206-97040A
Feb. 2008

INSTRUCTION MANUAL
System User's Guide
UV-1800
SHIMADZU
SPECTROPHOTOMETER

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

SHIMADZU CORPORATION
KYOTO JAPAN

ANALYTICAL & MEASURING INSTRUMENTS DIVISION

This page is intentionally left blank.

Introduction

Read this manual thoroughly before using the instrument.

Thank you for purchasing this instrument. This manual describes installation, operation, hardware validation, cautions for use, and details on accessories and options. Read the manual thoroughly before using the instrument. Use the instrument in accordance with the manual's instructions. Keep this manual for future reference.

IMPORTANT

- If the user or usage location changes, be sure this Instruction Manual is always kept together with the product.
- If this documentation or the warning labels on the instrument become lost or damaged, promptly obtain replacements from your Shimadzu representative.
- To ensure safe operation, read the Safety Instructions before using the instrument.
- To ensure safe operation, contact your Shimadzu representative if product installation, adjustment, or re-installation (after the product is moved) is required.

Safety Instructions

- To ensure safe operation of the instrument, read these Safety Instructions carefully before use.
- Observe all of the WARNINGS and CAUTIONS described in this section. They are extremely important for safety.

In this manual, warnings and cautions are indicated using the following conventions:

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

The symbol used in this manual is as follows:

	Indication of location for related information in the instruction manuals

Installation Site Precautions

WARNING

When using flammable and toxic samples, be sure to install ventilation equipment at an installation site.

CAUTION

- The weight of this instrument is 15 kg. During installation, consider the entire weight combined with other instruments.

  The lab table on which this instrument is installed should be strong enough to support the total weight of this instrument. It should be level stable, and have depth of at least 600 mm.
  Otherwise, the instrument could tip over or fall off the table.

- Avoid installation sites that are exposed to corrosive gases or excessive dust.

  These adverse conditions may be detrimental to maintaining instrument performance and may shorten its service life.

Installation Precautions

To ensure safe operation, contact your Shimadzu representative for installation, adjustment, or re-installation after moving the instrument to a different site.

WARNING

- Take measures to prevent the instrument from falling in the event of earthquake or other disaster.

  Strong vibrations could cause the instrument to fall over, resulting in injury.

- The power supply voltages and power consumptions of this instrument are listed below. The power supply voltage of the instrument is indicated on the label on the side of the instrument. Connect the instrument only to a power supply of the voltage indicated; otherwise, fire or electric shock could result. Check that the power supply voltage is stable and that its current capacity is sufficient to operate all the components of the system. If not, the instrument will not operate at its rated performance.

Power Supply Voltage (Indicated on the instrument)	Power Consumption	Frequency
AC100 V-120 V and AC220 V-240 V (100-120 V and 220-240 V ~)	140 VA	50-60 Hz

- Ground the instrument

  Grounding is necessary to prevent electric shock in the event of an accident or electrical discharge, and important for ensuring stable operation.

- Do not place heavy objects on the power cord, and keep any hot items away.

  The cord could be damaged, resulting in fire, electrical shock or malfunction. If the cord becomes damaged, contact your Shimadzu representative immediately.

- Do not modify the cord in any way. Do not bend it excessively or pull on it.

  The cord could be damaged, resulting in fire, electrical shock or malfunction. If the cord becomes damaged, contact your Shimadzu representative immediately.

Operation Precautions

WARNING

- Always wear protective gloves when handling any toxic or biologically infectious samples.
- Do not use flammable sprays (hair sprays, insecticide sprays, etc.) near the instrument.
  They could ignite and cause a fire.

CAUTION

- Do not use mobile phones near the instrument.
  They could damage data.

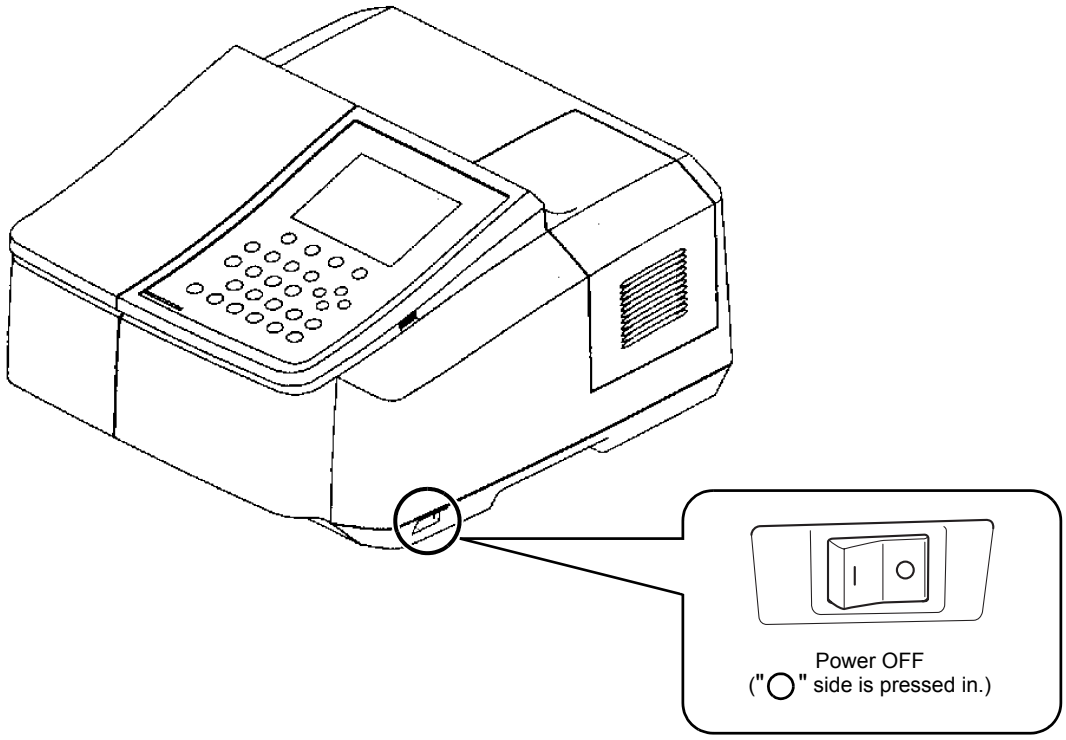
Precautions for Instrument Inspection, Maintenance, Adjustment and Care.

WARNING

- Unplug the instrument before inspection, maintenance, or parts replacement.
  Otherwise, electrical shock or short-circuit accidents could occur.
- Never remove the main cover.
  This may cause injury or malfunction of the instrument.
  The main cover does not need to be removed for routine maintenance, inspection and adjustment.
  Have your Shimadzu representative perform any repairs requiring removal of the main cover.
- If the power cord plug gets dusty, remove the plug from the power outlet and wipe away the dust with a dry cloth.
  If dust is allowed to accumulate, fire could result.
- Replacement parts must be of the specifications given in "1.1 UV-1800 Configuration" and "6.2 Maintenance Parts".
  Use of any other parts may result in instrument damage and malfunction.
- If any water gets onto the instrument, wipe it away immediately to prevent rust. Never use alcohol or thinner solvents for cleaning the instrument.
  They could cause discoloration.
- Dispose waste liquid properly and in accordance with the instructions of your administrative department.

Emergency Operation

In an emergency situation, press the "◯" side of the power switch located on the right side bottom of the UV-1800 to turn OFF the instrument.



Operation at Power Outage

In case of electrical failure, perform the following operations:

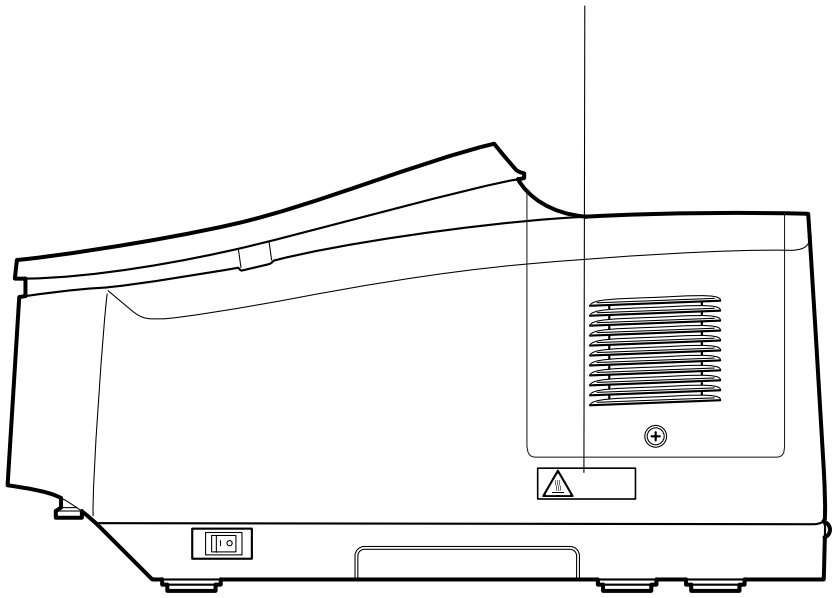
1. Press the "◯" side of the power switch located on the right side bottom of the UV-1800 to turn OFF the instrument.
2. After the power comes back on, start up the UV-1800 normally by following "Installation Precautions" and "Operation Precautions".

Warning Labels

For safety operation, warning labels are affixed where special attention is required.
Should any of these labels peel off or be damaged, obtain replacements from Shimadzu Corporation.

(Right side)

High Temperature
Light source and light source chamber are very hot. When replacing the light source, be sure to turn OFF the power and check that the light source is completely cooled.



Product Warranty

Our company provides a warranty on this product, as stated below.

Details

1. Warranty Period: Please consult your Shimadzu representative for information about the extent of the warranty.

2. Warranty Description: If failure occurs for reasons attributable to our company during the warranty period, our company will provide repairs or the replacement of parts without charge (including USB dongles). However, we may not be able to provide identical products in the case of products such as PCs, and their peripherals and parts, which have a short lifespan in the market.

3. Warranty Exceptions: The failures caused by the following events are excluded from the warranty, even if they occur during the warranty period.

1) The product is handled in an improper way.
2) Repairs or modifications are performed by companies or people other than our company and our designated companies.
3) This product was used in combination with hardware or software other than those designated by our company.
4) Device failures and damage to data and software, including the basic software, that are caused by computer viruses.
5) Device failures and damage to data and software, including the basic software, that are caused by power failures, including power outages and sudden drops of voltage.
6) Device failures and damage to data and software, including the basic software, that are caused by powering off the device without the proper shutdown procedure.
7) Failures caused by reasons other than the device itself.
8) Failures caused by use in harsh environments, such as in high temperature or humidity, corrosive gas, or vibration.
9) Failures caused by fires and earthquakes or any other act of providence, contamination by radio active substances and hazardous substances, or any other force majeure event including wars, riots, and crimes.
10) Problems occur because the device is transferred or transported after installation.
11) Expendable items and parts
Note: Recording media such as floppy disks and CD-ROMs are considered expendables.

* If there is a document such as a warranty attached to the product, or there is a separate contract agreed upon that includes warranty conditions, the rules stated in those documents shall be followed.
Warranty periods for products with special specifications and systems are provided separately.

After-Sales Service and Replacement Parts Availability

After-Sales Service

If any problem occurs with this instrument, inspect it and take appropriate corrective action as described in the Section "Troubleshooting". If the problem persists, or symptoms not covered in the Troubleshooting section occur, contact your Shimadzu representative.

Replacement Parts Availability

Replacement parts for this instrument will be available for a period of seven (7) years after the discontinuation of the product. Thereafter, such parts may cease to available. Note, however, that the availability of parts not manufactured by Shimadzu shall be determined by the relevant manufacturers.

Disposal Precautions

■ Disposal of UV-1800

When disposing of the UV-1800, contact your Shimadzu representative.
Otherwise, be sure to dispose of the product separately from general garbage, in compliance with the applicable laws or regulations in the country or region where it is used.

■ When disposing of deuterium (D2) lamp

If the deuterium (D2) lamp should be broken or its life is finished, dispose of the lamp separately from general garbage. When disposing of the deuterium (D2) lamp supplied from Shimadzu Corporation, select a method which will not adversely influence the environment or human body, or ask a special disposal dealer for advice or assistance.
The materials of deuterium (D2) lamp are as follows.

- Metals (Tungsten)
- Quartz glass
- Ceramic
- Plastic

Action for Environment (WEEE)

To all users of Shimadzu equipment in the European Union:

WEEE Mark

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

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

With your co-operation we are aiming to reduce contamination from waste electronic and electrical equipment and preserve natural resource through reuse and recycling.
Do not hesitate to ask Shimadzu service representative, if you require further information.

Regulatory Information

For Europe:
The product complies with the requirements of the EMC Directive 2004/108/EC and Low Voltage Directive 2006/95/EC.

Product Name:	UV-Visible Spectrophotometer
Model Name:	UV-1800
Manufacturer:	SHIMADZU CORPORATION ANALYTICAL & MEASURING INSTRUMENTS DIVISION
Address:	1, NISHINOKYO-KUWABARACHO, NAKAGYO-KU, KYOTO, 604-8511, JAPAN
Authorized Representative in EU:	Shimadzu Europa GmbH
Address:	Albert-Hahn-Strasse 6-10, 47269 Duisburg, F.R. Germany

CONTENTS

Chapter 5 Troubleshooting

Chapter 6 Reference

Chapter 1 General

CONTENTS

1.1 UV-1800 Configuration

This instrument is shipped with the following items. Upon opening the shipping container, confirm that all of the listed parts are accounted for in your shipment.

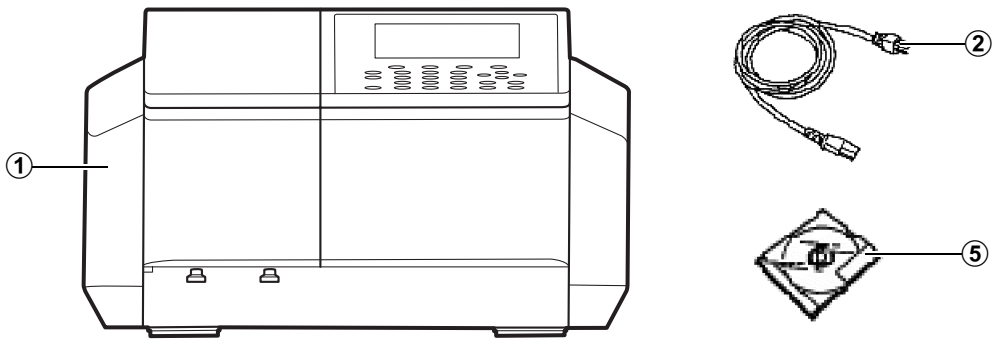


Fig. 1.1 Standard Contents

Table 1.1 Standard Contents

	Check	Description	Part No.	Qty.
①		Spectrophotometer	206-25201-91	1
②		AC Power Cable	071-60816-12	1
③		UV-1800 Instruction Manual-System User's Guide (This manual)	206-97040	1
④		UV-1800 Instruction Manual-Operation Guide	206-97042	1
⑤		UVProve Software (Install CD)	206-21439-91	1
⑥		UVProve Tutorial (Instruction Manual)	206-94459	1
⑦		Shimadzu User Authentication Tool Instruction Manual	223-10410	1

1.2 Components

1.2.1 UV-1800 Main Body, Front and Top Views

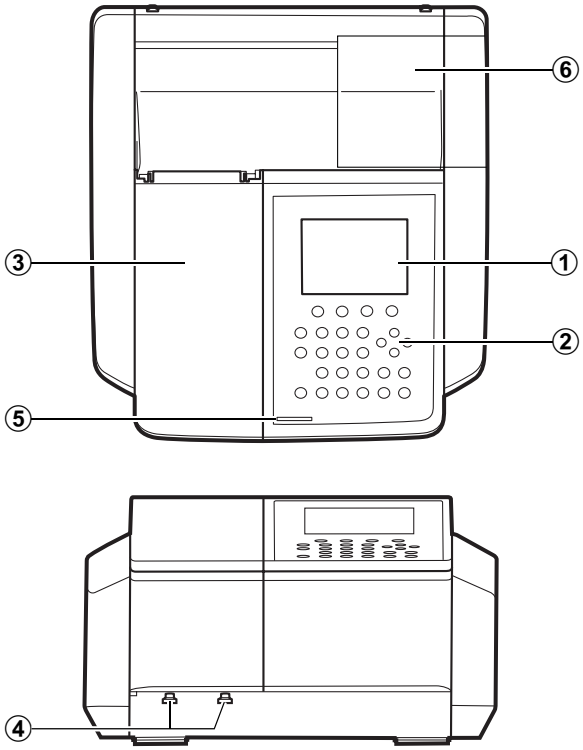


Fig. 1.2 Front and Top Views of UV-1800

No.	Name	Description
①	LCD	This displays the operation menus and measurement results.
②	Keypad	This is the input component for giving operation commands and numeric values to the instrument, etc. ☞ "1.2.5 Keypad"
③	Sample Compartment Cover	Open/close this cover when setting the measured sample. ☞ "1.2.4 Sample Compartment"
④	Sample Compartment Set Screws	These are screws for fastening the sample compartment unit. ☞ "4.2 Removing/Installing the Sample Compartment Unit (Standard)"
⑤	LED	This lights when the power to the unit is ON.
⑥	Light Source Compartment Cover	This is the cover of the light source compartment. Open/close this cover when replacing the light source lamp. ☞ "3.4 Replacing the Light Source"

1.2.2 UV-1800 Main Body, Left Side View

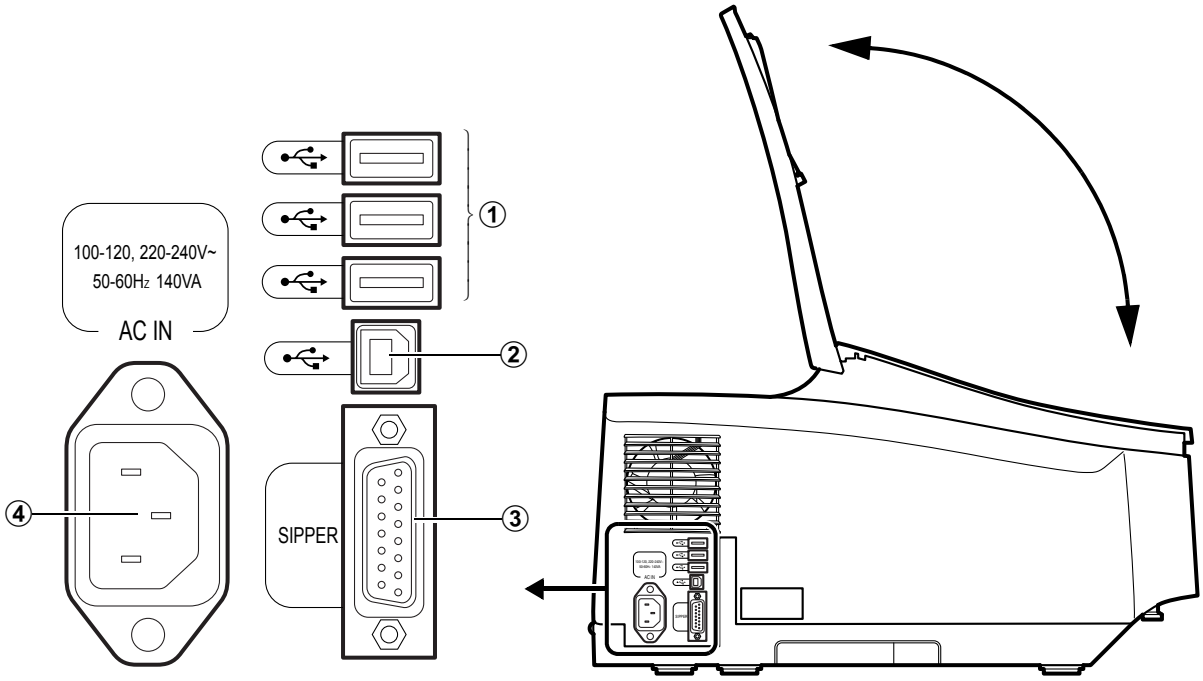


Fig. 1.3 Left Side View of UV-1800

No.	Name	Description
①	USB Connector	You can use these connecters for any of printer, or USB memory stick. You can also connect special accessories described below. In such cases, however, it is necessary to purchase separately and connect the designated USB conversion adaptor to each accessory. • 6-cell electronic temperature control cell positioner CPS-240A/B ⇨ USB adaptor for CPS (P/N 206-25234-91) • Auto sample changer ASC-5 ⇨ USB adaptor for ASC (P/N 206-25235-91) For installation and connection procedures, refer to the instruction manual of each accessory.
②	USB Connector (for PC)	This is the connector for connecting PC during external control operation. ☞ Operation Guide, "17.1 Connecting to a PC"
③	Optional Unit Connector	This is the connector to connect the "Sipper 160" or "Syringe sipper" (special accessories). For installation and connection procedures, refer to the instruction manual of each accessory.
④	AC Power Connector	Connect the enclosed AC power cable to the supply power from an AC electrical outlet. ☞ "2.2 Connecting Power"

1.2.3 UV-1800 Main Body, Right Side View

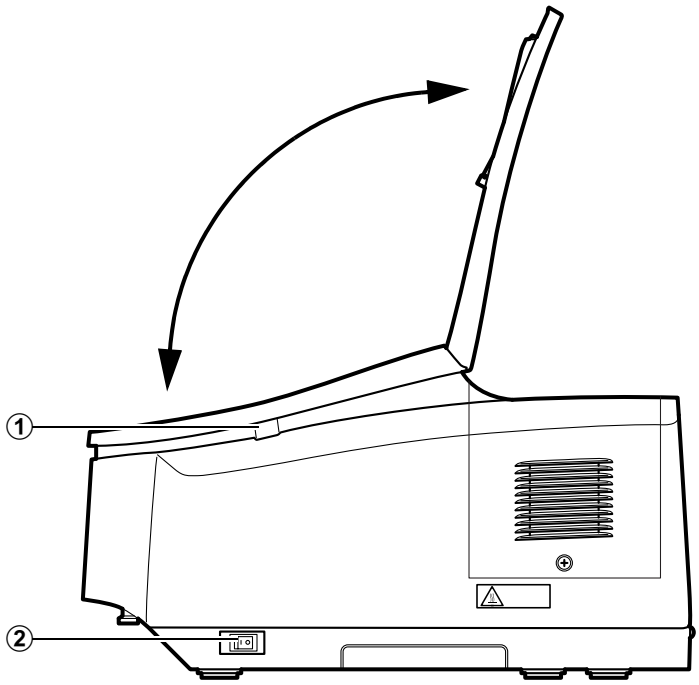


Fig. 1.4 Right Side View of UV-1800

No.	Name	Description
①	USB Connector	Plug in the USB memory to this connector.
②	Power Switch	Use this switch to turn ON/OFF the instrument. Press the "I" side on the switch to turn ON; press the "O" side to turn OFF.

