



# RIKEN PHOTOELECTRON SPECTROMETER

## AC – 2 INSTRUCTION MANUAL

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# 1. Product outline

## 1-1. Preface

Thank you for purchasing our Photoelectron Spectrometer AC-2. Please check the model number against the model number in the instruction manual.

This instruction manual describes the correct methods required to operate the instrument. Please read this manual carefully even if you have experience in handling this instrument. This manual should then be store in a place where operators can be reached easily when required for reference.

Following additional detailed manuals are available regarding operation of this instrument for you to refer.

Name of manual	Contents
AC-2 Instruction manual for WINDOWS (Measuring method for Work Function or Ionizing Potential)	Measuring method of Work Function and Ionization potential using this product.
AC-2 Instruction manual for WINDOWS (Measuring method for thickness and Counting rate)	Measuring method of thickness using this products.
AC-2 Service Manual	Consumable parts replacement method.

Operate according to the following Operation Method 1-2.

When operating or performing maintenance, be sure to follow the instruction manual. Do not modify or repair the instrument using tools other than those specified in the specification. Otherwise, the safety warranty of the product will not be guaranteed. We shall not be held responsible for accidents or damage caused when the product is handled in a way other than described in the instruction manual.

It is strictly prohibited to copy or transcribe a part or whole of this manual.

Specifications are subject to change without notice.

## 1-2. Purpose of use

This is designed to measure the photoelectron emission in air of solid state sample under normal temperature and normal pressure. The sample is measured in a clean room or laboratory for fine instrument where least contact of contamination to the surface of the sample is likely to occur.

- The measurement of threshold energy of photoelectron emission generated to radiate ultraviolet rays. (In most cases, this threshold energy is interpreted as work function and ionization potential.)
- The measurement of thickness on oxide film for thickness of a few to an around few hundred Å.

### 1-3. Definition of DANGER / WARNING / CAUTION / NOTE



**DANGER** indicates an imminently hazardous situation which, if not avoid, will result in death or serious injury. This signal word is to be limited to the most extreme situation.



**WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



**CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate inquiry. It may also be used to alert against unsafe practices.



This mark means the advice at the handling.

## 1-4. Method of confirmation for CE marking type

The CE marking is labeled on the detector in case of comply with CE marking. Please confirm the instrument specification before using. Please refer Declaration of Conformity that is at the end of this manual if you have CE marking type.

You can confirm instrument specification to see the CE marking as follows.

### 1-4-1.LC1



CE marking label(LC1 unit)

### 1-4-2.DC1



CE marking label(DC1 unit)

## 2. Important notice for safety

### 2-1. Warning cases

#### WARNING

##### Do not open the main unit cover with power on.

- There is the high voltage part inside, you may receive the electric shock.
- As the ultraviolet rays are radiated from the lit-on lamp, do not see it by naked eyes absolutely. This may cause the inflammation of skin.
- As the lamp lit on or just after light-on is heated up, do not touch it by hand. It may cause a burn.

##### Abnormal heat, fume, abnormal sound and nasty smell

If any abnormality should take place during operation, stop operation immediately, switch off the power and remove cable from the power socket. If continue to use, it may cause the electric shock and fire.

##### Shock such as dropping

Do not do the action to give shock or drop.

As this is composed of fine electronics parts, it may become far from normal operation and measurement.

- Operation at place with high temperature, humidity and plenty of dust.
- Do not store or operate at high temperature, humidity and plenty of dust. It may cause trouble action, electric shock and fire. The operation shall be made at the given range of temperature and humidity.
- When desired to move from low temperature place to high temperature place, there is the case of dew inside or on the surface. The operation in such may cause the trouble. When move the product, leave it for some hours alone at the operation place and let it used to the ambient temperature.

##### When use the deteriorated parts

- Check the pipeline regularly and replace the appropriate parts regularly. When continue to use the deteriorated parts, it may cause breakage of pipe and exploded accident.
- The lamp which passes away life excessively may cause explosion.

## WARNING

### • OPERATION POWER

Do not use other power voltage than the described. It may cause the breakage of product, electric shock and fire.

### • Connection of earth terminal(grounding)

For safety, connect the power cable to electric outlet with earth (3P).When use the accessory transducer plug, ground the earth terminal. If not grounded, it may cause the electric shock.

### • Handling of power cable

- Do not put things on the power cable, pull in, push out, bend or slice. As power cable is damaged, it may cause electric shock and fire.
  - When plug in and out the power cable into electric outlet, be sure to do it with power plug grasped. When pull the cable, a part may be disconnected and cause the fire.
  - Check that there is no dust on the power plug and plug into electric outlet fully. Then do not use the loose electric outlet which may cause the contact failure. It may cause fire.
  - When plug in the power cable, do not touch it by wet hand. It may cause the electric shock.
- Do not make power tapping hub.

Do not connect many cables into the same electric outlet. This may cause the fire and it may affect other product by power shutoff of breaker due to over use of power. This is subject to commercial power electric noise and may easily cause the trouble.

### • Intrusion of foreign substance

Do not put other material than the measuring goods from the sample door. Then, add the metal material or flammable material inside from the windows. When use as it is, it may cause the faulty action, electric shock and fire.

### • Put thing on the product

Do not put small metal goods such as pin, clip and container with water such as vane, plant. When they put inside and operate it as it is, it may cause the damage of products, the electric shock and fire.

### • When install or move the unit

The unit is big, heavy and precision instrument. So, the vibration may influence on the unit. When install or move, don't give the vibration to the unit. And don't fall it.

When install or move, we recommend that you contact and ask us to install or move.

## WARNING

- Do not stare the tip of the optical fiber.

During measurement, ultraviolet rays are emitted from the tip of the optical fiber.

Please do not stare absolutely.

This can cause visual impairment and eye pain.

- Do not stare the output port of the spectrometer.

During measurement, ultraviolet rays are emitted from the output port of the spectrometer. Please do not stare absolutely.

This can cause visual impairment and eye pain.

- Please do not connect to the OUTLET of the LC1, other than DC1.

Please do not connect to the INLET of DC1, other than the LC1.

It may cause the damage of products, the electric shock and fire.

- If it is used with methods other than we have specified, the protective functions provided by this unit may be deteriorated.

## WARNING



Caution, electricity

This label is attached on or inside of the unit to indicate that hazardous voltages may exist.



Caution, high temperature

This label is attached on or inside of the unit to indicate that the surface may be with hazardous high temperature.



Caution, ultraviolet

This label is attached on or inside of the unit to indicate that looking straight may cause vision disorder.



General warning

This label indicates that improper handling may cause serious damage on health or assets.



## 2-2. Caution item

### CAUTION

- Contact to the end surface of metal  
When required to contact the end surface such as iron plate, enough attention and care should be taken so that any damage cannot take place.

- The use of Walky-talky near the product  
When use the walky-talky etc which emits electric wave near the cable or product, there is the case that the correct measurement cannot be carried out and the attention for it would be required. When use such walky-talky etc, use it where there is no influence.

- Procedure of power on  
Make power on after Operating System (OS) for Personal Computer is set up. If the power gets on before Operating System is set put, it may cause the error of operation.

- Power on again  
When make power on gain, do it in 5 minutes again after power off. When make power on within 5 minutes, there is the case that the normal operation cannot be carried out.

- Operation at the unstable place  
Do not put it at the unstable place such as slant and vibrating place. It may not do the normal operation.

- The caution for compressed air  
When the following material is contained in the compressed air, it may deteriorate the detector and dry air generating conditioner and there is the possibility for damage.

Kind	Materials which should not contain
Solvent	Acetone, Benzene, Phenol, Toluene, Trichloroethylene, Xylene, Cresol, Thinner, Aniline, Chloroform, Alcohol, Dioxane, Tetrahydrofuran, Methylene chloride, Cyclohexanone, Carbon tetrachloride etc
Acid	Sulfuric acid, Nitric acid, Hydrochloric acid, Acetic acid, Acetic acid etc
Gas	Chlorine, Sulfurous acid, Hydrogen sulfide, Bromine, Semiconductor gas etc
Oil	Hydraulic fluid (Phosphatic Ester), Fuel oil, Water Soluble Cutting Fluid (Alkaline), Kerosene etc

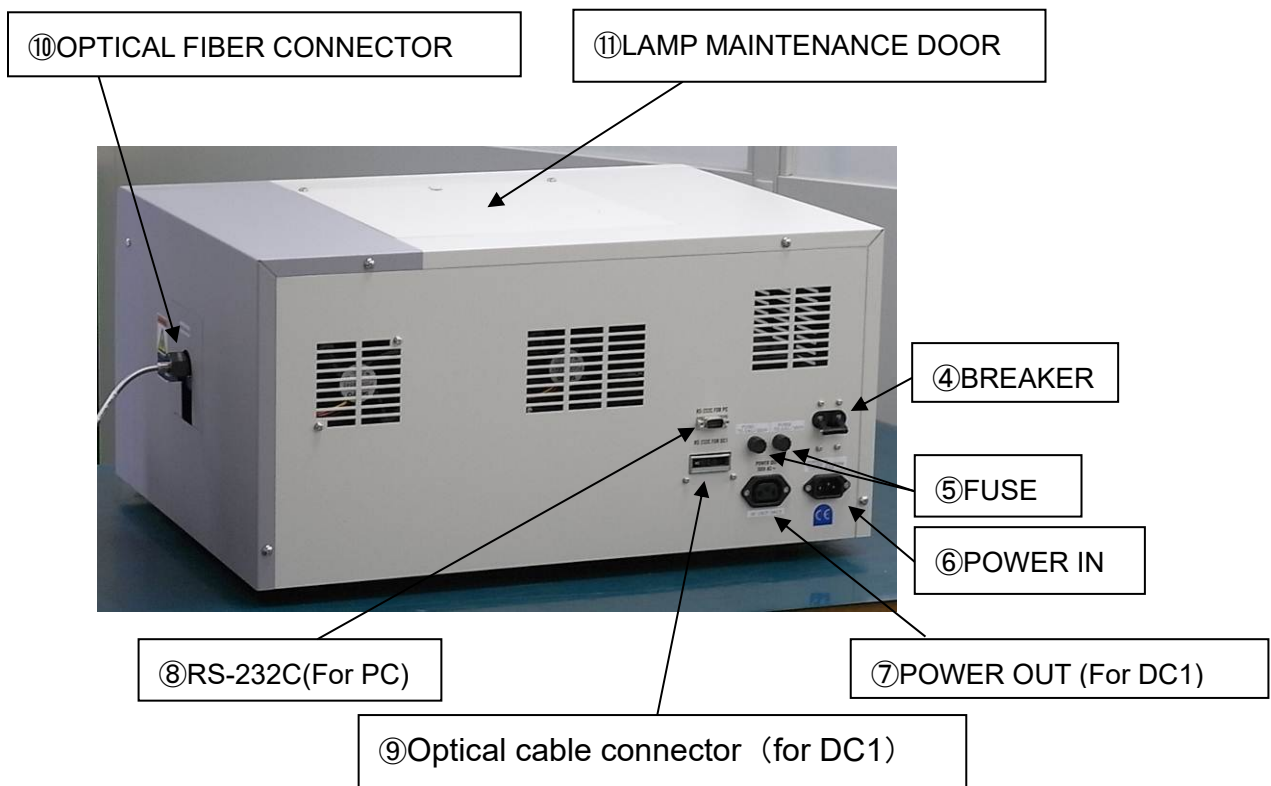
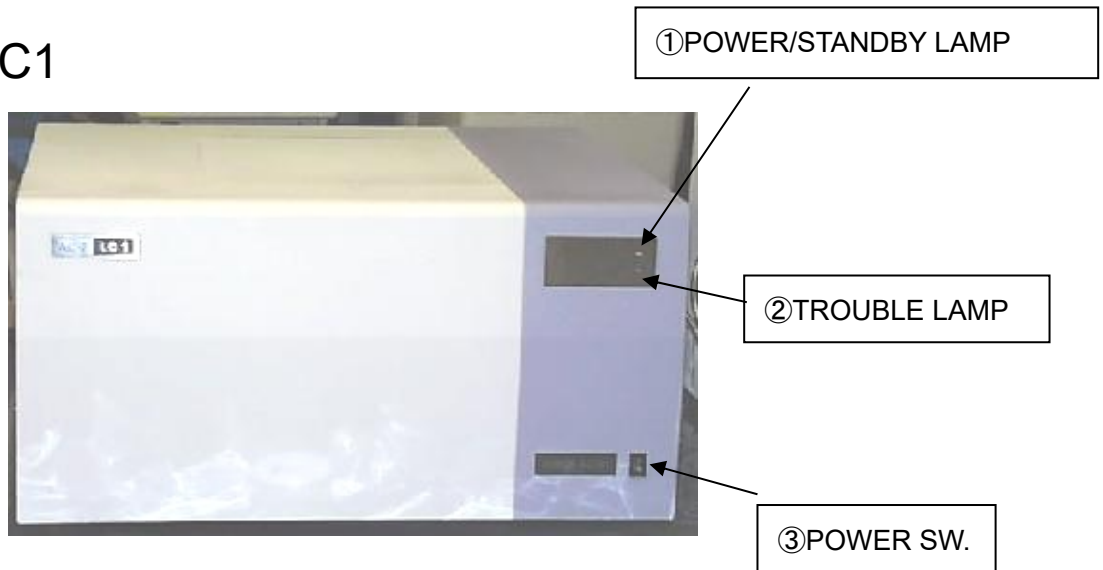
- When use at more than given pressure, it may damage dry air generating system.
- When induct liquid such as water from the compressed air pipe, it may damage the system.
- When induct other gas such as N2 gas, oxygen, inert gas than air from compressed air pipe, it may damage the system.

- When a PC is connected, use it according to operating environment conditions of the product.

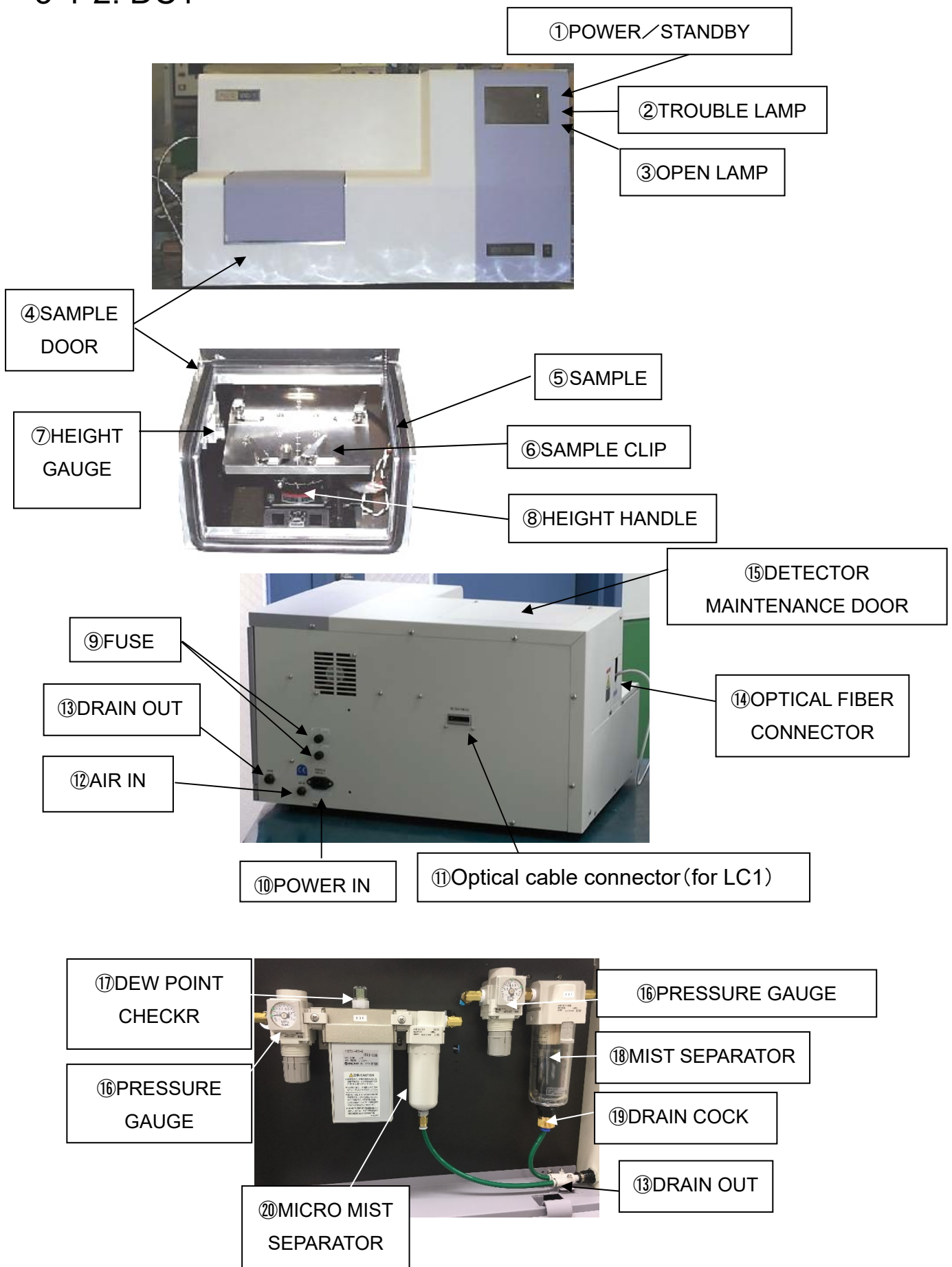
### 3. Function of products

#### 3-1. External drawing

##### 3-1-1. LC1



### 3-1-2. DC1



## 3-2. Name of each part and function

### 3-2-1. LC1

#### •Front panel

- ① POWER/STANDBY LAMP : Measurement time..... Light on of green lamp  
Waiting (Warming up)..... Blinking of green lamp
- ② TROUBLE LAMP : Power on initial/Trouble time• Red lamp blinking  
(Light off at measuring condition)
- ③ POWER SW. : ON( | ), OFF(O)

#### •Rear side panel

- ④ BREAKER
- ⑤ FUSE...2.5A T × 2 pcs
- ⑥ POWER IN
- ⑦ POWER OUT(for DC1)
- ⑧ RS232C(for PC)
- ⑨ Optical cable connector(for DC1)

#### •Right side panel

- ⑩ OPTICAL FIBER CONNECTOR

#### •UPSIDE PANEL

- ⑪ LAMP MAINTENANCE DOOR

### 3—2—2. DC1

#### •FRONT PANEL

- ① POWER/STANDBY LAMP : Measurement time..... Light on of green color  
Waiting(Warming up).....Blinking of green color
- ② TROUBLE LAMP : Power on initial/Trouble time•Red lamp blinking  
(Light off at measuring condition)
- ③ OPEN LAMP : Orange lamp blinks when SAMPLE DOOR is open.
- ④ SAMPLE DOOR
- ⑤ SAMPLE CLIP : This not only fixes sample but makes sample at earth.
- ⑦ HEIGHT GAUGE : This gives height control standard of measuring surface.
- ⑧ HEIGHT HANDLE : This changes the height of measuring surface.

•Rear side panel

- ⑨ FUSE···2.5A T × 2 pcs
- ⑩ POWER IN
- ⑪ Optical cable connector(For LC1)
- ⑫ AIR IN
- ⑬ DRAIN OUT

•Left side panel

- ⑭ OPTICAL FIBER CONNECTOR

•Upside panel

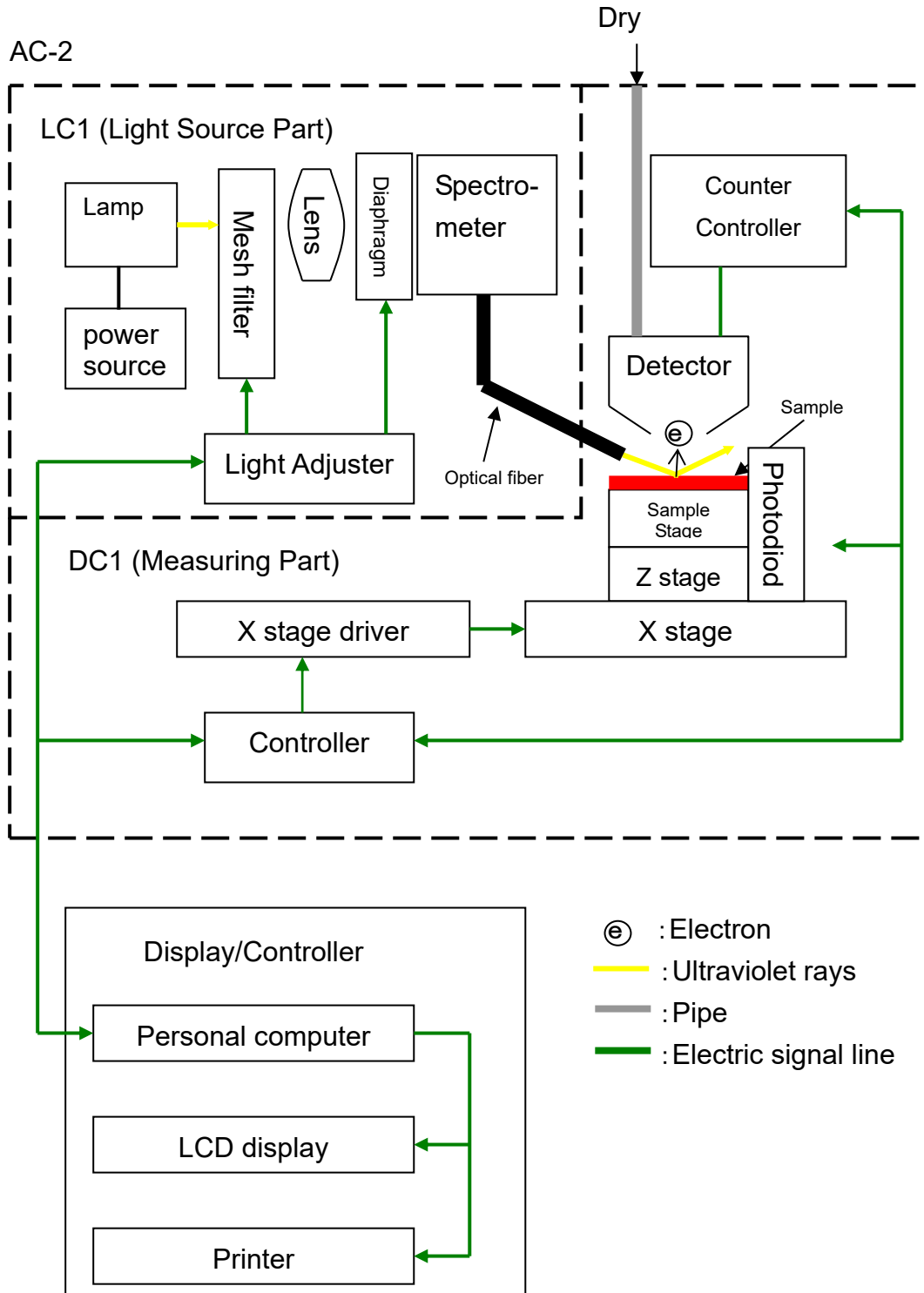
- ⑮ DETECTOR MAINTENANCE DOOR

•Right side panel

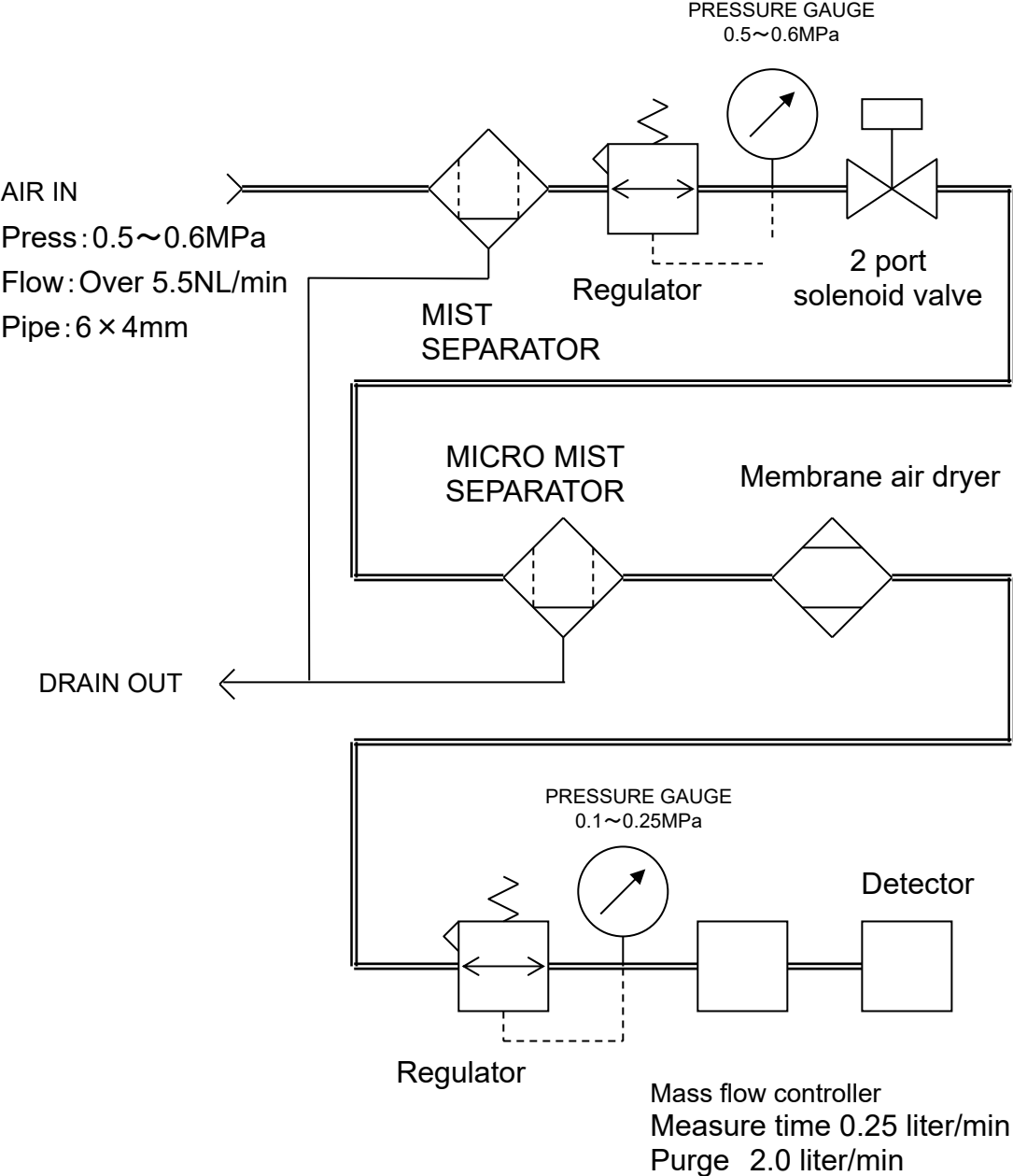
- ⑯ PRESSURE GAUGE
- ⑰ DEW POINT CHECKR
- ⑱ MIST SEPARATOR
- ⑲ DRAIN COCK
- ⑳ MICRO MIST SEPARATOR

