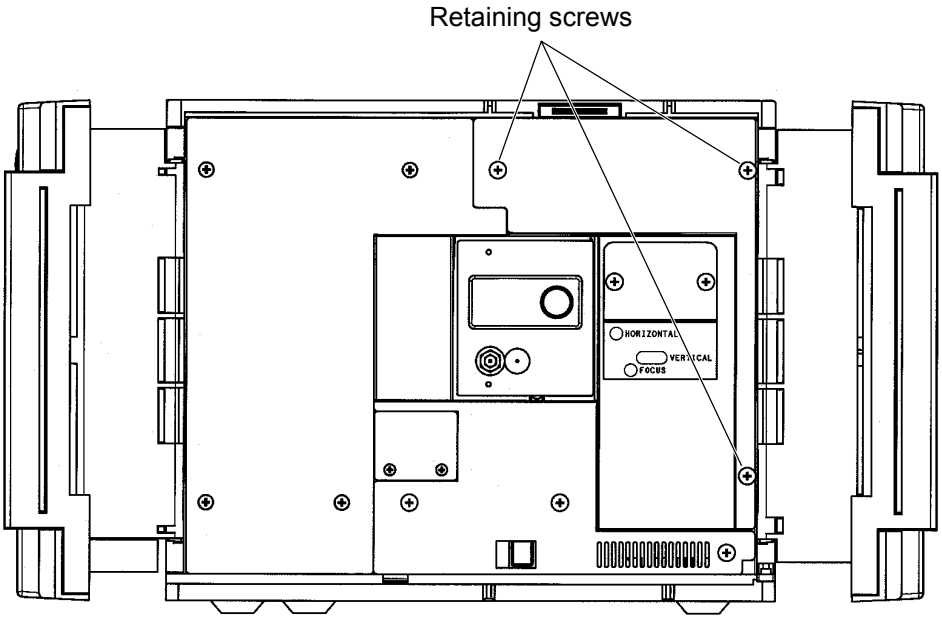


Fig. 5-1 Removal of Light Source Cover

(c) Put on safety goggles for the subsequent steps.

(d) Detach the connector between lamp house and main body, and loosen the lamp house retaining screw.

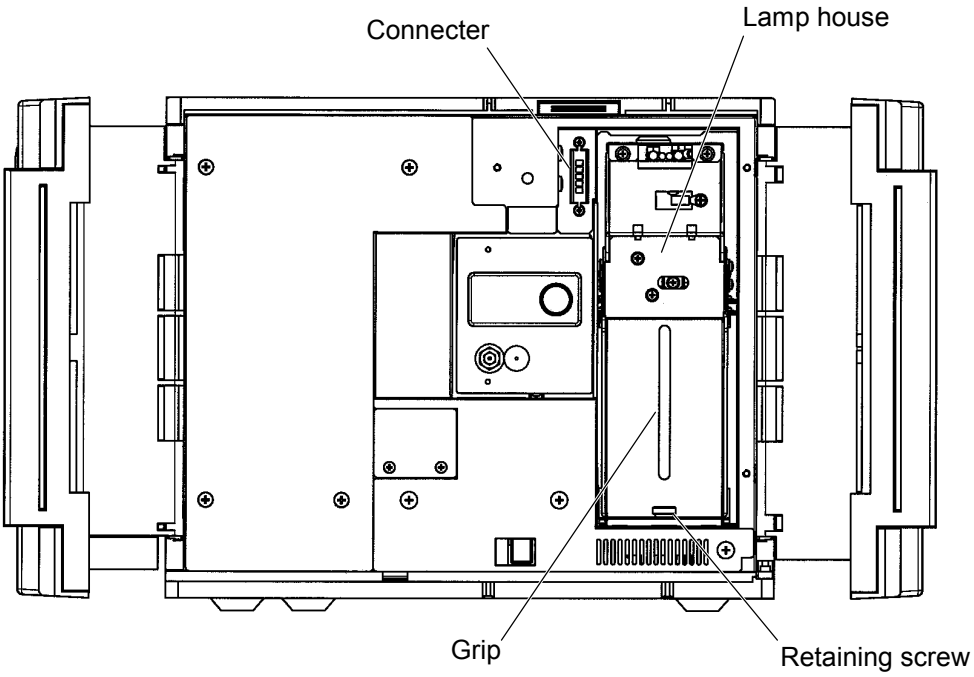


Fig. 5-2 Removal of Connector and Retaining Screw

(e) Lift the grip of the lamp house lightly and pull it toward you, then detach the lamp house from the main body.

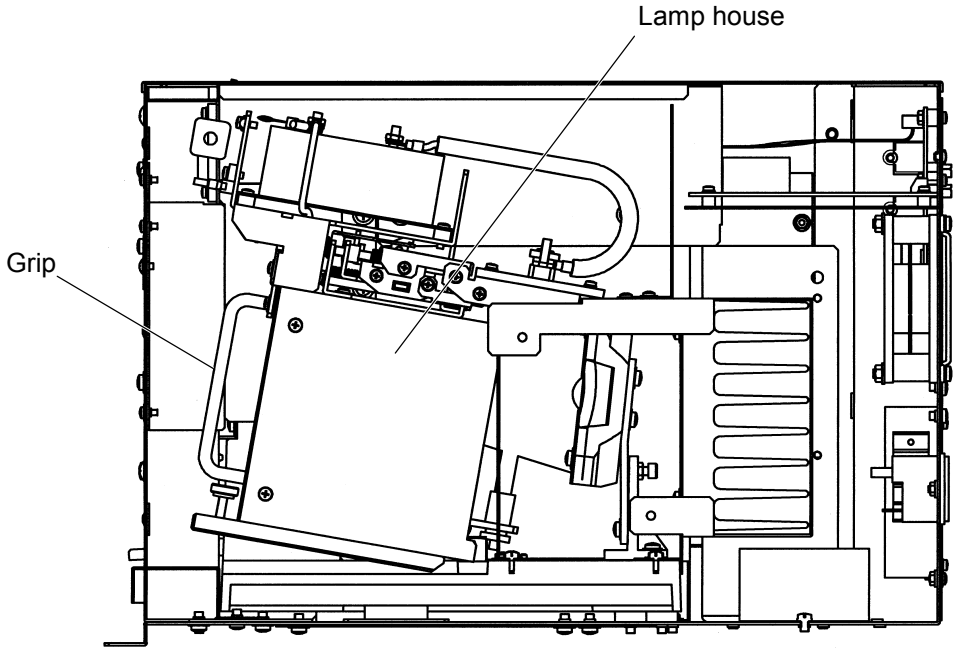


Fig. 5-3 Removal of Lamp House

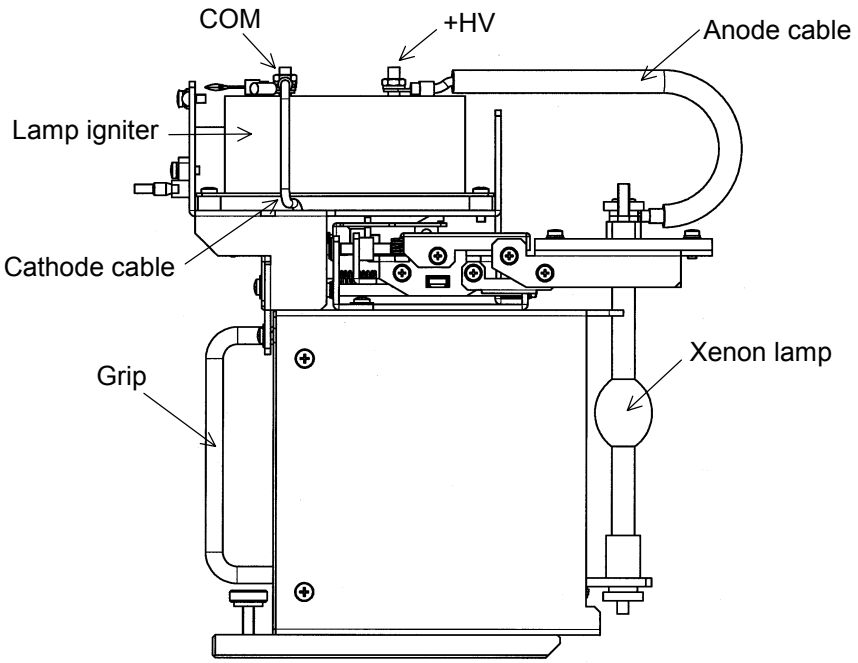


Fig. 5-4 Lamp House after Removal

(f) Removal of old xenon lamp

⚠ WARNING

Injury due to Xenon Lamp Explosion (at disposal)

The xenon lamp is filled with high-pressure gas (approx. 1 MPa at room temperature, approx. 4 MPa under operating condition), and this high-pressure gas still remains in the xenon lamp after it is demounted for replacement.
For disposal of the used xenon lamp, wrap it with a thick cloth (e.g., triple-folded cotton cloth) completely and crush its glass part with a hammer or the like. Then, discard the xenon lamp as a dangerous waste item properly.
If the xenon lamp is discarded without being crushed, it could explode due to possible impact at the time of disposal, scattering glass pieces to cause personal injury.

⚠ WARNING

Injury due to Xenon Lamp Explosion (at mounting)

When loosening or tightening the retaining nut for the xenon lamp, be careful not to apply excessive force to its glass bulb part. Never hold and turn the glass bulb part for loosening/tightening.

Loosen the anode nut of the lamp and detach the anode terminal of the lamp (marked +) from the metal fixture on the ceramic plate (Fig. 5-5). Be careful not to touch the lamp bulb. Note that a thin metal wire is attached near the center of the bulb, which facilitates ignition of the lamp. Take care not to break this wire when handling the lamp.

(g) Loosen the cathode nut and remove the cathode lead plate (Fig. 5-5).

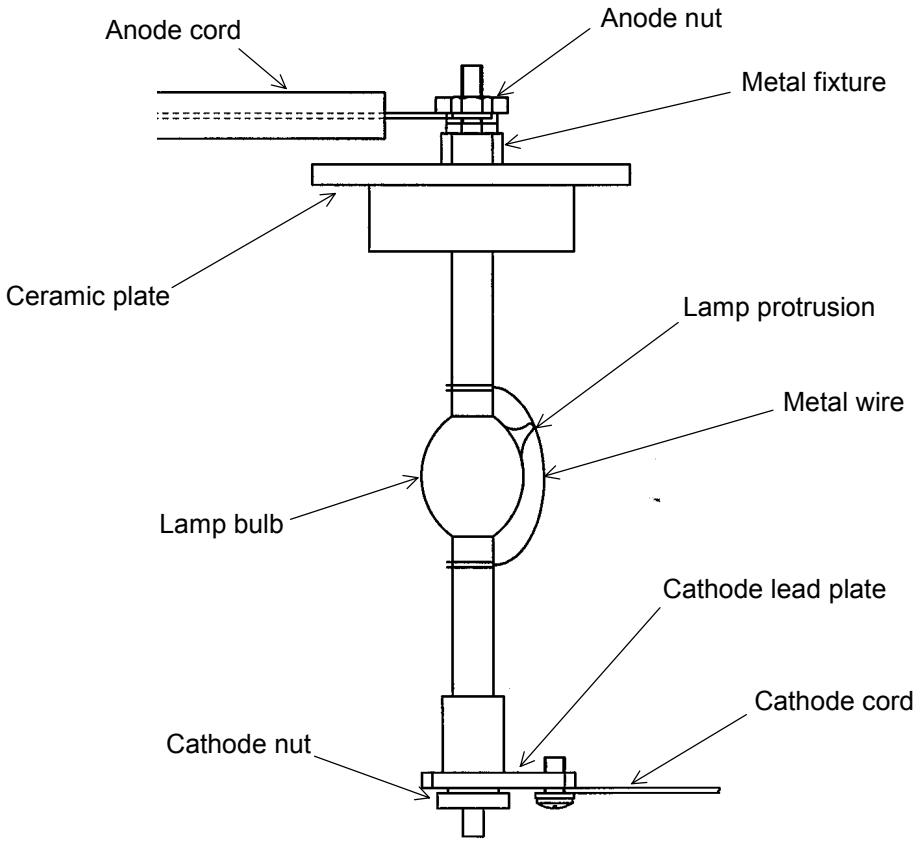


Fig. 5-5 Detachment of Xenon Lamp

(h) Mounting of new xenon lamp

WARNING

Injury due to Xenon Lamp Explosion (at mounting)

Do not touch the quartz glass part of the xenon lamp with bare hands.
If the quartz glass part of the xenon lamp is contaminated with dust or fingerprints, wipe it using a gauze sheet or absorbent cotton cloth slightly moistened with high-quality alcohol.
If the xenon lamp is turned on with dust or fingerprints left on the surface of the quartz glass part, it may cause contamination burn-in to decrease the mechanical strength of the glass part, resulting in explosion of the xenon lamp.