1.2.4 Sample Compartment

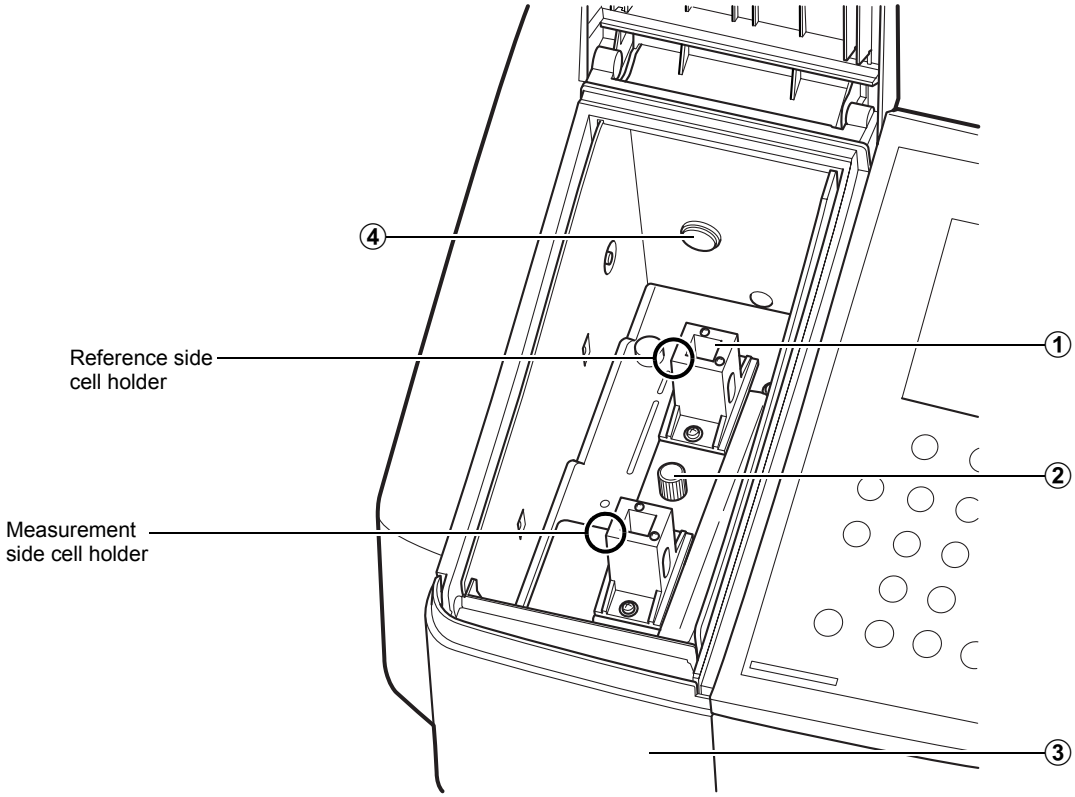


Fig. 1.5 Sample Compartment

No.	Name	Description
①	Cell Holder	The cell holder for the rectangular 10 mm light path cells has one sample cell holder and one reference cell holder. ☞ "6.5 List of Cells"
②	Cell Holder Set Screws	The cell holder can be easily removed by loosening the cell holder set screws. ☞ "4.1 Removing/Installing the Cell Holder"
③	Sample Compartment Front Cover	When using a flow cell, etc., holes are needed to pass tubing, etc. through. Therefore, this "Sample Compartment" can be removed and exchanged with different types of front panels. ☞ "4.3 Removing/Installing the Sample Compartment Front Cover"
④	Multi-cell Holder Drive Connector	This is the connector for connecting the control cables for multi-cell sample compartment and 8/16-cell micro multi cell holder (MMC-1600) (special accessories).

1.2.5 Keypad

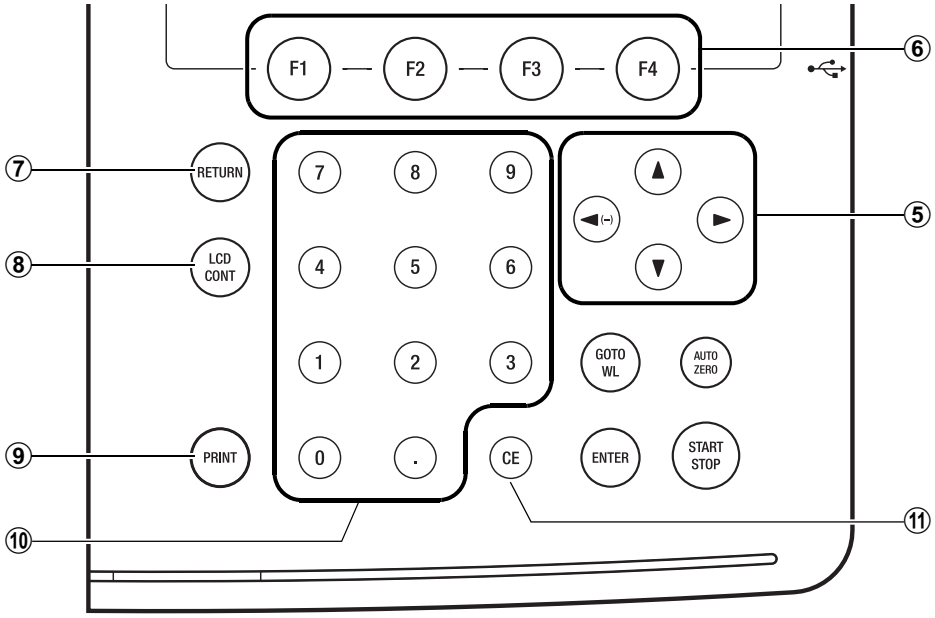


Fig. 1.6 Keypad

No.	Name	Description
①	START/STOP	This is the key for starting and stopping measurement once the parameter setting has been completed.
②	AUTO ZERO	When you press this key, the absorbance (transmittance) at the current wavelength will automatically be set to 0Abs (100 %T). Make sure that prior to sample measurement a blank cuvette is placed in both sample and reference sides.
③	GOTO WL	This is the key that is used to change the current wavelength.
④	ENTER	When you enter a value, press this key after the value to set the entering value.
⑤	◄(–) ► ▲ ▼	Use these keys to move the cursor on the screen upward/downward, or left/right. The left cursor key can also be used to enter a negative (–) value when entering numeric values.
⑥	F1 F2 F3 F4	These are the keys corresponding to the functions that are displayed at the bottom of the screen.
⑦	RETURN	Use this key to display to the previous screen.
⑧	LCD CONT	Use this key to adjust the screen contrast. Using cursor keys ▲ ▼ while holding down this key changes the contrast.
⑨	PRINT	Use this key to output a hard copy of the screen.
⑩	. 0 - 9	Use these keys to enter numeric values.
⑪	CE	Use this key to clear a numeric value entry error. When you press this key, the numeric value which has been entered will be cleared and then you may reenter the appropriate value.

1.2.6 Light Source Compartment

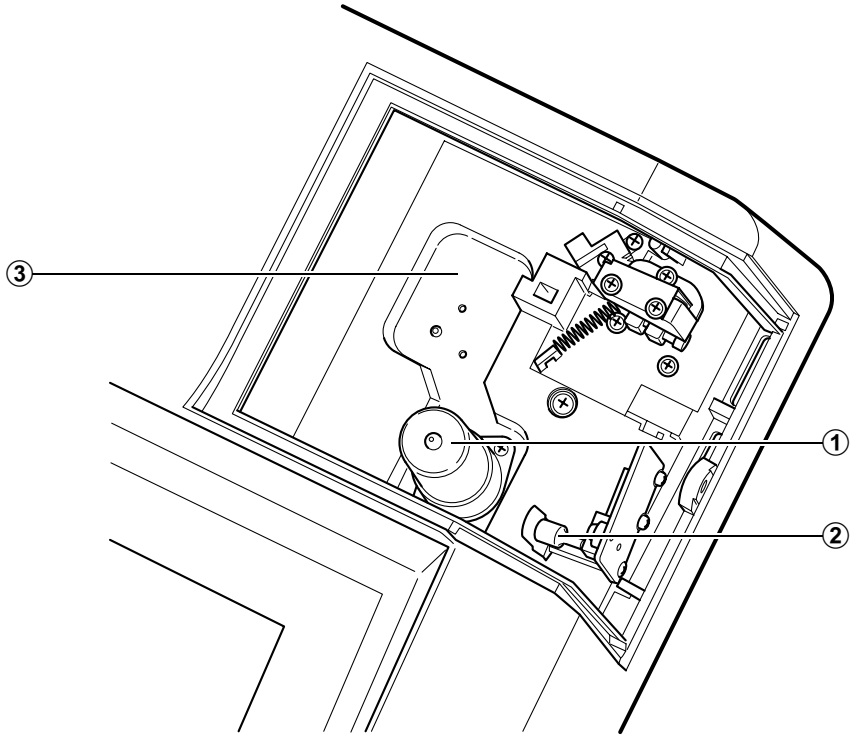


Fig. 1.7 Light Source Compartment

No.	Name	Description
①	Deuterium Lamp (D2 Lamp)	This is the ultraviolet range (190 nm to light source switch wavelength*) light source. For the D2 lamp replacement procedure, refer to "3.4 Replacing the Light Source".
②	Tungsten Halogen Lamp (WI Lamp)	This is the visible & near infrared range (light source switch wavelength* to 1100 nm) light source. For the WI lamp replacement procedure, refer to "3.4 Replacing the Light Source".
③	3rd light source (on installation site)	You can install a light source other than the standard lamps or the introduction unit of external light source.

* Light source switch wavelength
The light source switch can be set anywhere in the range from 295 nm to 364 nm in 0.1 nm increments. For details, refer to the Operation Guide, "12.2 Explanation for Setting Instrument Parameters", [4. Light Source Switching Wavelength].

Chapter 2 Installation

CONTENTS

2.1 Installation Site

2.1.1 Installation Requirements and Preparation

To use the UV-1800 properly and safely, install the instrument in an appropriate location that meets the following requirements.

WARNING

When using flammable and toxic samples, be sure to install ventilation equipment at installation site.

CAUTION

- DO NOT install the UV-1800 in an environment filled with dust or corrosive gas.

  These conditions will adversely affect the durability and performance of the UV-1800.

- DO NOT install the UV-1800 near an instrument that produces strong magnetic fields.

  Magnetic fields may adversely affect the accurate performance of the instrument. Filters may be added to the power supply lines to reduce any electrical noise.

- To ensure instrument performance, the installation site should meet the following requirements.
  - The ambient temperature must be between 15 °C and 35 °C with minimal temperature variations.
  - Air currents from air conditioners and heating systems must be avoided.
  - Exposure to direct sunlight must be avoided.
  - The site must be free from vibration.
  - Humidity must remain between 35 % and 80 %. No condensation.
    (Humidity must be maintained at under 70 % at ambient temperatures over 30 °C.)

2.1.2 Installation Space

CAUTION

- The weight of the UV-1800 is 15 kg. When selecting the installation location, take into account the total weight of the UV-1800 and other devices.

  Use a desk or stand for installation that can sufficiently support the total instrument weight, having a flat and stable surface with at least 600 mm depth. If these requirements are not satisfied, the instrument may tip over or fall down, causing an accident.

- Ensure that there is at least 100 mm of clearance between the left side of the UV-1800 and the wall.

  The power supply unit and the light source unit cooling fan are located on the left side of the instrument. If location specifications are not met, the air cooling system with fan may work improperly, overheating the instrument and deteriorating its performance.

The dimensions of the UV-1800 are as given in the figure below.

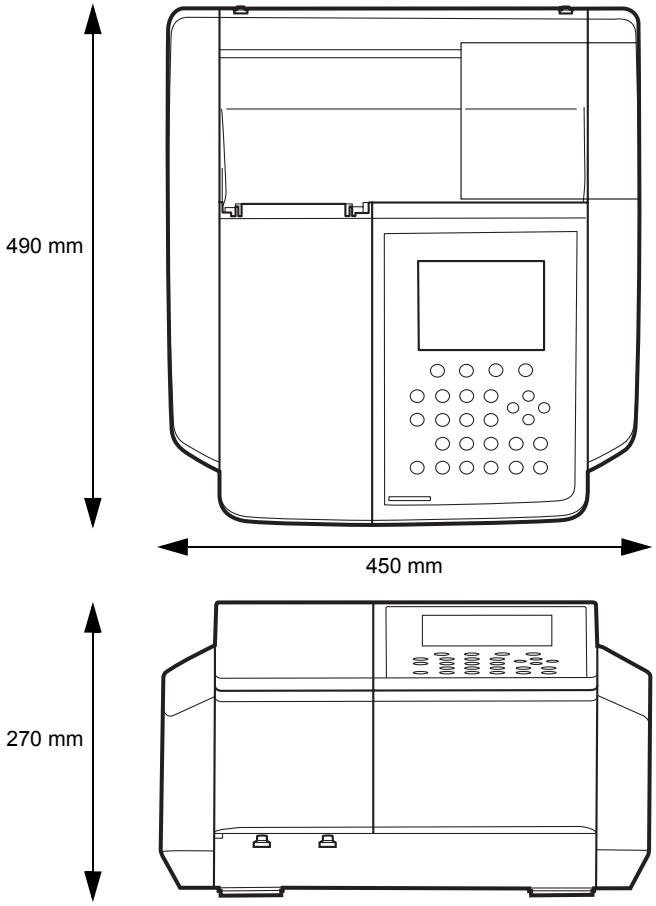


Fig. 2.1

2.2 Connecting Power

2.2.1 Verifying Power Supply Voltage

WARNING

The power supply voltage is indicated on the power supply connector on the side of the instrument. Be sure to connect the power supply that meets the indicated specifications.
Operating the UV-1800 at supply voltages other than the specified could cause fire, electric shock, and instrument malfunction.

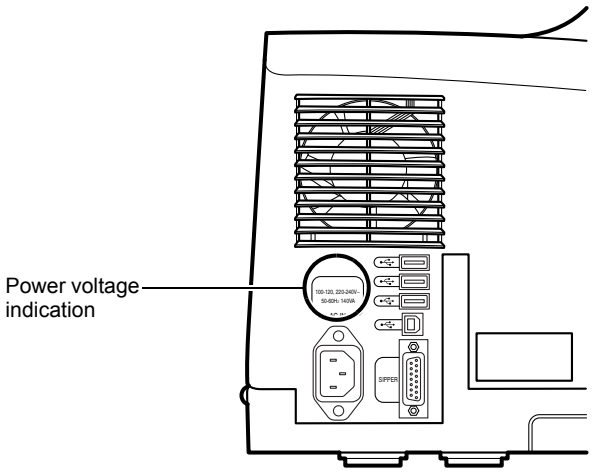


Fig. 2.2

The following table shows the power supply voltage, power consumption, and frequency of the UV-1800.

Power Supply Voltage (Indication on product nameplate)	Power Consumption	Frequency
100 V - 120 V AC, 220 V - 240 V AC (100-120, 220-240 V -)	140 VA	50 - 60 Hz

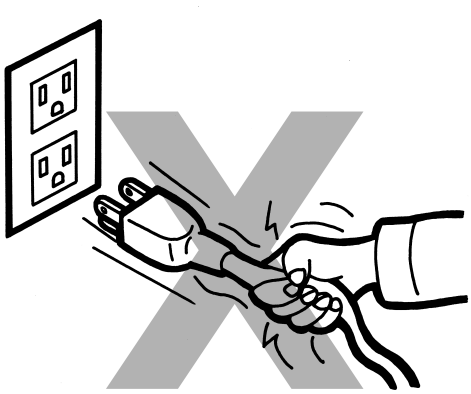
Verify that the outlet to be used has a sufficient power capacity. Insufficient power capacity may cause blackouts and voltage drops, affecting other instruments that use the same power supply.
The range of the allowable voltage fluctuation is within ±10 %. If the fluctuation exceeds 10 %, be sure to use a voltage stabilizer.

2.2.2 Connecting to the Power Outlet

WARNING

Handle the power supply cable carefully. Follow the warnings below to avoid cable damage and the consequent risk of fire, electric shock, and instrument malfunction.

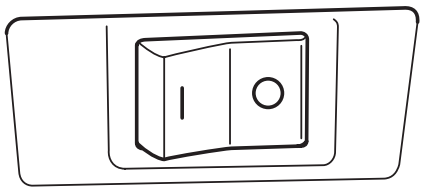
- Do not place heavy objects on the power supply cable.
- Keep thermal appliances away from the power supply cable.
- Do not modify the power supply cable.
- Do not forcefully bend or stretch the power supply cable.
- Hold the plug when inserting in and removing the cable from the power outlet.



Should the power supply cable become damaged, contact your Shimadzu representative.

CAUTION

Verify that the power switch of the UV-1800 is OFF (i.e., "O" is pressed in) before connecting the electric plug to the outlet.



1 Insert the connector of the power supply cable (accessory) into the power supply connector (Fig. 1.3) on the left side of the UV-1800.

2 Insert the electric plug of the power supply cable into the power outlet.

2.2.3 Grounding

WARNING

Ground the instrument to prevent electric shock and provide reliable performance of the UV-1800.

The power supply cable supplied with the UV-1800 consists of three wires including a ground wire. When installing the instrument, be sure to insert the cable into the three-wire system outlet.

2.3 Checking the Light Source Lamp (D2)

WARNING

- Before opening the light source compartment cover, turn OFF the instrument power switch and remove the electric plug from the outlet. Failure to do so may result in fire, electric shock, and instrument malfunction. DO NOT turn ON the instrument power while the light source compartment is visually exposed. Ultraviolet light may be generated, a serious health hazard.
- If the UV-1800 has been operating before opening the cover, turn OFF the instrument and let it stand until the lamp cools down sufficiently. Touching the lamp when it is still hot will burn you.

CAUTION

- When removing and installing the light source compartment cover, avoid hitting the protrusion on the top of the D2 (deuterium) lamp (Fig. 3.8) against the back of the cover. Doing so may cause a vacuum leak in the lamp tube.
- Be sure to wear gloves when handling the light source so as not to leave fingerprints on the glass part. A fingerprint will burn onto the bulb when the light source gets hot, and light transmission will deteriorate.
- Be careful not to break the lamp.

According to the procedure described below, check to be sure that the light source D2 (deuterium) lamp did not become dislodged from the designated position during transportation.
For details on the components on the light source compartment, and the procedure to remove the cover, refer to "3.4 Replacing the Light Source".

1 Remove the light source compartment cover.

2 Check to be sure that the D2 lamp is seated well in the socket with no gap.

If the lamp is mounted at an angle or there is any gap, reinstall the lamp so that there is no gap in between.

3 Reinstall the light source compartment cover.

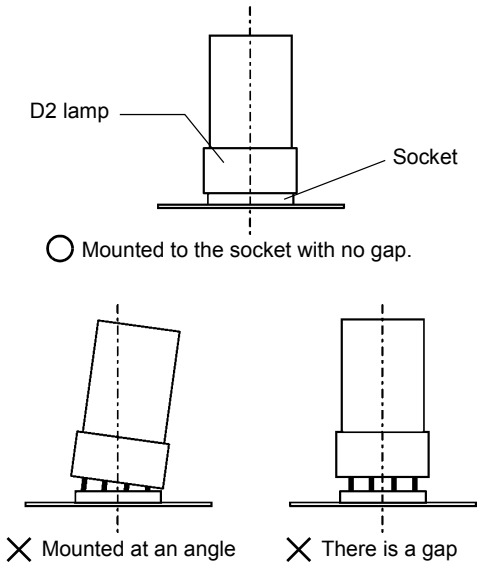


Fig. 2.3 Checking D2 lamp installation

2.4 Operation Precautions

■ Precautions Before Operation

CAUTION

- Before turning ON the power switch, check to be sure that nothing is placed in the sample compartment and cell holder.

  If the power is turned ON when a sample cell is mounted to the UV-1800, the light source energy check and wavelength check may be judged as "NG" since the light beam is obstructed.
  When this occurs, first turn OFF the power switch, remove the cell, and then turn ON the power switch again.

- If "Sipper 160" (special accessory) is mounted, turn ON the power switch with the flow cell filled with distilled water.

  If the sample remains halfway within the cell, the light source energy check and wavelength check may be judged as "NG" since the beam is refracted or scattered on the remaining sample.
  If this occurs, turn OFF the power switch and turn it ON again while pressing down the sipper 160 suction lever. After the pump of the sipper 160 starts rotating, suction the distilled water from the sample suction port. When the distilled water starts being drained, release the lever and finish the suction operation.

■ Precautions During Operation

CAUTION

- Keep the sample compartment cover closed during measurement or 100 %T (0 Abs) correction. Any outside light detected on the spectrometer may interfere with accurate measurement and correction.

NOTE

100 %T (0 Abs) is the function to correct the current photometric value to 100 %T for transmittance measurement, and 0 Abs for absorbance measurement. Performing this correction only for the specified wavelength is called "Auto-zero", and performing within the specified wavelength range is "Baseline correction".

