

# INSTRUCTION MANUAL

HALO RB-10 UV-VIS SPECTROPHOTOMETER

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## **HALO RB-10 Spectrophotometer Instruction Manual**

**Please read through this manual carefully and store it in a safe place.**

- Before using the instrument, please read the safety instructions and precautions carefully
- Keep this manual in a safe place nearby to access



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# INSTRUCTION MANUAL

Model HALO RB-10 UV-Vis Spectrophotometer

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<b>Read and keep this manual</b>
<ul style="list-style-type: none"><li>▪ Read the safety instructions carefully and understand them before using the equipment.</li><li>▪ Keep this manual at hand for reference.</li></ul>

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## PREFACE

Thank you very much for your purchase of Dynamica Model HALO RB-10 Spectrophotometer.

This instruction manual has been prepared for users of the HALO RB-10. It describes how to handle the Spectrophotometer.

The Model HALO RB-10 Spectrophotometer is intended for the purpose of photometric analysis. Do not use it for any other purpose.

The Model HALO RB-10 is designed for use by persons having a basic knowledge of chemical analysis. Other persons should operate the instrument in the presence of someone who has such basic knowledge. Remember that improper use of the instrument, chemicals or samples would result not only in wrong analytical data but in consequences adverse to safety.

Before using the instrument, be sure to read through this instruction manual to enable correct use.

For installation/maintenance of the instrument, read the instruction manual carefully to attain a full understanding of the instructions. Be sure to observe cautionary instructions.

Keep this manual handy for easy reference when necessary.

Information contained in this manual is subject to change without notice for product improvement.

## ABOUT THIS MANUAL

**Before using the instrument, be sure to read through this instruction manual.** First of all, read "SAFETY SUMMARY" included at the beginning of this manual for ensuring safety in operation of the spectrophotometer main unit.

# IMPORTANT

## Precautions on Electromagnetic Wave Interference

### 1. Possible Electromagnetic Wave Interference Caused by This Instrument

When this instrument is used in a residential area or an adjacent area thereto, it may cause interference to radio and television reception.

To prevent this, use the specified system connection cables in strict accordance with the instruction manual. The instrument is designed to minimize possible electromagnetic wave interference caused by it if the specified cables are connected properly.

However, there is no guarantee that electromagnetic wave interference will not be caused by the instrument. If the instrument does cause interference to radio or television reception, which can be determined by turning off and on the instrument, the user is encouraged to try to correct the interference by one or more of the following measures:

- Increase separation between the instrument and radio/TV receiver.
- Connect the instrument to an outlet on a circuit different from that to which the radio/TV receiver is connected.

### 2. Possible Electromagnetic Wave Interference Affecting This Instrument

If this instrument is used near an intense electromagnetic source, interference noise may be given to the instrument to incur an adverse effect on its performance or functionality.

To prevent this, use the specified system connection cables in strict accordance with the instruction manual. The instrument is designed to minimize possible electromagnetic wave interference affecting it if the specified cables are connected properly.

However, there is no guarantee that electromagnetic wave interference will not occur in this instrument. If the instrument does incur electromagnetic wave interference, which can be determined by turning on and off possible sources of electromagnetic wave interference nearby, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the instrument.
- Increase separation between the instrument and possible sources of electromagnetic wave interference.
- Increase separation between the power cable of the instrument and possible sources of electromagnetic wave interference.
- Connect the instrument to an outlet on a circuit different from that to which possible sources of electromagnetic wave interference are connected.
- Confirm that any other device connected with the instrument is not affected by electromagnetic wave interference.

## Warranty on Product

The Model HALO RB-10 Spectrophotometer is warranted to operate according to the specifications given in the instruction manual, provided it is used in accordance with the instructions described in the manual.

### (1) Scope of Warranty

- (a) Any parts which prove to be defective in design or workmanship during the warranty period will be repaired without charge.
- (b) A substitute part may be used for repair, or replacement with an equivalent product may be made instead of repair.
- (c) Such system components as a personal computer and printer to be updated frequently for improvement may not be available in original versions at the time of replacement.

### (2) Warranty Period

One year from the date of initial installation.  
Consumables such as WI and D<sub>2</sub> lamps are excluded from warranty.

### (3) Availability of Technical Support Service

Technical support service for this instrument is available within regular working hours on workdays predetermined by us.



(4) Limitations and Exclusions on Warranty

Note that this warranty is void in the following cases, even if they occur within the warranty period.

- (a) Failure due to operation at a place not meeting the installation requirements specified by us
- (b) Failure due to power supply voltage/frequency other than specified by us or due to abnormality in power supply
- (c) Corrosion or deterioration of the tubing due to impurities contained in reagent, gas, air or cooling water supplied by the user
- (d) Corrosion of the electric circuits or deterioration of the optical elements due to highly corrosive atmospheric gas
- (e) Failure due to use of hardware, software or spare parts other than supplied by us
- (f) Failure due to improper handling or maintenance by the user
- (g) Failure due to maintenance or repair by a service agent not approved or authorized by us
- (h) After disposal of this instrument, or after its resale without our approval
- (i) Failure due to relocation or transport after initial installation
- (j) Failure due to disassembly, modification or relocation not approved by us
- (k) Consumables, and failure of parts that have reached the end of specified useful life
- (l) Failure of parts excluded from the warranty in the instruction manual or other documents
- (m) Failure due to acts of God, including fire, earthquake, storm, lightning, social disturbance, riot, crime, insurrection, war (declared or undeclared), radioactive pollution, contamination with harmful substances, etc.

- (n) Failure of the hardware, or damage to the system software, application software, data or hard disk due to computer virus infection
  - (o) Failure of the personal computer connected with the instrument, or damage to the system software, application software, data or hard disk due to power interruption or momentary power voltage drop caused by lightning or the like
  - (p) Failure of the personal computer connected with the instrument, or damage to the system software, application software, data or hard disk due to disconnection of main power to the personal computer without taking the specified normal shutdown procedure
- (5) Disclaimer of Warranty
- (a) Any express warranties other than the explicit conditions indicated in (1) are excluded from this warranty. Any other implied warranties of merchantability and fitness for a particular purpose are not included in this warranty. No liability is assumed for direct or indirect damages arising out of explicit or implied warranties.
  - (b) Oral or written information or advice given by our dealers, distributors, agents or employees without our express permission shall not create a warranty or in any way increase the scope of this warranty.

## **Technical Service**

Installation of this instrument shall be carried out by or under supervision of qualified service personnel of Dynamica Corporation or its authorized service agent.

Before installation of the instrument, the user shall make preparations for satisfying the installation requirements in accordance with the instruction manual.

If relocation of the instrument becomes necessary after initial installation (delivery), please notify your local sales representative or nearest service office of Dynamica.

## **Disposal this instrument**

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When you discard equipment, please check and discard a related statute etc. or ask the service section of Dynamica.

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## **Other Precautions**

### **1. Handling of Chemicals and Samples**

- (1) The user is responsible for following relevant legal standards and regulations in handling, storage and discarding of chemicals and samples used in analytical operations of this instrument.
- (2) Reagents, standard solutions and accuracy-control samples shall be handled, stored and discarded as instructed by the respective suppliers.

### **2. Notice on Instruction Manuals**

- (1) Information contained in the instruction manuals furnished with the instrument is subjected to change without notice for product improvement.
- (2) This manual is copyrighted by Dynamica with all rights reserved.
- (3) No part of this manual may be reproduced or transmitted in any form or by any means without our express written permission.

### **3. Trademark Acknowledgments**

Microsoft, Windows, Microsoft Excel, Microsoft Word and Windows XP are registered trademarks, trademarks or trade names of Microsoft Corporation, USA, while other company names and product names are those of respective companies.



# SAFETY SUMMARY

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## PRECAUTIONS ON SAFETY

Before using the Model HALO RB-10 Spectrophotometer, be sure to read the following safety instructions carefully.

## GENERAL SAFETY GUIDELINES

- Follow all the operating procedures provided in this manual.
- Installation and maintenance of the product shall be carried out by service personnel qualified therefor.
- Be sure to observe the warnings indicated on the product and in the instruction manual. Failure to do so could result in personal injury or damage to the product.
- The hazard warnings which appear on the warning labels on the product or in the manual have one of the following alert headings consisting of an alert symbol and signal word DANGER, WARNING, or CAUTION.



**DANGER:** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

(This warning does not apply to this product.)



**WARNING** : Indicates a potentially hazardous situation which, if not avoided, can result in death or serious injury.



**CAUTION** : Indicates a hazardous situation which, if not avoided, will or can result in minor or moderate injury, or serious damage to the product.

: Precedes every signal word for hazard warnings, and appears in safety-related descriptions in the manual.

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# SAFETY SUMMARY

## General Safety Guidelines (Cont'd)

“NOTICE” and “NOTE” are heading words which do not concern personal safety directly.

<p><b>NOTICE :</b> Used to indicate an instruction for preventing damage to the product.</p>
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**NOTE:** Used to indicate an instruction for ensuring correct use of the product and accurate analysis therewith.

- Do not modify the product, replace parts that are not user-serviceable, use non-specified parts, nor remove safety devices, as it could be hazardous.
- Installation at delivery, maintenance and relocation should be referred to our qualified service personnel.
- Do not perform any operation or action other than described in the instruction manual. When in doubt, please contact our sales representative or service office nearest you.
- When using a chemical for analytical operation, be sure to provide proper ventilation in the laboratory room as per local requirements. Inadequate ventilation could endanger human health.
- Keep in mind that the hazard warnings in the manual or on the product cannot cover every possible case, as it is impossible to predict and evaluate circumstances beforehand.  
Be alert and use your common sense.

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# SAFETY SUMMARY

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## General Safety Guidelines (Cont'd)

This instruction manual contains the following cautious instructions.

### DANGER

The warning "DANGER" does not apply to this product.

### WARNING

- **Electric Shock in Contact with Dangerous High Voltage (500 V)**

In contact with D<sub>2</sub> lamp power supply voltage (500 V), you may receive an electric shock to cause fatal or serious injury.

Before replacing the D<sub>2</sub> lamp, make sure that the POWER switch of the spectrophotometer main unit is turned off. (Section 5)

- **Electric Shock in Contact with Dangerous Voltage**

In contact with power supply voltage, you may receive an electric shock to cause fatal or serious injury.

Before connecting the power cord, make sure that the POWER switch of the spectrophotometer main unit is turned off. (Section 1)

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# SAFETY SUMMARY

## General Safety Guidelines (Cont'd)



### CAUTION

- **Burn in Contact with High Temperature**

The D<sub>2</sub> lamp and WI lamp reach a high temperature.

They can burn you if touched.

Before replacing or adjusting the lamp, turn off the POWER switch and wait until it cools down sufficiently. (Section 5)

- **Fatigue on Long Use**

Watching the CRT screen in the same posture for a long time accumulates fatigue in your eyes or body. For long use, take a 10 to 15-minute recess every hour for your health.

- **Oxygen Deficiency due to Presence of Nitrogen  
(when using Ultra Violet region measurement system)**

If nitrogen purging is carried out for long hours in a narrow room without operating an exhaust duct, the oxygen concentration in the room will decrease and an oxygen deficiency could result.

Be sure to operate an exhaust duct or else open a window during the purge for ventilation purposes. (Section 1)

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# SAFETY SUMMARY

## Remarks on safety of spectrophotometer

### Electricity

- (1) Confirm the power supply to the spectrophotometer. Fluctuation in voltage or noise on the power line would not only affect the spectrophotometer main unit adversely but also cause an accident.
- (2) Be sure to provide grounding connection along with power connection. Make sure that the spectrophotometer is grounded at a grounding resistance of 100  $\Omega$  or less. If grounding is improper, the spectrophotometer is easily affected by external noise and floating voltage generated in it endangers physical safety.
- (3) High-voltage circuits are used inside the spectrophotometer. Do not open any other cover than necessary for operation.

### Fire

Avoid smoking and using a fire in the vicinity of the spectrophotometer.



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# SAFETY SUMMARY

## Computer Virus

If programs or data has suddenly been destroyed, if an unexpected operation takes place or if an abnormal display appears on the screen, your personal computer may have been infiltrated by a computer virus. The computer virus is a rogue program that secretly invades a personal computer and operates it willfully while destroying memorized data.

A program for eliminating the virus is called vaccine program. There is a possibility of contamination with a computer virus by downloading through communication a program including a computer virus, or by using an exchangeable recording medium such as a floppy disk that contains a computer virus. Also, it is possible to transmit the virus from one personal computer to another via communication or recording media. **So avoid using a program or recording medium that might include a virus.**

Carry out check using a vaccine program if there is a possibility of contamination with a virus. But depending on the type of vaccine program, it may be impossible to eliminate the virus.

**It is therefore recommended to back up the contents of the hard disk beforehand.**

Note that the preparation of a vaccine program and the elimination of a computer virus must be carried out by the user.

## Power Failure

A power failure or momentary voltage drop of the power supply due to lightning, etc. may cause failure of the personal computer used with the instrument and also damages the system software, application software and other data.

To avoid such problems, **it is recommended to use an AC uninterruptible power source.**



# SAFETY SUMMARY

## **Personal Computer (PC)**

Do not turn off the PC power supply alone. If the PC power supply is turned off during access to the hard disk or floppy disk, the PC may malfunction and the data or software stored in it may be destroyed. To turn off the PC power supply, be sure to complete the spectrophotometer control and data processing program (PC software) before taking the shutdown procedure for the system software.

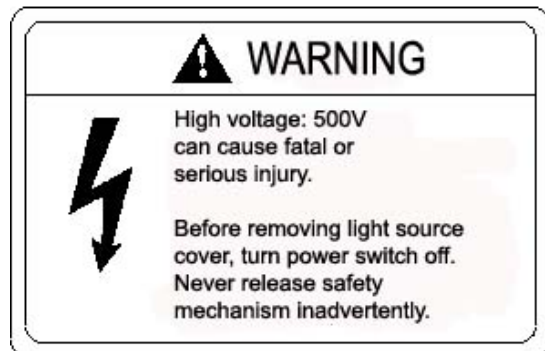
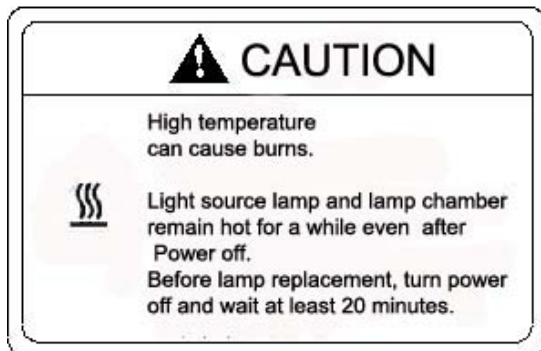
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# SAFETY SUMMARY

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## Warning Labels

The warning labels shown below are attached to the Model HALO RB-10 Spectrophotometer.



# Chapter 1 Installation

## 1.1 Unpacking

After unpacking the shipping crate, carefully take out the spectrophotometer and place it on a table.

Since the spectrophotometer weighs about 20 kg, care should be taken when removing it.



Fig. 1-1 Model HALO RB-10 Spectrophotometer

**Note:** The light source-switching mirror is secured with the sponge rubber material for transport at shipment from the factory. After using, open the light source cover and remove the protective sponge from the light source-switching mirror.

The shipping crate cannot be claimed for compensation even if it is damaged during the transportation.

Don't remove when instrument is turned on.

## 1.2 Installation site

### 1.2.1 Installation conditions

#### (1) Power requirements

Power supply voltage: AC100, 115, 220, 230 or 240V (There must be the

	devices for switching voltage.)
	Allowable fluctuation is within $\pm 10\%$ of rated voltage.
Frequency:	50 or 60 Hz
	Allowable fluctuation is within $\pm 4\%$ of rated frequency.
Power capacity:	200VA or more.
	A capacity of more than 500VA may be required for use with other accessory devices.
Grounding line:	Grounding line resistance of $100 \Omega$ or less is required.