### 3-3. Block diagram

#### 3-3-1. Electric line



### 3-3-2. Pipe line drawing



## 4. Before operation

### 4-1. Handling at mounting

- ① When transport, be sure to carry it with over 2 persons by supporting the bottom parts.
- ② Mount this product on the stand with a load capacity of 100kg or more.
- ③ Use this products inside of the room such as laboratory etc under stable temperature and humidity. Especially, the installation to the following place shall be requested to avoid. It may cause the trouble and accident.
  - Place outside of room and with water drops
  - Place full of dust and humidity
  - Place full of vibration
  - Drastic change place of temp and humidity. Sun-drought and ventilation wind.
  - Place full of solvent, acid, alkaline vapors, much chemical floating.
- ④ As this is composed of fine electronics parts, do not drop or throw and mount it in stable and horizontal place.
- ⑤ Keep noise source from large capacity of transducer, motor, motive power and high voltage generator.
- ⑥ When use the walky-talky or hand-phone, put it at over 1m away from it to prevent of the operation by electric wave barrier.



#### CAUTION

- Install the unit away from surroundings by 20 cm or more.
- To remove the power plug immediately after an abnormality occurs, separate the rear side from the surroundings by 20 cm or more.

### 4-2. Cable connection

Connect with the following procedure.

- ① Connect LC1 with DC1 by accessory power cable.
- ② Connect LC1 with DC1 by accessory optical cable.
- ③ Connect LC1 with personal computer by accessory RS cable (9pin).
- ④ Connect power cable to LC1.



#### CAUTION

- The cable connection shall be performed by our service engineer. Request service engineer for cable connection.
- Don't detach the cap from the optical cable connector for LC-1/DC-1.



### 4-3. Piping

- ① As piping material, use the following nylon or polyurethane tube.  
AIR IN side : Ex dia  $\phi 6$ mm、Inner dia  $\phi 4$ mm、Press resi. over 0.6MPa.  
DRAIN OUT side : Ex dia  $\phi 8$ mm、Inner  $\phi 5$ mm、Press resi. over 0.3MPa.
- ② Check that the tube is cut vertically, the cross section is circle and there is no damage.
- ③ Check that the tube plugs into depth surely and cannot be pulled out after mounting.
- ④ Connect instrumentation air or compressed air (Pressure : 0.5~0.6MPa) to AIR IN side.
- ⑤ Be sure to connect the pipe to DRAIN OUT side.



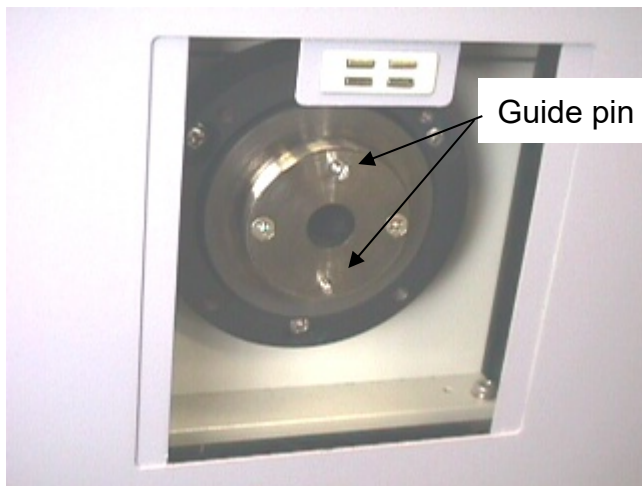
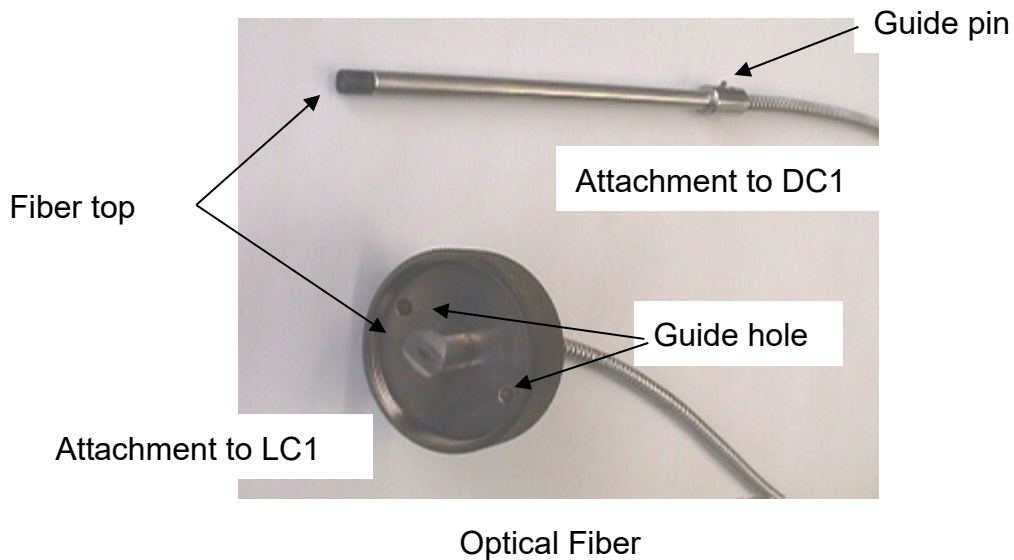
#### CAUTION

Water is produced from DRAIN OUT. Exhaust to the outside so that the spherical instrument cannot be wet. At this time, to prevent advertent flow, it is arranged that water can run down.

## 4-4. Optical fiber connection

### CAUTION

The optical fiber connection shall be performed by our service engineer. Request service engineer for optical fiber connection.



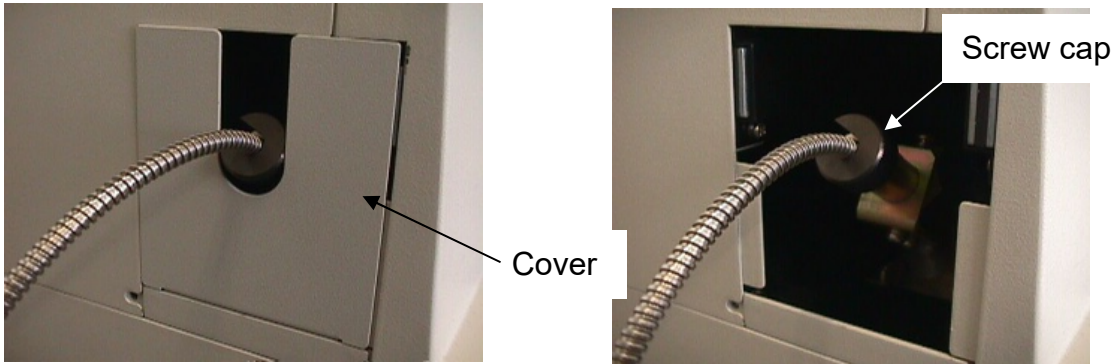
LC1 optical fiber connector



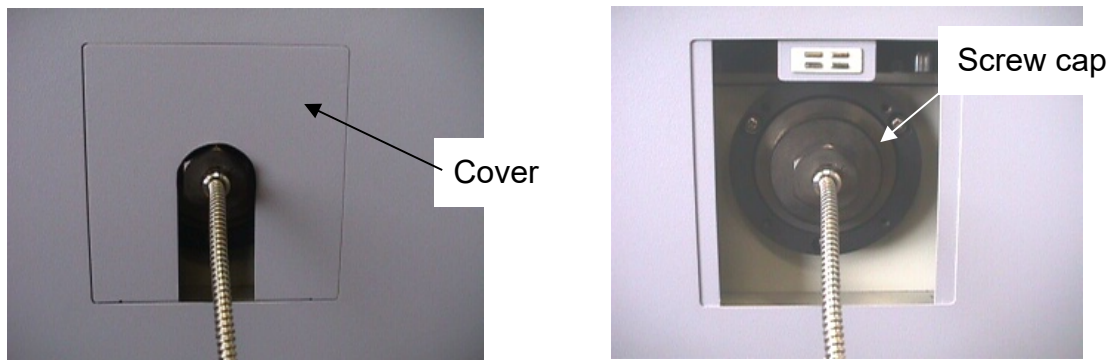
DC1 optical fiber connector

## Installation of optical fiber

- 1) Remove the cover of optical fiber at AC-2DC1 unit.
- 2) Insert the optical fiber into the Optical fiber connector of AC-2DC1 unit.  
Install the screw cap. At this time, guide pin must fit to the groove of guide.



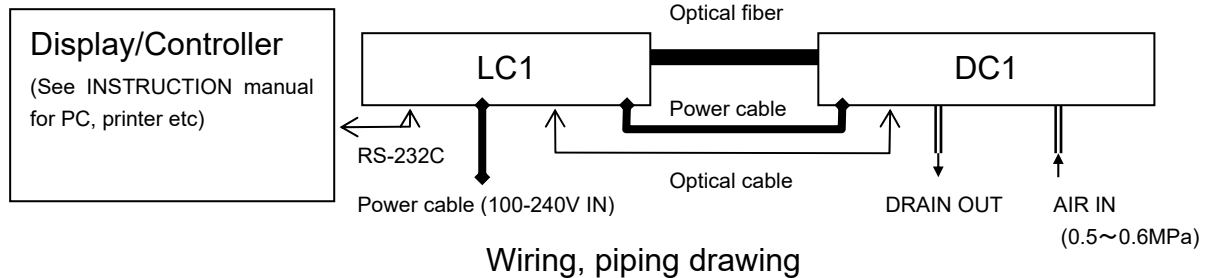
- 3) Remove the cover of optical fiber at AC-2LC1 unit.
- 4) Insert the optical fiber into Optical fiber connector of AC-2LC1 unit, and fix it by fitting guide pin and guide groove with screw cap.



## 5. Operation method

### 5-1. Check item

- Wiring: Check that the main unit and personal computer etc are connected correctly.
- Piping: Check that the given items(Pipe material or pressure etc) has no error or not.



### 5-2. Power input

If power switch is given on electric outlet, make it on. Then, after understanding below, make power on.

- Check that breaker on the rear side panel(LC1) is off.
- Check that the power voltage on electric outlet corresponds to that of product.

The power cable of LC1 and that of personal computer(including display, printer)are connected to the electric outlet with earth.

#### WARNING

Earth (ground) terminal connection

- For safety, connect the power cable to electric outlet. (3P)
- When use the accessory transducer plug, ground to earth terminal.
- If not grounded, there is the possibility of electric shock.

### 5-3. Power ON

Make power on with the following procedure.

- ① Turn power on for personal computer.
- ② Check that Windows PC is set up.
- ③ Make ON the breaker on rear side of product (LC1).
- ④ Make POWER SW."ON" of the surface of LC1 panel.

#### CAUTION

As this system may cause function error, do not make the following action absolutely.

- Make power on before Windows PC is set up.
- Connect AC-2 for Windows before trouble lamp flicker is put out.

## 5-4. Measurement

The measurement is carried out by use of AC-2 for Windows. For this detail, see AC-2 for Windows INSTRUCTION MANUAL『How to measure the Work Function or Ionization Potential』,『How to measure the Thickness and Counting rate』.

Now, for correct measurement, the following attention shall be made.

- ① Avoid the sample contamination as possible as can be. For handling, use the tweezers. Take care not to give your breathing breath to the sample. (To avoid the adsorption by water vapors in breathing.)
- ② As the dust is much smaller than measuring scope area, this does not affect the measuring value in most cases. If you worry about it, remove it by tweezers or blow it out by air.
- ③ Over 90% ultraviolet rays to be radiated is given in the square scope with one 1 mm stroke in the center of sample stage. Then, this is measuring scope. When over 2 kind of material are co-existing on the surface of measuring scope, the photoelectron is discharged from them. Then, slight ultraviolet rays are radiated in the spherical line of measuring scope.
- ④ Adjust the height of SAMPLE STAGE. It is available to adjust at within  $\pm 0.2\text{mm}$  by HEIGHT GAUGE. The radiation light beam comes in from optical fiber at angle of  $30^\circ$ . Then, if the height is deviated by 0.2 mm, the deviation of the radiation position shall be 0.3 mm.
- ⑤ The configuration of sample is rectangle with thickness at 10mm, one stroke at 20mm ~ 50mm or powder material. For other material, it cannot be fixed at the sample stage and tends fall down from the sample stage during operation.
- ⑥ When measure the same size sample or below as measuring scope, the attention is required. For example, when measure the photoelectron from ITO which was patterning in square with one stroke at 4 mm on aluminum plate with one stroke at 20mm, approx 10% ultraviolet rays shall be radiated onto aluminum though the position and height are adjusted precisely. As aluminum discharges over 50 times' photoelectron of ITO, this result shows photoelectron emission from aluminum. In such case, it is recommended to measure by masking with tape which is difficult to discharge photoelectron.
- ⑦ The counting rate of photoelectron should be measured at the range of below 2000cps. From the relation of correction, the accuracy of counting rate at over 2000cps will be worse. The counting rate of photoelectron should be controlled by UV Intensity.

### CAUTION

- During the measurement, you do not open the sample door intentionally.
- Please close immediately if the sample door is opened during the measurement.

## 6. Maintenance check

It is required to make the regular maintenance check to maintain the function and reliability of products.

### 6-1. Daily check

#### 6-1-1. Display lamp check

Check that POWER/STANDBY, TROUBLE and OPEN LAMP light on correctly.

- POWER/STANDBY LAMP : Measurement time.....Green light on  
Warming up ..... Green light flicker
- TROUBLE LAMP : Normal time..... Light off  
Trouble time.....Red light flicker  
(Just after power on)••Red light flicker
- OPEN LAMP : When SAMPLE DOOR opens, Orange light flickers.

#### 6-1-2. Check inside of sample room

Before power one, open SAMPLE DOOR and check that there is no dirt inside. If any dirt is found, remove it with the following method.

- ①Inhale the contamination by the vacuum cleaner.
- ②Wipe off contaminants attached to the stage with isopropyl alcohol.
- ③When use the liquid such as solvent to remove contamination, open sample door and leave it for a few hours and use it after the volatile vapors go out from the sample room.



### CAUTION

- When measure with electrified powder or volatile solvent left in the sample room, it may give damage to the detector and shorten the life.
- Wipe off contaminants attached to the stage with isopropyl alcohol.
  
- Isopropyl alcohol is a combustible liquid; therefore, it may catch fire. Handle it with care.

### 6-1-3. Check of pressure

Make 0 pressure (Supply pressure) at 0.5~0.6MPa and check PRESSURE GAUGE of dry air generator and DEW POINT CHECKER.

- PRESSURE GAUGE for 1st pressure check: 0.5~0.6MPa
- PRESSURE GAUGE for 2nd pressure check: Ceasing time / Within 15min after power on 0.0MPa  
After 15min after power on 0.1~0.25MPa
- DEW POINT CHECKER: To be green color.

At trouble time, re-check supply pressure. If there is no trouble, see" AC-2 INSTRUCTION MANUAL『Consumable parts replacement method』and maintain the air pipe line.

## 6-2. Consumable parts

### CAUTION

The consumables replacement shall be performed by our service engineer.  
Request RIKEN KEIKI for consumables replacement.

### 6-2-1. Detector

If the anode of open counter for detector of AC-2 should get dirty, it becomes impossible to measure. When「Troubled on detector」was displayed or the deterioration phenomenon of detector such as low detection efficiency, high noise and diversion of measurement value, replace it. The frequency of replacement is about 1 year.

The old sensors to be replaced can be reactivated by overhaul. The overhaul of this sensor should be contacted to Riken Keiki.

### 6-2-2. Lamp

Replace when the lamp blows or illumination gets unstable. The life of lamp is 1500 hours.

### 6-2-3. Optical fiber

When unable to get UV Intensity, replace it with new one. The replacement frequency is different from UV Intensity of the use. This shall be 1 year.

### 6-2-4. Pipe line maintenance

It is hinted that replacement frequency of MIST SEPARATOR ELEMENT is once in 2 years and that of membrane module is once in 4 years. Then, the high pressure is given to the pipe line and checks the flaws, crack and other damages for deterioration could be checked, replace that parts swiftly.

### 6-2-5. Activated carbon filter

The activated carbon filter is to adsorb ozone from ultraviolet rays and dissolve it. When the dissolving power gets lower, replace it with new one.



## 7. Trouble case measures

### 7-1. Self-diagnosis at trouble

This is provided with self-diagnosis that each function check is made at electromotive and operation time. When the trouble is checked, it is impossible to make normal operation. Research the cause and take the appropriate measures.

Now, this shows the trouble at the following two methods.

- Function of AC-2 main unit:

At trouble, TROUBLE LAMP(red) will flicker.

- Function of control PC:

At trouble time of software, it shows error message on the display.

 **CAUTION**

When the control unit is scrambled at unexpected cause, there is the case that error message and light-on of TROUBLE lamp could not be carried out.

### 7-2. Measures at trouble

Stop the operation and remove the trouble cause by seeing the next page. After removing the cause, re-operate it and check whether trouble phenomenon will re-appear or not.

If trouble should re-appear with unknown cause or different trouble should appear continuously, note down the trouble cause and inform it to Riken Keiki.

If there is the possibility that any harm could be given to human body by this trouble phenomenon, contact Riken Keiki without checking this re-appearance.

When the trouble data is measured, be sure to save this trouble data. In most cases, this will work for research of trouble cause.

### 7-3. Before trouble to be considered

Trouble	Cause considered	Measures	Notes
Cannot be power on	No plug into electric outlet of power cord	Make main switch off and plug right power cord in the electric outlet. Then, make power SW on.	
	No power in the electric outlet.		
	Electric FUSE is blown.	After checking why FUSE blew and found no problem, replace the fuse.	
	The breaker on the rear side of LC1 is broken down.	Make main SW off and after turning up breaker, make power SW off.	
Can make power on but cannot operate	SAMPLE DOOR cover is open.	Close the cover and it automatically operates.	
Communication fails though AC-2 for Windows is set up.	Connection of RS-232C cable fails	Re-connect RS-232 C cable connection	
Communication fails though AC-2 for Windows is set up.	Communication trouble by prompt electromagnetic noise.	Re-start up the main unit and AC-2 for Windows.	
Just after power on, TROUBLE LAMP (red) will flicker.	Flicker showing function check.	No trouble is when put out within a few minutes.	
TROUBLE LAMP (Red) will flicker.	The compressed air pressure is down.	Check the compressed air and re-start the main unit.	
TROUBLE LAMP (Red) will flicker.	Lamp is not lit.	① Re-start the main unit. ② Replace lamp.	
Trouble of detector is displayed.	Troubled detector.	Replace detector.	
Light Adjuster cannot be adjusted. UV Intensity (Max) will be on.	① Optical fiber is deteriorated. ② Lamp is at trouble.	① Replace optical fiber ② Replace lamp.	

## How to replace fuse

- (1) Turn the cap of the fuse holder counterclockwise to remove it.
- (2) Replace the fuse attached to the cap with a new one.
- (3) Put back the cap.



## CAUTION

Use a specified fuse.

If fuses others than the specified one are used, damages of the unit or abnormal operations may occur.

## Fuse specifications and characteristics

250 Vac T2.5AL

## 8. How to stop operation

- ① When Measurement Form is open by Display/Controller (personal computer), close it.
- ② After changing over POWER SW. on the surface panel of LC1 from ON (I side) to OFF (O side), make breaker off on the rear of LC1.
- ③ Close the original stopper of compressed air. Or, stop the compressor.
- ④ When water is deposited in MIST SEPARATOR, turn the DRAIN COCK to the right and exhaust it. After exhausted out, be sure to DRAIN COCK.
- ⑤ Close the Windows and make off the power of personal computer, display, and printer.

### \* NOTE

Though the main unit remains OFF, start up AC-2 for Windows and the measurement data can be seen.

## 9. For relocation

---

Please follow “4–1. Handling at mounting” when you relocate.

In addition, please refer to “4–2. Cable connection” “4–3. Piping” “4–4. Optical fiber connection”.

## 10. Definition of words

### Slope

This is the slope of graph between the energy of UV rays and photoelectron yield. It will be a hint of photoelectron emission.

### Threshold energy

This is the threshold energy to start up photoelectron emission.

### Work function

This is the required energy to take out 1 pce electron.

### Ionization potential

This is the lowest energy required for ionization of molecule and valence band maximum energy of semiconductors.

### The energy of UV rays

Energy per one photon of radiation light beam. By wave length of radiation light, it can be calculated with following chemical formula.

$$(\text{Energy [eV]}) = 1240 / (\text{Wave length [nm]})$$

### UV Intensity

Whole energy of radiation light per one hour. This can be calculated by output current of photo diode.  $(\text{UV Intensity [nW]}) = (\text{The number of the photon of UV ray par 1 min.}) \times (\text{energy [eV]}) \div 0.625$

By photoelectron spectrum measurement, UV Intensity will be 5.90eV.

