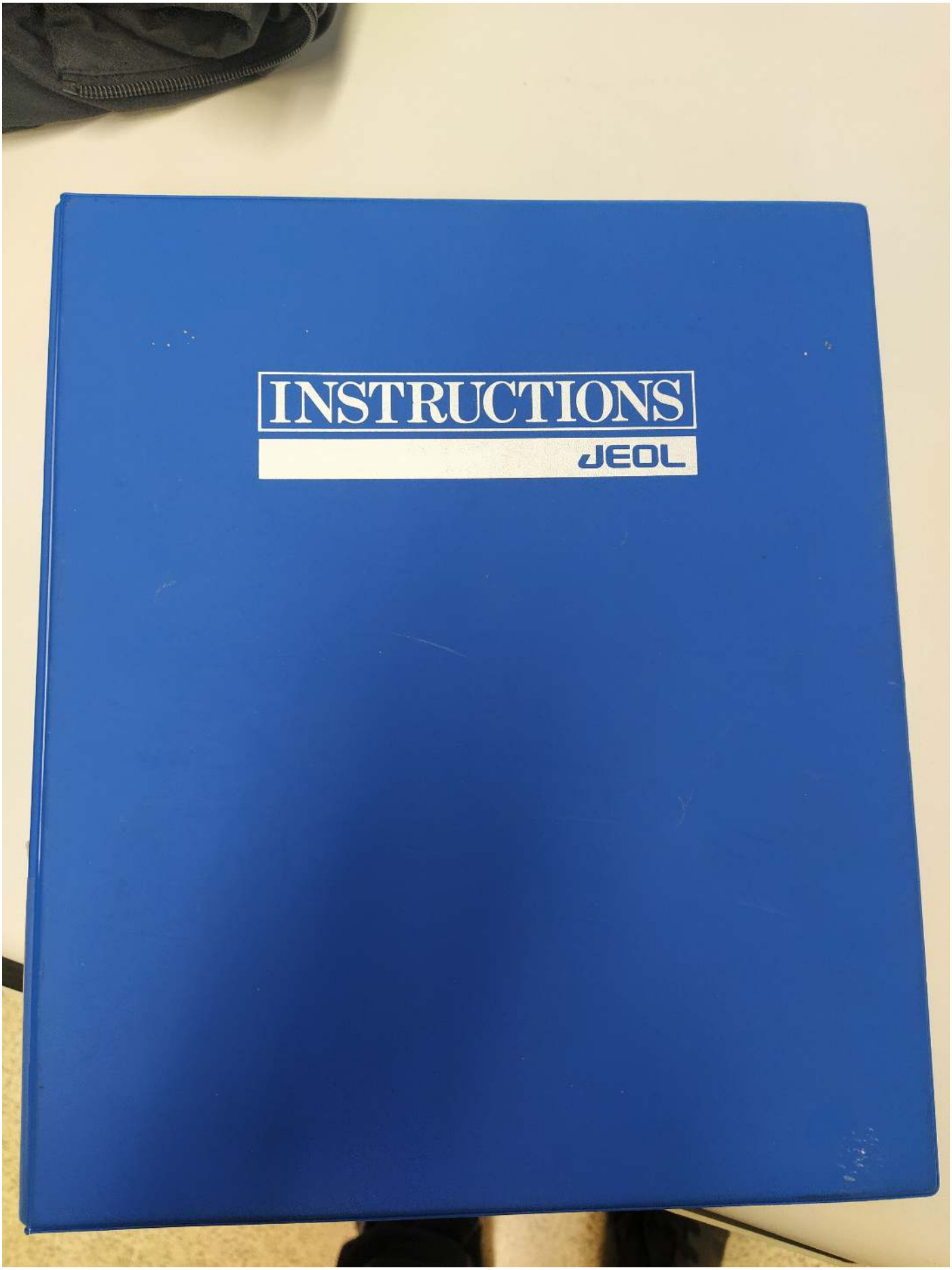
INSTRUCTIONS
JEOL

Note

This instrument has been tested and found to comply with the limits for CISPR 11 Class A. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment .

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the inter − ference at his own expense.

INSTRUCTIONS

JSM-5600

Scanning Electron Microscope

No. ISM5600-4

JEOL

Serving Advanced Technology

Note – AC outlets (Service receptacles)

- No one can use AC outlets but for service engineers.
- Never use AC outlets for power inlets of products other than those manufactured by JEOL Ltd.
- When using the AC outlets for connecting the attachments (including personal computer, etc.), use [AC100V OUTLET ADAPTER with cable (self – subsistence on the spot)] .
  If necessary installing or removing the attachments by operator, be sure to install or remove the attachments with a part of [AC100V OUTLET ADAPTER with cable].

Notice

- The information in this manual, which is based on specifications believed correct at the time of publications, is subject to change without notice due to improvements made in the instrument.
- In order to assist us in preparing future documentation, please advise your nearest JEOL service office if you find any errors in this manual.
- This manual has been prepared using a desktop publishing system in which photographs and drawings are read by the use of an image scanner.
  Therefore, details of some of the photos may not be as clear as those of the originals.
- In no event will JEOL Ltd. be liable for, indirect, incidental or consequential damages resulting from the use of software of this instrument must not be modified without leave.
  JEOL Ltd. assumes no responsibility for effect of such modifications.
- This instrument must not be modified, and products other than those manufactured by JEOL Ltd. must not be attached to this instrument, without prior written permission.
  If any such modification or attachment is made, all the stipulated warranties and services contacted by JEOL Ltd. or its affiliated company will be void.
- This manual is copyrighted. All rights are reserved. This document may not, in whole or part, be copied, photocopied, reproduced, translated or reduced to any electronic medium or machine readable from without prior consent, in writing, from JEOL Ltd.
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MANUFACTURE JEOL technics Ltd.
6-38 Musashino 2-Chome, Akishima-Shi, Tokyo, 196-0021 Japan

For servicing or inquires, contact your local service office at this manual.

Safety precautions

To ensure that you use this instrument correctly, read carefully following safety precautions prior to starting operation or maintenance.
The descriptions below contain important information related to safety.
Contact your local service center whenever you are unclear about an operation or maintenance.
Please keep the operation manual on hand so that you can consult it whenever necessary.
The safety definitions used in our company's operation manuals and their meanings are as follows:

⚠ WARNING:	A potentially hazardous situation which, if not avoided, may result in death or serious injury.
⚠ CAUTION:	A potentially hazardous situation which, if not avoided, may result in minor injury or material damage.

The following marks represent potential hazards. Please follow the instructions and never touch the parts marked with these signs.

We request that you use the instrument in a proper manner and within the scope of the purposes and usages described in the brochures and operation manuals. Never make modifications such as removing protective parts, replacing component parts and unlocking safety measures.
Safety precautions for optional attachments that are built into or attached to the instrument are described in the individual operation manuals.

⚠ WARNING

General warnings

- Do not unlock or remove any covered parts, modify or remove component parts, or dismantle these parts in any way other than their intended use, due to the risk of a thermal, electrical or radiation hazard occurring.

- Never remove the grounding wire or connect it to any other location than that specified, due to the risk of electric shock.
- If it is necessary to move the instrument, various hazards are expected. Confirm the specifications and installation requirements for the instrument, check the state of the new installation site and consult your local service center.
- When performing maintenance, checks, or routine operations, never stand on the operation console table on instrument frame.

Warnings for replacing the oil diffusion pump

Be sure not to touch the boiler or cover of the oil diffusion pump immediately after its heater has broken, because these parts are very hot and you may receive a burn. To cool the heated parts to room temperature, maintain the flow of cooling water for at least 30 minutes.

Warnings for replacing the filament

The wehnelt is very hot immediately after the filament burnt out. Do not touch the wehnelt. Allow it to cool down sufficiently(about one hour), then replace the filament with the removal tool.

⚠ CAUTIONS

General cautions

- If an abnormality occurs in the instrument, stop it immediately. To stop the instrument follow the instructions, then contact your local service center.
- If a power failure occurs, the instrument will automatically stop. When the power resumes, restart the instrument.
- If a water failure occurs, the main power is shut down auto-matically. When the water supply is restored, restart the instrument.
- When installing the specimen holder or inserting the objective lens aperture, take care not to get your fingers caught in the space between the specimen chamber and the specimen chamber door.
- Since the microscope column is placed on the frame via an anti-vibration mount, the microscope column will sway a little when you operate the knobs. Take care not to get your fingers caught in any clearance resulting from this sway.
- An instrument that has been installed properly will usually not vibrate or emit any unusual noise. Should this occur, stop the instrument immediately and contact your local service center.

Cautions concerning the vacuum pump oil

When the vacuum pump oil is replaced or vacuum pump is repaired., process the oil in the proper way.

Cautions concerning the oil rotary pump

- Be sure not to disconnect the rubber hose from the oil rotary pump during operation. If you do so, the oil in the oil diffusion pump will flow back to the microscope column, causing serious damage to the instrument.
- Do not let the oil level of the oil rotary pump fall below the lower limit. If the pump operates with only a small quantity of oil, trouble may occur.

Cautions when disassembling and cleaning the microscope column

- When it becomes necessary to perform maintenance that requires disassembling and cleaning of the microscope column or replacement of parts other than those specified in Maintenance, contact your local service center.
- When you clean microscope column components, use as a cleaning agent a nonflammable highly volatile, highly efficient solvent that is free from impurities and is not harmful to the human body. Be sure to use the solvent in a location free from combustible material and sources of ignition and with open windows or proper ventilation, regardless of the quantity used.
- When you use a cleaning agent, be sure to wear protective gloves that are resistant to the solvent.

Cautions concerning optional attachments

- Liquid nitrogen trap/Liquid nitrogen baffle

  When pouring liquid nitrogen into the tank, take care that your hands and feet are not splashed with liquid nitrogen.
- Cryo unit
  1) When pouring liquid nitrogen into the tank, take care that your hands and feet are not splashed with liquid nitrogen.
  2) Since the specimen holder in use is kept at an ultra low temperature, take care not to touch it with bare hands.
  3) When removing the cryo unit, take care because it is heavy.
- Specimen cooling unit

  Since the specimen holder in use is kept at a low temperature, take care not to touch it with bare hands. When removing the specimen holder, wait until it reaches room temperature.

- Specimen heating stage
  1) Since the specimen holder in use is kept at the high temperature, take care not to touch it with bare hands. When removing the specimen heating holder, wait until it's temperature reaches to room temperature.
  2) When removing the specimen heating stage, take care that it is heavy.
- Specimen tensile stage

  When removing the specimen tensile stage, take care that it is heavy.
- Energy dispersive X-ray analyzer
  1) Do not install or remove the energy dispersive X-ray analyzer on or from the instrument by yourself. If such a necessity arises, contact your local service center.
  2) Use a stable and safe stool when replenishing liquid nitrogen into the tank. Take care that your hands and feet are not splashed with liquid nitrogen during replenishment.
  3) Take care not to touch the analyzer drive motor shaft during measurement.
  4) The analyzer window uses a beryllium thin film for light element detection. Beryllium is harmful to the human body, so take particular care when handling the analyzer.
- Standard specimen for X-ray analysis

  When beryllium is embedded in the standard specimen, store and manage the specimen very carefully. When disposing of beryllium, use an appropriate method.
- Ion pump

  A person who wears a medical appliance such as a pacemaker may be affected by magnetic fields and must therefore keep well away from the SEM.
- Film holder

  When handling developing solution for instant film, read carefully the directions given in the of maker's instruction manual.

Contents

1. Outline, Specifications and Installation

Specifications guaranteed when no modification or addition is made, and subject to change without notice.

1.1 Outline

This scanning electron microscope allows you to observe full coverage of 125mm diameter specimen with X, Y and R (rotation) movements of the specimen stage. All operations can be performed by using a mouse of a personal computer. Practical auto-functions, such as auto-gun-alignment, auto-focusing, auto-astigmatism-correction and auto-contrast/brightness-adjustment, are completely provided. The optimum conditions for image observation can easily be set with the recipe function. Moreover, the simplified DTP (desk top publishing) function helps you to make a report. Thus, a full use of the personal computer makes all SEM works, from instrument evacuation to image observation and report making, easy and efficient.
Since an energy dispersive spectrometer and one channel of wavelength dispersive spectrometer can be attached simultaneously to the microscope, the application of this instrument can be expanded from high resolution morphological observation to elemental analysis of a specimen.

1.2 Specifications

Performance

- Resolution (SEI): 3.5nm guaranteed (Acc. volt 30kV, WD6mm)
- Magnification: × 18 (WD48mm) to 300, 000 (136 steps)
  Automatically corrected for Acc. volt and/or WD changes.
  Instantaneously changeable to an optionally preset magnification from any current magnifiation.
- Image mode: SEI (Secondary Electron Image)
  BEI (detected by the Secondary electron detector)
- Probe current: 10^{-12} to 10^{-6}A

Electron optical system (EOS)

- Electron gun

Accv. volt:	0.5 to 30kV (53 steps) (0.5 to 3kV: variable in 100V steps, 3 to 30kV: variable in 1kV steps)
Filament:	Precentered W hairpin filament LaB_6 single crystal filament is optionally available.
Bias voltage:	Self-bias
Alignment:	Electromagnetic 2-stage deflection type
Auto gun alignment:	Automatic gun control provided (auto bias voltage setting, auto filament heating current setting and auto gun alignment)
Beam blanking:	Provided

- Lens system

Condenser lens (CL):	Electromagnetic 2-stage zoom condenser lens system
Objective lens (OL):	Conical objective lens
Lens clear function:	Provided for CL, and OL (for hysteresis elimination)
Focusing:	AFD (auto focusing) provided Manual focusing possible
Focus link:	Provided for Acc. volt and/or WD changes.
Dynamic focus:	Provided for specimen tilt Linked to Acc. volt, and magnification
Auto magnification correction:	Provided for Acc. volt and/or WD changes.
O.L. aperture:	3-step variable with click stop mechanism Fine position adjustment in X and Y directions
Wobbler:	Provided for O.L. aperture alignment Linked to magnification
Stigmator (astigmatism correction):	Electromagnetic 8-pole Precentered X-Y adjustment type

Stigma-memory:	Provided Linked to the Acc. volt, and magnification
Auto stigmator:	Provided Manual correction possible
Scan coil:	Electromagnetic 2-stage deflection type
Image fine shifter:	Approx. ±10 μm in X and Y directions (Acc. volt 30kV, WD 20mm)

Specimen stage

• Type:	Eucentric goniometer stage
• Specimen movements	
X movement:	80mm
Y movement:	40mm
Z movement:	43mm • WD5 to 48mm continuously variable • WD8 to 48mm when backscattered electron detector is installed • WD6 to 48mm when specimen holder for 32mm dia. or more is used.
Tilt:	-10 to +90° Tilting range is limited when the backscattered electron detector is installed.
Rotation:	360° endless
• Specimen holder:	10mm dia. x 10mm height 32mm dia. x 10mm height (with four 10mm dia. specimen mounting adapter)
• Max specimen size	
Loadable:	6-inch (152.4mm) dia.
Full overage:	125mm dia. (with rotation)
• Specimen exchange:	Stage draw-out type Specimen holder slide-in type

Electron Detector

- Secondary electron detector: Collector, scintillator, light guide and photomultiplier tube
- Backscattered electron detector: Scintillator, light guide and photomultiplier tube
  Semiconductor (P-N junction) detector is optionally available.

Display system

- Display tube
  Display tube: 17-inch SVGA monitor
- Scan system
  Scanning mode: Full frame scan
  1/2 reduced scan

Scanning speed:

	Horizontal (ms)	Vertical (s)	Pixel
SCAN1	0.256	0.064	320 × 240
SCAN2	0.256	0.128	640 × 480
SCAN3	20(16.67)	10(8.33)	640 × 480
SCAN4*	80(66.67)	80(66.67)	1280 × 960
	160(133.3)	160(133.3)	1280 × 960
PHOTO*	80(66.67)	80(66.67)	1280 × 960
	160(133.3)	160(133.3)	1280 × 960

50Hz area, ( )60Hz area

* Selectable from two

- Frame memory
  - Capacity: 1280 × 960 × 8 bits
  - Number of pixels: 640 × 480
    1280 × 960
- Image processing
  - Averaging: 1 to 255 frames
  - Look up table: γ correction, binary level coding, multi-level coding, histogram
  - Pseudo color image: 16 colors (from among 256 colors)
  - Multi-display: 2 or 4 images display in one frame
  - Digital zoom: ×2 or ×4 magnified image display of optionally designated area on image
- Text display
  - Display position: 36 columns ×24 lines in on an image
  - Text letter: Alphabet, numeric character, symbol
  - Background: Black or image selectable
  - Text enter device: Keyboard
- Data display
  - Display position: Horizontal at the bottom of the screen
- Contents: Acc. volt, magnification, micro marker, micron value, film number(4 digits), alphanumeric character (10 characters)
  - Display ON/OFF selectable for each item.
  - Ten alphanumeric characters can be changed to date, WD, spot size or image mode.
- Background: Can be switched between black and a current image.
- File saving
  - Format: BMP or TIFF
  - Media: Floppy disk for the personal computer
    A magneto-optical disk is optionally available.

Operation system

- Basic system
  - Computer: Personal computer or IBM PC/AT compatible computer
  - Memory capacity: RAM 32MB
  - Operation System(OS): Windows 95 (Windows is a trade mark of Microsoft Corp.)
- Operation
  - Operation method: Graphical user interface (GUI), mouse and keyboard
    Operation keyboard is optionally available.
- Recipe functions
  - Number of recipe: 100 recipe each for 20 different operators are registerable
  - Function: Saving and loading of the operation conditions for each operator and lens conditions, etc.
- Automatic function
  - Auto gun alignment: Provided (effective only in the High vacuum mode)
  - Auto focusing: Provided
    Combination with ACB possible, Inked to photo recording and accelerating voltage change.
  - Auto astigmatism correction: Provided
    Combination with ACB and auto focusing possible
  - Auto contrast/ brightness: Provided
    Linked to photo recording and accelerating voltage change

Vacuum system

• System control:	Fully automatic	
• Ultimate pressure:	10^{-4} Pa order	
• Evacuation time:	Approx. 2.5 min.	
• Oil rotary pump:	100 lit/min	× 1
• Oil diffusion pump:	4-inch 420 lit/s with water cooling baffle	× 1

Safety devices

Protection devices against vacuum, water, power, and leakage current failures are provided.

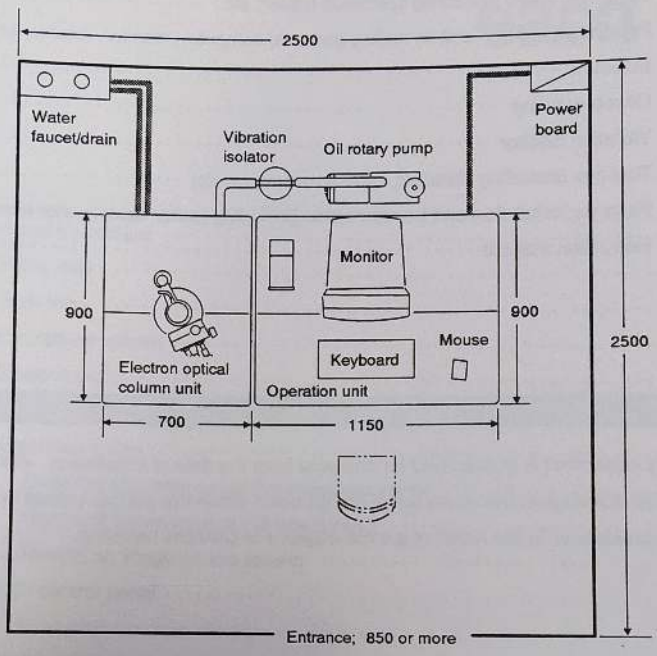
Others

• Ports for X-ray analyzing device		
EDS port:	Provided	× 1
WDS port	Provided	× 1
• TV signal out put		
TV signal:	Monochrome ITV (Industrial TV) signal Combined image signal, 1 Vp-p, Horizontal 15.75kHz, Vertical 60Hz	
Output terminal:	EIA BNC-R connector (75Ω)	× 1
• Service receptacle:	100V AC, 8A	× 1
	100V AC, 5A	× 1

1.3 Installation Requirements

- Power and grounding terminal
  - Power: Single phase 100V ±10%, 50 / 60Hz, 2.5kVA (Voltage drop should be within 3%)
  - Grounding terminal: One, 100Ω or less
- Cooling water
  - Pressure: 0.05 to 0.2 Mpa (gauge pressure)
  - Flow rate: 2 lit/min
  - Temperature: 15 to 25℃
  - Faucet: 14mm O.D. or ISO 7/1 Rc1/4 (JIS B0203 Rc1/4) × 1
  - Drain: More than 25mm I.D. or ISO 7/1 Rc1/4 (JIS B0203 Rc1/4) × 1
- Environment
  - Temperature: 15 to 25℃
  - Humidity: 60% or less
  - Stray AC magnetic field: 0.3 μT or less, AC(50 / 60Hz, sine wave, WD=15mm, Acc. volt=30kV)
  - Floor vibration: 2 μm(p − p) or less at sine wave of over 5Hz frequency
  - Floor space: 2500mm(W) × 2500mm(D) × 1800mm(H)
  - Door width: 850mm or more
- Dimensions and weight
  - Electron optical column unit: 700mm(W) × 900mm(D) × 1440mm(H) approx. 255kg (with standard configuration)
  - Operation unit: 1150mm(W) × 900mm(D) × 700mm(H) approx. 195kg (with standard configuration)
  - Oil rotary pump: 460mm(W) × 175mm(D) × 255mm(H) approx. 23kg
  - Vibration isolator: 270mm(W) × 200mm(D) × 200mm(H) approx. 10kg

Installation Layout Example



Unit: mm

- This above figure shows a typical installation layout for a JSM-5600 Scanning Electron Microscope. Be sure to maintain service areas at the left and right sides and the rear side of the microscope even if a small installation area is available.
- Install the microscope well apart from facilities producing vibrations or electromagnetic waves such as roads, busy passages, railroads, elevators, air conditioners and their air outlets, and power transmission lines.
- This microscope does not require any darkroom facilities such as blackout curtain.

1.4 Configuration

- Electron optical column unit ..... 1 set
- Operation unit ..... 1 set
- Specimen stage (including specimen holder, etc.) ..... 1 set
- Personal computer unit (including personal computer, monitor, mouse, keyboard, etc.) .. 1 set
- Software ..... 1 set
- Oil rotary pump ..... 1 set
- Vibration isolator ..... 1 set
- Tool box (including standard accessories and tools) ..... 1 set
- Parts for installation and transportation (including power cable, water hose, etc.) ..... 1 set
- Instruction manual ..... 1 set

1.5 Instrument Warranty

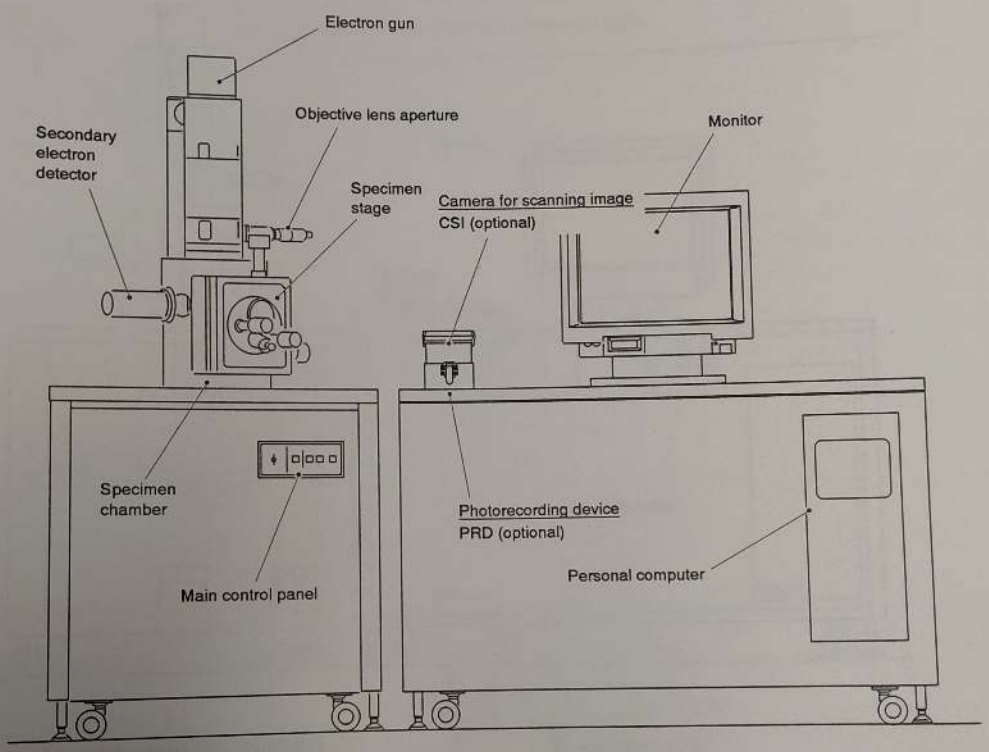
This instrument is guaranteed for one year from the date of installation. We undertake to repair it free of charge in the event that it breaks down within this period, except in cases where the breakdown is the result of a force majeure or careless handling.

2. Name and function of each part

2.1 Exterior of instrument

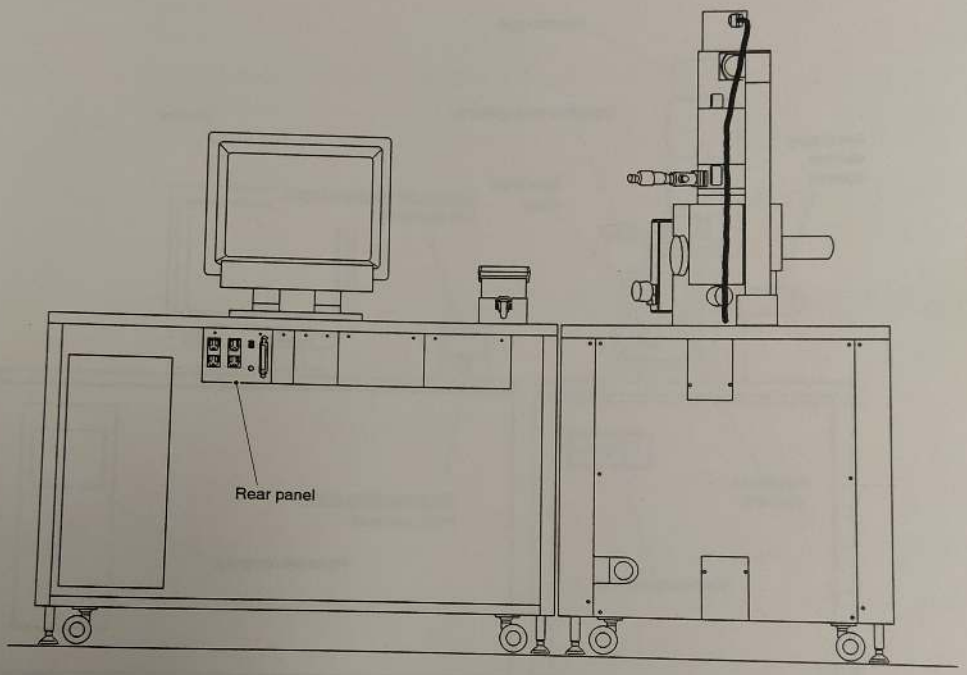
2.1.1 Front view

For details of the personal computer, refer to the maker's instruction manual.