2.5 Turning ON the Power and Initialization

2.5.1 Power ON/OFF

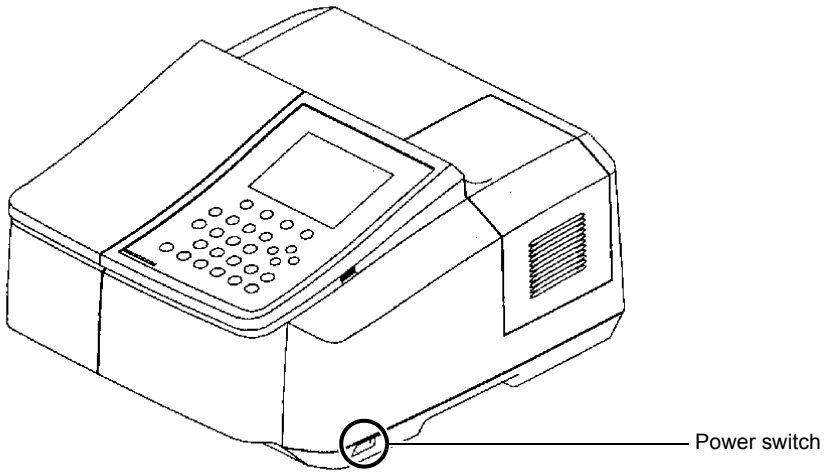
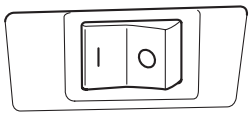


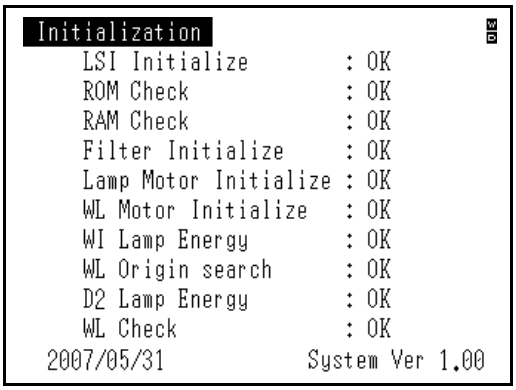
Fig. 2.4 UV-1800 Power Switch

■ Turning ON the Power

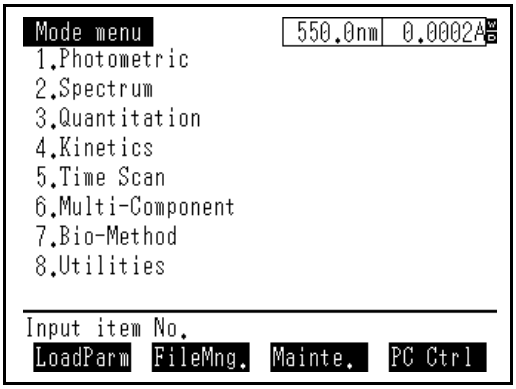
1 Press "I" on the power switch (Fig. 2.4) to turn ON the power.



2 The items to be initialized appear on the screen, and start being initialized or checked sequentially.
☞ "2.5.2 Initialization Operation"



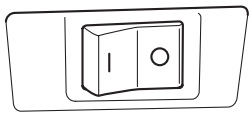
3 When all initialization items are judged "OK", the Mode menu screen appears.



NOTE
If the security function is ON, the Login screen is displayed prior to the Mode menu screen.
☞ Operation Guide, "1.3 Login Screen"

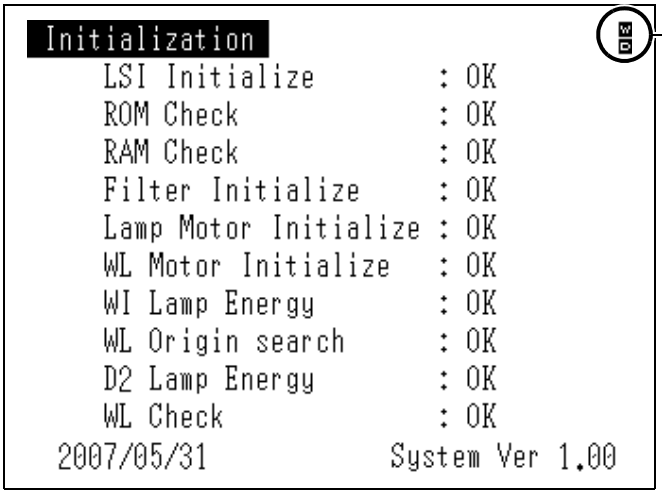
■ Turning OFF the Power

1 Press "O" on the power switch to turn OFF the power.



2.5.2 Initialization Operation

When the instrument power is turned ON, the spectrometer executes various initializations and checks for the items shown in Fig. 2.5. The time required for this initialization is approximately four minutes.



Light Source Lamp Icon
Indicates the illumination status of the light source lamp.
"W" and "D" stand for the halogen lamp and deuterium lamp, respectively. This icon is displayed when the lamp is ON, and not displayed when it is OFF. A blinking icon indicates that the lamp is OFF with some errors.

Fig. 2.5 Initialization screen

Table 2.1 Initialization items

Initialization items	Description
LSI Initialize	Initializes each I/O device.
ROM Check	Checks program ROM.
RAM Check	Checks memory elements (RAM).
Filter Initialize	Detects the reference position of the stray light filter.
Lamp Motor Initialize	Detects the reference position of the motor that drives the light source switching mirror.
WL Motor Initialize	Detects the mechanical wavelength origin position.
WI Lamp Energy	Checks whether or not the WI (halogen) lamp light energy is at a sufficient level.
WL Origin search	Checks 0-order light which is the optical origin.
D2 Lamp Energy	Checks whether or not the D2 lamp (deuterium) lamp light energy is at a sufficient level.
WL Check	Checks wavelength by detecting the emission line at 656.1 nm using the D2 lamp.

Each item is initialized in order, and if the initialization of the item is properly completed, "OK" is displayed next to the item. If any abnormality is detected, however, "NG" is displayed and the initialization process is terminated. In such a case, note the item for which "NG" is displayed, and turn OFF the instrument. To learn the check points when an error occurred, refer to "5.1 Errors during Initialization".

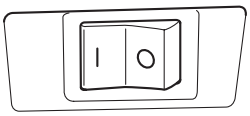
2.5.3 Switching System Language

You can arbitrarily change the UV-1800 system language.
If Japanese language instruction manuals are necessary, please contact your Shimadzu representative and purchase them separately.

- UV-1800series System Use's Guide..... P/N 206-97039
- UV-1800series Operation Guide..... P/N 206-97041

■ Switching Procedure (English to Japanese)

1 Turn ON the UV-1800 by pressing the "I" side of the power switch (Fig. 2.4) while holding down the ENTER key on the keypad.



2 The UV-1800 starts up in Japanese mode, and the initialization operation begins.
☞ "2.5 Turning ON the Power and Initialization"

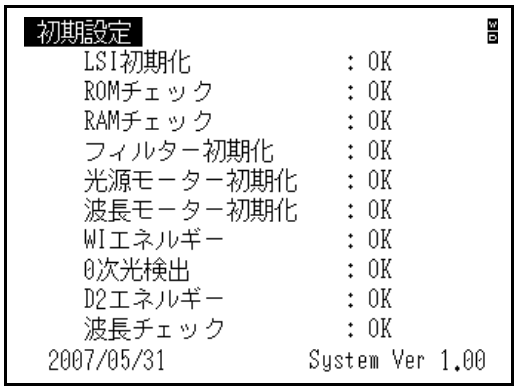


Fig. 2.6

NOTE
The language mode is switched only when turning ON the power switch with the ENTER key pressed. When not intending to change the language mode, turn ON the power switch as usual without holding down the ENTER key.

2.6 Instrument Baseline Correction

After installing the UV-1800, perform the instrument baseline correction.
The UV-1800 has the following two types of baseline correction:

① Instrument Baseline Correction
This corrects the optical balance of the spectrometer itself. The baseline is corrected with a shorter interval within the entire wavelength range (190 nm - 1100 nm), and the correction data is stored.

NOTE
If the instrument baseline correction is interrupted, the stored data is not overwritten.

② Baseline Correction
This corrects the baseline within the specified wavelength range to 100 %T (0 Abs). This correction is completed quickly since it is executed within a relatively wide interval.

The UV-1800 uses the correction data obtained from ① when performing ②. Therefore, the steps and shock noises can be removed in a short time. Usually they can be removed only when corrections are performed with the same interval as that used when the measurement data is obtained.

The procedure to perform "instrument baseline correction" is given below.
It takes approximately 17 minutes to complete the correction. Other UV-1800 operations are not available during that period.

1 Verify that nothing is set on the cell holder in the sample compartment, and close the sample compartment cover.

2 Select the **F3** [Mainte.] key in the Mode menu screen (Fig. 2.7).

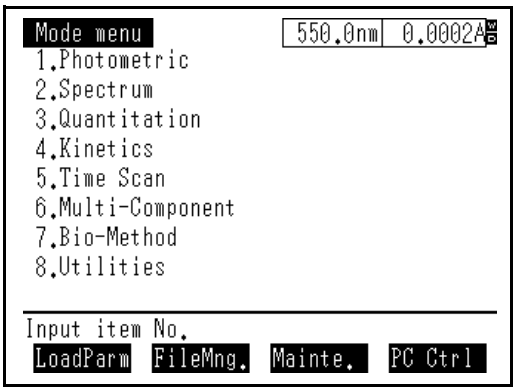


Fig. 2.7

3 Select **2** [Instrument Baseline Correction] in the Maintenance screen (Fig. 2.8).

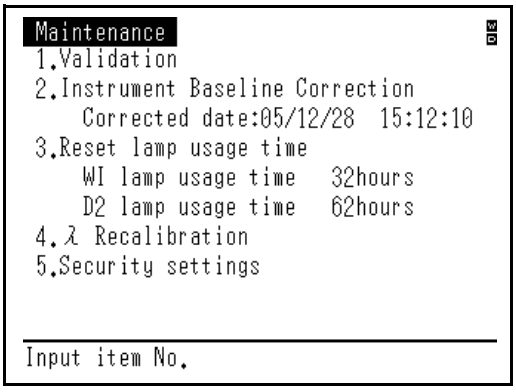


Fig. 2.8

4 Select [Yes] using the ◄ ► keys, and press the ENTER key.
The instrument baseline correction is started.

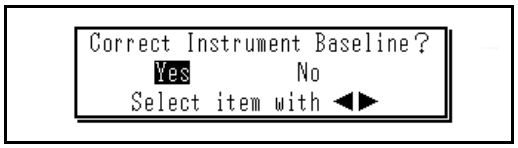


Fig. 2.9

5 During the correction process, a message will be displayed at the bottome of the screen.
To terminate the instrument baseline correction, press the START/STOP key.

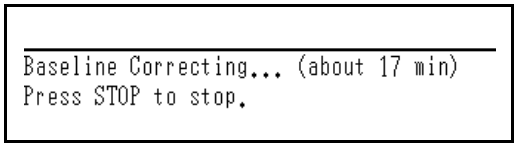


Fig. 2.10

2.7 Performance Check after Installation

Once the installation is complete, validate the performance for the following items:

- Noise level
- Baseline flatness
- Wavelength accuracy

Use the instrument validation function in order to check the performance of the UV-1800. For details on how to use the function, refer to the Operation Guide, "16. Instrument Validation Function".

2.7.1 Parameter Settings

Set validation parameters in the Parameter Input screen for each item as follows:

■ Noise level

Perform the validation using the parameters below.
Wavelength : 700 nm
Tolerance P-P : 0.30 mAbs or less
RMS : 0.05 mAbs or less

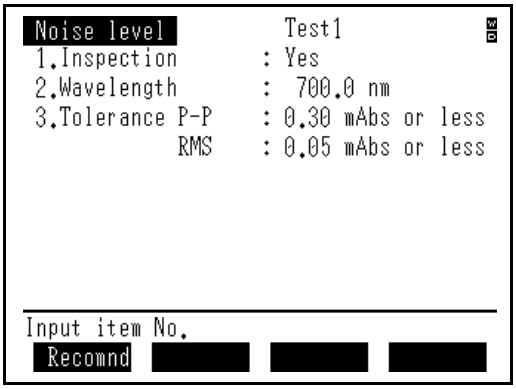


Fig. 2.11 Validation parameters for noise level

■ Baseline flatness

Perform the validation using the parameters below.

Scan range: 1100 - 200 nm
Tolerance : ±0.6 mAbs

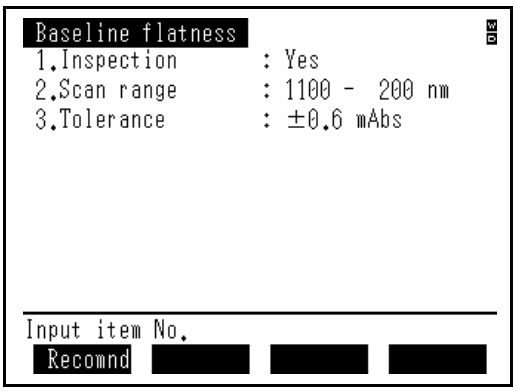


Fig. 2.12 Validation parameters for baseline flatness

■ Wavelength accuracy (D2 emission line)

Perform the validation using the parameters below.

Wavelength: 656.1 nm, 486.0 nm
Tolerance 656.1 nm: ±0.10 nm
486.0 nm: ±0.30 nm

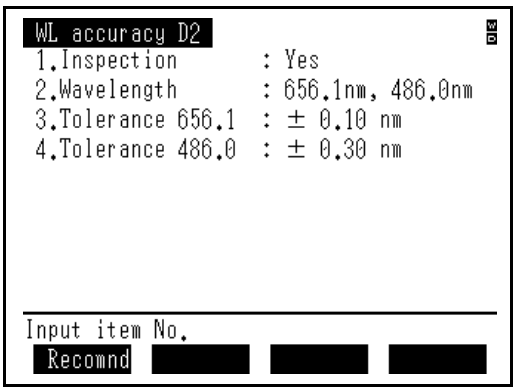


Fig. 2.13 Validation parameters for wavelength accuracy (D2 emission line)

2.7.2 Performing Validation

Connect the printer to the UV-1800, and start the validation by the following procedure:

1 Press the (F4) [Settings] key in the Parameter Input screen for the instrument validation.

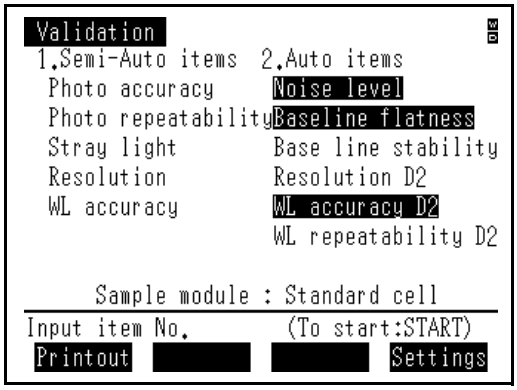


Fig. 2.14

2 In the Settings screen, set [1.Auto Print] and [Print Init. status] to [ON].

3 Press the (RETURN) key to return to the Parameter Input screen for the instrument validation.

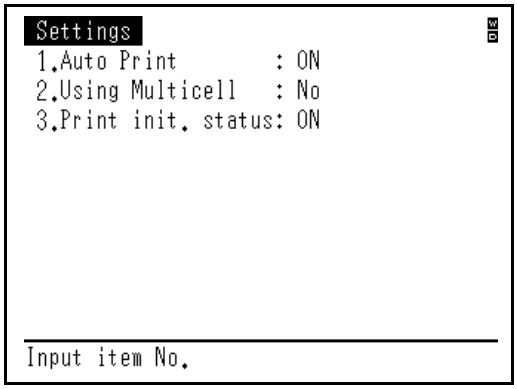


Fig. 2.15

4 In the screen, press the (START/STOP) key to start the validation.

5 The check result is printed out for each validation item when the validation is complete.

6 Check the performance of each item by referring to the printed result.

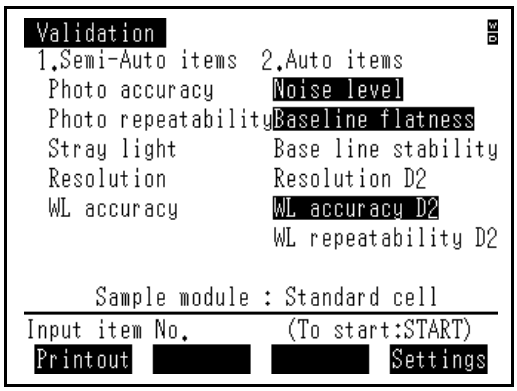


Fig. 2.16

Chapter 3 Maintenance & Inspection

CONTENTS

3.1 Inspection and Maintenance

To use the UV-1800 safely, be sure to perform inspection and maintenance on the instrument.

WARNING

Unless otherwise specified, be sure to turn OFF the UV-1800 and remove the electric plug from the outlet before performing inspection and maintenance. Failure to do so may result in fire, electric shock, and instrument malfunction.

CAUTION

- When replacing parts, always use the parts specified in "1.1 UV-1800 Configuration" or "6.2 Maintenance Parts". Using parts other than those specified may damage the parts, causing injuries or system malfunction.
- DO NOT remove the cover of the UV-1800. Ignoring this may cause injuries or system malfunction.

  For internal repair of the UV-1800, contact your Shimadzu representative.

3.1.1 List of Periodic Inspection & Maintenance Items

Inspection and maintenance item	Everyday	1 year	2 years	3 years	Reference
Sample compartment inspection	○				"3.2 Inspecting the Sample Compartment"
Lamp usage time check	○				"3.3 Checking and Resetting the Lamp Usage Time"
WI (halogen) lamp replacement			○		"3.4 Replacing the Light Source"
D2 (deuterium) lamp replacement			○		"3.4 Replacing the Light Source"

3.2 Inspecting the Sample Compartment

CAUTION

DO NOT spill water or organic solvent on the UV-1800. Doing so may result in electrical failure or instrument malfunction.

When analyzing liquid sample, check that no solution sample is spilled on the sample compartment before and after measurement. Should you spill any liquid sample, wipe it up immediately.

NOTE

If spilled sample is left in the sample compartment for a while, it evaporates and fills the compartment, corroding the internal components and interfering with correct measurement results.

If solution sample is spilled on the sample compartment bottom, wipe up the spilled solution after removing the sample compartment unit. For the procedure to remove/install the sample compartment unit, refer to "4.2 Removing/Installing the Sample Compartment Unit (Standard)".

3.3 Checking and Resetting the Lamp Usage Time

The UV-1800 has a function to record and display the accumulated usage time of the WI (halogen) and D2 (deuterium) lamps used for the light source.
Even though the accumulated usage time is saved to the instrument after the power is turned OFF, the data will be cleared if any electrical problem occurs. Therefore, if you wish to use the usage time data through this function as a reference for lamp replacement, write down the usage time on the inspection record periodically. For the service life of each lamp, refer to "3.4.1 Light Source Specifications".

3.3.1 Checking Procedure

1 Press the F3 [Mainte.] key in the Mode menu screen.

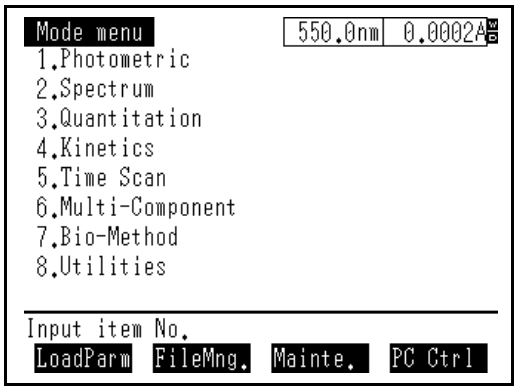


Fig. 3.1

2 The Maintenance screen (Fig. 3.2) appears and the accumulated usage time of the light source lamps are displayed.

3 Press the RETURN key to return to the Mode menu screen (Fig. 3.1).

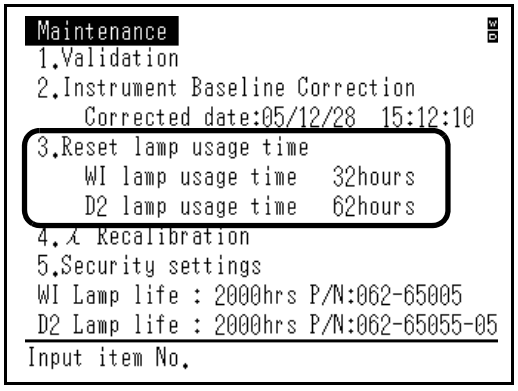


Fig. 3.2

3.3.2 Resetting Procedure

After replacing the light source lamp, reset the data of accumulated usage time by the following procedure.
For the light source replacement, refer to "3.4.2 Lamp Replacement Procedure".
The procedure for resetting the lamp usage time is given below, using the D2 lamp as an example.

1 Press the F3 [Maint.] key in the Mode menu screen (Fig. 3.3).

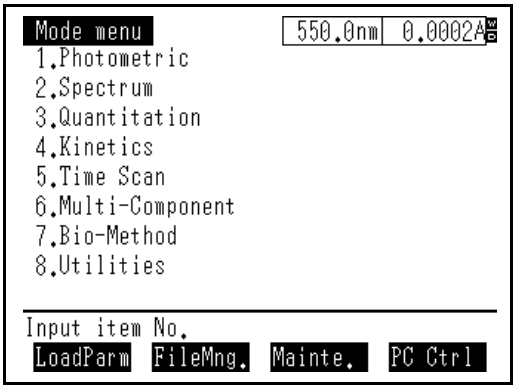


Fig. 3.3

2 Press the 3 [3. Reset lamp usage time] key in the Maintenance screen (Fig. 3.4).

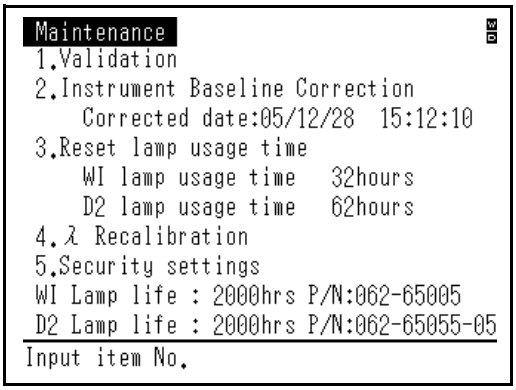


Fig. 3.4

3 The window for selecting the lamp whose usage is to be reset appears.
Use the ▲ ▼ keys to move the cursor to [D2 lamp] (Fig. 3.5), and press the ENTER key.