### Light correction

As there is the difference of every energy UV Intensity, correct it. Suppose that the yield will be in direct proportional to UV Intensity. it shall be corrected by the following formula.

$$(\text{The counting rate after correction}) = (\text{the counting rate before correction}) \div (\text{The Number of photon}) \times (\text{The Number of photon of 5.90eV})$$

## 11. Measurement principle

### 11-1. Measurement principle of photoelectron

An electron emitted from a sample surface moves several  $\mu$  meters toward the detector. (This is called the "Mean Free Path of electron in air".) After that, the electron attaches to an oxygen molecule, and it drifts to Anode (A) through Suppressor Grid (Gs) and Quenching Grid (Gq). The intensity of the electric field is increased by high voltage. When the electron approaches the Anode (A), the speed is accelerated by the intensified electric field. Then, an electron slide is triggered. As a result, the energy from a single electron is amplified up to  $10^5 \sim 10^7$  times, and the discharge pulse signal is generated in the preamplifier output ( $V_s$ ). When the low energy electron counter receives discharge pulse signal it transmits the electron detection signal to the controller, and changes the Quenching Grid Voltage ( $V_{Gq}$ ) and the Suppressor Grid Voltage ( $V_{Gs}$ ) as shown in the drawing below. The Quenching Grid erases the discharge by lessening the voltage gap to the anode (A). The Suppressor Grid captures the positive ion generated at discharge, and prevents the electron from entering into the detector as the discharge is erased.

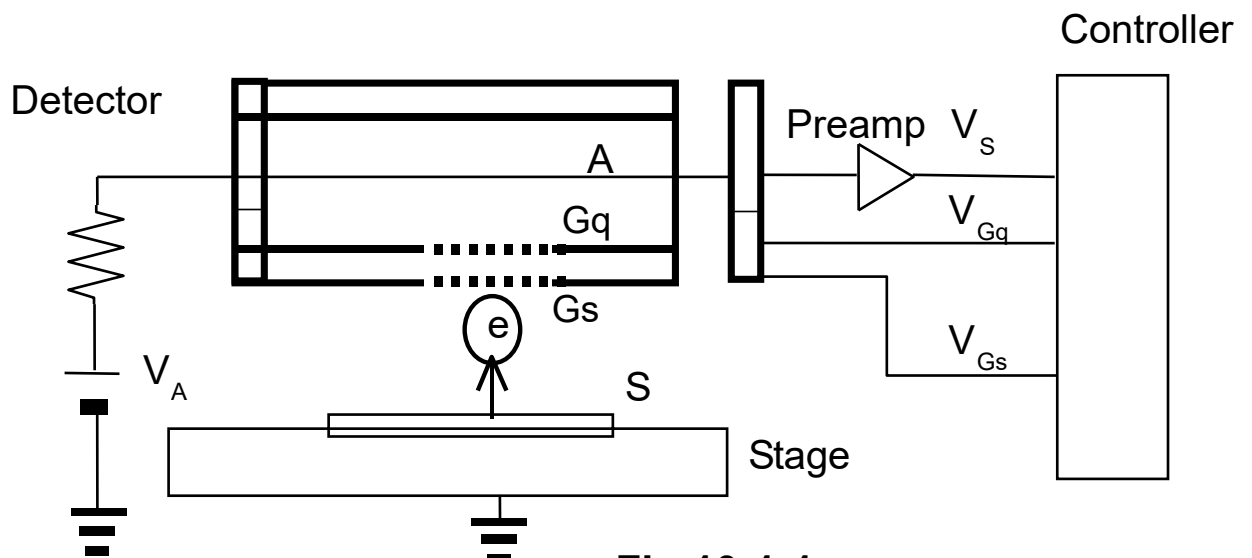


Fig 10-1-1 Open counter

Gs : Suppressor Grid

Gq : Quenching Grid

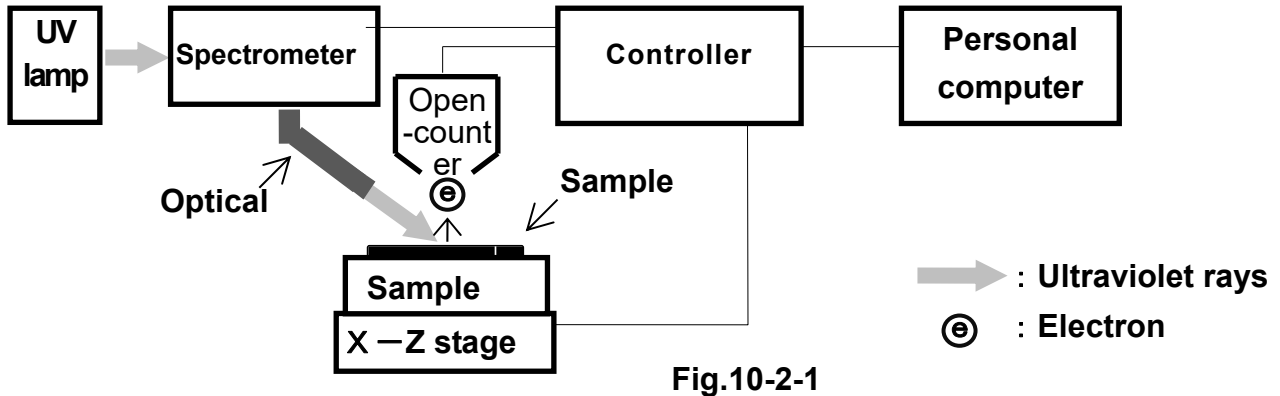
A : Anode

S : Sample

$\textcircled{e}$  : Electron

## 11-2. Measurement of photoelectric work function

AC-2 consists of lamp, spectrometer, open counter, controller, X-Z stage and personal computer.



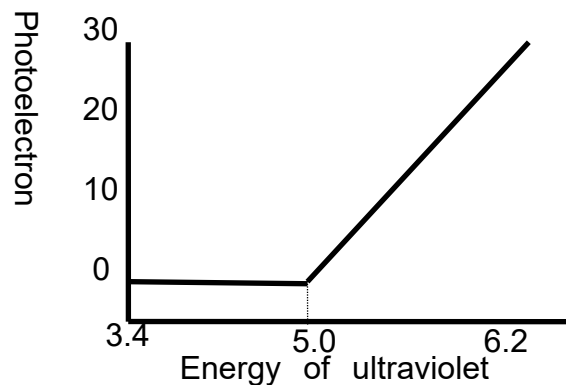
For light source, heavy mercury lamp is used. By diverging the light beam of wavelength 200 ~ 300 nm emitted from lamp into the arbitrary wavelength by spectrometer.

The intensity of light emitted from the ultraviolet lamp which enters the spectrometer is controlled by the light adjuster. and it enters the spectrometer. The spectrometer selects the desired wavelength of UV light, and irradiates the result, photoelectrons may be emitted from surface (several Å to hundreds of Å), due to photoelectrons effect.

The photoelectrons emitted are counted by the detector and open counter. The result is then printed or displayed on a CRT after analysis by the AC-2 software. This instrument is operated by a PC utilizing Windows.

When a surface is bombarded with a slowly increasing amount of ultraviolet energy, photoelectrons start to emit at a certain energy level. This energy level is called the “Photoelectron Work Function(Work Function).”

When the photoelectron output is plotted on an X/Y axis, with horizontal axis as the UV energy applied, and the vertical axis as the standardized photoelectron yield ratio (Yield<sup>n</sup>, or Y), the result is a line with a specific slope of degree (Y/eV).



**Fig.10-2-2**



## 12. List of Product Specifications

### 12-1. Product specifications

#### 12-1-1. Specifications of the main unit

Item	Standard specifications
Model	AC-2
Measurement method	Low energy electron counter method
Photoelectron Measure Energy-scanning	3.4~6.8eV (364~182nm)
UV Intensity Measure Energy-scanning	3.4~6.2eV (364~200nm)
Repeatability precision (Standard deviation)	Work function 0.02eV Log the counting rate 0.03logCPS (at 2.7logCPS)
Measurement time	Standard time required for work function measurement: Approx 5min (10 sec./1 energy)
Ultraviolet rays lamp	Deuterium Lamp
Ultraviolet rays spot size	2~4mm square
Spectrometer	Grating spectrometer
Sample	50mm × 50mm Max Thickness 10mm Max SAMPLE STAGE, Center 1pt measure
SAMPLE STAGE	50mm × 50mm Ni grating metal
Stage	Z axis (Manual) : 10mm
Operating environment conditions	<ul style="list-style-type: none"> <li>• Operation location: Indoor</li> <li>• 2000 meters above sea level or lower</li> <li>• TRANSIENT OVERVOLTAGES up to the levels of OVERVOLTAGE CATEGOLY II</li> <li>• Short-term TEMPORARY OVERVOLTAGE: 1300 V</li> <li>• Long-term TEMPORARY OVERVOLTAGE: 350 V</li> <li>• POLLUTION DEGREE 2</li> </ul>
Ambient temp/humidity	15~35°C、Below 60%RH
Power source	AC100-240V 50/60Hz 500VA(MAX)
Dimensions	AC-2 LC1(Light Source Part): approx. 600(W) × 450(D) × 310(H)mm AC-2 DC1(Measuring Part): approx. 600(W) × 450(D) × 360(H)mm
Weight	AC-2 LC1(Light Source Part): Approx 40kg AC-2 DC1(Measuring Part): Approx 50kg

### 12-1-2. Display/controller specifications

Item	Specifications
Display	Size: 17 inch or more Resolution: 1024 x 768 or more
Control computer (PC)	Desktop type Processor: 1 GHz or more 32-bit (X86) processor Memory: Above 1 GB RAM Hard disk 16 GB free space RS-232C with port(D-SUB 9 pin) CD-ROM or DVD-ROM drive Mouse
Printer	Color, Ink Jet method
OS*	Windows

### 12-1-3. Software function specifications\*

Functions	Description
Work function measurement	By measuring photoelectron spectrum, the work function or ionization potential can be determined.
Function for Measurement of thickness	Make up Calibration Line. Based on it, the thickness is calculated from the counting rate.
Automatic light beam adjustment	If load in the target UV Intensity, UV Intensity is adjusted automatically.
Automatic system start up function	Initial of the system and anode voltage of detector is automatically set up.
Cut and paste function	The measurement data is made use of by other application software through cut and paste.

\*The description of software will be Japanese if OS is Japanese. For other country case, it will be English.

### 12-1-3. CE marking compliance directive and standard

Conforms with the protection requirements of the Council Directive 89/336/EEC relating to Electromagnetic Compatibility, by the application of the following EMC standards :

EN 61326-1 2013

Conforms with the protection requirements of the Council Directive 73/23/EEC relating to Low Voltage Directive, by the application of the following LVD Standards

IEC 61010-1 2010

## 12-2. List of configuration

### 12-2-1. Standard components

Description	Model	Q'ty	Notes
Measuring Part	AC-2 DC1	1	See the specifications of the main unit.
Light Source Part	AC-2 LC1	1	See the specifications of the main unit.

### 12-2-2. Standard accessories

Description	Q'ty	Notes
Display	1	See the display/controller specifications.
Personal computer	1	See the display/controller specifications.
Printer	1	See the display/controller specifications.
Operation system	1	See the display/controller specifications.
Power cable for LC1	1	
Power cable for DC1	1	
Conversion plug	1	
RS-232C cable(Between PC-LC1)	1	
Optical cable (Between LC1-DC1)	1	
Detector	1	
Optical fiber	1	See the specifications of the main unit.
D2 lamp	1	See the specifications of the main unit.
Standard sample	1	
Standard sample hold cover	1	
Tweezers	1	
Spanner	1	FOR MICRO MIST SEPARATOR ELEMENT replacement
System soft(CD-ROM)	1	
INSTRUCTION MANUAL	1	
Warranty	1	

### 12-2-3. Special accessories

Description	Model	Notes
SUS make SAMPLE STAGE		
Power sample tray		20pcs/1 set
Compressor	C3-AIR	※
Kelvin probe	FAC-1	

※The supply condition of compressed air is pressure at 0.5~0.7MPa and flow rate at over 5.5NL/min. The piping should be nylon or polyurethane tube with over  $\phi 6$ mm(outer dia),  $\phi 4$ mm(inner dia), and over 0.9MPa(pressure proof).

### 12-2-4. Option (Maintenance parts etc)

Description	Model	Notes
Detector	LE-6110	
Optical fiber (For spot size 2-4mm)		
D <sub>2</sub> lamp		
Activated carbon for ozone filter		
ELEMENT FOR MIST SEPARATOR		
ELEMENT FOR MICRO MIST SEPARATOR		
Membrane module		

—How to measure the Work Function or  
the Ionization Potential—

## Contents

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# 1 . Outline

Here in this manual, how to seek for work function and ionization potential is described by measuring the sample threshold energy with AC-2.

# 2 . Caution

This manual is described in the premise of following.

- ① AC-2 and personal computer are set up correctly.
- ② AC-2 for Windows is correctly installed.
- ③ Operator knows Operation of Windows.
- ④ Operator knows the meaning of work function, ionization potential and relation with photoelectron emission.

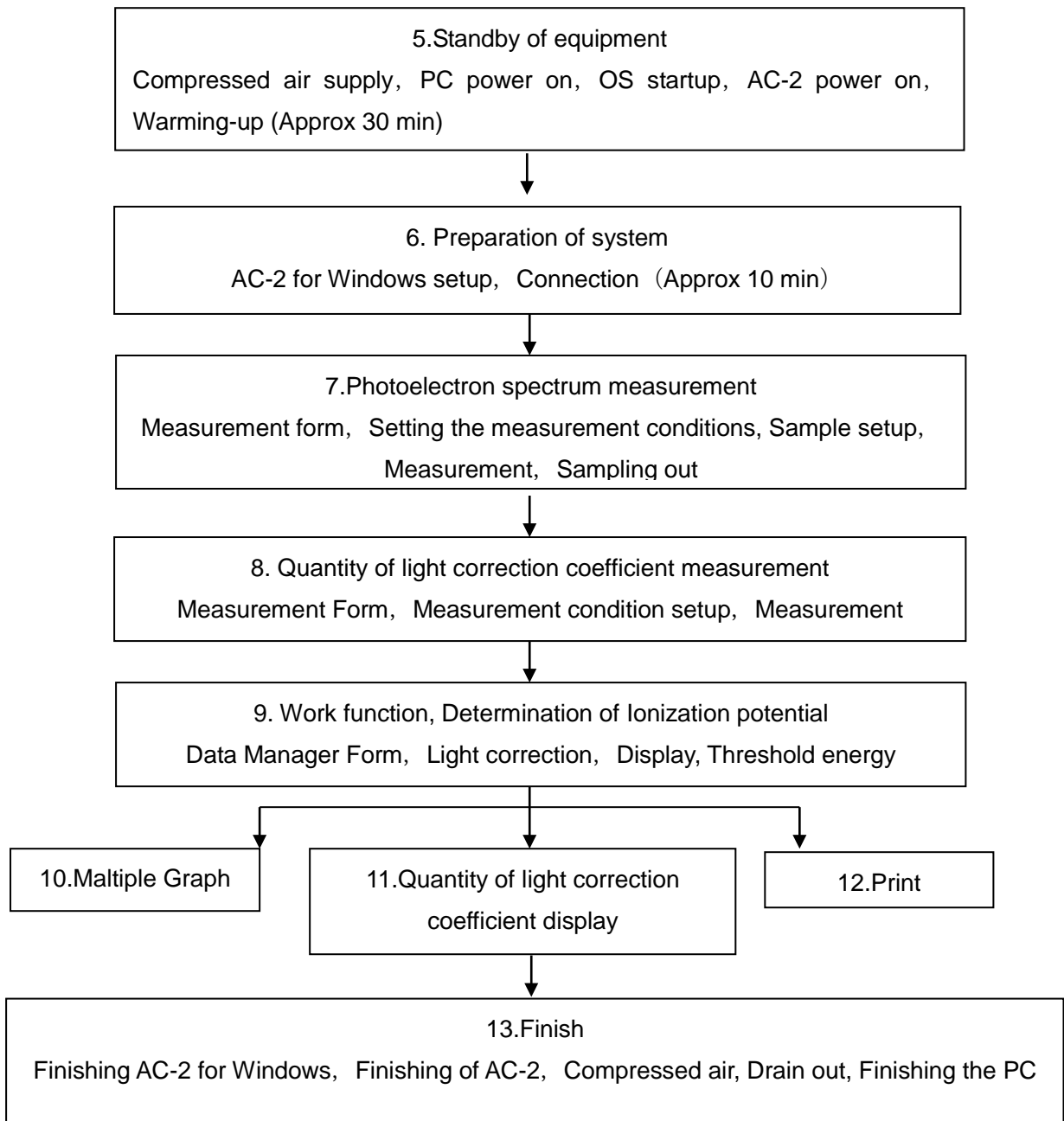
Prior to this manual, read PHOTOELECTRON SEPCTROMETER AC-2 INSTRUCTION MANUAL and Windows INSTRUCTION MANUAL.

# 3 . How to use this manual

For users who use AC-2 first, prepare the standard sample and tweezers. Start to measure according to this manual. At that time, the required set condition, see the sample. The experienced users, see \* Note and start to measure.

Read this manual well and arrange to measure correctly.

4 . Flow of the measurement(The number corresponds to chapter)



## 5 . Standby of equipment

It is prepared to measure by AC-2.

- ①Supply the compressed air (0.5—0.6Mpa) .When supply it by pump, make this power on. When supply from factory pipe, open the original supply valve.
- ②Make POWER SW of personal computer ON and start up Windows.
- ③Check that Windows is started up.
- ④Make on the breaker power on rear side of LC1.
- ⑤Make on ON ( | side) POWER SW. on the surface panel LC1.
- ⑥Warming up starts with power ON. After completion of warming up (After about 30min) POWER/STANDBY LAMP will show green lamp light on.

### \* Note

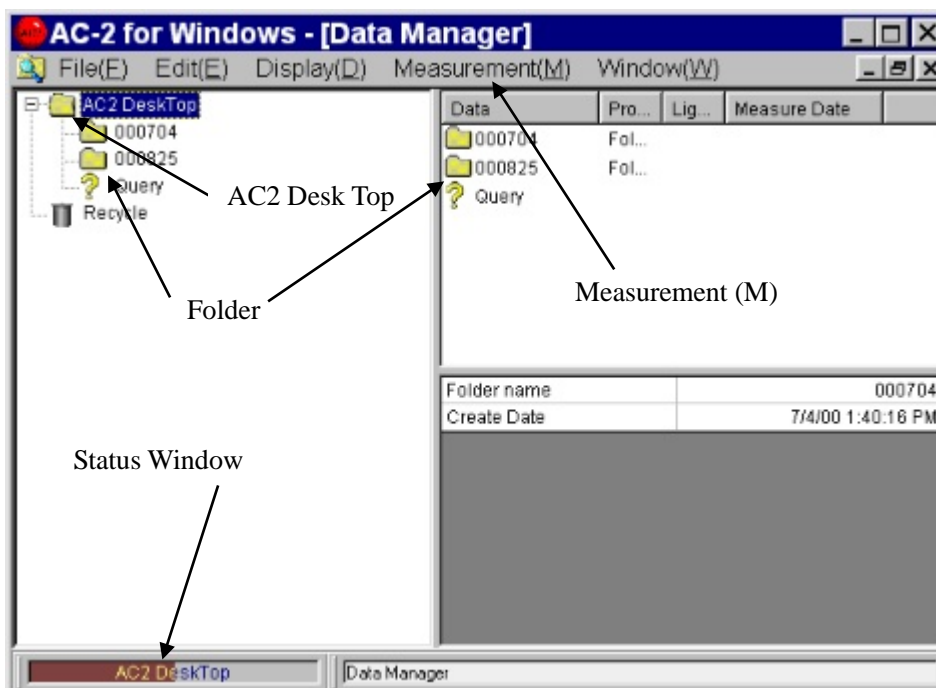
For checking the past measurement data, you may proceed to “6. Preparation of system” just after ③. (After warming up and connection, start to measure.)

## 6 . Standby of system

Prepare the personal computer and AC-2 for Windows.

### 6-1.Standby of system

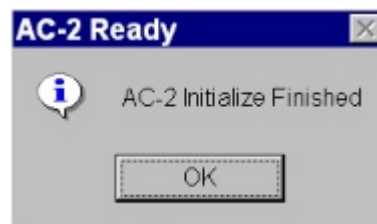
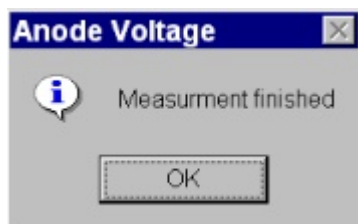
- ①Start up AC-2 for Windows. Example) start up from program of **Start button**.
- ②Open Main Form, and Data Manager Form.





## 6-2.Connection

- ①Enter the **Measurement(M)–Connection(N)**.
- ②Prepare Connection. Connection means the establishment of communication with main unit, **Initialize Light Adjuster** and **Setting Anode Volts**. The existing status is displayed on **Status Window**.
- ③After about 10minutes, Connection is finished. Anode Voltage and ready condition of AC-2 are displayed. Click **OK** on message box.



### Caution

When make other application software treatment or that of AC-2 for Windows during connection or measurement through OS spec, there is the case of inability for communication. During communication treatment with main unit for connection and measurement, do not let personal computer make other treatment.

## 7 . Measurement of photoelectron spectrum

### 7-1.Make up folder and Work Function Form getting started up

- ①Click the icon of AC-2 Desk Top and make it active.
- ②Enter **File(F)–Create Folder(W)**.
- ③Enter **Folder name**. Example) test
- ④Check that the prepared **Folder** is active.
- ⑤When select **Measurement(M)–Work Function**, the work Function Form is open.

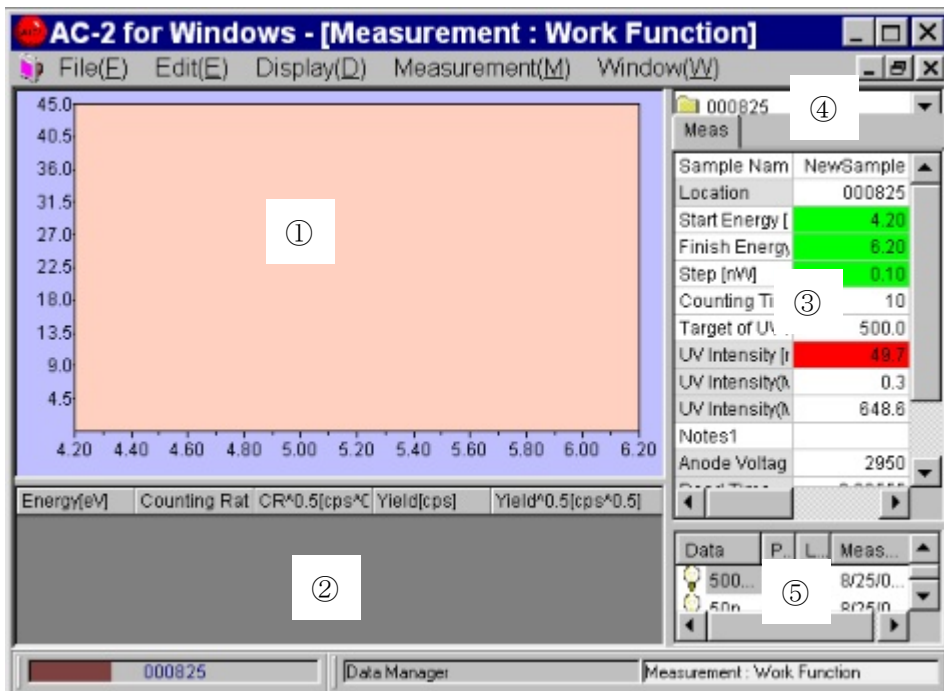
### \* Note

When the another form is active, Measurement Form cannot get started up.

### \* Note

When Measurement Form is started up, close beforehand and open Work Function Form.

## 7-2.Explanation of Work Function Form



### ① Graph

The measurement data is depicted on the Graph.

### ② Data Table

The measurement data is listed.

### ③ Control List

The required condition for measurement can be entered. After clicking the right side box for each items of words and number, enter from key board. For selection, when click the right side box, ▼ button is displayed. When click it, the selection menu is displayed. Select it from this.

### ④ Folder Window

This shows the Folder filing the measurement data.

### ⑤ Quantity of light correction coefficient Window

This displays **Quantity of light correction coefficient** used for light correction.

### ⑥ Menu Bar

This changes over measurement and form.

### ⑦ Task Bar

This shows the existing condition and changes over form.

### \* Note

The default of Control List is in the same condition as last measured data.

### 7-3.Measurement condition setup

Enter measurement condition from **Control List**.