【Electron optical column unit】 【Operation unit】

2.1.2 Rear view



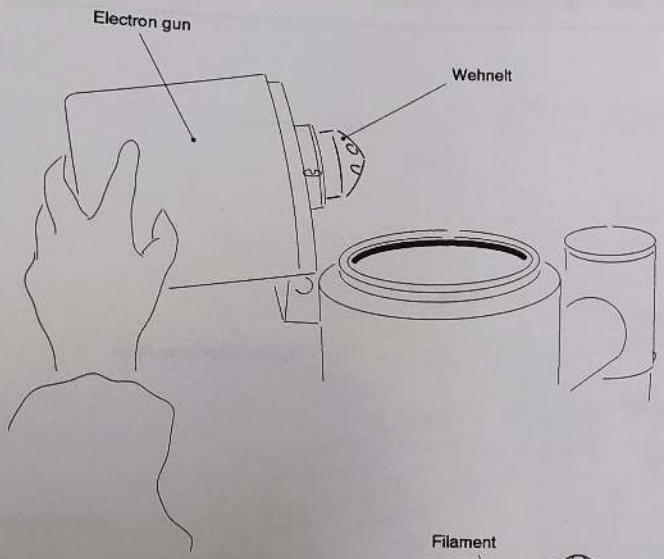
【Operationunit】 【Electron optical column unit】

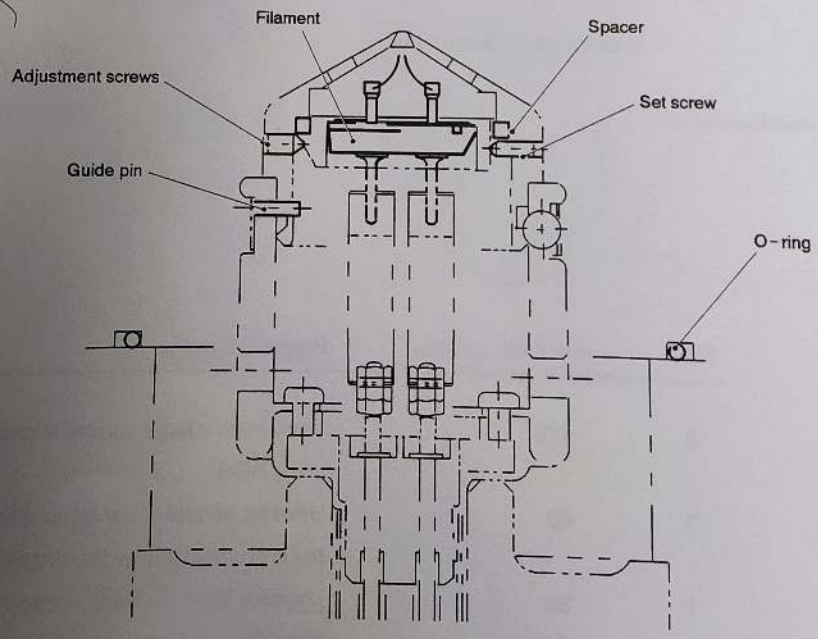
2.2 Electron optical column

2.2.1 Electron gun

Do not open the electron gun other than to perform maintenance (filament replacement, etc.).

> ⚠ WARNING Do not touch the Wehnelt immediately after the filament breaks because it is hot and you may receive a burn. Before removing the Wehnelt, wait for about one hour, then remove it using a dedicated tool.



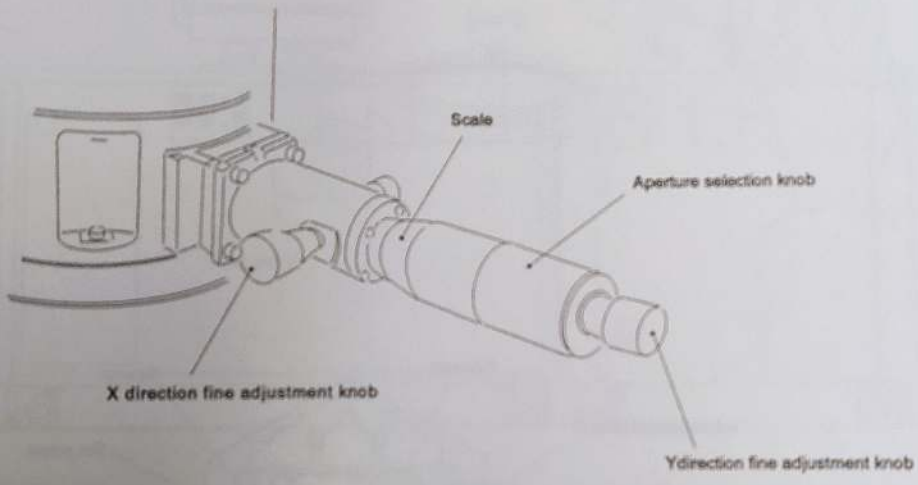


【Cross-section of the Wehnelt】

2.2.2 Objective lens aperture

- By rotating the "Aperture selection knob" clockwise through the [0] → [1] → [2] → [3] positions, you can select an aperture that corresponds to the scale.
- If you wish to switch the aperture in the sequence [3] → [2] → [1] → [0], pull the aperture selection knob forward, rotate it counterclockwise until it stops, then turn it one step at a time.
- X and Y direction fine adjustment knobs used for adjusting the objective lens aperture.

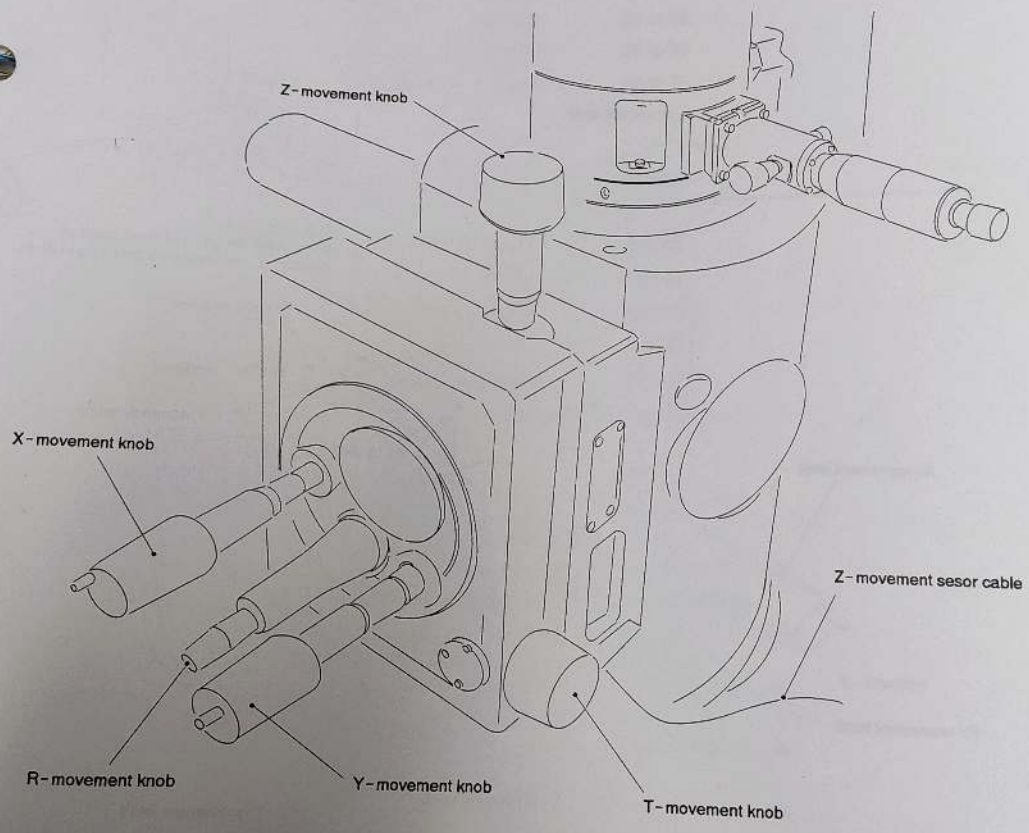
> ⚠ CAUTION When selecting the aperture of the objective lens aperture, be careful not to get your fingers caught in the grip.



Scale	Aperture(μm dia.)	Purpose of use
3	120	Used when a large current is necessary such as when using WDS.
2	60	Used for normal observation. (the axis are adjusted before the instrument leaves the factory)
1	30	Used for high resolution observation.
0	None	Used for maintenance work.

2.2.3 Specimen stage

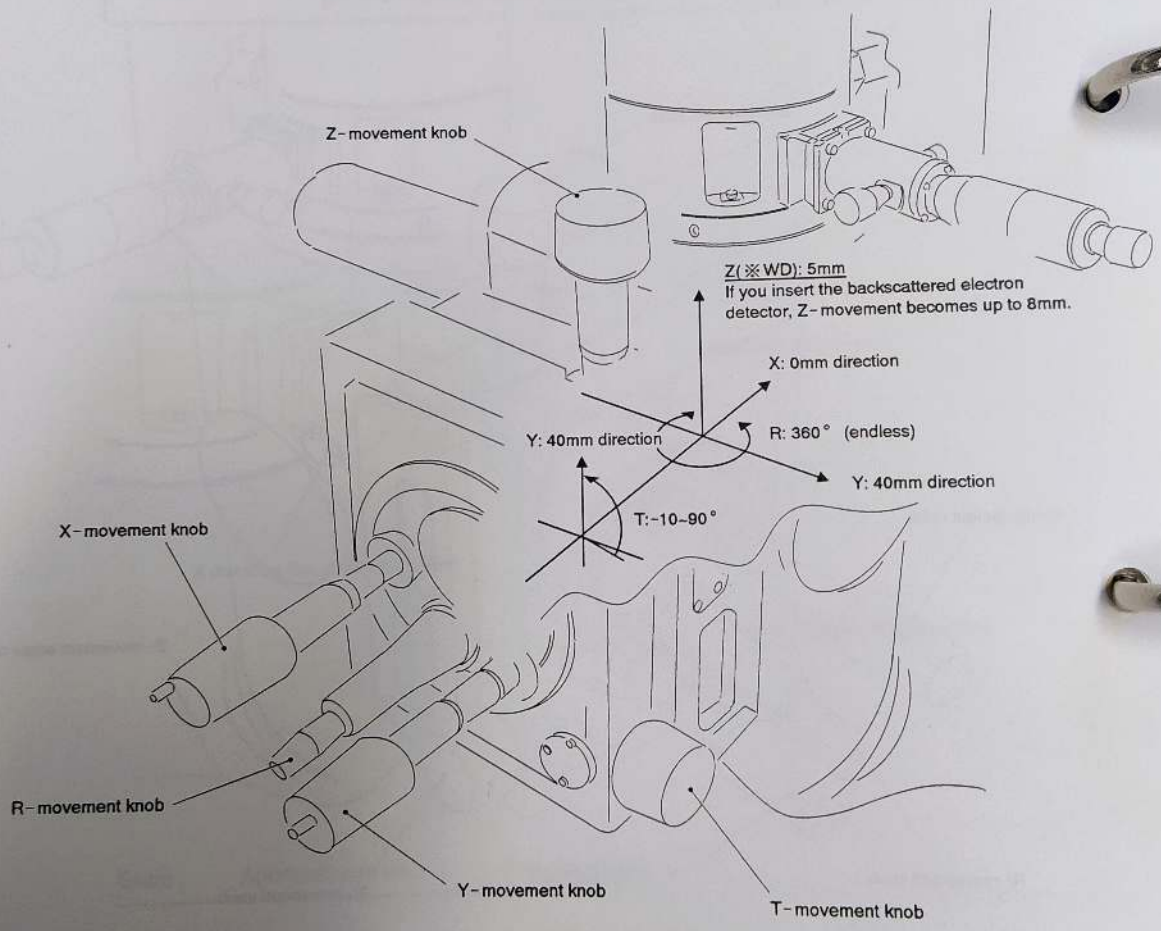
> ⚠ CAUTION When inserting or removing the specimen stage, take care not to get your fingers caught between the specimen stage and the specimen chamber.



2.2.3a Direction of movement of the specimen stage

⚠ CAUTION

- When the tilt of the stage is 90° , Y- movement takes place in the - Z direction, so be careful.
- For a short WD of no more than 8mm, use a 10mm dia. specimen holder.
- If you move the specimen without the range of observation of the specimen (refer to 2.2.3b), the specimen stage or specimen holder is contacted to the bottom of objective lens which may result in damage.



※WD(working distance): The distance from the underside of the objective lens to the specimen surface.

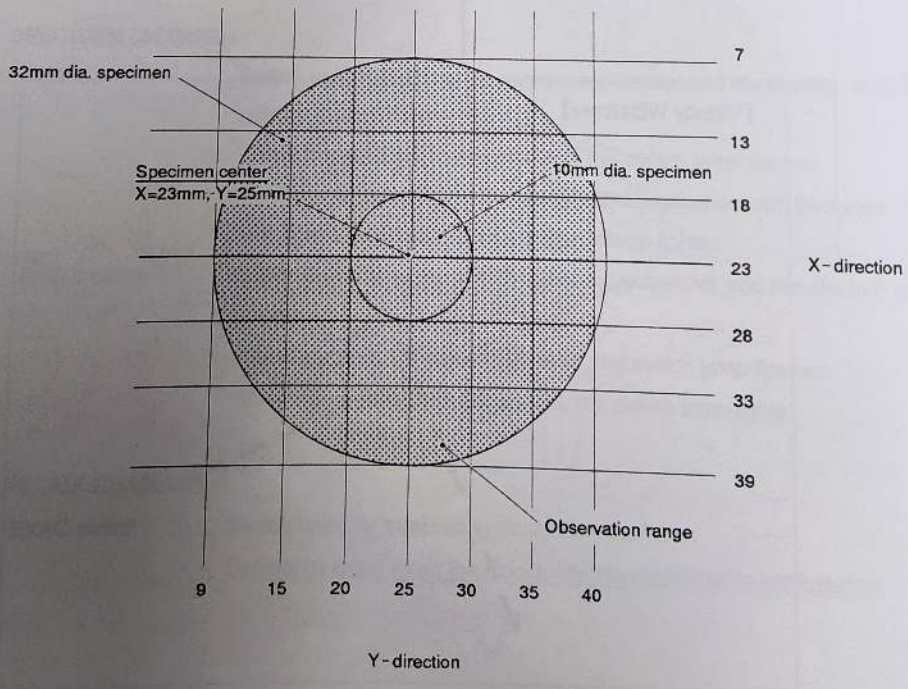
2.2.3b Range of observation of the specimen

10mm dia. specimen

Z(mm)	T(°)	X(mm)	Y(mm)
6	0 to10	18 to 28	20 to 30
8	0 to 30	18 to 28	20 to 30
15	−10 to 45	18 to 28	20 to 30
20	−10 to 55	18 to 28	20 to 30
30	−10 to 60	18 to 28	20 to 30
40	−10 to 65	18 to 28	20 to 30
48	−10 to 70	18 to 28	20 to 30
	70 to 90	18 to 28	20 to 25

32mm dia. specimen

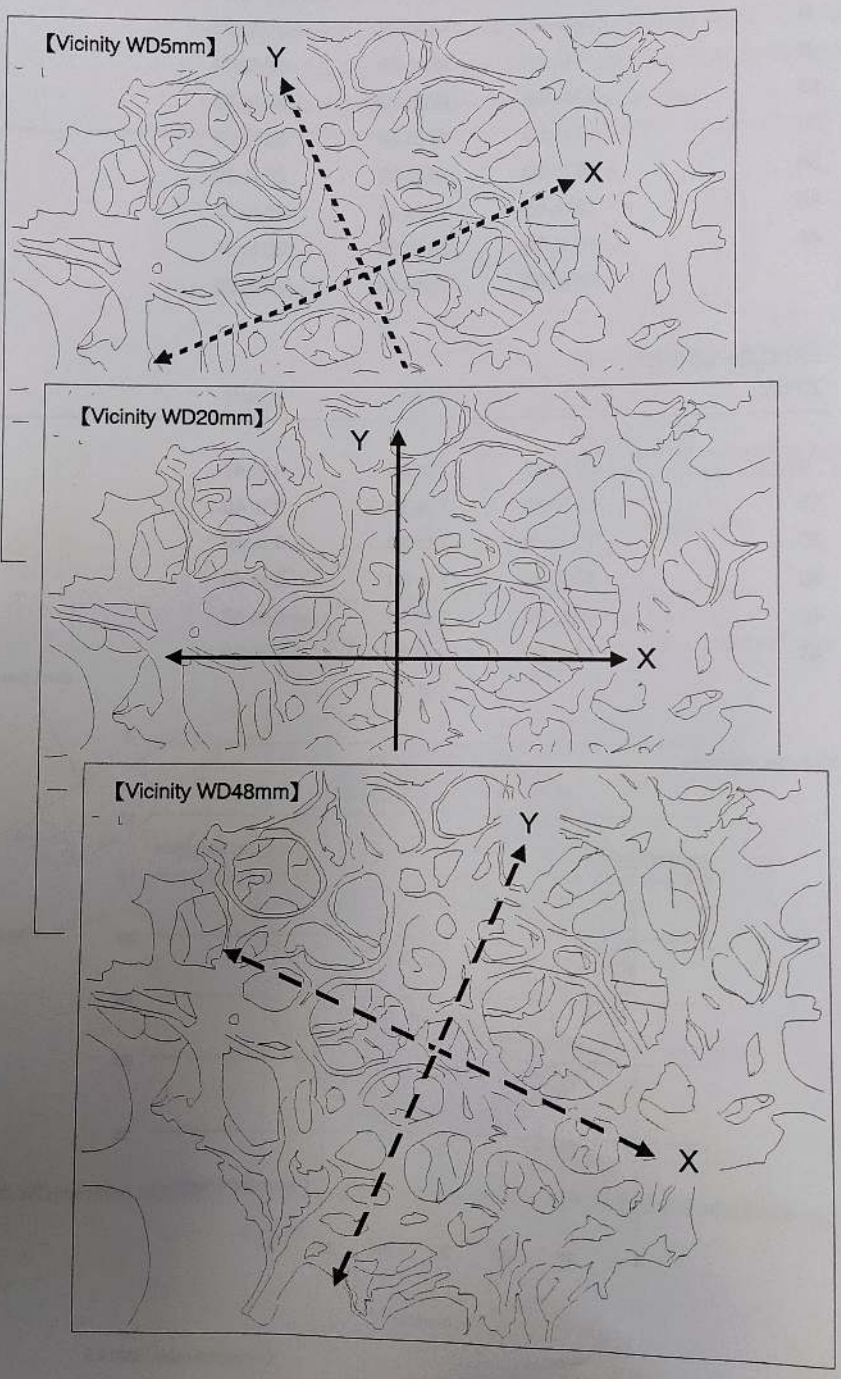
Z(mm)	T(°)	X(mm)	Y(mm)
8	0 to 15	7 to 39	9 to 40
15	−10 to 30	7 to 39	9 to 40
20	−10 to 35	7 to 39	9 to 40
30	−10 to 45	7 to 39	9 to 40
40	−10 to 65	7 to 39	9 to 40
48	−10 to 90	7 to 39	9 to 25



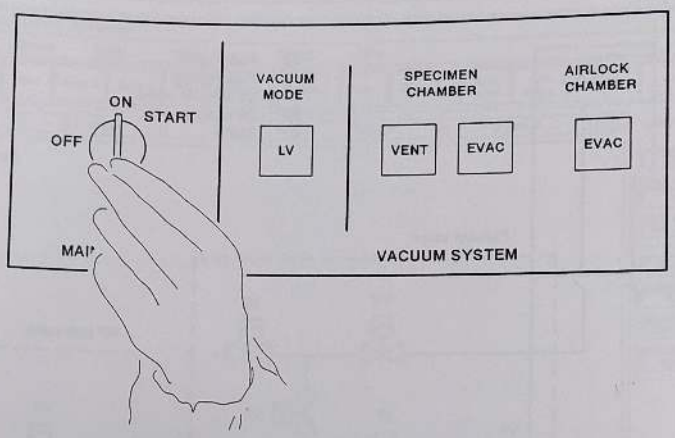
【Enlarged scale: 200%】

2.2.3c Moving an image on the screen

If you change the WD using the Z movement knob, the visual field on the image rotates, and the shift direction differs slightly.



2.2.4 Main control panel



MAIN POWER switch Key switch used to set the status of the main power supply to OFF or ON.

VACUUM MODE

LV swicth Cannot be used.

SPECIMEN CHAMBER

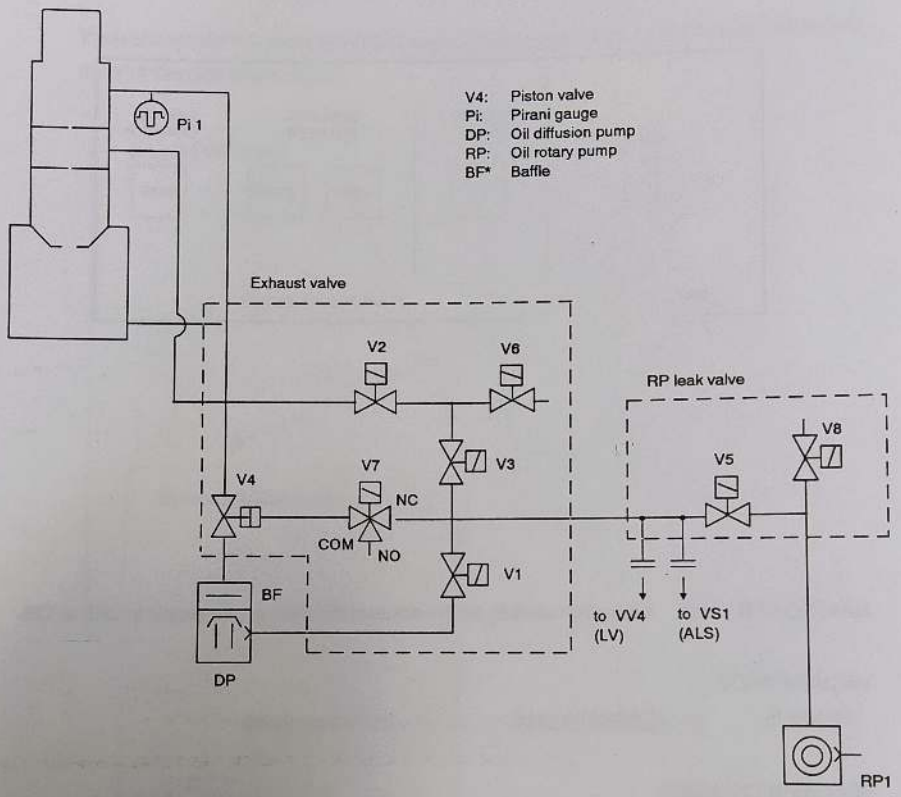
VENT switch Switch used for venting the specimen chamber and the electron optical column to atmosphere.
When this switch is pressed for vent, the switch lamp flashes.
When the specimen chamber and electron optical column becomes atmospere pressure, the VENT switch lamp lights.

EVAC switch Switch used for evacuating the specimen chamber and the electron optical column
When this switch is pressed for evac, the switch lamp flashes.
When the evacuation is completed, the switch lamp lights.

AIRLOCK CHAMBER

EVAC switch Switch used for evacuating the airlock chamber.
Cannot be used when the airlock chamber(optional)is not installed.

2.2.4a Evacuation system diagram

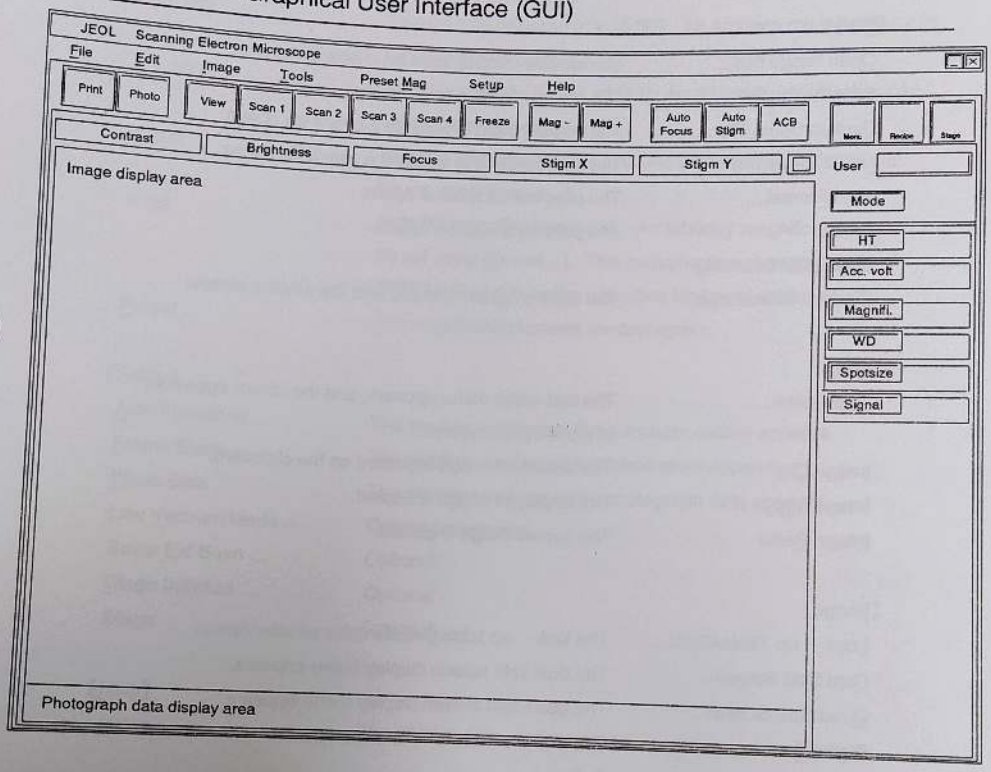


	V1	V2	V3	V4	V5	V6	V7	V8
DP BACK (DP exhaust)	○	×	×	×	○	×	×	×
PRE EVAC (Rough pumping)	×	○	○	×	○	×	×	×
EVAC (Fine pumping)	○	×	×	○	○	×	○	×
VENT (Atmosphere)	○	○	×	×	○	○	×	×
LOCK (Locked)	×	×	×	×	○	×	×	×
SHUT DOWN (Stop)	×	×	×	×	×	×	×	○

○: Open(COM-NC in the case of a 3-way valve)
×: Close(COM-NO in the case of a 3-way valve)

2.3 Operation section

2.3.1 Graphical User Interface (GUI)



Title bar	Displays a title [JEOL Scanning Electron Microscope], minimize button and close button. If you click the close button, SEM window (GUI) closes.
Menu bar	Uses for performing the various menus.
SEM control button	Uses for controlling or starting the print, photo, scan speed or auto function.
Image adjustment tools	Uses for manually adjusting the image contrast, brightness, focus, astigmatism, or for changing the image display size.
Image display area	Displays the image with 640 × 480 pixels.
Photograph data display area	Displays an accelerating voltage, magnification, micron marker, micron value, film number and note.
Icon	Uses for opening the SEM Menu window or SEM Recipe window.
User	Displays the current user name.
Mode	Displays the High vacuum mode or Low vacuum mode status.
SEM status display	Displays SEM status (HT ON/OFF, accelerating voltage, Magnification, etc.)