WARNING

Injury due to Xenon Lamp Explosion (at mounting)

Be sure to mount the xenon lamp in the specified direction.
If the mounting direction (polarity) is wrong, the cathode will be consumed significantly to disable turn-on of the lamp.
Mount the lamp so that the '+' (anode) mark on it will be positioned at the support metal of the lamp holder.
If the lamp with its cathode consumed excessively is used continuously, pressure inside the lamp bulb may become too high, causing possible explosion. To prevent this, replace the lamp with a new one immediately if its cathode has been consumed substantially.

WARNING

Injury due to Xenon Lamp Explosion (at mounting)

If the nut on the lamp base and wiring part is loose, the contact resistance between them will increase due to poor contacting. This could generate a large amount of heat to make the lamp extremely hot, resulting in possible explosion. To prevent this, be sure to tighten the nut securely.

Attach a new xenon lamp in place.
Attach the cathode lead plate to the threaded part of the cathode, and secure the lead plate with the cathode nut (Fig. 5-6). Mount the lamp so that the protrusion on the bulb faces the instrument front panel (Fig. 5-7).
Be careful not to touch the lamp bulb. Note that a thin metal wire is attached near the center of the bulb, which facilitates ignition of the lamp. Take care not to break this wire when handling the lamp.
Also, if the thin metal wire is not located on the side of the lamp having the small protrusion, slide the wire so it is properly positioned there.

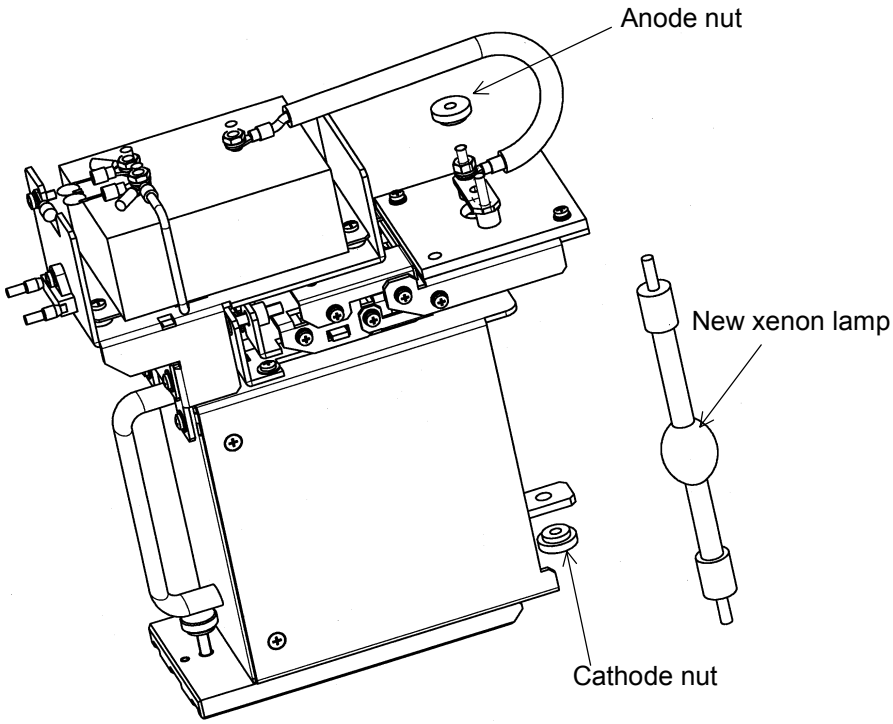


Fig. 5-6 The Xenon Lamp

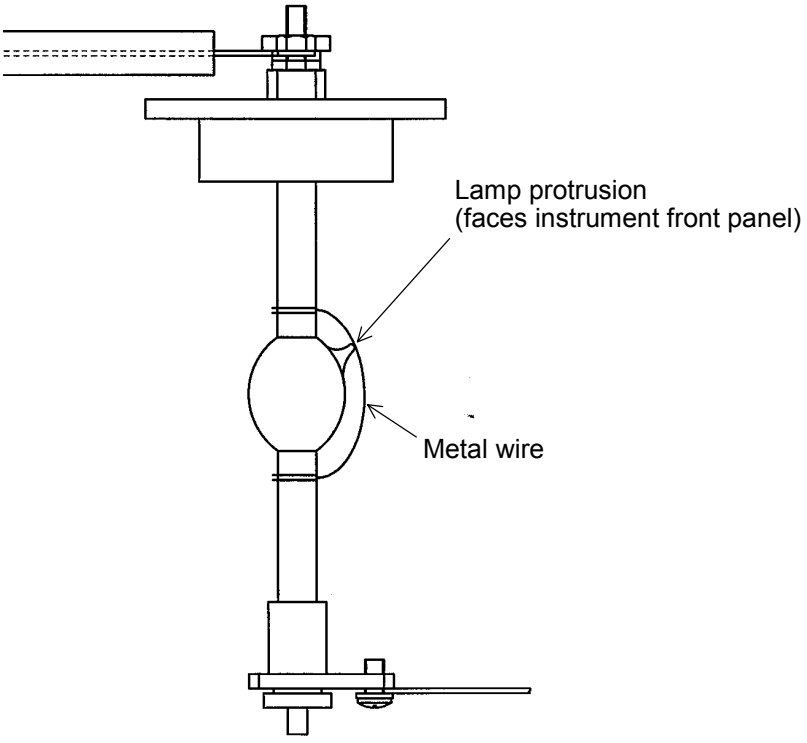


Fig. 5-7 Orientation of Lamp Bulb Protrusion

(i) As shown in Fig. 5-6, put the anode terminal (marked "+") of the lamp into the metal fixture on the ceramic plate. Then, using the anode nut, mount the lamp so that the protrusion on the bulb is positioned as shown in Fig. 5-7. Refer to Fig. 5-4 for a view of the lamp when assembled.

NOTE: Mount the xenon lamp so that the protrusion on the bulb faces the instrument front panel (Fig. 5-4). A mistake in the orientation may cause an increased light loss and preclude obtaining the desired performance from the instrument.

(j) After mounting the Xe lamp in the lamp house, assemble it into the main body (Fig. 5-2).
Raise the lamp house and insert it into the main body, then lower it and press it downward into place.
The lamp house will not move if installed correctly.
Finally, secure the lamp house with retaining screws and connect its connector with the main body.

(k) When installation of the lamp house is finished, close the light source cover and turn ON the power (check that the lamp comes on).
Now proceed to positional adjustment of the Xe lamp.

(3) Positional Adjustment of Xe Lamp

⚠ CAUTION

Direct Gazing at Illuminating Xenon Lamp Could Cause Eye Damage

The xenon lamp radiates intense ultraviolet light when it is on.
If you look at the illuminating xenon lamp during coarse adjustment of its position, your eyes could be damaged.
Do not look at the xenon lamp directly when it is lit.
Be sure to wear tinted safety glasses to prevent possible eye damage.

The position of the beam slightly differs from one lamp to another, so it is necessary to adjust the lamp position before the detector is first used or when the lamp is replaced. Use the three adjusting screws on the right side of the instrument for the adjustment.

HORIZONTAL	:	For adjusting horizontal position
FOCUS	:	For adjusting the focal point of light source
VERTICAL	:	For adjusting vertical position

Lamp adjustment involves coarse adjustment, in which the image of the light beam is monitored, and fine adjustment, in which detailed adjustment is made while observing the data. Coarse adjustment is required at first.

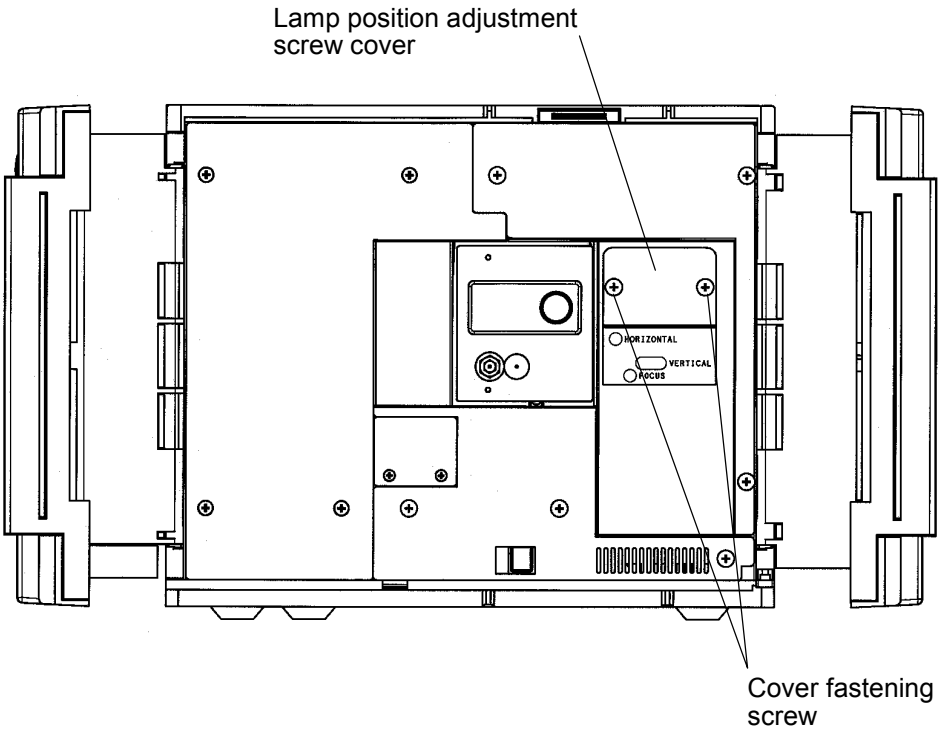


Fig. 5-8 Lamp Position Adjustment Screw Cover

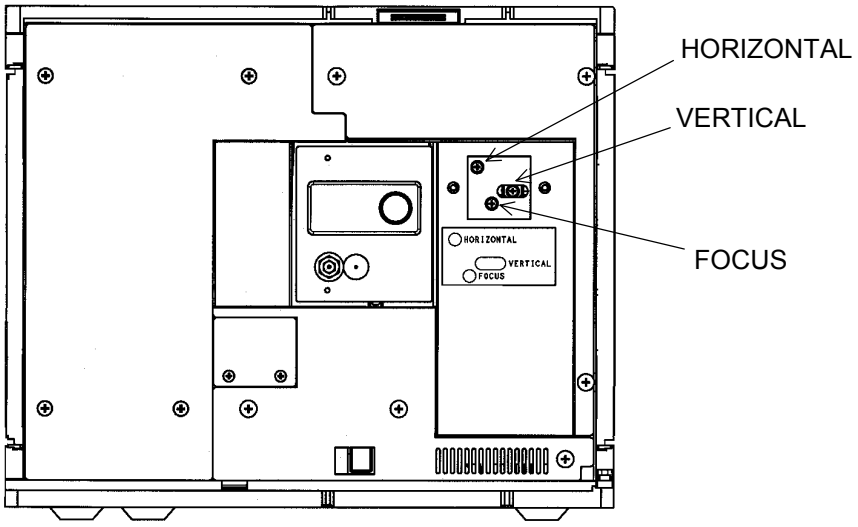


Fig. 5-9 Lamp Positional Adjustment

(a) Coarse adjustment

Set the excitation (Ex) wavelength at 550 nm, and make the adjustment while observing the image of the light beam. Take the following steps for the adjustment (see section 3.1.4).