- ①Enter the sample name. The name entered here will be name of Work Function Data File displayed in the Data Manager Form. Click the right side box of **Sample Name**. Operate key and press enter. When re-write the sample name entered already, press space key after having clicked.  
Example) TEST
- ②When click **Folder Window**, it shows folder. Select the folder filing Work Function Data measuring from now on. Example) test
- ③Enter **Start Energy**. Example) Open List Box of **Start Energy** and select 4.20eV.
- ④Enter **Finish Energy**. Example) Open List Box of **Finish Energy** and select 6.20eV.

**\* Note**

It is impossible to make light correction for Measure Energy to be in range of 6.25-6.80eV.

- ⑤Enter **Step**. Example) Open List Box of **Step** and select 0.10eV.

**\* Note**

When make preliminary measurement, it shall finish sooner by spreading Step.

- ⑥ Set up **Counting Time**. Example) 10
- ⑦Set up UV Intensity. Firstly enter **Target of UV Intensity Adjustment**. Target of UV Intensity Adjustment should be set up between UV Intensity(Max) and UV Intensity(Min). Example) 10
- ⑧Select **Measurement(M)-UV Intensity Adjustment(L)** of Menu Bar. As message box of UV Intensity Adjustment is displayed, click **YES(Y)** and start up automatic control of UV Intensity. When finish controlling, UV Intensity will be the same as Target value. When finish UV Intensity Adjustment, the message box which finishes set-up will open and click OK. Now, the black color of Control List will be green at  $\pm 5\%$  of target, yellow at  $\pm 5\sim 20\%$  of target, and red at over  $\pm 20\%$  of target.

**\* Note**

- Appropriate UV Intensity differs by sample. make preliminary measurement of photoelectron spectrum and arrange so that an appropriate slope can be obtained.
- When Target of UV Intensity Adjustment is near from the Minimum or maximum of UV Intensity, there is the case set at within  $\pm 5\%$  of set value.

 **Caution**

When open the cover of SAMPLE DOOR during measurement of UV Intensity, the sample stage may move suddenly and give inquiry by it. Or there is the case that UV Intensity gets troubled.

- ⑨ Input information of measuring sample, material etc in **Notes 1** .
- ⑩ Select **Quantity of light correction coefficient** out of Quantity of light correction coefficient windows and make double click. When make light correction from the back, make right side click for Name of **Quantity of light correction coefficient** on **Control List** and then delete it.  
Example) **Adjustment Data Delete**
- ⑪ Input **Power Number**. Power Number is that of vertical line for data to be displayed on Graph.  
Input the decimal number below 1. Example) 0.5

## 7-4. Sample mounting

- ① Enter **Measurement(M)-Sample(S)** on Menu Bar.
- ② As message box of sample stage confirming the movement is displayed, click **YES(Y)**.
- ③ Check that the roaring sound of sample stage could not be heard.
- ④ Push the cover of SAMPLE DOOR on the part named "Push" and when tick sound could be heard, release your hand.



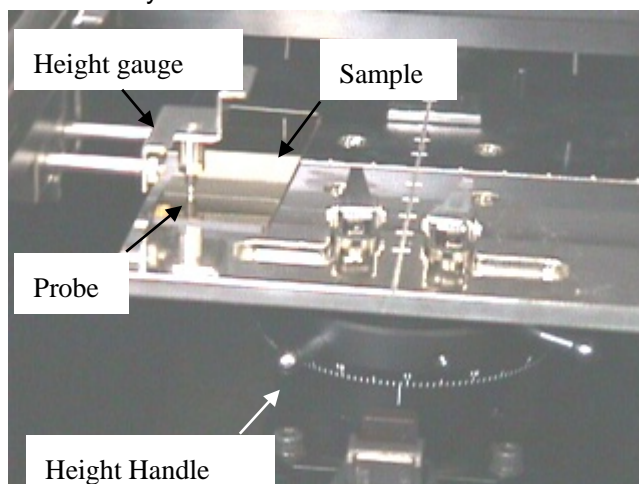
- ⑤ SAMPLE DOOR cover is open. Check that OPEN LAMP will flicker in red.



### Warning

When OPEN LAMP cannot flicker in red, there is the trouble of interlock trouble. In this case, even if SAMPLE DOOR cover is open, there is the possibility that sample stage will move.

- ⑥ Put SAMPLE to the left side of you on SAMPLE STAGE.



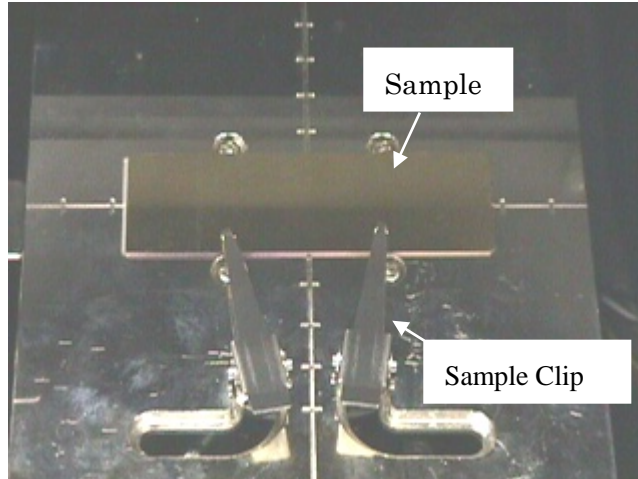
- ⑦ Control the sample stage height level. Put SAMPLE on left side of SAMPLE STAGE. Next, Draw HEIGHT GAUGE and sandwich the SAMPLE between SAMPLE STAGE. Then, Rotate Height Handle of sample stage so that the top end will correspond to the height of measuring unit.



### Warning

When put a part of sample in higher position than HEIGHT GAUGE probe, there will be possibility that the main unit or sample may be damaged by the crush of detectors. Then be sure to control the height.

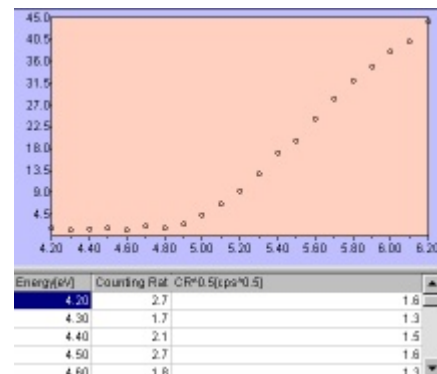
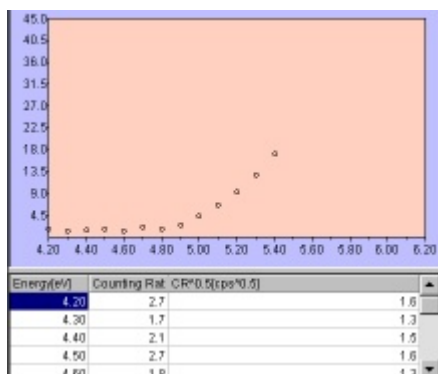
- ⑧ Fasten Sample by sample clip in the center of sample stage.



- ⑨ Close the SAMPLE DOOR and push in the vicinity of “Push”. Release hand until it sounds ticking.
- ⑩ Check that SAMPLE DOOR is closed and click OK on screen.

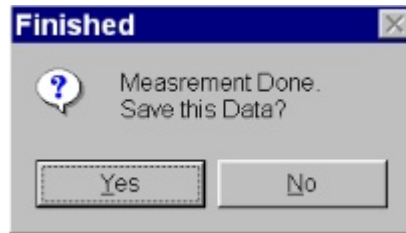
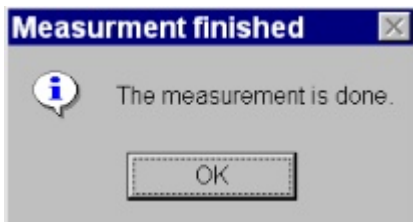
## 7-5.Measurement

- ① When select **Measurement(M)-Measurement(G)** of Menu bar, the photoelectron spectrum measurement will start.
- ② When measurement starts, Graph and data shall be displayed and the counting rate of each energy is plotted. The horizontal line of Graph is the energy of UV rays and the unit is eV. The vertical line is “n” multiplier unit [cps<sup>n</sup>] of the counting rate. This “n” is the power number. The upper limit of vertical line will automatically be about 2000<sup>n</sup>.
- ③ After measurement of background, whenever the energy of UV rays is changed, the counting rate will be counted.



④ When the measurement is finished, the message box showing finish will open and click **OK**.

The measured photoelectron spectrum data is saved in Folder in **Work Function Data File**.



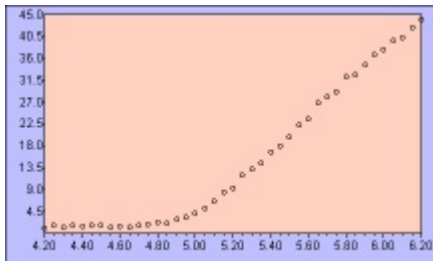
**⚠ Caution**

From OS spec, when make treatment of AC-2 for Windows and other application soft during connection and measurement, there will be possibility of no communication with main unit. While communicating with main unit such as connect, measurement, do not let the computer do other treatment.

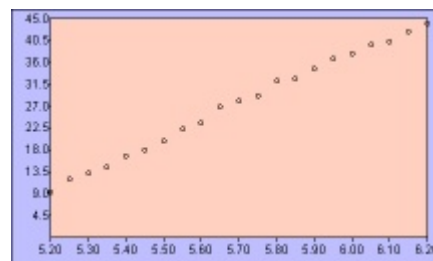
**\* Note**

Measurement is interrupted by **Measurement(M)-Measurement Cancel(G)**.

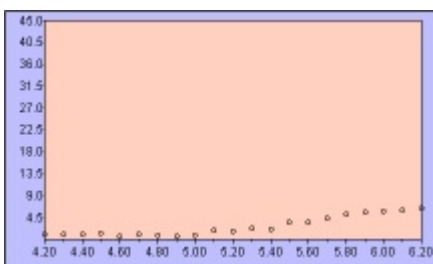
⑤ When UV Intensity is small or the area of measure energy is not appropriate, control them and start re-measurement.



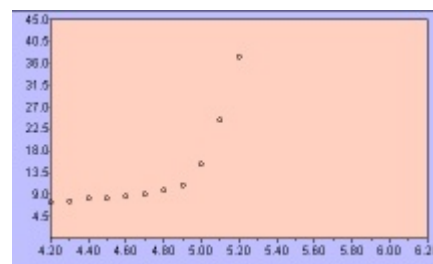
Step 0.05eV



Big Start energy.



Low UV Intensity.



High UV Intensity

## 7-6.Sampling

- ① Select the **Measurement(M)-Sample(S)** of Menu Bar.
- ② Check that the message box is displayed and active sound of sample stage becomes off.
- ③ By pushing SAMPLE DOOR on the part of Push marking, release hand after tick sound could be heard.
- ④ SAMPLE DOOR gets open.
- ⑤ Take out sample.
- ⑥ Close by pushing SAMPLE DOOR on the part of Push marking and release hand after tick sound could be heard.
- ⑦ Check that SAMPLE DOOR is closed and click **OK** on the screen.

## 7-7.Setting Anode Voltage, Initialize Light Adjuster

After connection, when continue to measure for a long hour of over 24 hours or temperature and atmospheric pressure varies, re-set Anode Voltage and do Initialize Light Adjuster.

The re-set of Anode Voltage shall automatically be carried out by operating **Measurement(M)—Anode Voltage(V)**. Finished after about 5 minutes and as the message box is open, click **OK**. Initialize Light Adjuster shall automatically be carried out. Finished after about 5 minutes and as the message box is open, click **OK**.

## 7-8.How to finish Work Function Form

Under active condition of Work Function Form, finish Work Function Form by **File(F)—Close(X)**.



## 8. Quantity of light correction coefficient

### 8-1. Start-up of Light Spectrum Form

- ① By Data Manager, click the folder and make it active.
- ② When select **Measurement(M)–Quantity of light correction coefficient(L),Light Spectrum Form** shall open.



Caution

When Measurement Form is started up, close in advance and open Light Spectrum Form.

### 8-2. Explanation of Light Spectrum Form

Energy[eV]	UV Intensity[nW]	Photon Number[cps]
4.20	15.3	2.27E+10
4.30	16.8	2.44E+10
4.40	18.8	2.66E+10
4.50	20.8	2.89E+10
4.60	23.5	3.19E+10
4.70	25.1	3.34E+10
4.80	27.4	3.57E+10
4.90	29.9	3.82E+10
5.00	33.1	4.14E+10
5.10	36.7	4.50E+10
5.20	40.7	4.89E+10
5.30	44.0	5.19E+10
5.40	46.2	5.35E+10
5.50	47.7	5.42E+10
5.60	49.5	5.53E+10
5.70	50.5	5.54E+10
5.80	50.6	5.45E+10
5.90	49.8	5.27E+10
6.00	48.4	5.04E+10

Control List:

- Sample Name: 50nW 000922
- Location: 000825
- Start Energy [eV]: 4.20
- Finish Energy [eV]: 6.20
- Step [nW]: 0.10
- Target of UV I: 50.0
- UV Intensity I: 49.8
- UV Intensity(h): 0.3
- UV Intensity(h): 648.6
- Notes1:

#### ① Data Table

Make list of the measurement data.(Space before measurement starts)

#### ② Control List

Enter the required conditions for measurement(How to enter is the same as Work Function Form.)

#### ③ Folder Window

This indicates the folder filing the measurement data.

#### ④ Menu Bar

This makes measurement and change-over of form.

#### ⑤ Task Bar

This indicates the current condition and changes over the form.

### 8-3.Measurement condition adjustment

Input measurement condition from control List.

- ① Input the **Sample Name**. The name inputted herewith will be the **name of Light Spectrum Data File** shown on **Data Manager Form**. Click the right side box and input the word into keyboard. Then, press Enter. When try to re-write the Sample Name, input by pressing space key after click. Example) test
- ② When click **Folder Window**, it shows folder. Select the folder filing Light Spectrum Data to be measured from now on.
- ③ Input **Start Energy**. Example) Open the List Box of **Start Energy**. Select 4.20eV.
- ④ Input **Finish Energy**. Example) Open List Box of **Finish Energy**. Select 6.20eV.
- ⑤ Input **Step**. Example) Open List Box of **Step**. Select 0.10eV.

#### \* Note

When make preliminary measurement, this finishes earlier by widening **Step**.

- ⑥ UV Intensity shall be set up. When measure at the same value with the current UV Intensity (**UV Intensity**) ,input the value of  $\pm 5\%$  of UV Intensity to Target of UV Intensity Adjustment. Example) 10
- ⑦ When set UV Intensity newly, input **Target of UV Intensity Adjustment** and select **Measurement(M)-UV Intensity Adjustment(L)** of Menu Bar.
- ⑧ Input the information such as measurement condition at **Notes 1** .

### 8-4.Measurement

- ① By selecting **Measurement(M)-Measurement(G)**,start measurement.
- ② When start measurement, Quantity of light correction coefficient of the each energy is shown on data table.
- ③ When finish measurement, the message box is open and click **OK**. As the message box is open, click **YES(Y)** button and save it. The measured light spectrum data is saved in the folder as light spectrum data file.

#### Caution

From OS spec, when make treatment of AC-2 for Windows and other application soft during connection and measurement, there will be possibility of no communication with main unit. While communicating with main unit such as connect, measurement, do not let the computer do other treatment.

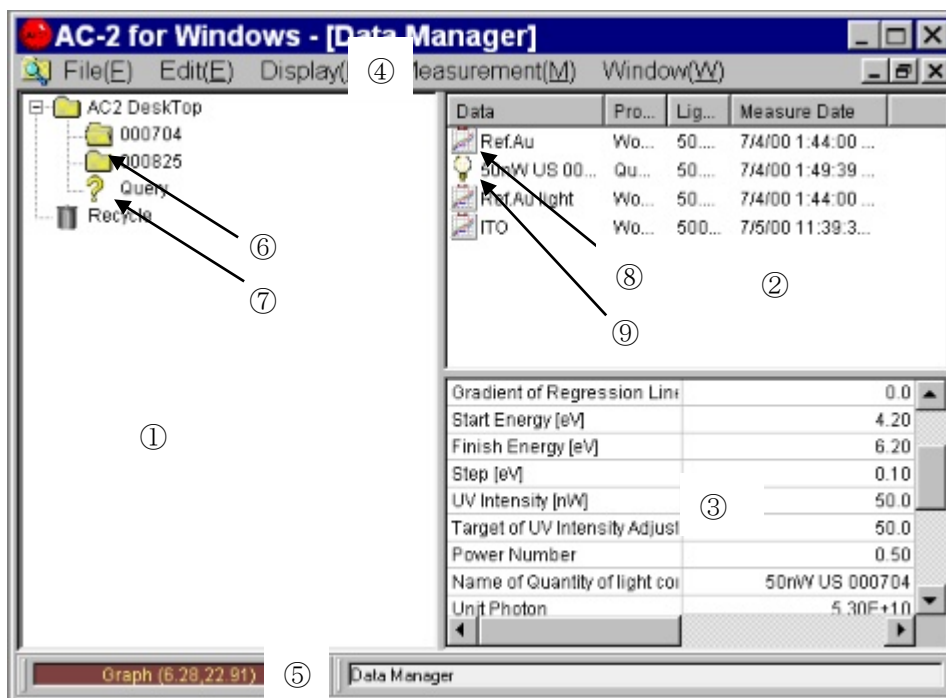
## 8-5.How to finish Light Spectrum Form

Under active condition of **Light Spectrum Form**, close the form from **File(F)-Close(X)**.

## 9 . Determination of the work function or the ionization potential

Click **Data Manager** button of Task Bar and make Data Manager Form displayed. Then, operate **Display(D)-Refresh Data(D)**.

### 9-1.Explanation of Data Manager Form








- ① **Tree**  
displays folder into tree form.
- ② **Data Manager**  
Displays data or folder.
- ③ **List Table**  
Displays data outline.
- ④ **Menu Bar**  
makes Print, Delete, Create Folder, Move, and Rename of data
- ⑤ **Task Bar**  
indicates the name of data or folder selecting now and changes over form.
- ⑥ **Folder**  
The measurement data is stored.
- ⑦ **Query**  
Researching result.
- ⑧ **Work Function Data File**
- ⑨ **Light Spectrum Data File**

## 9-2.Light correction

- ① Firstly, Open the folder. Example)test of work function data file to be corrected.

### \* Note

The folder with  in left is provided with much lower layers. When click , the lower folder can be displayed. At this time,  becomes . When click , lower folder can be non-displayed.

- ② Click and select **Light Spectrum Data File** [Example) TEST] to use for correction, operate the copy( C ) of **pop up menu** by right click.
- ③ Select **Work Function Data File** [Example] TEST] and operate the Paste (P) of **pop up menu**. When correction is made, **name of quantity of light correction coefficient** on list table displays name of quantity of light correction coefficient used for correction. [Example) TEST].

### \* Note

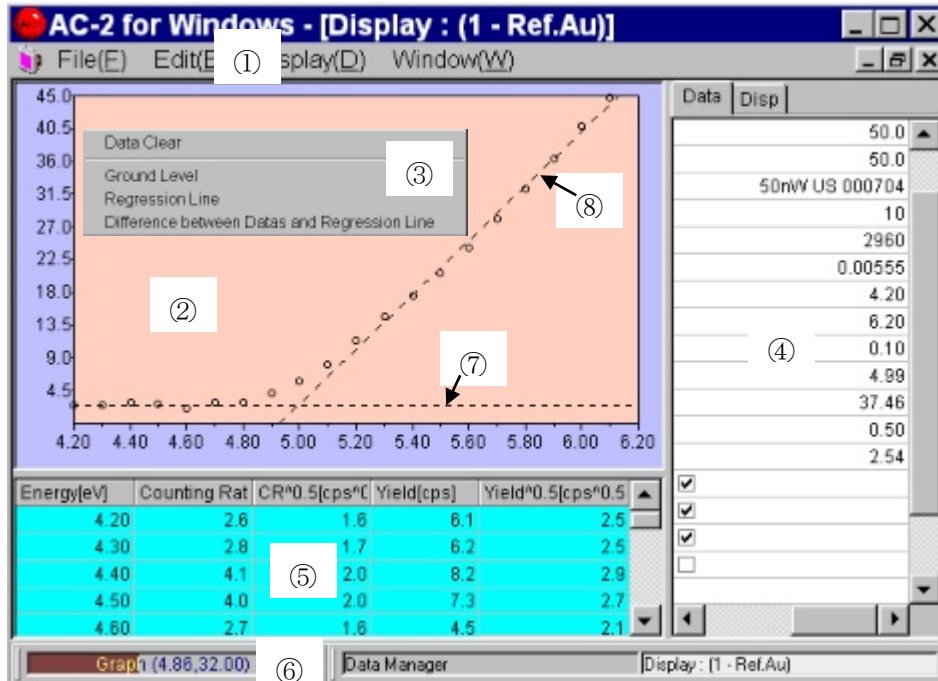
When ceases light correction, click **Name of Quantity of light correction coefficient** with right hand and operate Adjustment Data Remove.

### Caution

When delete **Light Spectrum Data File** related with Work Function Data File, database may cause trouble. In this case, there is the case to replace with back up of database.

### 9-3. Display of Graph

Select **Work Function Data File** [Example] TEST] desired to analyze and making active **File(F)** —**Open(O)**, open **Single Graph Form**.



① **Menu Bar**

This makes data copying.

② **Graph Box**

Display the measurement data as Graph.

③ **Pop up menu**

To seek for the threshold of graph, this is used when draw Ground Level and Regression Line. When there is the mouse pointer located in the Graph Box, it is displayed by right click.

④ **Control List**

This can input the depicted condition of Graph.

⑤ **Data Table**

Display the measurement data as table.

⑥ **Task Bar**

Indicate the coordinates of mouse pointer on **Graph Box** or change over the form.

⑦ **Ground Level**

⑧ **Regression Line**

## 9-4. Determination of threshold energy

This determines the threshold energy of measured spectrum. This value is interpreted as work function and ionization potential.

- ① Click Data tab of Control List and by making **Power Number** at 0.5, make Y axis for a square root of yield.

### Caution

Appropriate power number shall be different from material each. Check it with thesis etc. Generally speaking, it is said that the power 0.5 is for the sample material, the power 0.3(1/3) is for semiconductor and the power 0.5 is mostly for organic material.

- ② Click **Disp tab** of Control List. Control the display condition of Graph suitably.  
For numbers etc, input it from keyboard after click the box.  
When check for check box, it becomes on and when make it off, it will be off.  
For example) Minimum of X Axis [eV] : 4.20, Maximum of X Axis [eV] : 6.20, Scale Space of X Axis [eV] : 0.10, Minimum of Y Axis [CPS<sup>0.5</sup>] : 0.0, Maximum of Y Axis [CPS<sup>0.5</sup>] : 40.0, Scale Space of Y Axis [CPS<sup>0.5</sup>] : 4.5, Back Color : default, Center Area Color : default, Scale of X Axis : On, Scale of Y Axis : On, Scale Color : default, Grid : Off, Dot Style : default, Dot Size : 30, Dot Color : default, Line Display : Off, Line Style : default, Line Color : default, Selected Dot : On, Selected Dot Style : default, Selected Dot Size : 35, Selected Dot Color : default.
- ③ By guessing the plain part of Graph, select the range by click and drag. After selection by right side, display the pop up menu. Then, click the Ground level.
- ④ By guessing **the range of Regression Line**, select by click and drag. After selection by right side click, display the pop up menu and click Regression Line.
- ⑤ On the **Data tab** of Control List, **Work Function**, **Gradient of Regression Line** (slope) are displayed.
- ⑥ By **Edit(E)-Copy(C)**, graph and data can be copied on the clipboard and it can be used in other application of Windows. After click on the display desired to copy in advance, start up **Edit(E)-Copy(C)**.
- ⑦ When close the form, start up **File(F)—Close(X)**. Now, when the form is closed, this shall be updated.