2.3.1a Menu bar

【File】

Open Image File ...	The window used to open an image file opens.
Save Image File ...	The window used to save an image opens.
Backup Users File ...	The window used to back up a user's file opens.
Install Users File ...	The window used to installed a user's file opens.
Print Format ...	The print format window opens.
Print ...	The print style window opens.
Exit JEOL Scanning Electron Microscope	The SEM program is exited and the window closes.

【Edit】

Text Editor ...	The text editor menu appears, and the cursor appears at top left of the screen.
Image Clip	The displayed image is pasted on the clipboard.
Image Copy	The displayed image is copied.
Image Paste	The copied image is pasted.

【Image】

Look – up Table/Color ...	The look – up table/pseudo color window opens.
Dual Split Screen ...	The dual split screen display menu appears.
Quad Split Screen ...	The quad split screen display menu appears.
Digital Zoom ...	The digital zoom menu is displayed.
Dual Magnification ...	Optional
Scaler ...	Optional
Multi Point Measurement ...	Optional
Beam Controller ...	Optional

【Tools】

Dynamic Focus Correction ...	The dynamic focus window opens.
Scan Rotation ...	Optional
Beam blanking	Beam blanking takes place.
OL Wobbler	The OL wobbler operates.
Lens Reset	Lens reset (OL, CL Reset) takes place.
Stigma Reset	The stigma value returns to the preset value.
Auto Focus Traser	Optional
Probe Current Detector	Optional

【Preset Mag】

× 100,000	Sets the magnification to x100,000. An arbitrary magnification can be set using [Preset ...].
× 10,000	Sets the magnification to x 10,000. An arbitrary magnification can be set using [Preset ...].
× 1,000	Sets the magnification to x1,000. An arbitrary magnification can be set using [Preset ...].
× 100	Sets the magnification to x100. An arbitrary magnification can be set using [Preset ...].
× 35	Sets the magnification to x35. An arbitrary magnification can be set using [Preset ...]. This magnification corresponds to INST MAG switch on the operation keyboard (optional).
Preset ...	The magnification preset window opens.

【Setup】

Auto Functions ...	The window used to set the automatic setting appears.
Frame Store ...	The window used to set the frame store appears.
Photo Data ...	The window used to set the photograph data appears.
Low Vacuum Mode ...	Cannot be selected.
Setup Ext Scan ...	Optional
Stage Initialize ...	Optional
Stage ...	Optional

【Help】

About ...	The version data window opens.

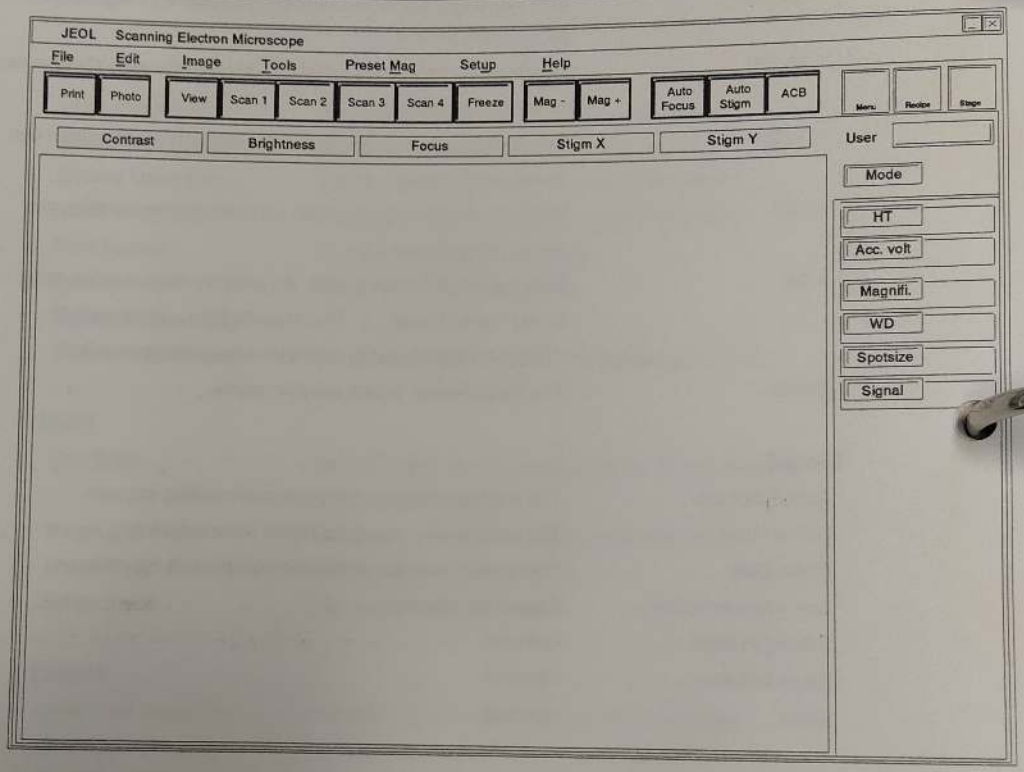
How to open a pull-down menu

Move the mouse pointer to the location of the menu that you wish to open and click the left mouse button. Alternatively, simultaneously press the Alt key and the key corresponding to the underlined letter using the keyboard.
For example, in the case of [File], simultaneously press the Alt key and the F key.

Selection of a menu in a pull-down menu

Move the mouse pointer to the location of the menu to be selected and click the left mouse button. Alternatively, press the key corresponding to the underlined letter using the keyboard.
For example, in the case of [Open Image File], press the O key.

2.3.1b SEM control button



Print	The print style forme opens.
Photo	Photographing starts. (Select the photographing speed/number of pixels using [Frame Store] of [Setup] on the menu bar.)
View	If you click [View], the magnification becomes the minimum magnification for the WD at that point in time, and the scanning speed becomes Scan 2. If you click [View] once again, the magnification and scanning speed revert to the original values. If you change the magnification or the scanning speed while [View] remains ON (the button is white), [View] goes OFF, and the original magnification and scanning speed are canceled. For [View], you can set an averaging coefficient using [Frame Store] of [Setup].

WD and minimum magnification (minimum magnification may be differ with probe current value)

5 to 10.9mm	× 70	11.0 to 17.9mm	× 50
18.0 to 29.9mm	× 35	30.0 to 44.9mm	× 25
45.0 to 48mm	× 18		

Scan1, 2, 3, 4	Click one of [Scan 1to4], then click the scanning speed. (You cannot make multiple selections.) [Scan1, 2, 3] enable you set an averaging coefficient using [Frame store] of [Setup]. [Scan 4] enables you to set the scanning speed and number of pixels using [Frame store] of [Setup]. If you click [Scan 1], a small screen and an exposure marker appear (when [Exposure marker] is checked using [Frame store] of [Setup]. A live image appears in the small screen, and a frozen image appears outside it.
Freeze	In the case of View and Scan 1/2/3, if you click [Freeze], a frozen image appears instantaneously. In the case of Scan 3, if you click [Freeze], a frozen image appears after one frame of data has been acquired. When [Freeze] is ON (button is white), if you click the button once again, or click [View] [Scan 1/2/3/4], [Freeze] goes OFF and acquisition of the image starts.
Mag −	Magnification DOWN button
Mag+	Magnification UP button
Auto focus	Auto focus starts. Make the setting that links the auto focus operation to ACB using [Auto Functions] of [Setup].
Auto stigm	Auto astigmatism correction starts. Make the setting that links the auto stigma operation to ACB using [Auto Functions] of [Setup].
ACB	ACB (auto contrast and brightness) starts. You can set each of the contrast and brightness levels over a range of ± 4 steps using [Auto Functions] of [Setup].

2.3.1c Image Adjustment tools

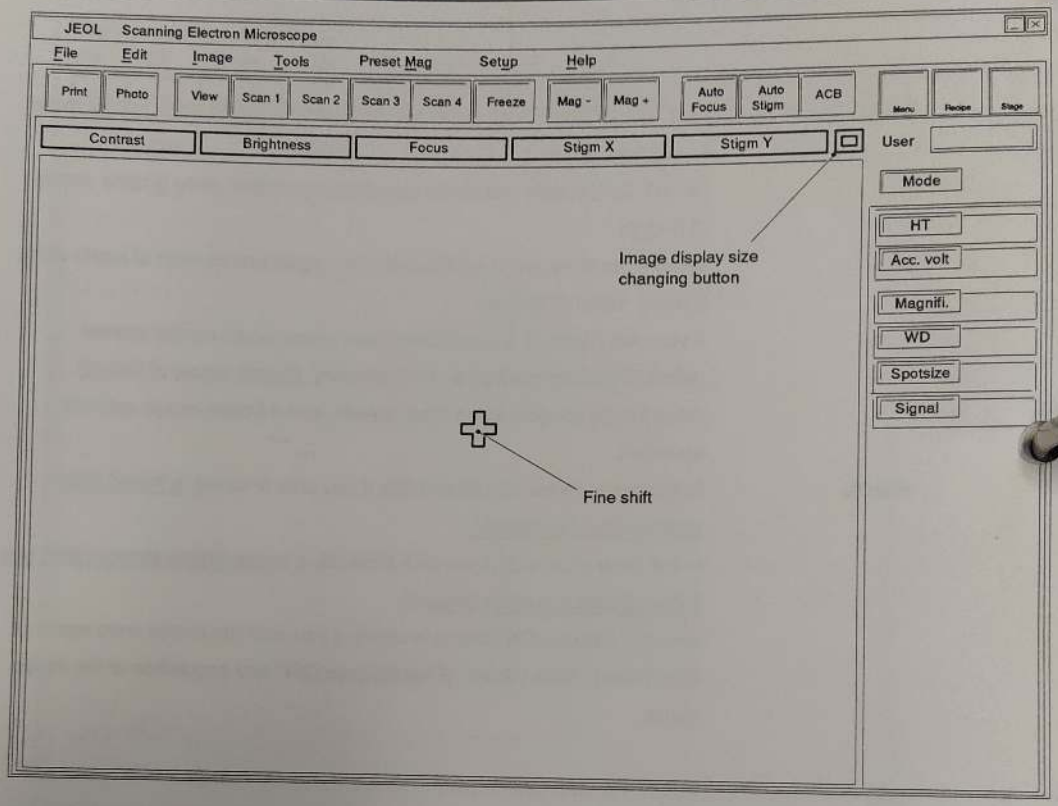


Image adjustment tools:

Contrast: Adjusts the contrast. Brightness : Adjusts the brightness.

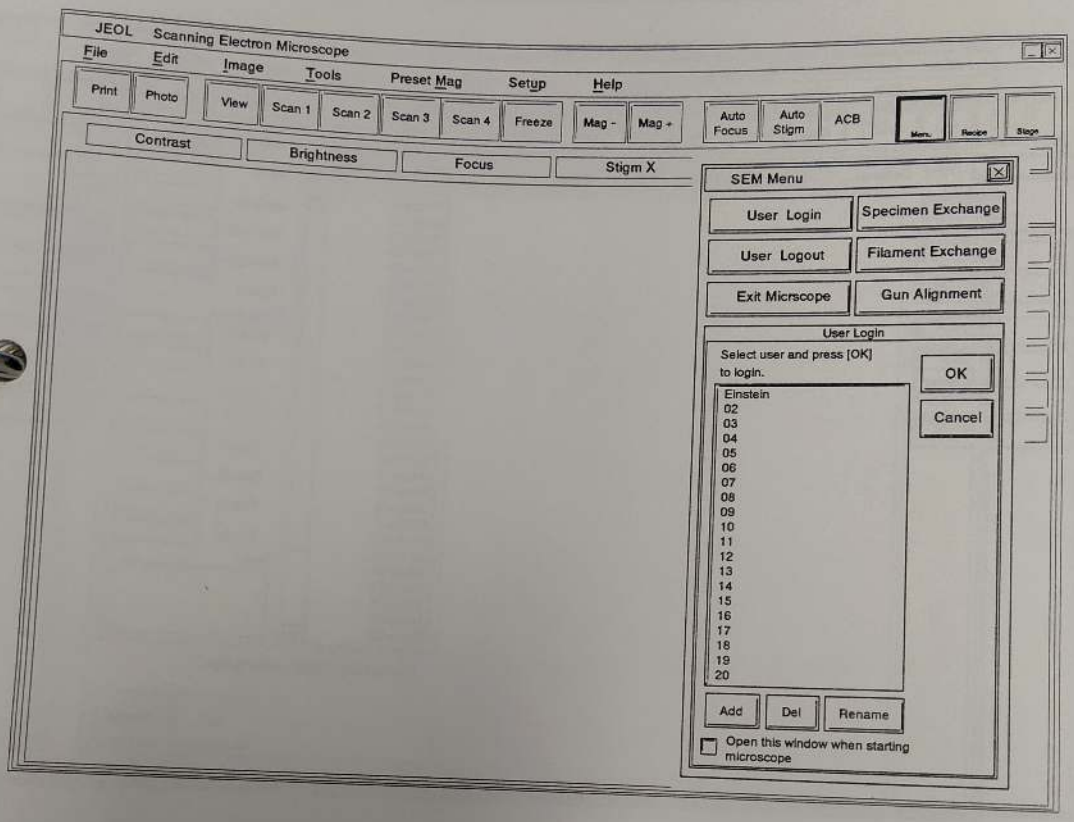
Focus : Adjusts the focus. Stigm X,Y: Adjusts the X and Y astigmatism.

Move the pointer to the location of the item that you wish to adjust, then while keeping the left mouse button (fine adjustment) or the right mouse button (rough adjustment) pressed, move the mouse up and down.

Image display size changing button: If you click this button every time, the image display size changes over to standard or one-half reduction size when the live image is displayed. (frozen image; standard only)

Fine shift: If you move the pointer over the image, the pointer becomes cross-shaped (white). In this case, you can perform a fine shift by moving the mouse back and forward or left and right while keeping the left mouse button pressed. The image moves in the direction in which you move the mouse. However, the shift distance is not linked to the magnification. (The shift distance is approx. ± 10 μm at an Acc. volt of 30 kV and WD of 20mm.)
If a fine shift stops at the end, double-click the left mouse button to reset the image (return it to center). The image will return to its original position.

2.3.1d Menu icon



User Login: If you click [User Login], the user login page opens.

User Logout: If you click [User Logout], the logout page appears.

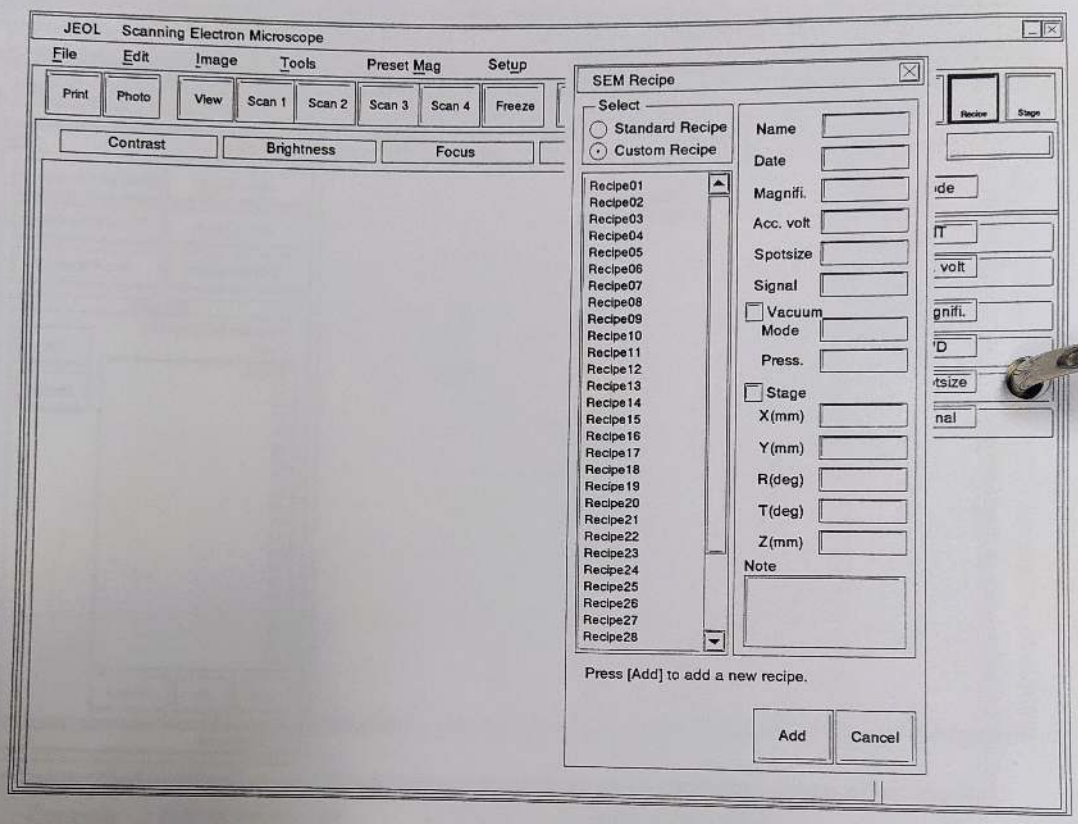
Exit Microscope: If you click [Exit Microscope], the exit SEM page opens.

Specimen Exchange: If you click [Specimen Exchange], the specimen exchange page opens.

Filament Exchange: If you click [Filament Exchange], the filament exchange page opens.

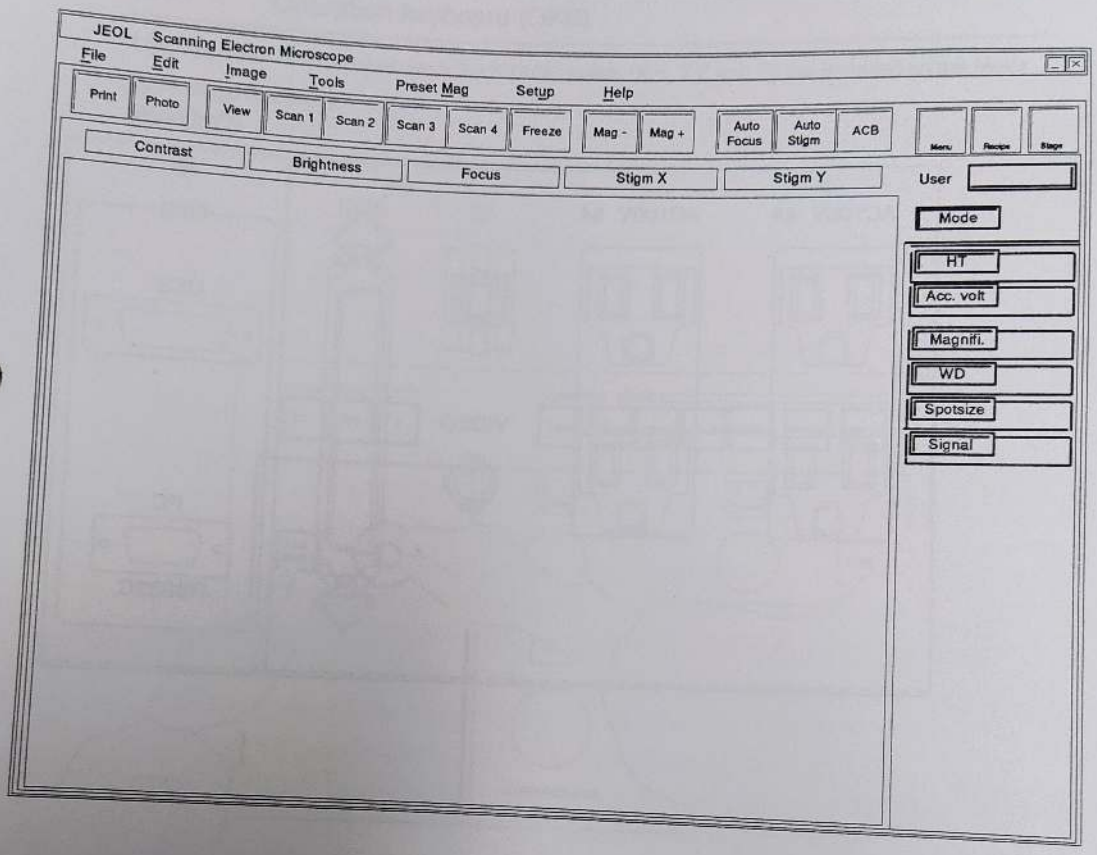
Gun alignment: If you click [Gun Alignment], the gun alignment window opens.

2.3.1e Recipe icon



Select	Standard Recipe	A recipe that can be used commonly by all users(A standard recipe is registered in the instrument before it is shipped from the factory.)
	Custom Recipe	A recipe in which each user can register up to 100 items
List	Displays a recipe list selected by [Select].	
Recipe	Displays the contents of a recipe selected from [List]. If you check the Vacuum or Stage [Motor drive stage (option)is installed] check box, an each contents are displayed simultaneously. You can rewrite the contents of [Note] by clicking the inside of the frame to display the cursor.	
Add	If you click [Add], the Add dialog box opens.	
Cancel	If you click [Cancel], the recipe window closes without anything taking place.	

2.3.1f Status display



User: Displays the current name. Log in using the [User Login] menu icon.

Mode: Displays the [High vac.] status.

HT: Displays the HT ON/OFF status. If you click [HT], the status switches from ON to OFF, or vice-versa. If the instrument is in an evacuation wait status, this switch displays the evacuation sequence.

Acc. volt: Displays the current accelerating voltage. If you click [Acc. volt], the Acc. volt window opens.

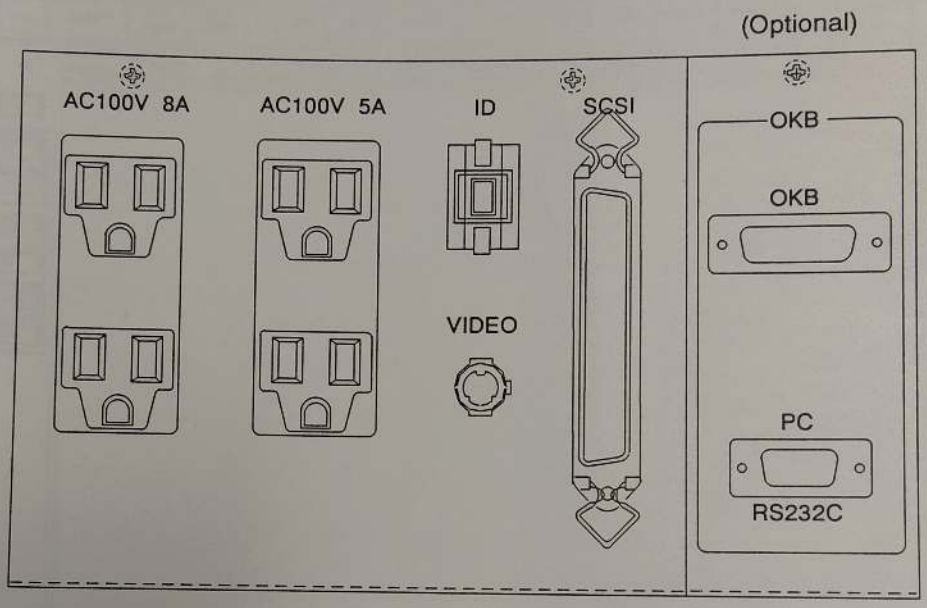
Magnifi. Displays the current magnification. If you click [Magnifi.], the Magnification window opens.

WD: Displays the current working distance. If you click [WD], the WD window opens.

Spotsize: Displays the current spot size. If you click [Spotsize], the Spotsize window opens.

Signal: Displays the current signal. If you click [Signal], the Signal window opens.

2.3.2 Rear panel

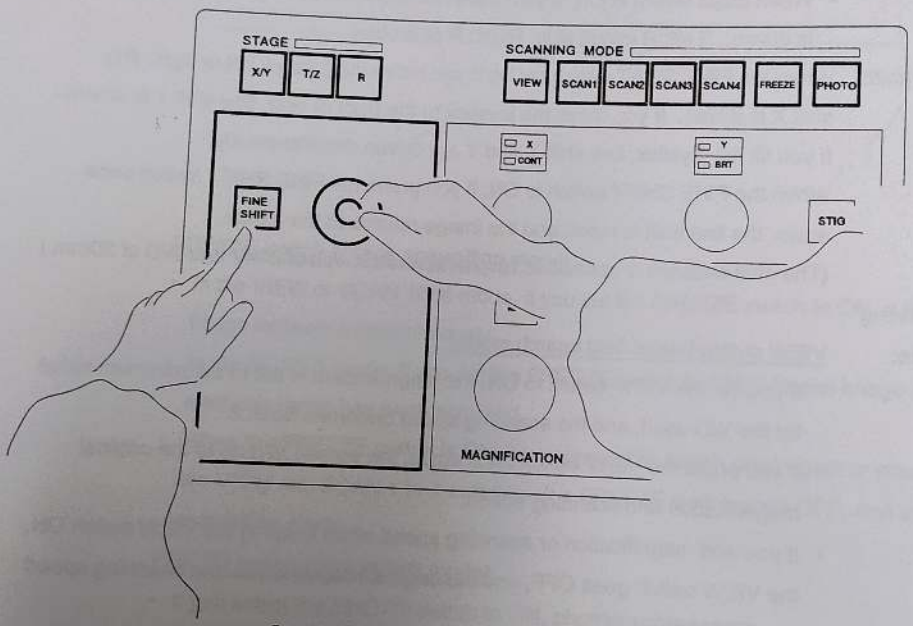


AC100V 8A:	Service outlet	
AC100V 5A:	Service outlet	
VIDEO:	Connect to Personal computer	
SCSI:	Connect to Personal computer	
ID	ID number	
OKB (optional)	OKB	Connect to operation keyboard
	PC RS232C	Connect to RS232C board of personal computer

2.4 Options

2.4.1 Operation keyboard (OKB)

This board can only be used when the STAGE switch (X/Y, T/Z and R) are installed on the Motor Drive Stage (optional).



【Joystick】
When the joystick is moved through a small angle, the drive speed falls, and when the joystick is moved through a large angle, the drive speed rises. (The drive speed changes linked to the magnification.)

Stage: X/Y switch

- When the X/Y switch is ON, if you move the joystick left or right, the X axis is driven. If you move the joystick to the front or rear, the Y axis is driven.
- When the X/Y switch is ON, if you tilt the joystick, the X and Y axes are driven simultaneously.