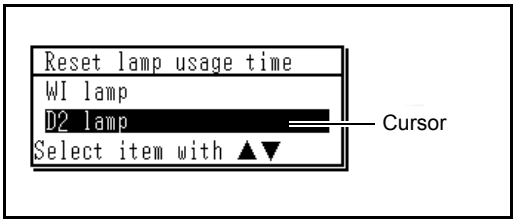


Fig. 3.5

4 Use the ◄ ► keys to select [Yes], and press the ENTER key.
The lamp usage time will be reset.

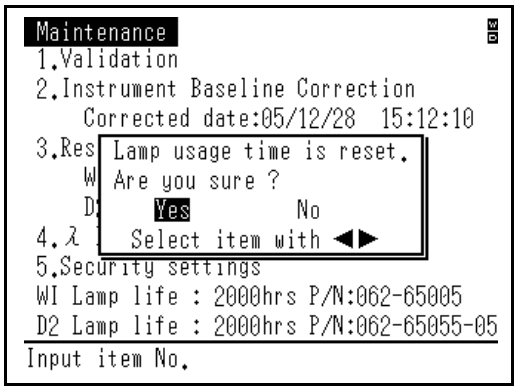


Fig. 3.6

5 You will return to the [Maintenance] screen (Fig. 3.7). Verify that [D2 lamp usage time] is reset to "0 hours".

6 Press the RETURN key to return to the Mode menu screen (Fig. 3.3).

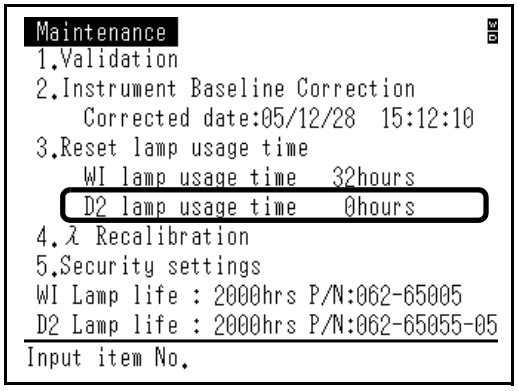


Fig. 3.7

3.4 Replacing the Light Source

3.4.1 Light Source Specifications

The UV-1800 uses two types of light source lamps: D2 (deuterium) lamp and WI (halogen) lamp. The D2 lamp and WI lamp are used for ultraviolet region (190 nm - light source switching wavelength[*1]) and visible/near-infrared region (light source switching wavelength[*1] - 1100 nm), respectively.
The closer the lamp service life comes to its end, the smaller the light intensity of each lamp, and the greater the noise in photometric data.
Replace the light source lamp by referring to the "Rating life[*2]" described in the table below.

*1 The light source switching wavelength can be arbitrarily specified within the range between 295 nm and 364 nm in increments of 0.1 nm. For details, refer to the Operation Guide, "14.1 Setting Instrument Parameters", [4. Light source].

*2 The rating life below has been determined based on "average life" of a large number of lamps by the lamp manufacturer. Please note that some lamps may burn out before they reach the end of their rating lives.

Table 3.1

Name	Part No.	Type	Rating Life
① WI (halogen) lamp	062-65005	NA55917	Appox. 2000 hours
② D2 (deuterium lamp)	062-65055-05	L6380	Appox. 2000 hours

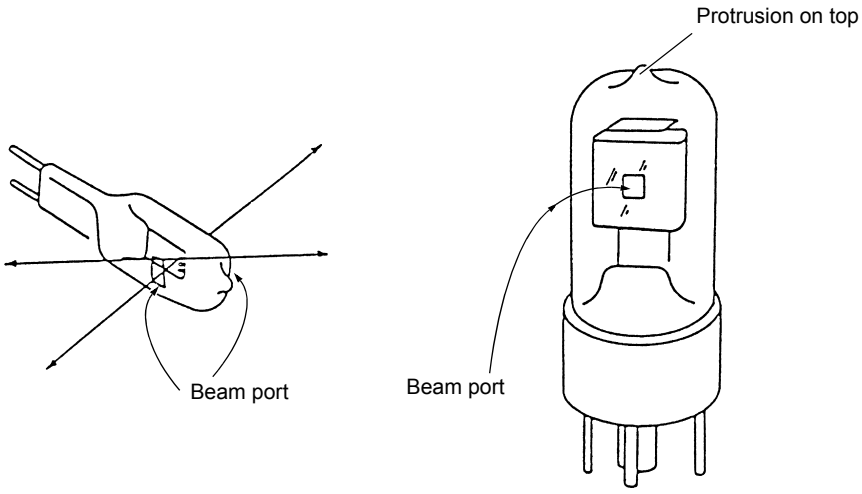


Fig. 3.8 Light source appearances

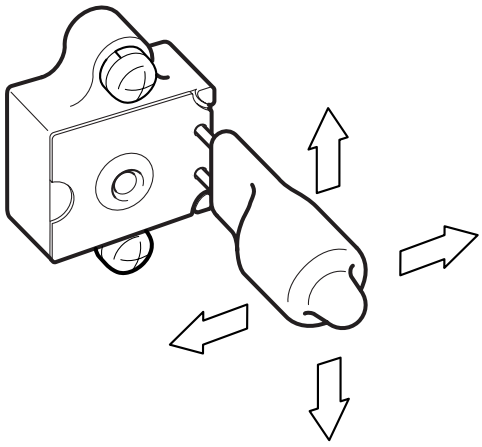
3.4.2 Lamp Replacement Procedure

WARNING

- Before replacing the lamp, turn OFF the instrument power switch and remove the electric plug from the outlet. Failure to do so may result in fire, electric shock, and instrument malfunction. DO NOT turn ON the instrument power while the light source compartment is visually exposed. Ultraviolet light may be generated, a serious health hazard.
- Before replacing the lamp, turn OFF the instrument and let it stand until the lamp cools down sufficiently. Touching the lamp when it is still hot will burn you.

CAUTION

- When removing and installing the light source compartment cover, avoid hitting the protrusion on the top of the D2 (deuterium) lamp (Fig. 3.8) against the back of the cover. Doing so may cause a vacuum leak in the lamp tube.
- Be sure to wear gloves when handling the light source so as not to leave fingerprints on the glass part. A fingerprint will burn onto the bulb when the light source gets hot, and light transmission will deteriorate.
- Be careful not to break the lamp.
- When replacing the WI (halogen) lamp, your hand may contact the D2 lamp. Cover the D2 lamp with a clean paper or cloth or remove the D2 lamp before the work.
- After inserting the WI lamp into the socket, DO NOT forcedly move it to right and left or up and down. The connection part between the pin and glass may crack, which makes it impossible for the lamp to illuminate.



■ Removing the light source compartment cover

1 Using a Philips screwdriver, loosen the fixing screw located on the side of the light source compartment cover.

2 Lift up the side part of the cover to release the notch from the fixing screw.

3 While sliding the light source compartment cover and lifting it up at an angled (following the arrow direction in Fig. 3.9), remove it from the main body.

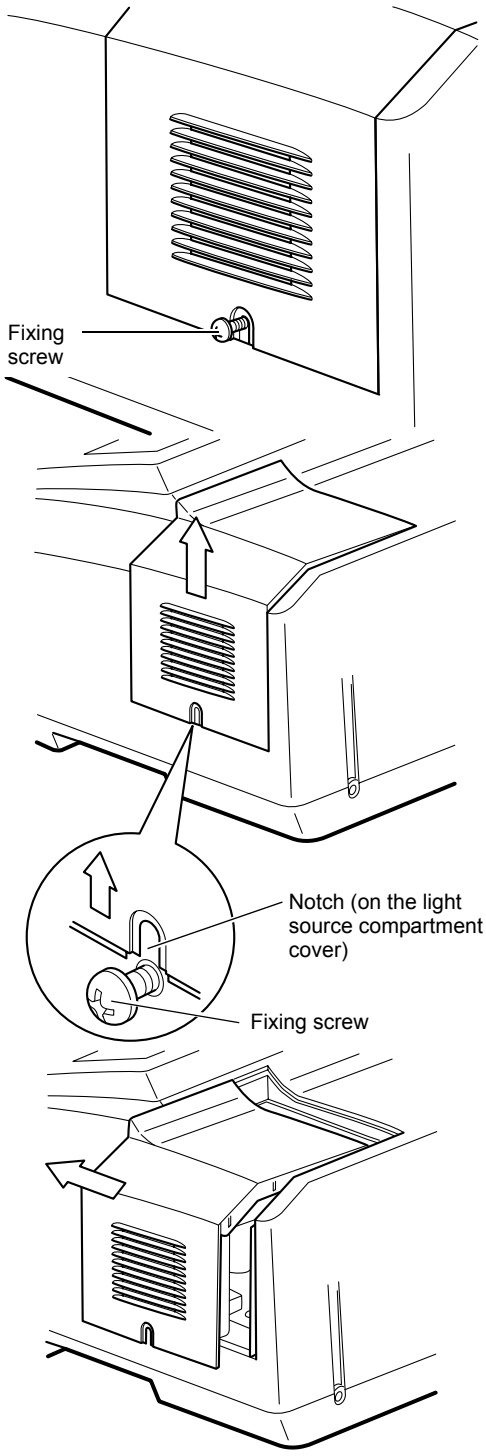
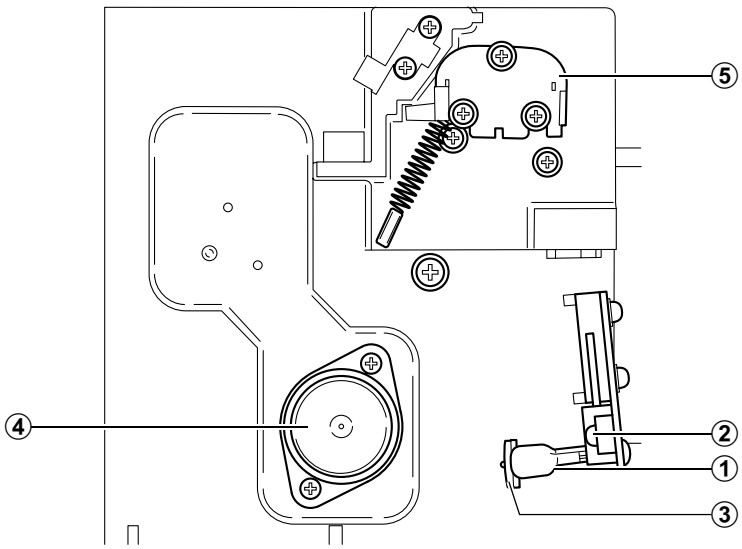


Fig. 3.9 Removing the light source compartment cover



① WI lamp
② WI lamp socket
③ WI lamp retainer spring
④ D2 lamp
⑤ Light source switching mechanism

Fig. 3.10 Interior of light source compartment

■ Replacing the WI (halogen) lamp

When replacing the WI (halogen) lamp, your hand may contact the D2 lamp. Cover the D2 lamp with a clean paper or cloth or remove the D2 lamp before the work. To remove the D2 lamp, refer to "■ Replacing the D2 lamp" in this section.

1 Remove the WI lamp retainer spring from the top of the WI lamp.

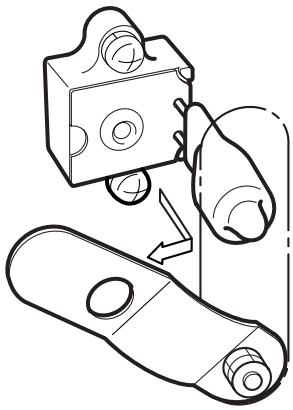


Fig. 3.11

2 Pull out the WI lamp from the socket.

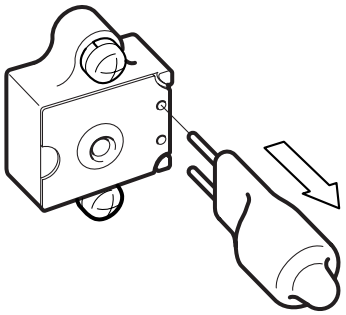


Fig. 3.12

3 Wear gloves. Hold the new WI lamp at the top and bottom so as not to taint its beam port.

4 Insert the new WI lamp into the socket. Push it forward until the two pins of the WI lamp contact the back of the socket and stop.

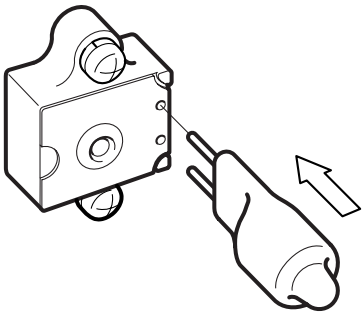


Fig. 3.13

> **NOTE**
> The two pins of the WI lamp do not have polarity. Either pin can be the upper side.

5 Return the WI lamp retainer spring, removed in procedure 1, to the original position.

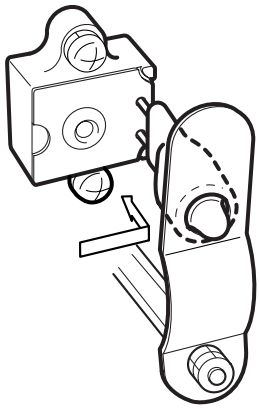


Fig. 3.14

6 Reinstall the D2 lamp to the original position. Make sure that no paper or cloth used for the work is left in the light source compartment.

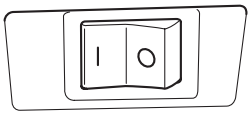


Fig. 3.15

7 Install the light source compartment cover by the reverse procedure of that described in "■ Removing the light source compartment cover" in this section.

8 Insert the electric plug into the outlet, and switch ON the UV-1800. (Press the "|" side on the switch.)

9 The initialization process starts. Verify that the initialization for all items is successfully completed. (i.e., "OK" is displayed for all items.)

10 When the Mode menu screen is displayed, follow the procedure in "3.3.2 Resetting Procedure" to reset the WI lamp usage time.

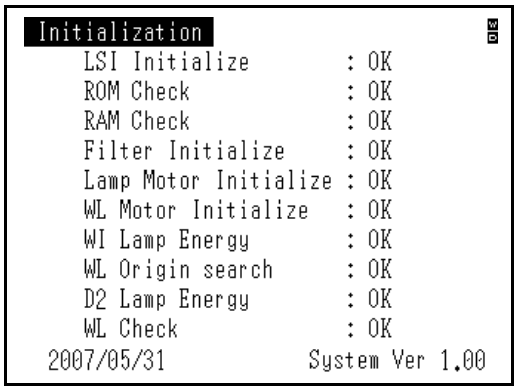


Fig. 3.16

■ Replacing the D2 lamp

1 Wear gloves. Hold the resin part of the D2 lamp, and slowly pull it straight up.

2 Slowly extract the D2 lamp upward to remove it from the socket.

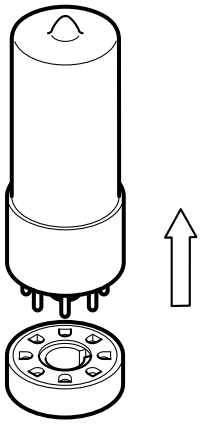


Fig. 3.17

3 Insert the new D2 lamp into the socket. Fit the locating lug at the bottom of the D2 lamp to the socket notch.
Make sure that the lamp is inserted all the way.

4 Install the light source compartment cover by the reverse procedure of that described in "■ Removing the light source compartment cover" in this section.

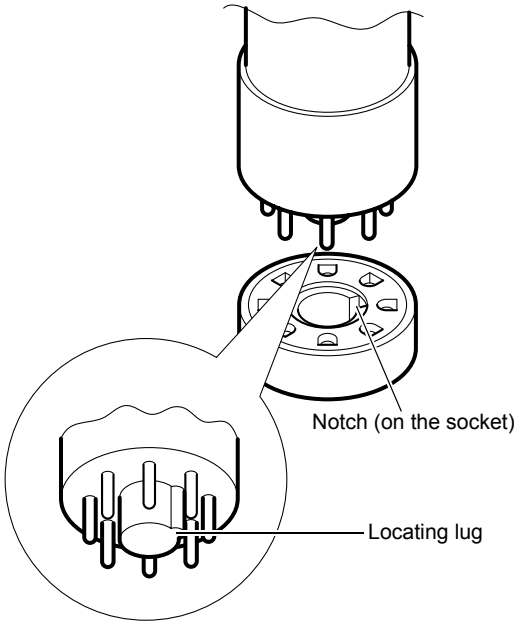


Fig. 3.18

5 Insert the electric plug into the outlet, and switch ON the UV-1800. (Press the "|" side on the switch.)

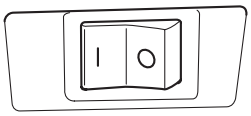


Fig. 3.19

6 The initialization process starts. Verify that the initialization for all items is successfully completed. (i.e., "OK" is displayed for all items.)

7 When the Mode menu screen is displayed, follow the procedure in "3.3.2 Resetting Procedure" to reset the D2 lamp usage time.

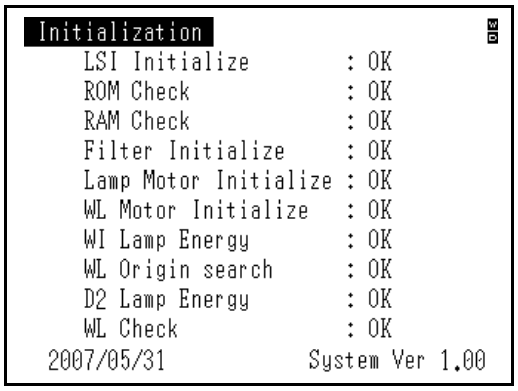


Fig. 3.20

3.5 Cleaning the Exterior

When the instrument case, sample compartment cover, and operation keypad get dirty or stained, wipe them with a dry, soft cloth or tissue.
Remove more stubborn stains by the following procedure:

1 Dip a cloth into watered-down mild detergent and wring it well. Wipe the instrument with it.

2 Dip a cloth into water and wring it well. Wipe off any detergent residue on the instrument completely. Then, wipe the moisture off with a dry cloth.

NOTE
DO NOT leave any spilled water on the UV-1800. DO NOT use alcohol or paint thinner solvents for cleaning. Doing so may cause the instrument surface to rust or discolor.

This page is intentionally left blank.

Chapter 4 Replacing the Sample Compartment Parts

CONTENTS

4.1 Removing/Installing the Cell Holder

To install some special accessories, such as Ultra-micro cell holder (P/N 206-14334), it is necessary to replace the standard cell holder in the sample compartment.
In such a case, remove/install the cell holder by the following procedure:

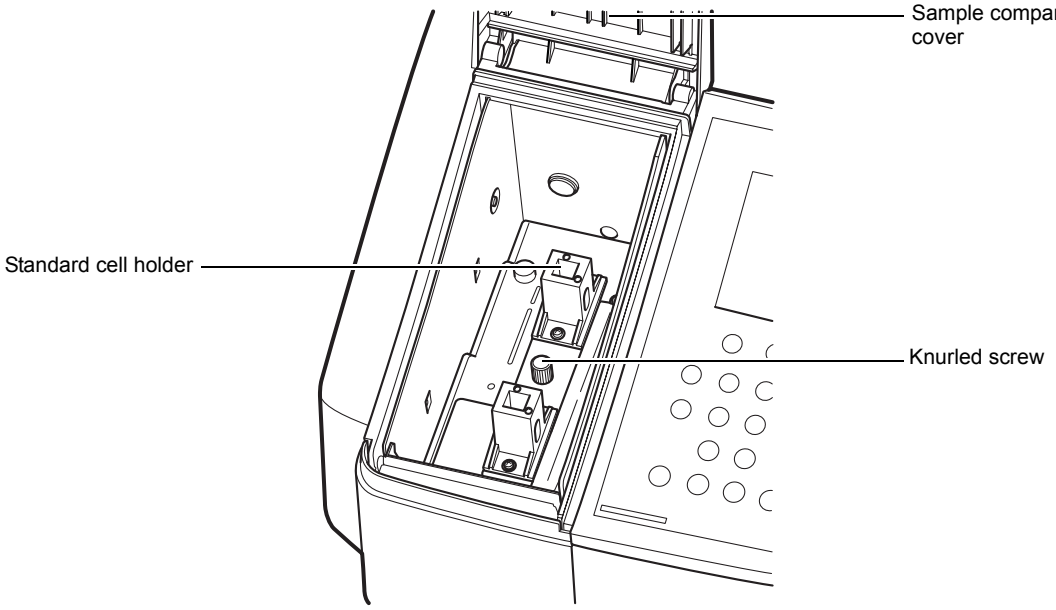


Fig. 4.1 Sample compartment (standard)

4.1.1 Removing the Cell Holder

1 Open the sample compartment cover.

2 Loosen the knurled screw fixing the cell holder.
Remove the cell holder.

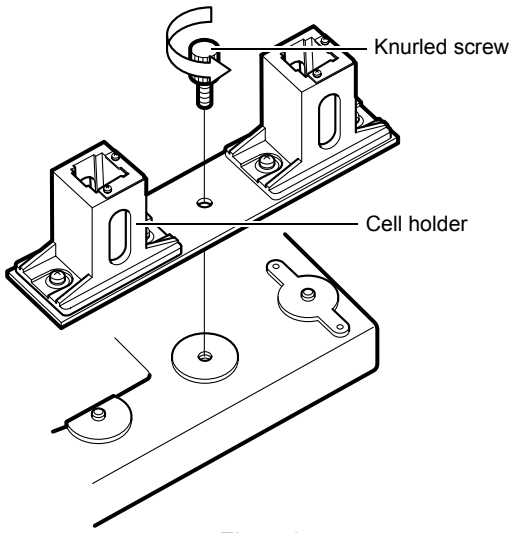


Fig. 4.2

4.1.2 Installing the Cell Holder

1 While aligning the locating hole on the cell holder with the locating pin on the sample compartment unit, place the cell holder on the sample compartment unit.