### Caution

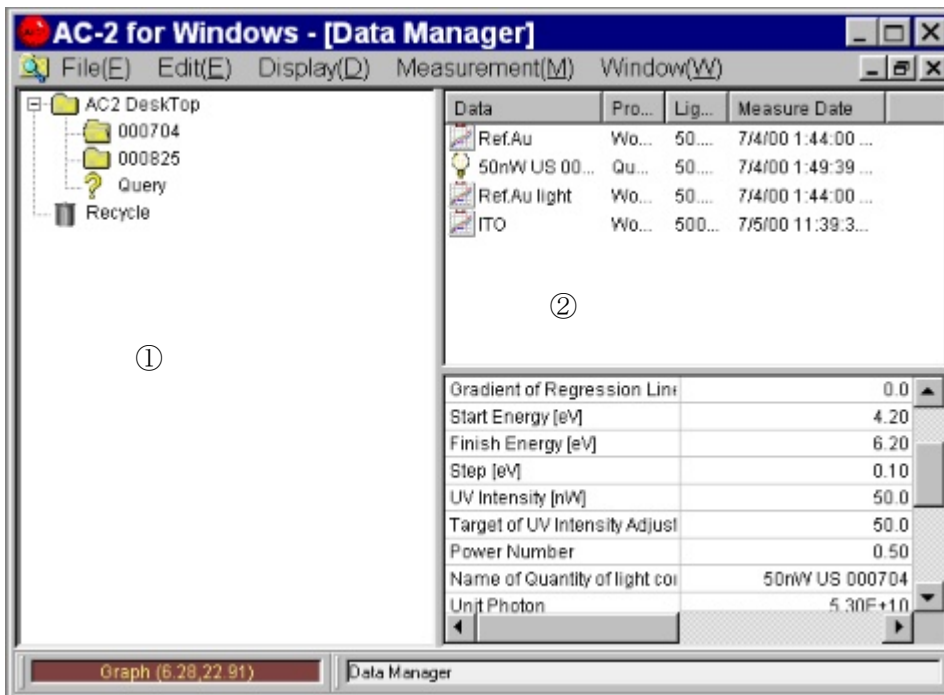
**Single and Multiple Graph Form** cannot be displayed over 5 copies. Close unnecessary Form.

# 1 0 . Multiple Graph

By displaying upto 5 copies graphs on Multiple Graph Form concurrently, the comparison can be made. The graph for this comparison shall be required in the same folder.

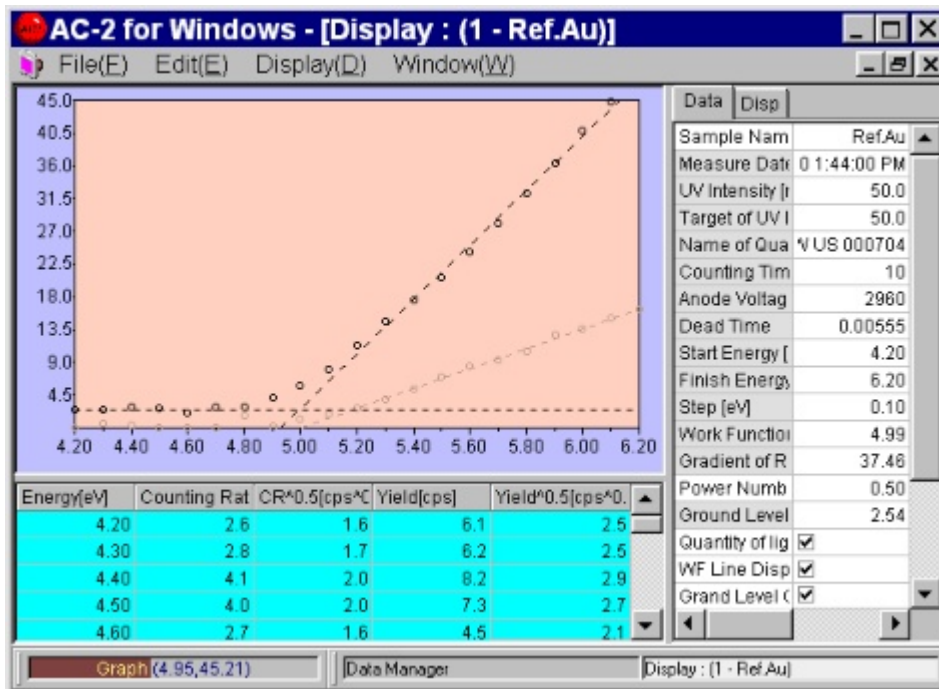
## 10-1. How to open Multiple Graph Form

- ① Open the form provided with Graph on the **tree** (①) of Data Manager Form, and let the desired data displayed on Multiple Graph Form of Data Manager (②) .



- ② Click the icon of Work Function Data File desired to depict as Graph by holding on pressing Ctrl key, all the those file can be selected simultaneously.
- ③ Open the pop up menu by right side click and click open.
- ④ **Multiple Graph Form** shall be open.
- ⑤ When close form, start up **File(F)–Close(X)**.

## 10-2.Explanation of Multiple Graph Form



- ① Except the Graph of data selected on **Sample Name**, it is depicted at the same density in “Not Selected Sample Overlay Level of **Disp tab.**”
- ② The selected data at **Sample Name** is displayed on **Data Table**.
- ③ When select a different data, click Sample Name. Then, as the button is displayed and click it, the data name of others shall be displayed. Select it.



## 1 1 . Display of Quantity of light correction coefficient

- ①After selecting **Light Spectrum Data File** [Example] TEST] desired to display, start up **File(F)** – **Open(O)** and open Display Form.
- ②By **Edit(E)-Copy(C)**, paste the data on clipboard and can use the Windows through from other applications.
- ③When close the form, start up **File(F)**– **Close(X)**.

The screenshot shows the 'AC-2 for Windows - [Display : (2 - 50nW US 000704)]' window. The main area contains a table with the following data:

Energy[eV]	UV Intensity[nW]	Photon Number[pcs]
4.20	15.2	2.26E+10
4.30	16.7	2.43E+10
4.40	18.6	2.85E+10
4.50	20.7	2.87E+10
4.60	23.3	3.16E+10
4.70	24.9	3.32E+10
4.80	27.2	3.54E+10
4.90	29.7	3.79E+10
5.00	32.9	4.11E+10
5.10	36.4	4.46E+10
5.20	40.4	4.86E+10
5.30	43.7	5.15E+10
5.40	45.9	5.31E+10
5.50	47.4	5.39E+10
5.60	49.3	5.50E+10
5.70	50.3	5.52E+10
5.80	50.3	5.42E+10
5.90	49.5	5.24E+10
6.00	48.0	5.00E+10

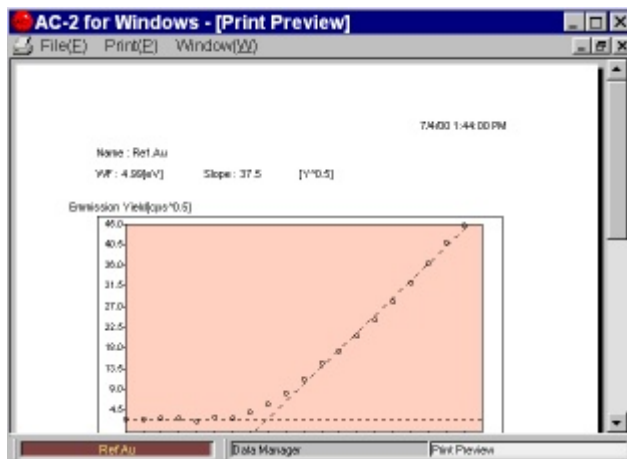
On the right side, there is a 'Data' panel with the following information:

- Sample Name: i0nW US 000704
- Measure Date: 7/4/00 1:49:39 PM
- UV Intensity [r]: 50.0
- Target of UVI: 50.0
- Start Energy [eV]: 4.20
- Finish Energy [eV]: 6.20
- Step [eV]: 0.10
- Notes1, Notes2, Notes3: (Empty)

The status bar at the bottom shows '50nW US 000704', 'Data Manager', and 'Display : (2 - 50nW US 000704)'.

## 1 2 . Print-out

- ①After selecting the Work Function Data File [Example] TEST] desired to print out, start up **File(F)** – **Print(P)**.
- ②As **Print Setting Box** is displayed, check it and click **OK**.
- ③**Print Preview Form** shall be displayed.



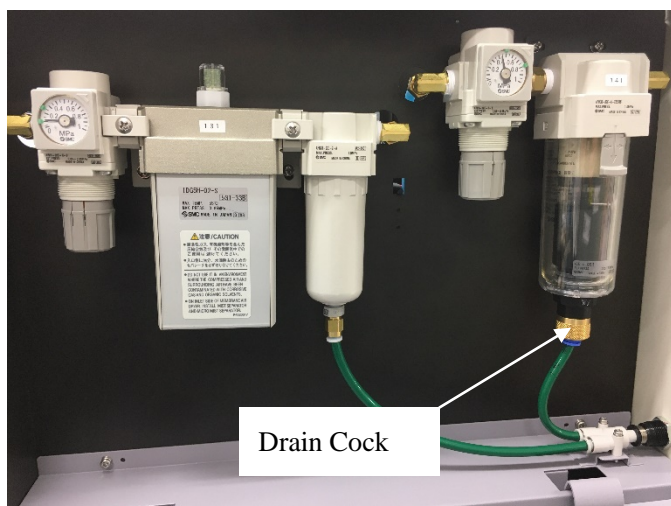
- ④ After checking Graph to display, start up **Print(P)—Print(G)**.

 **Caution**

- When print out Single Graph Form directly, there is the case that the drastic changed condition could not be reflected.
- The data is printed out by the printer designated normally with OS.
- Print condition is set up with OS.

## 1 3 . How to finish windows

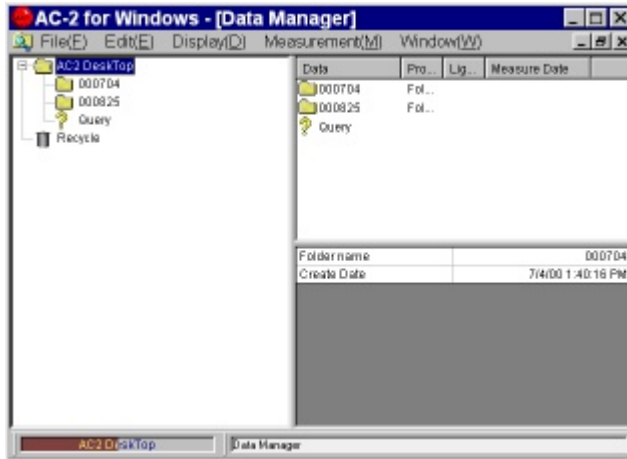
- ① **Repeat the File(F)—Close(X)** and close all the child form (Measurement, Data Manager etc) .
- ② Close the **main form** by **File(F)—Close(X)**.
- ③ After changing over POWER SW on the surface panel of main unit (LC1) from ON( | side) to OFF( 0 side), make off of breaker on rear side of LC1.
- ④ Close the main cock of compressed air. Or stop the operation of compressor.
- ⑤ When water is deposited in MIST SEPARATOR, turn DRAIN COCK to the right and exhaust it out. After exhaust out, be sure to close DRAIN COCK.
- ⑥ Finish Windows and stop personal computer, display and printer.



## 1 4 .Other function

### 14-1.Data Manager

When start up AC-2 for Windows, this shall be displayed.



#### 14-1-1.File(F)

- ① **Open(O)** : Open the Data File.
- ② **Create Folder(W)** : New Folder is made up.
- ③ **Save Data(A)** : A part of the measurement data is saved as CSV form.
- ④ **Data base-Import** : Data base is imported under Folder.



#### Caution

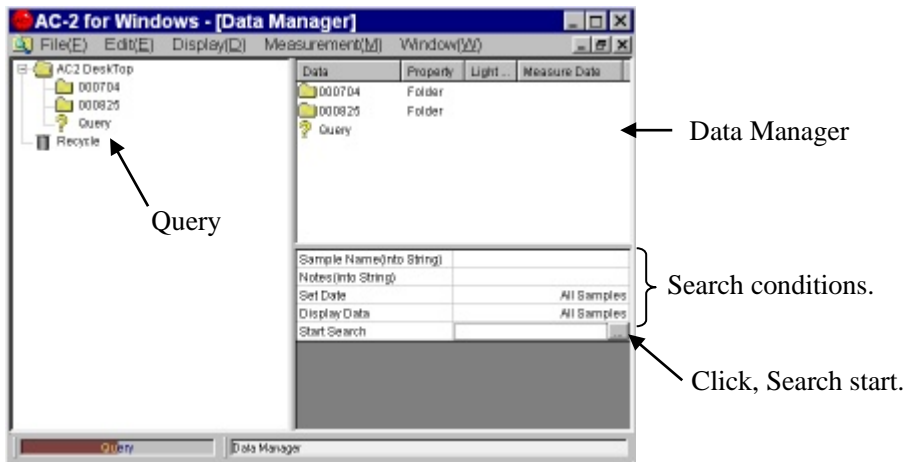
When import other material than Data base exported from AC-2 for Windows, Data base has the possibility to break down.

- ⑤ **Data base-Export** : Export Data File or Folder as Data base.
- ⑥ **Data base-Repair and Conditioning** : This makes the Repair and Conditioning of Data base.
- ⑦ **Print(P)** : Print the Data File.
- ⑧ **Delete(D)** : Delete the Data File or Folder.
- ⑨ **Rename(R)** : Change Data File or re-name the Folder.
- ⑩ **Close(X)** : Close the form.

#### 14-1-2. Edit (E)

- ① **Return(U)** : Put the moved away Data File or Folder where it was.
- ② **Cut(X)** : Cut out Data File or Folder.
- ③ **Copy(C)** : When make the light correction, designate Light Spectrum Data File.
- ④ **Past(P)** : Correct Work Function File by Light Spectrum Data File appointed by copy.
- ⑤ **Select All(A)** : Make the data file all inside of folder or folder itself active.

⑥ **Search(S)** : Search Data File. Input searching conditions and click the searching start box. When click the button, the searching will start. The searching result is filed in **Query** and displayed in **Data Manager**.



#### 14-1-3. Display(D)

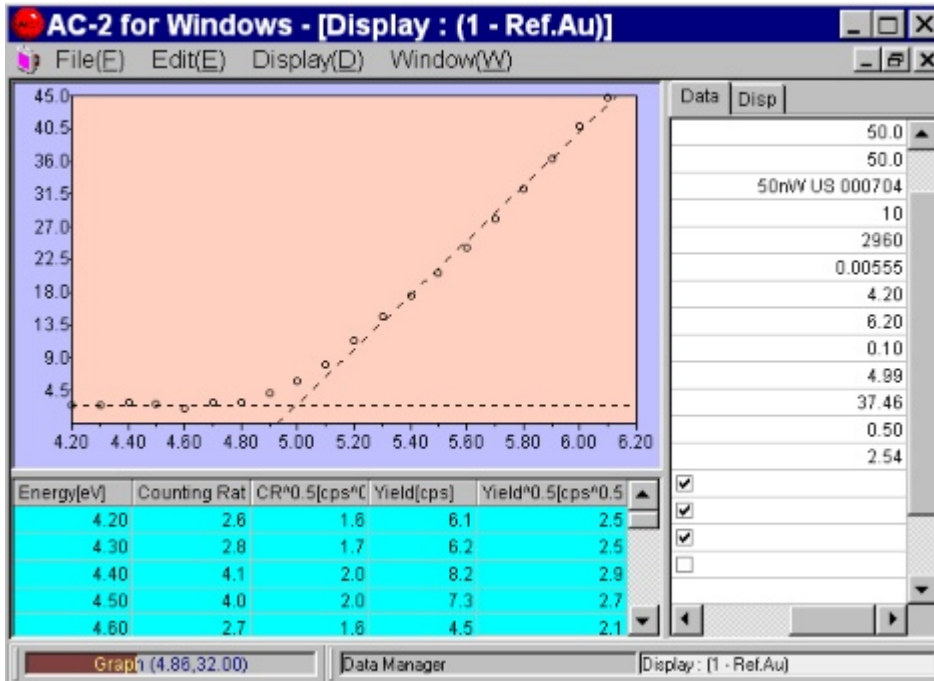
- ① **Status Bar(S)** : This changes over the appear/disappear of Status Bar.
- ② **Refresh Data(D)** : Update the latest information.

#### 14-1-4. Window(W)

- ① Cascade Display
- ② Tile Vertical Display
- ③ Tile Horizontal Display
- ④ Window : This displays the form to be opened now.

## 14-2.Display

Make Data file desired to display **Data Manager** at active condition and it shall be displayed or by starting up **File(F)-Open(O)** by making double click for icon of Data file desired to display.



### 14-2-1. File(F)

① **Print(P)** : Can print out.



### Caution

When print without finishing the form after changing Graph condition, there is the case that the change will not work. After close once, print out.

### 14-2-2. Edit(E)

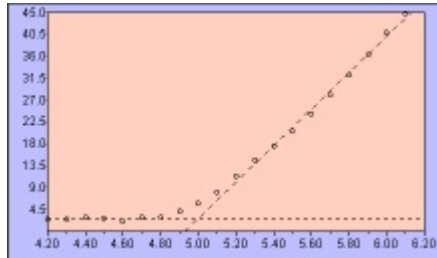
① **Copy(C)** : Copy graph, table and status on clipboard.

### 14-2-3. Display(D)

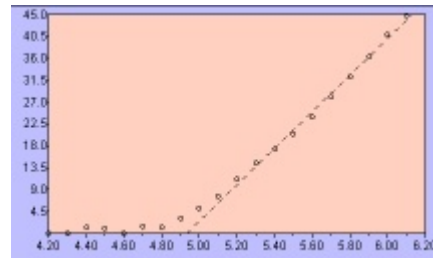
① **Graph(G)** : Change over On/Off of graph.

#### 14-2-4.Data tabs

- ① **Power Number** : Change the power number of vertical line.
- ② **WF Line Display** : Change over appear/disappear of Regression Line.
- ③ **Grand Level ON** : Change over appear/disappear of grand line.
- ④ **Display of Difference between Data and Grand level** : Change over the calculation method of ground level(Normally not checked).



Not checked



Checked

#### ⑤ Notes

#### 14-2-5.Disp tab

- ① X Axis : Minimum, Maximum, Scale Space.
- ② Y Axis : Minimum, Maximum, Scale Space.
- ③ Back Color
- ④ Center Color
- ⑤ Scale of X Axis/Y Axis : Appear/Disappear of scale.
- ⑥ Scale Color
- ⑦ Grid : Appear/Disappear of grid
- ⑧ Dot : Style, Size, Color.
- ⑨ Line : Regression Line Style, Size, Color.
- ⑩ Selected Dot : Appear/Disappear of Dot when select Ground level and Regression line, Style, Size and Color.

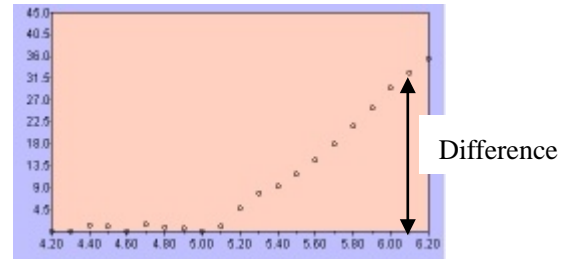
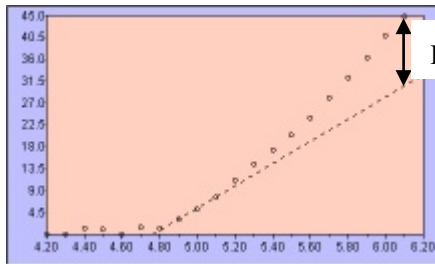
#### 14-2-6.Pop up menu



- ① **Data Clear**  
Clear up Ground Level and Regression Line.
- ② **Ground Level**
- ③ **Regression Line**

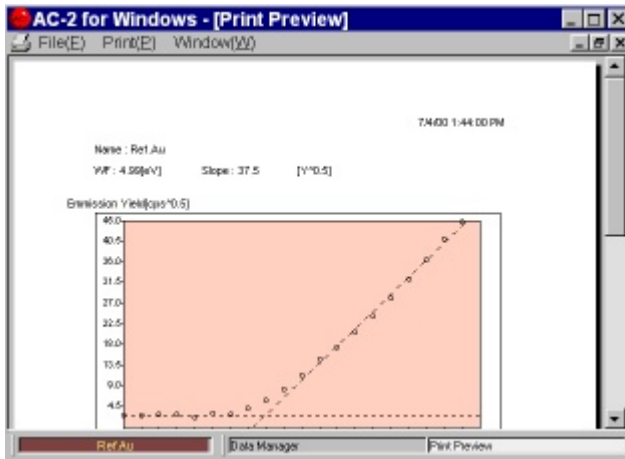
#### ④ Difference between Data and Regression Line

Make the different portion between regression line and measurement data as new data file. A sample name of different portion data will be (Original sample name) \_Dif.



### 14-3. Print Form

Make the data file desired to print out at active condition by Data Manager and it is displayed by selecting the print.



#### 14-3-1. Print(P)

- ① **Print Setting(S)** : This can check the printing condition. Now the set printer shall start from OS.
- ② **Print(G)** : Start printing.

## 14-4.Main Form

This is displayed when close all the other forms.



### 14-4-1.Display (D)

- ① **Data Manager(D)** : This displays Data Manager Form.
- ② **Font** : This can change the Font of display.



**Caution**

When change Font inadvertently, there will be the possibility of making error.

## 14-5.Back up of Data base

It is recommended to make the back up data of ac2.mdb regularly.

The “ac2.mdb” is the data base stored with the measurement data of AC-2. At an initial condition, it is located in AC-2 for Windows of Program file of “c” Drive.



—How to measure the Thickness and Counting rate—

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# 1. Outline

This instruction manual indicates how to measure the thickness.

# 2. Caution

The following things should be done prior to the operation.

- ① AC-2 and PC are correctly installed and set.
- ② AC-2 for Windows is installed.
- ③ The user has understood how to operate the Windows.
- ④ The user has understood the meaning of photoelectron, and the relationship with contamination and quantity. Before reading this manual, read the “Photoelectron Spectrometer AC-2 Instruction Manual”, “AC-2 for Windows Instruction Manual (How to measure the Work Function or Ionization Potential)” and “Instruction Manual for Windows”.

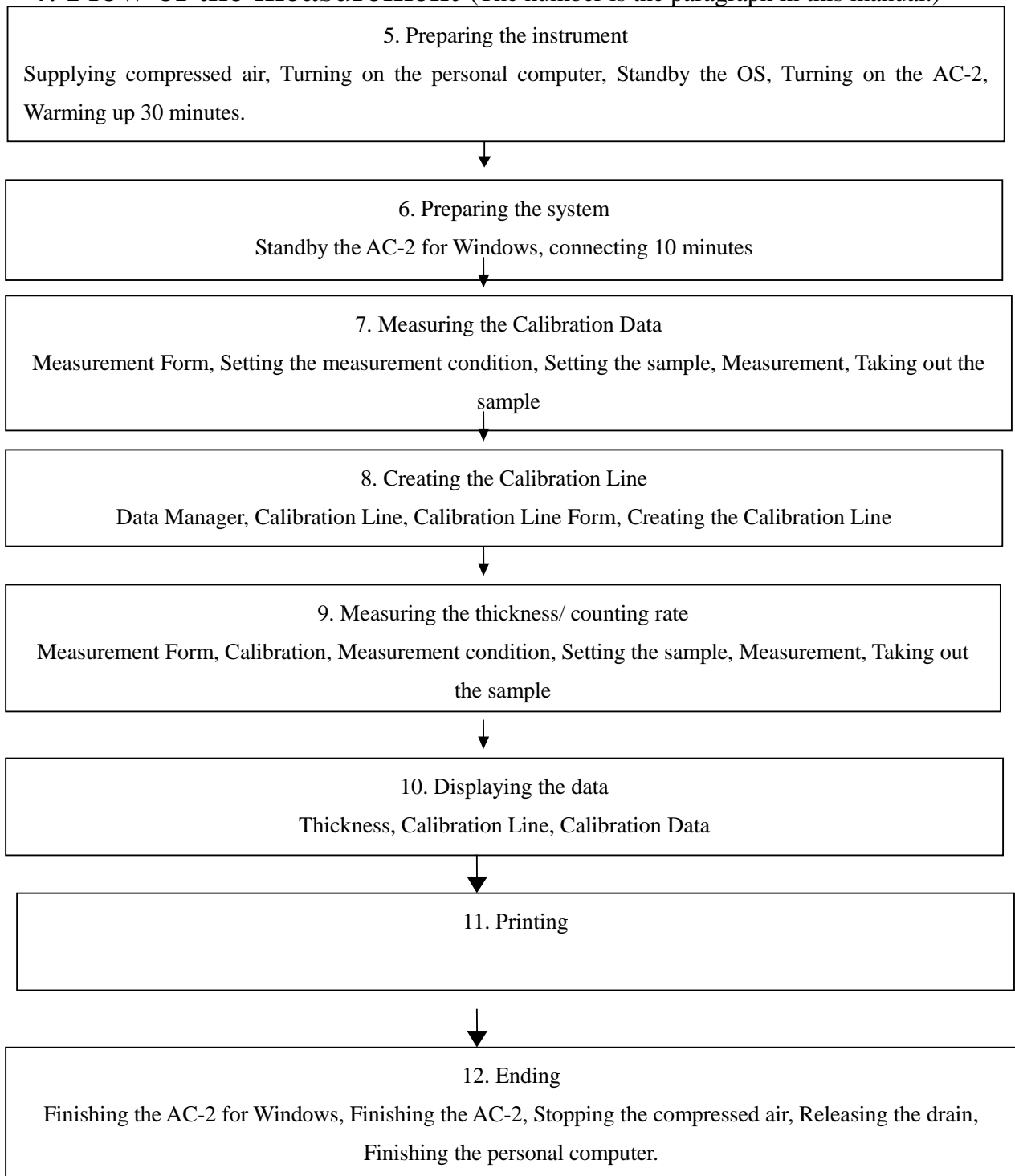
# 3. How to apply this manual

If you are a beginner user, prepare the standard samples whose thickness are different from each other, and tweezers. Then, start the measurement, referring to examples on each section.