T/Z switch – Cannot be used

- When the T/Z switch is ON, if you move the joystick left or right, the T axis is driven. (Left: T minus side, Right: T plus side)
- When the T/Z is ON, if you move the joystick to the front or rear, the Z axis is driven. (Front: Z long WD side, Rear: Z short WD side)

R switch – Cannot be used

- When the R switch is ON, if you move the joystick left or right, the R axis is driven. (Left: R minus side, Right: R plus side)

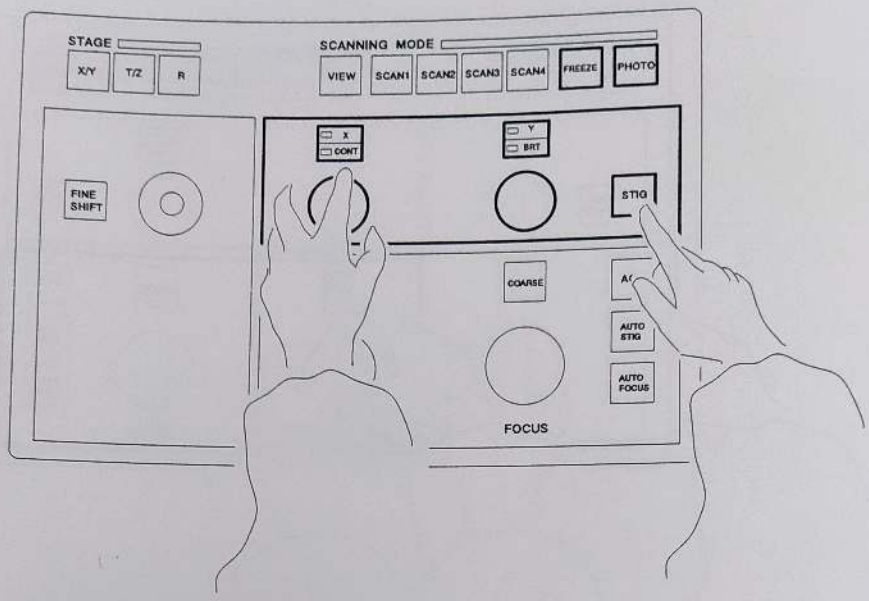
Fine shift: When the FINE SHIFT switch is ON, if you move the joystick left or right, fine shift X is driven. If you move the joystick to the front or rear, fine shift Y is driven. If you tilt the joystick, fine shift X and Y are driven simultaneously.
When the FINE SHIFT switch is ON, if you press the FINE SHIFT switch once again, the fine shift is reset, and the image returns to the center.
(The shift distance is approx. ±10 μm at an Acc. volt of 30kV and WD of 20mm.)

Scanning mode: VIEW switch (visual field search mode)

- If you set the VIEW switch to ON, the magnification is set to the minimum value for the WD used, and the scanning speed becomes Scan 2.
- If you press the VIEW switch once again, the screen reverts to the original magnification and scanning speed.
- If you add magnification or scanning speed while keeping the VIEW switch ON, the VIEW switch goes OFF, and the original magnification and scanning speed are canceled.
- The VIEW switch enables you to set an averaging coefficient using [Frame Store] of [Setup].

SCAN 1 to 4 switches (scanning speed select mode)

- Press one of SCAN switches 1 to 4, and select a scanning speed. (You can make multiple selections.)
- The SCAN 1 to 3 switches enable you to set an averaging coefficient using [Frame Store (F)] of [Setup (U)].
  The SCAN 4 switch enables you to set the scanning speed and number of pixels using [Frame Store] of [Setup].
- If you press the SCAN 1 switch, a small screen and exposure meter appear (when [Exposure meter] is checked using [Frame Store] of [Setup]). A scanning image appears in the small screen, and a frozen image appears outside it.



FREEZE switch (image acquisition mode)

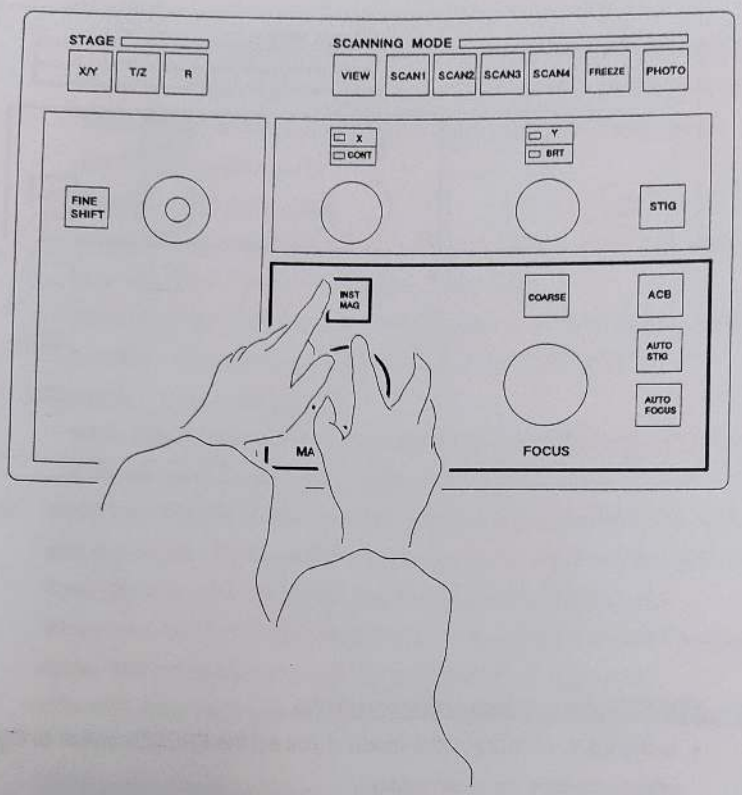
- In the VIEW or SCAN 1/2/4 mode, if you set the FREEZE switch to ON, a frozen image appears instantaneously.
- In the SCAN 3 mode, if you set the FREEZE switch to ON, a frozen image appears after one frame has been acquired.
- When the FREEZE switch is ON, if you press this switch once again or press one of the VIEW and SCAN 1 to 4 switches, the FREEZE switch goes OFF, and image acquisition starts.

PHOTO switch (photograph mode)

- If you select the PHOTO switch to ON, photographing starts.
- When the FREEZE switch is OFF, if you set scanning image photographing to ON, a frozen image starts to be photographed.
- If you press one of VIEW and SCAN 1 to 4 while photographing is taking place, photographing is canceled.

Contrast and brightness adjustments:

When the STIG switch is OFF (the CONT and BRT LEDs are lit), adjust the contrast and brightness of the image using the left and right control knobs.
Turning the left control knob counterclockwise reduces the contrast, and turning it clockwise increases the contrast.
Turning the right control knob counterclockwise makes the image dark, and turning it clockwise makes the image bright.



Astigmatism Correction: When the STIG switch is ON (the X and Y LED indicators are lit), correct the astigmatism of the image using the left and right control knobs.

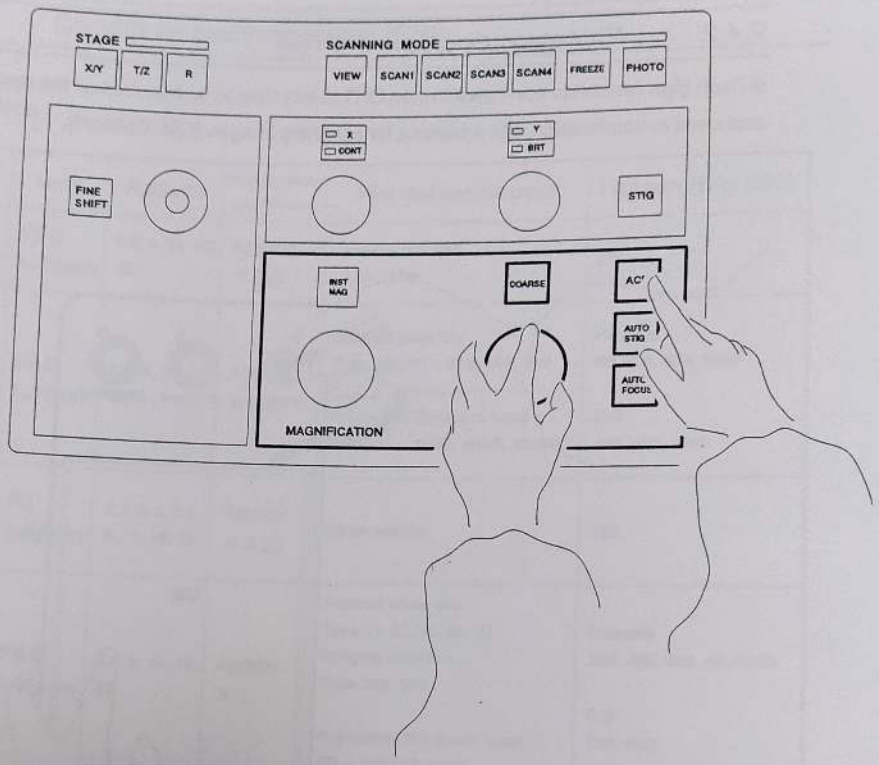
The left control knob corrects astigmatism X, and the right control knob corrects astigmatism Y.

Instant magnification: If you set the INST MAG switch ON, the magnification set using [Preset Mag] on the menu bar (the magnification displayed in the bottom list box) is selected.

If you set the INST MAG switch to OFF, the original magnification is restored.

When the INST MAG switch is ON, if you change the magnification using the MAGNIFICATION knob or press the VIEW switch, the INST MAG switch goes OFF.

Magnification: Turning the MAGNIFICATION knob counterclockwise lowers the magnification, while turning it counterclockwise raises the magnification.



Focusing:

When the COARSE switch is ON, you can carry out rough focusing using the FOCUS knob.

When the COARSE switch is OFF, you can carry out fine focusing using the FOCUS knob.

Turning the FOCUS knob counterclockwise results in underfocusing, and turning it clockwise results in overfocusing.

Automatic functions

ACB switch

ACB (auto contrast and brightness) take place.

You can set the levels of both the contrast and brightness over a range of ±4 steps using [Auto Functions] of [Setup].

AUTO STIG switch

Auto stigma starts.

Make the setting that links the auto stigma operation to auto focus and ACB using [Auto Functions] of [Setup].

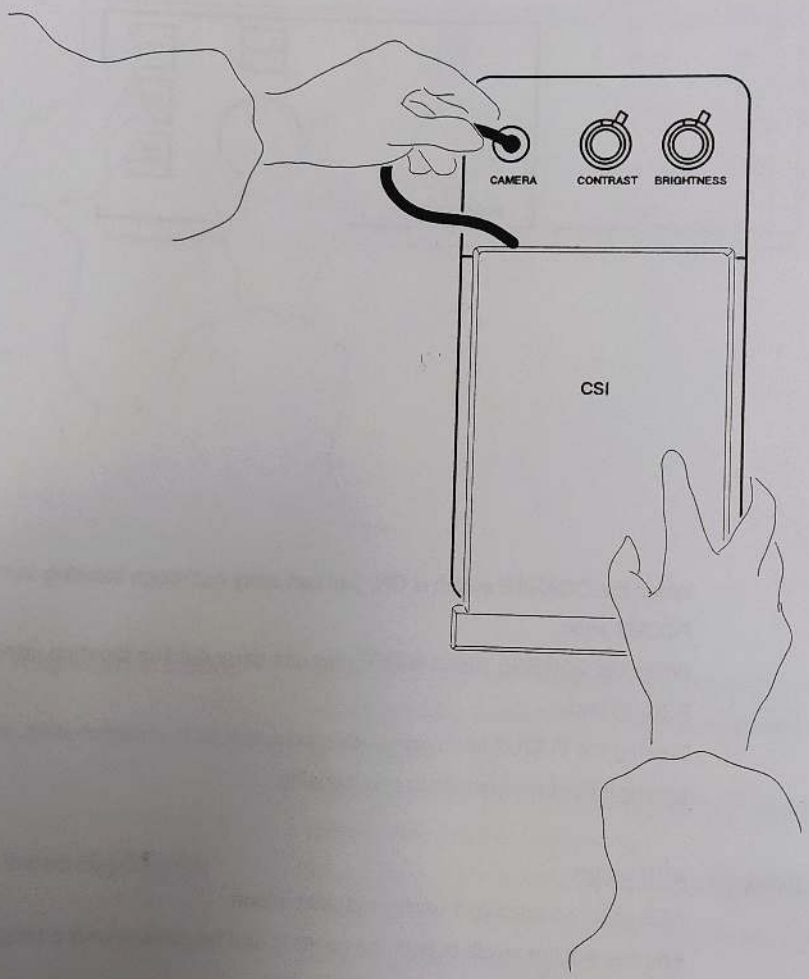
AUTO FOCUS switch

Auto focus starts.

Make the setting that links the auto focus operation to ACB using [Auto Functions] of [Setup].

2.4.2 Photorecording device (PRD)

9-inch high resolution non-persistence CRT is intended to be mounted on the operation base, and used in combination with a camera for scanning images (CSI: Optional).



CAMERA:	Connect to the connector on the camera. Power and signals are supplied to the CSI.
CONTRAST:	Adjusts the contrast of the PRD. (Normally, set to 5.0.)
BRIGHTNESS:	Adjust the brightness of PRD. (Normally, set to 5.0.)

2.4.3 Camera for scanning image (CSI)

Specifications

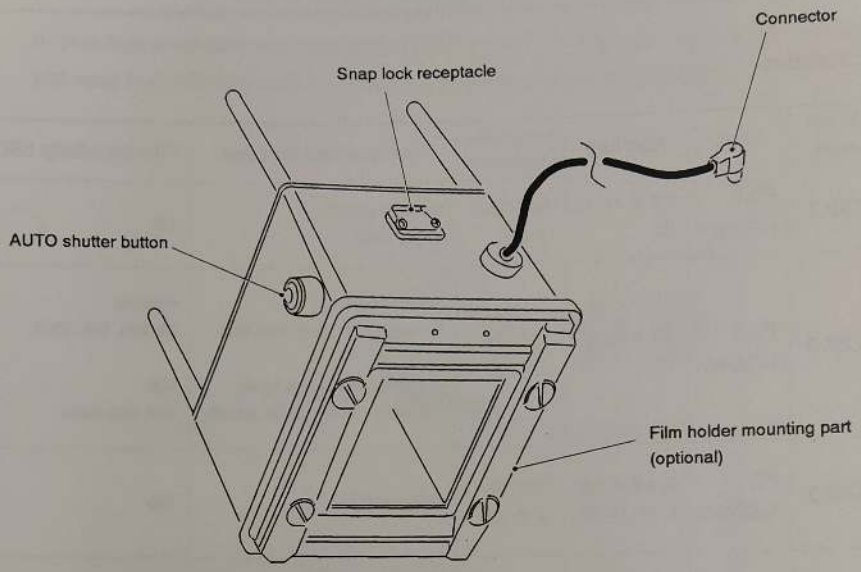
Model name	Lens	Aperture	Photographing magnification	Film that can be used	Film sensitivity (ISO)
CSI 1	F5.6 f=75mm	5.6, 8, 11, 16, 22	Approx. × 0.5	Brownie size film J120 , 220	100
CSI 2	F5.6 f=75mm	5.6, 8, 11, 16, 22	Approx. × 0.8	Polaroid pack film Type 665, 611, 613, 107, 667 Fuji instant film (pack type) Type FP – 100B, 400B, 3000B	Polaroid 80, 200, 800, 3000 Fuji 100, 400, 3000
CSI 3	F2 f=50mm	2, 2.8, 4, 5.6, 8, 11, 16, 22	Approx. × 0.25	35mm roll film	100
CSI 5	F5.6 f=75mm	5.6, 8, 11, 16, 22	Approx. × 1	Polaroid sheet film Type 51, 52, 53, 55, 57 Polaroid pack film Type 552, 553 Fuji instant film (pack type) FP – 100B45, 500B	Polaroid 320, 400, 800, 50, 3000 Fuji 100, 500

Remarks

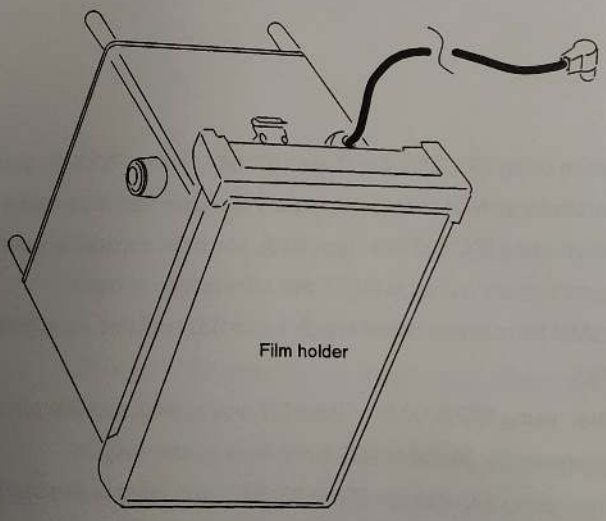
CS12:
- When using ISO 3000 film (Type 107, 667, or FP - 3000B), you must separately purchase an ND4 filter (commercially available M37.5 mm bore screw-in type).
- When using ISO 800 film (Type 613), you must separately purchase an ND2 filter (commercially available M37.5 mm bore screw-in type).

CS13: A "35MM film camera power supply (option) is available for automatically winding up the film.

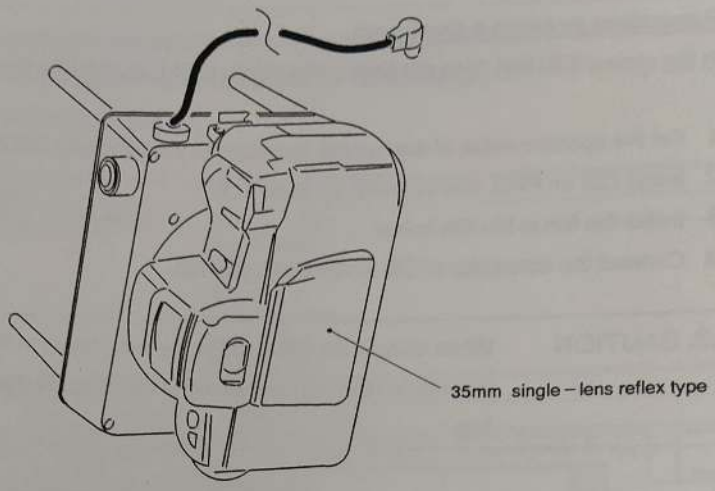
CS15:
- When using ISO 3000 film (Type 57), you must separately purchase an ND4 filter (commercially available M37.5 mm bore screw-in type).
- When using ISO 800 film (Type 53, 553), you must separately purchase an ND2 filter (commercially available M37.5 mm bore screw-in type).


Connector
Snap lock receptacle
AUTO shutter button
Film holder mounting part
(optional)

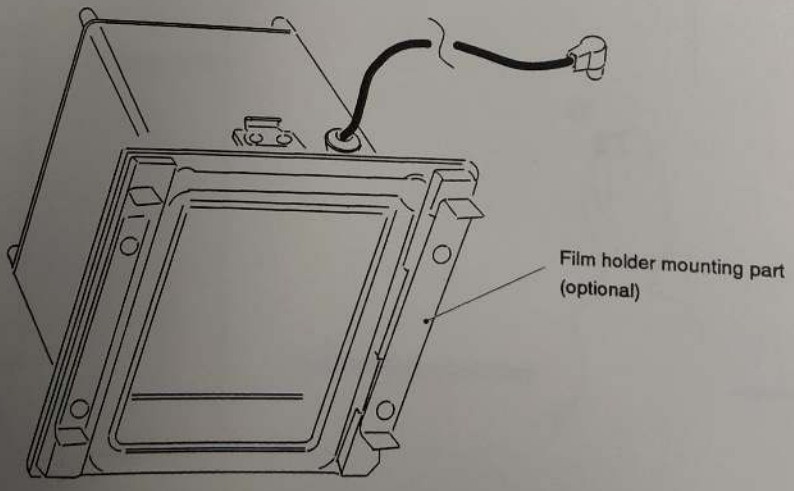
【CSI 1】


Film holder

【CSI 2】


35mm single – lens reflex type

【CSI 3】


Film holder mounting part
(optional)

【CSI 5】

Preparations for taking a photograph

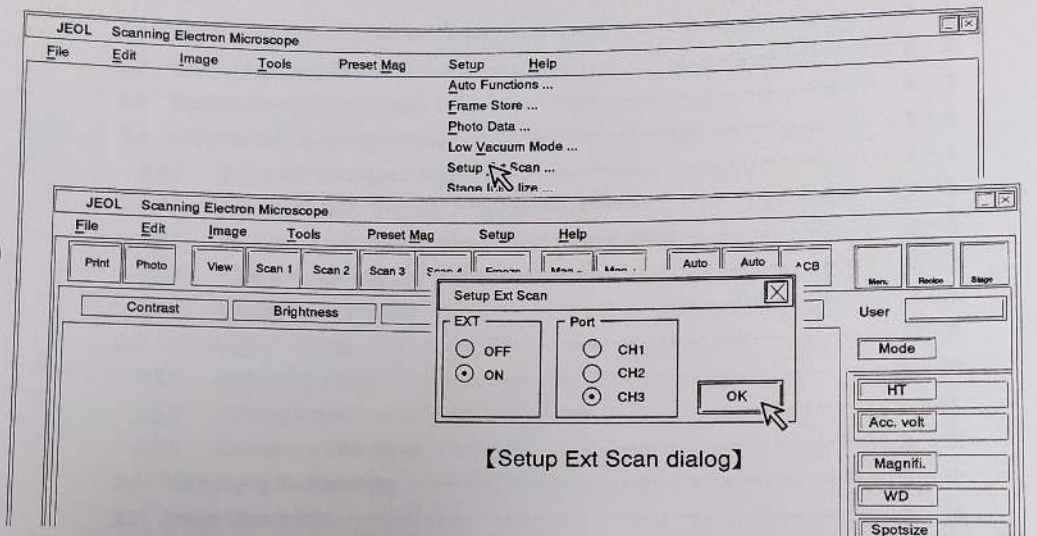
In the case of CSI that does not have a film holder (CSI 1, 5), install a film holder in advance.

1 Set the aperture value of the camera according to the sensitivity (ISO) of the film used.
2 Install CSI on PRD, and fix it with the snap lock.
3 Install the film in the film holder.
4 Connect the connector of CSI to CAMERA on PRD.

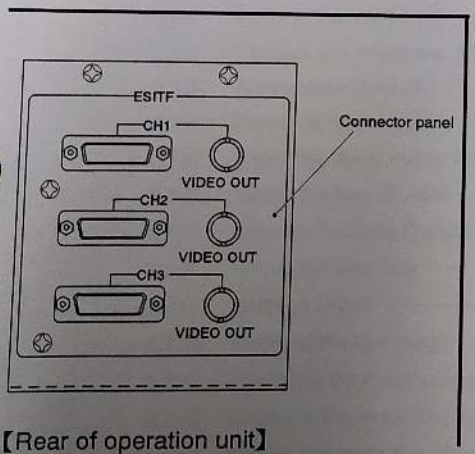
> ⚠ CAUTION When using instant film, follow the instructions in the maker's instruction manual concerning the method of handling the developing fluid for instant film.

2.4.4 External Scan Interface (ESITF)

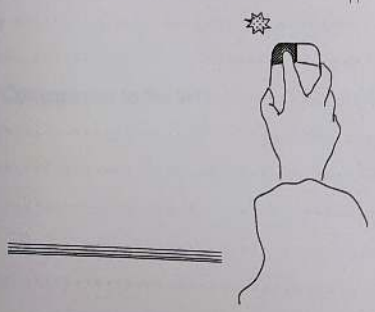
This interface used to scan the electron beam by scanning signal from the external device, then outputs the image signal to the external device. Open [Setup] and click [Setup Ext Scan], the Setup Ext Scan dialog opens.



【Setup Ext Scan dialog】



【Rear of operation unit】



EXT	If the TTL signal- High level is inputted to the SEM, external scan is set to OFF.
	If the TTL signal- Low level is inputted to the SEM, external scan is set to ON.
Port	Selectable the connected CH (channel).
OK	If you click [OK], Setup Ext Scan window closes.

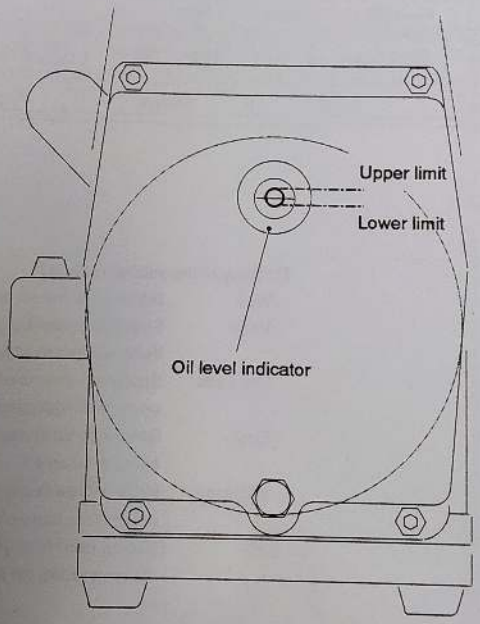
3. Operation

3.1 Pre-starting Check

1 Using the oil level indicator of the RP's, check the reduction of the oil level and also whether or not the oil is contaminated.

- Perform this check about once every 3months, or at shorter intervals if the pump is used more frequently.
- If it is necessary to replenish or replace the oil, contact your nearest JEOL service office.

> ⚠ CAUTION If you continue to operate the pump with insufficient oil, the pump may break down. Take care that the oil level does not fall below the lower limit.



3.2 Starting the Instrument

1 Pass cooling water through the system. (Flowrate: 1.5 to 2.0 lit/min.)

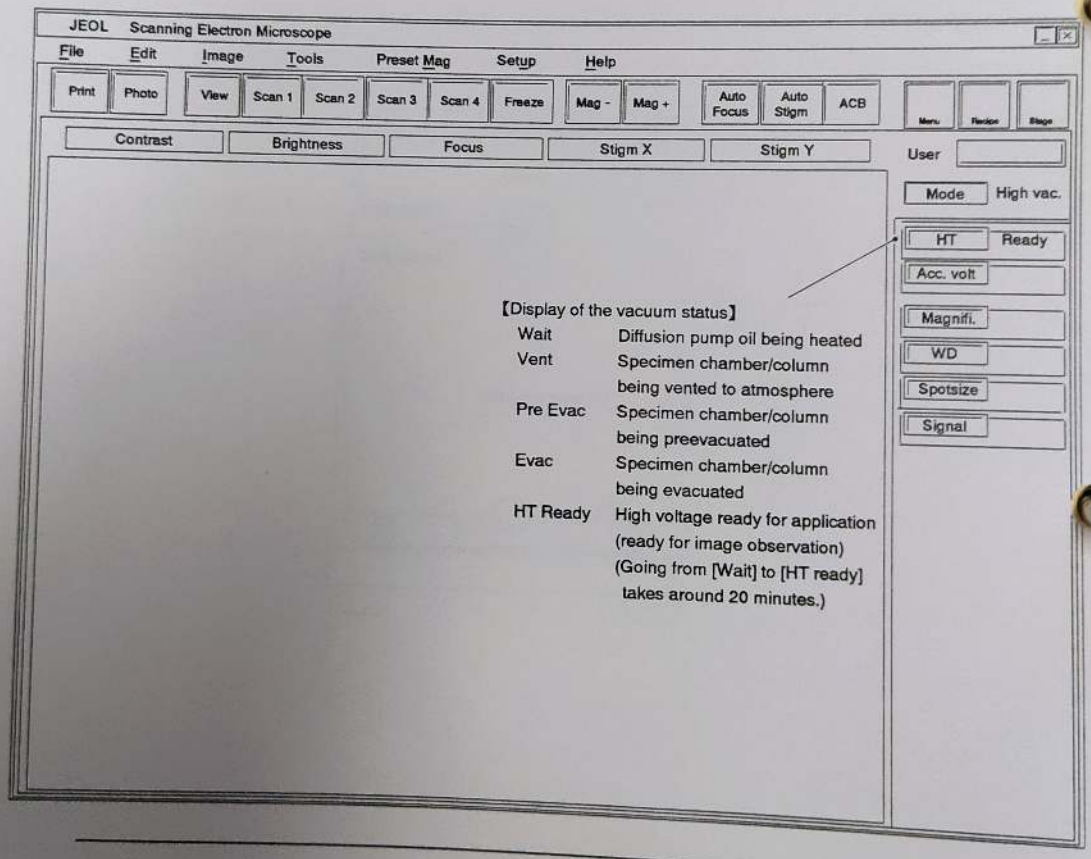
2 Turn ON the power board switch .