**Note: If warning labels cannot be read because of stains or because they are coming off, please notify the local Dynamica sales representative or service office. New labels will be provided.**

## (2) Place for Installation

Minimum floor area: Floor area with a width of 460 mm and a depth of 590 mm or more is required.

Floor strength: Floor strength 20kg or more.  
Select a rigid and horizontal plane capable of withstanding the above load as an installation area.

### 1.2.2 Installation Environment

- (1) Operating temperature: 5~35 deg C.  
In order to perform a measurement under the most stable condition, we recommend that the instrument is used in an air-conditional room of 20 ~ 25 Deg C.
- (2) Operating humidity: 45% ~ 85%.
- (3) Storage temperature: -20~ 60 Deg C.
- (4) Atmospheric environment:
  - a) Free from acid gas or alkaline gas and other gases which may corrode metals significantly.
  - b) Free from gases which may dissolve paint such as from organic solvents (particularly benzene, thinner etc).
- (5) Other general notes:
  - a) Avoid direct sunlight (otherwise optical performance might deteriorate or the housing might become discolored). Avoid installation by a window if at all possible.
  - b) Vibrations or shocks strong enough to be felt by the human body must not be transmitted to the instrument (otherwise the fine adjustment mechanism might malfunction).

- c) Avoid installation in near heat generating apparatus such as a gas burner, electric heater or oven in order to prevent the mainframe cover being heated beyond 70 Deg C.
- d) Avoid installation near instruments which generate a strong electric field (such as an electric welding machine, high frequency furnace or pole transformer).
- e) Avoid a dusty environment (otherwise optical performance might deteriorate).
- f) The line voltage must be stable and free from a rapid fluctuation (otherwise noise might increase).
- g) Do not frequently turn on and off electric instruments (stirrer, vibrator, etc) which are connected to the same power line as the HALO RB-10 but are not fitted with noise suppressors.

**Note:** The optical system is very delicate.

In addition, the control unit incorporates high-density electronic circuit components which function as a computer.

The above cautions should be strictly observed.

## 1.3 Check of Contents

After unpacking, check the contents of delivery against the packing list.

In the HALO RB-10, you should find the following items.

- a. HALO RB-10 Main unit
- b. Operating Manual
- c. Power cord with fuse
- d. 4 cell holder for HALO RB-10
- e. Dust cover
- f. One Philips and one flat blades screw driver

If any part is missing or damaged, or if you have a question, contact the nearest Dynamica sales representative.

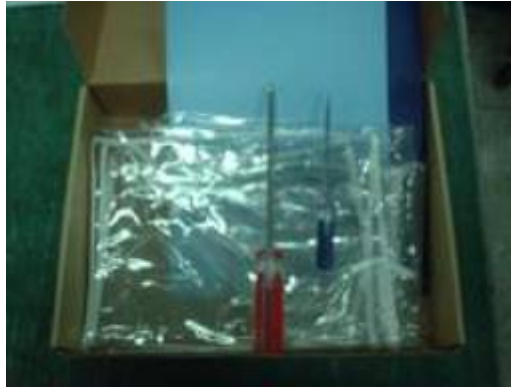


Fig. 1-2 Standard Accessories

Note: The standard accessories are subject to change without prior notice.  
Check them for the correct quantity against the packing list supplied with the instrument.



Fig. 1-3 Rectangular Standard Four Cell Holder for HALO RB-10 Accessory

## 1.4 Check of Voltage and Fuse

**Warning: Before checking, make sure the power cord is not connected.**

First check that the line voltage is within the range indicated on the label beside the power connector.

(1) Confirmation of the Fuse

Select the fuse in accordance with the line voltage to be used.

Voltage	Fuse Capacity
100 V	3.15A
220 V	3.15A



Fig. 1-3 the Power Connector of Model HALO RB-10

## 1.5 Side Panel of the HALO RB-10

The HALO RB-10 has 6 ports on the side panel.

They are

- a. Power connector and switch
- b. Printer port
- c. LCD brightness adjustment port
- d. Local-Remote switch for PC software control or local keypad control
- e. Acc. Port for connection of accessories such as auto sipper.
- f. 9- pin Serial port for connection to personal computer

## 1.6 Connection of Power Cord and Grounding Wire

**Note:** Before plugging in the power cord, make sure the POWER switch is turned off.



- (1) Plug the power cord securely into the connector of the mainframe.
- (2) When using a power extension lead, make sure the ground wire is securely connected to the grounding terminal.

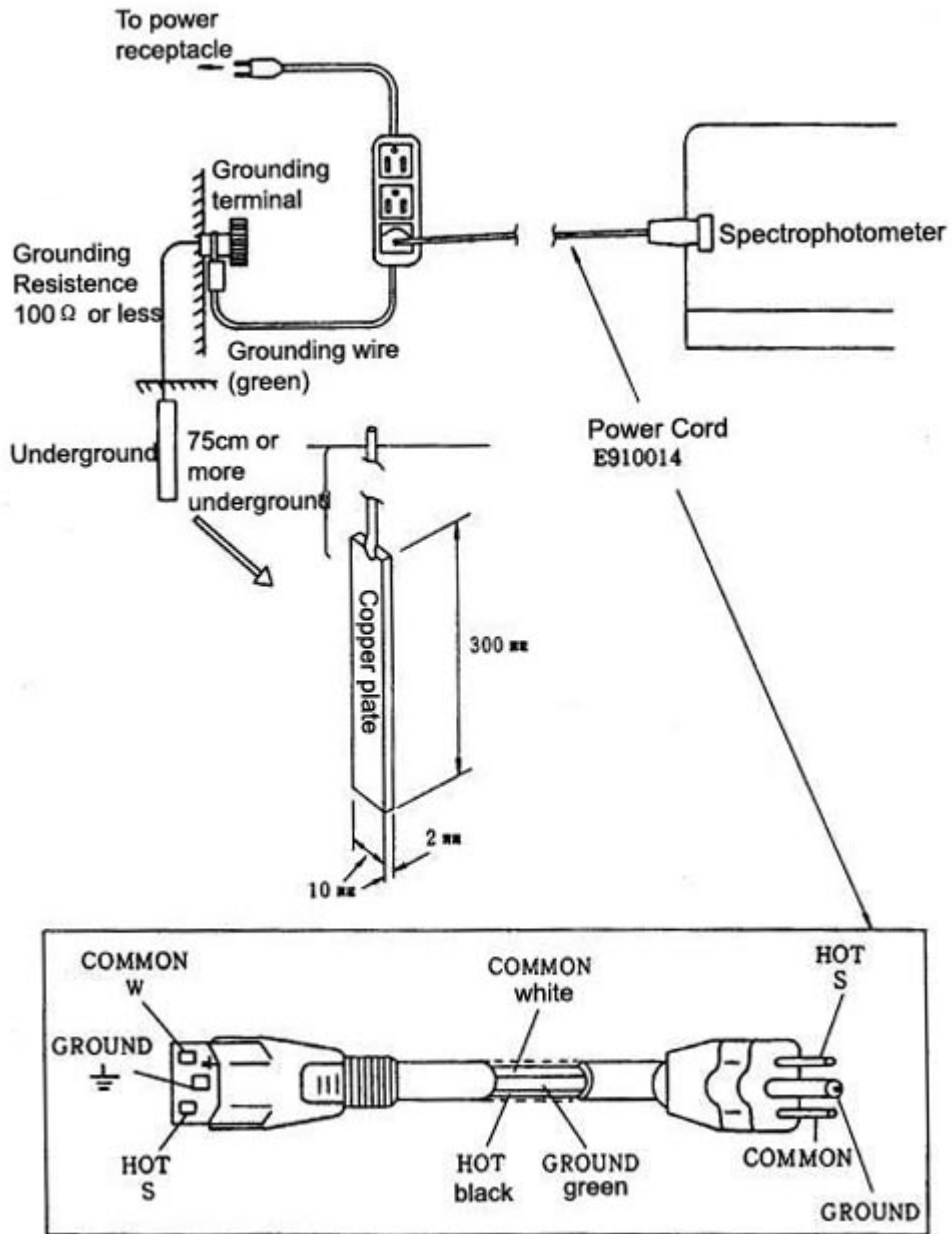


Fig. 1-3 How to Ground the Model HALO RB-10

## 1.7 Connection of Printer

A printer can be connected to the instrument using a standard parallel printer cable.

The printer connector is on the right side of the instrument as shown in Fig 1-3. The HALO RB-10 is compatible with many printers, including the Seiko thermal printer with DPU setting, Hewlett Packard printer with PCL/3 setting and the Epson Printer with ESC/P setting. For a detailed list of the printers that are compatible with the HALO RB-10, contact your local Dynamica representative. To define the printer type connected to the HALO RB-10, please refer to the System setting section interface under printer setting sub menu.

Please refer to the relevant printer instruction manual to install the printer.

## **1.8 Local-Remote switch**

The HALO RB-10 can be controlled by the optional PC software, or simply via keypad control. Please put the Local-Remote switch to Local when using the keypad and LCD on the HALO RB-10. When connecting to PC software, switch the Local-Remote switch to the Remote position. The LCD will display < PC Control > when connected to PC software for complete instrumentation control and data analysis.

## **1.9 LCD Brightness adjustment port**

The LCD brightness can be adjusted through this port by turning the screw using a small flat blade screwdriver.

## **1.10 Connecting Accessories to the HALO RB-10**

The Acc port is provided for the connection and control of a variety of optional accessories available from Dynamica, such as a sample autosipper or electronic thermostatic cell holder. Connect the optional accessories using the cable provided with the accessories themselves. Please refer to the installation manual for installation details for the optional accessories.

## **1.11 Connecting the HALO RB-10 to PC Software**

The optional PC software allows the HALO RB-10 to be fully controlled by the software and perform data analysis. Connect the serial cable provided with PC software to the port marked PC. Please also set the Local-Remote switch to Remote when using PC software.

## Chapter 2 Function

### 2.1 Theory

The Model HALO RB-10 Spectrophotometer is designed for absorption analysis of liquid, solid and gaseous samples in the ultraviolet and visible spectral regions.

Measurements are based on the Lambert-Beer law, as shown in Figure 2-1

A monochromatic beam with intensity ' $I_0$ ' travels through a liquid phase having concentration ' $c$ ' and path length ' $l$ ', which results in the intensity of monochromatic radiation decreasing to ' $I_t$ '.

The initial intensity ' $I_0$ ' and attenuated intensity ' $I_t$ ' of monochromatic radiation, follows equation (1).

$$I_t/I_0 = 10^{-\epsilon \cdot c \cdot l} = \tau \dots\dots\dots(1)$$

Where,  $\epsilon$  is a constant known as absorptivity, which varies depending on the sample.

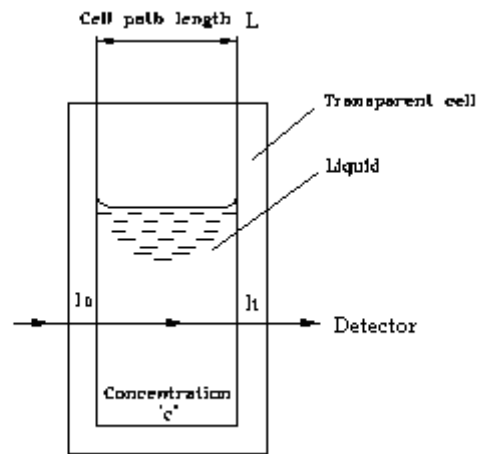
Equation (1) represents the Lambert-Beer law, ' $\tau$ ' indicates transmittance which is often expressed as a percentage, i.e. ' $\tau * 100 = T$ ' (percent transmittance or %T).

Also, the common logarithm of inverse transmittance can be expressed as follows:

$$\text{Log} (1/\tau) = \epsilon \cdot c \cdot l = E \dots\dots\dots(2)$$

Where ' $E$ ' is called absorbance (abbreviated as Abs).

Absorbance ' $E$ ' is proportional to concentration ' $c$ ' and is a unit of measurement essential for quantitative measurement.



$$I_1/I_0 = 10^{-\epsilon \cdot c \cdot l} = \tau$$

Fig. 2-1 Lambert-Beer law

## 2.2 Principle of Operation

### 2.2.1 Optical System

Figure 2-2 shows the optical system of the Model HALO RB-10.

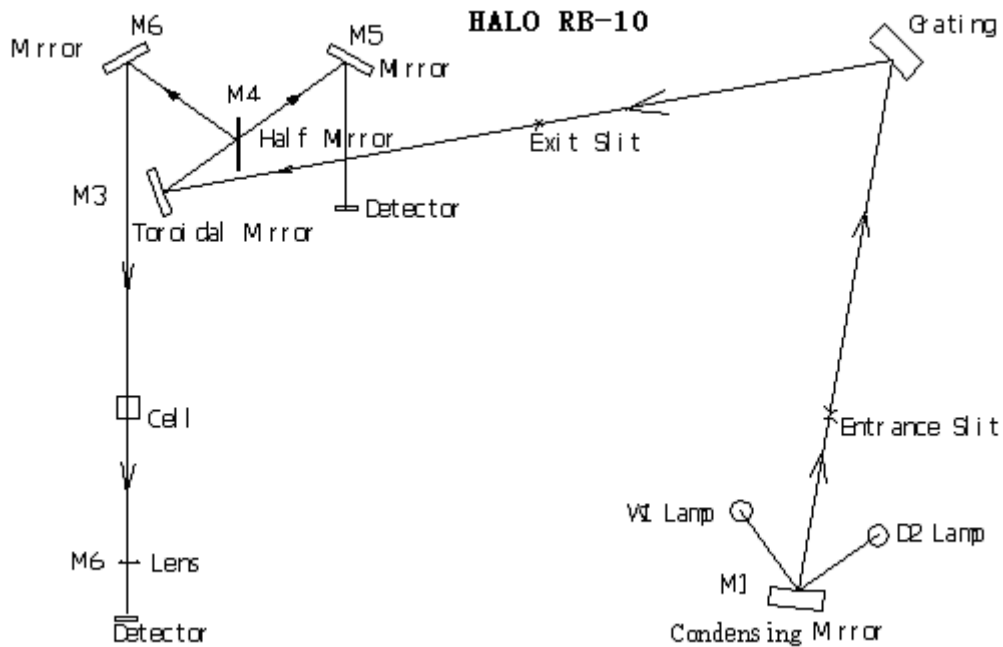


Fig 2-2 Optical System of Model HALO RB-10 Spectrophotometer

The HALO RB-10 is a ratio beam system, which features a half mirror to split the beam into a reference beam and sample beam. This design makes it possible to attain a highly stable photometric value, surpassing the analytical performance of a typical single beam spectrophotometer.

Light emitted from the light source is fed to the Seya-Namioka Mount monochromator utilizing a concave diffraction grating (with a grating constant of 1/600 mm, a blaze wavelength of 250nm and a grating area of 20mm × 25mm), where it is transformed into a monochromatic beam. The beam sent from the monochromator is reflected by the toroidal mirror (M3), and then separated into the reference beam and sample beam.

The sample beam passing through the sample compartment is focused by lenses onto the detector(D1) where it is converted into electric signals. Simultaneously, the reference beam irradiates detector 2 (D2) where it is converted into electric signals.

## 2.2.2 Signal Processing and Control System

The electric signal converted from optical signal enters the LOG amplifier where it is LOG converted to provide absorbance data.

This data is amplified, and is then A/D converted to be processed as digital value.

The processed results are displayed on the LCD and recorded onto the printer.

## 2.3 Proper Use of the Spectrophotometer

### 2.3.1 Solvent Selection

Solvents used for sample preparation, should have the following properties:

- Small absorption in the spectral region of measurement wavelength.
- No interaction with the solute.
- Low volatility.

Table 2-1 lists the applicable wavelength ranges of common organic solvents.