If you are an experienced user, perform the measurement, referring to \* NOTE on each section.

Read this manual carefully, and perform the correct measurement.

#### 4. Flow of the measurement (The number is the paragraph in this manual.)



## 5. Preparing the instrument

Prepare the measurement on AC-2.

- ① Supply the compressed air (0.5—0.6Mpa) to the AC-2. If the compressed air is supplied by a pump, turn the power of the pump on. If the air is supplied by the tubing of the factory, open the valve.
- ② Turn on the PC and let the Windows start.
- ③ Confirm if the Windows starts.
- ④ Turn on the circuit breaker on the rear panel of the LC1.
- ⑤ Turn on the power switch on the front panel of the LC1.
- ⑥ In accordance with the power-on, warming-up starts soon. When the warming-up finishes 30 minutes later, POWER/STANDBY LAMP turns GREEN.

### \* NOTE

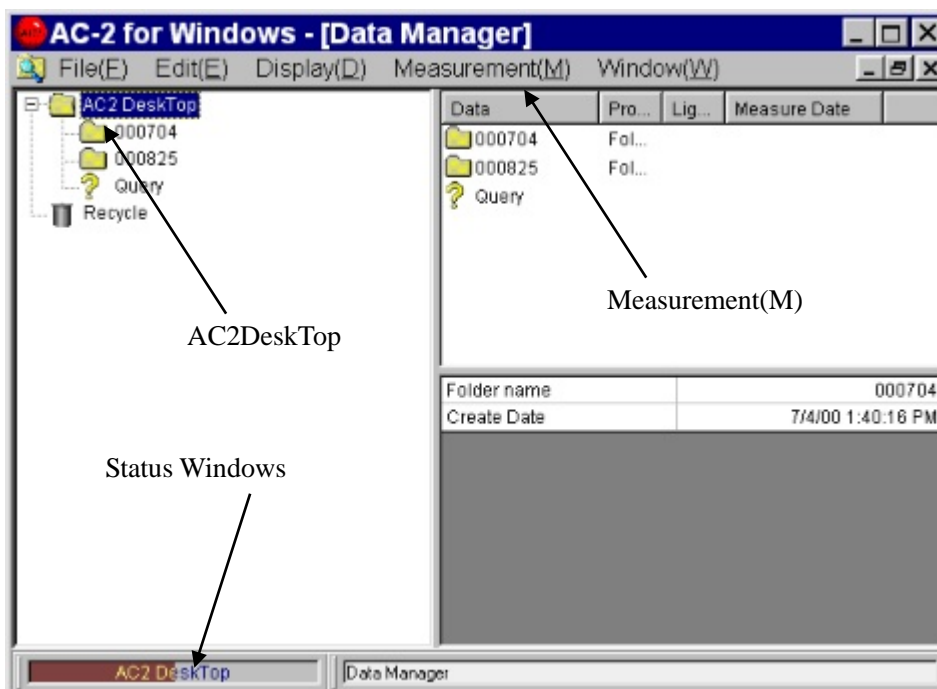
If you just want to confirm the data measured in the past, you can skip the order from ③ to ⑥. (But, the measurement must be started after the warming-up finished.)

## 6. Preparing the system

In this paragraph, you prepare the PC and AC-2 for Windows.

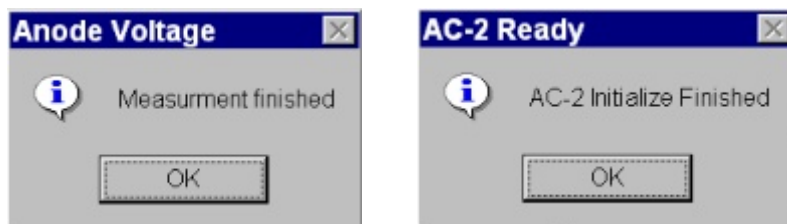
### 6-1. Preparing the system

- ① **Start the AC-2 for Windows** e.g.) Startup with the **start** button in **Program**.
- ② **Then, Main Form and Data Manager Form** are open.



## 6-2. Connection

- ① Execution of **Measurement (M) — Connection (N)**
- ② Connection starts. The meaning of the connection is “security of the communication with the instrument”, “**Initialize Light Adjuster**” and “**Setting Anode Volts**”. The current status is displayed on the “**Status Window**”.
- ③ The Connection finishes approx. 10min. later. The messages “Measurement finished” and “AC-2 initialize finished” appear on the message boxes. Then, click the OK.



### Caution

Depending upon the OS version, the communication with the instrument might be disturbed by managing “AC-2 for Windows” or other application during the connection or measurement. Do not activate another application on the PC while managing the communication like connection and measurement.

## 7. Measurement of Calibration data

Calibration Data becomes the base data for creating the Calibration Line. At least 2 pieces of the standard samples whose thickness is acknowledged.

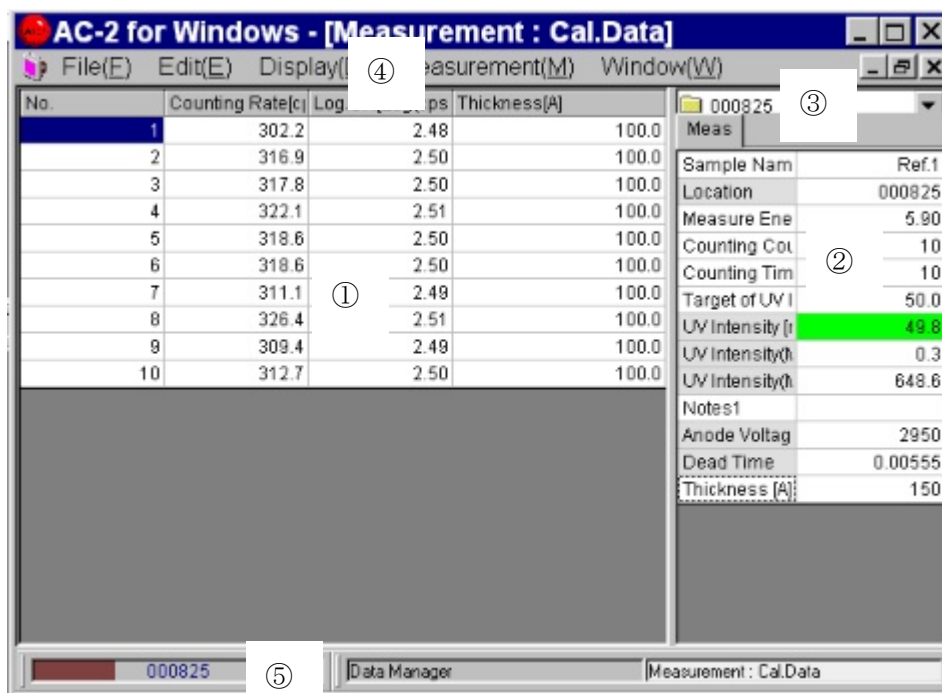
### 7-1. Creating a folder and Activating the Data Form

- ① Activate the **AC-2 Desk Top** by clicking the icon.
- ② **File (F) — Create Folder (W)** execute.
- ③ Enter the **folder name**. e. g.) test
- ④ Make sure if the created folder is active.
- ⑤ When execute the **Measurement (M) — Calibration Data (D)**, **Cal. Data Form** becomes open.

### Caution

When another Measurement Form is active, close it and open the Cal. Data Form.

## 7-1. Explanation of Cal. Data Form



### ① Data Table

arranges the measurement data into a table.

### ② Control List

can enter the necessary conditions for the measurement.

### ③ Folder Window

shows the folder which files the measurement data.

### ④ Menu Bar

performs the switching of the placement/ removal of the sample, UV Intensity Adjustment, and form.

### ⑤ Task Bar

shows the current status or changes the form.

## 7-2. Setting the Measuring Conditions

Entering the measuring conditions from Control List.

- ① Enter the sample name. The name entered here will be the one for Cal. Data File displayed in Data Manager Form. Click the right box of **Sample Name** and type some characters, and press the Enter. If you re-write the sample name already entered, click it and press the space bar. e.g.) TEST1, TEST2, TEST3 etc.
- ② When the **Folder Window** is clicked, the folder is displayed. Choose the folder which is going to save the Cal. Data which is measured from now. e.g.) User's name
- ③ Enter the **Measure Count**. e.g.) 20
- ④ Set the **Counting Time**. e.g.) 10
- ⑤ Enter the thickness of the standard sample in the **"Thickness"**.
- ⑥ Enter the **Start and Finish Energy**. e.g.) 5.9
- ⑦ Set the UV Intensity. First, enter **"Target of UV Intensity Adjustment"**. **Target of UV Intensity Adjustment** has to be set between **UV Intensity(Max)** and **UV Intensity(Min)**. e.g.) 10
- ⑧ Select the **Measurement(M)-UV Intensity Adjustment(L)** of the Menu Bar.

Automatic adjustment of UV Intensity starts. After the adjustment, the value UV intensity becomes almost the same as that of the Target. The black color changes to Green within  $\pm 5\%$ , yellow within  $\pm 5\sim 20\%$ , and red beyond  $\pm 20\%$ .

### \* Note

Appropriate UV Intensity depends on a sample. To get the appropriate slope, perform the preliminary measurement of photoelectron spectrum.

- ⑨ Enter the thickness of the standard sample by the unit of angstrom (A).

### \* Note

When contamination quantity is measured, enter an appropriate value which indicates the contamination quantity.

- ⑨ Enter any information such as lot number in the **"Note 1"**.

### 7-3. Setting the Standard Sample

- ① Activate the **Measurement (M)–Sample (S)** of Menu Bar.
- ② The message to confirm the movement of the SAMPLE STAGE appears in the message box. Click **YES (Y)**.
- ③ Confirm the noise of the movement from the sample stage stops.
- ④ Push the position of the “PUSH” on the SAMPLE DOOR, release your hand when tick sound could be heard.

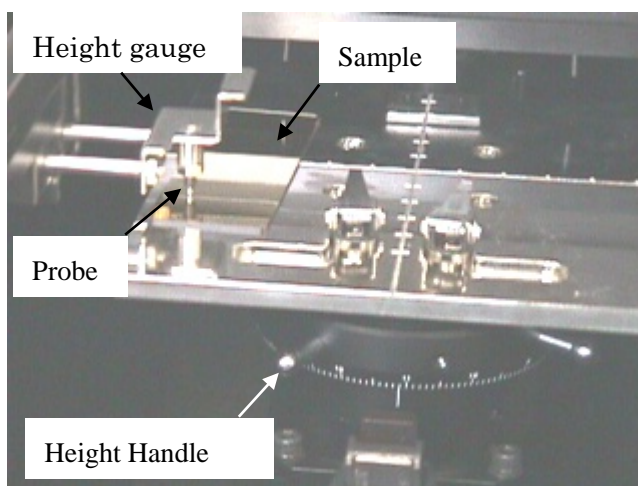


- ⑤ The SAMPLE DOOR opens. Confirm if the OPEN LAMP blinks red.

#### **Warning**

If the OPEN LAMP does not blink red, the interlock might be broken. In this case, the sample stage would move even while the SAMPLE DOOR is open.

- ⑥ Place the sample on the left-front of the SAMPLE STAGE.



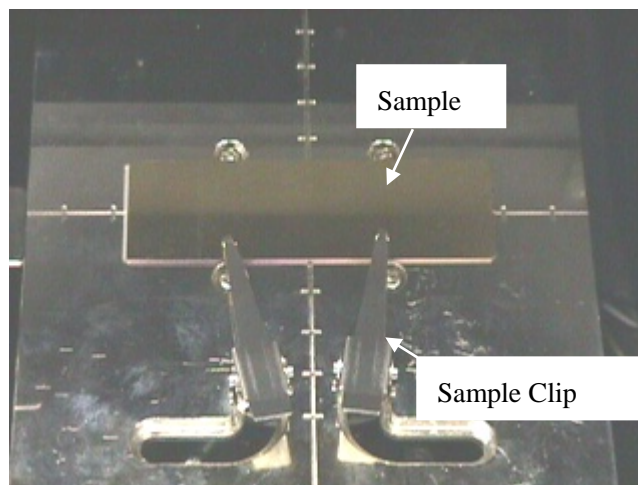


- ⑦ Adjustment of the Height of the sample stage. Place the sample on the left-front of the sample stage. Next, pull the HEIGHT GAUGE as if press the sample with SAMPLE STAGE. And, revolve the HEIGHT HANDLE of the sample stage until the tip of the probe of the HEIGHT GAUGE matches the height of the measuring part of the sample.

**⚠ Warning**

If even any part of the sample is placed higher than the probe of the HEIGHT GAUGE, the sample might hit the detector. As a result, the sample or the instrument might break. Adjust the height appropriately.

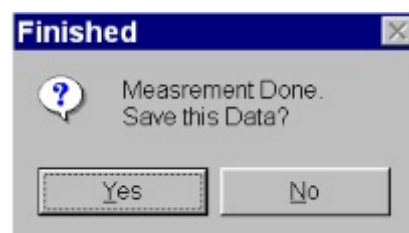
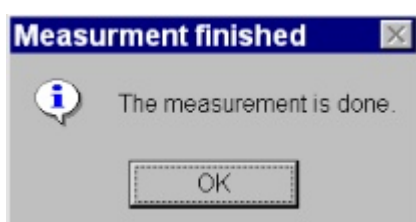
- ⑧ Place the sample on the center of the sample stage and fix it with the SAMPLE CLIP.



- ⑨ Shut the SAMPLE DOOR, Push the door and release your hand when you hear tick sound.  
⑩ Confirm if the SAMPLE DOOR is closed and click **OK**.

#### 7-4. Measurement

- ① Once the **Measurement (M)– Measurement (G)** in **Menu Bar** is chosen, measurement of the Calibration Data starts.  
② After the measurement starts, the data displays.  
③ When the measurement finishes, **message box** which tells the ending opens. And, click **OK**.  
The Calibration Data measured save in the Folder as **Cal. Data File**.



## Caution

The communication between the PC and the instrument might not be able to perform depending on OS if the AC-2 for Windows or another application is managed during the communication. We recommend you do not allow the PC to manage other applications during the communication.

### 7-5. Taking out the Sample

- ① Choose the **Measurement (M)–Sample (S)** in Menu Bar.
- ② Confirm that the message box appears and the noise of the sample stage disappears.
- ③ Push the SAMPLE DOOR and release your hand when you hear the tick sound.
- ④ SAMPLE DOOR opens.
- ⑤ Taking out the sample.
- ⑥ Close the SAMPLE DOOR.
- ⑦ Confirm the SAMPLE DOOR closes and click **OK**.

### 7-6. Measuring the next standard sample

A few of the measurement data files for standard samples that have different thickness are required to create the Cal. Line Data File.

Firstly, repeat 7-2~7-5 by changing the UV Intensity. And, find the UV intensity that makes the counting rate of thinnest standard sample be approx. 2000CPS.

Next, measure another standard sample with the UV intensity. Measure the standard sample by this UV Intensity. Create the Cal. Line Data File together with other data, which is generated by the same UV intensity. Cal. Data Files to create one Cal. Line Data File must be stored in the same folder.

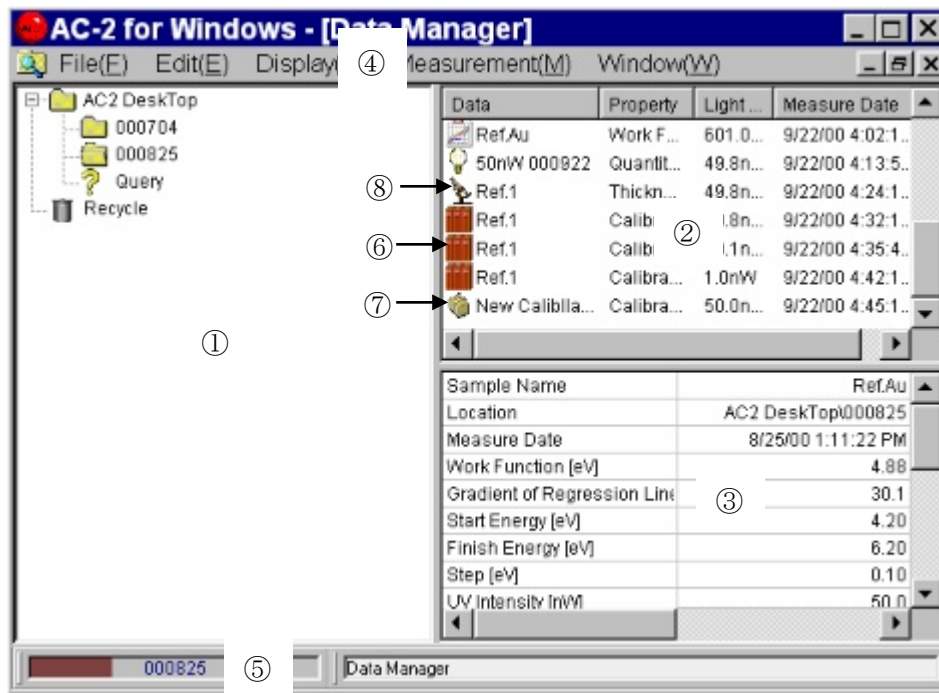
### 7-7. Finishing the Cal. Data Form

When the **Cal. Data Form** is active, finish the **Cal. Data Form** by the **File(F)–Close(X)**.

## 8. Creating the Calibration Line

Creating the **Cal. Line Data File** by using the **Cal. Data File** measured at Section 7. First, click the **“Data Manager”** of **Task Bar** and display the **Data Manager Form**. And, perform the **Display(D)–Refresh Data(D)**.

### 8-1. Explanation of Data Manager Form



#### ① Tree

This displays the folder like a tree.

#### ② Data Manager

This displays the Data File or folder.

#### ③ List Table

This displays the outline of the Data File.

#### ④ Menu Bar

Print, Deleting Data Files, Creating Folders, Movement, Renaming

#### ⑤ Task Bar

This displays name of the folder or Data File currently chosen and changes the form.

#### ⑥ Cal. Data File

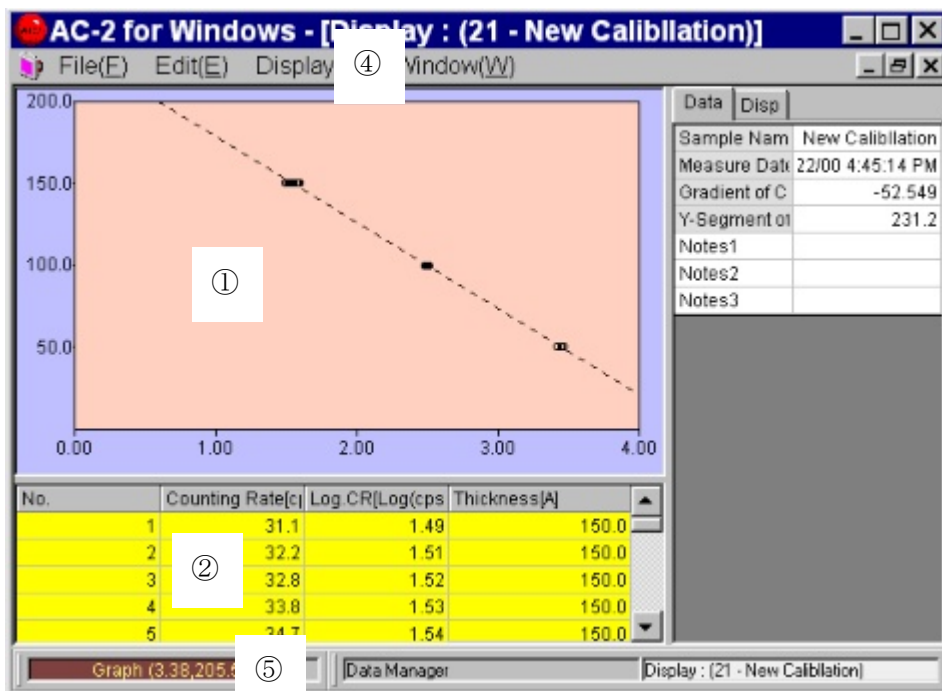
#### ⑦ Cal. Line Data File

#### ⑧ Thickness•Counting Rate Data File

## 8-2. Creating the Calibration Line

- ① Click the **Folder** which saves the **Cal. Line Data File**.
- ② Activate **Measurement(M) —Calibration Line** and create a new **Cal. Line Data File**.
- ③ Click the icon of the new **Cal. Line Data File** and change the name. e.g.) 1
- ④ Click the **Cal. Data File** e.g.) TEST 1, TEST 2, TEST 3 which are already measured, pressing the Ctrl to choose. And, right-click to perform the copy of the **pop up menu**.
- ⑤ Attach it on the **Cal. Line Data File** created at ①.
- ⑥ Double-click the icon of the **Cal. Line Data File** and let it open on the **Calibration Line Form**.

## 8-3. Explanation of the Calibration Line Form



- ① **Graph**  
Drawing the measurement data.
- ② **Data Table**  
Tabling the measurement data.
- ③ **Control List**  
Conditions to create the Calibration Line can be entered.
- ④ **Menu Bar**  
Changing the measurement and form.
- ⑤ **Task Bar**  
Changing the form.

## 8-4. Creating the Calibration Line

- ① The **Disp** tab of **Control List** conditions the Maximum, Minimum and space of the Graph. And it makes the graph easy to see.
- ② Click and drag to fix the range of the Calibration Line.
- ③ Right-click to open the **pop up menu** and choose the **Calibration Line**.
- ④ Regression Line displays on the Graph and Calibration Line is created.
- ⑤ When close the form, perform the **File(F) – Close(X)**. When the form closes, Data is automatically renewed. And the Calibration Line is save in the **Folder** as **Cal. Line Data File**.

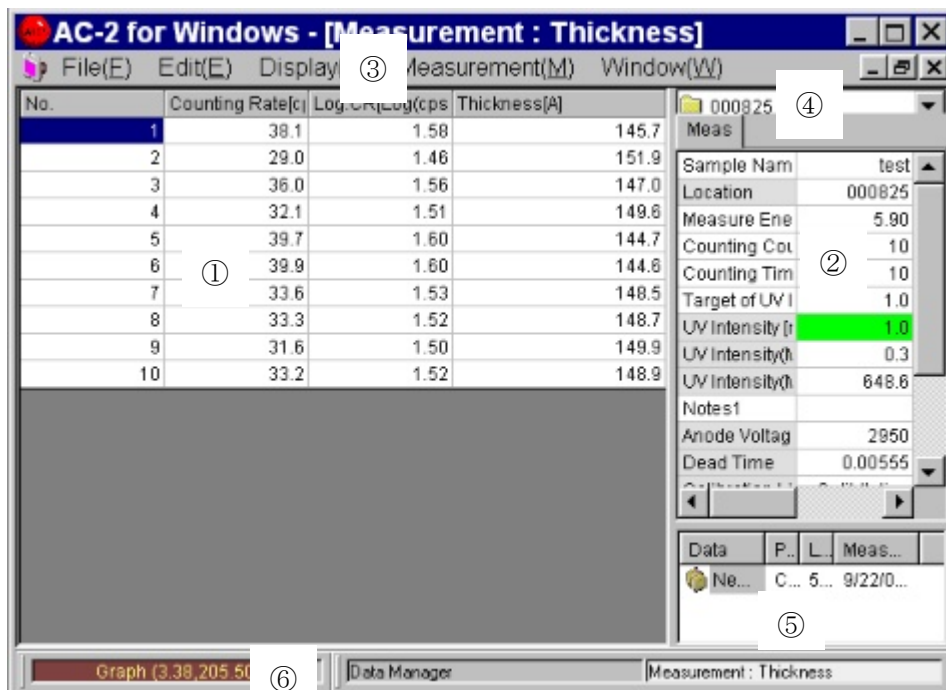
## 9. Measuring the thickness/ counting rate

When the **Measurement (M) – Thickness • Counting Rate (C)** performs, **Thickness • Counting Rate Form** opens.