3 Turn ON the MAIN POWER switch on the main control panel.
Insert the key into the MAIN POWER switch, turn it to [START], then take your hand away.
The key returns to ON, and power is supplied to the evacuation system.

4 Wait for about 10seconds, switch on the computer and run Windows.

5 Click [START] on the desktop, then select [Program].

6 Click [JSM-5600 Scanning Electron Microscope], then select [JSM-5600 Main menu].
The starting screen appears, and when the software starts running, the screen changes over to GUI of SEM. The system logs into "GENERAL" as the user. If you wish to log in to a user other than [GENERAL] or register the new user, etc., refer to 3.5.



If you start the instrument when the room temperature is extremely low, such as in winter, excessive current is likely to flow through the motor of the RP (oil rotary pump). In this case, the overcurrent protector on the motor operates to stop the RP, protecting the motor from damage. If this happens, carry out the operation of 3.4.4 or 3.4.5.

3.3 Shutting Down the Instrument

1 Open the [Menu].

2 Click [OK] of [Exit Microscope].

The [HT] goes [OFF] automatically, and the SEM window (GUI) closes. (the screen returns desktop of the Windows.)

If you click [Cancel], the SEM Menu window closes without anything taking place.

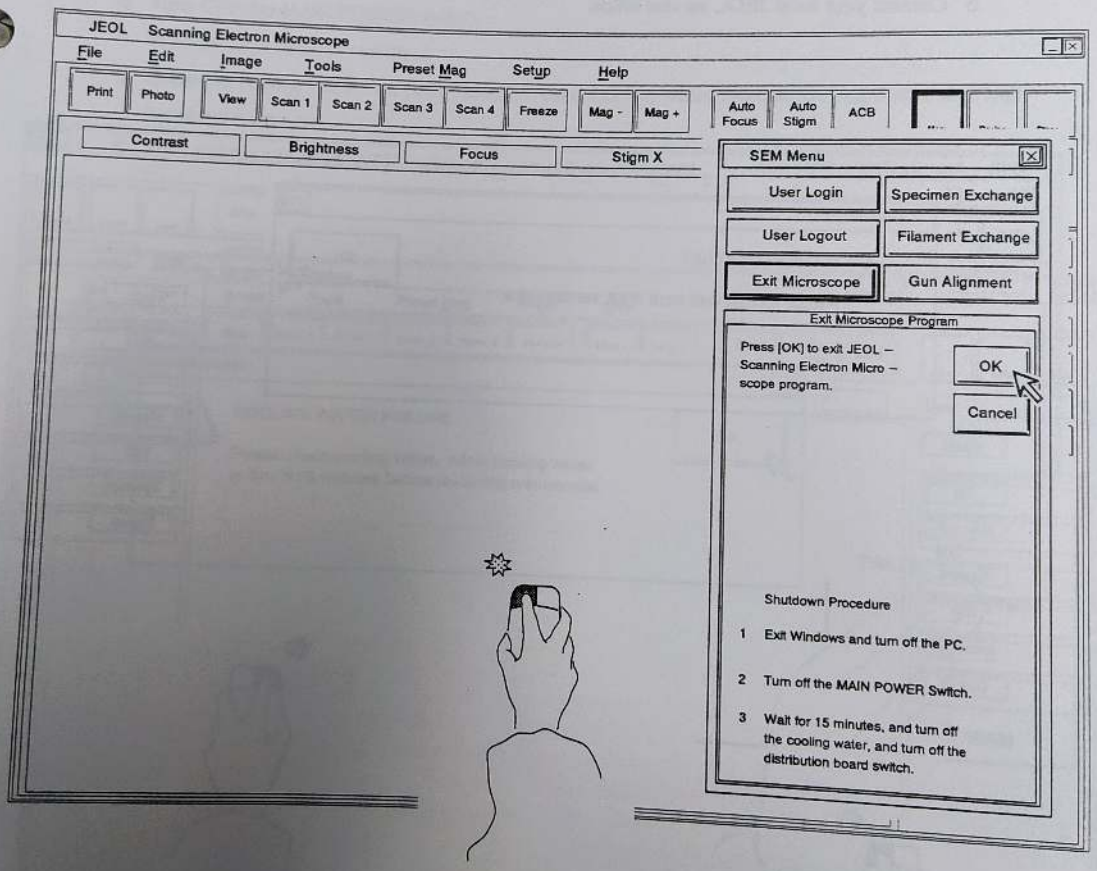
3 Click [START] on the desktop.

4 Exit Windows, then switch off the computer.

5 Turn OFF the MAIN POWER switch on the main control panel.

6 Turn OFF the power board switch.

7 Wait for about 15 minutes, then turn off the cooling water.



If you wish to restart the instrument, perform above steps 1~5 and turn the MAIN POWER switch to START, then take your hands away. Several seconds later, then switch on the computer. As soon as the evacuation sequence becomes [HT Ready], SEM can be used again.

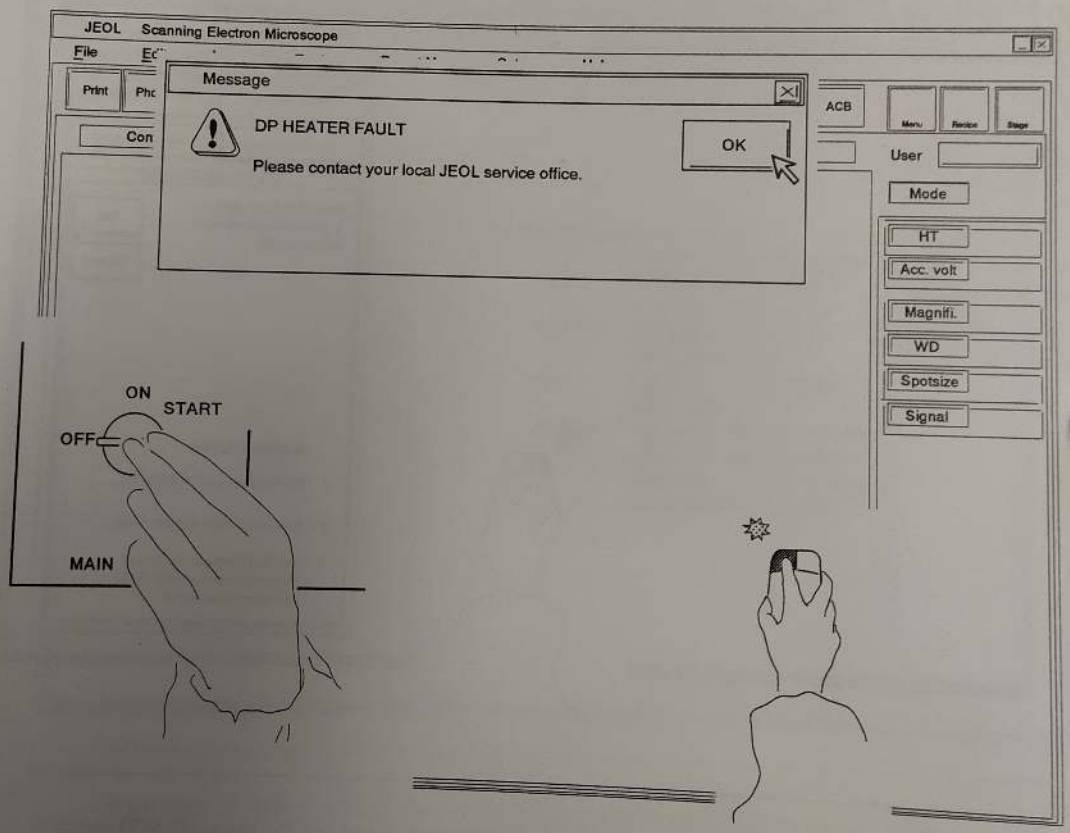
3.4 Action to Take in an Emergency

3.4.1 If an alarm message is displayed

Follow the instruction in the message.

If you contact your local JEOL service office, use the following procedures.

1 The message is displayed (a number of message may be displayed simultaneously).
2 Click [OK] for closing the Message dialog box.
3 Close the SEM window (GUI), then switch off the computer. (refer to 3.3)
4 Turn OFF the MAIN POWER switch.
5 Contact your local JEOL service office.



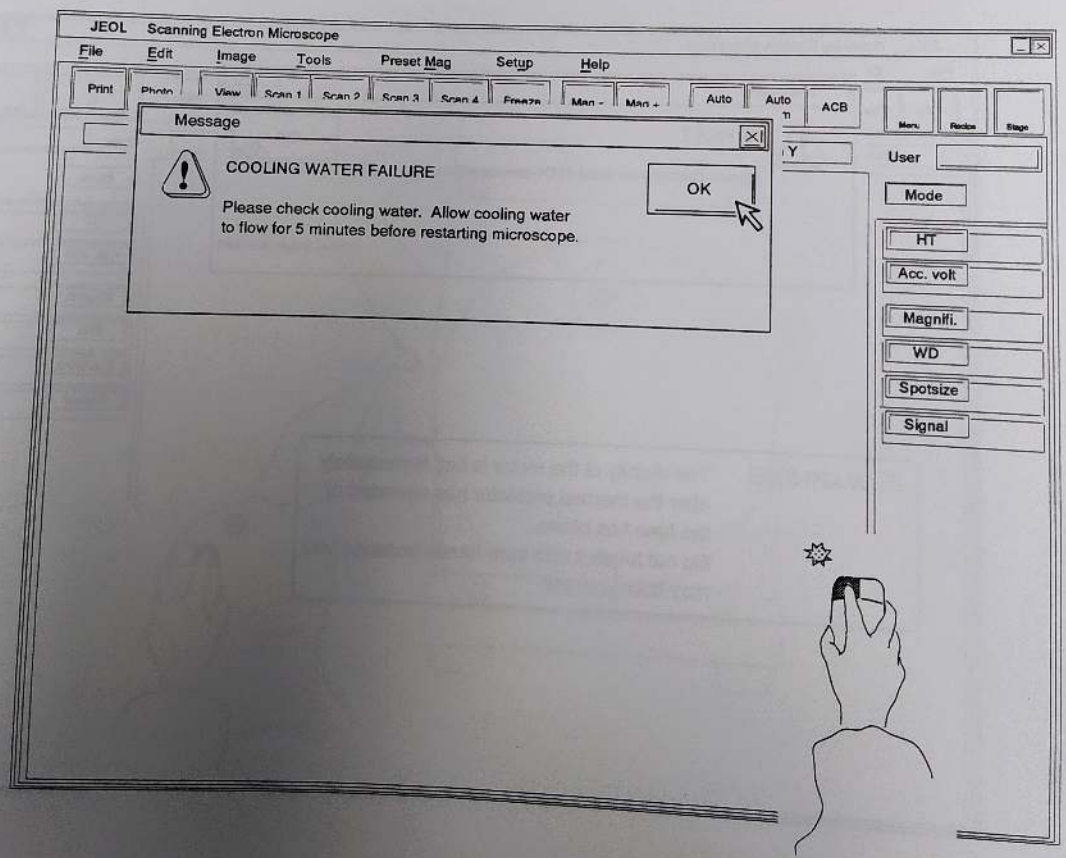
【MAIN POWER switch】

3.4.2 If the instrument stops suddenly due to a power

1 Turn OFF the MAIN POWER switch.
2 Wait until the power is restored.
3 Once a power has been restored, confirm that cooling water is flowing through the instrument.
4 Turn ON the MAIN POWER switch, then start the instrument.

3.4.3 If the instrument stops suddenly due to a water failure

1 Click [OK] for closing the Message dialog box.
2 Close the SEM window (GUI), then switch off the computer. (refer to 3.3)
3 Turn OFF the MAIN POWER switch.
4 Wait until the water is restored.
5 Once the cooling water has been restored, pass cooling water through the instrument and wait for about 5 minutes.
6 Turn ON the MAIN POWER switch, then start the instrument.



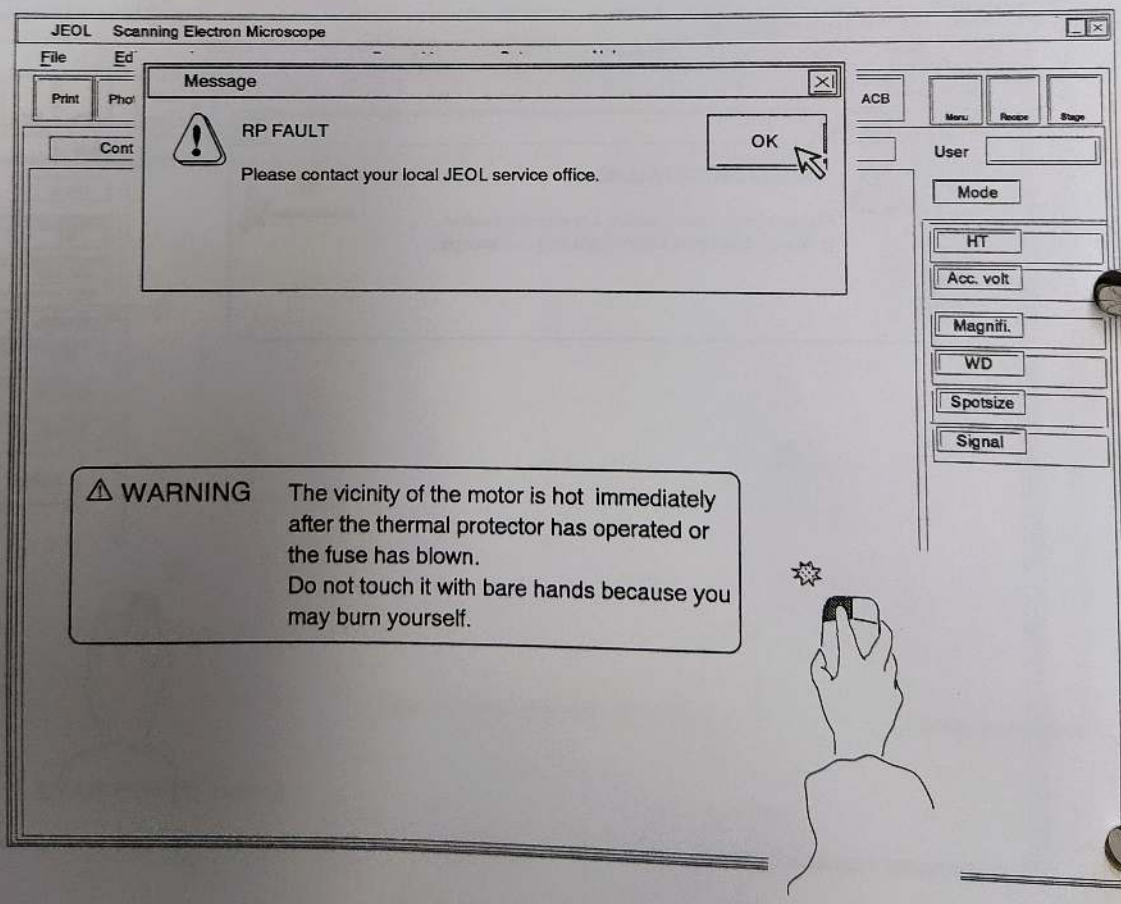
3.4.4 If the RP stops while the instrument is running

If excessive current flows through the motor of the RP (oil rotary pump) while the instrument is running, the power supply circuit is automatic cut off, protecting the motor from damage.
If the thermal protector operates or the fuse blows, the instrument goes into the following status.

a The VENT and EVAC switch lamp flashes.
b The no-image displays on the screen.
c An alarm message displays on the screen.

Use the following procedures, then contact your local JEOL service office.

1 The message is displayed (a number of message may be displayed simultaneously).
2 Click [OK] for closing the Message dialog box.
3 Close the SEM window (GUI), then switch off the computer. (refer to 3.3)
4 Turn OFF the MAIN POWER switch.
5 Contact your local JEOL service office.



⚠ WARNING The vicinity of the motor is hot immediately after the thermal protector has operated or the fuse has blown.
Do not touch it with bare hands because you may burn yourself.

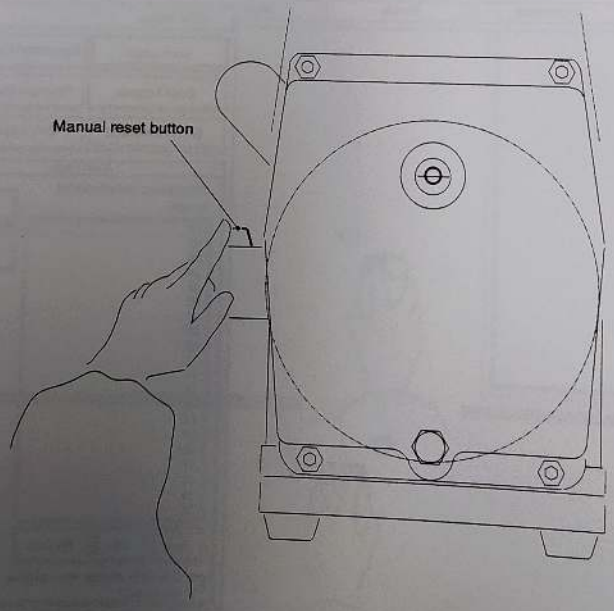
3.4.5 If the RP does not start

If you start the instrument at an extremely low room temperature, the power supply circuit is automatic cut off, protecting the motor from damage. If the thermal protector operates, the instrument goes into the following status. (before switch on the personal computer)

a The RP does not start.
b The VENT and EVAC switch lamp flashes.

Restart the instrument as indicated below.

1 Turn OFF the MAIN POWER switch.
2 Confirm that the room temperature is 15 to 25℃.
3 Confirm that cooling water is flowing through the instrument.
4 Press the manual reset button, then start the instrument. (refer to 3.2)
If the instrument remains in the above status (a, d) when it is restarted, it is likely that the fuse has blown. Turn OFF the MAIN POWER switch, and contact your local JEOL service office.



3.5 User Login or Logout

You can register up to 20 user.

If you login to a selected user from the list, the system is reproduced to the SEM status of selected user. The SEM is means set contents and the conditions of the lens system (Accelerating voltage, Magnification, Spotsize, Signal, etc.) for image observation.

If you log out from the current user, the SEM status of logged out is saved to the hard disk of the personal computer, and the system logs into GENERAL again.

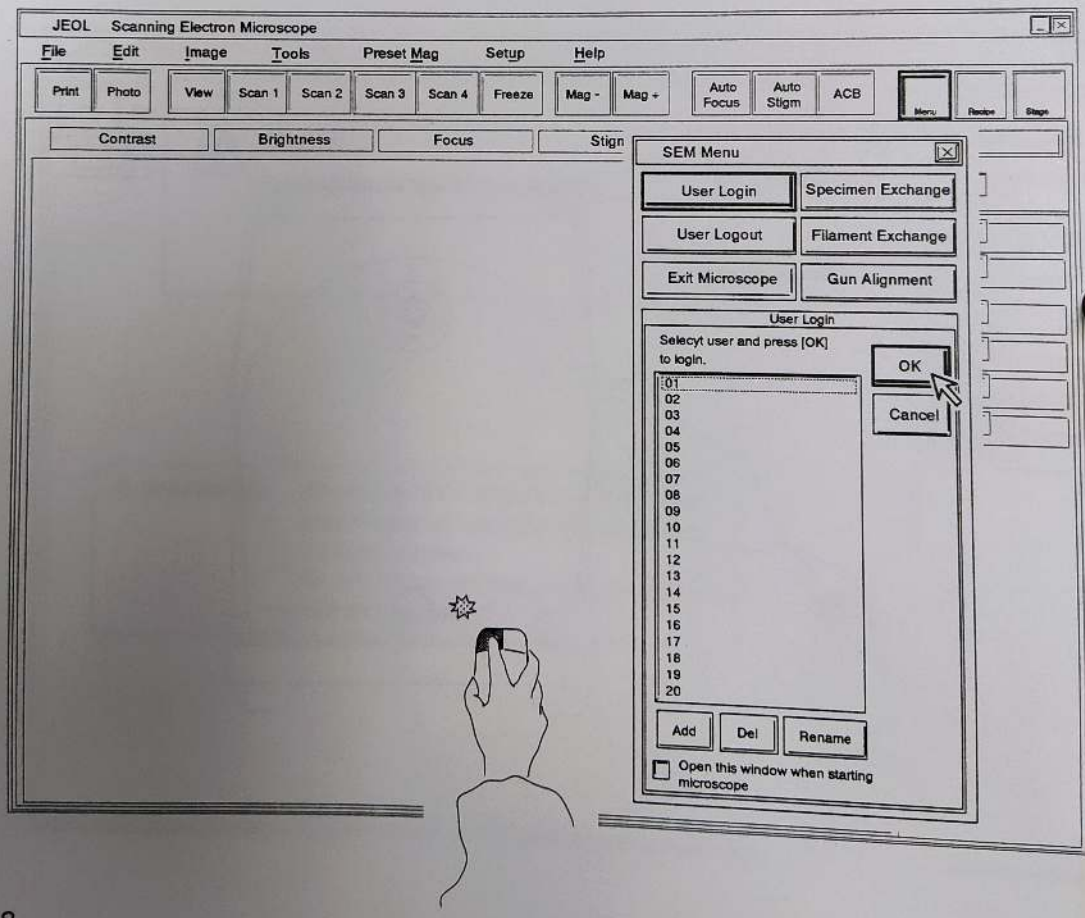
User Login

1 Open [Menu].

2 Click [User Login].

3 Select a user name from the list, then click [OK].

The system is logged in to the selected user. (the message is displayed until the setting up microscope is completes.) If you click [Cancel], the SEM Menu closes without anything taking place.

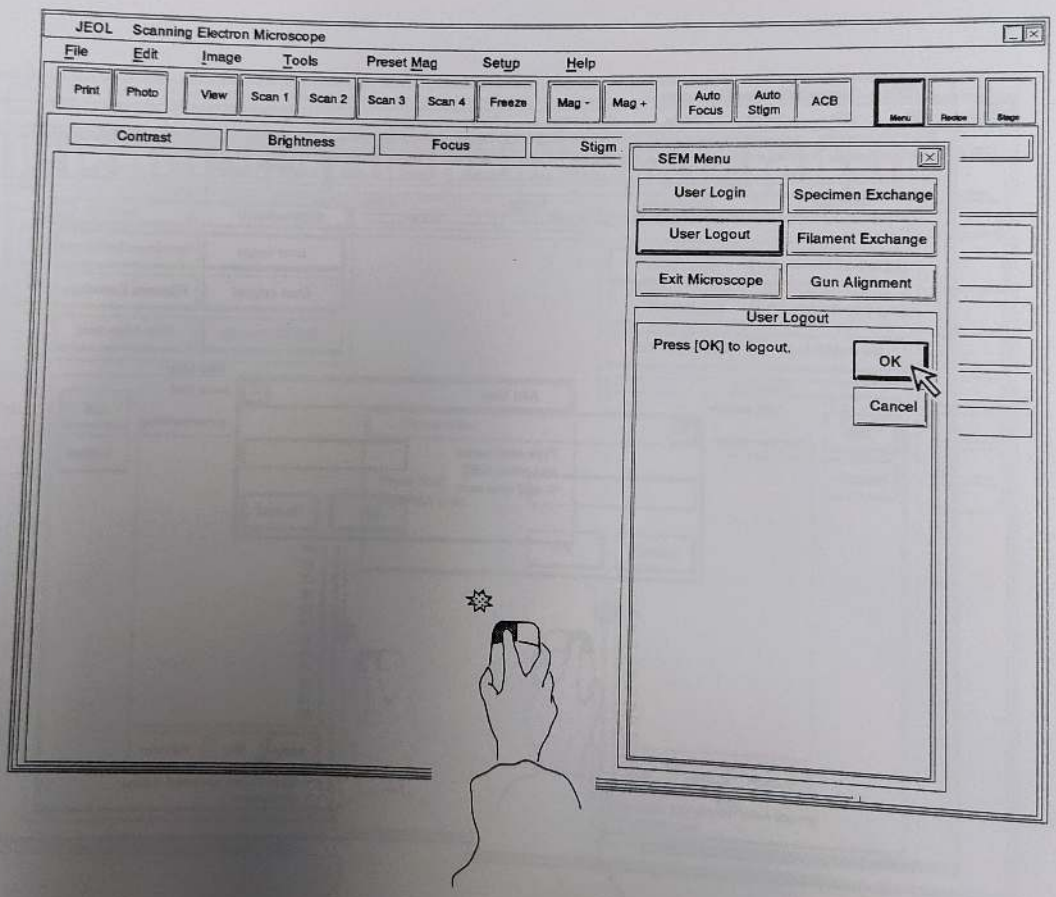


User Logout

1 Open [Menu].
2 Click [User Logout].
3 Click [OK].

The current user is logged out, and the system logs into GENERAL again. (the message is displayed until the setting up microscope completes.)

If you click [Cancel], the SEM Menu closes without anything taking place.