(i) Turn ON the power switch, and the 1st monitor screen appears.

<1st monitor screen>

TIME	Ex	Em	FL	PROG	LAMP	[I]
0.0	250	350	0.0	1	Xe	

(ii) In the present status, pull out the flow cell unit (see Fig. 5-2). "****" will be indicated at FL on the 1st monitor screen.

<1st monitor screen>

TIME	Ex	Em	FL	PROG	LAMP	[I]
0.0	250	350	****	1	Xe	

(iii) Press the WL key and the wavelength setting screen appears.
Set an excitation (Ex) wavelength.

<Wavelength setting screen (Ex indicated)>

Ex	Em	(200 - 850.0)
550	350	

Press numeric keys 5 5 0 and then the ENT key.

(iv) Emission (Em) wavelength will not be set here. Leave the present setting as it is.

<Wavelength setting screen (Em indicated)>

Ex	Em	(250 - 900.0)
550	350	

Press the ENT key.

(v) The 1st monitor screen appears.

<1st monitor screen>

TIME	Ex	Em	FL	PROG	LAMP	[I]
0.0	550	350	****	1	Xe	

(vi) In this status, place a paper strip at the Ex beam exit center of the sample compartment as shown in Fig. 5-9 and observe the condition of the excitation beam.
Repeat the VERTICAL, HORIZONTAL and FOCUS adjustments in this order little by little until the excitation beam (rainbow color) becomes brightest. The coarse adjustment of the light source position is thus completed. Please adjust VERTICAL first in installation because the lamp position is shifted downward for fixation of the transport screw.

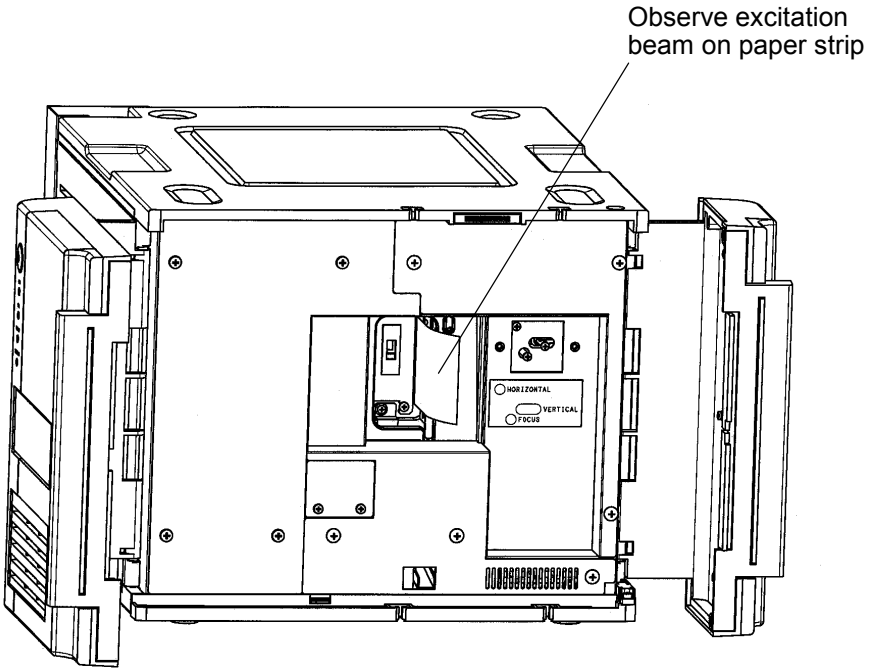


Fig. 5-10 Observation of Ex Beam

(b) Fine adjustment

Following the coarse adjustment, set the excitation (Ex) wavelength at 350 nm make a fine adjustment while observing the data. Take the procedure given below (refer to sections 3.1.1, 3.1.4).

(i) Re-mount the flow cell unit.

(ii) Press the WL key and the wavelength setting screen appears. Set an excitation (Ex) wavelength.

<Wavelength setting screen (Ex indicated)>

Ex	Em	(200 - 850.0)
350	350	

Press numeric keys 3 5 0 and then the ENT key.

(iii) Emission (Em) wavelength will not be set here. Leave the present setting as it is.

<Wavelength setting screen (Em indicated)>

Ex	Em	(250 - 900.0)
350	350	

Press the ENT key.

(iv) The 1st monitor screen appears.

(v) Press △ or ▽ key and the 2nd monitor screen appears.

<2nd monitor screen>

Ex	Em	MONITOR (Ex)	(Em)	LAMP	[I]
350	350	*******	*******	Xe	

(vi) In the present status, turn the FOCUS, HORIZONTAL and VERTICAL adjusting screws gradually in a repetitive manner while watching the MONITOR (Ex) value on the screen until this value is maximum. When a maximum value is reached, the fine adjustment of the lamp position is completed.

(vii) Press △, ▽ or ESC key and the 1st monitor screen will return.

(4) Entry of Lamp Replacement Date

When the above procedure is finished, enter a lamp replacement date (see .3.3.2). With this entry, the cumulative on-time is set to “0” and the number of lightings to “1”.

5.2.2 Hg lamp replacement

(1) Replacement of Hg Lamp

(a) Turn off the power switch and unplug the power cord.

(b) Loosen the six retaining screws of the light source cover and detach the cover (Fig. 5-11).

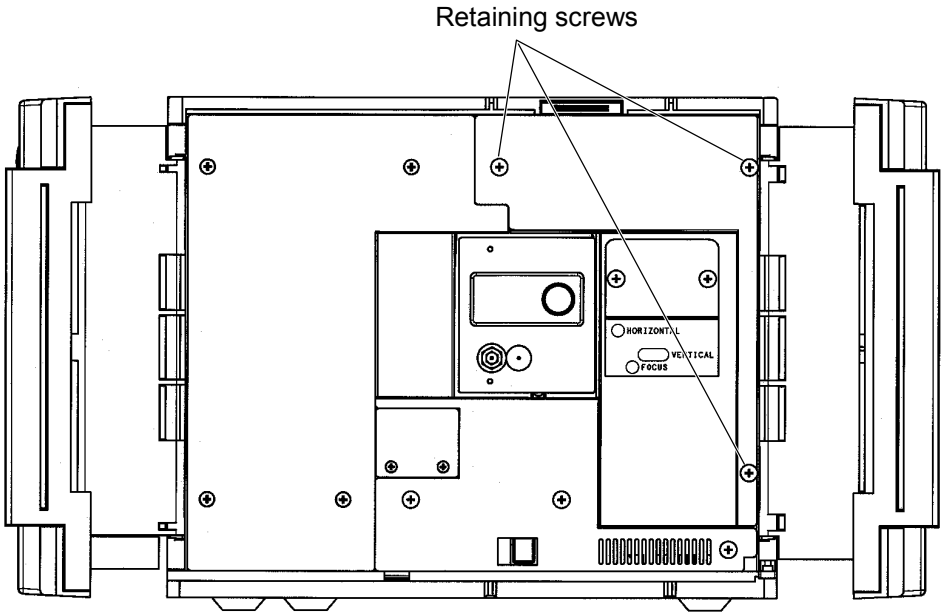


Fig. 5-11 Removal of Light Source Cover

(c) Loosen the screw retaining the mercury lamp cover (Fig. 5-12).

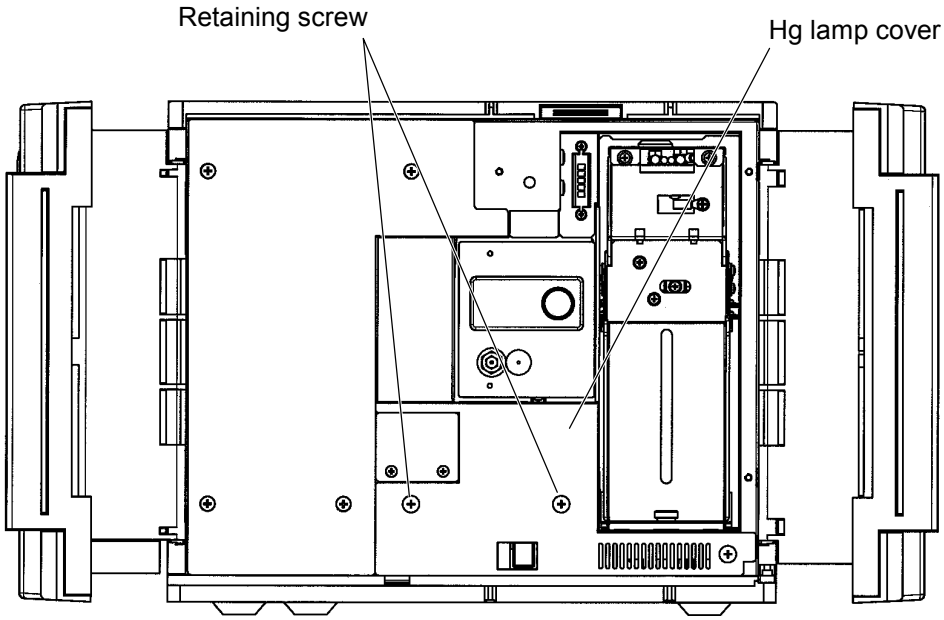


Fig. 5-12 Removal of Hg Lamp Cover

(d) Pull the Hg lamp cover straight out, and the Hg lamp will be seen attached at the right side interior of the main body (Fig. 5-13).

(e) Detach the connector between the Hg lamp and main body, loosen two retaining screws and detach the Hg lamp.

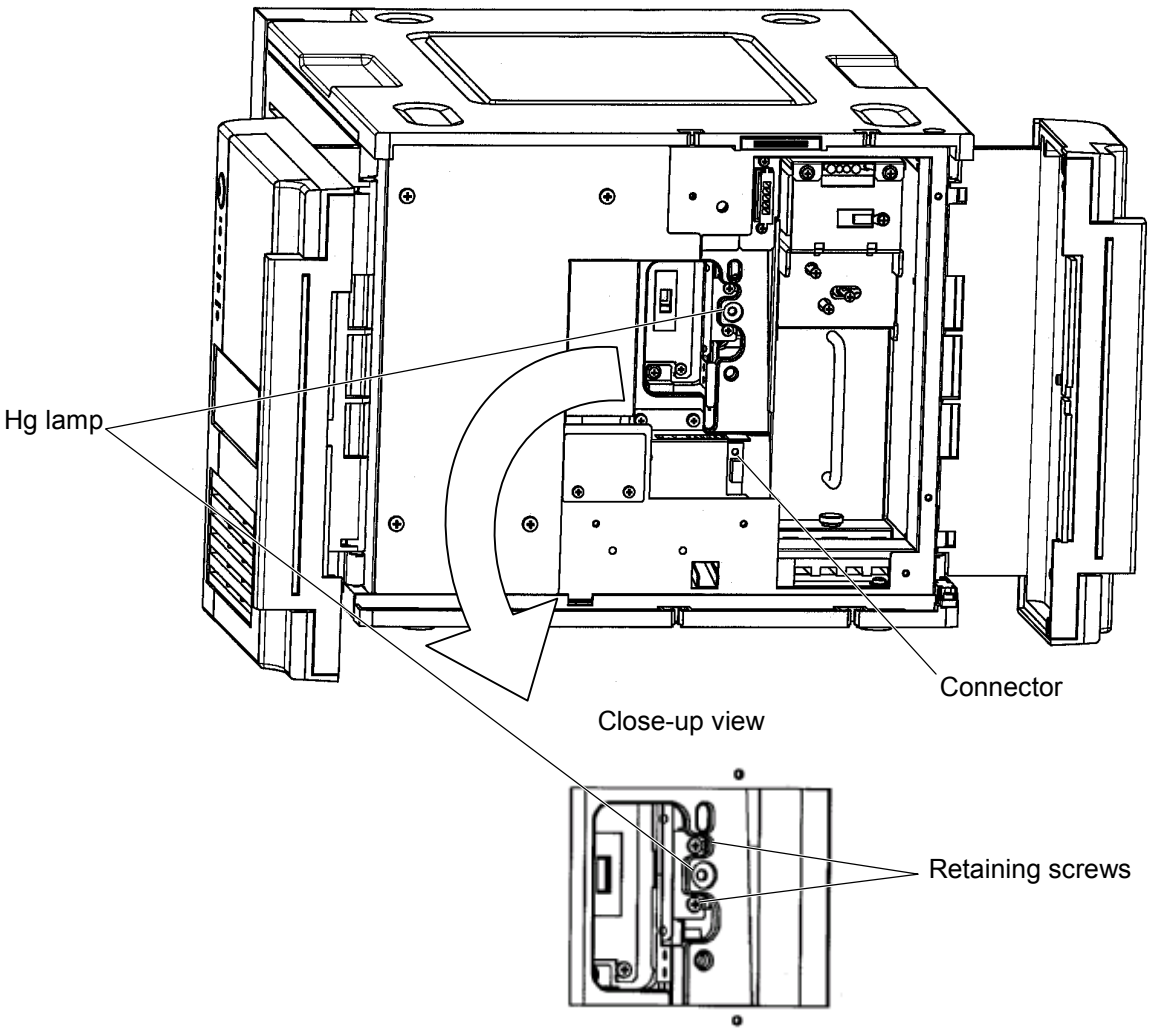


Fig. 5-13 Removal of Hg Lamp

(f) Attach a new Hg lamp in place.
Fasten the lamp with the two retaining screws, then connect the connector with the main body.