> **NOTE**
> Install the cell holder so that the beam passes through it as directed by the arrow mark.

2 Fix the cell holder with the knurled screw.

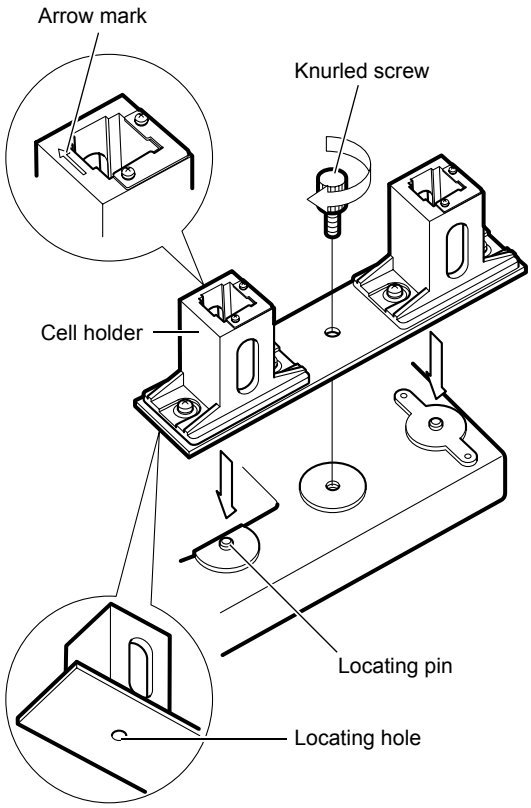


Fig. 4.3

4.2 Removing/Installing the Sample Compartment Unit (Standard)

To install some special accessories, such as Sipper 160 series (P/N 206-23790-91, etc.), it is necessary to replace the standard sample compartment unit in the sample compartment. In such a case, remove/install the standard sample compartment unit by the procedure described below. For installing/removing those special accessories, refer to the instruction manual of each special accessory.

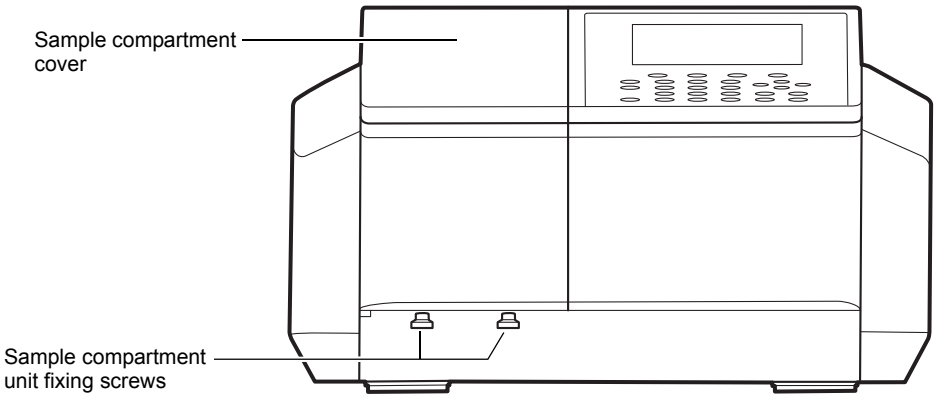


Fig. 4.4 Main body front view

4.2.1 Removing the Sample Compartment Unit

1 Loosen two of the sample compartment unit fixing screws located at the bottom of the sample compartment.

2 Open the sample compartment cover to remove the sample compartment unit.

1) Pull out the sample compartment in the direction that releases the notch from the fixing pin.

> **NOTE**
> DO NOT loosen the fixing pin. You can release the notch without loosening the fixing pin.

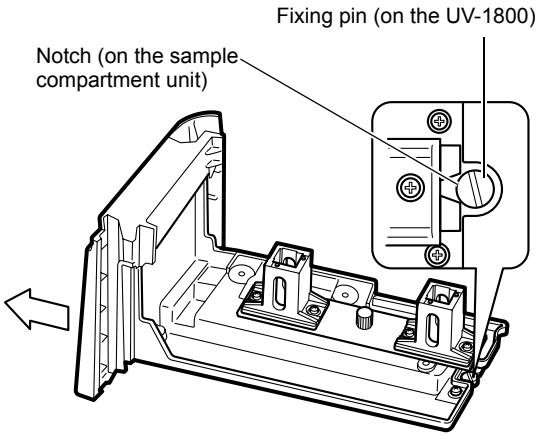


Fig. 4.5

2) While slightly lifting up the sample compartment unit, pull the unit out from the fixing pin at an angle.

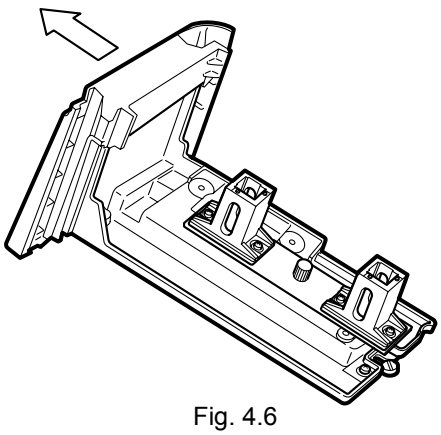


Fig. 4.6

4.2.2 Installing the Sample Compartment Unit

CAUTION

Fix the sample compartment unit securely to the instrument main body using the fixing screws (knurled screws). If the sample compartment unit is not seated properly, outside light from the gap makes it impossible to obtain accurate measurement data.

1 Open the sample compartment cover and install the sample compartment unit.

1) At an angle from above, insert the notch on the sample compartment unit to the locating pin at the far side of the sample compartment.

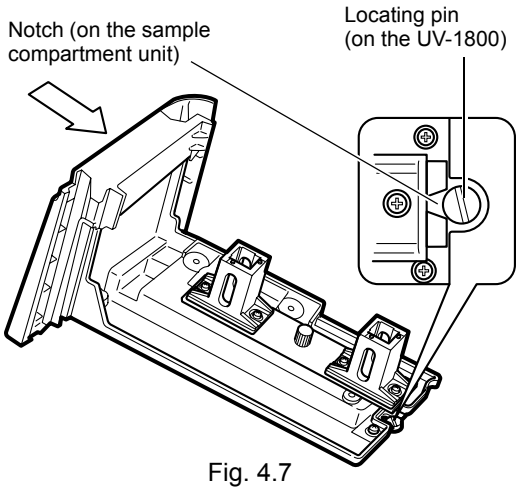


Fig. 4.7

2) Push the sample compartment unit forward so that the notch is pressed into the locating pin.

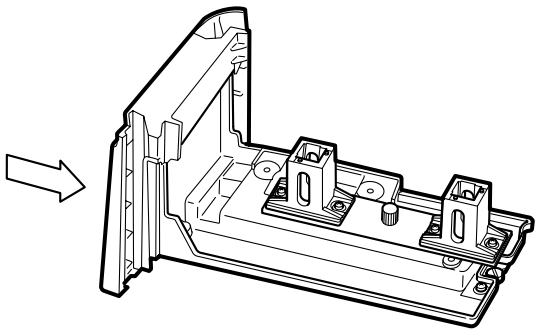


Fig. 4.8

3) Make sure that the sample compartment unit front cover and the UV-1800 main body fit together snugly.
If they don't, press the sample compartment unit down to the sample compartment bottom.

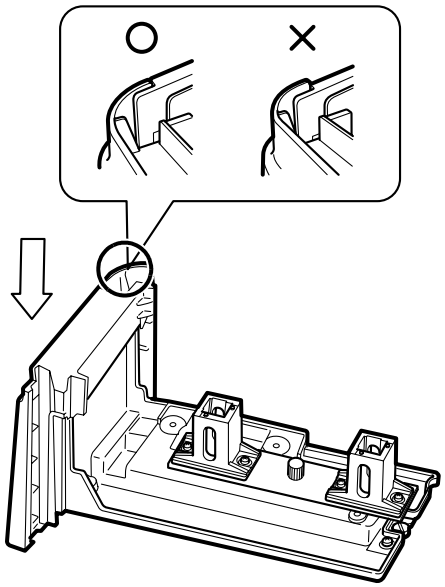


Fig. 4.9

2 Tighten two of the sample compartment fixing screws (Fig. 4.4) to fix the sample compartment unit.

> **NOTE**
> Align the screw holes on the sample compartment unit with the knurled screws by moving the unit back and forth.

3 Close the sample compartment cover (Fig. 4.4).

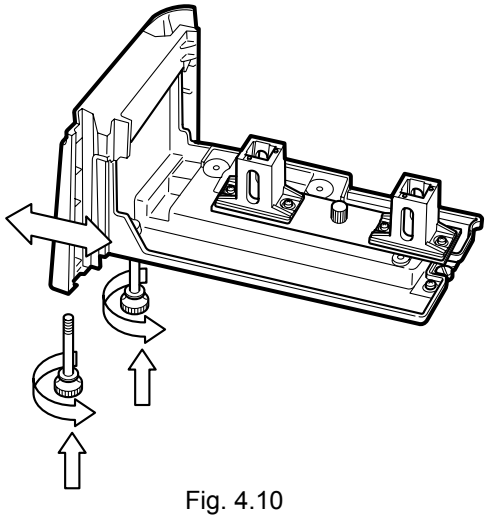


Fig. 4.10

4.3 Removing/Installing the Sample Compartment Front Cover

To install some special accessories, such as syringe sipper (P/N 206-23890-91), it is necessary to install the designated front plate on the sample compartment.
In such a case, remove/install the sample compartment front cover by the procedure described below. For installing/removing those special accessories, refer to the instruction manual of each special accessory.

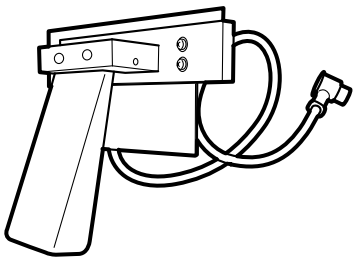


Fig. 4.11 Front plate for syringe sipper (switching unit)

4.3.1 Removing the Sample Compartment Front Cover and Installing the Front Plate

1 Remove the sample compartment unit from the UV-1800 by the procedure described in "4.2.1 Removing the Sample Compartment Unit".

2 Turn the sample compartment unit upside down. Press the tabs (2 places) on the cover in the arrow direction as shown in Fig. 4.12 to release them from the unit. (Fig. 4.13)

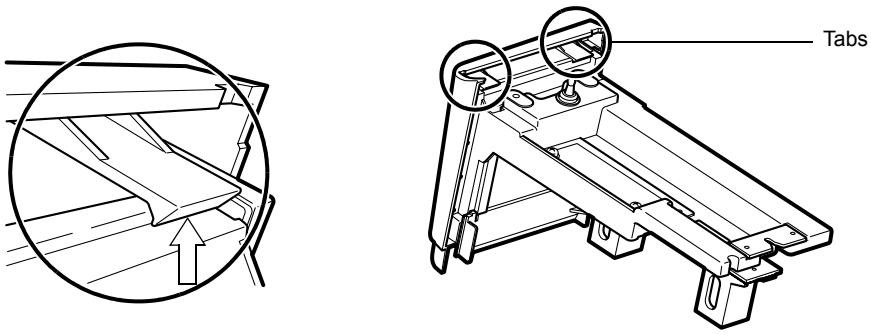


Fig. 4.12 Tabs on the sample compartment front cover

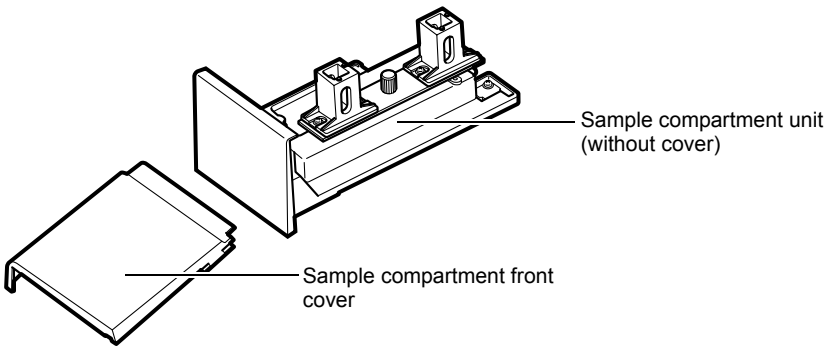


Fig. 4.13 Sample compartment unit

3 Install the sample compartment unit (without cover) to the UV-1800 main body by the procedure described in "4.2.2 Installing the Sample Compartment Unit".

4 Install the designated front plate (special accessory) to the sample compartment unit.

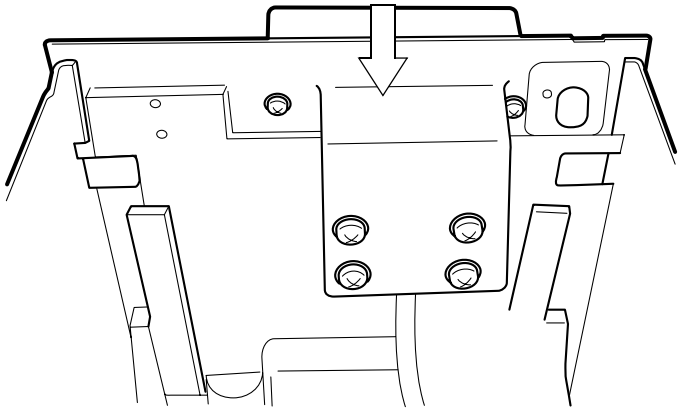


Fig. 4.14 Installing the front plate

5 Close the sample compartment cover (Fig. 4.4).

4.3.2 Installing the Sample Compartment Front Cover

1 Open the sample compartment cover and remove the designated front plate (special accessory).

2 Remove the sample compartment unit from the UV-1800 main body by the procedure described in "4.2.1 Removing the Sample Compartment Unit".

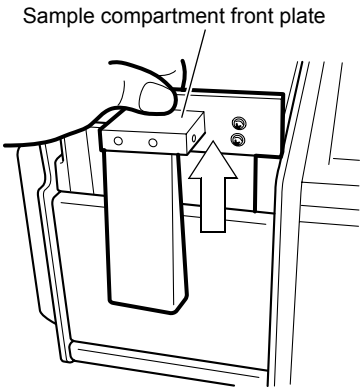


Fig. 4.15 Sample compartment front plate

3 Fit the protruded parts on the sample compartment unit to the corresponding protruded parts on the front cover (2 places).

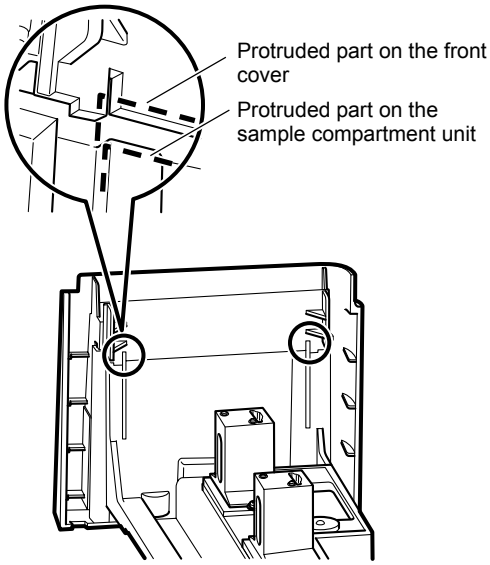


Fig. 4.16 Fitting the sample compartment front cover

4 Snap the sample compartment front cover into the sample compartment unit. Push the cover in the arrow direction in Fig. 4.17 until it snaps.

5 Install the sample compartment unit to the UV-1800 main body by the procedure described in "4.2.2 Installing the Sample Compartment Unit".

6 Close the sample compartment cover (Fig. 4.4).

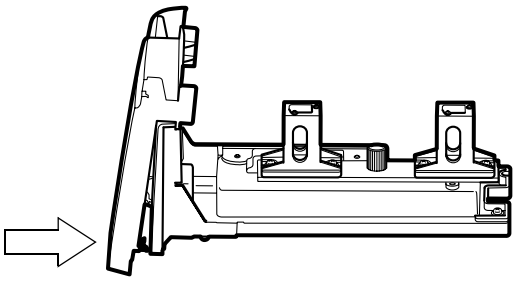


Fig. 4.17 Snapping the sample compartment front cover

This page is intentionally left blank.

Chapter 5
Troubleshooting

CONTENTS

5.1 Errors during Initialization

After the power is turned ON, the UV-1800 initializes and checks the following items listed in the table below.

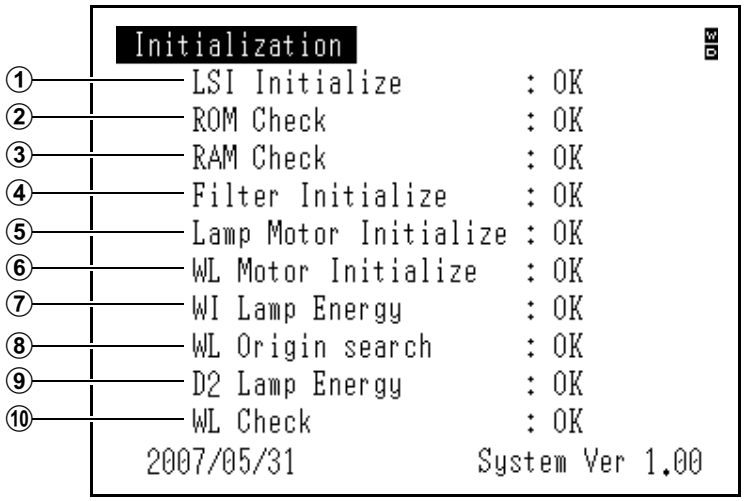
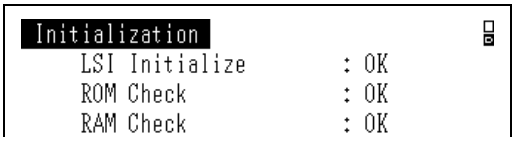
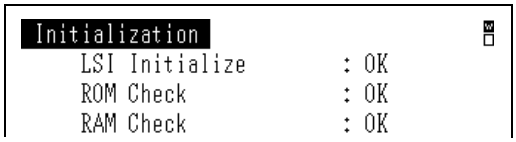


Fig. 5.1 Initialization screen

Table 5.1 Initialization items

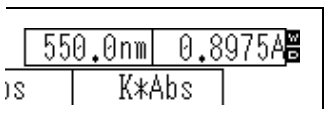
Item No.	Initialization items	Description
①	LSI Initialize	Initializes each I/O device.
②	ROM Check	Checks program ROM.
③	RAM Check	Checks memory elements (RAM).
④	Filter Initialize	Detects the reference position of the stray light filter.
⑤	Lamp Motor Initialize	Detects the reference position of the motor that drives the light source switching mirror.
⑥	WL Motor Initialize	Detects the mechanical wavelength origin position.
⑦	WI Lamp Energy	Checks whether or not the WI (halogen) lamp light energy is at a sufficient level.
⑧	WL Origin search	Checks 0-order light which is the optical origin.
⑨	D2 Lamp Energy	Checks whether or not the D2 (deuterium) lamp light energy is at a sufficient level.
⑩	WL Check	Checks wavelength by detecting the emission line at 656.1 nm using the D2 lamp.

When [NG] is displayed during initialization, perform the appropriate remedial actions by referring to the table below. If the problem is not resolved by these actions, contact your Shimadzu representative.

Item No.	Check Point	Remedial Action	Reference Page
① ~ ⑥		Turn OFF the UV-1800 power switch, and turn it ON to initialize the instrument again.	P2-9
⑦, ⑧	Is there anything obstructing the beam in the sample compartment cell holder?	Turn OFF the UV-1800 power switch. Remove the obstruction and turn ON the power switch again.	P2-9
	Is the light source lamp icon [W] displayed on the upper right of the screen?	If the icon is not displayed (i.e., only frame is displayed), it means that the WI lamp is currently OFF.  Fig. 5.2 Turn OFF the UV-1800 power switch, and turn it ON again. If the lamp still does not illuminate, replace the WI lamp by the procedure described in "3.4 Replacing the Light Source".	P2-9 P3-7
⑨, ⑩	Is there anything obstructing the beam in the sample compartment cell holder?	Turn OFF the UV-1800 power switch. Remove the obstruction and turn ON the power switch again.	P2-9
	Is the light source lamp icon [D] displayed on the upper right of the screen?	If the icon is not displayed (i.e., only frame is displayed), it means that the WI lamp is OFF.  Fig. 5.3 Turn OFF the UV-1800 power switch, and turn it ON again. If the lamp still does not illuminate, replace the WI lamp by the procedure described in "3.4 Replacing the Light Source".	P2-9 P3-7

5.2 Problems: Symptoms and Solutions

Check whether the problem exhibits the following symptoms before requesting a repair.
Contact your Shimadzu representative if the error cannot be resolved through the remedial action described below, or if the symptom is not covered in the table.