<b>Solvent</b>	<b>Wavelength Range</b>
Cyclohexane	200nm ~ 400 <sup>+</sup> nm
Ethyl alcohol	220 nm ~ 400 <sup>+</sup> nm
Methyl alcohol	220 nm ~ 400 <sup>+</sup> nm
Ethyl ether	220 nm ~ 400 <sup>+</sup> nm
Dioxane	220 nm ~ 400 <sup>+</sup> nm
Hexane	220 nm ~ 400 <sup>+</sup> nm
Chloroform	250 nm ~ 400 <sup>+</sup> nm

Isopropyl alcohol	250 nm ~ 400 <sup>+</sup> nm
Acetic acid	250 nm ~ 400 <sup>+</sup> nm
Ethyl acetate	270 nm ~ 400 <sup>+</sup> nm
Carbon tetrachloride	275 nm ~ 400 <sup>+</sup> nm
Benzene	280 nm ~ 400 <sup>+</sup> nm
Methyl ethyl ketone	335 nm ~ 400 <sup>+</sup> nm
Acetone	340 nm ~ 400 <sup>+</sup> nm
Carbon disulfide	380 nm ~ 400 <sup>+</sup> nm

### 2.3.2 Special Samples

Note that the laws expressed by Equations (1) and (2) are not applicable to the following special samples.

- Fluorescing samples
- Appreciably turbid samples

When measuring solid samples such as a glass plate, the beam energy undergoes a loss (r) due to reflection at the surface of the solid substance.

In this case, Equation (1) must be transformed as shown below.

$$I_t / I_0 = 10^{-\epsilon \cdot c \cdot l} - r \dots\dots\dots (3)$$

Where, 'r' varies according to the reflectance of the substance.

## 2.4 Functions

### 2.4.1 Quantitative Analysis

The Model HALO RB-10 is capable of calculating the concentration of a sample after generating a standard calibration curve or by entering a factor into the system.

The following are the features of this function.

- (1) Generation of standard calibration Curve
  - (a) Working curve can be generated by measuring up to 20 standards by segmented line method or regression line by least square method.
  - (b) Any standard sample can be re-measured to generate the working curve.
  - (c) A working curve can also be generated by manually inputting concentration and photometric values.
  - (d) Analytical results are displayed on the LCD together with the working curve. Thus, the results can be confirmed while observing the working curve.

- (e) The working curve can be graphically plotted on the printer.
- (f) Entering factor values can generate the working curve.
- (g) It is possible to generate a working curve by 2 - /3 – wavelength measurement.

## 2.4.2 Wavelength Scan

- (1) The highest wavelength scan speed is 3600 nm/min. The wavelength range from 1100~190 nm can be scanned in a little over 20 seconds even if the filter and light source are switched over halfway through the scan.
- (2) Wavelengths can be scanned repeatedly to record spectra of a sample which changes with time.
- (3) Photometric values can be printed out at a specified wavelength interval.
- (4) Photometric values can also be displayed on the LCD.
- (5) The graphic display on the LCD can be output onto the printer. It takes a little over 10 seconds to make a hard copy.

## 2.4.3 Secondary Processing Functions

- (1) A graph can be displayed with a time scale on the abscissa.
- (2) Photometric values can be printed out at a specified time interval.
- (3) Data can be calculated for rate assay.

## 2.4.4 Secondary Processing Functions

The Model HALO RB-10 can store the measured spectrum and its change with time in the memory.

A variety of secondary processing functions can be applied to the stored data.

- (1) The data related to the peak and valley can be printed out in a list format.
- (2) Expansion
  - Three methods are available for expanding the graphic display on the LCD.
  - (a) Simultaneous Expansion of X and Y Axes
    - The cursor should be moved to define a desired expansion range.
  - (b) Expansion of X Axis
    - Numeric values can be input to specify a desired expansion range for the abscissa.

(c) Expansion of Y Axis

Numeric values can be input to specify a desired expansion range for the ordinate.

(3) Smoothing

A spectrum with a large noise level can be corrected to form a smooth curve.

(4) Differentiation

The data of a spectrum currently displayed on the LCD are differentiated. First order derivatives may be obtained.

### **2.4.5 Automatic Calibration and Self – Diagnosis Functions**

(1) Memory (RAM and EPROM) check

(2) Wavelength drive mechanism check

(3) Lamp ignition check

(4) Automatic wavelength calibration

The wavelength is automatically calibrated with reference to the beam emitted from the D<sub>2</sub> lamp.

(5) Baseline Correction



## 2.5 Specification

Table 2-1 HALO RB-10 Specifications

Item	Description
Monochromator	Equipped with high resolution concave diffraction grating and Seya-Namioka mount
Wavelength range	190~1100nm
Spectral bandpass	4nm
Stray light	≤0.05%T (220nm NaI, 340nm NaNO <sub>2</sub> )
Wavelength Accuracy	±0.5nm
Wavelength Repeatability	0.5nm
Photometric mode	Abs, %T, Conc
Photometric range	Abs: -0.3~3.000 %T: 0~200%T Conc: 0.000~9999
Photometry Accuracy (measured with NIST 930D)	±0.002Abs (0~0.5Abs) ±0.004Abs (0.5~1.0Abs) ±0.008Abs (1.0~2.0Abs) ±0.3%T
Photometry Repeatability (measured with NIST 930D)	±0.001Abs (0~0.5Abs) ±0.002Abs (0.5~1.0Abs) ±0.004Abs (1.0~2.0Abs) ±0.15%T
Wavelength Scan Speed	10,100,200,400,800,1200,2400,3600nm/min
Baseline Flatness	±0.005Abs(200~950nm)
Baseline Stability	0.001Abs/h (500nm) 2 hours after power up
Noise (500nm)	≤0.0005Abs
Light Source	WI lamp, D <sub>2</sub> lamp
Light Source Switchover	Automatic changeover(at 340nm)
Detector	Silicon photodiode
Display	Liquid Crystal Display (LCD); RS232 PC Computer Interface
Printer	PCL/3, ESC/P or DPU
Serial	RS-232C
Dimensions	370 (W) ×535 (D) ×270 (H) mm
Weight	Approx. 20kg
Power Source	100, 115, 220, 230, 240V 50/60Hz
Power Capacity	200VA
Wavelength adjustment	0.1nm
Wavelength moving speed	6000nm/min
Photometric method	Proportion single beam of light
Sample chamber Dimensions	115 (W) ×197 (D) ×150 (H) mm

# Chapter 3 Operation Method

## 3.1 Basic Operation

### 3.1.1 Operating Procedure

The user interface of the Model HALO RB-10 is convenient and easy-to-use. Screen prompts help you to select the variables that are required for method set-up and data acquisition.

### 3.1.2 Keypad functions

Figure 3-1 shows the keypad of the Model HALO RB-10.

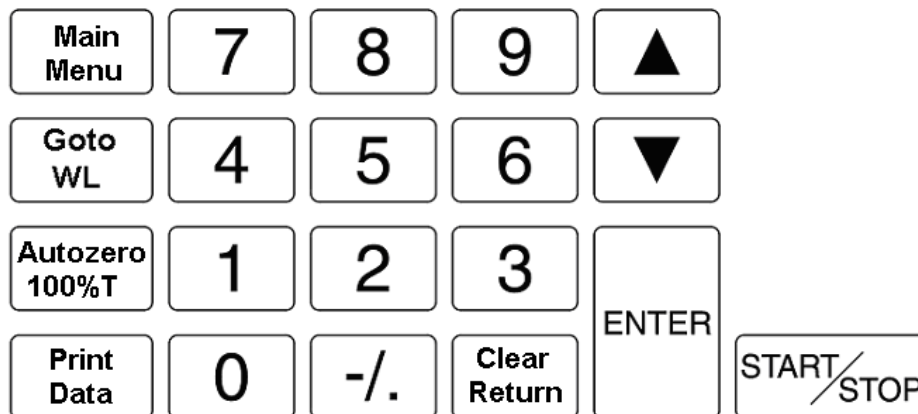


Fig. 3-1 Function of Each Operation Key



There are three groups of touch type keys on the panel.

- Numeric keys
- Special function keys
- Control Keys

The function of each key on the Model HALO RB-10 Key Panel is as follows

- **Main Menu**  
Lists the five data processing functions and returns to the initial main menu frame when pressed.
- **Goto WL**

Used to select a desired wavelength. The system moves to the specified wavelength after pressing this key.

- **Enter**  
Enters numeric values specified through the keyboard or selects a test for which analytical conditions are to be set.
  
- **Clear Return**  
This key acts as a backspace key to move the cursor back and erase all characters entered or acts as a return key to advance the screen display.
  
-   
Moves the data in the data list up.
  
-   
Moves the data in the data list down.
  
- **Print Data**  
Only print out current Wavelength and value (ABS / %T / E(S)).
  
- **Autozero 100%T**  
Automatic zero adjustment. Pressing this key with a blank solution in the sample compartment will store the photometric value of the solution in the memory as 0 Abs or 100%T.  
In subsequent measurements, each photometric value is determined with reference to the value stored above.
  
- **Start/Stop**  
Start or stop the measurement.

## 3.2 Starting up the Spectrophotometer

### 3.2.1 Initialization

At power up, the HALO RB-10 spectrophotometer automatically runs a self-diagnostic sequence that checks the following system in the INITIALIZATION frame.

- RAM
- EPROM
- Wavelength drive
- D<sub>2</sub> lamp

- **WI lamp**
- **AD conversion**
- **656.1nm**

Upon completion of each test item, the message <OK> will display if the item's function is normal or the message <NG> will display if the item's function is abnormal.

**CONSULT THE TROUBLESHOOTING SECTION IF AN ERROR MESSAGE OCCURS DURING INITIALIZATION.**

**ERROR Messages**

1. If the RAM, EPROM, or Wavelength drive is abnormal, the system will stop.
2. If WI Lamp is abnormal and the others are OK, press **Clear Return** and the system will skip it and continue to run.
3. If D<sub>2</sub> lamp and 656.1nm are abnormal, press **Clear Return** and the parameters of last display (what was previously displayed on the screen) will appear on the screen.
4. If only 656.1nm is abnormal, press **Clear Return** and the same will happen as above.

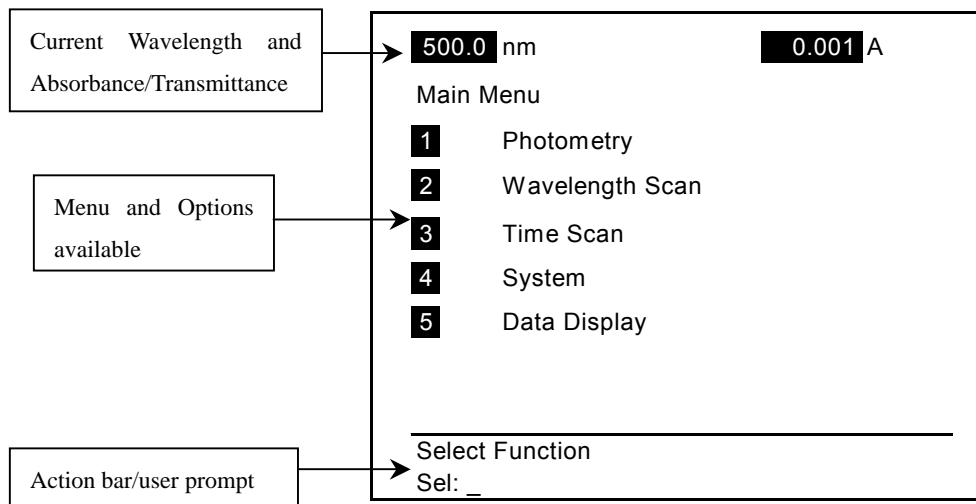
The INITIALIZATION screen will automatically change to the screen which powered off last time if the system passes the self-tests in about 1 minute or launch a parameter set that you have selected to use as an Autostart method.

If the instrument is initialize at the first time, the display will change to the main menu screen after initialization.

### **3.2.2 Main Menu**

After initialization, press **Main Menu** key and the main menu screen appears on the display as shown below. If the auto – start function has been preset, the screen goes to the measurement frame or operational parameters frame automatically.

The Main Menu lists five options and also displays the current wavelength and photometric values at the top of the screen. To guide you through each procedure, there is a prompt displayed at the bottom of each screen page. For function of each optional item, please refer to section 2.



The wavelength and photometric value indicated at the top of the Main Menu remain displayed on the submenu. The guide message is indicated at the bottom of Main Menu. On the submenu screen, the relevant instruction message is also displayed to guide the user through each procedure.

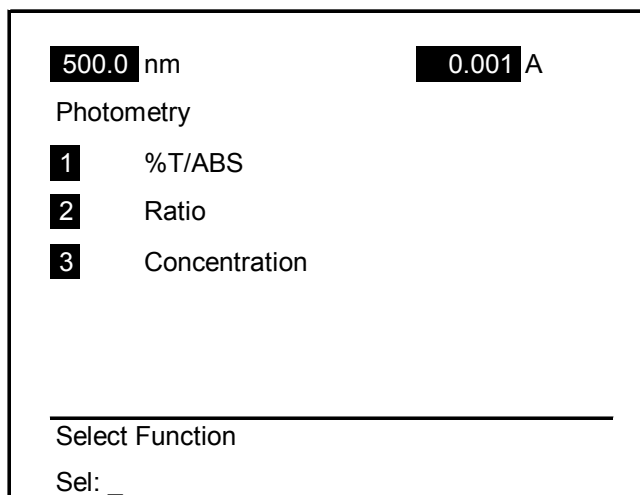
### 3.2.3 Selecting Options from the Main Menu

To select the function displayed on the menu, the operator can use:

- a. The numeric key as the function key, just press the number, such as **1** and then press **Enter** to start the Photometry sub menu. Press **Clear Return** key to cancel the function key selection and re-enter the required function key.
- b. The sub menu selection will be highlighted. Press **Enter** to select the required sub menu.
- c. Press **Menu** to return the Main menu.

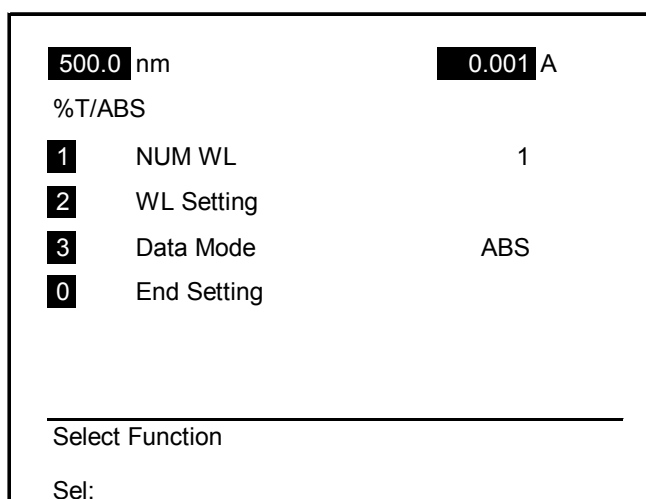
### 3.3 Photometry

Press **1** on the keyboard from main menu to enter the photometry mode. The photometry mode submenu will be displayed on the LCD.



#### 3.3.1 Using Photometry Mode

Press **1** on the keyboard from photometry mode to select proper parameter. A submenu list appears on the screen as shown in the illustration below:



#### 1. Step by Step Operation

This section provides step-by-step instructions for how to use your Model HALO RB-10 spectrophotometer in the Photometry mode.

To select the function displayed on the menu, you can use:

- a) The numeric key as the function key, just press the number, such as **1** to start the Photometry sub menu. The HALO RB-10 will automatically enter the submenu after pressing the numeric key.
- b) To return to the previous menu, press **Clear Return**.
- c) Press **0** to end setting the parameter.