(g) Reattach the flow cell unit and light source cover in their original positions.

(2) Entry of Lamp Replacement Date

When the above procedure is finished, enter a lamp replacement date (see 3.3.4). With this entry, the cumulative on-time is set to “0” and the number of lightings to “1”.

5.3 Fuse Replacement

⚠ WARNING

Electric Shock due to Contact with Inside of Instrument

When replacing the fuse with a new one, be careful not to receive an electric shock. To prevent this, be sure turn off the power switch and unplug the power cord before proceeding to fuse replacement.

(1) Item to prepare: 2 new fuses (P/N J821349 T5A)

(2) Items to Check: Prior to fuse replacement, make sure the power switch of the instrument is off and the power cord is unplugged.

(3) Replacement of Fuse

(a) Hold the tabs on both sides of the fuse holder and detach the holder.

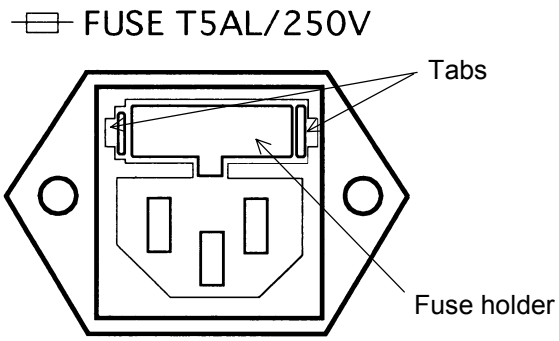


Fig. 5-14 Fuse Replacement

(b) Replace two fuses with new ones, then reattach the fuse holder in place.

6. INDEX

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APPENDIX

APPENDIX 1. INSTALLATION

1. Unpacking

CAUTION

Carrying Heavy Instrument

This instrument weighs as much as 25 kg. Be careful not to drop it and to handle it with care when carrying it, for preventing injury. Hold the right and left parts of the instrument firmly.

Carefully unpack the shipping case, take out module units and standard accessories, and place them on a sturdy, level desk or bench.

NOTE: It is not permitted for the user to carry out installation at the time of delivery. For ensuring safety and high accuracy in operation of the instrument, installation of the instrument shall be carried out by qualified service personnel trained by the manufacturer or its authorized maintenance service agent. Before installation, however, the user shall make adequate preparations for installing the instrument, referring to this instruction manual. If relocation of the instrument becomes necessary after delivery, please be sure to consult your dealer or nearest Hitachi High-Technologies authorized maintenance service agent in order to avoid possible trouble involved in relocation.

2. Installation Conditions

Confirm that the following requirements are satisfied before installing the instrument.

(1) Power Supply

Power supply voltage	:	100 to 115/220 to 240 V AC Fluctuation should be within ±10% of the rated voltage.
Frequency	:	50 or 60 Hz Fluctuation should be within ±0.5 Hz of the rated frequency.
Power capacity	:	330 VA or more for a single instrument, and 1050 VA or more for the total system. The total system shown comprises Chromaster organizer, Chromaster 5110 pump, Chromaster 5210 column oven, and Chromaster 5440 fluorescence detector. Check and prepare a power supply meeting the power supply requirements for your actual system configuration and OA equipment to be used in combination.
Power outlet	:	A power outlet shall be available near the installation position of the system including this instrument. This instrument requires a single grounded power outlet (3-pole type). At least one additional outlet is needed for the entire system.

⚠ WARNING

Electric shock due to improper grounding!

This instrument is designed in conformity with the specifications of Class I in Annex H of the IEC 61010-1 (International Electrotechnical Commission Standards) - Issue 1. To prevent an electric shock hazard, provide a proper grounding connection.

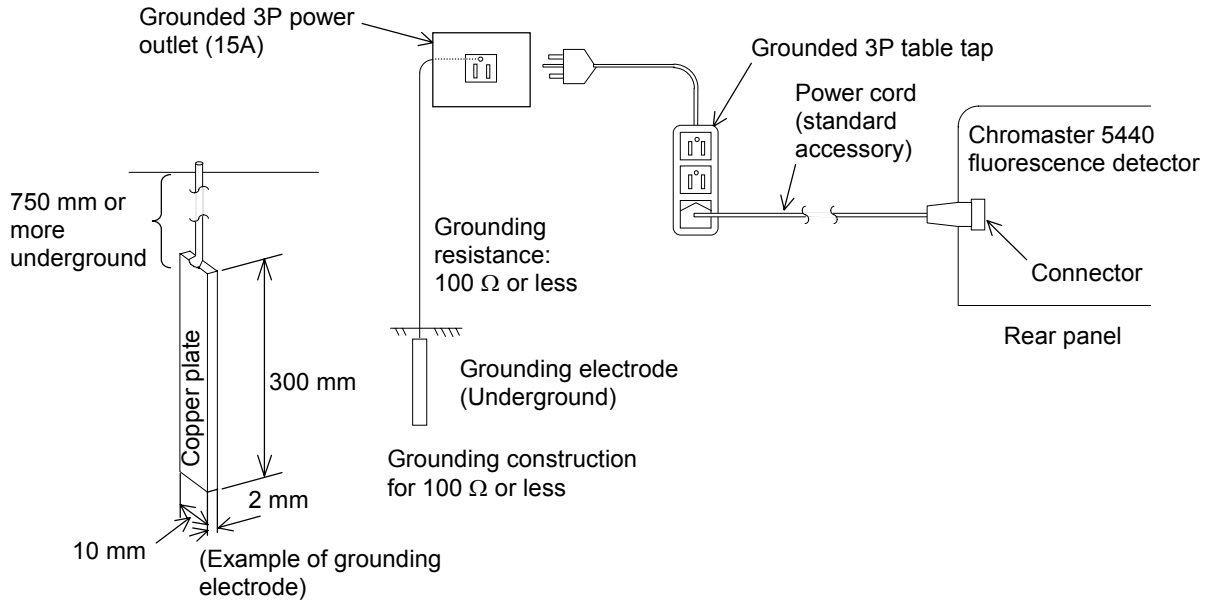
(a) Be sure to use the grounded 3P power cable which is supplied as a standard accessory for the instrument. The use of a different type of power cable may result in an electric shock hazard. Connect the 3P power cable to a grounded 3P power outlet.

(b) If a grounded 3P power outlet is not available, use a grounded 3P table tap or a 3P-to-2P adapter. In this case, be sure to provide a proper grounding connection. For grounding connection, use a screw having a diameter of M4 or higher and a turn count of 3 or more in threading, and a wire having a thickness of 1.25 mm.

(2) Ground Terminal

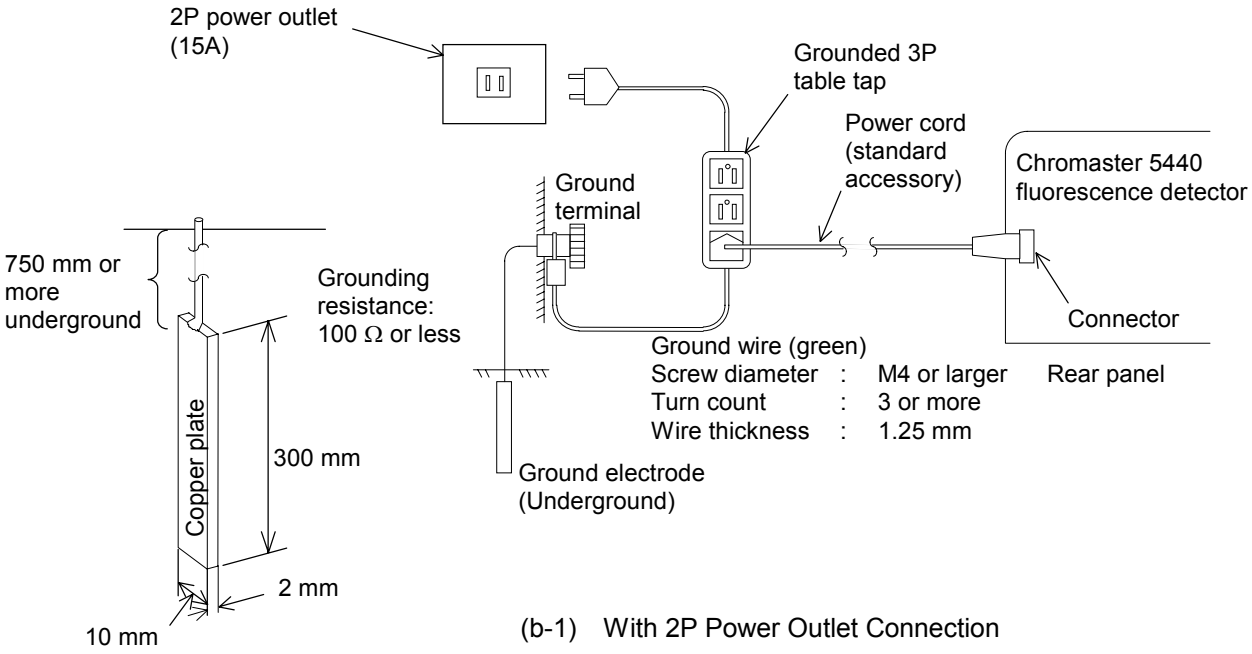
Shall have a grounding construction for a ground resistance of 100 Ω or less.