Symptom	Typical Cause	Remedial Action	Reference Page
Turning ON the power switch does not supply the power.	Is the AC power cable plug connected properly?	Connect the AC power cable plug correctly.	P2-5
	Is the AC power cable trapped underneath or twisted?	Replace the AC power cable with the cable of the same type if it is damaged.	P1-2 P2-5
	Does the supplied power satisfy the power supply specification of the UV-1800?	Use the power supply that satisfies the instrument power supply specification of the UV-1800.	P2-4
[NG] is displayed next to initialization items.	————	Perform an appropriate action by following the instruction in "5.1 Errors during Initialization".	P5-2
Nothing appears on the screen.	Is the display contrast properly adjusted?	Adjust the display contrast by using the ▼ ▲ keys while holding down the LCD CONT key on the keypad.	P1-7
Numbers cannot be entered from the keypad.	Is an incorrect value being entered? Example: GOTO WL, 1150 (nm)	Enter the correct value.	——
Photometry values are odd.	Is the light source lamp lit?	Check if the light source lamp icon ([W] or [D]) is displayed.  Fig. 5.4 ■ When the icon is not displayed (Only frame is displayed) **[Action]** The lamp is currently OFF. 1)Turn OFF the UV-1800 power switch, and turn it ON again. 2)When the result of the energy check during initialization is [NG] (☞ Fig. 4.1), replace the lamp by the procedure in "3.4 Replacing the Light Source".	P2-9 P3-7

Symptom	Typical Cause	Remedial Action	Reference Page
Photometry values are odd.	Is the light source lamp lit?	■ When the icon is blinking **[Action]** The lamp is currently OFF with some errors. The fan is not working or the thermo censor on the circuit board has detected overheating. Turn OFF the UV-1800 power switch and contact your Shimadzu representative.	——
	Did you mistakenly press the AUTO ZERO key during measurement?	Return to the blank condition (reference condition) and press the AUTO ZERO key again.	P1-7
	Is the cell being used an appropriate one?	Do not use a glass cell in the ultraviolet range.	——
	Is a cell phone being used near the instrument?	The measured value may be influenced depending on the types of cell phones and the radio waves conditions. Avoid using a cell phone near the instrument during measurement.	——
Baseline curve does not meet normal specifications. (☞ "6.1.1 Hardware Specifications")	When correcting the baseline, did you put a solvent with high absorbance in the cell holder on only one side?	Place cells with the same solvent in both the sample side and the reference side and perform baseline correction again.	——
	Is the beam on only one side restricted?	Set the beam conditions so that they are identical on both the sample side and the reference side.	——
	Are you using an optional accessory?	Some of the unit specifications may not be met when certain optional accessories are installed.	——
	If none of the above three scenarios applies.	Correct the instrument baseline according to "2.6 Instrument Baseline Correction".	P2-13

Symptom	Typical Cause	Remedial Action	Reference Page
Neither light source lamp lights.	Is the Cooling fan working?	Check if air is expelled from the exhaust port located on the left side rear of the instrument. If the fan has stopped, turn OFF the UV-1800 power switch and contact your Shimadzu representative.	——
"It failed in the access to the file."	Is the USB memory or its file system intact?	Use a normal USB memory.	——
	Did you unplug the USB memory during file access?	Reconnect the USB memory and retry accessing the file.	——
	Is the USB memory write-protected?	Turn OFF the USB memory write protection function.	——
	Is the USB memory drive encrypted by its security function?	Cancel the encryption of the USB memory.	——
"Cannot load this file."	Has the file been saved in the UVProbe?	The files once saved in the UVProbe cannot be loaded on the UV-1800.	——
	Has the file been properly saved?	The selected file may be corrupted. In that case, the file cannot be loaded.	——

Chapter 6 Reference

CONTENTS

6.1 Specifications

6.1.1 Hardware Specifications

Measurement Wavelength Range	190~1100 nm
Spectral Band Width (Resolution)	1±0.2 nm
Wavelength Accuracy	±0.1 nm (656.1 nm D2), ±0.3 nm (All region)
Wavelength Repeatability	±0.1 nm
Wavelength Scanning Speeds	When shifting wavelength: approx. 6000 nm/min When scanning wavelength:approx. 3000 nm/min ~ 2 nm/min
Light Source Switching	Automatic switching with wavelength range. Can be set anywhere in range from 295 nm to 364 nm (0.1 nm units)
Stray Light	0.02 % or less (220 nm, NaI) 0.02 % or less (340 nm, $NaNO_2$) 1 % or less (198 nm, KCl)
Photometric System	Double beam optics
Photometric Range	Absorbance: -4~4 Abs, Transmittance: 0~400 %
Photometric Accuracy	±0.002 Abs (at 0.5 Abs), ±0.004 Abs (at 1 Abs), ±0.006 Abs (at 2 Abs); Tested by using NIST930D or NIST1930, or other appropriate standard filter.
Photometric Repeatability	0.001 Abs or less (at 0.5 Abs), 0.001 Abs or less (at 1 Abs), 0.003 Abs or less (at 2 Abs)
Noise Level	Within 0.00005 Abs (700 nm)
Baseline Flatness	±0.0006 Abs (190 nm ~ 1100 nm) 1 hour after the light source is ON.
Baseline Stability	Within 0.0003 Abs/h (700 nm) 1 hour after the light source is ON.
Light Source	20 W halogen lamp, Deuterium lamp Built-in light source position automatic adjustment mechanism
Monochromator	Czerny-Turner spectrometer Uses blazed holographic grating
Detector	Silicon photodiode
Sample Compartment	Interior dimensions: 110 × 250 × 115 (mm) (W × D × H)
Dimensions	450 × 490 × 270 (mm) (W × D × H)
Weight	15 kg
Operating Temperature	15 °C ~ 35 °C
Operating Humidity	30 % ~ 80 % (No condensation, 70 % or less at 30 °C or higher)
Power Supply	AC 100 V/120 V/220 V/230 V/240 V, 50/60 Hz
Power Consumption	140 VA

6.1.2 Software Specifications

Photometric	**One-wavelength measurement** (1) Photometric modes: Absorbance (Abs), transmittance (%T) (2) Simple quantification by K-factor method (3) Save/Load table data function **Multi-wavelength measurement** (1) Photometric modes: Absorbance (Abs), transmittance (%T) (2) Max. 8 wavelengths (Wavelength setting is possible by the unit of 0.1 nm.) (3) Wavelength calculation function: Calculation using data at up to 4 wavelengths is possible. • Ratio and difference between the photometric values of two wavelengths, three wavelength calculation • 4 data calculation: (K1 × A1 + K2 × A2 + K3 × A3 + K4 × A4) × K5 • 4 data calculation: K5 × (K1 × A1 + K2 × A2)/(K3 × A3 +K4 × A4) * An (n = 1 to 4) indicates absorbance at the measurement wavelength of λn (n = 1 to 4)
Spectrum	(1) Measurement mode: Absorbance (Abs), transmittance (%T), and energy (E) (2) Scan range: 190 nm to 1100 nm (3) Scan speeds: Fast, Medium, Fast, Medium, Slow, Very slow (4) Vertical axis recording range: Abs; -4.000 to 4.000 (Min. range; - 0.001 to 0.001) %T, E; -400.0 to 400.0 (Min. range; - 0.1 to 0.1) (5) Scan repetitions: 1 to 99 (6) Recording method: Overlay/ Sequential selectable (7) Reduce/Expand [zoom], Display data with cursor (8) Save/Load data function

Quantitation	(1) Measurement method: One-wavelength/Two-wavelength/Three-wavelength quantitation, Quantitation by derivative (1 to 4 order) calculation (2) Functions regarding calibration curve Automatically calculate concentration by K-factor method Automatically calculate concentration by one-point calibration curve method Multi-point calibration curve 1 to 3 order regression calibration curve Number of standard samples (1 to 10) Select pass-through-origin conditions Display of calibration curve formula Display of relative coefficient of calibration curve (3) Measurement parameter Quantitation by repeat measurement (1 to 10 times) and taking the average measurement value (4) Save/Load table data function (5) Automatic data print function: Results are automatically output on hard-copy printer for every measurement. (6) Special accessories • Linked measurement with multi-cell, 8/16 micro-multicell and CPS-240 is possible. • Sipper: linked measurement with the ASC-5 is possible
Kinetics	**Kinetics** (1) Measure Abs time change and calculate activity values. (2) Measurement time: 1 to 9999 sec/min (3) Measurement using Abs difference between two wavelengths is possible. **Rate-measurement** (1) Measure Abs time change and calculate the change in absorbance quautity. (2) Measurement time: 1 to 9999 sec/min (3) Determine whether the measured reaction result is progressing in linear fashion.

Time Scan	(1) Measure time course change in photometric values. (2) Measurement mode: A Absorbance (Abs), transmittance (%T), energy (E) (3) Measurement time: 1 to 9999 sec/min (4) Linked measurement with multi-cell, 8/16 micro-multicell and CPS-240 is possible. (5) Reduce/Expand [zoom], Display data with cursor (6) Save/Load data function
Multi-Component Analysis	(1) Up to 8 components (2) Pure and mixed samples of each constituent component can be used as standard samples (3) Besides measurement wavelengths, standard sample data can be filed. (4) Quantitation can be done by calling up spectra
Bio-method	**DNA quantitation** (1) Calculate DNA/Protein concentrations and Abs ratio. DNA concentration =K1×A1-K2×A2 Protein concentration = K3×A2-K4×A1 (2) Factor/measurement wavelength can be set arbitrarily. (3) Background correction can be applied. **Protein quantitation** (1) Quantitation method: Lowry method, BCA method, Biuret method, CBB method (Bradford method), UV absorption method

Maintenance and Inspection Function	(1) Instrument baseline correction function (2) Display/Reset of lamp lighting time (3) Security setting Faculty limitation can be set for each user account. (4) Unit validation function 1) Correspond to 9 items Wavelength accuracy, wavelength repeatability, spectral band width, stray light, photometric accuracy, photometric repeatability, baseline flatness, baseline stability, noise level, initialization result record 2) Semi-automatic test: For items requiring test jigs, test can be progressed in the form of dialog. 3) Full automatic test: Test is automatically performed from measurement to pass/fail judgment/result printing. 4) Setting test conditions/pass fail judgment criteria 5) Detailed printing of the test results 6) Printing of all test result
File Management Function	(1) Convert spectrum and time course curve to CSV format. (2) Copy and delete files.
Data Processing Function	Following processings can be performed on curve data such as spectrum and time course curve. • Peak/Valley detection (both possible up to 20 pcs.) • The four rules of arithmetic • Derivative processing • Smoothing processing • Area calculation • Point-pick processing • Print processing (printing waveform data in text format)

Common Function	(1) Selection function of the setting conditions after power is supplied, Standby at the condition setting menu of each measurement mode, Specifying a condition file is possible (2) Selection function of data display digits below decimal point Abs (3 digits) %T (1 digit) or Abs (4 digits) %T (2 digits) (3) Number of files that can be stored (built-in memory) Measurement conditions: Max. 24 files Curve data : Max. 8 files Table data : Max. 8 files (4) Accumulation time set function (for fixed wavelength measurement) (5) External control function UV-1800 can be controlled from PC. This function is applied for the control with bundled UVProve software. * USB cable (that supports USB 1.1) separately required

6.2 Maintenance Parts

6.2.1 Consumable Parts

Part Name	Part No.	Remarks	Replacement Cycle
Tungsten iodine lamp	062-65005	Light source	2 years
Deuterium lamp	062-65055-05	Light source	2 years

* Replacement cycle above is a recommended value.

6.2.2 Maintenance Parts

Part Name	Part No.	Remarks	Replacement Cycle
Mirror, R(30.60)-FR	206-25347-91	Light source switching mirror	3 years
Quartz plate	206-25346-91		3 years
Lens	206-25348-91		3 years

* Replacement cycle above is a recommended value.

6.2.3 Repair Parts

Part Name	Part No.	Remarks
AC power cable	071-60816-12	
Fuse, 218 004	072-02004-22	For 100-120 V, 220-240 V
Battery, CR2032H 38	074-73306-08	
O-ring	036-15501-21	Used for fixing the quartz plate.
Alternate Sample Compartment	206-60184-07	
Standard cell holder	206-82009-91	
Sample compartment front cover ASSY	206-25269	
Sample compartment cover	206-25269	

6.3 Spectrophotometer Basics

6.3.1 What is Light?

Light is a type of electromagnetic radiation with a speed of 3.0 x 10^8 m/sec in a vacuum. Electromagnetic radiation includes X-ray, ultraviolet ray, visible ray, infrared ray, and radio waves.

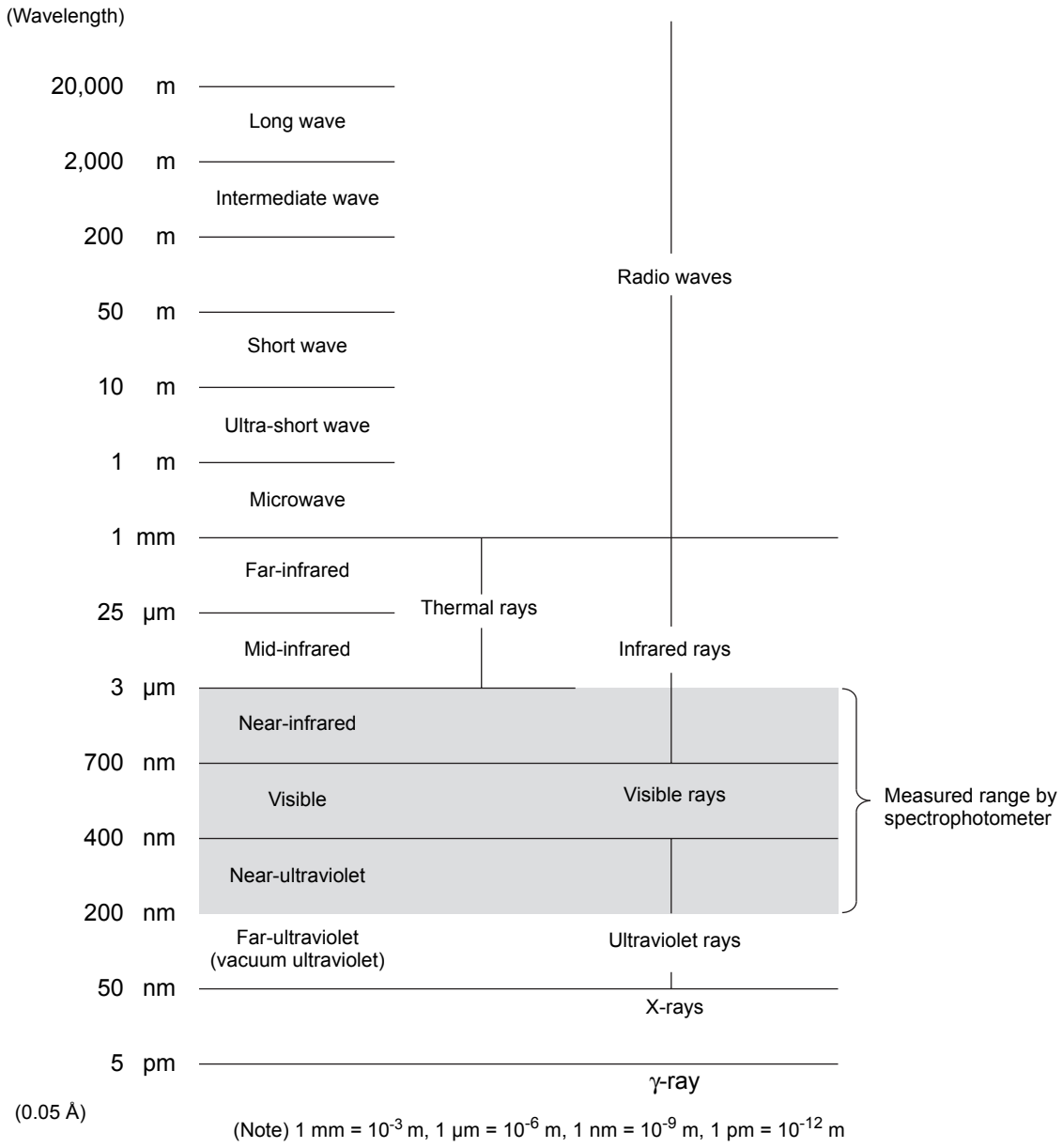


Fig. 6.1 Types of electromagnetic waves

Wavelength is defined as the length of a single cycle and is usually indicated by a sign called lambda, λ.
For the range of ultraviolet ray and visible lights, a unit called nm (nanometer) is used.

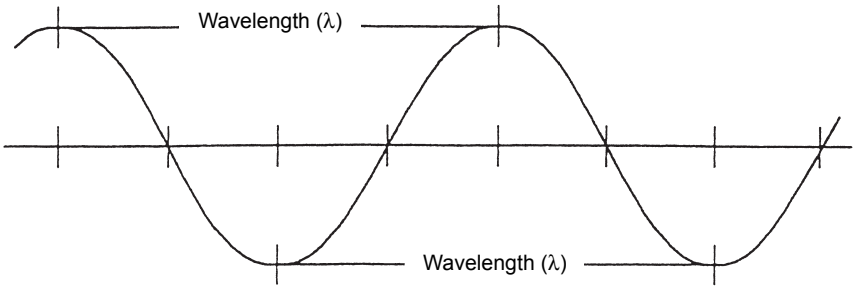


Fig. 6.2 Wavelength

Generally, rays of various wavelengths are mixed in the light emitted from a light source (although some emit rays of specific wavelength such as laser light source, or others emit light of several specific wavelengths such as mercury lamps). The light of a certain wavelength extracted selectively by the use of a monochromator is called monochromatic light. Light that includes all the rays in the wavelength range of visible rays is called white light.
The relation between wavelength and color is as follows:

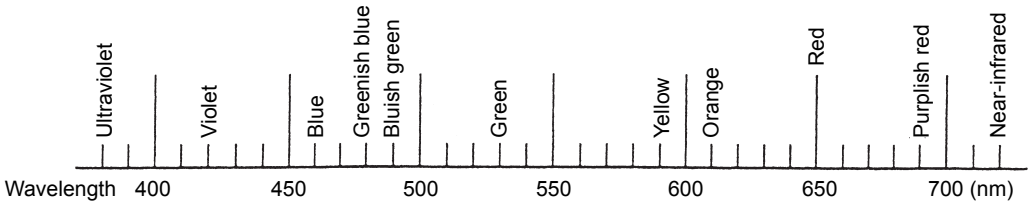


Fig. 6.3 Wavelength and color of light

When white light is irradiated on some substance and the substance absorbs the blue light, it appears yellow, which is the (additive) complementary color of blue. If blue monochromatic light is irradiated on this substance, the light is absorbed and the substance appears black, indicating that no color exists.

Wavelength (nm)	Color	Complementary color
400 - 435	Violet	Yellow green
435 - 480	Blue	Yellow
480 - 490	Greenish blue	Orange
490 - 500	Bluish green	Red
500 - 560	Green	Purplish red

Wavelength (nm)	Color	Complementary color
560 - 580	Yellow green	Violet
580 - 595	Yellow	Blue
595 - 610	Orange	Greenish blue
610 - 680	Red	Bluish green
680 - 700	Purplish red	Green

6.3.2 Ultraviolet/Visible Spectrum

The energy (E) of light can be expressed as follows.
$E = ch/\lambda$
c is the velocity of light, h is Planck's constant, and λ is wavelength.
When light is irradiated on a substance, the light of certain wavelengths is absorbed according to the molecule structure of that substance. This happens as the result of the fact that the electrons existing at the ground state of the molecule absorb light energy and a transition to excitation state occurs. The amount of absorption differs depending on wavelength, and so the absorption spectrum (the curve measuring absorption when monochromatic light is irradiated to a substance with varying wavelengths) becomes unique to that substance. The analysis of substances based on this principle is called absorptiometry and this method allows (1) Identification, (2) Quantitative analysis, and (3) Analysis of electron state. Also, the excited molecule loses energy due to heat and collision with other molecules and returns to its original ground state. This process is called "radiationless transition". In addition, the molecule may emit the absorbed light energy as light when returning to the ground state. Fluorescent light and phosphorescence exhibit the behavior and analysis utilizing these phenomena is called fluorometry.

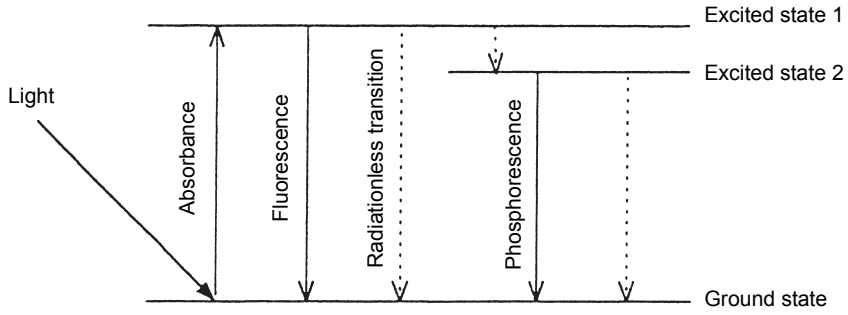


Fig. 6.4 Molecule energy

6.3.3 Bouguer-Beer's Law

This law, which is the basic principle of quantitative analysis, is also called Lambert-Beer's law.

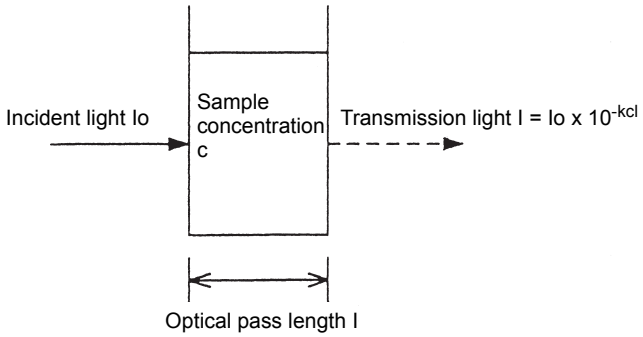


Fig. 6.5 Bouguer-Beer's law

When light with the intensity of Io is irradiated on a certain substance and the light with the intensity of I has transmitted, the following relational formula is established, where K stands for proportional constant.
At this time, I/Io is called transmittance (T), I/Io × 100 is percent transmittance (%T) and (1/T) = log (Io/I) is called absorbance (Abs).

$$T = I/Io = 10^{-k \cdot c \cdot l}$$

$$Abs = \log (1/T) = \log (Io/I) = k \cdot c \cdot l$$

As known from the above formula, transmittance is not proportional to the concentration of the sample, but absorbance is proportional to the concentration of the sample (Beer's law) and is proportional to light path length (Bouguer's law). Also, the proportional constant at the time when the light path length is 1 cm and the concentration of object component is 1 mol/l is called molar absorptivity and is represented by the sign of ε. This molar absorptivity becomes a value unique to the substance under specific conditions.
To fulfil Bouguer-Beer's law, it is necessary to satisfy conditions such as being free from stray light, emission, scattering, and reflection.