**NOTE:** After you press **0** on the keyboard, the variables you enter are checked automatically at this time to ensure that there are no inconsistencies in the photometry range. An error message will appear at the bottom of the screen if a variable is incorrect and must be modified. Also the variables you set will be stored in non-volatile memory for future use.

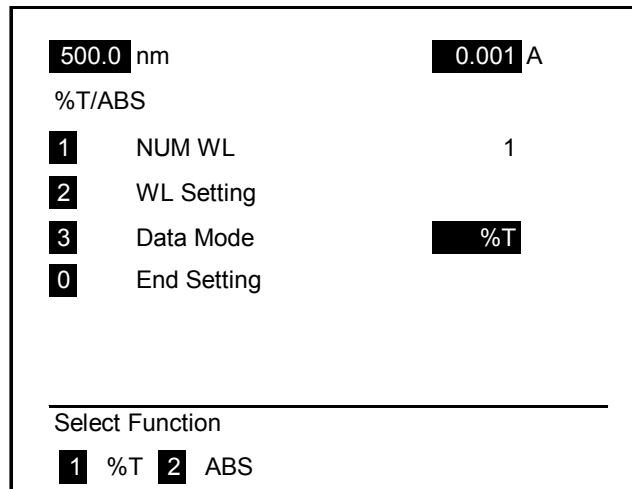
## 2. Photometry setup definition

The different sub menu functions are defined as follows:

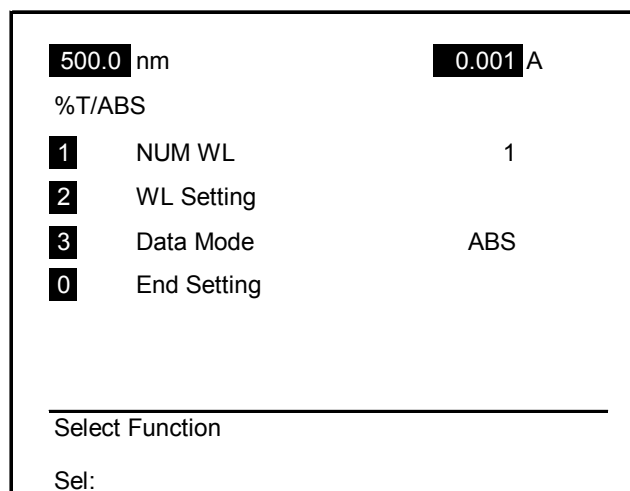
**Table 3-1 Photometry Options and Variables**

Submenu Option	Variable	Range	Description of Function
<WL> <NUM>	1~6	WL1~WL6	Specifies the number of samples (wavelengths)
<Data> <Mode>	Abs %T	-3.000~3.000 0~1000%	Measures absorbance Measures percent transmittance
WL Setting	Wavelength	190.0 ~ 1100.0nm	Wavelength for the analysis (The number of wavelengths displayed here is specified under WL NUM. After you finished entering the value, press [Clear] to back to T/A menu.)

Press **3** on the keyboard to enter the data mode, a sub menu will prompt you to select the data mode (%T, ABS).



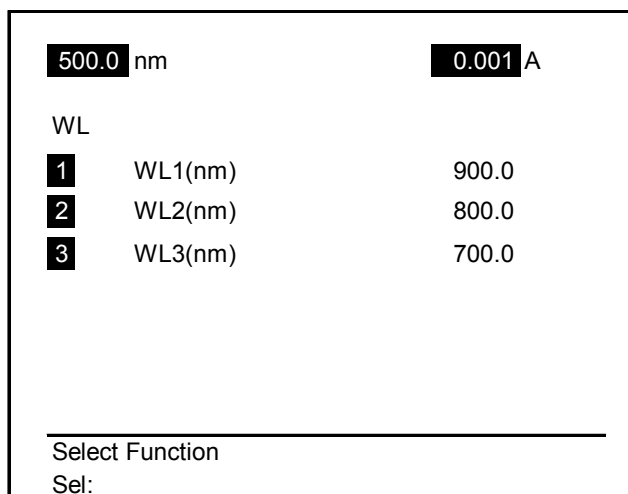
Select either ABS (Absorbance) or %T (Transmittance) by pressing the corresponding numeric key. The photometry value displayed on the top right hand side of the screen will change accordingly. Press **2** on the keyboard to obtain the following screen.



### Wavelength

Press **3** on the keyboard to enter the Wavelength selection submenu.





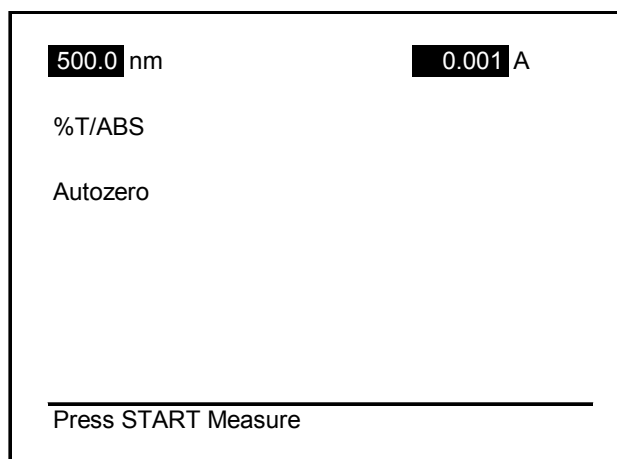
The number of wavelengths displayed is specified under WL NUM. Press the numeric key to modify the wavelength; the wavelength being changed will be highlighted. Enter the required wavelength by pressing the numeric key; press **Enter** to confirm setting.

Modify the wavelengths required to perform the photometry test. The Wavelength range limit is 190.0 ~ 1100.0nm. Press **Clear Return** to save the setting and return to the %T/A menu.

### 3. Beginning Autozero

After Photometry setup, the system will give the display as shown below:

The action bar/user prompt will prompt the action required.



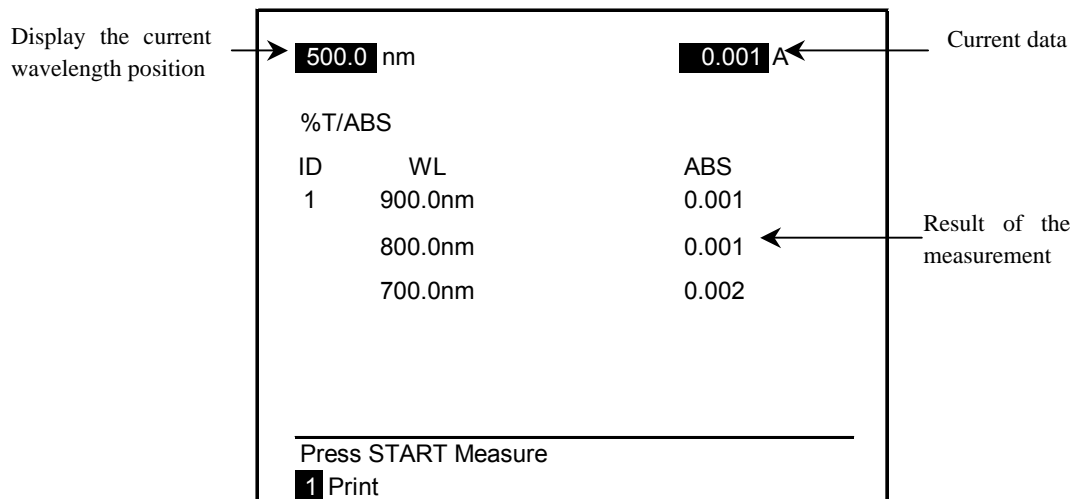
Press **Start/Stop** to begin an Autozero that use the setup parameters. The Model HALO RB-10 will autozero automatically on every wavelength selected in the setup before a Photometry test.

#### 4. Running a Photometry Test

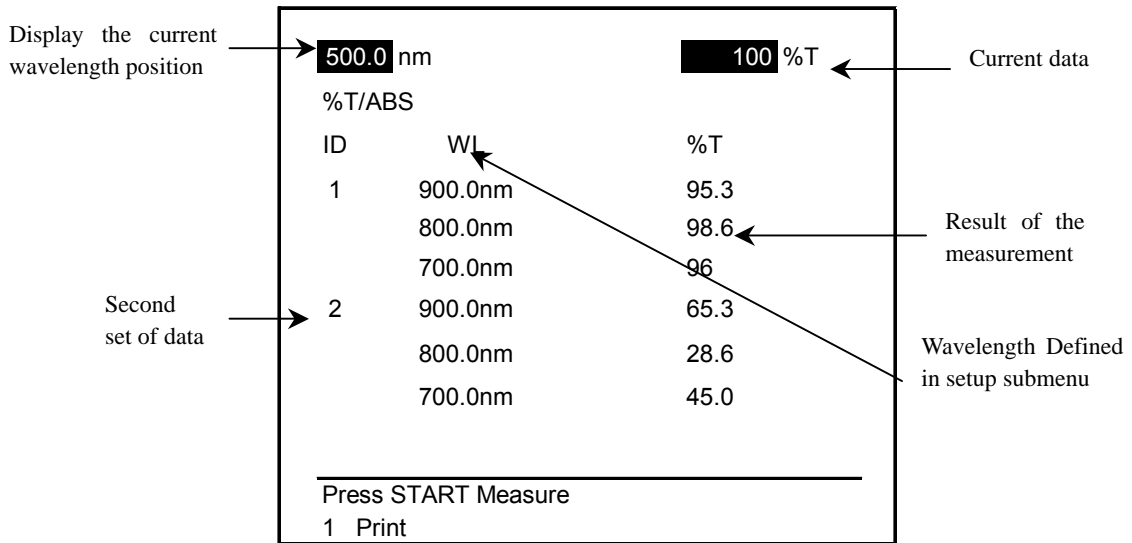
After Autozero, the HALO RB-10 is ready for Photometry Test; data obtained will be based on the Autozero data.

Press **Start/Stop** on the keyboard to begin a photometry test.

The motor will hum while moving to the required wavelength defined in the setup. The HALO RB-10 measures the wavelength defined and displays the following menu:



The wavelength in the left top corner will change according to the wavelength selected when performing the test. Press **Start/Stop** again to measure the next sample. The second set of data will be displayed as in the following figure.

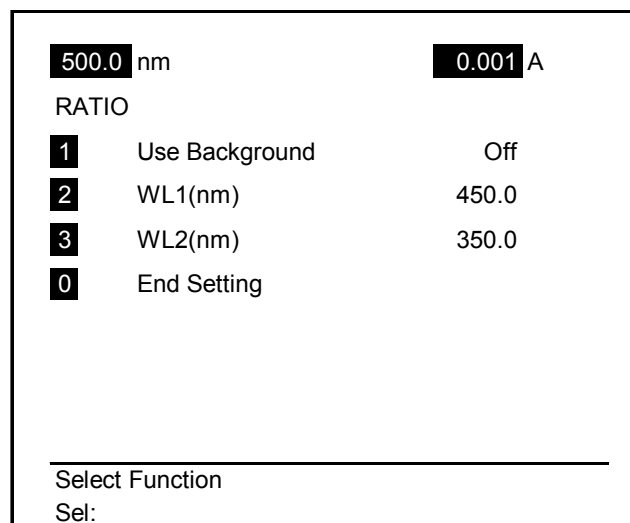


Press **[1]** on the keyboard to print the analysis results. When the numbers of the data exceed the display area of the LCD, press the **[▲]** and **[▼]** key to scroll the data.

- NOTE:**
1. Press **[100%T]** to autozero the sample again.
  2. Press **[Clear Return]** to return to the previous menu.
  3. Press **[Main Menu]** to back to the main menu.

### 3.3.2 RATIO Mode

1. Press **[2]** on the keyboard from the photometry submenu to select the Ratio mode.
2. The following Ratio mode submenu will appear



## Step by Step Operation

### 1. RATIO parameter Setup

To select the function displayed on the menu,

- Press the number to setup the parameters. For example, press **2** to define the Wavelength used in the ratio.
- To return to the previous menu, press **Clear Return**
- Press **0** to end setting the parameter.

### 2. Definition of the Display

**WL1 or WL2 define the wavelengths that will be used in the ratio analysis. A maximum of 3 can be used, if using the background. If not using the background, only 2 wavelengths can be used.**

**NOTE: WL3 will be used as the background if 3 wavelengths are selected**

Press **1** to enter the use background option. The <On> or <Off> option will appear in the Select function bar, press **1** or **2** to select On or Off.

<b>500.0</b> nm	<b>0.001</b> A
RATIO	
<b>1</b>	Use Background                      On
<b>2</b>	WL1(nm)                                      450.0
<b>3</b>	WL2(nm)                                      350.0
<b>4</b>	WL3(nm)                                      500.0
<b>0</b>	End Setting
Select Function	
Sel: _	

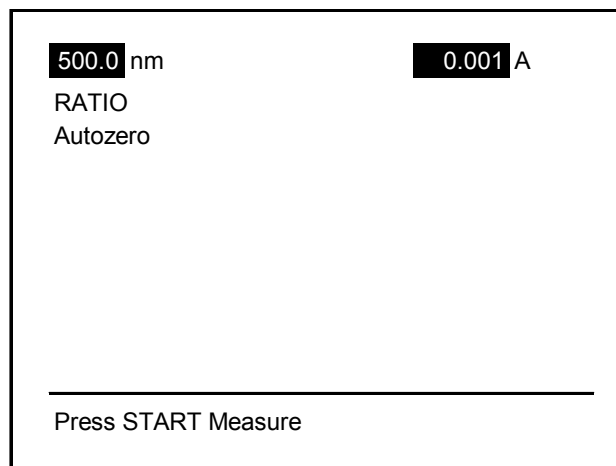
Press **2** or **3** to change the wavelength use for the ratio test. The wavelength range limit is from to 190.0 ~ 1100.0 nm. The wavelength will be highlighted,

enter the required wavelength in the selection function bar and press enter to save the change.

### 3. Beginning Autozero

Press **0** to select the <End Setting> to save the setting and the HALO RB-10 will automatically change to the autozero menu.

The Autozero interface



Press **Start/Stop** from the selection function bar to begin an Autozero with the setup saved. The HALO RB-10 automatically autozeroes on the selected wavelength before a RATIO Test.

### 4. Running a RATIO Test

HALO RB-10 is now ready for RATIO Test; the test will be based on the data collected in the Autozero cycle.

Press **Start/Stop** on the keyboard to begin test.

The motor will hum while moving to the required wavelength defined in the setup.

The wavelength on the left top corner will change according to the wavelength selected when performing the test. The data will be displayed as in Fig. below. Press **Start/Stop** again to measure the next sample.

500.0 nm			0.001 A		
ID	WL1	WL2	WL3	Diff	Ratio
1	0.001	-0.001	-0.002	0.002	1.500
2	0.001	-0.001	-0.002	0.002	1.500
3	0.001	-0.001	-0.002	0.002	1.500
Press START Measure					
1	Print				

The definition of the <DIFF> and <Ratio> is:

If the <WL> number is 2, the <DIFF> value and <RATIO> value are calculated from the following formula.

$$\text{DIFF} = \text{WL1} - \text{WL2}$$

$$\text{RATIO} = \text{WL1}/\text{WL2}$$

If the <WL> number is 3, the <DIFF> value and <RATIO> value are calculated from the following formula.

$$\text{DIFF} = \text{WL1} - \text{WL2}$$

$$\text{RATIO} = (\text{WL1} - \text{WL3}) / (\text{WL2} - \text{WL3})$$

To measure a second sample, press **Start/Stop** again.

Press **1** to print the data. An example of the result is shown on the following page.

One set of data is displayed on the screen, for multiple sample measurement.