(a) Ordinary Grounding Connection (Grounded 3P power outlet)

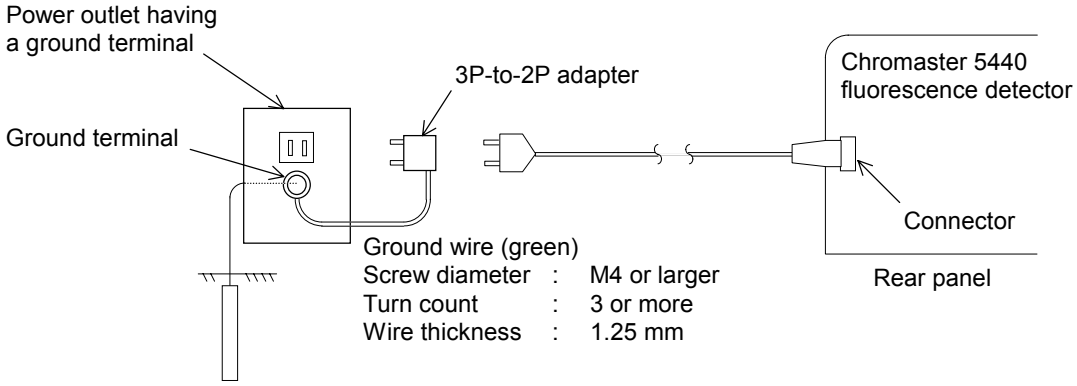


Appended Fig. 1-1 Grounding Connection

(b) Grounding Connection when grounded 3P power outlet not available



(b-1) With 2P Power Outlet Connection



(b-2) With Power Outlet with Ground Terminal

Appended Fig. 1-2 Connection when Only 2P Power Outlet is Available

3. Installation Place

For Chromaster Series system installation, it is required to provide a space of 540 mm in width, and 550 mm in depth at least.
A space of 150 mm or more in width shall be provided on the rear side of the instrument, and a space of 100 mm or more in width shall be provided on each of the left and right sides of the instrument.
Prepare a level, sturdy installation table capable of bearing a load of at least 150 kg.
In an example of a total system arrangement, Chromaster organizer, Chromaster 5110 pump, Chromaster 5210 autosampler, Chromaster 5310 column oven, and Chromaster 5440 fluorescence detector, stacked in two blocks, are included.
Check and prepare an installation place satisfying the space requirements for your actual system and OA equipment to be used in combination.

4. Installation Environment

The following environmental conditions must be satisfied.

(1) Operating Ambient Temperature
Within a range of 4 to 35 °C. And temperature variation should be minimum during measurement. Also, be careful not to allow condensation to form.

(2) Operating Ambient Humidity
25 to 85% RH

(3) Atmospheric Gas

(a) There should be adequate ventilation.

(b) Should be no acidic, alkaline or other gas that would highly corrode metal.

(c) Should be free from organic solvent gases (especially benzene, paint thinner) that would dissolve the painted surfaces of the instrument.

(4) Other Conditions

(a) Avoid placing the instrument near a window where it would be exposed to direct sunlight. Exposure to sunlight may cause a degraded performance and/or discoloration of the painted surfaces.

(b) Protect the instrument from drafts.

(c) Do not allow the instrument to be exposed to any strong vibration or shock.

(d) Do not place the instrument near equipment that radiates heat, such as gas burner, electric heater or oven.

(e) Do not place the instrument near equipment that generates an intense magnetic field, such as electric welder, high frequency furnace, pole transformer, etc.

(f) Protect the instrument from excessive dust.
Dust would degrade the performance.

(g) Connect the instrument to a line that is free from abrupt voltage fluctuations. Such would increase the detector noise.

(h) If a motor-driven apparatus (such as stirrer or vibrator) not having a noise suppressing device is connected to the same power line as this instrument, avoid frequent ON-OFF operations of that apparatus.

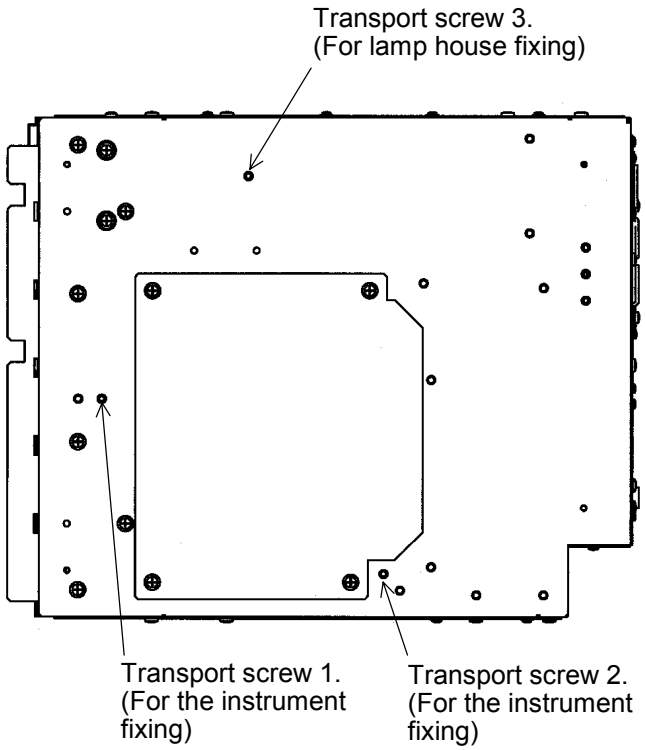
5. Checking the Contents

When the unpacking is finished, check the delivered contents against the packing list that comes with the instrument. If any part is missing or damaged, or if you have any question, contact our nearest sales representative or our authorized maintenance service agents.

6. Assembling

6.1 Removal of Transport Screws

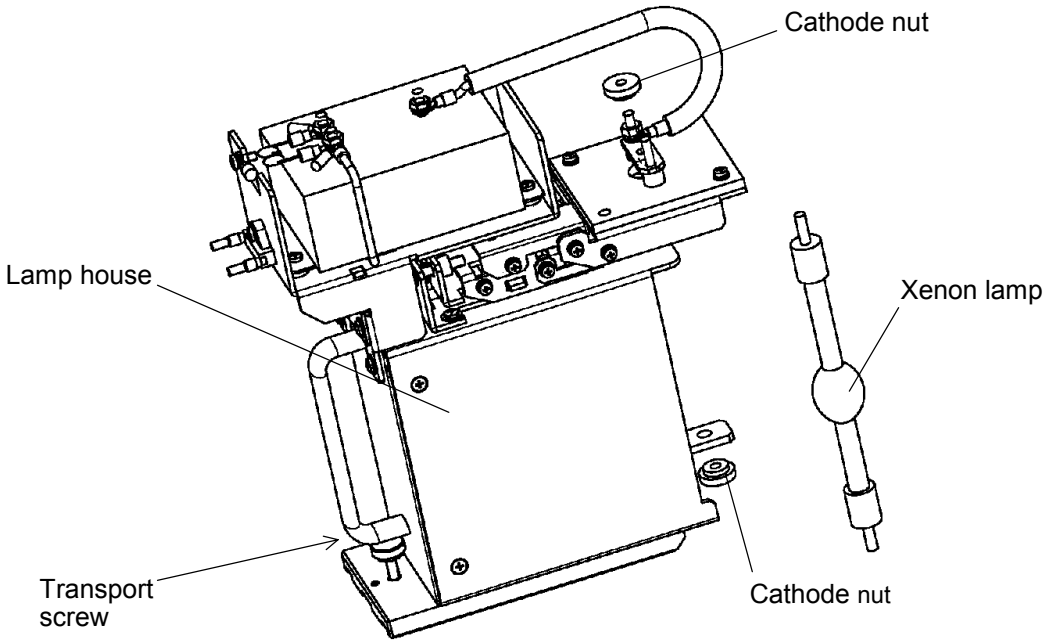
(1) There are three screws for transport installed on the bottom of the instrument. Remove the transport screws with a phillips screwdriver.



Appended Fig. 1-3 Removal of Transport Screws

(2) Pull out the lamp house from the instrument (see ② to ⑤, in section 6.2.1 (2).)

(3) A transport screw is installed in the lamp house.
Remove the transport screw with the phillips screwdriver.



Appended Fig. 1-4 Transport Screws and Mounting Xenon Lamp

(4) Install the xenon lamp in the lamp house. And mount it to the instrument (see ⑧ to ⑪ in section 6.2.1 (2).)

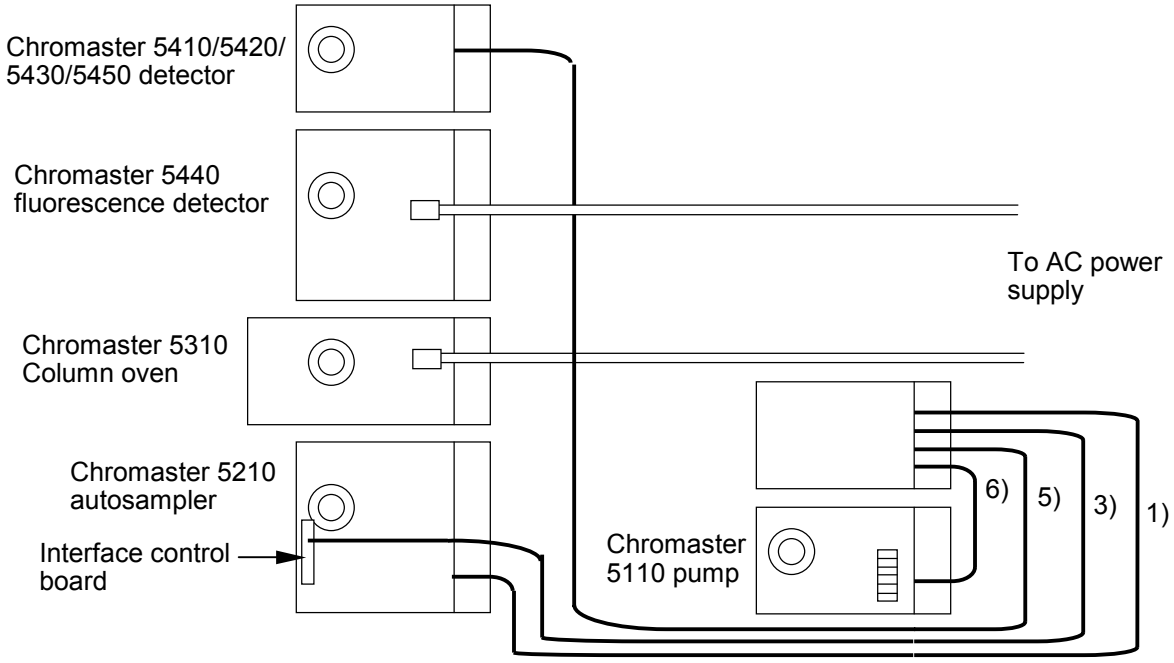
(5) Adjust the position of the xenon lamp.
The xenon lamp position had drastically moved to the downward of the vertical direction to fix the transport screws. For this reason, adjust VERTICAL first (see section 6.2.1 (3).)

NOTE: After removing the transport screws, please store them.

- **Power Supply**

The power cord is furnished together with the Chromaster 5440 fluorescence detector. Connect this power cord to the rear of the instrument.

(1) Isocratic System/Low-pressure Gradient System (stacked in two blocks)



Appended Fig. 1-5 Power Cable Connection Diagram

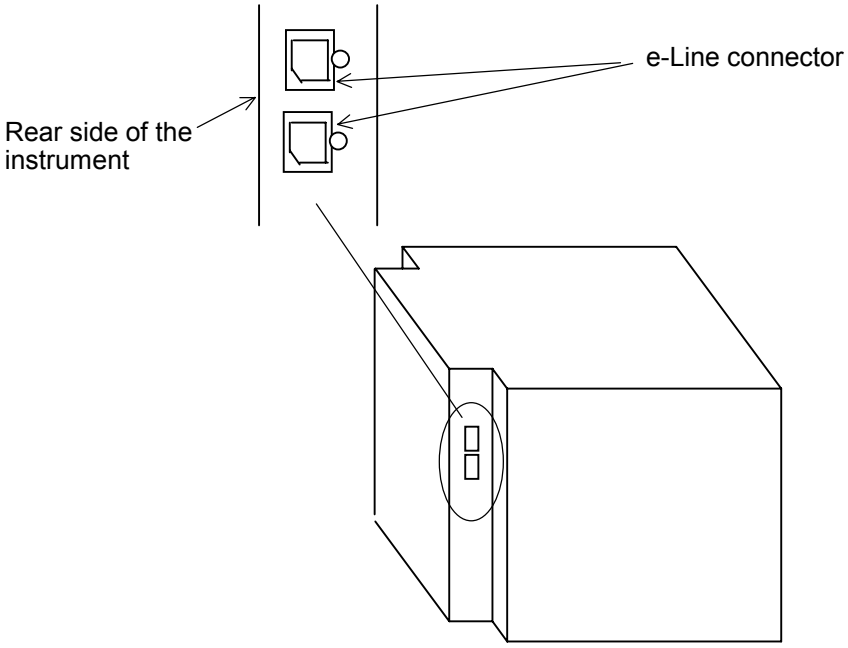
Appended Table 1-1 Cables to be Used

Connector cable 1)	P/N 892-6909 (attached to organizer)
Connector cable 3)	P/N 892-6911 (attached to organizer)
Connector cable 5)	P/N 892-6914 (separately available)
Connector cable 6)	P/N 892-6913 (separately available)
AC power cable	Use the power cable attached to each module unit.