3.5.1 Registering a User

1 Open [Menu].

2 Click [User Login].

3 Click [Add].

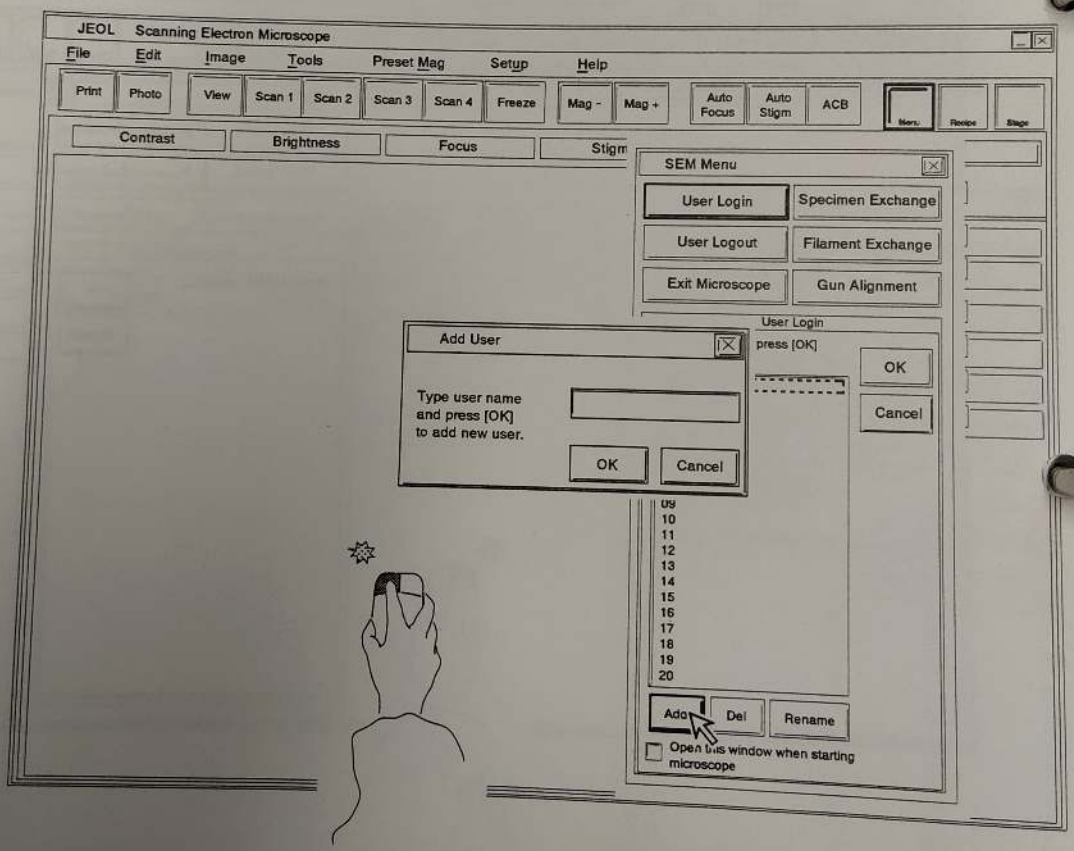
The Add User dialog opens.

4 Enter the user name from the keyboard, then click [OK].

The new user is registered to the list. (You can register up to 20 user names.)

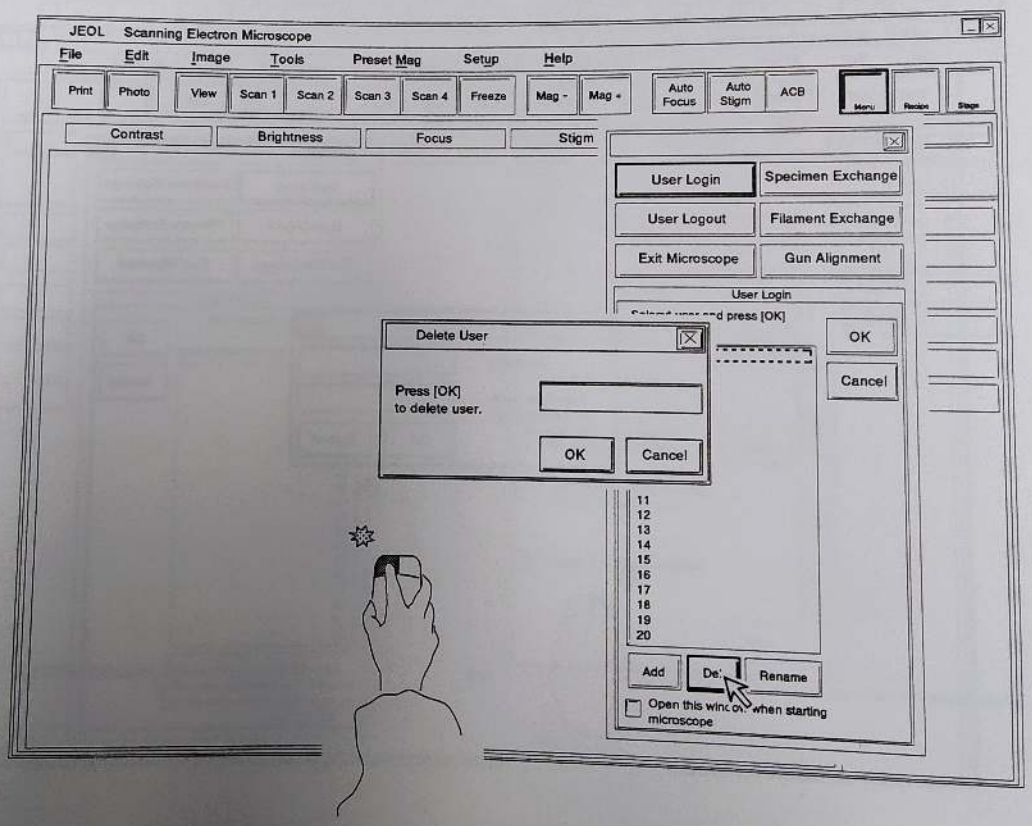
Enter a user name using up to 8 alphanumeric characters.

If you click [Cancel], the Add User dialog closes without anything taking place.



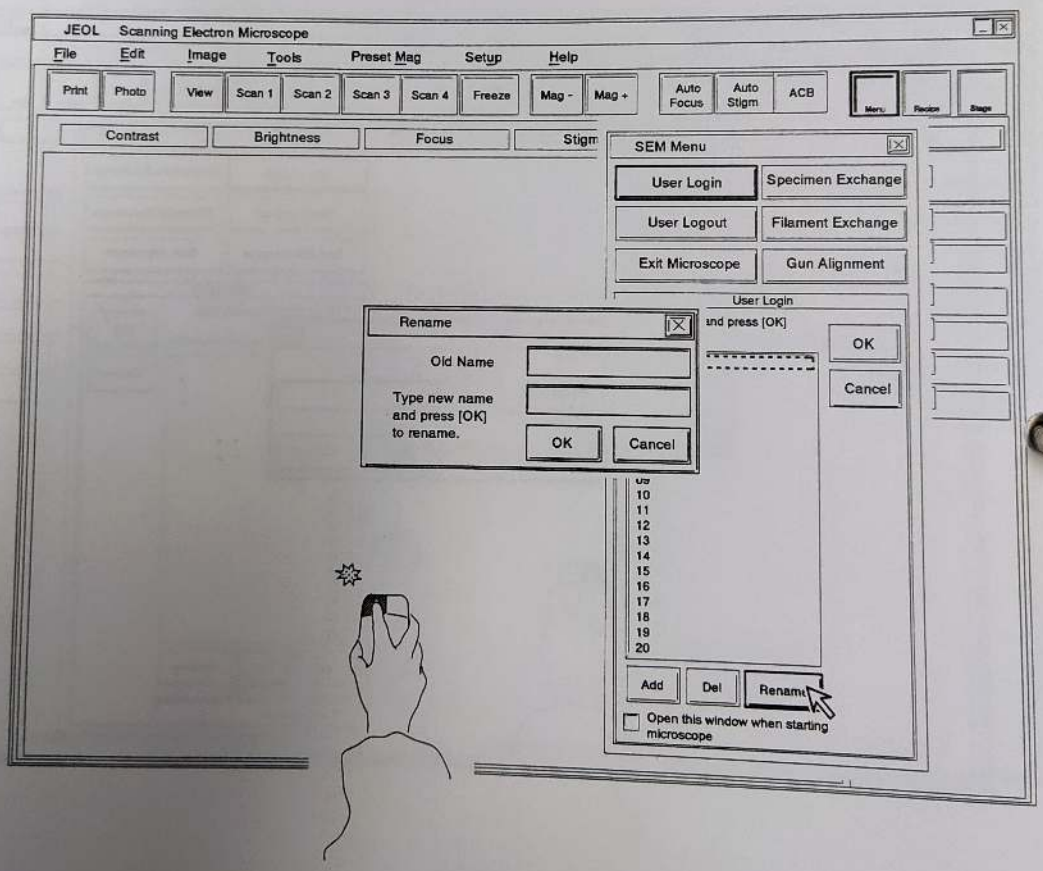
3.5.2 Deleting a User

1 Open [Menu].
2 Click [User Login].
3 Click the user name that you wish to delete from the list.
4 Click [Del].
The Delete User dialog opens.
5 Click [OK].
The user that you selected from the list is deleted. If you click [Cancel], the Delete User dialog closes without anything taking place.



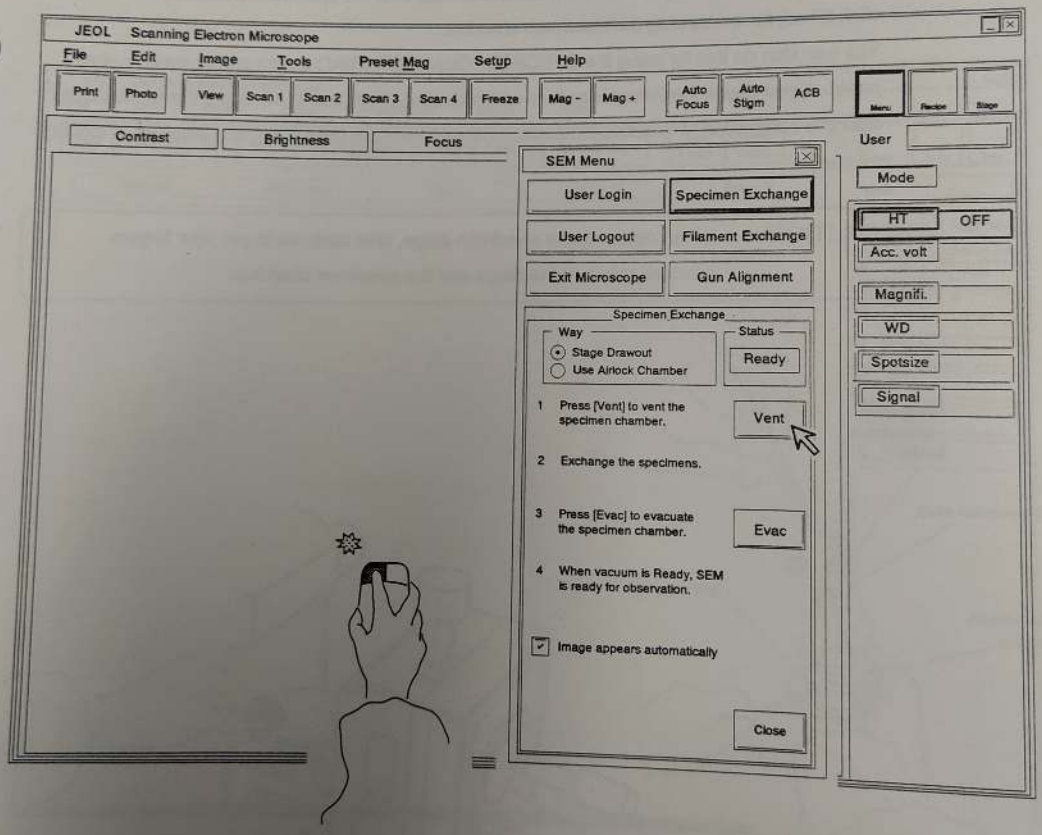
3.5.3 Changing a User Name

1 Open [Menu].
2 Click [User Login].
3 Click the user name that you wish to change from the list.
4 Click [Rename].
The Rename dialog opens.
5 Enter the new user name from the keyboard, then click [OK].
The user name is changed to the new user name. Enter a user name using up to 8 alphanumeric characters.
If you click [Cancel], the Rename dialog closes without anything taking place.



3.6 Exchanging the Specimen

1 Click [HT] on the status display so that OFF appears to the right of [HT].
2 Open [Menu].
3 Select [Specimen Exchange], then click [Stage Drawout].
4 Click [Vent] for venting the specimen chamber to atmosphere.
You can also do this by using the SPECIMEN CHAMBER VENT switch on the main control panel.
5 Wait for about 30 seconds, then withdraw the specimen stage, and remove the specimen holder on the stage.



The [Way - Use Airlock Chamber] of the Specimen Exchange can only be selected when an optional ALC/ALS is installed. For details, refer to the instruction manual.

6 Make a specimen.

Place the specimen on the specimen base, then fix the specimen base in such a way that the observation face of the specimen coincides with the top face of the specimen holder.

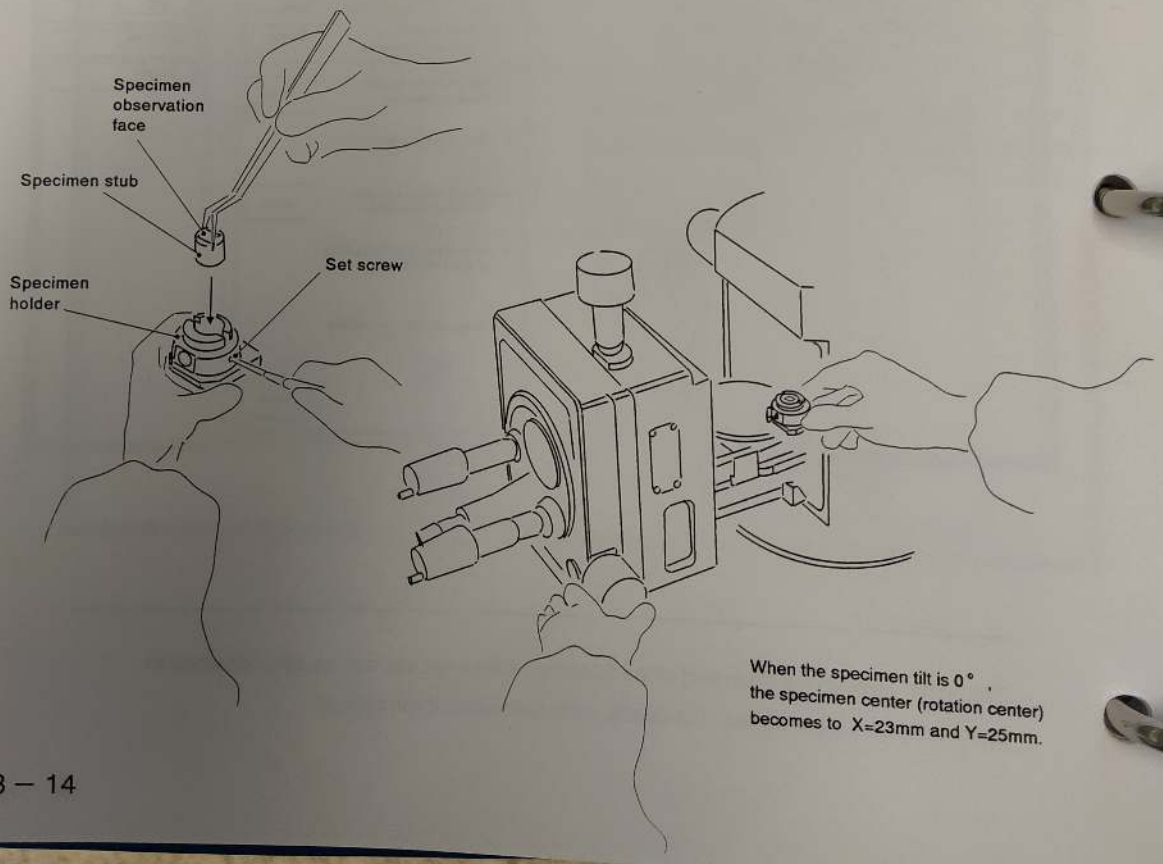
- If the observation face of the specimen protrudes above the top face of the specimen holder, you should perform [Specimen Height]. (refer to 3.7.13)
- Depending upon the particular kind of specimen, use electrically conductive paint to prevent the specimen from becoming electrically charged.
- Avoid installing a specimen containing more moisture or oil than necessary because this will contaminate the inside of the electron optical column.

7 Install the specimen holder on the stage.

8 Push the specimen stage until it is in intimate contact with the specimen chamber, then click [Evac] for evacuating the specimen chamber.

You can also do this by using the SPECIMEN CHAMBER EVAC switch on the main control panel. If you check the [Image appears automatically] check box in advance, the menu closes after the completion of evacuation, and the HT automatically goes [ON], enabling you to display an image.

> ⚠ CAUTION When returning the specimen stage, take care not to get your fingers crushed between the stage and the specimen chamber.



3.7 Image observation

1 Install the specimen that you wish to observe. (Refer to 3.6)

2 Check that the vacuum status display becomes [HT Ready].

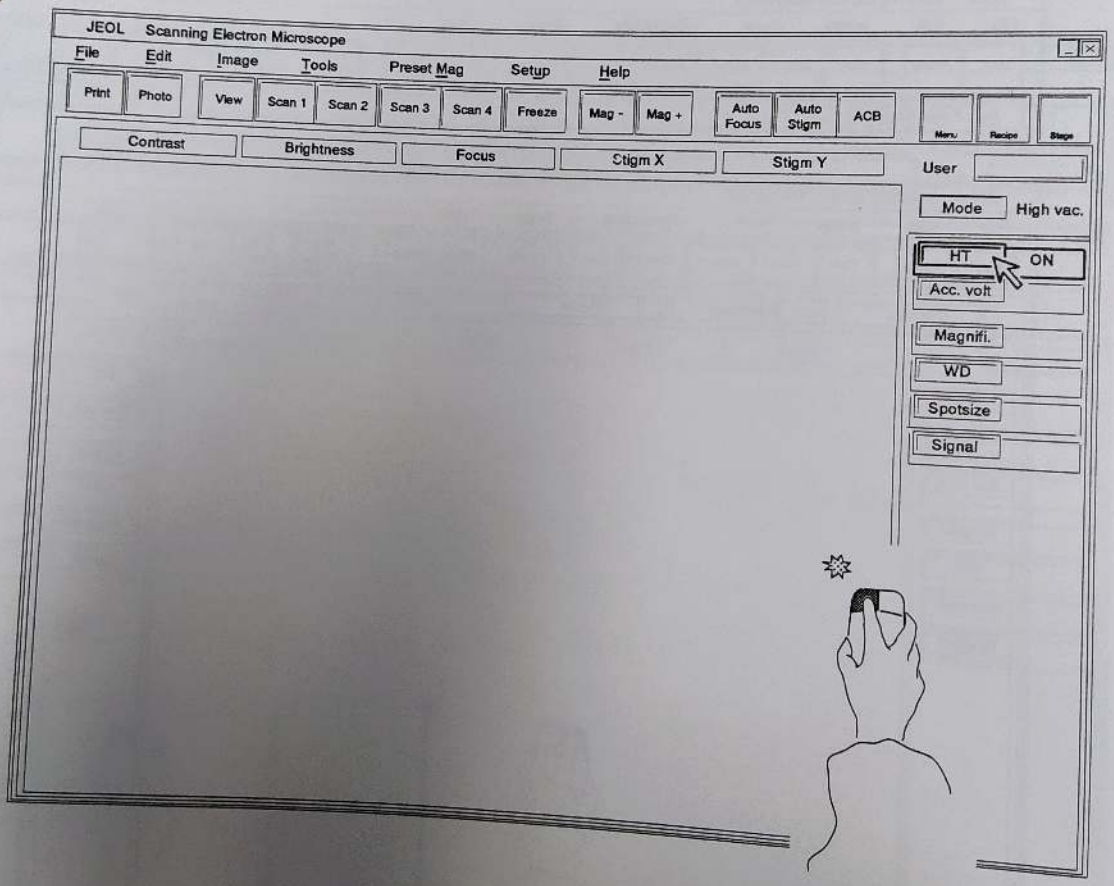
3 Click [HT] on the status display so that ON appears to the right of [HT].

If the filament is broken or the load current of higher than 150 μA is flowed to the filament, message dialog appears.

Close the message message dialog, the Filament Exchange menu automatically opens.

Replace the filament or check the tip of the filament according to the Filament Exchange menu. (refer to Chapter 4)

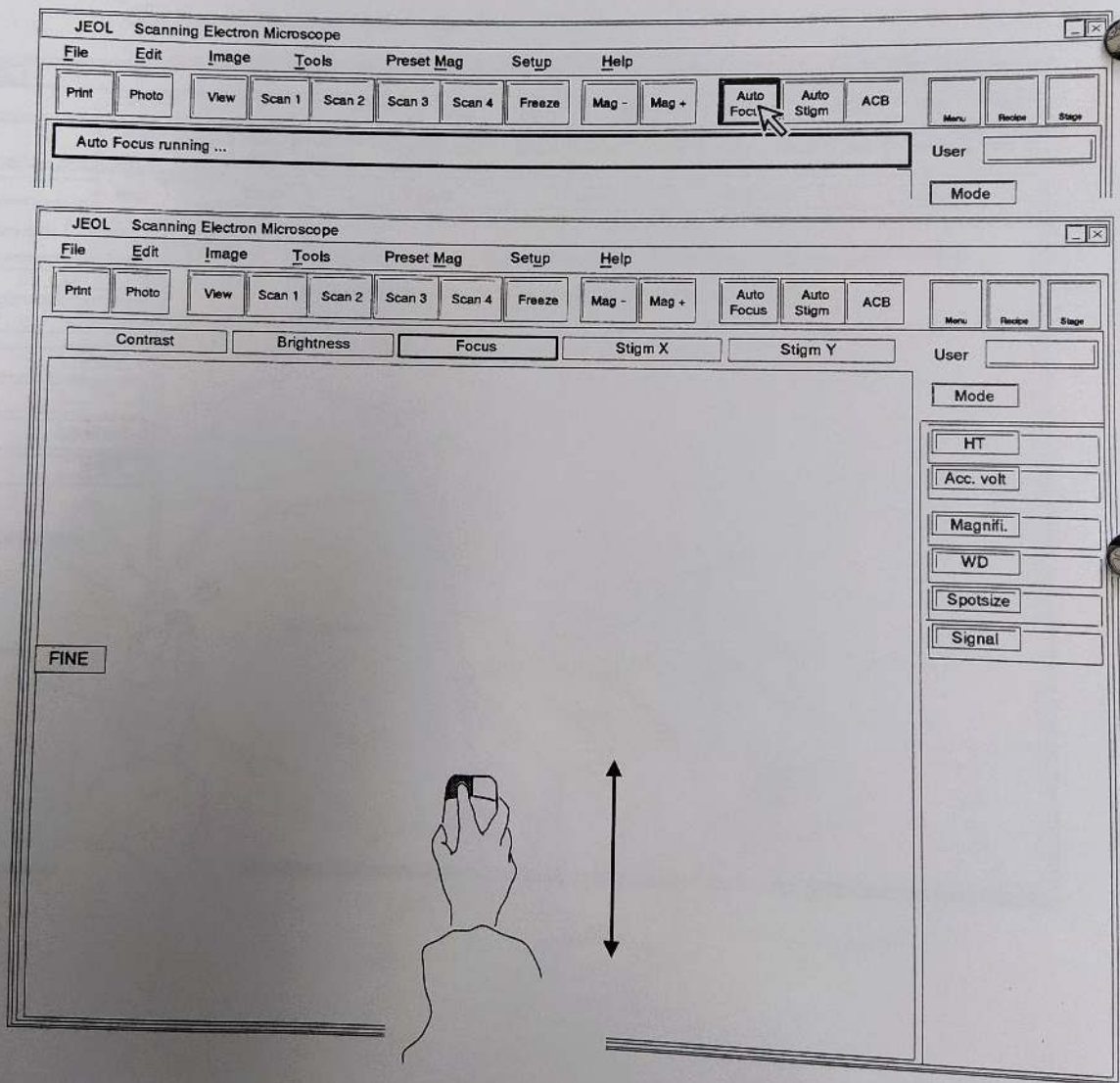
4 Adjust the focus, contrast and brightness of the image.



3.7.1 Focus Adjustment

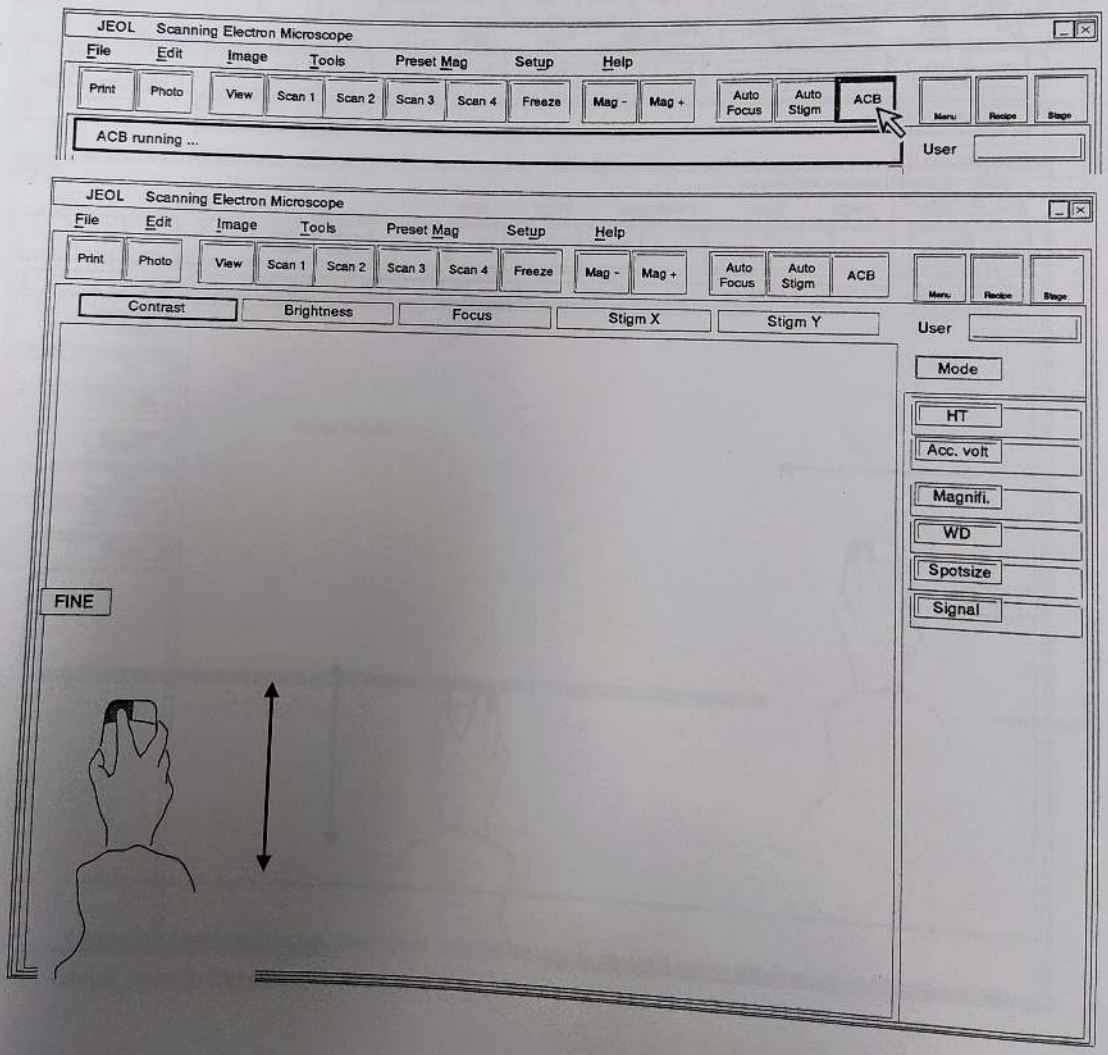
- Several seconds after you click the [Auto Focus] SEM control button, a focused image appears.
- If you wish to fine adjust the focus, align the pointer with [Focus] on the image adjustment tool bar, then, while keeping the left button pressed, move the mouse up or down so as to focus the image. ([FINE] is displayed to the left side on the screen.)
- If you wish to rough adjust the focus, align the pointer with [Focus] on the image adjustment tool bar, then, while keeping the right button pressed, move the mouse up or down so as to focus the image. ([COARSE] is displayed to the left side on the screen.)