6.3.4 Qualitative Analysis and Quantitative Analysis

To analyze what a substance is and what substances it consists of is called qualitative analysis, while analysis of the amount of these substances is called quantitative analysis.

■ Spectrum and Chemical Structure (Qualitative Analysis)

The absorbance of ultraviolet/visible light is determined by chromophore (functional group that absorbs light such as C = C, C = O, N = N, and N = O, having multiplet bonding) and auxochrome (functional group that bonds with chromophore and changes its absorbance position and intensity such as - OH, -NH2, and -SH, having non-bonding electron pair), and so is related to the chemical structure. In this case, absorbance may change depending on introduction of substitution group and types of solvent. Movement of the absorbance wavelength to a longer wavelength is called "bathochromic movement", and its movement to a shorter wavelength is called "hypsochromic movement". Also, an increase of absorbance is called the "hyperchromic effect" and a decrease is called the "hypochromic effect".

■ Colorimetric Analysis (Quantitative Analysis)

Analysis to perform quantitative analysis by comparing the color darkness of a substance is called colorimetric analysis. When the substance is transparent, if absorbance exists in the invisible ultraviolet/near infrared area, it is measured. The latter is broadly included in colorimetric analysis.

6.3.5 Calibration Curve

The quantitative method to measure the concentration of a sample with unknown concentration from the absorption of a sample with known concentration is provided in two methods: (1) Calibration curve method and (2) Standard additive method.

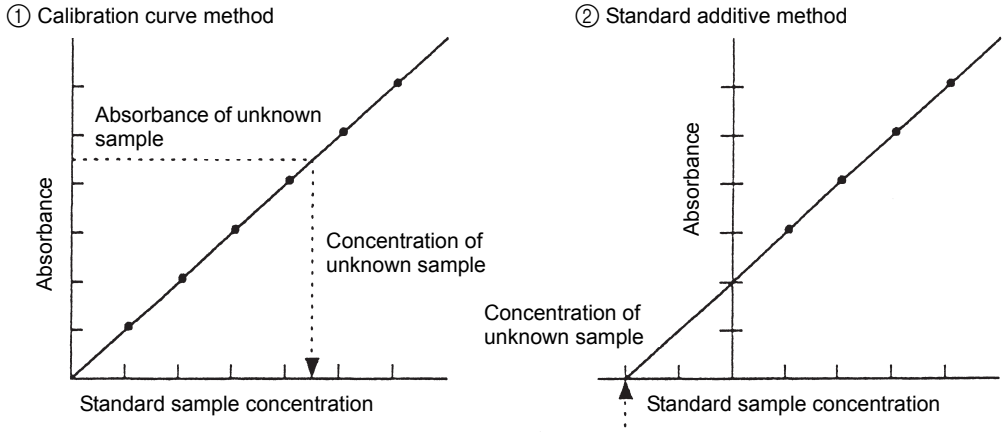


Fig. 6.6 Calibration curve

In the calibration curve method, standard samples are operated according to an established method and then measured for absorbance. A calibration curve is prepared by using the absorbance obtained here in the vertical axis and the standard sample in the horizontal axis. There are times when the calibration curve does not make a straight line such as when the solution to be measured is a suspension. Although the calibration curve is sure to pass the origin when a blank solution is used, if it is not used, the curve may not pass the origin. Next, the concentration of the object components in the unknown sample is obtained using this calibration curve.
In the standard additive method, standard sample is added by stages to four or more samples of measurement sample solution of the same concentration. Similarly to the calibration curve method, a relation curve between added value and absorbance is prepared. The concentration of the object component in the unknown sample is obtained from the point where the related curve crosses the vertical axis. This method is applied only when the related curve is straight as far as to the low concentration range.
Generally, extra-large absorbance wavelength is used as measurement wavelength for quantitative analysis.

6.3.6 Solvent Selection

Generally when a sample is analyzed, it is measured as a solution. Accordingly, the type and the concentration of the solvent must be adequate. A solvent that dissolves the sample well and that is free from mutual action, has small absorbance in measurement wavelength range and has small volatility is desired. A cell with a lid is necessary for volatile solvent.
As a solvent, water is excellent for measuring absorbance in visible/ultraviolet range, as it has no absorbance itself. On the other hand, many of the normally used organic solvents are transparent to the human eye, so it can be mistakenly believed that absorbance does not exist in ultra-violet range either. The solvents and their available operating wavelength ranges are as follows:

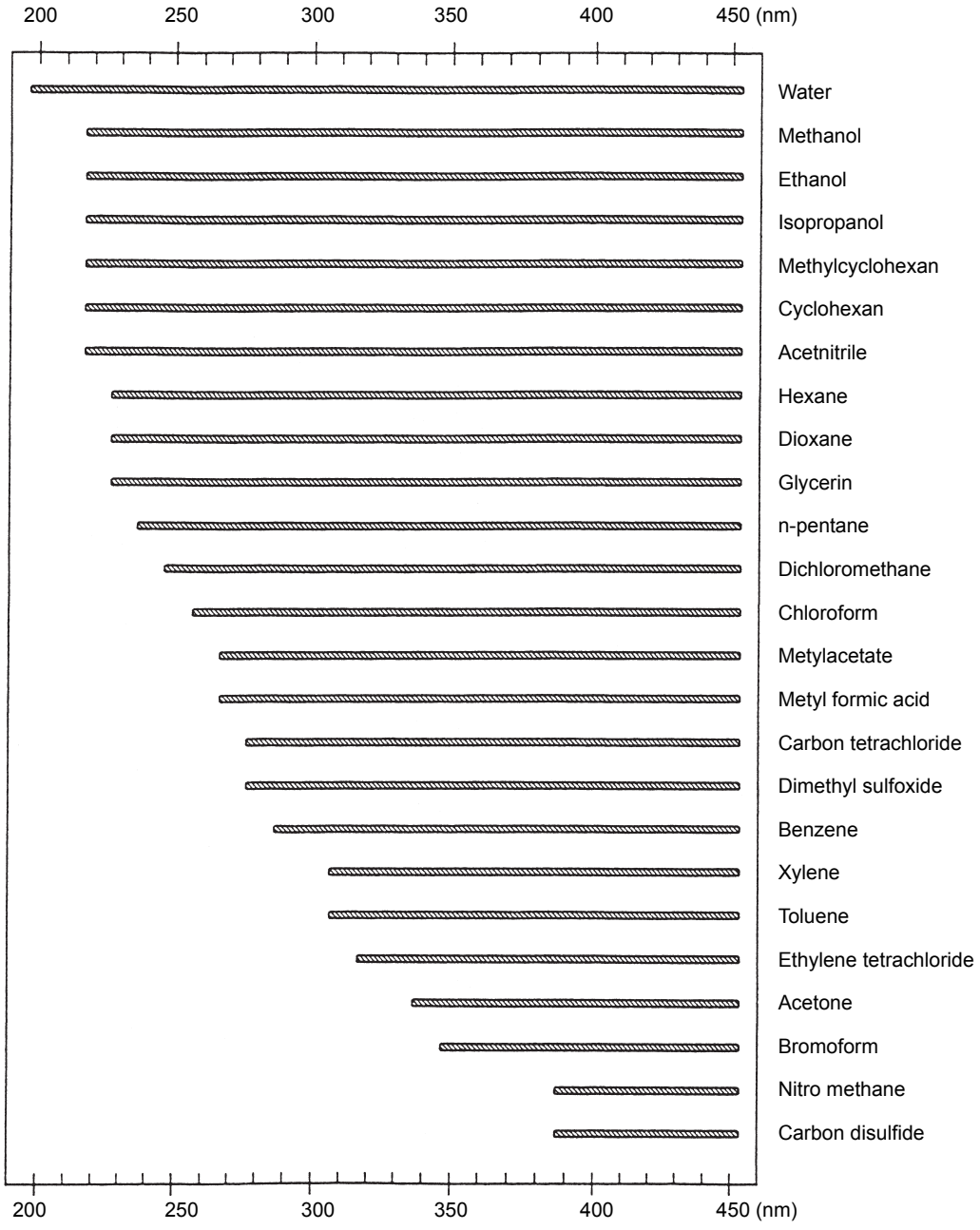


Fig. 6.7 Wavelength range for solvent to be used (using a 10 mm cell)

6.3.7 Calibration Curve Curvature

A calibration curve is generally straight. However, it may bend due to various reasons. The probable causes are ① drift of measurement circuit, ② fluorescent sample, ③ stray light, ④ broad band width, and ⑤ measurement at the spectrum shoulder.

① As a spectrophotometer has some drift immediately after power is supplied to it, it should be allowed to warm up for 30 min. to one hour. Also, drift may be observed over a long period of time, so it is important to check the wavelength accuracy and measurement accuracy periodically using a filter etc.

② When a sample emits fluorescent light and if that light enters the detector, the absorbance may appear low and the amount of fluorescent light increases as sample concentration becomes higher. As a result, the calibration curve may be bent toward the lower side. If this occurs, it is necessary to reduce the influence of fluorescent light as much as possible by increasing the distance between the sample and the detector or by inserting a mask between the sample and the detector.

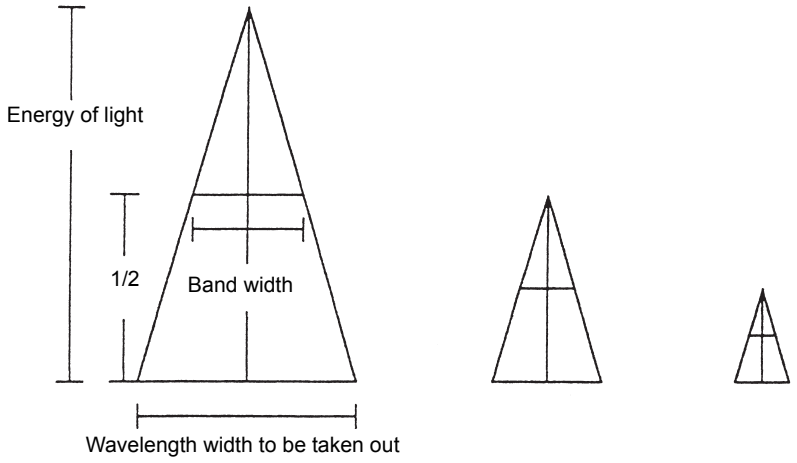
③ Stray light is the total of the light of the wavelength deviated from a certain spectrum width having the set wavelength of the monochromator placed in the center and the light emitted from monochromator, but does not transmit the sample and pass the side of the sample. For example, with 0.1% of stray light included in the monochromatic light, when a sample with the wavelength of λ o and absorbance of 2 (transmittance 1%) is measured, because 0.1% stray light is added in addition to 1% of the light with the wavelength of λ o, the transmitted light will have 1.1% of transmittance (absorbance 1.959), causing 2% error. As known from this, the higher the sample absorbance is, the larger the error due to stray light becomes. To reduce stray light, it is generally effective to form a double-monochromator by connecting two monochromators. Although it is expensive due to the complex mechanism, the amount of stray light is reduced from one-fiftieth (1/50) to one-one thousandth (1/1000) of that of normal single monochromator.

Table 6.1 Absorbance error due to stray light

Stray light (%)	Absorbance								
	0.8	1.0	1.2	1.5	1.8	2.0	2.5	3.0	4.0
1	0.0222	0.0370	0.0595	0.1150	0.2081	0.2967	0.6150	1.0370	2.0000
0.5	0.0133	0.0190	0.0309	0.0615	0.1169	0.1739	0.4096	0.7759	1.7059
0.2	0.0045	0.0077	0.0126	0.0257	0.0507	0.0783	0.2119	0.4762	1.3213
0.1	0.0022	0.0038	0.0063	0.0130	0.0261	0.0409	0.1188	0.3005	1.0409
0.05	0.0011	0.0019	0.0032	0.0065	0.0132	0.0209	0.0635	0.1758	0.7799
0.02	0.0004	0.0007	0.0012	0.0026	0.0053	0.0085	0.0365	0.0790	0.4770
0.01	0.0002	0.0003	0.0006	0.0013	0.0026	0.0042	0.0134	0.0413	0.3009
0.005	0.0001	0.0001	0.0003	0.0006	0.0013	0.0021	0.0067	0.0211	0.1791
0.002	0.0000	0.0000	0.0001	0.0003	0.0005	0.0008	0.0027	0.0085	0.0791
0.001	0.0000	0.0000	0.0000	0.0001	0.0002	0.0004	0.0013	0.0043	0.0413
0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0004	0.0043

(Test and Engineering Vol.9 No.9,702,1981)

④ A halogen lamp or deuterium lamp are used as the light source of a spectrophotometer. Because these lamps emit a continuous spectrum, taking out 500 nm monochromatic light from the monochromator does not mean that only the light of 500 nm is taken out, but the light in a wavelength range having a certain width is taken out.



Band width	1	1/2	1/4
Area	1	1/4	1/16
Total amount of energy of light	1	1/4	1/16

Fig. 6.8 Band width and energy of light

Because the absorption coefficient of a substance differs depending on wavelength, even if the central wavelength is the same, with different bandwidth, the wavelength width of the light to be taken out varies. This causes the absorption coefficient to be changed in appearance and this results in absorbance change. It is sufficient to set the bandwidth of a spectrophotometer from one-eighth (1/8) to one-tenth (1/10) of the half width of a sample's absorbance spectrum. The half-width of the absorbance spectrum means the width at the half of the peak of the absorbance spectrum. Because the absorbance spectrum often has a broad half-width in colorimetric analysis, a bandwidth of 10 nm is sufficient. Making the bandwidth extremely narrow generates large noise due to energy shortage and may result in poor measurement accuracy. If the bandwidth is made large, the peak height becomes low in appearance and this may cause the calibration curve to be bent.

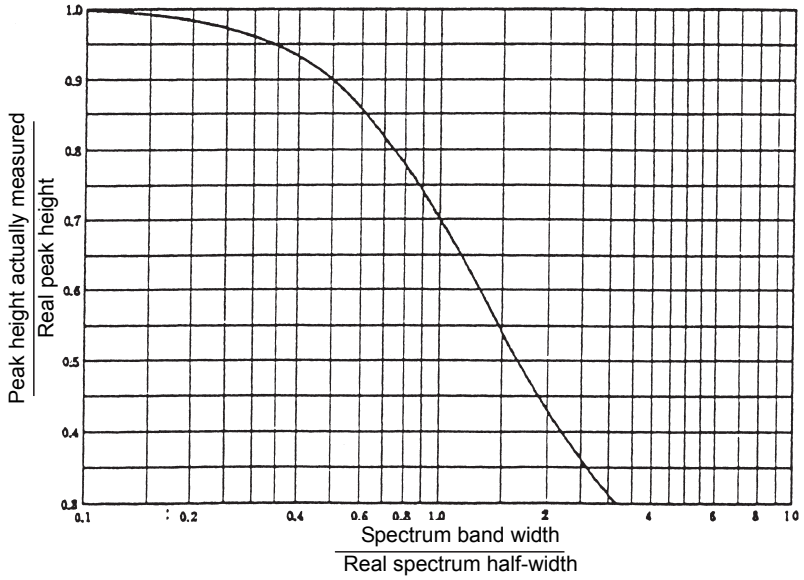
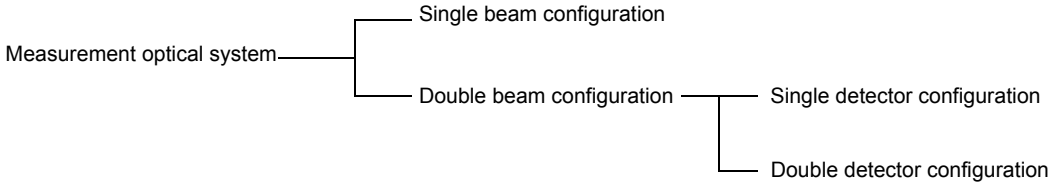


Fig. 6.9 Band width and peak height

6.3.8 Spectrophotometer Types

Spectrophotometers can be categorized broadly by optical systems as follows:



■ Single and Double Beam Configurations

- Single beam configuration
  This configuration allows only one beam to pass through the sample compartment. First, set the transmittance to 100 % or the absorbance to 0 using the cell filled with solvent. Then replace it with the cell containing sample and perform measurement.

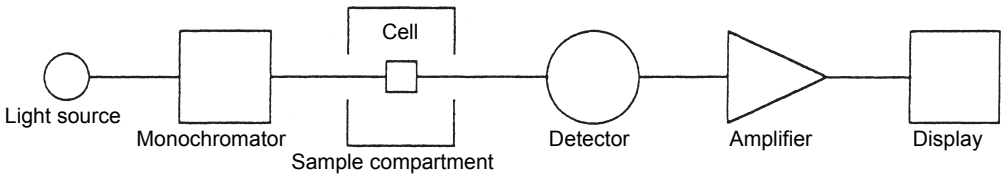


Fig. 6.10 Single beam configuration

- Double beam configuration
  This configuration divides the monochromatic light into two beams using mirrors, such as a rotating mirror and a semi-transparent mirror, so as to make two beams, the sample beam and reference beam. When the sample cell with sample in it is placed for the sample beam and the reference cell with solvent in it is placed for reference beam in the sample compartment, each transmitted light enters the detector. The feature of this configuration then is that transmittance and absorbance can be measured once from the sample sign I and the reference sign Io simultaneously.

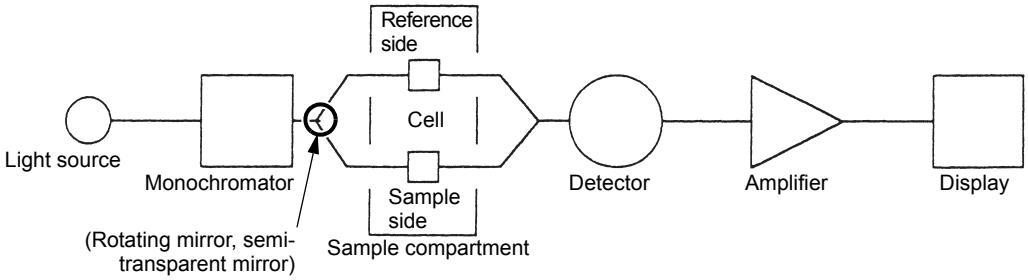
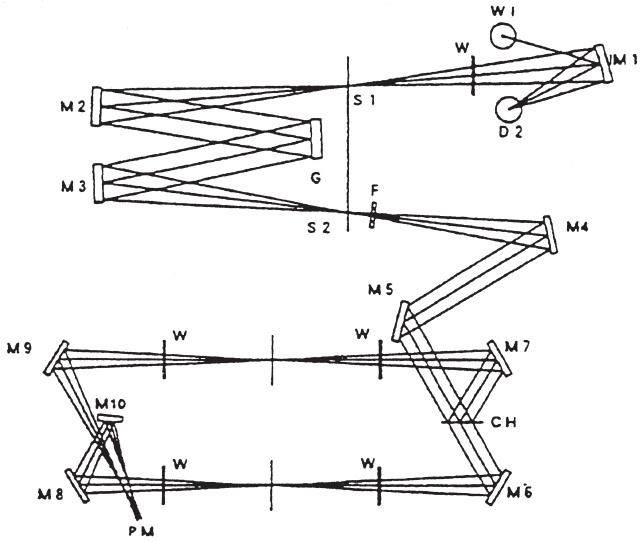


Fig. 6.11 Double beam configuration

■ Single and Double Detector Configuration

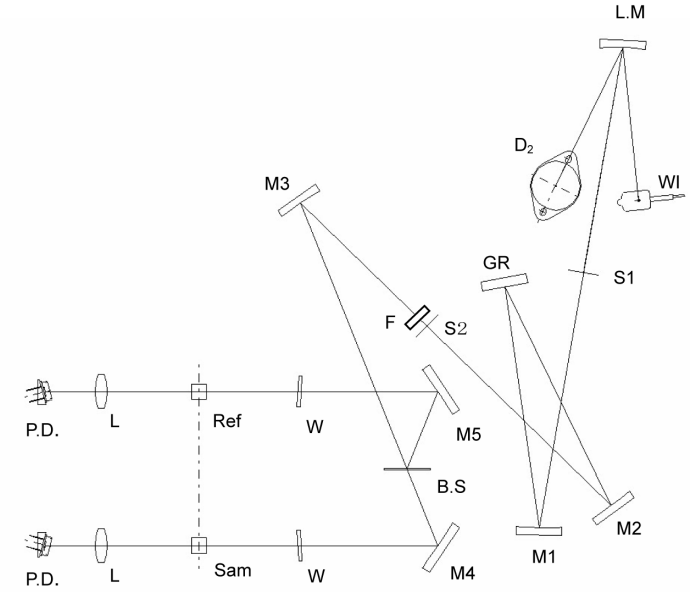
- Double beam - single detector configuration
  In this configuration, a sample beam and reference beam alternately enter one detector.
  So unlike the double-detector configuration, the result is less likely to be influenced by the difference in characteristics of the two detectors.



WI:	Halogen lamp
D2:	Deuterium lamp
W:	Window plate
S1-2:	Slit
M1-10:	Mirror
G:	Grating
F:	Filter
CH:	Chopper mirror
PM:	Photomultiplier

Fig. 6.12 Double beam - single detector configuration (UV-2400 series)

- Double beam - double detector configuration
  In this configuration, the sample beam and the reference beam enter different detectors respectively. Thus, it is necessary to use two detectors with similar characteristics. The advantage of this configuration is that it is not necessary to always pass two beams to the same detector as in the case of the single detector configuration, and so a larger space is possible in the sample compartment, convenient for measuring unclear samples by keeping them in close contact with the light receiving surface. However, in the case of the photomultiplier, this configuration is not used because matching the detector is difficult.