Plug the power cables from the organizer and column oven into AC power outlets.
For the Chromaster 5110 pump, Chromaster 5210 autosampler and Chromaster 5410/5420/5430/5450 detector, plug the connector cable from the organizer into the power connector of each unit.

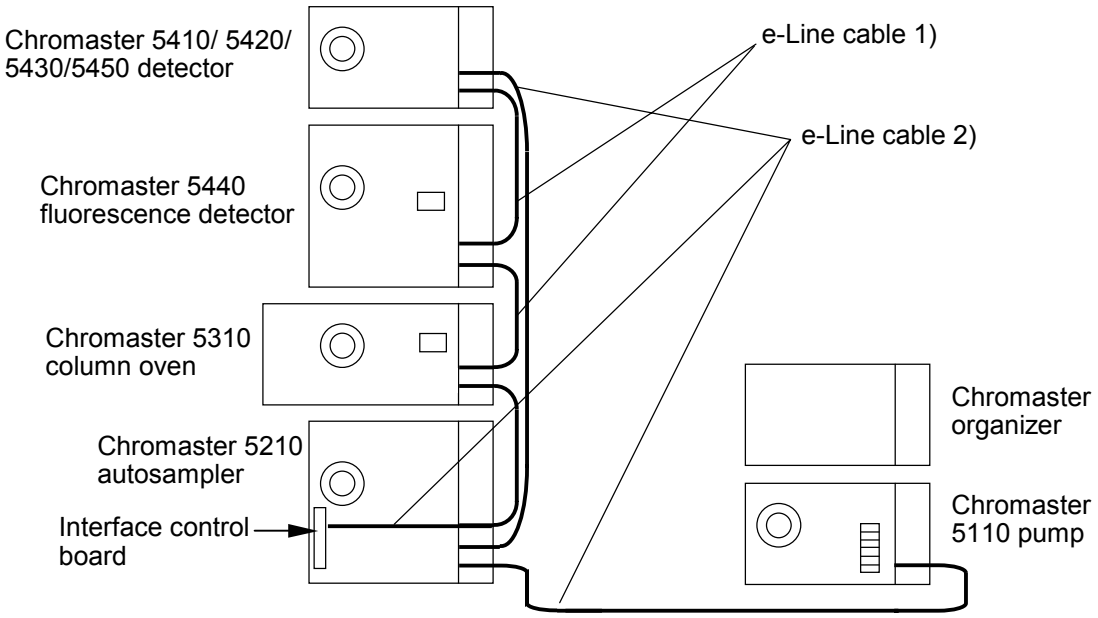
- **Wiring Arrangement**

In the Chromaster series, it is required to connect the e-Line cable between the instruments. On the left rear of each instrument, insert the e-Line cable into the e-Line connector.



Appended Fig.1-6 e-Line Connector on the Rear of Instrument

(1) Isocratic System/Low-pressure Gradient System (stacked in two blocks)



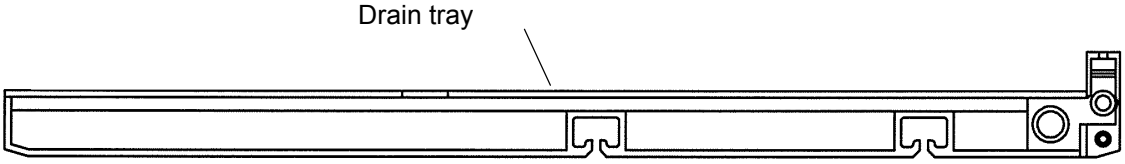
Appended Fig. 1-7 e-Line Cable Connection

Appended Table 1-2 Cables to be Used

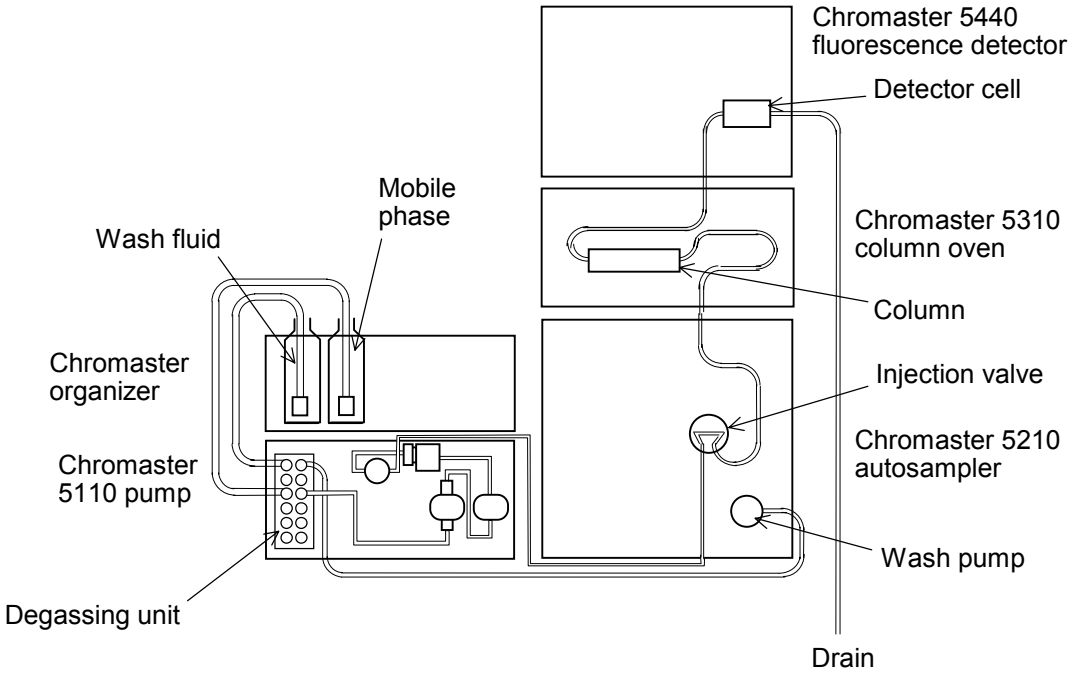
e-Line cable 1) (50 cm)	P/N 890-6105 (attached to each unit)
e-Line cable 2) (80 cm)	P/N 892-6107 (attached to autosampler, fluorescence detector and interface control PC board)

- **System Tubing**

In the Chromaster series, the inlet tube up to the pump and drain tube are fastened to the right/left side face of each unit with tube clamps. And the tubes are connected from the pump to the autosampler, column and detector through the central hole of each module unit.



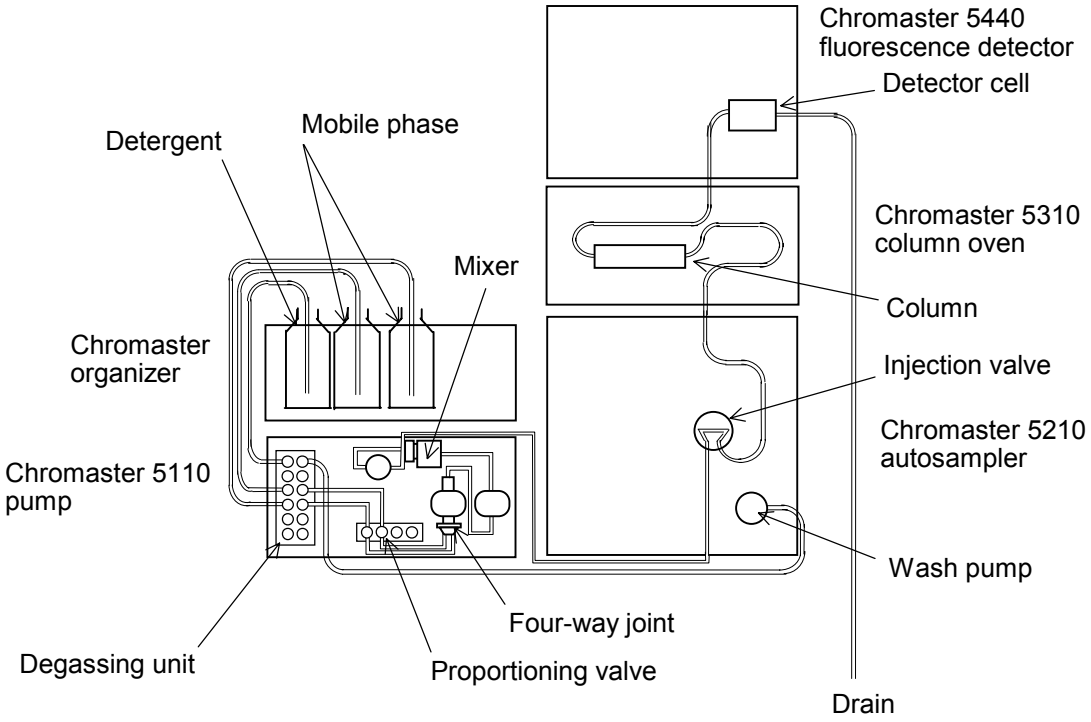
(1) Isocratic System



Appended Fig. 1-8 Isocratic System

Connect the inlet tube of the mobile-phase container to the IN port of the degassing unit. Connect the OUT port of the degassing unit to the inlet of the pump. Connect the drain valve of the pump to port 1 of the injection valve of the autosampler. Connect port 2 of the injection valve to the column inlet. Connect the column outlet to the inlet tube of the detector cell. For detergent, provide connection to the three way solenoid valve of the syringe valve of the autosampler through the degassing unit.