### ⚠ Caution

When other Measurement Forms are open, close them and open the Thickness • Counting Rate Form.

### 9-1. Explanation of the Thickness • Counting Rate Form



#### ① Data Table

It tables the measurement data.

## ② Control List

Conditions required for the measurement can be entered.

## ③ Folder Window

It shows the Folder which files the measurement data.

## ④ Calibration Line Window

It displays the **Cal. Line Data File** used for Calibration.

## ⑤ Menu Bar

It changes the measurement and form.

## ⑤ Task Bar

It displays the current status and changes the form.

## 9-2. Calibration

The efficiency of the detector depends on the temperature, humidity and pressure. Therefore, “calibration” of the Calibration Line is required. The calibration performed at one calibration point. A calibration sample is required for the calibration.

### 9-2-1. Setting the Calibration Conditions

- ① Find the **Cal. Line Data File** which is going to use now from **Calibration Line Window**.  
And double-click.
- ② Confirm the **Calibration Line Name**.
- ③ Enter the **Thickness of Calibration Sample** by angstrom (Å) unit.
- ④ Enter the **Measure Count**. e.g.) 5
- ⑤ Set the **Counting Time**. e.g.) 10
- ⑥ Enter the **Measure Energy**. **Measure Energy** has to be the same value as **Measure Energy of Cal. Line Data file**. e.g.) 5.9
- ⑦ When the **Measure Energy** changes, the Light Adjuster is automatically initialized.
- ⑧ Setting the UV Intensity. Firstly, enter the **Target of UV Intensity Adjustment**. **Target of UV Intensity Adjustment** has to be the value between **UV Intensity(Max)** and **UV Intensity(Min)**. e.g.) 10
- ⑨ Choose the **Measurement (M)-UV Intensity Adjustment (L)** in **Menu Bar**. Automatic adjustment of the UV Intensity automatically starts. When the adjustment is done, UV Intensity becomes almost the same value as the Target. The back color turns green  $\pm 5\%$  of the target, yellow  $\pm 5\sim 20\%$  of the target and red  $\pm 20\%$  of the target.

## 9-2-2. Setting the Calibration Sample

- ① Activate the **Measurement (M)–Sample (S)** in the Menu Bar.
- ② The **message box** that confirms the movement of the SAMPLE STAGE appears. Click **YES (Y)**.
- ③ Confirm if the noise of the sample stage is gone.
- ④ Confirm that the **message box** which instructs to change the sample appears, and open the SAMPLE DOOR.
- ⑤ SAMPLE DOOR opens.
- ⑥ Place the sample on the left-front of the SAMPLE STAGE.
- ⑦ Adjusting the height of the sample stage. Place the sample on the left-front of the SAMPLE STAGE. Pull out the HEIGHT GAUGE and place it as if the sample is pressed with the SAMPLE STAGE. And, revolve the HEIGHT HANDLE until the tip of the probe matches the height of the measuring part of the sample.

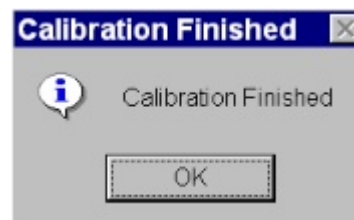
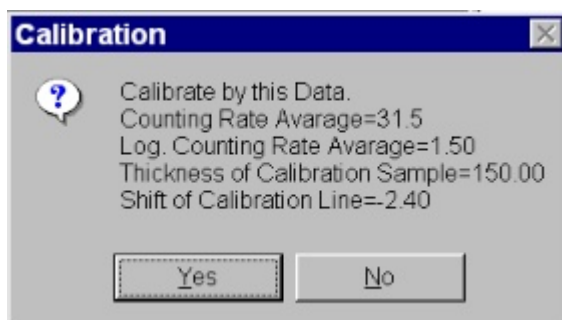
### Warning

If even any part of the sample is placed higher than the probe of the HEIGHT GAUGE, the sample might hit the detector. As a result, the sample or the instrument might break. Adjust the height appropriately.

- ⑧ Place the sample at the center of the SAMPLE STAGE and fix it by the SAMPLE CLIP.
- ⑨ Close the SAMPLE DOOR.
- ⑩ Confirm that the SAMPLE DOOR is closed. And click **OK** on the display.

## 9-2-3. Calibration

- ① Activate the **Measurement (M) – calibration (A)**.
- ② Once the calibration starts, the counting rate shows up on the measurement display.
- ③ After finishing the calibration, the calibration result appears in the **message box**. If you want to perform the calibration based on the result, click **Yes**. If not, click **No**.



- ④ The **Shift of Calibration Line** is displayed on the **Control List**.

### Caution

The communication between the PC and the instrument might not be able to perform depending on an OS if the AC-2 for Windows or another application is managed during the communication. We recommend you do not allow the PC to manage other applications during the communication.

## 9-2-4. Taking out the Calibration Sample

- ① Choose the **Measurement (M)–Sample (S)** in Menu Bar.
- ② Confirm that message box displays and the noise of the sample stage disappears.
- ③ Open the SAMPLE DOOR.
- ④ SAMPLE DOOR opens.
- ⑤ Take out the sample.
- ⑥ Close the SAMPLE DOOR.
- ⑦ Confirm that the SAMPLE DOOR is closed. And, click **OK** on the display.

## 9-3. Setting the Measuring Conditions

Entering the measurement conditions from the **Control List**.

- ① Entering the sample name. The name entered here will be the name for **Thickness/Counting Rate Data File** displayed in **Data Manager Form**. Click the right box next to the **Sample Name**, and enter the characters. e. g.) TEST 1, TEST 2, TEST 3 etc. When rewriting the sample name already existed, press the space key after clicking.
- ② If the **Folder Window** is clicked, folders are displayed. Choose the folder to file the Thickness/Counting Rate Data which is measured from now. e. g.) test
- ③ Enter the **Measure Count**. e. g.) 20
- ④ Setting the **Counting Time**. e. g.) 10
- ⑤ UV Intensity has to be the same value as the one at calibration. Cal. Data File, calibration, Measurement of thickness are taken place under the same UV Intensity.
- ⑥ Enter the Information such as about lot number about the measuring sample in **Notes 1**.

## 9-4. Setting the Sample

- ① Activate the **Measurement (M)–Sample (S)** in **Menu Bar**.
- ② A message box which confirms the movement of the SAMPLE STAGE displays. **Click YES (Y)**.
- ③ Confirm that the noise of the sample stage disappears.
- ④ Confirm that a **message box** which instructs to change the sample. And, open the SAMPLE DOOR.
- ⑤ SAMPLE DOOR opens.
- ⑥ Place the sample on the left-front.
- ⑦ Adjusting the height of the sample stage. Place the sample on the left-front of the SAMPLE STAGE. Pull out the HEIGHT GAUGE and place it as if the sample is pressed with the SAMPLE STAGE. And, revolve the HEIGHT HANDLE until the tip of the probe matches the height of the measuring part of the sample.



### Warning

If even any part of the sample is placed higher than the probe of the HEIGHT GAUGE, the sample might hit the detector. As a result, the sample or the instrument might break. Adjust the height appropriately.

- ⑧ Fix the sample at the center of the SAMPLE STAGE by the SAMPLE CLIP.
- ⑨ Close the SAMPLE DOOR.
- ⑩ Confirm the SAMPLE DOOR closes, and click **OK**.

### 9-5. Measurement

- ① When the **Measurement (M)-Measurement (M)** in **Menu Bar** is chosen, the measurement of the counting rate and thickness starts.
- ② When the measurement starts, the data displays.
- ③ A **message box** which tells the ending of the measurement opens. Click **OK**. The measured counting rate and thickness Data are saved in a **Folder** as **Thickness•Counting Rate Data File**.

### Caution

The communication between the PC and the instrument might not be able to perform depending on OS if the AC-2 for Windows or another application is managed during the communication. We recommend you do not allow the PC to manage other applications during the communication.

### 9-6. Taking Out the Sample

- ① Choose the **Measurement (M)-Sample (S)** in **Menu Bar**.
- ② Confirm that a **message box** appears and the noise of the sample stage disappears.
- ③ Open the SAMPLE DOOR.
- ④ SAMPLE DOOR opens.

### \* NOTE

**Measurement (M)-Measurement Cancel (G)** can be suspended even during the measurement.

- ⑤ Take out the sample.
- ⑥ Close the SAMPLE DOOR.
- ⑦ Confirm that the SAMPLE DOOR closes. And, click **OK**.

## 9-7. Measuring the Next Sample

If the measurement is taken place under the same conditions, rewrite the sample name, change the sample and start the measurement (following the 9-4 to 9-6.) If you change the Cal. Line Data File, perform the calibration and re-set the conditions.

## 9-8. Anode Voltage, Initialize Light Adjuster

After starting up the instrument, if measurement takes a long time or measurement takes place under the temperature/humidity change, re-set the Anode Voltage and perform the Initialize Light Adjuster.

If the **Measurement (M) – Anode Voltage (V)** is activated, the Anode Voltage automatically performs. It takes 5 minutes and a **message box** opens. Click **OK**.

If the **Measurement (M) – Initialize Light Adjuster (I)** is activated, the Initialize the Light adjuster automatically starts. It takes 5 minutes and a **message box** opens. Click **OK**.

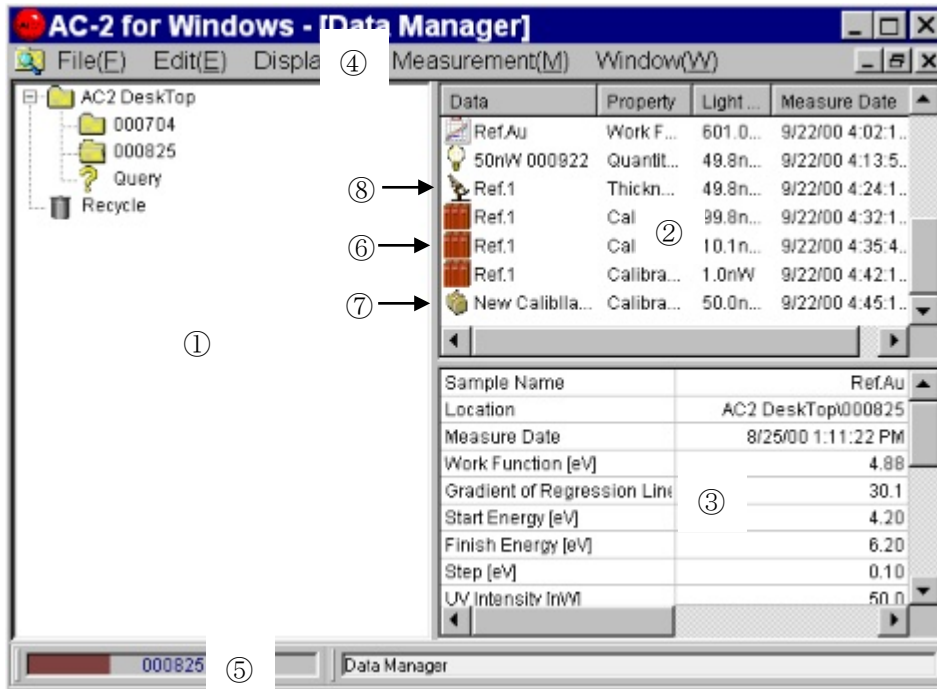
## 9-9. Finishing the Thickness·Counting Rate Form

While the **Thickness·Counting Rate Form** is active, finish the **Thickness·Counting Rate Form** by the **File (F) – Close (X)**.

# 10. Displaying the Data

**Data Manager Form** displays the Data File you want to open. Click the button "Data Manager" of **Task Bar** to display the **Data Manager Form**. Next, activate the **Display(D)-Refresh Data(D)**.

## 10-1. Explanation of Data Manager Form



### ① Tree

It displays the Folder like a tree.

### ② Data Manager

It displays the Data File or folder.

### ③ List Table

It displays the explanation of the Data File.

### ④ Menu Bar

Printing, Deleting the Data File, Creating the Folder, Renaming

### ⑤ Task Bar

It displays the folder and Data file currently chosen and changes the form.

### ⑥ Cal. Data File

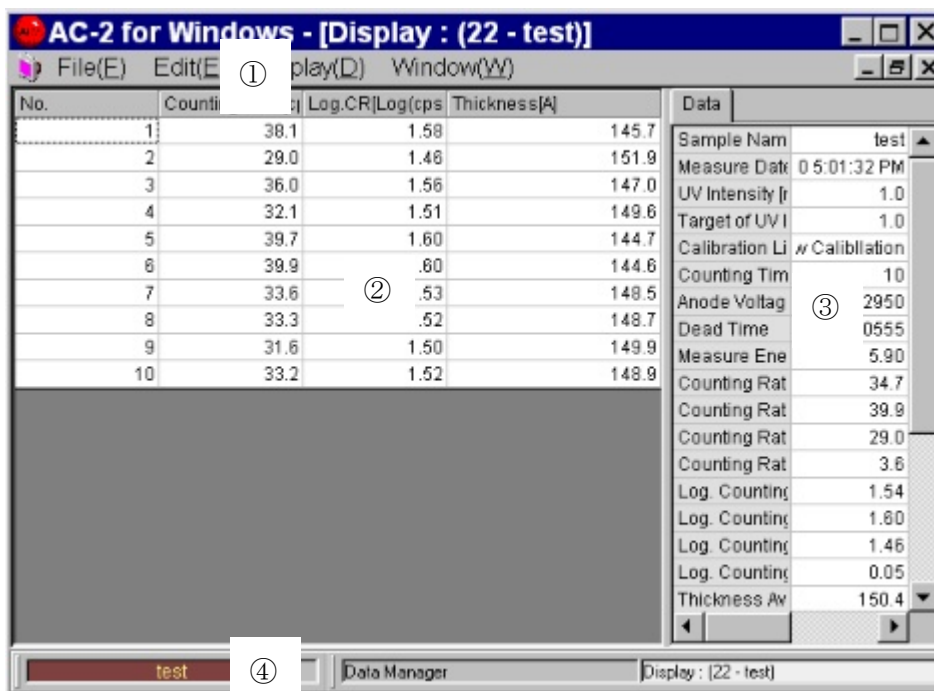
### ⑦ Cal. Line Data File

### ⑧ Thickness·Counting Rate Data File

## 10-2. Displaying the Data

- ① Open the Data File which you want to display on the **Tree**. e.g.) TEST. And, choose a data file by the **Data Manager**. e.g.) TEST1, TEST2, TEST3, etc. Execute the **File(F) –Open(O)**, and open the file.
- ② Open the **Display Form**.
- ③ Data can be copied by activating the **Edit(E)–Copy(C)**. The data can be used in another application of WINDOWS.
- ④ When **File(F) –Close(X)** is executed, **Display Form** is closed. The Data is renewed when the **Display Form** closes.

## 10-3. thickness



### ① Menu Bar

It copies the Data File.

### ② Data Table

It displays the measurement data as a table.

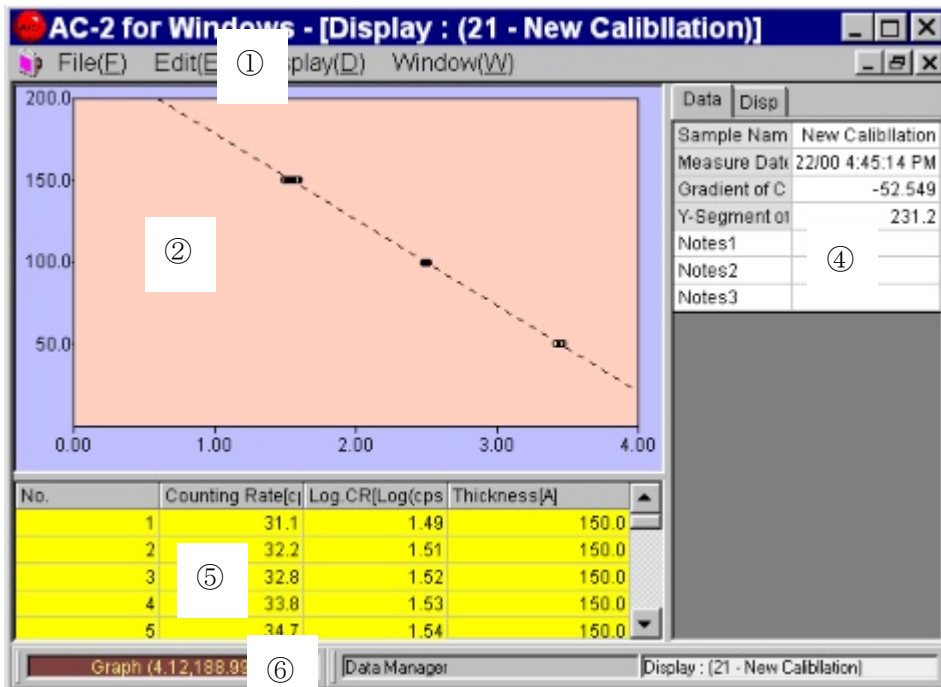
### ③ Control List

Conditions to draw Graph can be entered.

### ④ Task Bar

It displays the coordinates of the mouse pointer on the Graph Box, and changes the form.

## 10-4. Cal. Line Data



### ① Menu Bar

It makes a copy of the Data File.

### ② Graph Box

It displays the Cal. Data File as a Graph. The vertical axis of the Graph indicates "Thickness", and horizontal axis indicates "LogCR of the counting rate".

### ③ pop up menu

It is used to draw the Calibration Line. When the mouse pointer is on the Graph, it appears by right-clicking.

### ④ Control List

Conditions to draw the Graph can be entered.

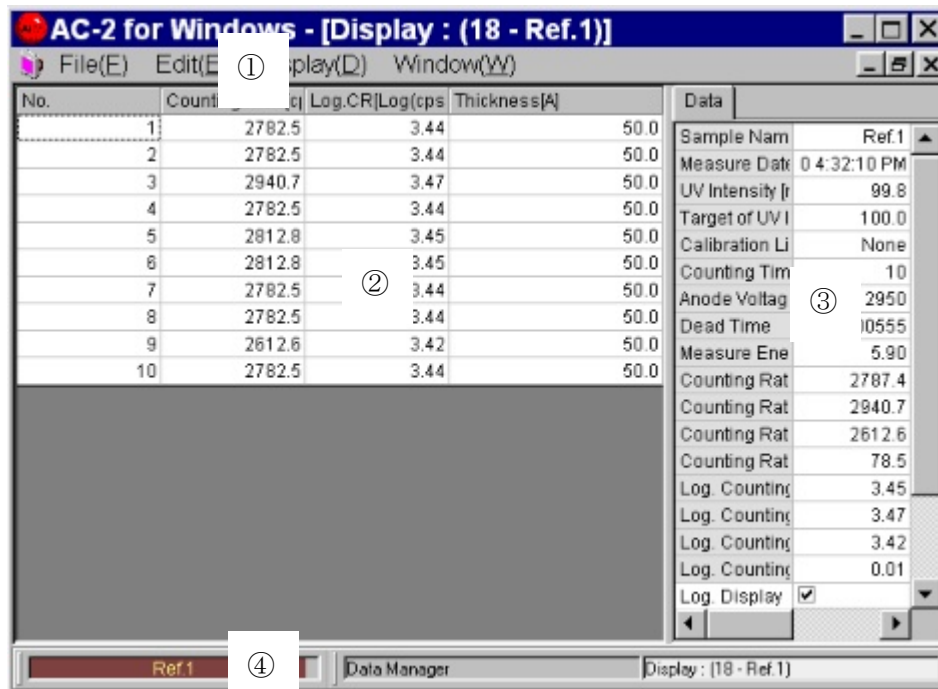
### ⑤ Data Table

It displays the measurement data as a table.

### ⑥ Task Bar

It displays the coordinates of the mouse pointer on the Graph Box, and changes the form.

## 10-5. Cal. Data File



### ① Menu Bar

It makes the copy of Data File.

### ② Data Table

It displays the measurement data as a table.

### ③ Control List

Conditions to draw the Graph can be entered.

### ④ Task Bar

It displays the coordinates of the mouse pointer on the Graph Box, and changes the form.

## 1 1. Printing

- ① Choose the Data File which you want to print by the **Data Manager**. e. g.) TEST. Perform it by managing the **File(F) –Print(P)**.
- ② Then, the **Print Setting Box** displays. After setting the printing pages, click **OK**.
- ③ **Print Preview Form** displays.

No.	Counting Rate(cps)	Log CR[Log(cps)]	Thickness[A]
1	38.1	1.58	145.7
2	29.0	1.46	151.9
3	36.0	1.56	147.0
4	32.1	1.51	149.5

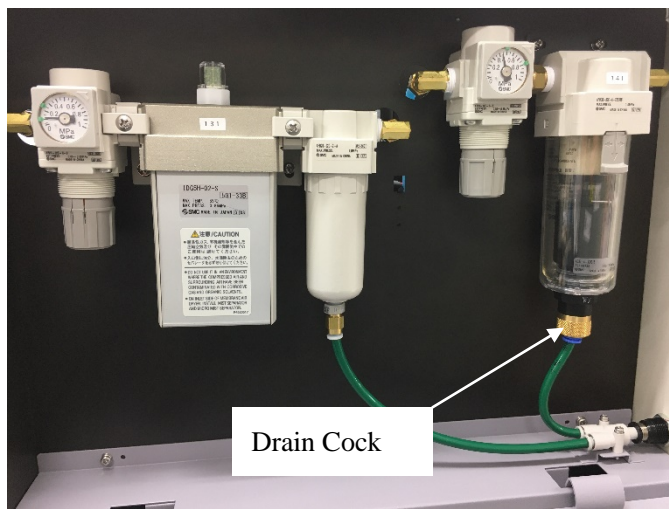
- ④ After confirming the Graph to display, activate the **Print(P) –Print(G)**.

### Caution

- If you try to print the data directly from the data form, the most recent change might not be recorded.
- The data is printed by the printer which is designated by the OS as the usual printer.

## 1 2. Ending

- ① Repeat the **File(F) –Close(X)**, close all the small forms such as measurement, Data Manager, etc.
- ② Close the main information by the **File(F) –Close(X)**.
- ③ Turn off the power sw. on the front pane of the LC1. And, turn the breaker off.
- ④ If the compressed air is supplied by a pump, turn the power off. If it's supplied by the tubing from the factory, shut the valve off.
- ⑤ If the water is in the MIST SEPARATOR, turn the DRAIN COCK (valve) to the right and release the water. After releasing, shut the valve off.
- ⑥ Finish the Windows and turn off the personal computer, display and printer.





—Consumable parts replacement method—

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## 1. General

This document describes the installation of AC-2 main unit and the maintenance / replacement procedures for consumables (the detector, lamp, and optical fiber and dry air generator).

## 2. Warning

### WARNING

Do not open the main unit cover while the unit is energized.

- High-voltage parts exist within the main unit; an electric shock may be generated.
- Never look at the ultraviolet lamp while it is lighting up with naked eyes because ultraviolet is being emitted from the lamp. Pain in the eyes and vision disorder will be caused.
- Never apply ultraviolet directly on your skin. Skin inflammations will be caused.
- Never touch the ultraviolet lamp while it is lighting up or immediately after the lamp is turned off because it is hot.

## 3. Caution

This manual is described at following precondition.

- 1) AC-2 and Personal computer are installed in the correct way.
- 2) Windows software is installed correctly.
- 3) The operator understands the operation of Windows.