Press the

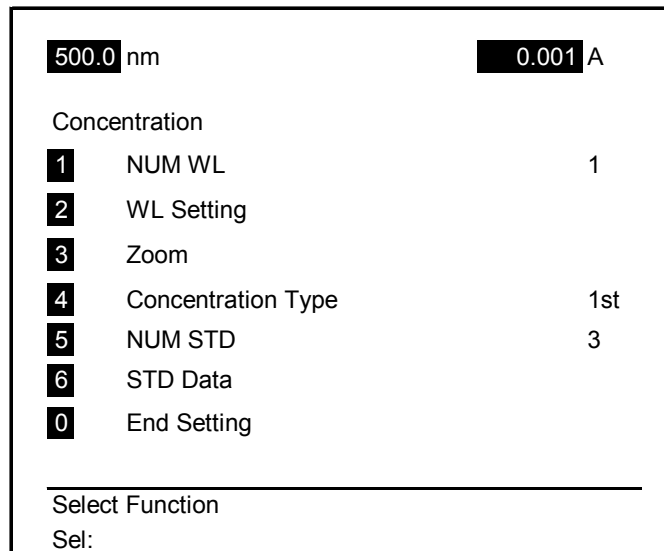
**▲** ARROW or **▼** ARROW to browse the data. <ID> on the left corner for the sample set indicates the sample set.

Once **Start/Stop** is pressed, the latest set of measured data will be displayed on the screen.

- NOTE:**
1. Press **Autozero 100%T** to autozero the sample again.
  2. Press **Clear Return** to return to the previous menu.
  3. Press **Main Menu** to back to the main menu.

### 3.3.3 Using the Concentration Mode

Press **3** on the keyboard at the main menu to select the Concentration mode



#### Step by Step Operation

##### 1. Concentration Test Setup

To select the function displayed on the menu, the operator can use

- The numeric key as the function key, just press the number, such as **2** to start the Photometry submenu. The HALO RB-10 will automatically enter the submenu after the numeric key is pressed.
- To return to the previous menu, press **Clear Return**
- Press **0** to end setting the parameter.

##### 2. Definition of the display in the concentration Sub-Menu

The function of each option is outlined in Table 3-2.

Table 3-2 Concentration Menu

Submenu Option/Variables	Range	Description
NUM WL	1 ~ 3	Numbers of Wavelength
WL Setting	190 ~1100nm	Setting Wavelength
Zoom		Rescale the spectrum of working curve
Concentration Type	1st k – factor	
NUM STD	1 ~ 20	Number of Standard used
STD Data	0 ~ 9999	Concentration of Standards
Coff Set	$K_0$ $K_1$	$C=K_1 \cdot Abs + K_0$

**Selecting Concentration Type:** 2 types of Concentration calculation is available

- **1st order Linear Regression analysis**
- **K- factor concentration analysis**

Press **4** in the concentration type submenu, the selection of 1st order linear regression analysis and K- factor will appear in the action bar/user prompt.

**500.0** nm
**0.001** A

Concentration

<b>1</b>	NUM WL	1
<b>2</b>	WL Setting	
<b>3</b>	Zoom	
<b>4</b>	Concentration Type	<b>1st</b>
<b>5</b>	NUM STD	3
<b>6</b>	STD Data	
<b>0</b>	End Setting	

---

Select Function: \_

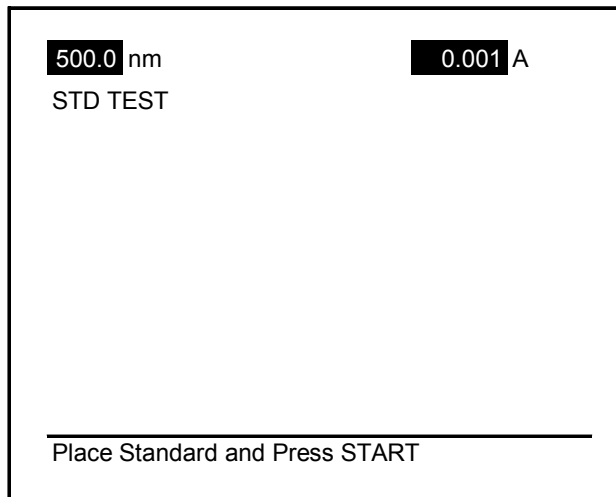
**1** 1st
**2** k-factor

-1st order linear regression analysis  
-K factor concentration analysis

To select 1st, press **5** to define the number of standard sample for the calibration curve. The number of standard sample that can be used in the HALO RB-10 is 1~20.

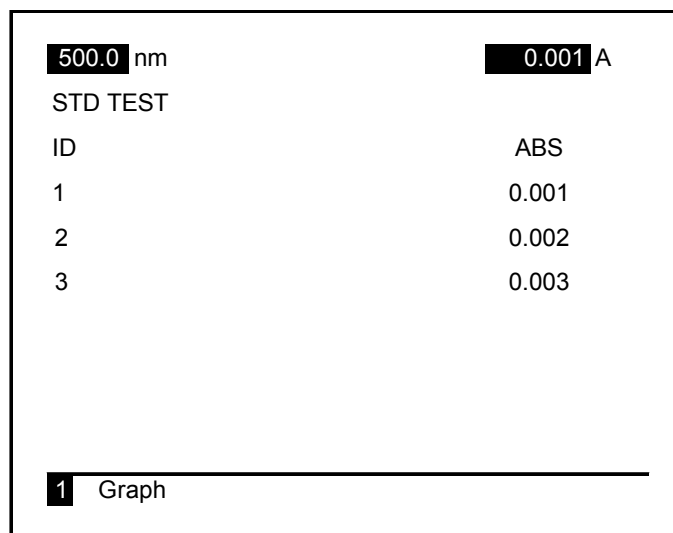




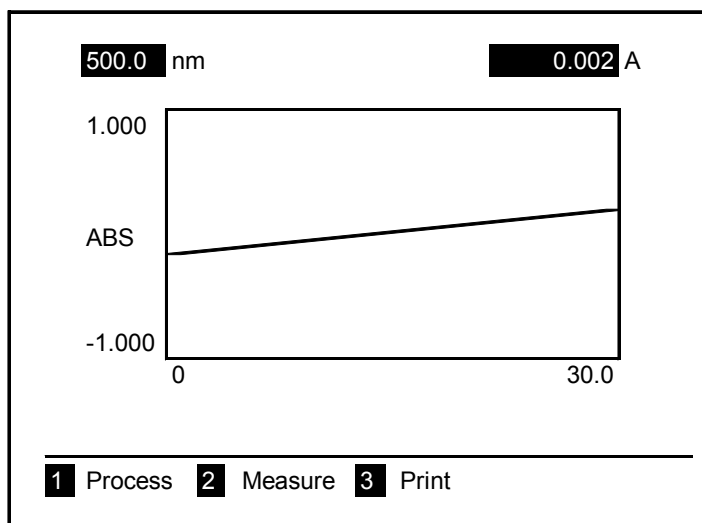


Place your first standard sample in the cell holder, close the sample compartment and then press **Start/Stop**.

Replace with the next standard sample and then press **Start/Stop** again. After all standards are measured, a sub menu will appear on the screen as shown below.



Press **1** and a graph will be displayed on the screen as below. There are three prompts under the line. <Process> , <Measure> and <Print>.

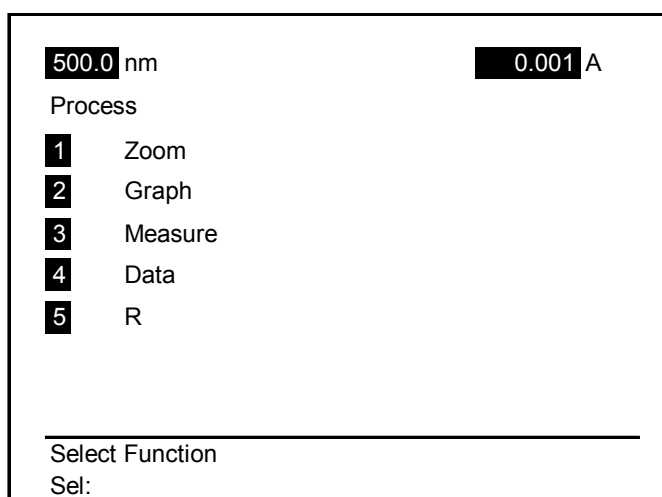


Press **1** to choose the <Process> function to define how the data is processed, you can also enter the sample concentration measurement mode in this menu.

Press **2** to enter the sample concentration measurement mode directly

### Post-run Processing

Press **1** on the keyboard to display the < processing > interface.



The definition of the post-run processing option is outlined below:

- <Zoom>:      Re-scale either or both axes
- <Graph>:     Display the standard calibration curve

- <Measure>: Measure the concentration of sample.
- <Data>: List all data of standards.
- <R>: Correlation coefficient

**Selecting Concentration Type: K – factor**

Press **2** in the concentration type menu and the following submenu will appear

**500.0** nm
**0.001** A

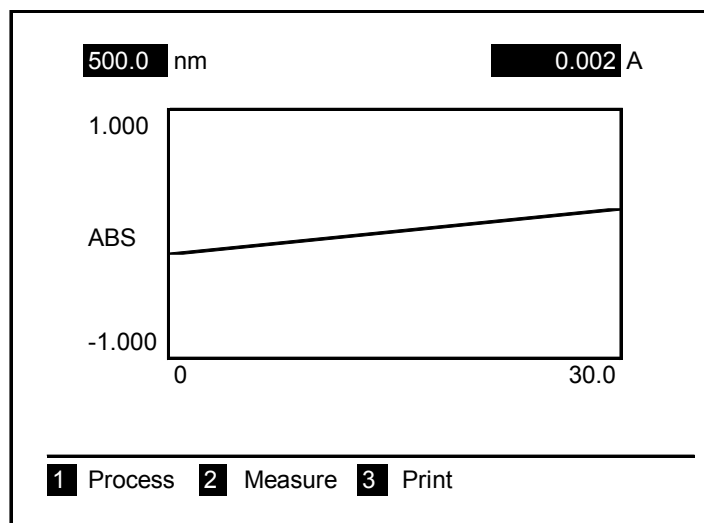
Concentration

<b>1</b>	NUM WL	1
<b>2</b>	WL Setting	
<b>3</b>	Zoom	
<b>4</b>	Concentration Type	<b>k-factor</b>
<b>5</b>	Coef Set	3
<b>0</b>	End Setting	

---

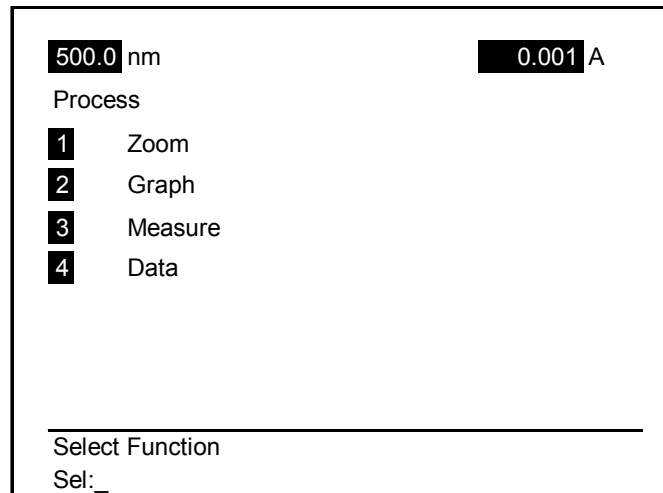
Select Function  
Sel: \_

Press **5** to input the coefficients  $k_0$  and  $k_1$  ( $k_1$  for slope and  $k_0$  for intercept)  
 Press **Clear Return** to save the data and return to the previous submenu.  
 Press **0** to end setting and the system will generate a curve according to the parameters set.



## Post-run Processing

Press **1** on the keyboard to display the processing interface.



The definition of the post-run processing option is outlined below:

- <Zoom>: Re-scale either or both axes
- <Graph>: Display the standard calibration curve
- <Measure>: Measure the concentration of sample.
- <Data>: List data of K1, K0.

## 3.4 Wavelength Scan

This section describes how to perform a scan spectrum using Wavelength Scan.

### 3.4.1 Wavelength Scan Mode

Select wavelength scan from the Main Menu.

Press **[2]** on the keyboard to enter the Wavelength Scan sub menu

- 1) Wavelength Scan Sub menu

<b>500.0</b> nm	<b>-0.001</b> A
Wavelength Scan	
<b>1</b> Start WL(nm)	900
<b>2</b> Stop WL(nm)	800
<b>3</b> Data Mode	ABS
<b>4</b> Upper Limit	3.000
<b>5</b> Lower Limit	-3.000
<b>6</b> Speed (nm/min)	400
<b>0</b> End Setting	
Select Function: _	
Sel: _	

### 3.4.2 Step by Step Operation

#### Wavelength Scan Test Setup

To select the function displayed on the menu, the operator can use

- a. The numeric key as the function key, just press the number, such as **[1]** to set the wavelength for a scan. The HALO RB-10 will automatically enter the submenu after pressing the numeric key.
- b. To return to the previous menu, press **[Clear Return]**
- c. Press **[0]** to end setting the parameter.

### 3.4.3 Definition of the options

#### <START WL> and <STOP WL>

The minimum scan range is 10nm. The Action bar-user prompt will guide you to enter the appropriate value within the range.

Enter the <START WL> or <STOP WL> wavelength by pressing the numeric key on the keyboard and then press **Enter**

Press **0** on the keyboard to save the setup. The HALO RB-10 will check the setup automatically. If the scan range is under 10nm, the HALO RB-10 will not start until a correct range has been entered.

The HALO RB-10's default setting is that the <START WL> is larger than <STOP WL>. The HALO RB-10 will swap the <START WL> and the <STOP WL> wavelength automatically if the <STOP WL> is larger than the <START WL>.

#### Data Mode

Press **3** on the keyboard, the data mode selection will be highlighted. The Action Bar/user prompt display the section of the data mode.

- <1- %T - % Transmittance>
- <2- ABS – Absorbance>
- <3- E (S) – E >

Press the numeric key to select the data mode

<b>500.0</b> nm	<b>-0.001</b> A
Wavelength Scan	
<b>1</b> Start WL(nm)	900
<b>2</b> Stop WL(nm)	800
<b>3</b> Data Mode	<b>ABS</b>
<b>4</b> Upper Limit	3.000
<b>5</b> Lower Limit	-3.000
<b>6</b> Speed (nm/min)	400
<b>0</b> End Setting	
Select Function: _	
<b>1</b> %T	<b>2</b> ABS <b>3</b> E(S)

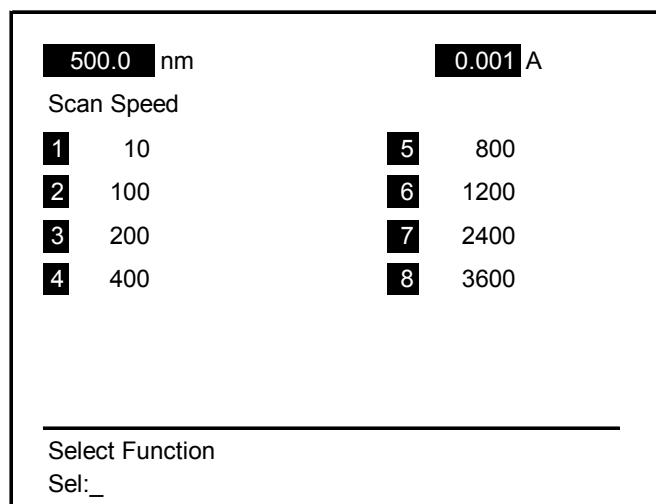
%T: 0.0%~1000.0% ABS: -3.00~3.00 E(S): 0-600.0

Set up the <Upper Limit>, <Lower Limit>, <Scan speed> as in the procedure shown above

**NOTE:** To enter a negative value, press the key **[ -/. ]** before entering the numeric key, the key will act as <-> (minus). Otherwise the key acts as “.” decimal point.