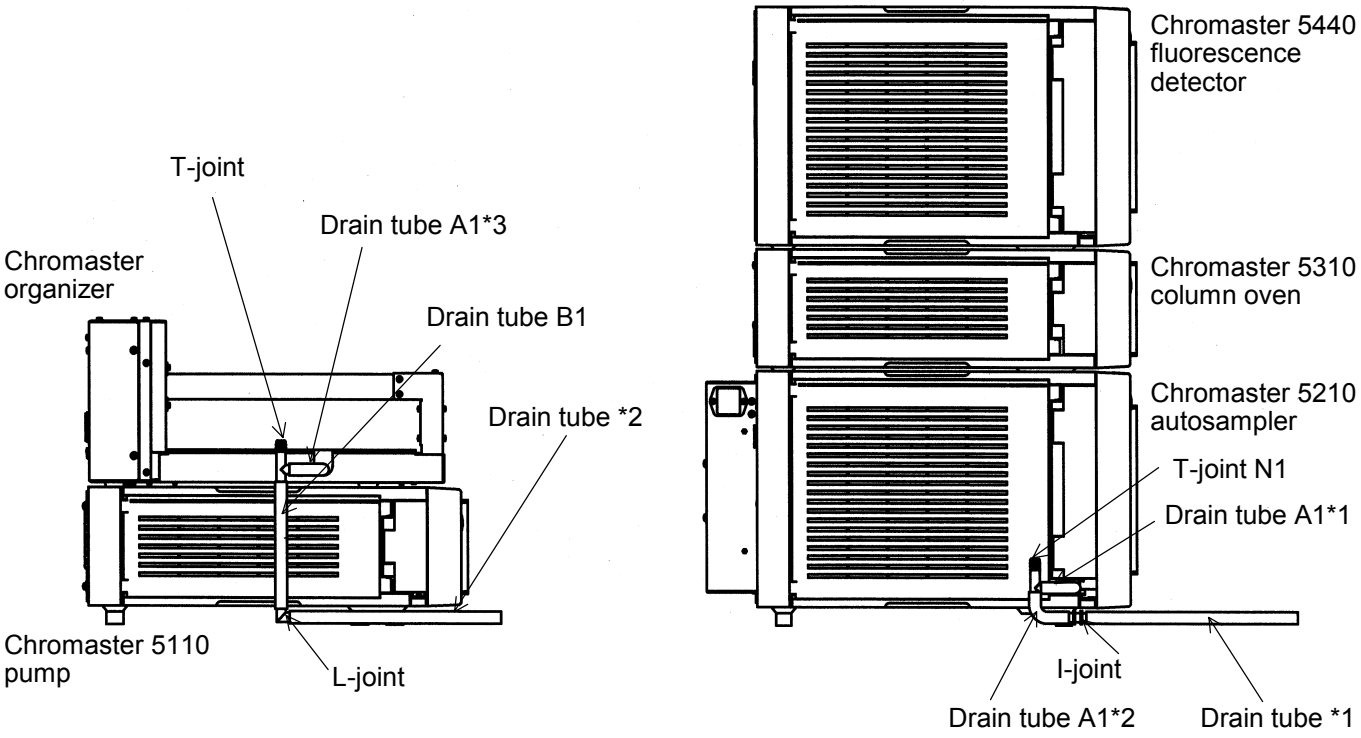
(2) Low-pressure Gradient System



Appended Fig. 1-9 Piping Arrangement for Low-pressure Gradient System

Connect the inlet tube of the mobile-phase container to the IN port of the degassing unit. Connect the OUT port of the degassing unit to the IN port of the proportioning valve. Connect the OUT port of the proportioning valve to the four-way joint.
Connect the mixer of the pump to port 1 of the injection valve of the autosampler. Connect port 2 of the injection valve to the column inlet. Connect the column outlet to the inlet tube of the detector cell. For detergent, provide connection to the three way solenoid valve of the syringe valve of the autosampler through the degassing unit.

- **Drain Tubing**



Appended Fig. 1-10 Tubing Diagram for Drain (when stacking module units in two blocks)

Appended Table 1-3 Drain Tubes to be Used

Drain tube B1	P/N 893-2875 (attached to organizer)
Drain tube A1*1*2	P/N 893-2872 (attached to autosampler)
Drain tube A1*3	P/N 893-2872 (attached to organizer)
Drain tube *1	P/N 080-3090 (attached to autosampler)
Drain tube *2	P/N 080-3090 (separately available)
T-joint	P/N 810-1362 (attached to organizer)
T-joint N1	P/N 890-3493 (attached to autosampler)
I-joint	P/N 893-2876 (attached to autosampler)
L-joint	P/N L369125 (attached to organizer)

- **GUI Controller**

The GUI controller is a touch panel type operation panel. This operation panel alone enables the user to control the respective modules.
For operation, refer to the instruction manual of the GUI controller.

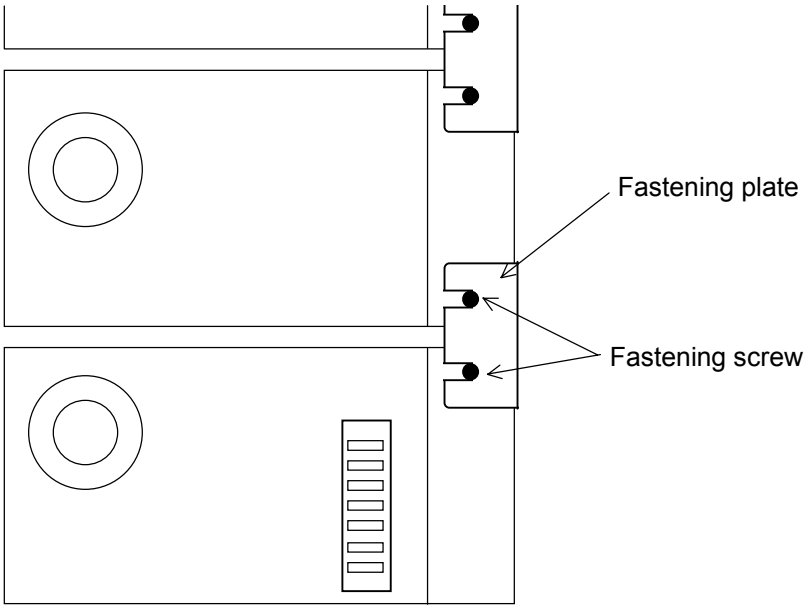
- **Fastening between Component Units**

CAUTION

Prevention of Instrument Tipover

Personal injury could be incurred if the instrument tips over. When installing the instrument, provide a proper means for fastening between module units.

On the rear of each module unit, a cabling cover is attached. The adjacent models are fastened with each other by attaching the fastening plate between the cabling covers.



Appended Fig. 1-11 Attachment of Cabling Cover

- **Assembly of Constant Temperature Flow Cell (Option)**

Chromaster 5440 fluorescence detector can incorporate the constant as an option.
The temperature switching equipment installed in the constant temperature flow cell keeps constant the temperature of the mobile phase and the sample which is poured into the flow cell. Therefore, change in sensitivity caused by environment temperature change can be reduced.

> **NOTE**: It is not permitted for the user to carry out installation at the time of delivery. For ensuring safety and high accuracy in operation of the instrument, installation of the instrument shall be carried out by qualified service personnel trained by the manufacturer or its authorized maintenance service agent.

(1) Turn off the power to the instrument.

(2) Remove the inlet tube connected to the bulkhead union of the standard flow cell.

(3) Loosen the retention screws to remove the standard flow cell.

(4) Connect the constant temperature flow cell connector.

(5) Install the constant temperature flow cell, and fasten it by tightening the retaining screws.

(6) Set up the constant temperature flow cell setting as use (Refer to section 3.5.2).

APPENDIX 2. Description on Contact Signal Communication

1. Outline

The following two types of contact signals are used in the Chromaster series.

(1) Contact signals (START, ERROR, BUSY) entering the e-Line connector.
These are contact signals having input/output functions that are used in common for each unit. These signals are respectively formed from the START (IN/OUT), ERROR (IN/OUT), and BUSY (IN/OUT) lines.

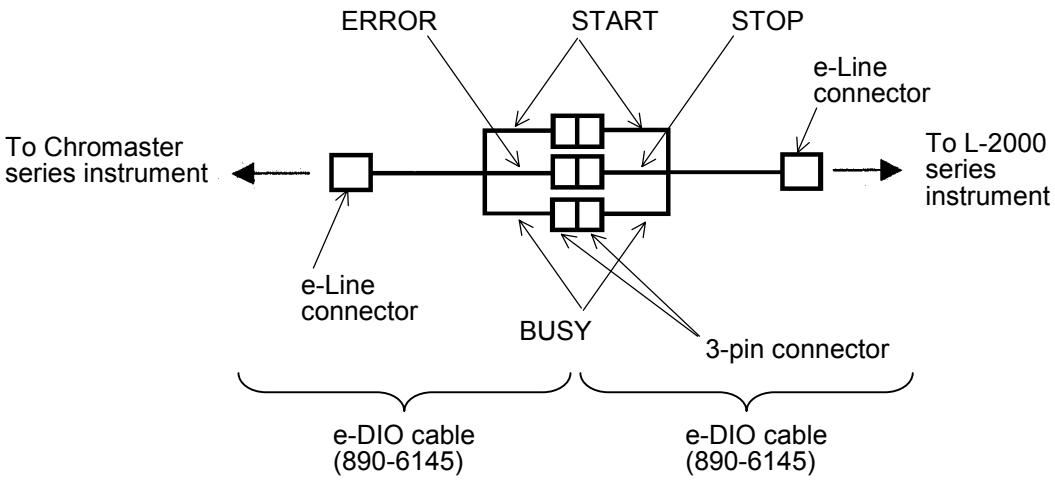
(2) Individual contact signals used by each unit.
These are contact signals that are input and output via 3-pin connector. Their names and functions vary with the unit. A name that indicates the function is given at each connector.
- Example of output contact signal: EVENT of pump
- Example of input contact signal: LAMP OFF IN of detector

2. Contact Signals Entering the e-Line Connector

Each unit has two e-Line connectors for connection at the rear of the main unit, and the signals of each unit in series via the e-Line cable, synchronism of the Chromaster series system can be easily achieved.
For obtaining synchronism with the L-2000 series and/or D-2500 by way of contact signals, use the cables listed below for the connection.

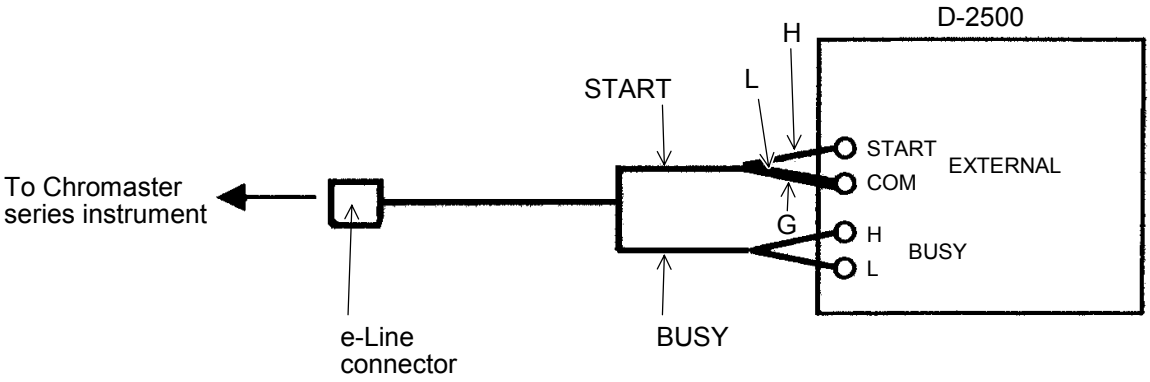
(1) Connection with L-2000 Series

Use the e-DIO cable (890-6145) for connection.



(3) Connection with Model D-2500

Use the e-DIO cable (890-6146) for connection.



Connect the START L and G terminals of the e-DIO cable (890-6146) to the EXTERNAL-COM terminal of the Model D-2500.

3. Individual Contacts of Each Unit

(1) Contact Signal Input Terminals

These are contact signal input terminals for control using contact signals from an external switch, relay etc. Any of the signals is activated by shorting the terminal for 0.1 second or longer. The input circuit is shown in Fig. 3.

(2) Contact signal Output Terminals

These are contact signal input terminals for control using contact signals of an external unit. The output circuit is shown in Fig. 4. The rating of contacts used is 12 V, 0.1 A. Make sure the load connected does not exceed this rating.