### Caution

- Before doing the maintenance work, turn off the power and wait for 1 hour at least. Because, even turning off the power, lamp and other parts may be still hot, and it may injure the hands.
- Before doing the maintenance work, close the valve of compressed air to the dry air generator. And, open the drain cock to release the pressure.
- During the maintenance work, take the necessary protection tools such as eyes glass, gloves long sleeve ware.
- Take care the direction of polarity of lamp when installing.
- Do not give any strong impact on the lamp. It may be damaged and burst.
- Do not touch the lamp with hands. It may lose the life of the lamp.
- Do not touch the edge of optical filter.
- Please replace the MAINS supply cord if it is inadequate RATED cord.

## 4. How to use this manual

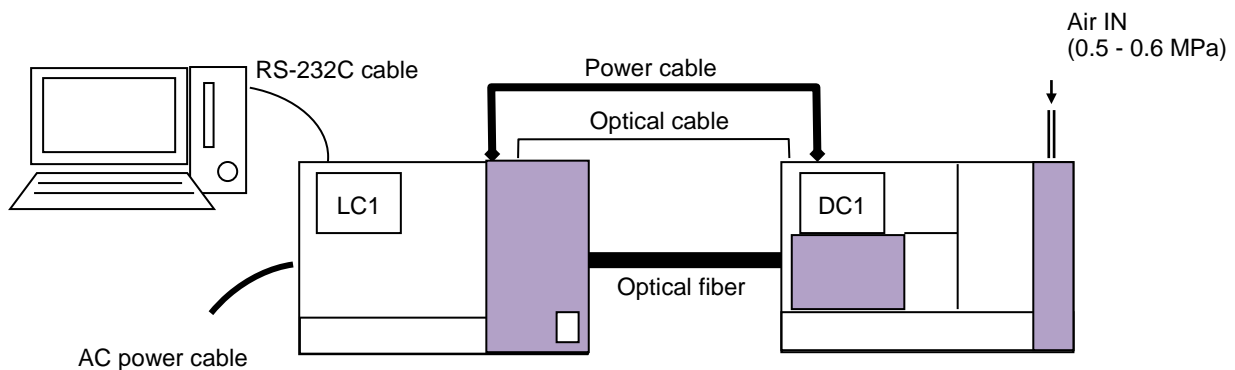
Read this manual carefully to perform the maintenance or replacement of the spare parts (detector, lamp, optical filter and dry air generator) on AC-2. The replacement frequency of the detector is depending upon the frequency of use, but our recommendation is 1 year.

The detector part replaced can be sent to Riken Keiki for the overhaul.

## 5. Cable connection

Connect the cables in the order below.

- (1) Connect LC1 and DC1 with the supplied power cable.
- (2) Connect LC1 and DC1 with the supplied optical cable.
- (3) Connect LC and PC with the supplied RS-232C cable.
- (4) Connect the supplied power cable to LC1.



## 6. How to replace the detector

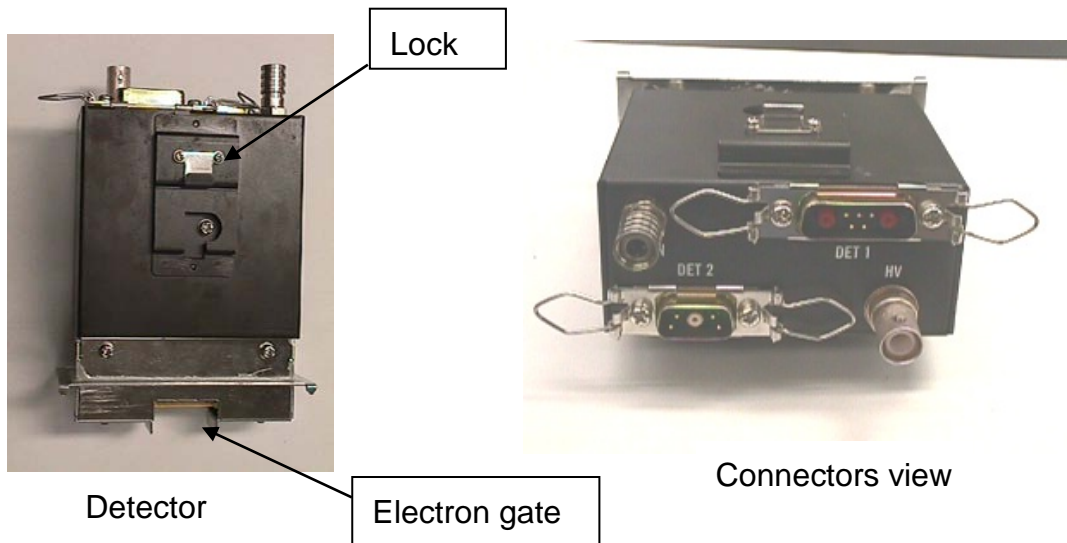
### 6-1 Replacement frequency

When the anode of the open counter which is the detector of AC-2 becomes dirty, it makes the serious problem on the measurement.

So, if the condition, example, the PC shows [The trouble happens on the detector], low detection efficiency, large noise or fluctuation of the measurement value, are found, replace the detector. The replacement frequency is depending upon the frequency of use, but the standard life time of the detector is 1 year.

The detector exchanged can be restored by performing overhaul, so if necessary, ask Riken Keiki for overhaul.

## 6-2 Appearance and caution



### ⚠ Caution

- The detector is supplied only from Riken Keiki
- Before doing the maintenance work, turn off the power switch at the rear side of DC1 unit. If not, it may receive electrical shock.
- Use protection tools like the long sleeve cloth and gloves.
- Do not touch the electron gate.

## 6-3 How to replace the detector

### 6-3-1 Take off the existing detector.

- 1) Prepare the cover of detector, detector bag and detector case.



**Detector Cover**



**Detector Bag**



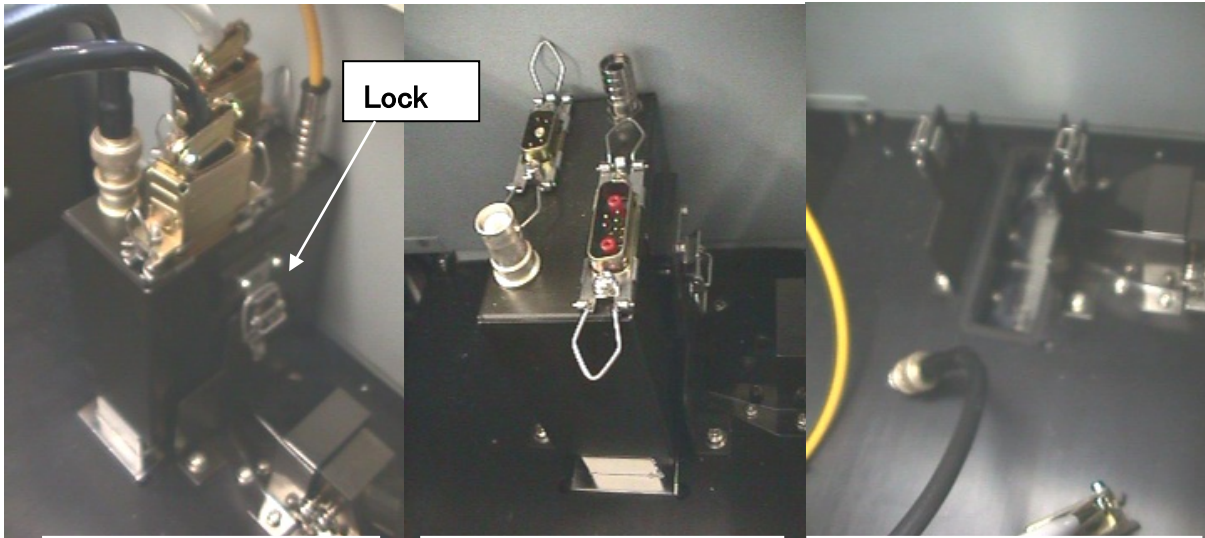
**Detector Case**



- 2) Open the detector maintenance door of AC-2 DC1 unit.

- 3) Take off the cables.

- 4) Release the rock.
- 5) Pull up the detector part and remove it.

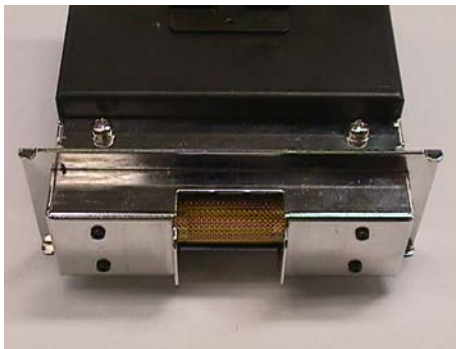


**The detector installed to AC-2DC1 Part.**

**All cables were removed from the detector.**

**The detector was removed from AC-2DC1 Part.**

- 6) Put the detector cover to the detector removed.



**The Detector without the cover**



**The Detector with the cover**

- 7) Put the detector in to the detector bag, and keep it in the detector case.

#### 6-3-2 Installation of new detector

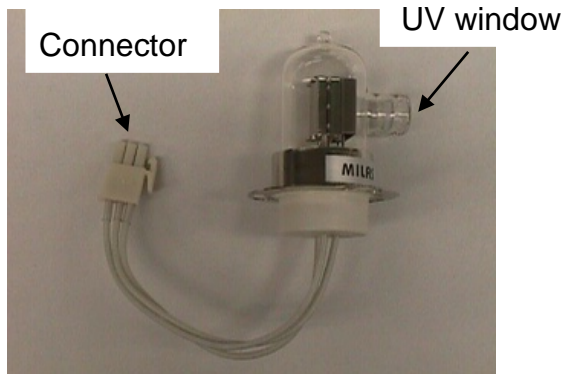
- 1) Take the new detector from the detector bag and case.  
(Keep the detector bag and case for next use)
- 2) Remove the detector cover.
- 3) Install the detector on AC-2DC1 unit.
- 4) Rock the detector unit.
- 5) Apply the cables.

## 7. How to replace the lamp

### 7-1 Replacement frequency

If the lamp is out of order or unstable, replace it. The standard life time for the lamp is 1500 hours.

### 7-2 Appearance



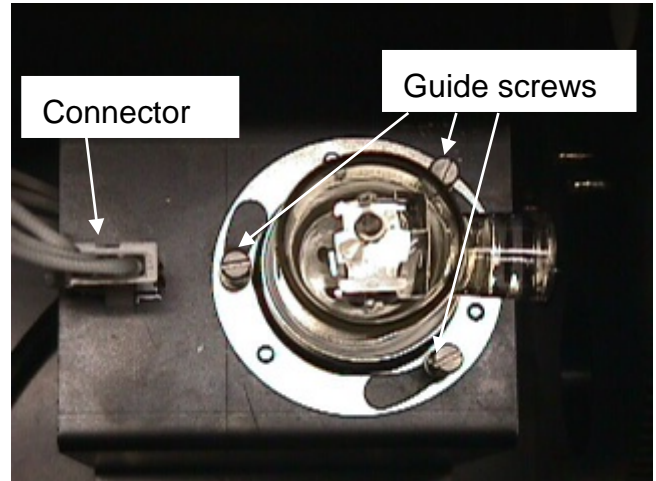
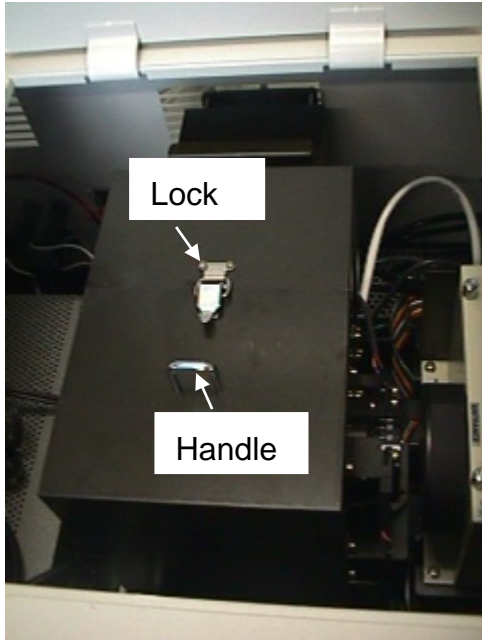
D<sub>2</sub> Lamp

### Caution

- Before doing the maintenance work, turn off the power and wait for 1 hour at least. Because, even turning off the power, lamp and other parts may be still hot, and it may injure the hands.
- Take care the installation detection of lamp and polarity.
- Do not give any high impact to the lamp. It may be damaged or burst.
- Use the eyes glass, long sleeve cloth glove for lamp replacement.
- Do not touch the lamp by hands, the lamp may be damaged.
- When turn on the lamp, install the lamp cover and close the lamp maintenance door absolutely.
- When open the lamp maintenance door for the confirmation at powered condition, use ultraviolet rays protection tools, long sleeve cloth gloves not to get the ultraviolet rays.

### 7-3 Replacement of D2 lamp

- 1) Open the lamp maintenance door.
- 2) Release the lamp house lock, and remove it by pulling up the cover using handle.



- 3) Take off the connector.
- 4) Loosen the screws (3 each) at 5 turns by using the screwdriver.
- 5) Remove existing D2 lamp by rotating it.
- 6) Prepare the new lamp.
- 7) Install the new lamp, and tighten the guide screws.
- 8) Install the connector.

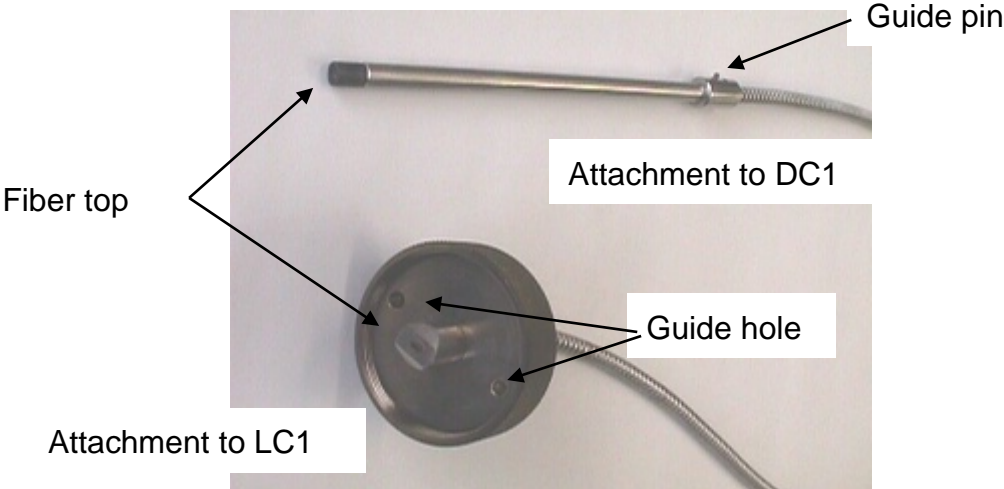


# 8. How to replacement optical fiber

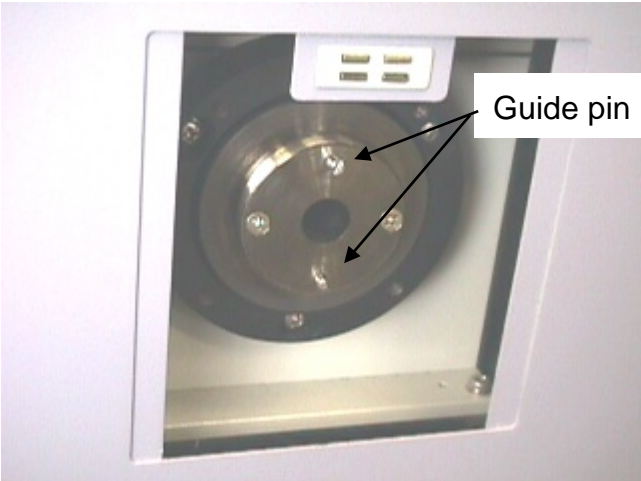
## 8-1 Replacement frequency

When enough UV Intensity is not obtained, replace it. The replacement frequency is depending on the frequency of use and level of UV Intensity used, the standard is 1 year.

## 8-2 Appearance



Optical Fiber



LC1 optical fiber connector



DC1 optical fiber connector

**⚠ Caution**

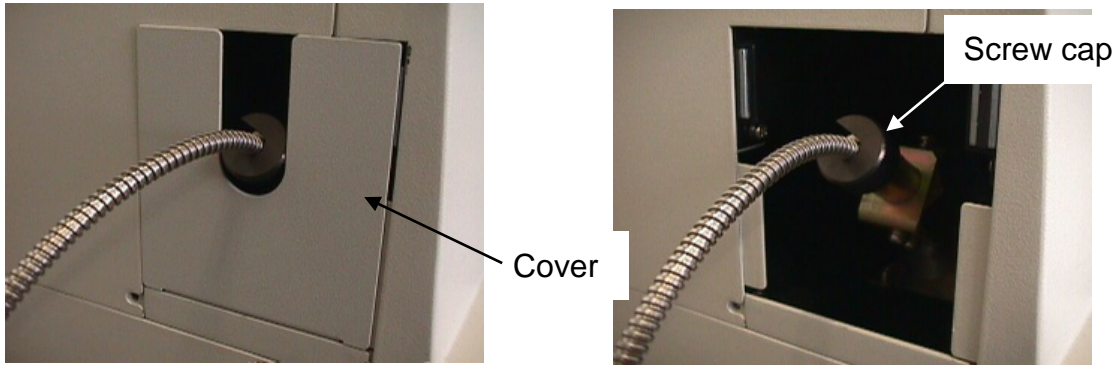
- Before the replacement work, turn off the power switch at the rear side of DC1 unit.
- When taking off the parts, use protection tools like long sleeve cloth, gloves.
- Do not touch of edge of optical fiber.



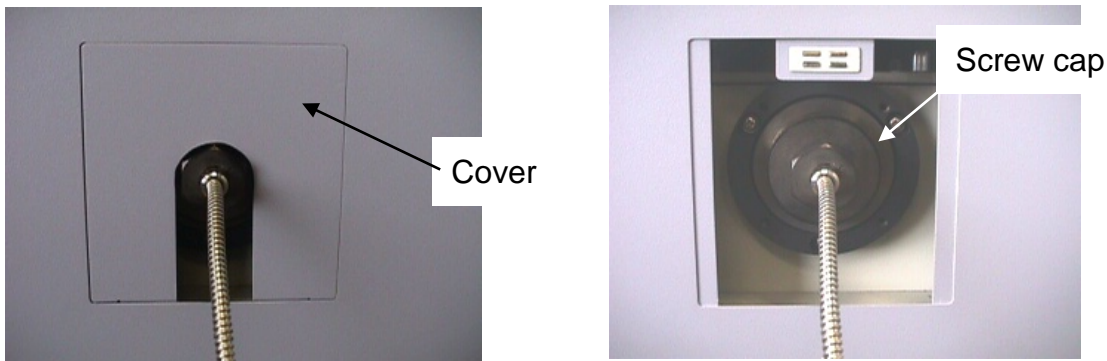
### 8-3 Replacement procedure

#### 8-3-1 Remove existing optical fiber.

- 1) Keep the distance 25cm between AC-2DC1 unit and AC-2LC1 unit.
- 2) Remove the cover of optical fiber connector of AC-2DC1 unit.  
Remove the screw cap, and pull out the optical fiber.



- 3) Remove the cover of Optical fiber connector of AC-2LC1 unit.  
Remove the screw cap, and pull out the optical fiber.



#### 8-3-2 Installation of new optical fiber

- 1) Remove the cover of optical fiber at AC-2DC1 unit.
- 2) Insert the optical fiber into the Optical fiber connector of AC-2DC1 unit.  
Install the screw cap. At this time, guide pin must fit to the groove of guide.
- 3) Remove the cover of optical fiber at AC-2LC1 unit.
- 4) Insert the optical fiber into Optical fiber connector of AC-2LC1 unit, and fix it by fitting guide pin and guide groove with screw cap.

## 9. Maintenance of air supply piping

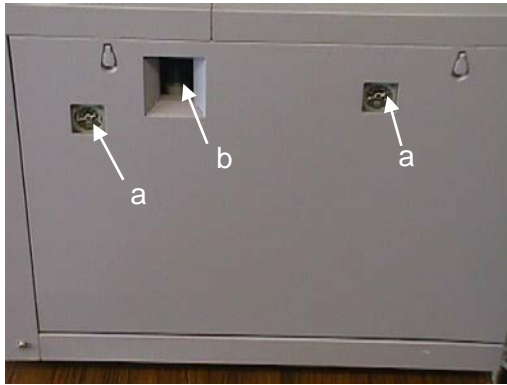
### 9-1 Maintenance frequency

The Mist separator and Micro mist separator must be maintained every 2 year or the pressure drops by 0.1 MPa. In case of Dew point checker, it must be maintained every 2 year or if the color changes from green to other colors, it must be replaced.

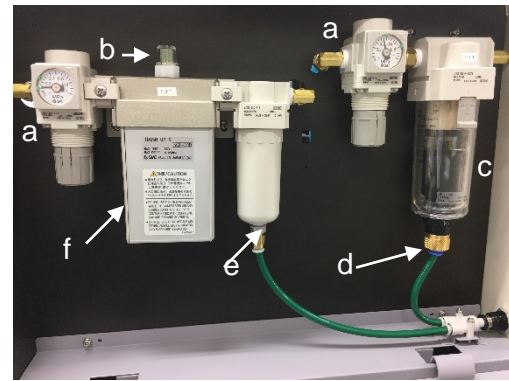
The replacement frequency of membrane filter is every 4 years or if it loses the capacity of dehumidifier or the color of the Dew point checker turns to yellow, replace it.

### 9-2 Instruction of piping

It locates the right side of AC-2DC1, and it dry the compressed air supplied from the rear of the unit, and finally it supplies the dry air to the detector.



**Right side view of AC-2DC1**



**Open the side door**

a: Presser gauge

b: Dew point checker

c: Mist separator

d: Drain Cock

e: Micro Mist separator

f: Membrane Air Dryer

### Caution

- Before the maintenance work, turn off the power switch of rear side of DC1 unit absolutely.
- Close the compressed air valve to the dry air generator; open the drain cock to release the pressure, before the maintenance work.
- Use the protective tools like long sleeve cloth and gloves.

### 9-3 Maintenance of piping

See individual instruction manual related.

- 1) Mist separator: AFM300 series (SMC Co.,Ltd.)
- 2) Micro mist separator: AFD2000 series (SMC Co.,Ltd.)
- 3) Membrane air dryer: IDG5H (SMC Co.,Ltd.)
- 4) Pressure meter : AR2001 series (SMC Co.,Ltd.)

## 10. Safety checks after maintenance

### 10-1. Detector

No.	Item	Check detail	Check
1	Detector installation	The detector is installed properly.	
2		It is locked.	
3	Cable connection	The cables (three cables) are not disconnected.	
4		They are locked.	
5	Tubing	The tubes are not disconnected.	
6	AC-2 DC1 unit detector maintenance door	The screw for the AC-2 DC1 unit detector maintenance door is tight.	

### 10-2. Lamp

No	Item	Check detail	Check
1	Lamp installation	The lamp is installed properly.	
2		The screw is fixed.	
3	Connector connection	The connector is not disconnected.	
4	Lamp cover	The lamp cover is installed.	
5	AC-2 LC1 unit lamp maintenance door	The screw for the AC-2 LC1 unit lamp maintenance door is tight.	

### 10-3. Optical fiber

No	Item	Check detail	Check
1	Optical fiber installation	The optical fiber is installed properly at the LC side and DC side.	
2		It is not bent.	
3		It is through the guide rail.	
4		The cap screw is fixed.	
5	Cover	The cover is installed.	



# EU-Declaration of Conformity

Document No.: 320CE21033



We, RIKEN KEIKI Co., Ltd. 2-7-6, Azusawa, Itabashi-ku, Tokyo, 174-8744 Japan declare under our sole responsibility that the following product conforms to all the relevant provisions.

Product Name: RIKEN PHOTOELECTRON SPECTROMETER  
Model: AC-2

Council Directives		Applicable Standards
2014/35/EU	LVD Directive	EN 61010-1:2010
2014/30/EU	EMC Directive	EN 61326-1:2013
2011/65/EU	RoHS Directive	EN IEC 63000:2018

Place: Tokyo, Japan

Date: Sep. 22, 2021

Takakura Toshiyuki  
General manager  
Quality Control Center