  Moving the mouse up results in overfocusing, and moving it down results in underfocusing.



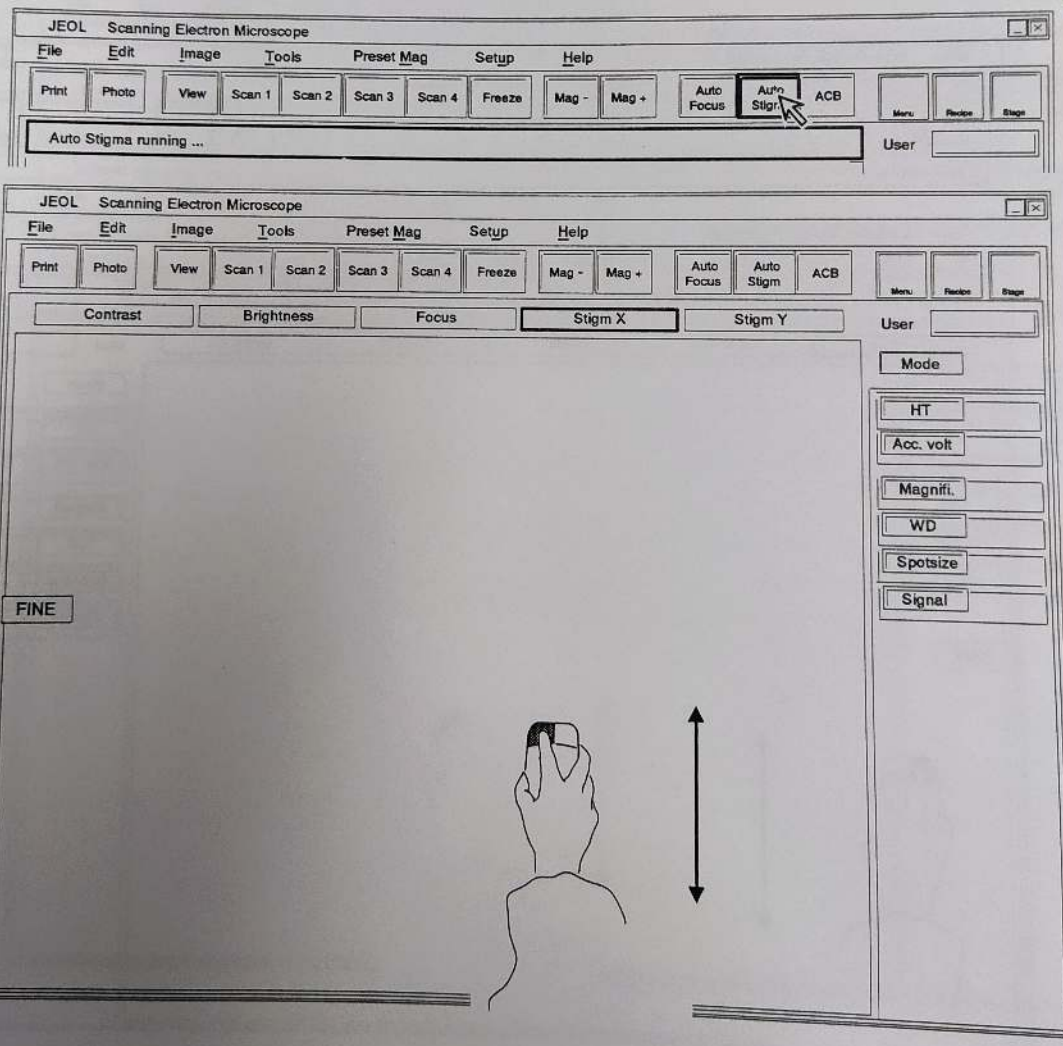
3.7.2 Contrast and Brightness Adjustments

- Several seconds after you click the [ACB] SEM control button, an image whose contrast and brightness have been adjusted appears.
- If you wish to fine adjust the contrast or brightness, align the pointer with [Contrast] or [Brightness] on the image adjustment tool bar, then, while keeping the left button pressed, move the mouse up or down so as to adjust the contrast or brightness.
  ([FINE] is displayed to the left side on the screen.)
- If you wish to rough adjust the contrast or brightness, align the pointer with [Contrast] or [Brightness] on the image adjustment tool bar, then, while keeping the right button pressed, move the mouse up or down so as to adjust the contrast or brightness.
  ([COARSE] is displayed to the left side on the screen.)
  Moving the mouse up makes the image bright, and moving it down makes the image dark.



3.7.3 Astigmatism Correction

- Several seconds after you click the [Auto Stigm] SEM control button, an image whose astigmatism has been adjusted appears.
- If you wish to fine adjust the astigmatism, align the pointer with [Stigm X] or [Stigm Y] on the image adjustment tool bar, then, while keeping the left button pressed, move the mouse up or down so as to adjust the astigmatism. ([FINE] is displayed to the left side on the screen.)
- If you wish to rough adjust the astigmatism, align the pointer with [Stigm X] or [Stigm Y] on the image adjustment tool bar, then, while keeping the right button pressed, move the mouse up or down so as to adjust the astigmatism. ([COARSE] is displayed to the left side on the screen.)



3.7.4 Fine Shift (fine field shift)

1 Move the mouse pointer to the image display area.

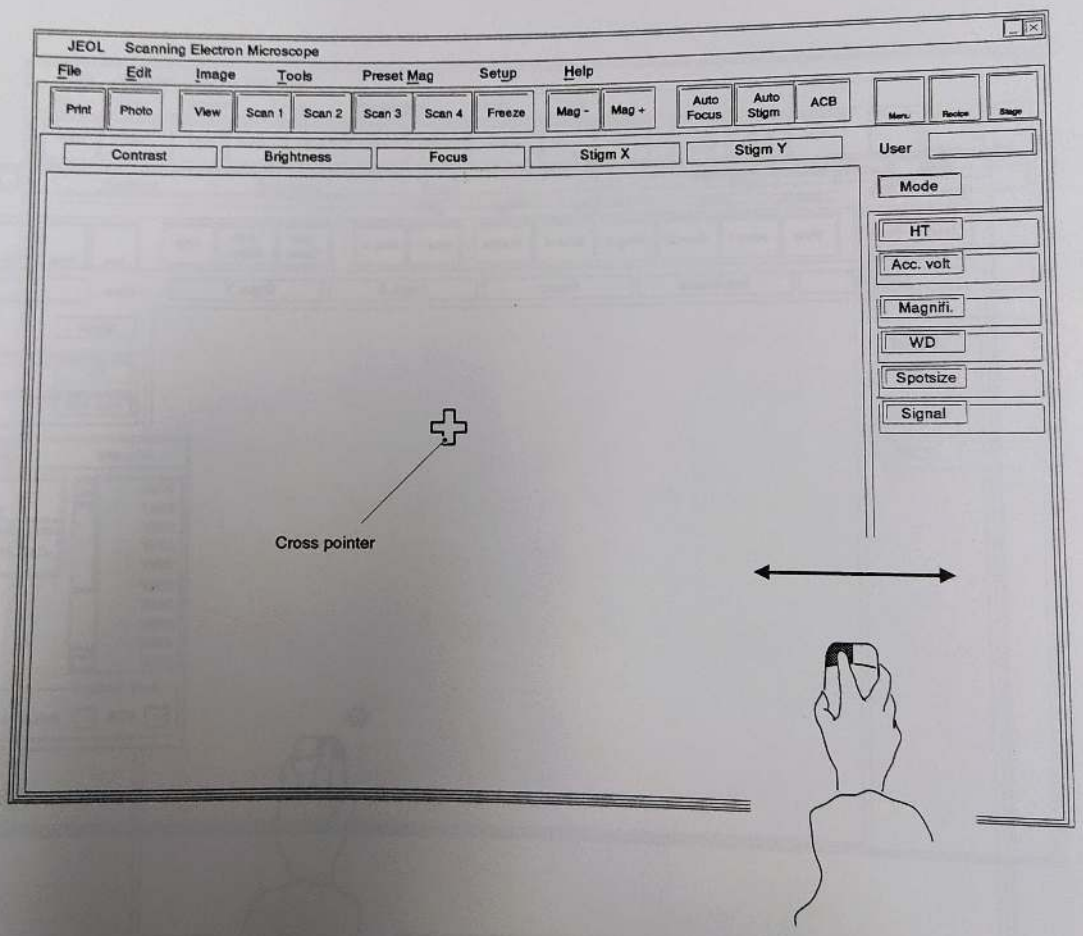
2 Since the mouse pointer changes to a cross, then while keeping the left button pressed, move the mouse back and forth, or left and right.

The image undergoes a fine shift in the direction in which the mouse is moved.

(The shift is about $\pm 10\,\mu$m at an Acc. volt of 30kV, and WD of 20mm.)

If you remove the mouse left button, the fine shift stops.

If you double-click the mouse left button, the fine shift returns to the mid-point.

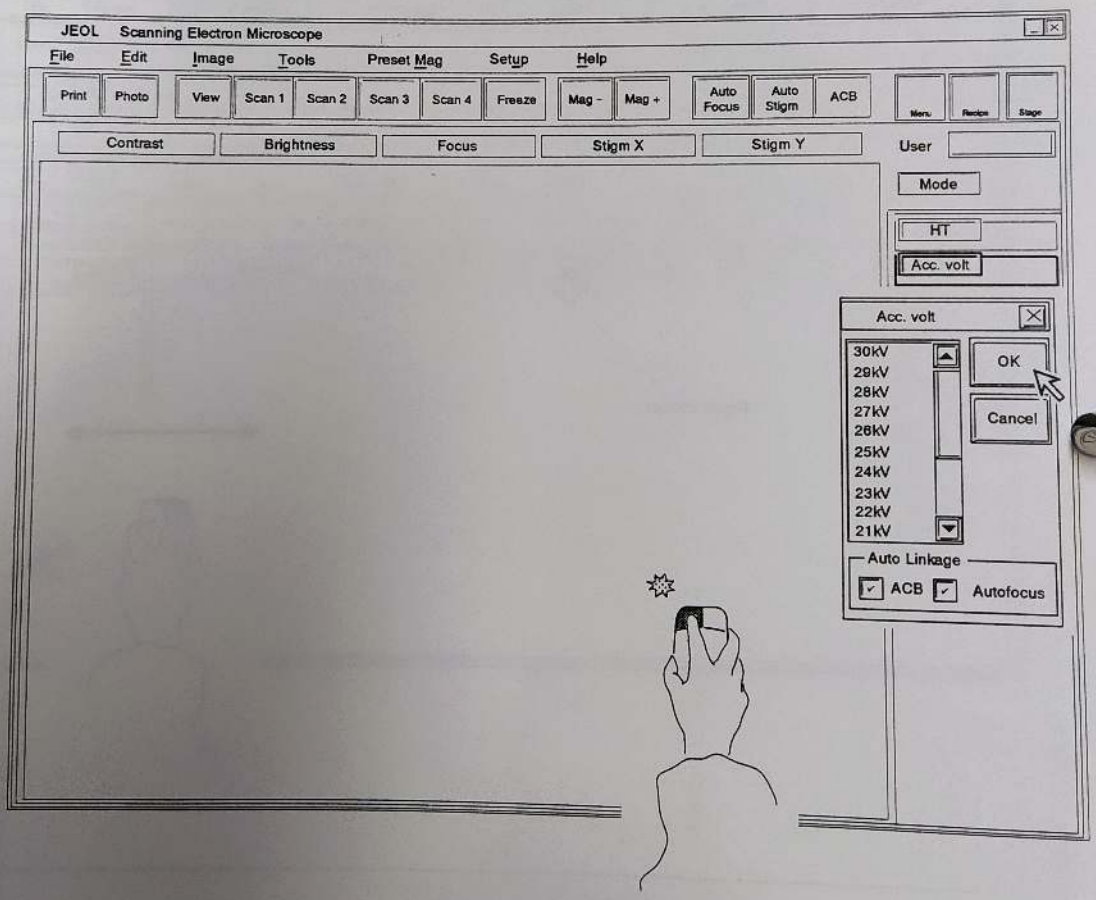


If you wish to move the specimen over a large distance, move it using the knobs on the specimen stage. (refer to Chapter 2)

3.7.5 Setting the Accelerating Voltage

1 Click [Acc. volt] on the status display.
The Acc. volt window opens.

2 Select the desired accelerating voltage from the list, and click [OK].
The accelerating voltage changes over, and the Acc. volt window closes. The same operation takes place if you double-click the desired accelerating voltage. If you click [Cancel], the Acc. Volt window closes without anything taking place.
If you check [ACB] or [Autofocus] of Auto Linkage, then change over the accelerating voltage, ACB or auto focus changes according to the selected voltage.

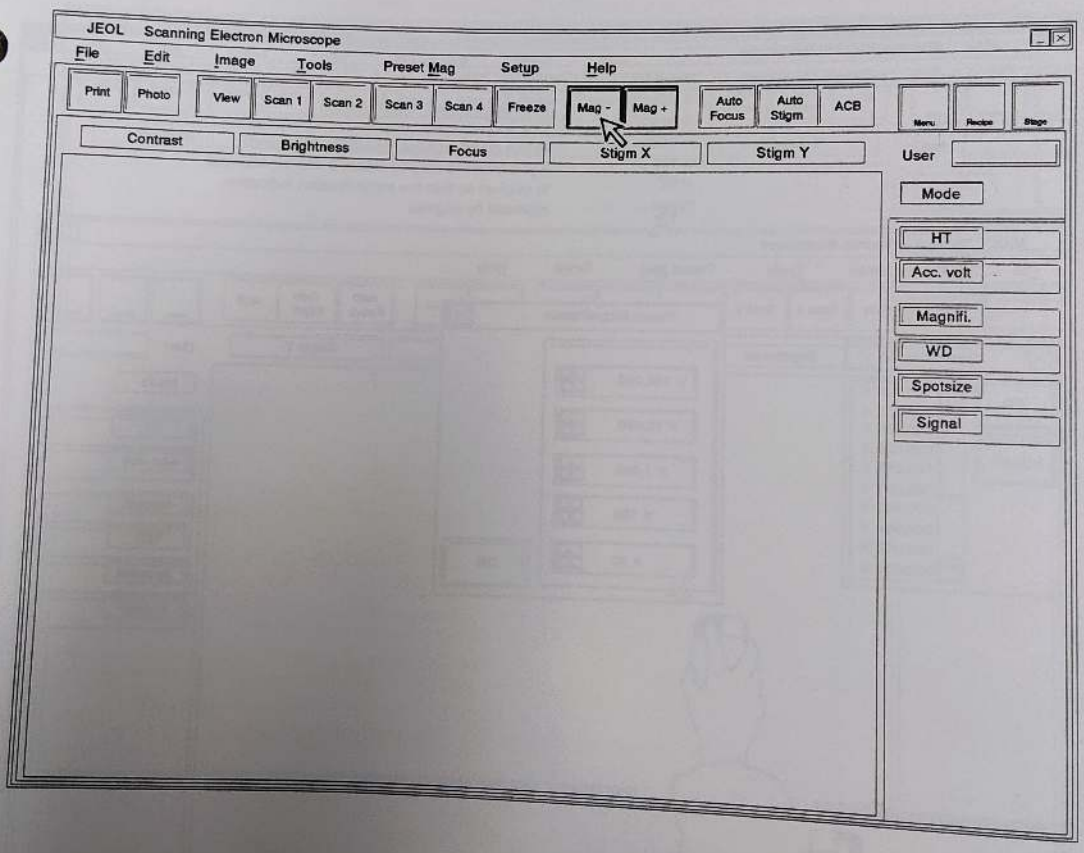


3.7.6 Setting the Magnification

There are three methods for setting the magnification. (refer to Page.3-21~23)

SEM control button [Mag −], [Mag +]

1 Click [Mag −] or [Mag +] .
The current magnification becomes down(−) or up(+).



【Setting the Magnification −①】

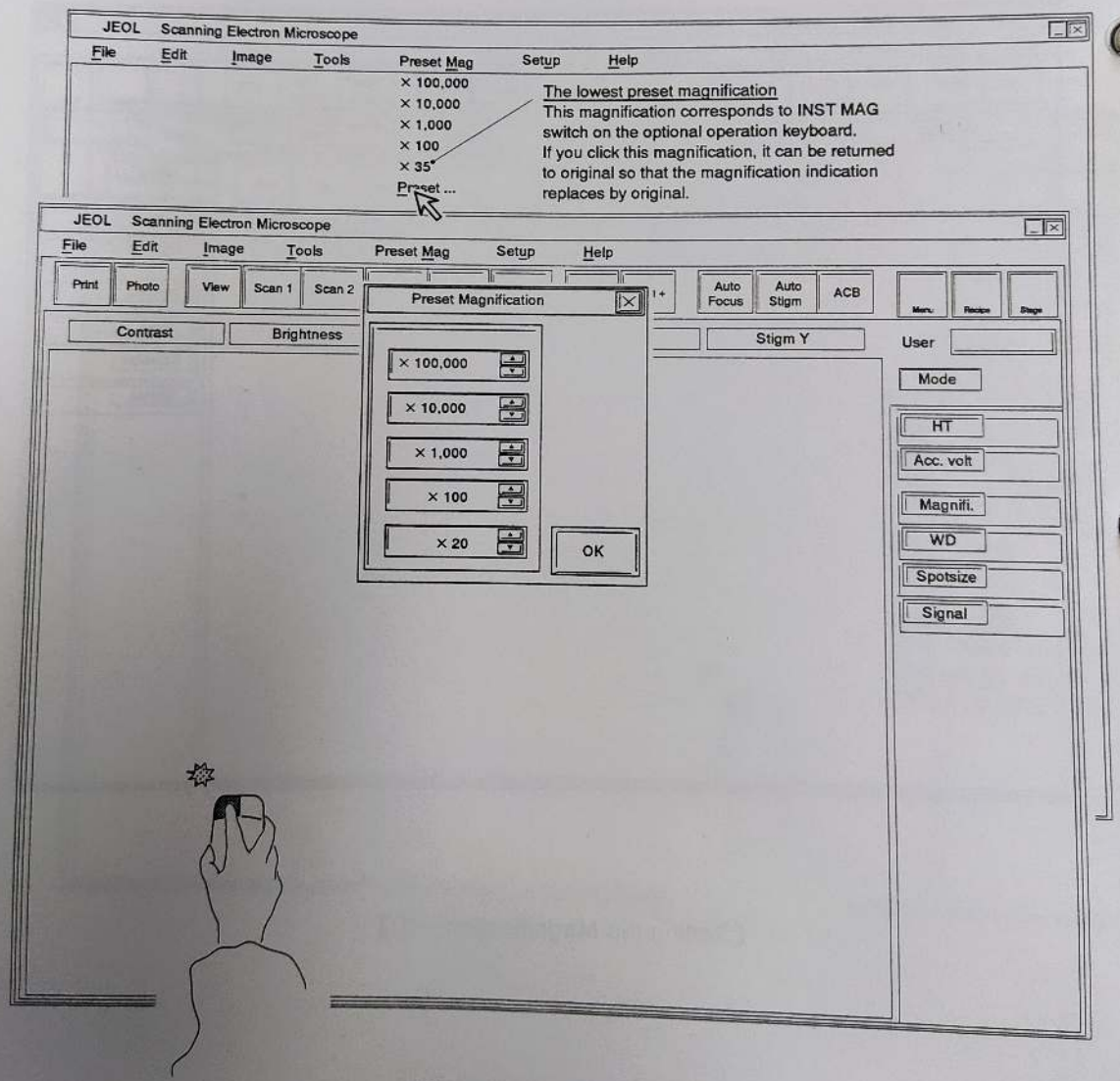
Preset Magnification

Can be switched over instantaneously from an arbitrary magnification to a preset magnification.

1 Open the [Preset Mag] on the menu bar.

2 Click the desired magnification from a pull-down menu.

To set the magnification, click [Preset ...] of [Preset Mag] , set the desired magnification (×18~ ×300,000) using arrow button on the Preset Magnification dialog, then click [OK].

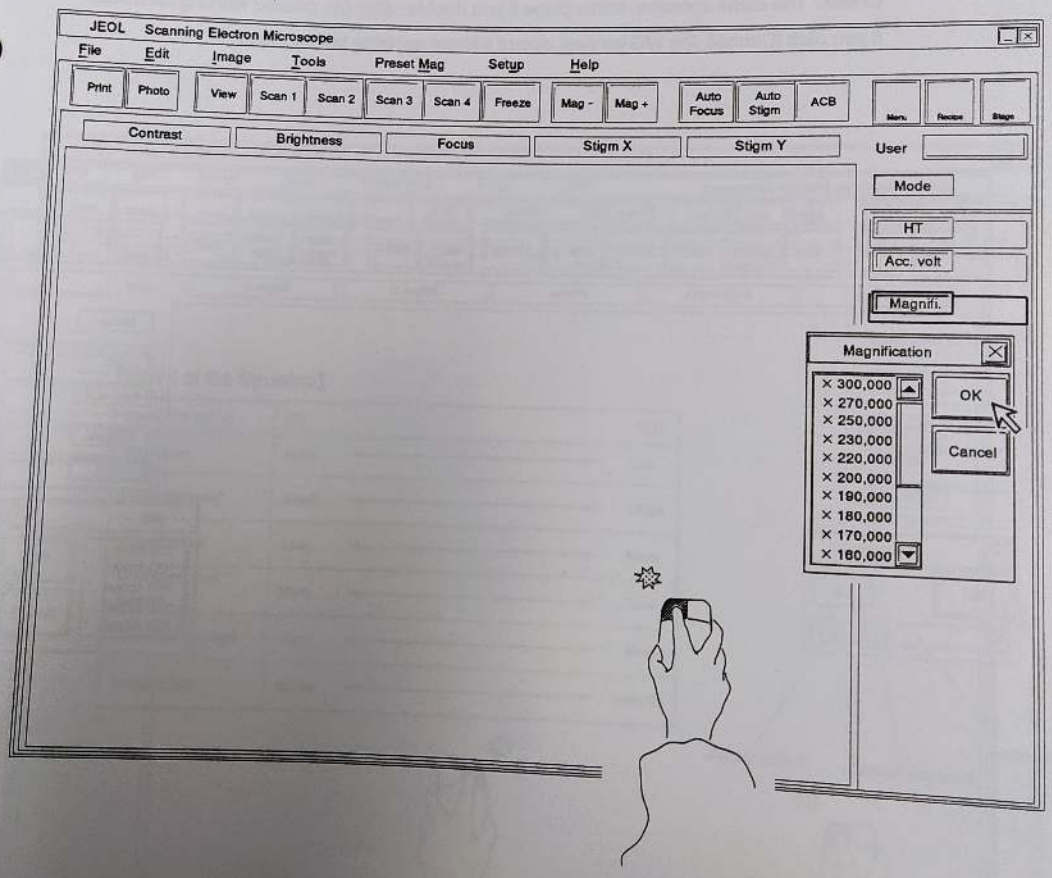


【Setting the Magnification –②】

[Magnifi.] on the status display

1 Click [Magnifi.] on the status display.
The Magnification window opens.

2 Select the desired magnification from the list, then click [OK].
The magnification changes over, and the Magnification window closes. The same operation takes place if you double-click the desired magnification.
If you click [Cancel], the Magnification window closes without anything taking place.

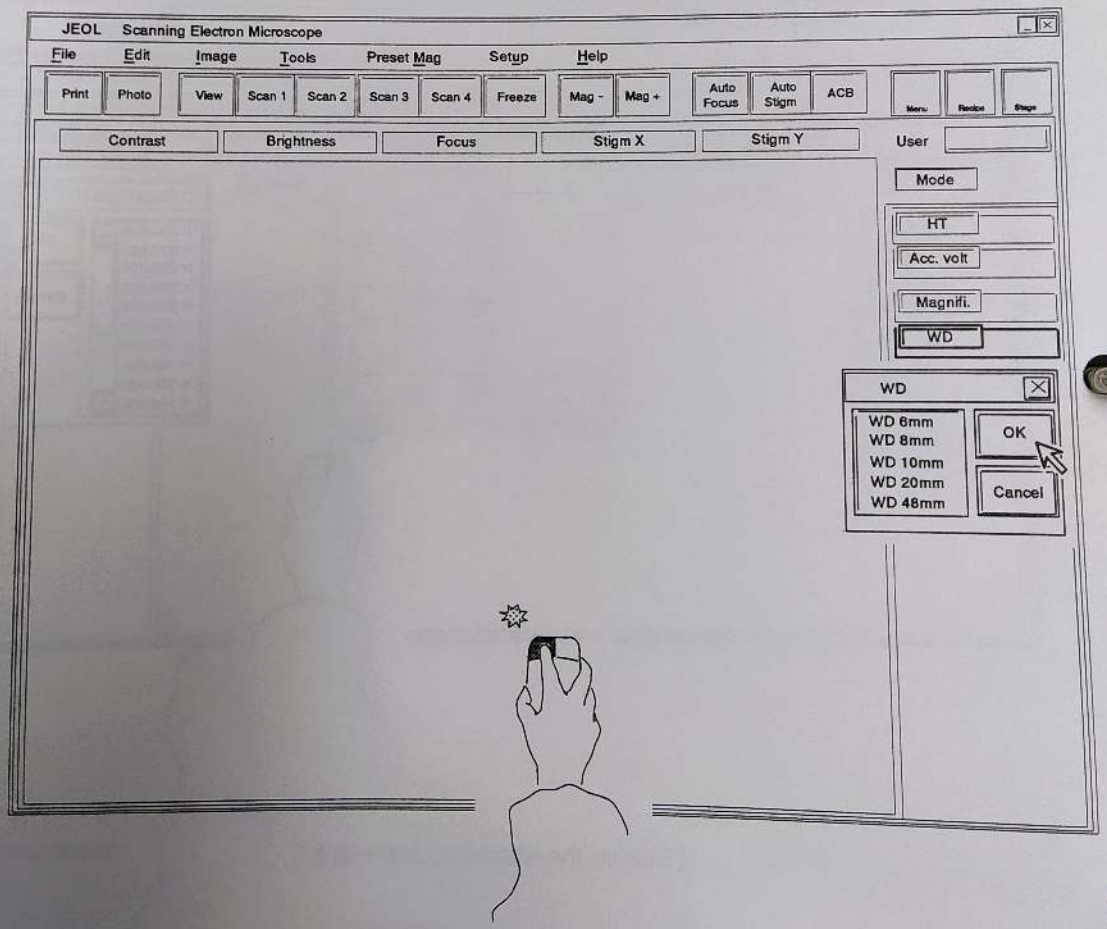


【Setting the Magnification –③】

3.7.7 Setting a Focusing Current that Corresponds to the WD

If you know the WD in advance, you can quickly adjust rough focusing using this function.
If you wish to keep the WD (example WD10mm) for X-ray analysis, etc., select [WD10mm] and click [OK], then adjust focusing with the Z movement knob of the specimen stage.