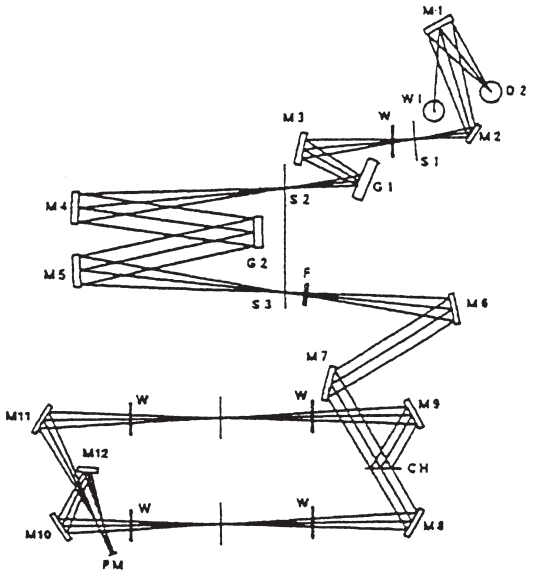


WI:	Halogen lamp
D2:	Deuterium lamp
W:	Window plate
S1-2:	Slit
L.M.:	Light-source switching mirror
M1-5:	Mirror
GR:	Grating
F:	Filter
B.S.:	Beam splitter
Sam:	Sample side cell
Ref:	Reference side cell
L:	Lens
P.D.:	Photodiode

Fig. 6.13 Double beam - double detector configuration (UV-1800)

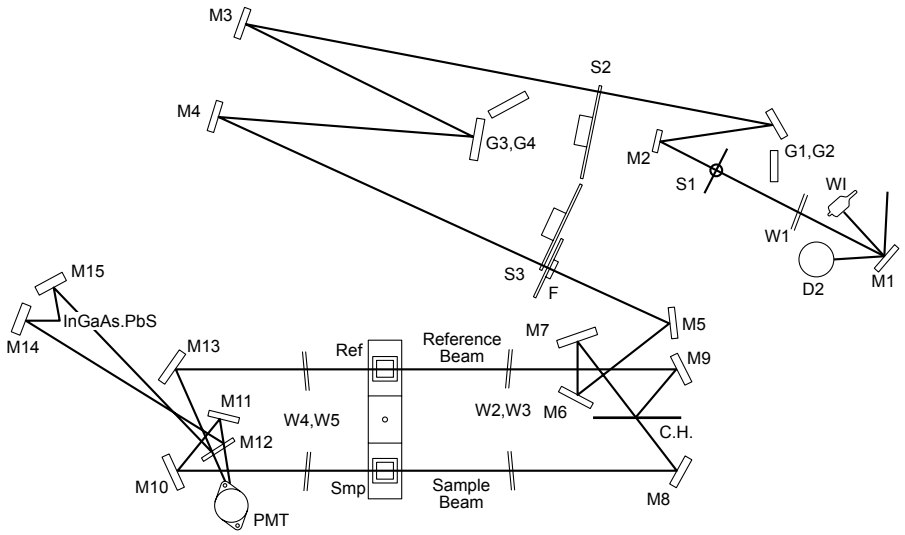
■ Single Monochromator and Double Monochromator

A single monochromator system has one monochromator and a double monochromator system has two monochromators aligned in a series. Accordingly, when two monochromators are aligned in parallel as in the case of a two-wavelength spectrophotometer, the system is not called a double-monochromator even though it has two monochromators.
The double monochromator disperses the monochromatic light emerging from the first monochromator again by means of the second monochromator. So stray light is greatly reduced and a calibration curve of good linearity is obtained even though absorbance becomes high, allowing analysis of samples with a broad concentration range.



WI:	Halogen lamp
D2:	Deuterium lamp
W:	Window plate
S1-3:	Slit
M1-12:	Mirror
G1-2:	Grating
F:	Filter
CH:	Chopper mirror
PM:	Photomultiplier

Fig. 6.14 Double monochromator configuration (UV-2500 series)



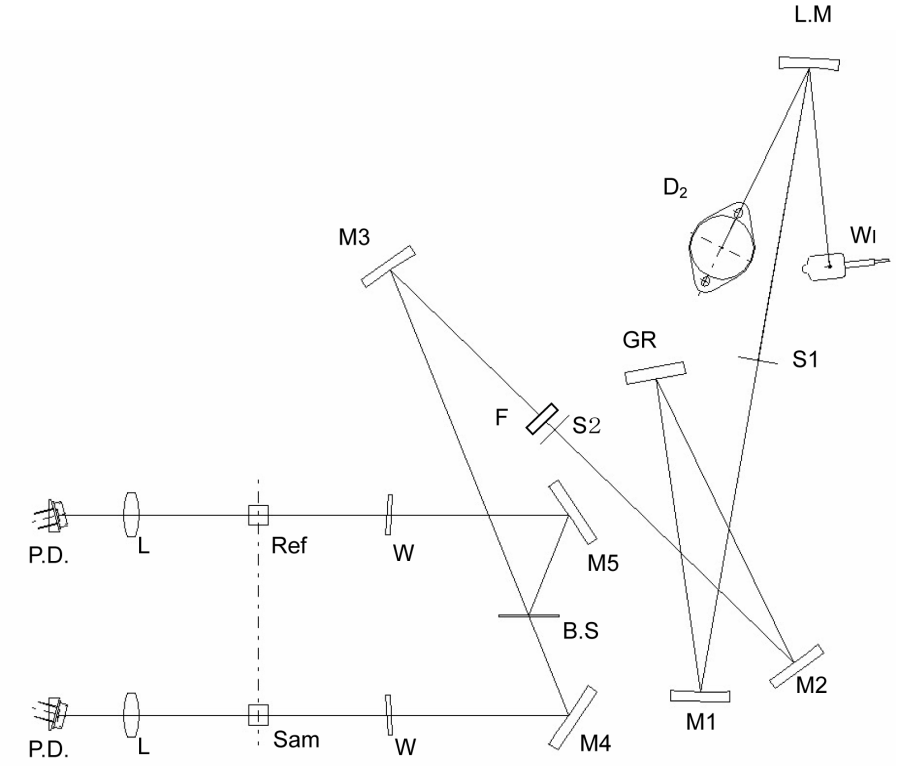
D2:	Deuterium lamp	WI:	Halogen lamp
S1:	Entrance Slit	M1-15:	Mirror
S2:	Intermediate slit	PbS:	PbS cell
S3:	Exit Slit	InGaAs:	InGaAs cell
F:	Filter	PM:	Photomultiplier
G1, G2:	Diffraction grating (First monochromator)	Reference:	Reference side cell
		Sample:	Sample side cell
G3, G4:	Diffraction grating (Second monochromator)	W1 ~ W3:	Window plate (ø 30 mm)
		W4 ~ W5:	Window plate (ø 40 mm)
C.H.:	Chopper mirror		

Fig. 6.15 Double monochromator configuration (UV-3600 series)

6.4 Measurement System

6.4.1 Optical System

A schematic of the optical system for the UV-1800 is shown in Fig. 6.16.



D2:	Deuterium lamp	L.M.:	Light-source switching mirror
WI:	Halogen lamp	M1~M5:	Mirrors
F:	Filter	B.S.:	Beam splitter
GR:	Grating	L:	Lens
S1:	Entrance slit	Sam:	Sample cell
S2:	Exit slit	Ref:	Reference cell
W:	Window Plate	P.D.:	Photodiodes

Fig. 6.16 Schematic of optical system

The light coming from the light source (deuterium lamp D2 or halogen lamp WI) is reflected by mirror L.M. and then enters the monochromator. Light source switching is entirely automatic, with the instrument selecting the next light source by rotating the mirror L.M. according to the wavelength.

Deuterium lamp: 190 nm to light source switch wavelength
Halogen lamp: Light source switch wavelength to 1100 nm
The light source switch wavelength can be set anywhere in the range from 295.0 to 364.0 nm (default setting: 340.8 nm).

With the exception of the light sources and light source mirrors, the optical system is constructed so as to prevent exposure to dust and contaminants.
The monochromator slit aperture is fixed at 1 nm.
The Shimadzu blazed holographic grading is used for the diffraction grading.
The light coming out of the monochromator passes through a stray light cutting filter F and strikes the mirror M3 and is then split by the beam splitter B.S. into the sample-side beam and the reference-side beam, which then pass through their respective cells and strike the detectors (photodiodes).
The relationship between the positions of the cell holders and the beams is as shown in Fig. 6.17.
The image of the exit slit S2 appears near the cell position in the sample compartment. The dimensions of the cross section of the beam on the image plane are

Width approx. 0.8 mm Height approx. 9 mm

Whenever possible, please use black cells for the microcells when using them, as they are minimally affected by scattered light. (☞ "6.5 List of Cells")

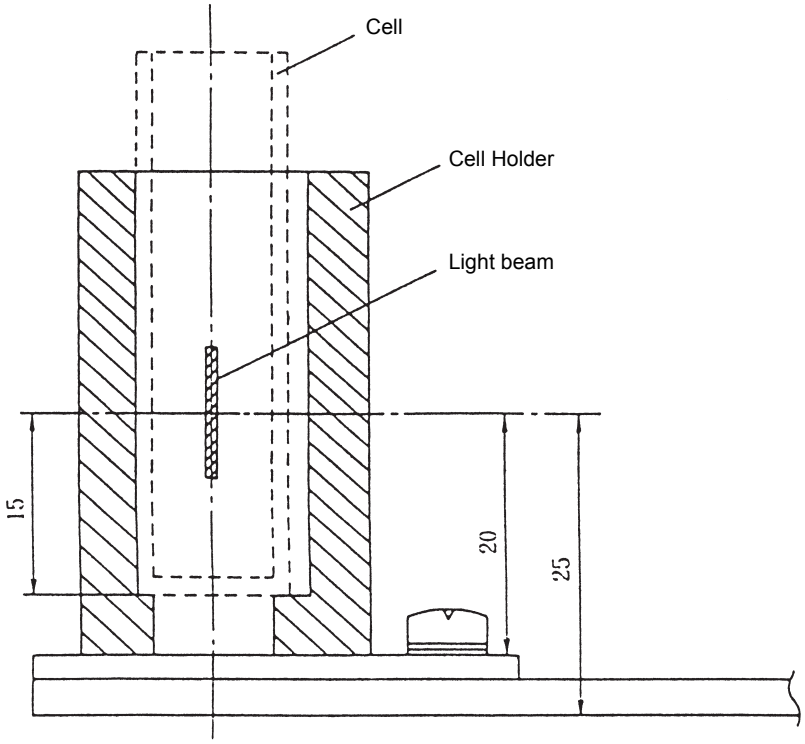


Fig. 6.17 Positional relationship of cell holder (cell) and light beam

6.4.2 Electrical System

A schematic of the electrical system for the UV-1800 is shown in Fig. 6.18.
The center of control is the microcomputer (CPU), which performs all controls of light sources, switching of light sources, filter switching, wavelength scanning pulse motor, LCD monitor display, keyboard and printer, USB interface etc.
After the sample-side beam and reference-side beam are picked up by detectors (photodiodes) and converted into the voltage by the pre-amplifier, the signal is then fed into an A/D converter and finally read by the CPU.
On energy-measurement mode (of spectrum mode) only the signal from the sample-side beam is read. In this case, S/R switching status is "Normal". If the status "Reverse", only the signal from the reference-side beam is read.

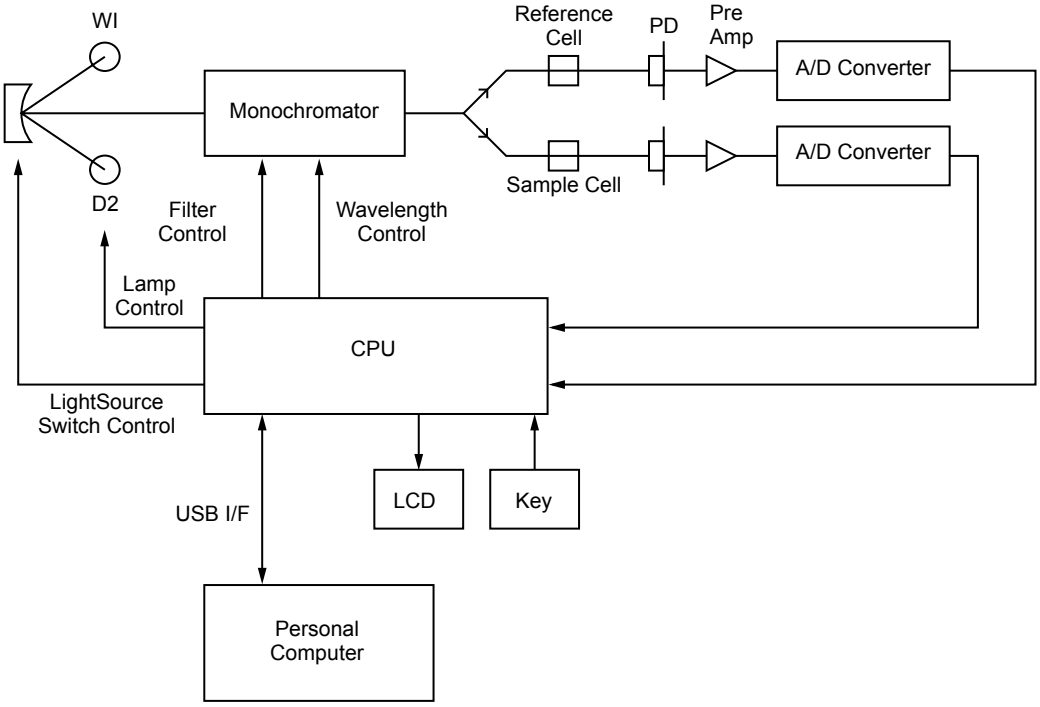


Fig. 6.18 Schematic of electrical system

6.5 List of Cells

Table 6.1 List of Optional Cells

Name		shape	Quartz (S cell)	Glass (G cell)	Q'ty	Special holder
Square cell, optical length 10 mm		A	200-3442	200-34565	1	Not required
Square cell, matching type		A	201-98716	200-98746	2/sets	Not required
Sealed-type square cell, optical length 10 mm		B	200-34444	200-34444-01	1	Not required
Semi microcell, optical length 10 mm required sample volume 1.0mL or more		C	200-66501	200-66501-01	1	Not required
Semi-micro black cell, optical length 10 mm required sample volume 1.0 mL or more		D	200-66551		1	Not required
Ultra-micro black cell, optical path length: 5 mm Required sample volume: 25 µl or more		K	208-92116		1	Ultra micro cell holder (206-55050-91) is req'd
Super-micro black cell, with 10 mm optical path and required sample volume of 50 µl more		L	200-66578-11		1	Super-micro cell holder (206-55050-91) req'd
Micro black cell, with 10 mm optical path and required sample volume of 50 µl more		M	200-66578-12		1	Super-micro cell holder (206-55050-91) req'd
Cylindrical cell (OD 25µ") (ID 22µ")	L (Optical.length) = 10 mm	E	200-34448 (quartz window)	200-34448-01 (glass window)	1	Cylindrical cell holder (204-06216) req'd
	L = 20 mm		200-34472 (quartz window)	200-34472-01 (glass window)	1	
	L = 50 mm	F	200-34447-01 (quartz window)	200-34473-03 (glass window)	1	
	L = 100 mm		200-34473-02 (quartz window)	200-34473-04 (glass window)	1	
Square long absorption cell	L = 20 mm	G	200-34446	200-34446-01	1	Long-path rectangular cell holder (204-23118-01) req'd
	L = 50 mm		200-34944	200-34944-01	1	
	L = 100 mm		200-34676	200-34676-01	1	
Short optical length cell	L = 1 mm	H	200-34660-01	200-34662-01	1	Short optical length cell spacer req'd
	L = 2 mm		200-34655	200-34662-11	1	
	L = 5 mm		200-34449	200-34449-01	1	
Spacer for short optical length cell K	for 1 mm	J		204-21473-03	1	Not required
	for 2 mm			204-21473-01		
	for 5 mm			204-21473-02		
Micro multi-cell (8 cells) optical length 10 mm and required sample volume of 100 µl more		N	208-92089		1	Micro multi-cell holder req'd (206-23680-91 206-23690-91)
Micro multi-cell (16 cells) optical length 10 mm and required sample volume of 100 µl more		P	208-92088		1	Micro multi-cell holder req'd (206-23680-91 206-23690-91)

6.5 List of Cells

Name	Shape	Quartz cell (S cell)	Capacity	Optical width of cell	Special holder	Remarks
Flow cell, optical path length: 10 mm	I	200-34670	1.5 mL	4×36	Unnecessary, but front plate with holes is necessary	For general use Without tube
Square flow cell (ultra-micro) for syringe sipper, optical path length: 10 mm Standard required sample volume: 0.9 ml or more	Q	208-92114	30 µl	ø2	Unnecessary	With tube
Square flow cell (micro) for syringe sipper, light path length: 10 mm Standard required sample volume: 1.0 ml or more	R	208-92113	80 µl	ø3	Unnecessary	With tube
Square flow cell (semi-micro) for syringe sipper, light path length: 10 mm Standard required sample volume: 5.0 ml or more	S	208-92005	390 µl	3.5 × 11	Unnecessary	With tube

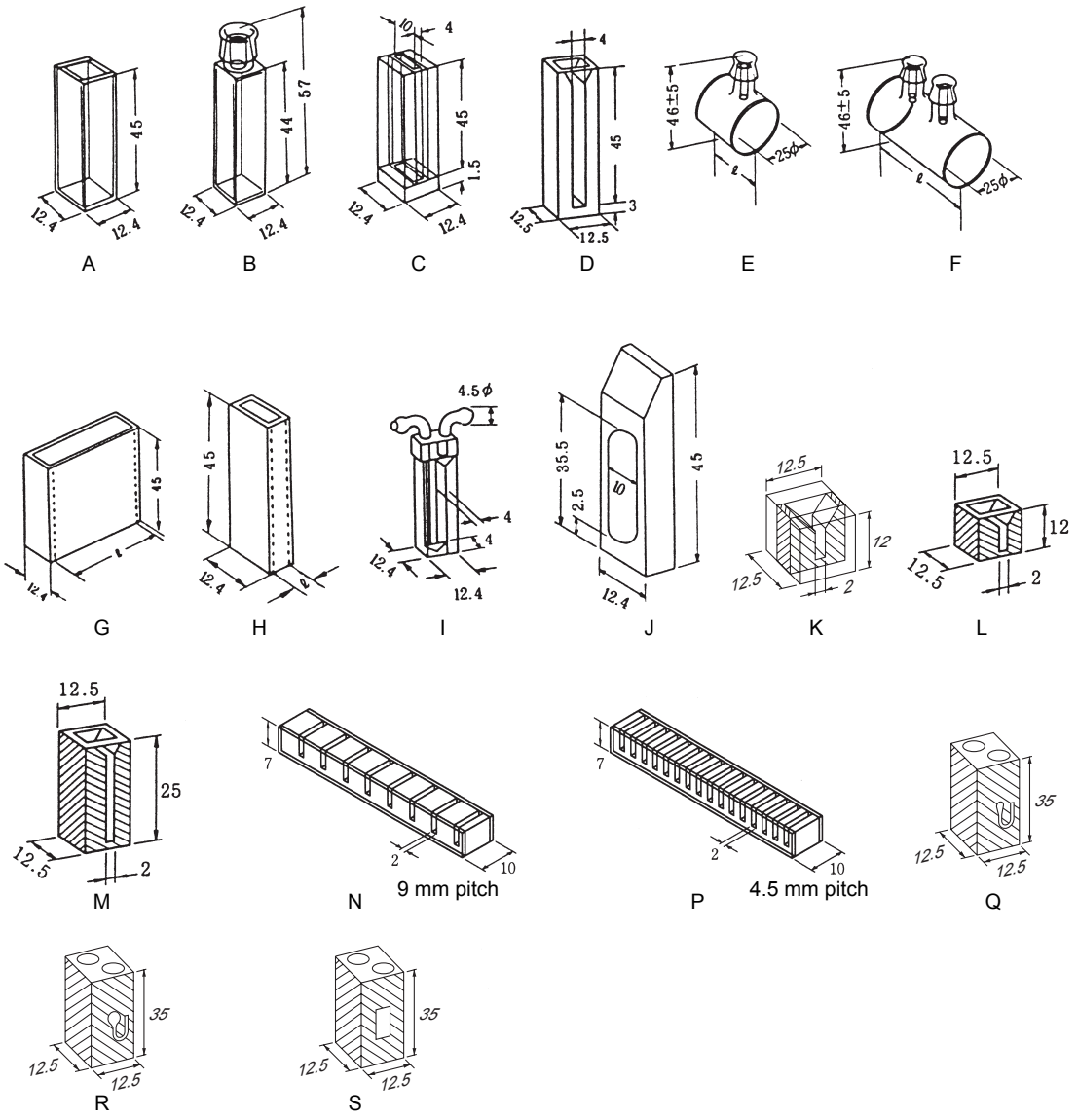


Fig. 6.19 Optional Cell Shapes

6.6 Cleaning the Cell

Remove the sample from the cell immediately after the completion of measurement.
After measurement of water solution samples, wash the cell with water thoroughly, then wash it with ethanol lightly, and let it dry well.

Wash with distilled water

↓

Wash with ethanol

↓

Dry

If the cell is stained, remove the stain by dipping the cell into cleaning agent or acid.

Dip into cleaning agent (30 °C - 50 °C) - Approx.10 minutes

↓

Wash with distilled water

↓

Dip into diluted nitric acid + small amount of hydrogen peroxide - Approx. 30 minutes

↓

Wash with distilled water

↓

Dry

If the cell gets stained with organic matter, first dip it into an organic solvent such as acetone and then wash it with distilled water.
However, when washing the flow cell for the sipper 160 series (special accessory), it is required to replace the "PVC tube for peristaltic pump" since the tube corrodes and hardens from the solvent.
Be sure to fill the flow cell with distilled water after washing. If the flow cell is left empty, the cell may get stained and it becomes hard to clean afterwards.

Record of Revision

Date	Revision	Changed Page	Description
2/2008	A	Front, 2-15, 6-2, 6-8, and more A: Record of Revision	

Note)

A ...Added Page No.

D ...Deleted Page No.