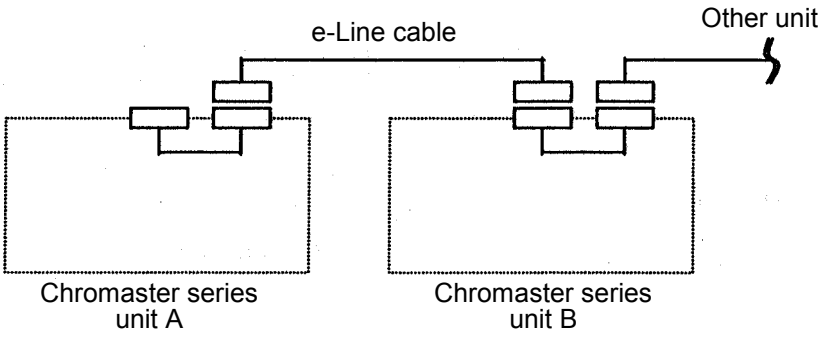


Fig. 1 e-Line Cable Connection

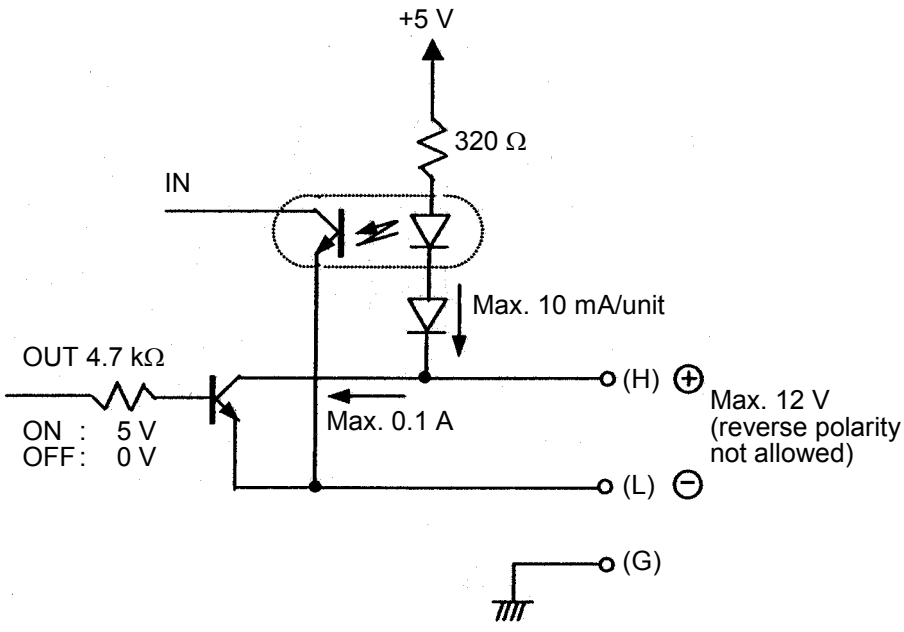


Fig. 2 e-Line Contact Circuit Configuration

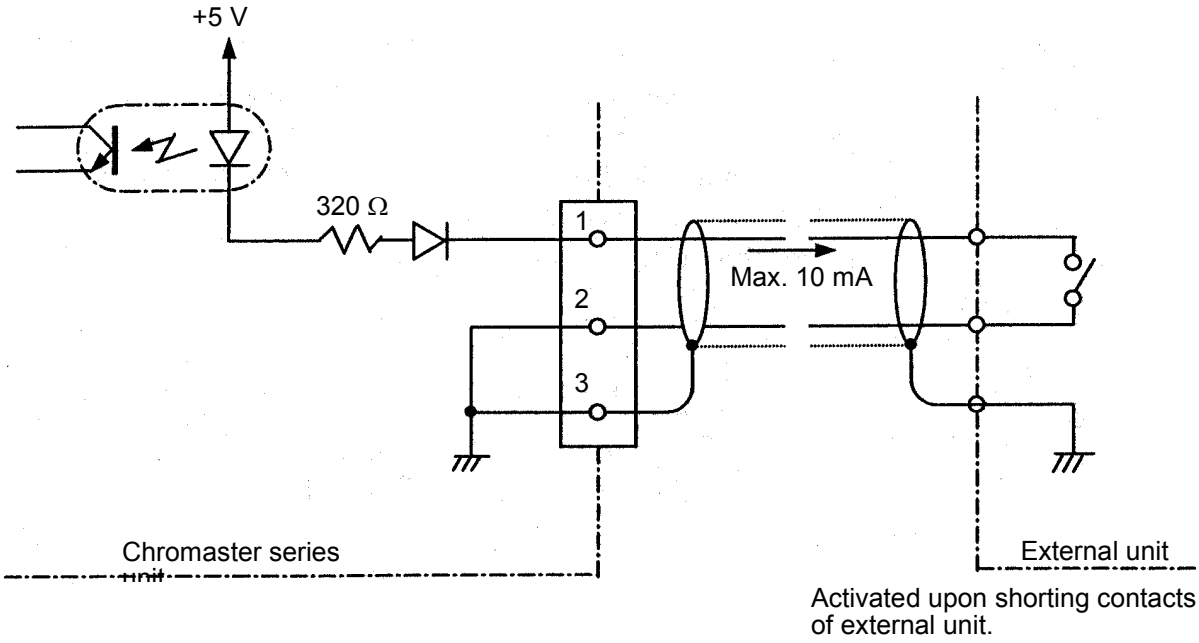


Fig. 3 Contact Signal Input Circuit

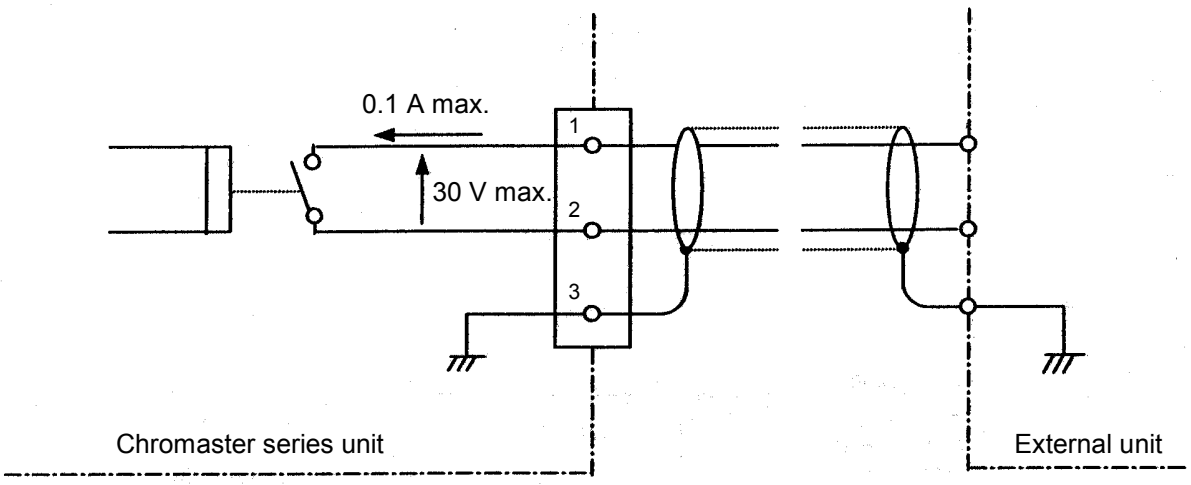


Fig. 4 Contact Signal Output Circuit

APPENDIX 3. GLOSSARY

Initial screen .....After power on, the initial screen appears upon completion of initialization.

Auto zero [A/Z].....Absorbance is electrically adjusted to zero to cancel insignificant parts of data. In common analytical practice, perform auto zero adjustment immediately before or after the start of operation.

Auto zero in .....The external contact signal can be input for auto-zero adjustment.

Off Set .....On output, a preset input signal value is added to an actually measured value. This function is particularly useful when the baseline varies on the negative side.

Diffusion plate.....A quartz plate. Used for diffusion of excitation beam.

Xenon Lamp .....Used for fluorescence measurement.

Key Lock.....This protective function prevents an erroneous key input during operation of the instrument.

GLP .....The confidence function is used to check the status of instrument.

Fluorescence .....A kind of luminescence, which is emitted from a sample when a stimulating excitation beam is given to it.

Emission (Fluorescence) intensity .....Unit of fluorescence (Relavive intensity)

Emission (Fluorescence) wavelength ..A particular wavelength of fluorescence emission caused by excitation.

3^{rd}-order light ..... A spectral peak (a kind of scattered light) which appears at a wavelength of 3 times the level of excitation intensity. In a common arrangement, a filter is used to remove or cut off the 3rd-order scattered light.

Scattered light.....Raman scattered light, 2^{nd}-order light, and 3^{rd}-order light.

Output range .....Used to determine the magnitude of output signal to such an external device as data processor.

Scan .....Means a sequential shifting operation of monochromator wavelength for spectral measurement.

Stokes law .....The law states that the wavelength of a fluorescent emission is always longer than the excitation wavelength.

Time Program.....Used to adjust such measurement parameters as detection wavelength according to measurement time.

e-Line .....Digital network line dedicated for analytical system.

Drain port.....Equipped for allowing liquid leaked from the flow cell/joint to flow to an external waste bottle.

2^{nd}-order light.....A spectral peak (a kind of scattered light) which appears at a wavelength of 2 times the level of excitation intensity. In a common arrangement, a filter is used to remove or cut off the 2nd-order scattered light.

Full scale .....Used to determine the magnitude of output to such an external device as data processor (chromato-integrator).

Processor .....The terminal for analog output to the data processor.

Flow Cell.....Contains a sample for measurement.

Photomultiplier.....Used to detect fluorescence emission.

Marker in .....The external contact signal can be input to provide marking on record.

Raman scattering .....In Raman effect, a kind of scattered light appears on the side of wavelength slightly longer than excitation wavelength.

Raman spectrum .....Scattered light spectrum produced from Raman effect.

Lamp energy .....Represents the intensity of lamp radiation. This value is used as an approximate value of lamp service life.

Lamp-off in .....The external contact signal can be input for turning off the light source lamp.

Lamp turn-on count .....Indicates the number of times the light source lamp has been turned on.

Lamp turn-on cumulative time.....Indicates a cumulative total time of lamp turn-on periods.

Ex (Excitation wavelength) .....Used for exciting a sample.

Recorder (RECORDER).....Used for analog output to a recorder.

Logbook.....Means the information containing records of instrument operating conditions.

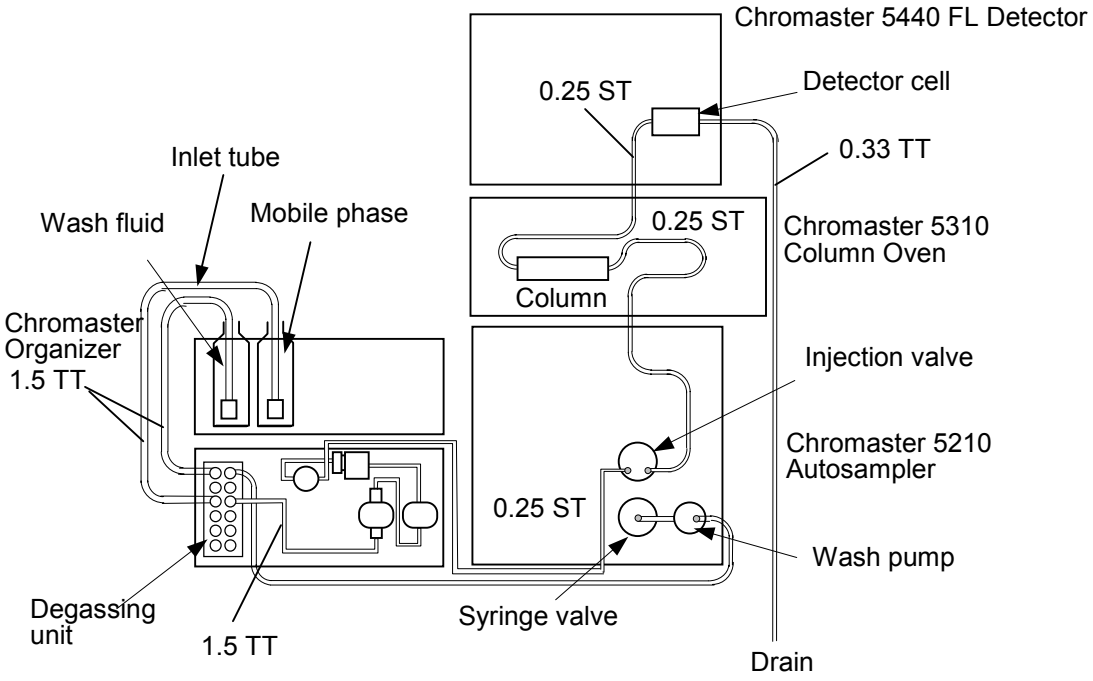
Utility .....Used to set up operating conditions of the instrument.

FLOWPATH FIGURES

General flowpath figures are shown below. Please select a plumbing according to your system configuration and the purpose.

ST :Stainless-steel pipe
TT :Teflon tube
Numbers :Inside diameter.

1. Isocratic System



2. Low Pressure Gradient System