### Scan Speed

Press **[ 6 ]** on the keyboard, the system will display a series of options on the screen as shown below:

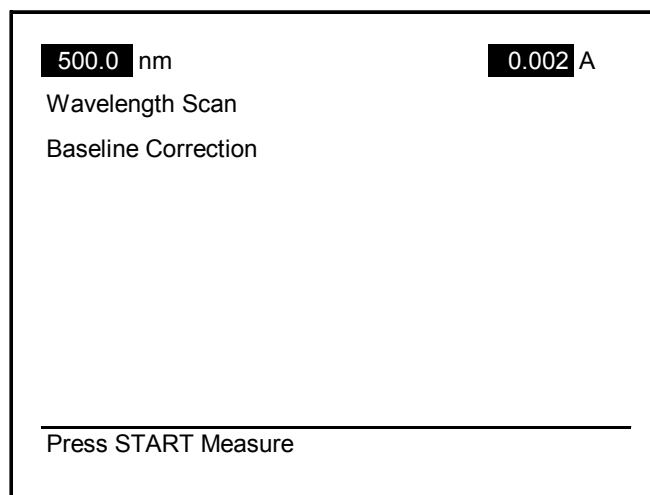


Select the desired speed by pressing the corresponding numeric key.

### 3.4.4 Baseline Correction

Press **[ 0 ]** to save the setting, the following menu will display automatically.

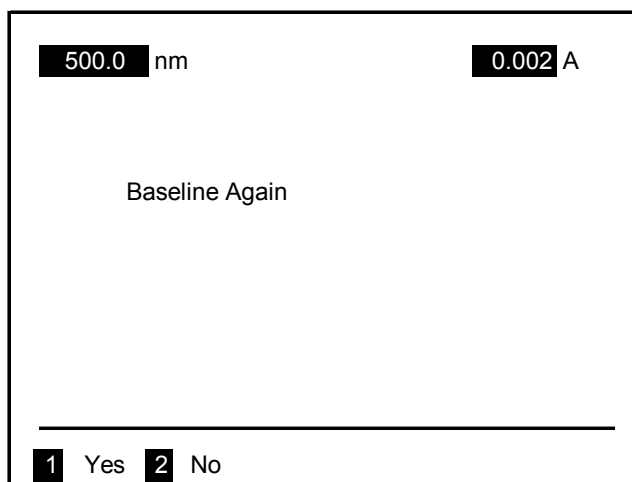




Press **Start/Stop** to begin a baseline scan using the setup saved.

**NOTE:**

- a) While scanning is in progress, the compound key **Start/Stop** is used as [STOP], otherwise it acts as [START].
- b) If the parameters are not changed, the system will prompt you to correction baseline again. (See the following interface)



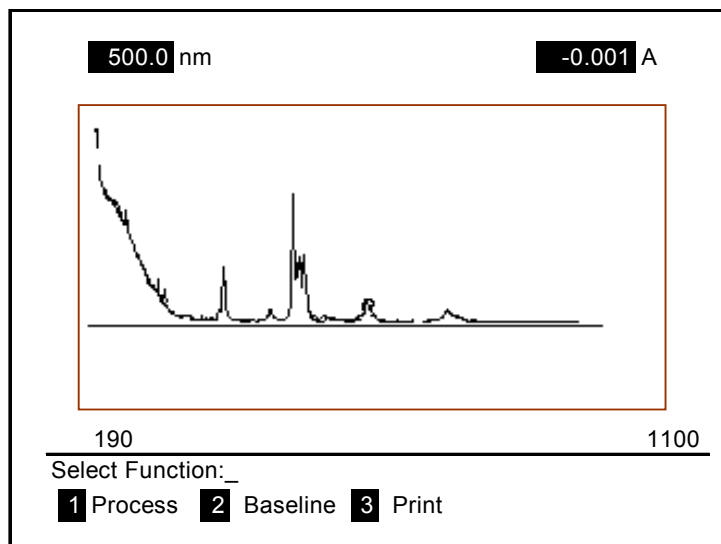
While wavelength scanning is in progress, the current wavelength and photometric values on top of the LCD will change accordingly to reflect the current wavelength and the %T or ABS value.

### 3.4.5 Beginning a Wavelength Scan

After the baseline correction is completed, a wavelength scan can be performed using the acquired baseline

Press **Start/Stop** on the keyboard to begin a sample scan after the baseline correction is completed.

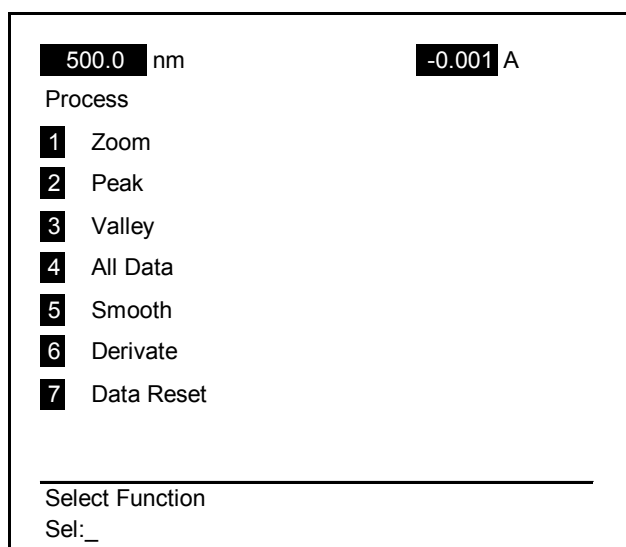
Press **Start/Stop** key again to interrupt the scan in progress.



**Note: The prompt Baseline again will appear on the screen. If the scan parameters are identical, it is not necessary to perform Baseline correction again.**

### 3.4.6 Post-Run Processing

Press **1** on the keyboard to display the processing interface.



Post-run processing function is outlined below:

- 1) <Zoom> RE-scale either or both axes
- 2) <Peak> Lists the value of the peaks of a spectrum.
- 3) <Valley> Lists the value of the valleys of a spectrum
- 4) <All Data> Lists all data of wavelength scan.
- 5) <Smooth> Smoothing of a spectrum.
- 6) <Derivate> Displays the 1<sup>st</sup> derivative spectrum.
- 7) <Data Reset> Goes back to the graph display based on the original data.

### Rescaling a Spectrum

The axes of a selected spectrum can be re-scaled by using the following procedure:

- Press **1** on the keyboard. The ZOOM interface is displayed as below:

<b>500.0</b> nm	<b>-0.001</b> A
Zoom	
<b>1</b> Start WL (nm)	900
<b>2</b> Stop WL (nm)	800
<b>3</b> Upper Limit	3.000 ABS
<b>4</b> Lower Limit	-3.000 ABS
<b>0</b> End Setting	
Select Function: _	
Sel: _	

- Reenter the <START WL> and <STOP WL> to modify the X-axes value.
- Reenter the <Upper Limit> and <Lower Limit> to modify the Y-axes value.
- Press **0** to end setting the parameters and the new spectrum is rescaled.

**NOTE: The parameter of rescale cannot exceed the parameter set in the Wavelength Scan interface.**

### Listing the Peaks and Valleys of a Spectrum

Press **2** on the keyboard to select <PEAKS>; the Abs or the %T value of the peak will be listed:

<b>500.0</b> nm		<b>0.001</b> A
Peak		
ID	WL	ABS
1	880.0	0.001
2	850.0	0.002
3	834.0	-0.001
4	824.0	0.002
5	813.2	0.001
6	803.5	0.002



Select Function: \_  
Sel: **1** Process **2** Graph **3** Print

If the data list can't be completely displayed on the screen, use the **▲** ARROW or **▼** ARROW on the keyboard to scroll the data.

Press **3** on the keyboard to select <Valleys>; the Abs or the %T value of the valleys will be listed:

<b>500.0</b> nm		<b>0.001</b> A
Peak		
ID	WL	ABS
1	870.0	0.001
2	850.0	0.002
3	834.0	-0.001
4	824.0	0.002
5	813.2	0.001
6	803.5	0.002

Select Function: \_  
Sel: **1** Process **2** Graph **3** Print

If the data list can't be completely displayed on the screen, use the  ARROW or  ARROW on the keyboard to scroll the data.

### Printing a Spectrum or Data List

Press  to print the spectrum or the data list.

The HALO RB-10 can be configured for automatic printing of the Spectrum after the tests are completed. Refer to the Printer configuration menu for detail.

**NOTE: To select printer mode and printing format, please refer to Printer configuration section.**

### Smoothing the Spectrum

Use this smoothing routine to smooth the curve of the graph.

### Displaying a derivative spectrum

Use this derivate routine to display a 1st derivative spectrum.

**NOTE:**

1. Press [Menu] on the keyboard to return to main menu at any time unless the system is busy scanning.
2. Press [Clear Return] on the keyboard to return to the last interface at any time unless the system is busy scanning.

## 3.4.7 Wavelength Scan Sampling Interval List

Wavelength scan sampling interval (Unit: nm) as following List.

Scan range Velocity (nm/min)	(1-100) nm	(100.1-200) nm	(200.1-500) nm	(500.1-910) nm
3600	5	5	5	5
2400	5	5	5	5
1200	2	2	2	2
800	1	1	1	1
400	0.5	0.5	0.5	1
200	0.2	0.2	0.5	1
100	0.1	0.2	0.5	1
10	0.1	0.2	0.5	1

## 3.5 Time Scan

### 3.5.1 Using Time Scan Mode

To select time scan from the Main Menu, Press **3** on the keyboard. The time scan submenu will be displayed on the screen.

<b>500.0</b> nm	<b>-0.001</b> A
Time Scan	
<b>1</b> Wavelength (nm)	900
<b>2</b> Data Mode	ABS
<b>3</b> Upper Limit	3.000 ABS
<b>4</b> Lower Limit	-3.000 ABS
<b>5</b> Scan Times (s)	60
<b>6</b> End Setting	
Select Function: _	
Sel: _	

### 3.5.2 Step by Step Operation

To select the function displayed on the menu, the operator can use

- The numeric key as the function key, just press the number, such as **5** to define the Scan Time sub menu. The HALO RB-10 will automatically enter the submenu after the numeric key is pressed.
- To return to the previous menu, press **Clear Return**
- Press **0** to end setting the parameter.

#### Definition of the Setup

##### Wavelength

The <WL> in which the Time Scan is performed, limit of range is 190.0-1100.0nm.

### Data Mode

Press **2** on the keyboard, the data mode selection will be highlighted. The Action Bar/user prompt display the section of the data mode.

- <1- %T - % Transmittance>
- <2- ABS – Absorbance>

### Upper Limit and Lower Limit

The <Upper Limit> and <Lower Limit> determine the Y-Axis value of a spectrum.

Default value of the <Upper Limit> must be larger than the <Lower Limit>. The scale range will swap value automatically, the data mode as follows:

**%T:** 0.0%~1000.0%

**ABS:** -3.000~3.000

**NOTE:** To enter a negative value, press the key **[-./]** before entering the numeric key, the key will act as **[-]** (minus). Otherwise the key acts as **[.]**(Point).

### Time Scan

Defines the time over which the photometric value will be measured. Note that the data acquisition time interval depends upon the specified scan time: as the scan time increases, data points acquired are separated by longer time intervals.

The time range of Time Scan is 60-99999 S.

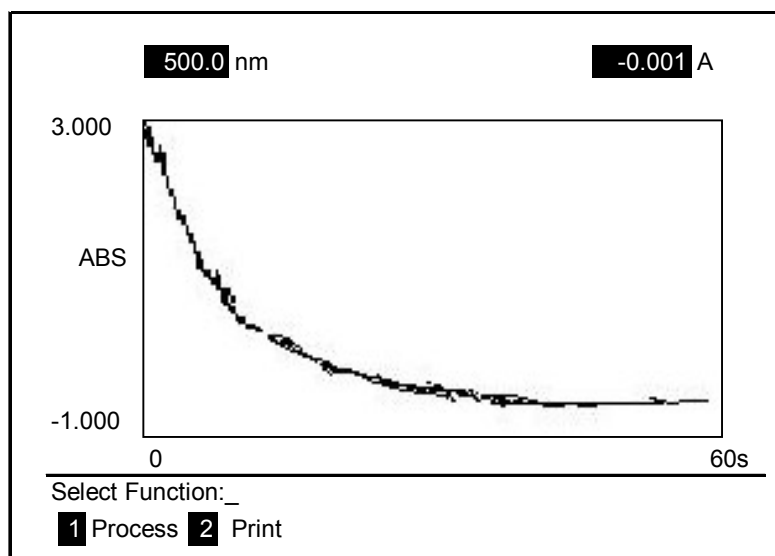
**REMINDER:** To return to other submenu list, press **Clear Return** on the keyboard.

## 3.5.3 Beginning a Time Scan

Press **Start/Stop** on the keyboard to begin a scan

Interrupt the scan by pressing the **Start/Stop**

The following spectrum will be displayed after the scan is completed or interrupted by pressing **Start/Stop**



### 3.5.4 Post-Run Processing

Press  on the keyboard, and the Post-Processing commands 1-7 are listed

The definition of the functions is outlined

- |                 |  |
|-----------------|--|
| 1) <Zoom>       | Expands either or both axes                                      |
| 2) < Peak>      | Lists the peaks of a spectrum                                    |
| 3) <Valley>     | Lists the valleys of a spectrum                                  |
| 4) <All Data>   | Lists all data of wavelength scan.                               |
| 5) <Smooth>     | Uses a smoothing routine to reduce apparent noise in a spectrum. |
| 6) <Derivate>   | Displays a 1 <sup>st</sup> derivative spectrum.                  |
| 7) <Data Reset> | Goes back to the graph display based on the original data.       |

## 5. Rescaling a Time Scan

You can expand or reduce the axis scaling of your time scan. The procedures below that allow you to expand both the X- and Y-axis, or either one selectively. Use the steps listed below to enter the <ZOOM> function.

- Press  on the keyboard to come to the <ZOOM> menu.
- Reenter the <Start Time> and <Stop Time> to modify the X-axis value.
- Reenter the <Upper Limit> and <Lower Limit> to modify the



Y-axis value.

- Press **0** to end setting the parameters and soon you will get the new spectrum rescaled.

**NOTE: 1. The parameter of rescale cannot exceed the parameter set in the Time Scan interface.**

### 3.5.5 Time scan sampling internal List

Time scan sampling internal list as follows.

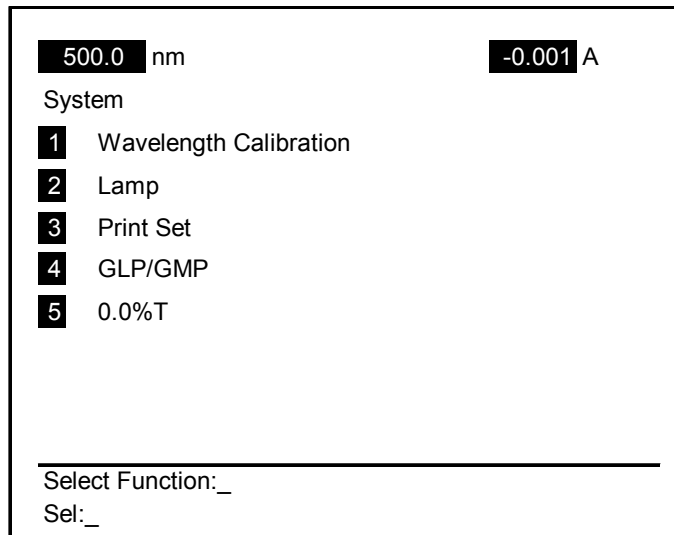
Time Scan Range (s)	Sampling Internal (s)
60-99	0.1
100-199	0.2
200-499	0.5
500-999	1.0
1000-1999	2.0
2000-4999	5.0
5000-9999	10.0
10000-99999	100.0

## 3.6 System Setting

### 3.6.1 Using System Mode

Press **4** on the keyboard.

A submenu list appears on the screen as shown in the illustration below.



### 3.6.2 Step by Step Operation

#### Using the System Menu

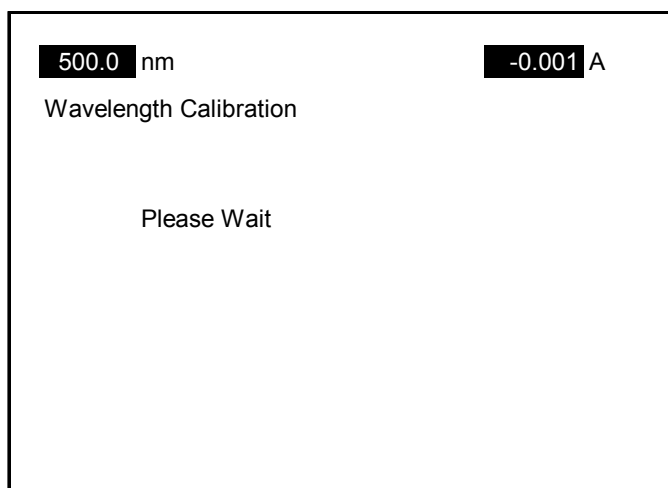
- Press the numeric key on keyboard and the submenu will be displayed on the screen.
- Select the option by entering appropriate numbers from the keyboard.

#### Menu Option definition

##### <Wavelength Calibration>

Make sure that the cuvette holders are empty and Sample Compartment door is closed

Press **1** on the keyboard

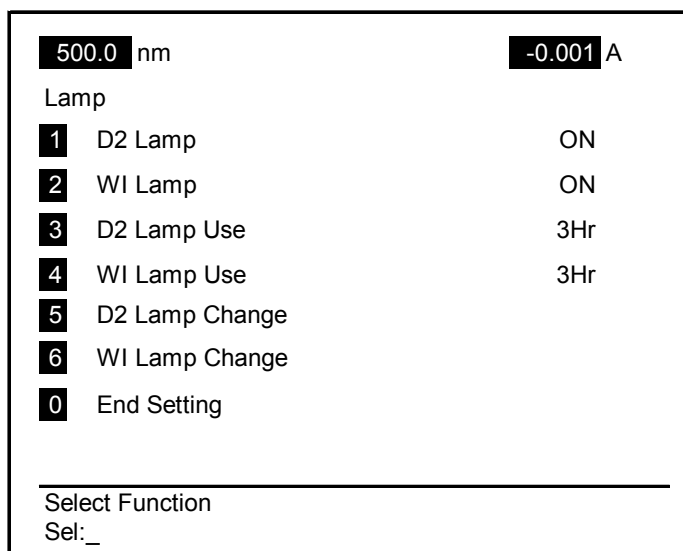


The entire calibration procedure is automatic and uses the 656.1nm emission line from the deuterium lamp.

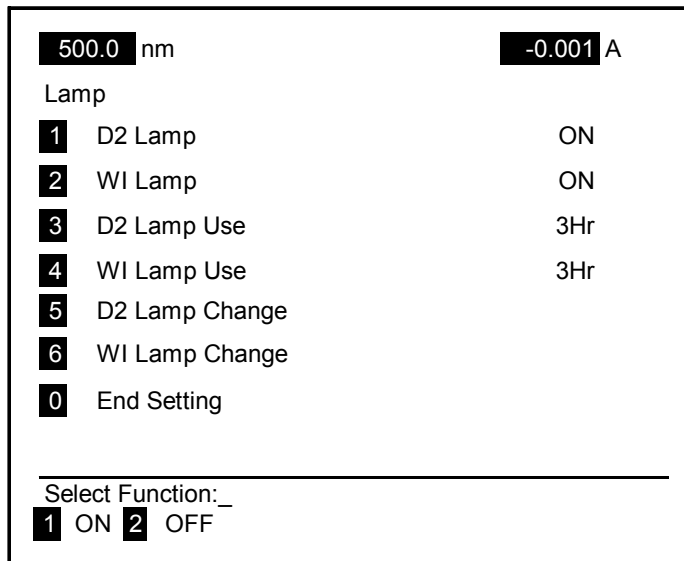
**Note: If there is any error, the system will return to the system menu. If there is no error, the system will return to the main menu.**

**<LAMP>**

Press **2** on the keyboard from the system submenu.



Press **1** or **2** on the keyboard to select switching on or off the D2 lamp or WI lamp, the selection is displayed in the action bar/user prompt.



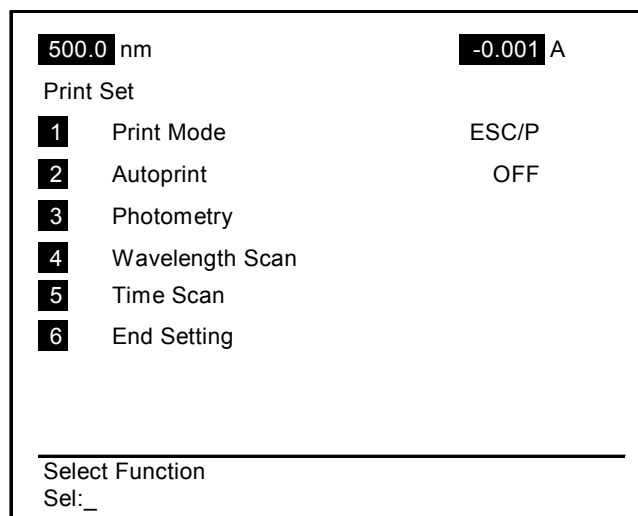
Items 3 and 4 are a timer for the D2 and WI lamps respectively. The HALO RB-10 maintains a timer on the hours of use of the D2 or the WI lamp for service purpose. The memory is non-volatile; the memory will not be erased by power off.

Once a new lamp is installed, please reset the new lamp timer. Press **5** or **6** on the keyboard and the corresponding lamp using time will be cleared.

Press **0** to back to system menu.

### Printer Set

Press **3** on the System Menu to displayed the following submenu:



## Print Set up

Press **1** on the keyboard to select the required printer. The HALO RB-10 supports printers that uses the following printing protocols; ESC/P; DPU or PCL/3. A typical supplier for ESC/P is EPSON, for DPU is SEIKO, for PCL/3 is HP. Consult your distributor to obtain the latest list of compatible printers. Press [1], [2] or [3] on the keyboard to select the printer you want to connect to the HALO RB-10.

Press **2** to select <Auto print> function. If the autoprint function is on, the HALO RB-10 will print the content following the parameter set in the print set menu. But if the autoprint function is off, the print content will depend on the display menu.

For example, if the display is the peak list, the system only needs to print the peak list although the peak list maybe turned off in the parameter set menu. When the function is not in the following modes (SPECTRUM, PEAK, VALLEY, ALL DATA, WORKING CURVE, STD DATA, SAMPLE DATA), the HALO RB-10 will only print the current data for WL position and photometry.

Press 3, 4 or 5 and the print set submenu will be appear on the screen as shown like below.

<b>500.0</b> nm	<b>-0.001</b> A
Photometry	
<b>1</b> Working Graph	ON/OFF
<b>2</b> STD Data	ON/OFF
<b>3</b> Sample Data	ON/OFF
Select Function	
Sel: _	

<b>500.0</b> nm	<b>-0.001</b> A
Wavelength Scan	
<b>1</b> Graph	ON/OFF
<b>2</b> Peak	ON/OFF
<b>3</b> Valley	ON/OFF
<b>4</b> All Data	ON/OFF
Select Function	
Sel: _	

Press **0** to save the setup and go back to system menu.

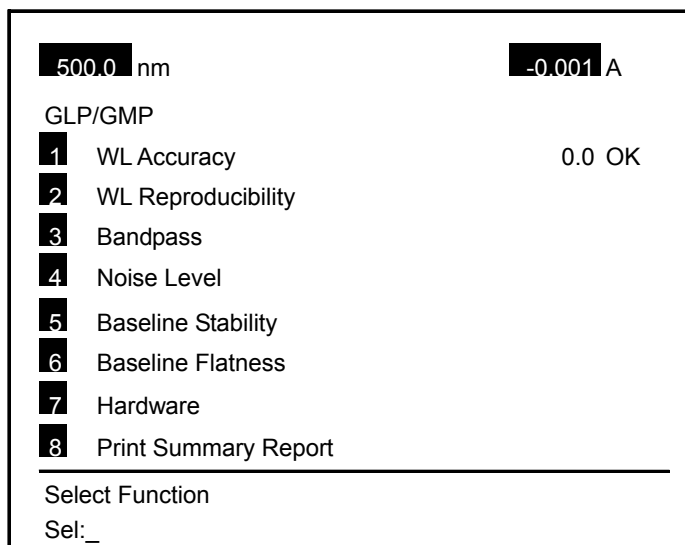
You also may press **Clear Return** to go back to the system menu but the variables will not be saved.

**NOTE:** After you press **0** on the keyboard, the setting will be saved in non-volatile memory of the HALO RB-10.

### GLP/GMP Wizard

The GLP/GMP Wizard is a self-diagnosis function that assists the user to perform day to day system calibration and instrumentation qualification as required by Good Laboratory Practice. Please note that it is not a replacement of good laboratory practice and other compliance requirement required by the GLP. Please make sure that the Sample and Reference cuvette holders are empty before running the GLP/GMP function.

Press the function key required on the keypad in the following submenu to perform the test



The following function can be performed automatically

- 1) WL Accuracy
- 2) WL Repeatability
- 3) Bandpass
- 4) Noise Level
- 5) Baseline Stability
- 6) Baseline Flatness
- 7) Hardware
- 8) Print Summary Report

The measure condition of GLP/GMP is shown as below:

Check item	Process	Specification
WL Accuracy	Wavelength Scan, Range: (660-650nm) or (490.0-480.0), speed:100nm/min	+/-0.5nm
WL Reproducibility	Wavelength Scan, Range: (660-650nm), 3 times, speed:100nm/min	+/-0.3nm
Bandpass	Wavelength Scan, Range: (660-650nm), speed:100nm/min	3.0-4.5nm
Noise Level	Time Scan, WL:500.0nm, 5min	0.001ABS
Baseline Stability	Time Scan, WL:500.0nm, 3600s	0.002ABS
Baseline Flatness	Wavelength Scan, Range:1100.0-190.0, Speed:400nm/min,	+/-0.010ABS

1. <WL Accuracy>

After scanning the wavelength from 660.0nm to 650.0nm, the system will get the maximum value and the corresponding wavelength position. If the wavelength position is within the range of  $656.1 \pm 0.5\text{nm}$ , the WL Accuracy item will display <OK>.

2. <WL Reproducibility>

The HALO RB-10 will perform a wavelength scan from 660.0 to 650.0nm as in the first stage of the WL Accuracy test. The maximum value of wavelength will be located, then the motor moves from 650.0 to 190.0nm, and then from 190.0 to 660.0nm.

In second stage, the HALO RB-10 will scan from 660.0-650.0nm again, find another wavelength position at the same time.

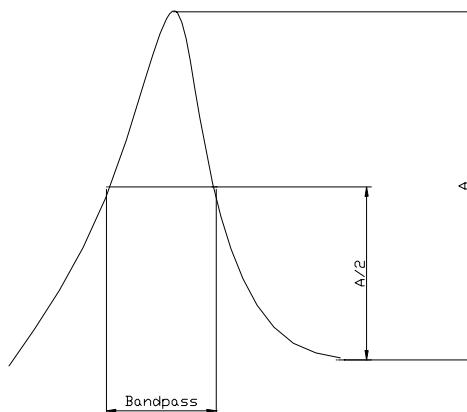
In the third stage, the HALO RB-10 will move from 650.0-1100.0nm, from 1100.0-660.0nm and perform a wavelength scan the third time and mark the third wavelength peak position.

From the three values recorded in the 3 stages, the HALO RB-10 will obtain the maximum wavelength value and the minimum wavelength value, taking the mean of the two values i.e.  $(\text{max}-\text{min})/2$ . If the result is within 0.5nm, the WL Reproducibility item will display <OK>.

3. <Bandpass>

The HALO RB-10 performs a wavelength scan from 660.0 to 650.0nm as in the WL Accuracy test. From the measured data, the HALO RB-10 identifies the maximum value and the minimum value and takes the mean of the absorbance value i.e.  $A/2 = (\text{Max}-\text{Min})/2$ .

At  $A/2$  Abs value, two wavelength values which are close to  $A/2$  can be identified. The difference between these two wavelengths is the value of bandpass. If the bandpass value is within 3.0-4.5 nm, the bandpass item will display <OK.>





4. <Noise Level>

After a time scan of 300S at 500.0 nm, the HALO RB-10 will identify the maximum value and the minimum value of the measured data. The noise level value is the difference between the maximum value and the minimum value (peak to peak). If the noise level value less than 0.001ABS, the item will display <OK>.

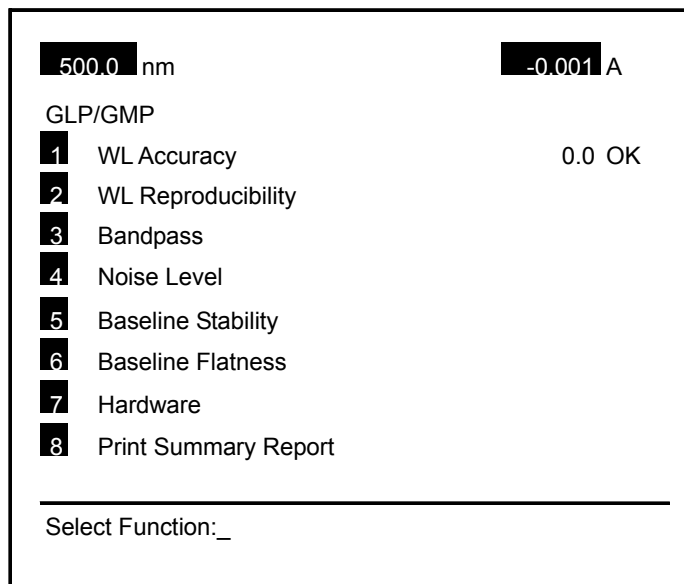
5. <Baseline Stability>

After a time scan of 3600 S at 500.0 nm, the peak to peak value of the wavelength scan is defined as baseline stability value. If this value is less than 0.002ABS, this item will display <OK>.

6. <Baseline Flatness>

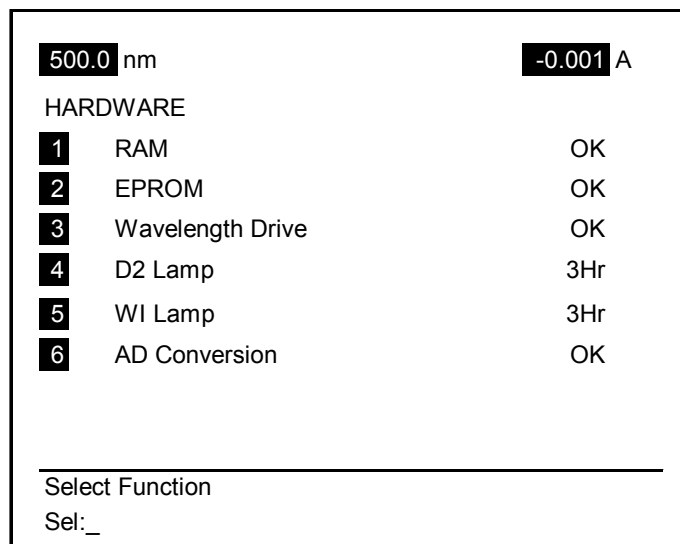
The HALO RB-10 will perform a wavelength scan from 1100.0nm to 190.0nm twice. The first time the measured data is recorded as the baseline, and the second group of data is defined as absorbance. The maximum value and the minimum value will be identified in this scan. The result  $\pm(\text{Max}-\text{Min})/2$  is defined as baseline flatness. If the value is less than (0.010ABS), the baseline flatness item will display as <OK>.

When each function is completed, the system displays <OK> or <NG> as described above.



After each measurement, the action bar/ user prompt will guide the user to choose printing the result or not. Once **2** is pressed on the keypad, the system will not let the user print out the graph. Measurements can be performed by pressing **2** ~ **7** in this display. After each measurement, the result will be displayed on the same screen. The measurement result will not be erased until returning to the main menu when the user presses **Clear Return** or **Main Menu**.

Press **7** on the keypad, the display will change to as below:

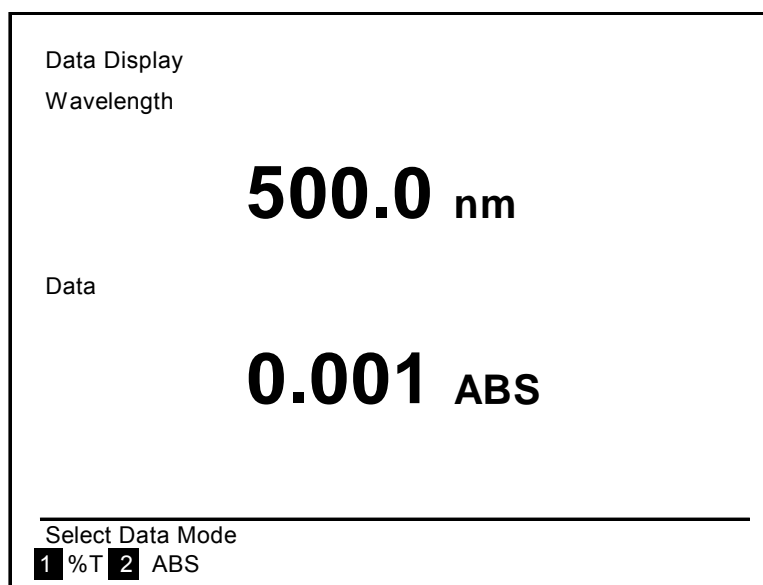


After 5 Seconds, the system will return to the GLP/GMP Menu. Press **1** to print out the data.

Press **8** <Print Summary Report> to print out the measured results from the GLP/GMP screen . A spectrum will not be printed using this function.

### 3. Data Display

This function will display the data and parameters in a bigger font on the LCD screen for easy viewing.



Press  or  to change the data mode. Press [**Goto WL**] to enter the new <WL value >and the motor will move to the new position.

# Chapter 4 Maintenance

## 4.1 Self Diagnosis and Automatic Adjustment

The Model HALO RB-10 spectrophotometer is capable of executing self-diagnosis and automatic adjustment immediately after the power switch is turned on. For details, refer to chapter 3.

## 4.2 Confirmation of Specifications

### 4.2.1 Wavelength Accuracy

Switch the Light Source Mirror to D2 Lamp side.

- (1) Select Wavelength Scan from the Main Menu and set the measurement conditions with the Wavelength Scan displayed as shown in the below.

START WL (nm)	660.0
STOP WL (nm)	650.0
Upper Limit	100.0
Lower Limit	0.00
Scan Speed (nm/min)	100

- (2) Make sure that no sample is placed in the sample compartment, and then press Start/Stop key to measure spectra. Upon completion of the measurement, select <2 PEAKS> to detect each peak. If the detected peak is within a range of 655.7 to 656.6 nm, it is normal.

If the peak is over the scale limit, change the existing <Upper Limit> to display the spectrum. If the peak is not within the abovementioned range, perform the <Wavelength Calibration> again, and repeat the above procedure to make sure that the peak is within the specified scale range.

### 4.2.2 Spectrum Band Width

Use the spectrum bandwidth function under the GMP/GLP program.

### 4.2.3 Check for Baseline Flatness

Use the baseline bandwidth function under the GMP/GLP program.

## 4.3 Periodic Inspection

### 4.3.1 Cleaning of Sample Compartment

The sample compartment is susceptible to contamination the compartment should be cleaned if a sample is spilled inside. Remove the respective parts from the compartment as shown in Fig. 4-1 through Fig. 4-3. If they are cleaned, be sure to dry them thoroughly before reassembling them.

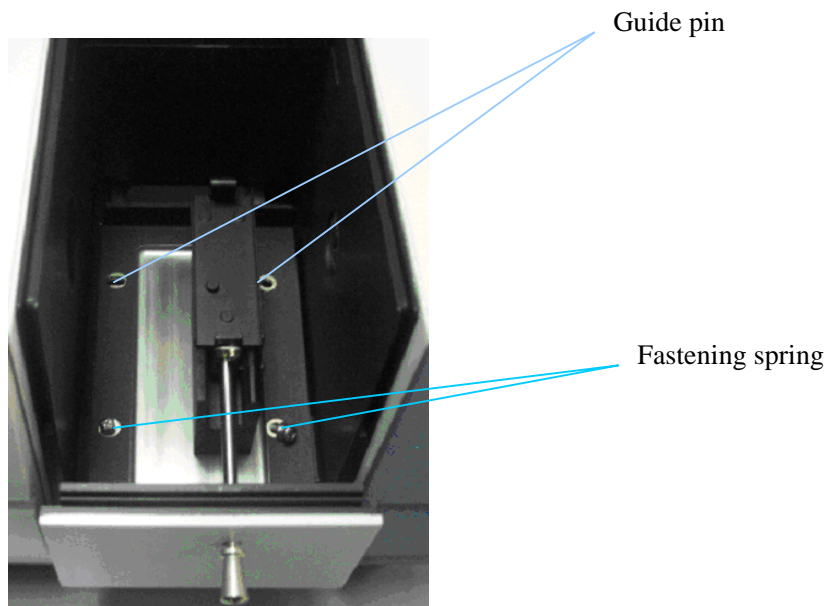


Fig. 4-1 Removal of Sample Compartment Cover

1. Open the cover of sample compartment.
2. Completely loosen the fastening and remove the fastening screw with the screwdriver supplied.

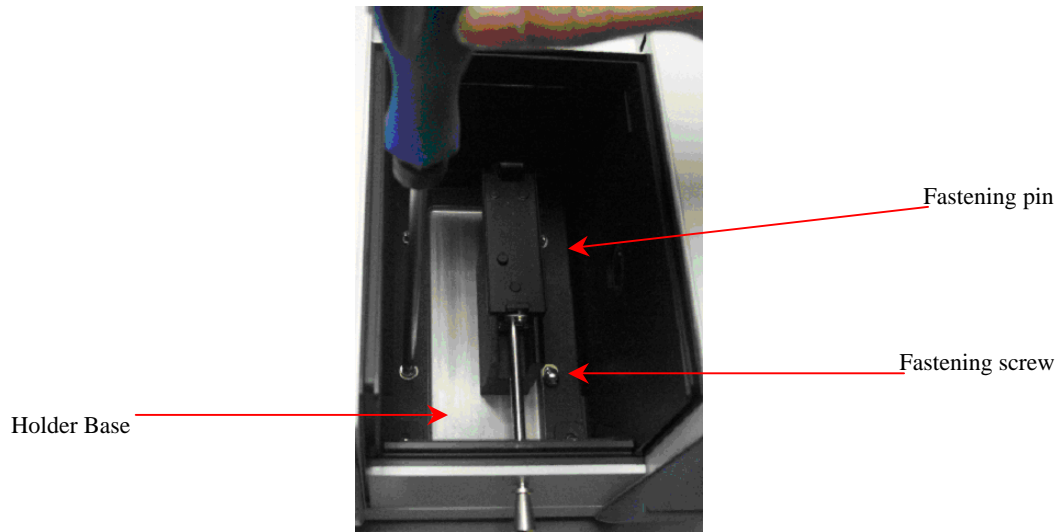
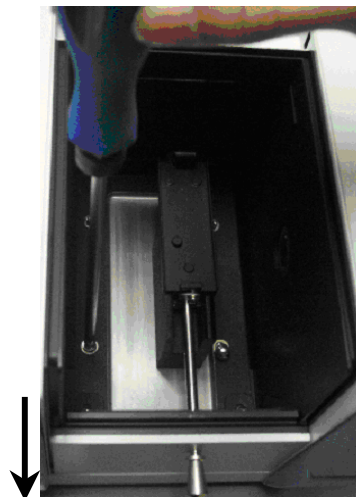


Fig. 4-2 Remove the Fastening screw



Removal direction

Fig. 4-3 Remove the Cell Holder

3. Take out the sample compartment base and clean the sample compartment.
4. After cleaning the sample compartment, reinstall the sample compartment.

### 4.3.2 Cleaning the Sample Compartment Windows

If the transparent window of the sample compartment is contaminated, remove the window plate, and then clean it completely.

Be sure to wash your hands thoroughly before cleaning the window, and then wipe off the contaminant with a soft paper or cloth soaked with alcohol and ether solution (mixed in a ratio of 1 to 1).

**CAUTION:** Pinch both ends of the window plate with your fingers to set it back in the sample compartment. Do not leave fingerprints on the window plate.

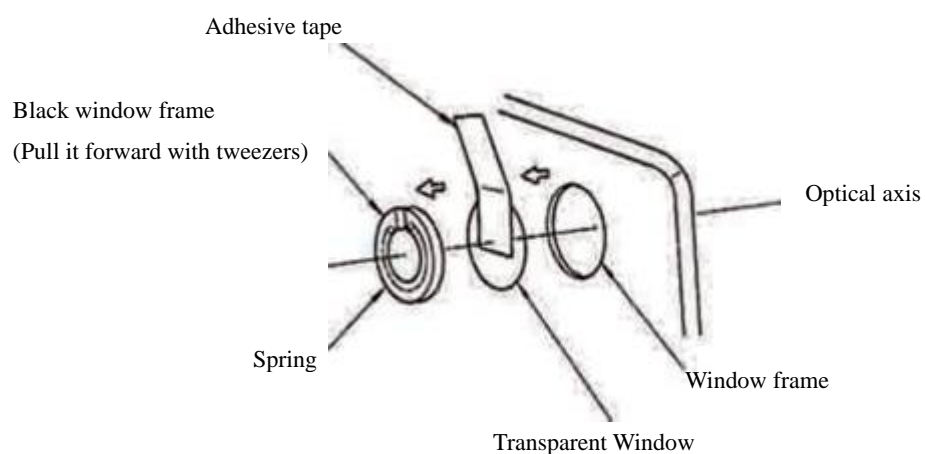


Fig. 4-4 Removal of Sample Compartment Window Plate

## 4.4 Troubleshooting

For any abnormality, rectify the problem by referring to the following table.

No.	Symptom	Cause	Solution
1	Lamp fails to light if power switch is turned on.	a. Fuse is not in place. b. Fuse is blown.	a. Reinsert the fuse. b. Replace the fuse.
2	“CALIBRATE INSTRUMENT”, appears at the bottom of the screen during initialization.	Wavelength calibration values have been deleted.	a. Execute CALIBRATION. b. Contact the nearest Dynamica agent if the error display does not go off even after executing CALIBRATION.
3	D <sub>2</sub> LAMP or WI LAMP Error is displayed on the screen	Lamp filament has failed	Replace the lamp.
4	“PRINTER HARDWARE ERROR” appears on the LCD screen.	Printer head is abnormal.	a. Turn off the power switch, and see if the error display goes off. b. Contact the nearest Dynamica agent if the error message is displayed again.
5	Error message appears on the bottom of the LCD.	Instrument has been operated erroneously.	a. Operate the instrument properly referring to the message displayed.
6	Too large variations in displayed data	a. Lamp deteriorated. b. Lamp contaminated with fingerprints or dust. c. Cell or window contaminated with water drops or dust.	a. Replace lamp. b. Remove contamination or water drops.



## Chapter 5 Replacement Parts

### 5.1 Consumables and Spare Parts

The following parts are consumables. Contact the nearest Dynamica agent before consuming all of them.

WI Lamp (Tungsten Iodide Lamp): P/N: 25-03-0001

D<sub>2</sub> Lamp (Deuterium Lamp): P/N: 25-02-0013

Main Power Fuse: P/N: 13-02-0004

Table 5-1 Guaranteed life of lamp

	Guaranteed time	Guaranteed Period
WI Lamp	1000h	6 months after delivery to customer's site
D <sub>2</sub> Lamp	1000h	6 months after delivery to customer's site

### 5.2 Part Replacement

#### 5.2.1 Replacement of Light Source Lamp

#### **Cautions on Replacement of Lamp**

- Do not replace the lamp with the power switch on. Note that high voltage is applied to the lamp.  
High voltage is discharged while the power is turned off.
- Wait for at least 10 minutes after the power switch is turned on.
- Wear clean gloves for mounting a new lamp. Do not leave fingerprints on the lamp tube wall.  
For D<sub>2</sub> lamp, care should be taken to prevent leaving fingerprints on the protruded sections.

The following shows how to replace the existing lamp with a new one.

- (1) Turn off the power switch. Pull off the power cord and wait for at least 20 minutes until the lamp cools down.
- (2) Remove the fastening screw from the side face of the light source cover, and then remove the cover. (See Fig. 5-1)



Fig. 5-1 Remove the cover

After opening the cover of light source lamp compartment, the WI lamp and D<sub>2</sub> lamp can be shown as the illustration in Fig. 5-2.



Fig.5-2

(3) Replacement of WI Lamp

Press the lamp base and then pull it out slowly. Push in a new lamp to the extreme end of the lamp holder.



Fig. 5-3 Remove the WI Lamp



Fig. 5-4 Secure the WI lamp position

(5) Replacement of D<sub>2</sub> Lamp

- a) Pull out the D<sub>2</sub> Lamp connector.



Fig. 5-5 Pull out the D<sub>2</sub> Lamp connector

- b) Hold the top end of the D<sub>2</sub> lamp, and turn it counterclockwise until it is separated from the holder.

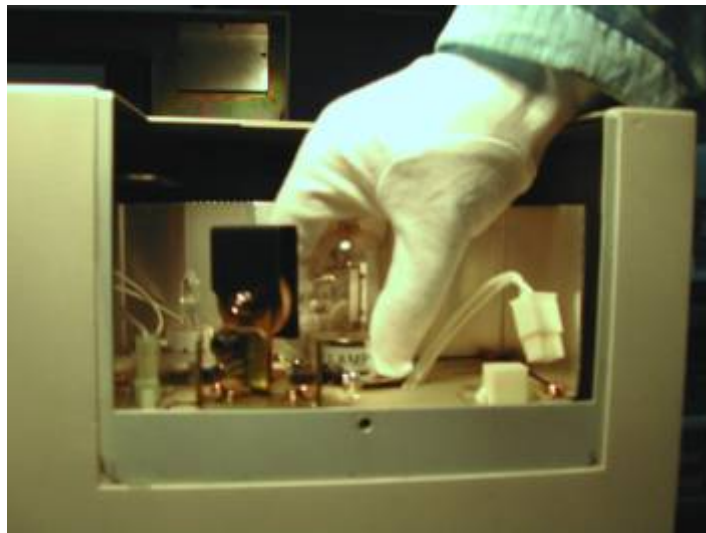


Fig. 5-6 D<sub>2</sub> Lamp replacement

- c) Attach a new D<sub>2</sub> lamp by reversing the procedure described above. Clean glove should be use when attaching the D<sub>2</sub> lamp to avoid leaving fingerprint on the lamp surface.
- d) Plug in the D<sub>2</sub> lamp connector as shown in Fig. 5-7



Fig. 5-6

(6) Put back the light source cover. (See Fig. 5-7)



fastening  
the screw

Fig. 5-7

### 5.3 Reset the lamp usage time

After replacing the light source lamp, please clear the lamp usage time. Please reset the the lamp usage time according as chapter 3.

## **Notice**

For the updated contact of Dynamica, applications and other product updated information about HALO RB-10 spectrophotometer. Please visit Dynamica website periodically.

Dynamica Website: <http://www.dynamica.com.au/>