1 Click [WD] on the status display.
The WD window appears.
2 Select the desired working distance from the list, then click [OK].
A focusing current corresponding to the selected working distance is set, then the WD window closes. The same operation takes place if you double-click the desired working distance.
If you click [Cancel], the WD window closes without anything taking place.

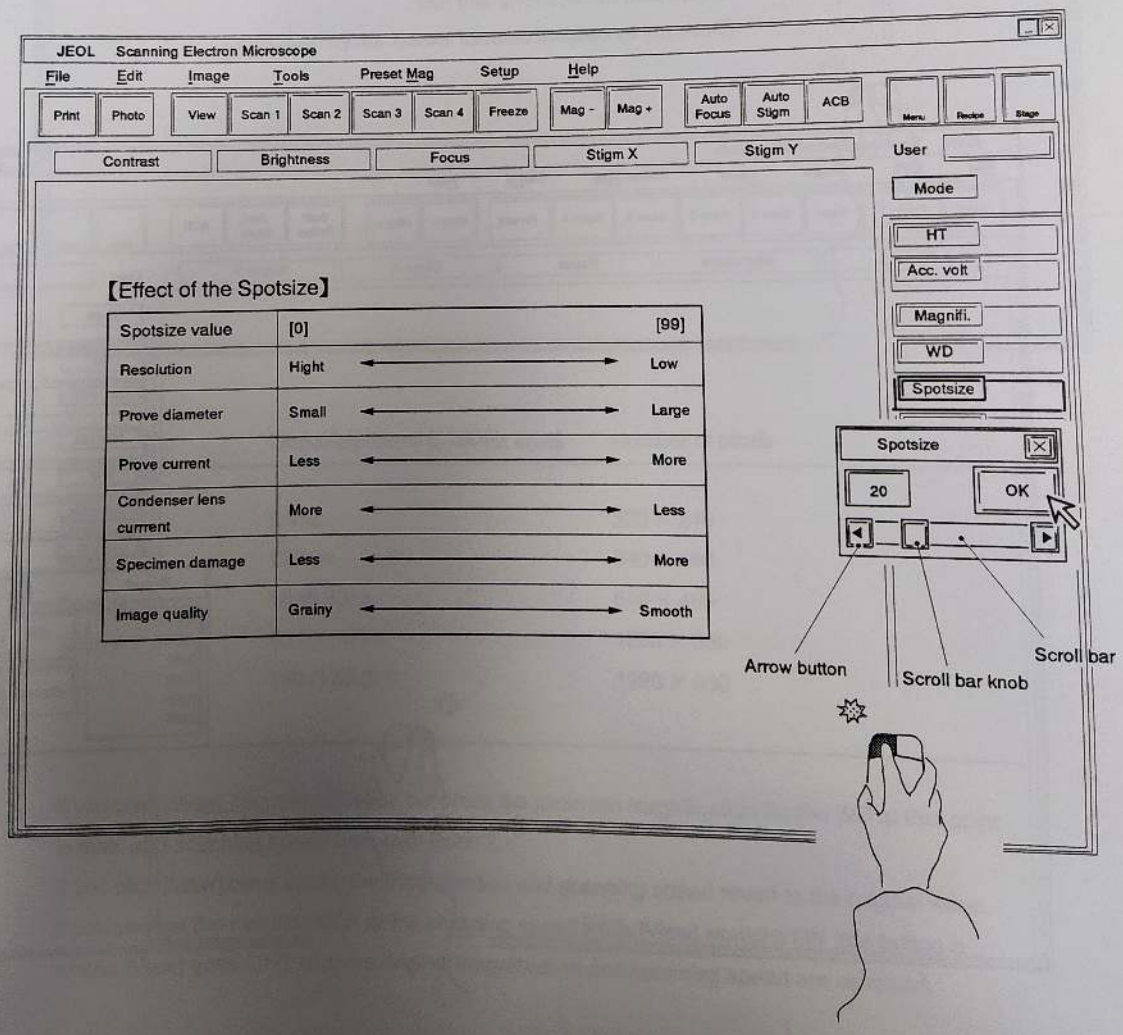


3.7.8 Setting the Spot Size

1 Click [Spotsize] on the status display.
The Spotsize window appears.

2 Adjust the spotsize value. (Range: 0~99)
To adjust, drag the scroll bar knob or click the arrow button.
Ordinary observation, adjust the spot size to about "20".
High resolution, adjust spot size to "20 or less".
Analysis, adjust spot size to "20 or more".

3 Click [OK].
The Spotsize window closes.



【Effect of the Spotsize】

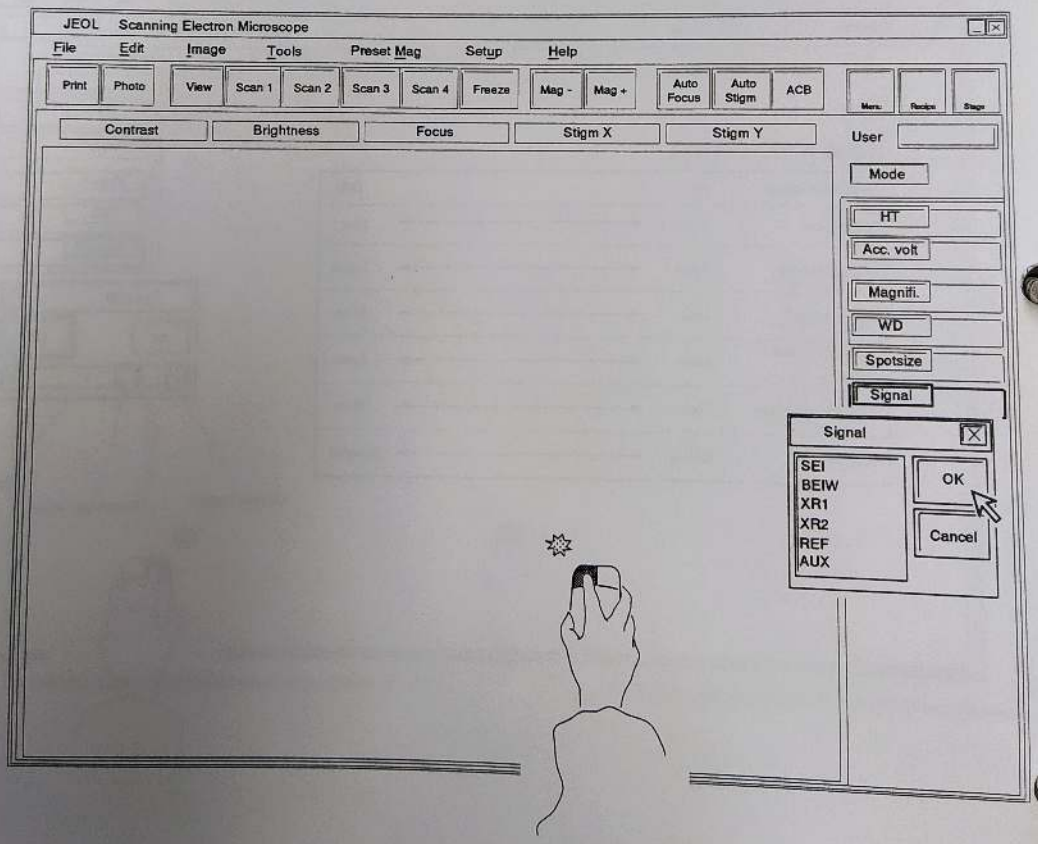
Spotsize value	[0]		[99]
Resolution	Hight	← →	Low
Prove diameter	Small	← →	Large
Prove current	Less	← →	More
Condenser lens currrent	More	← →	Less
Specimen damage	Less	← →	More
Image quality	Grainy	← →	Smooth

3.7.9 Setting a Signal

1 Click [Signal] on the status display.
The Signal window opens.

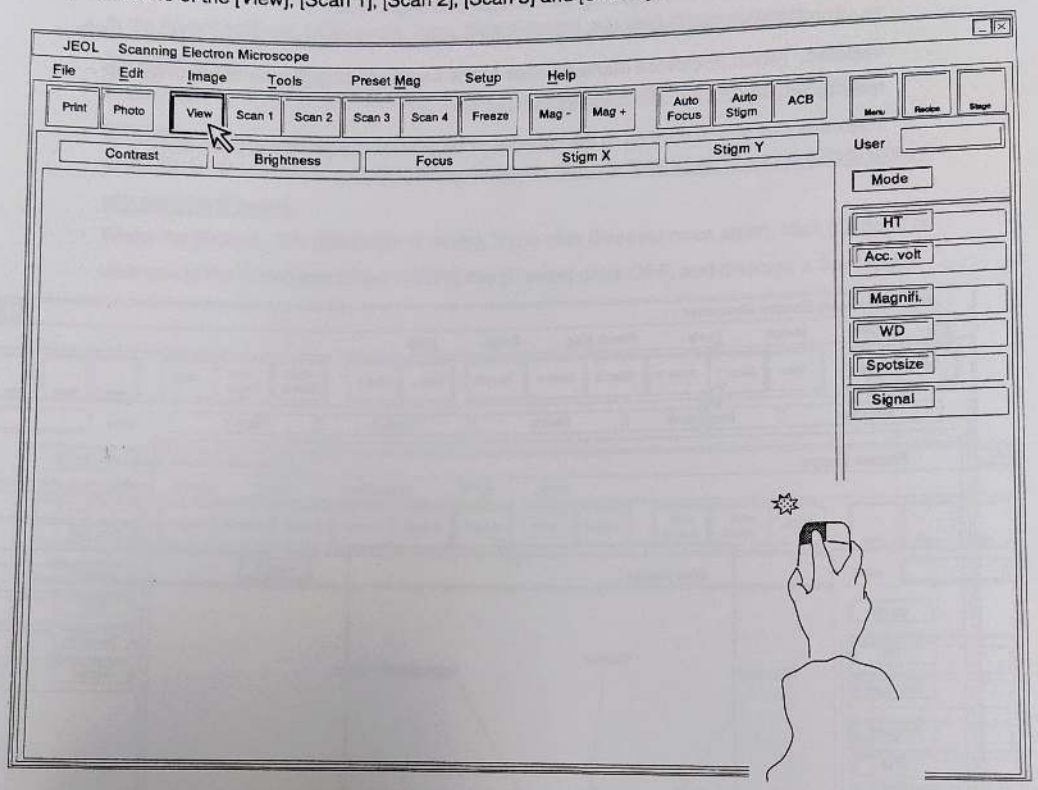
2 Select the desired signal from the list, then click [OK].
The signal changes over and the window closes. The same operation takes place if you double-click the desired signal. If you click [Cancel], the Signal window closes without anything taking place.

SEI:	Secondary Electron Image
BEIW:	Backscattered Electron Image [Detected by Backscattered electron detector)
XR1/2:	X-ray Image [EDS, WDS (optional)]
REF:	Backscattered Electron Image (Detected by Secondary electron detector)
AUX:	Except SEI, BEIW, XR1/2 and REF. (Detected by optional detector except above detectors.)



3.7.10 Selecting the Live image

1 Click one of the [View], [Scan 1], [Scan 2], [Scan 3] and [Scan 4] .



	Scanning speed [( ):60Hz area]	Number of pixels
Scan 1	64ms	320 × 240
Scan 2	128ms	640 × 480
Scan 3	10 (8.33) s	640 × 480
Scan 4	80 (66.67) s	1280 × 960
	160 (133.3) s	1280 × 960

If you click [View], the magnification becomes the minimum magnification for the WD at that point in time, and scanning speed becomes Scan 2.

If you click [View] once again, the magnification and scanning speed revert to the original value.

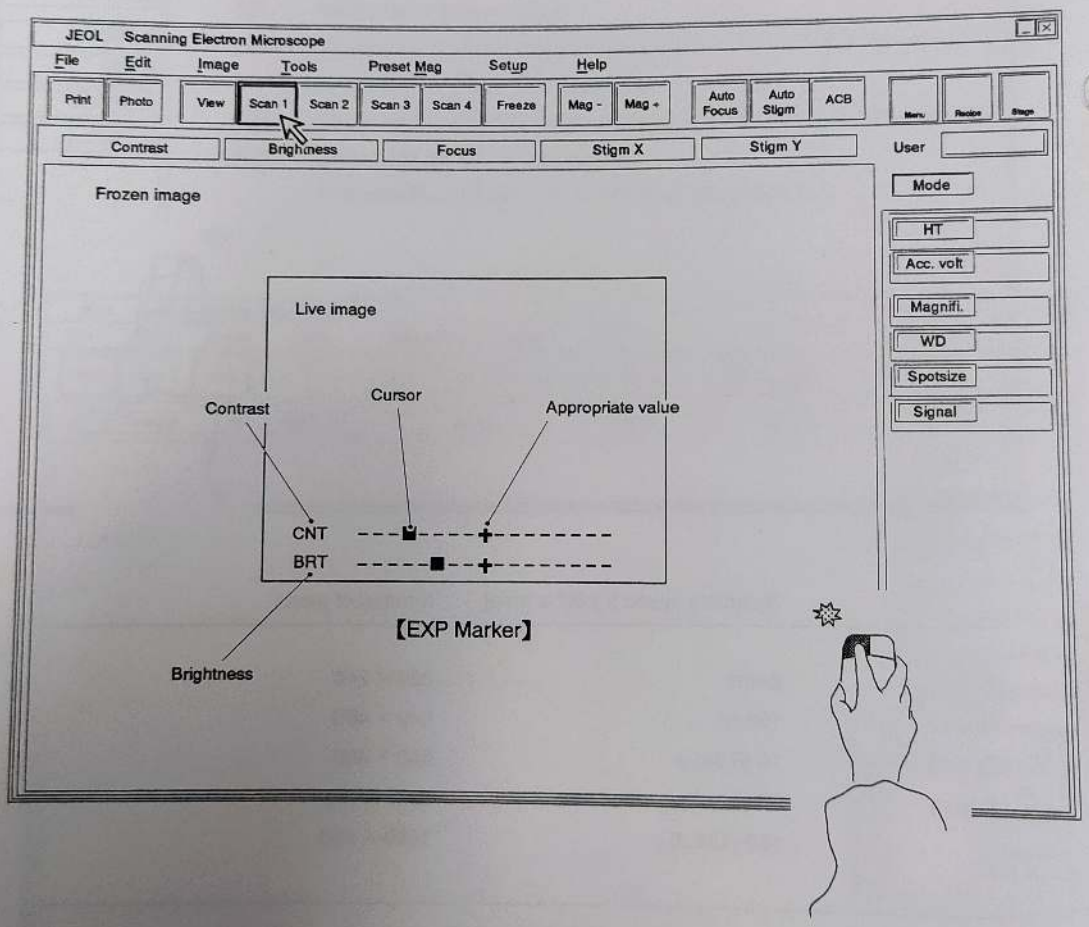
If you change the magnification or the scanning speed while [View] remains ON (the button is white), [View] goes OFF, and the original magnification and scanning speed are canceled.

Exposure Marker (EXP Marker)

Use the EXP Marker for adjusting the contrast and brightness.

The EXP Marker can only be displayed when the [Scan 1] or SCAN 1 switch (optional OKB) is selected. (when [Exposure Marker] check box is checked using [Frame Store] of [Setup] – refer to 3.7.14)

The cursor moves according to the contrast or brightness adjustment of the image.

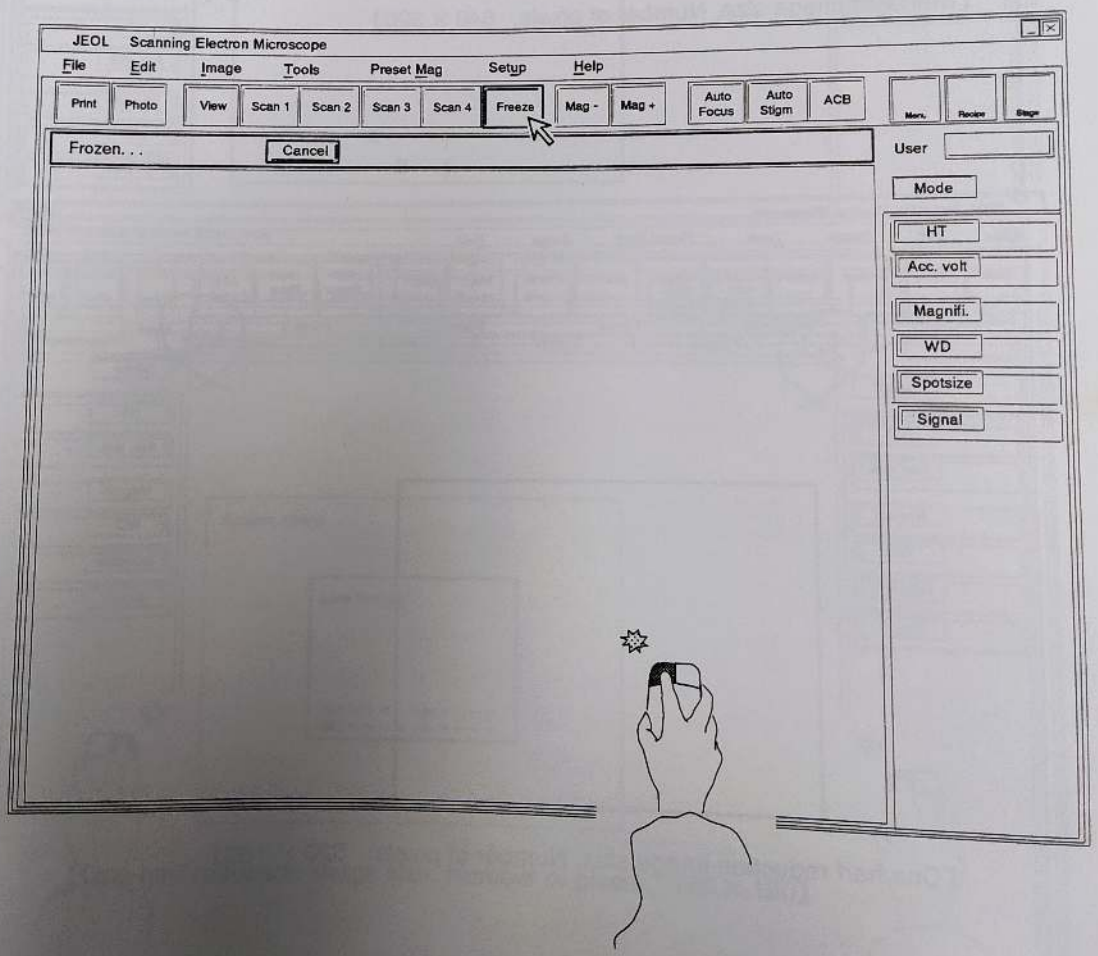


【EXP Marker】

3.7.11 Displaying the Frozen image

1 Click [Freeze].

- In the [View] or [Scan 1/2/4] mode, if you click [Freeze], a frozen image appears instantaneously.
- In the [Scan 3], if you click [Freeze], a frozen image appears after one frame has been acquired.
- In the [Scan 4] or [Photo], a frozen image appears after one frame has been acquired, even if you not click [Freeze].
- When the [Freeze] ON (the button is white), if you click [Freeze] once again, click [Cancel] or click one of the [View] and [Scan 1/2/3/4], the [Freeze] goes OFF, and displays a live image.

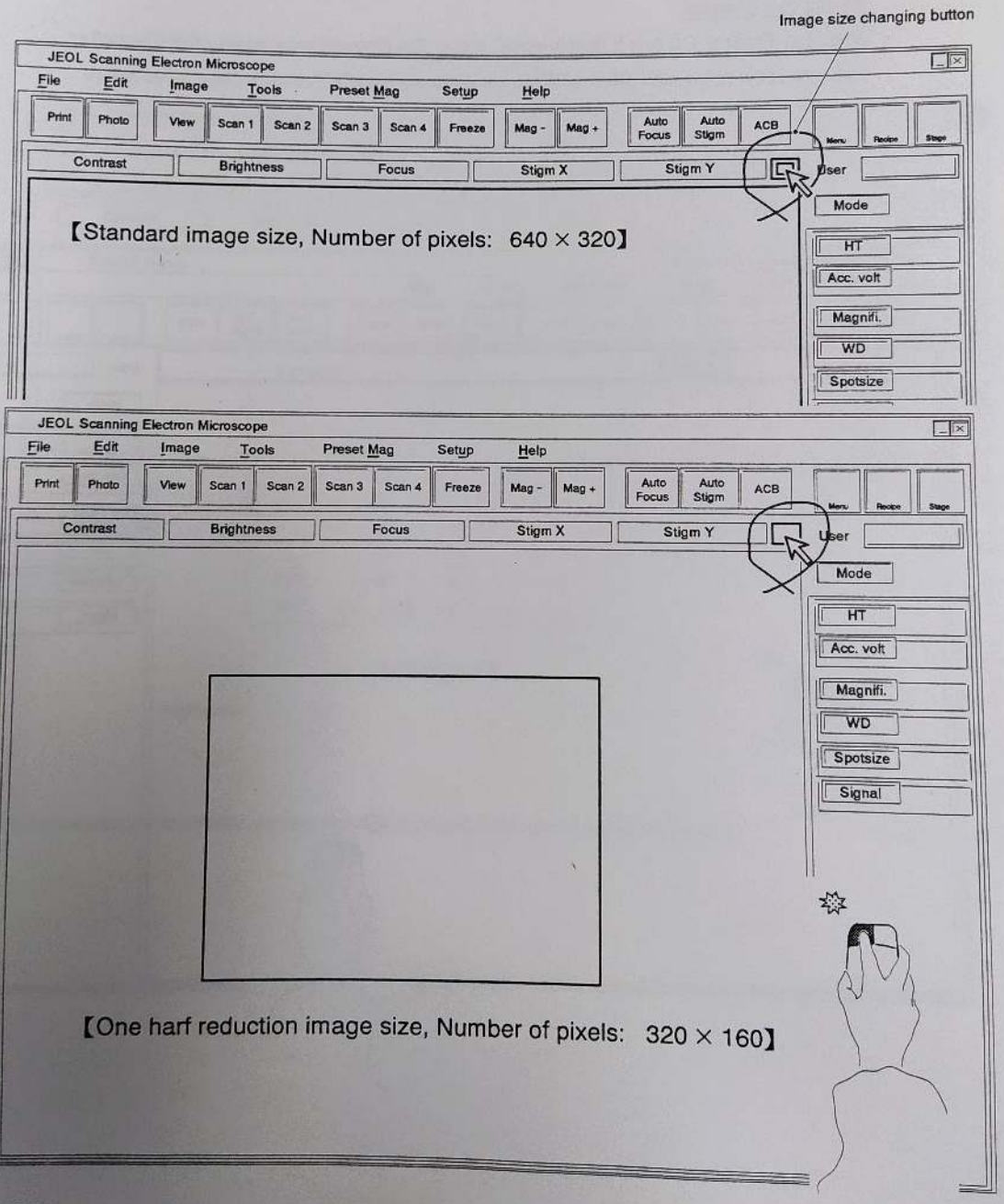


3.7.12 Changing the Image Display Size

Use this function when you wish to change the image display size. (Frozen image; standard only)

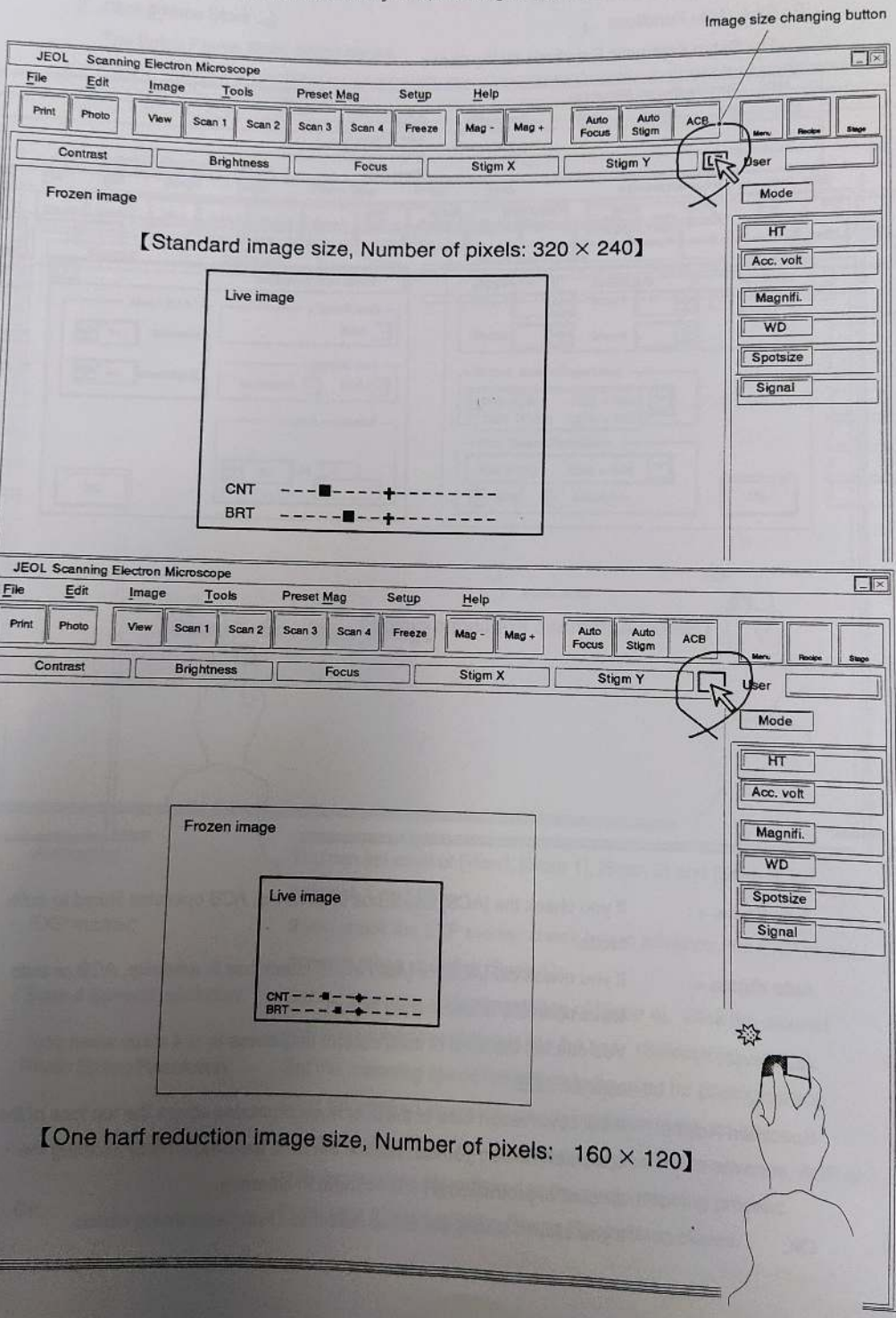
When the current scanning speed is set to View, Scan 2/3/4 or Photo

Click Image size changing button every time, the image display size changes over as illustration.



When the current scanning speed is set to Scan 1

Click Image size changing button every time, the image display size changes over as illustration.

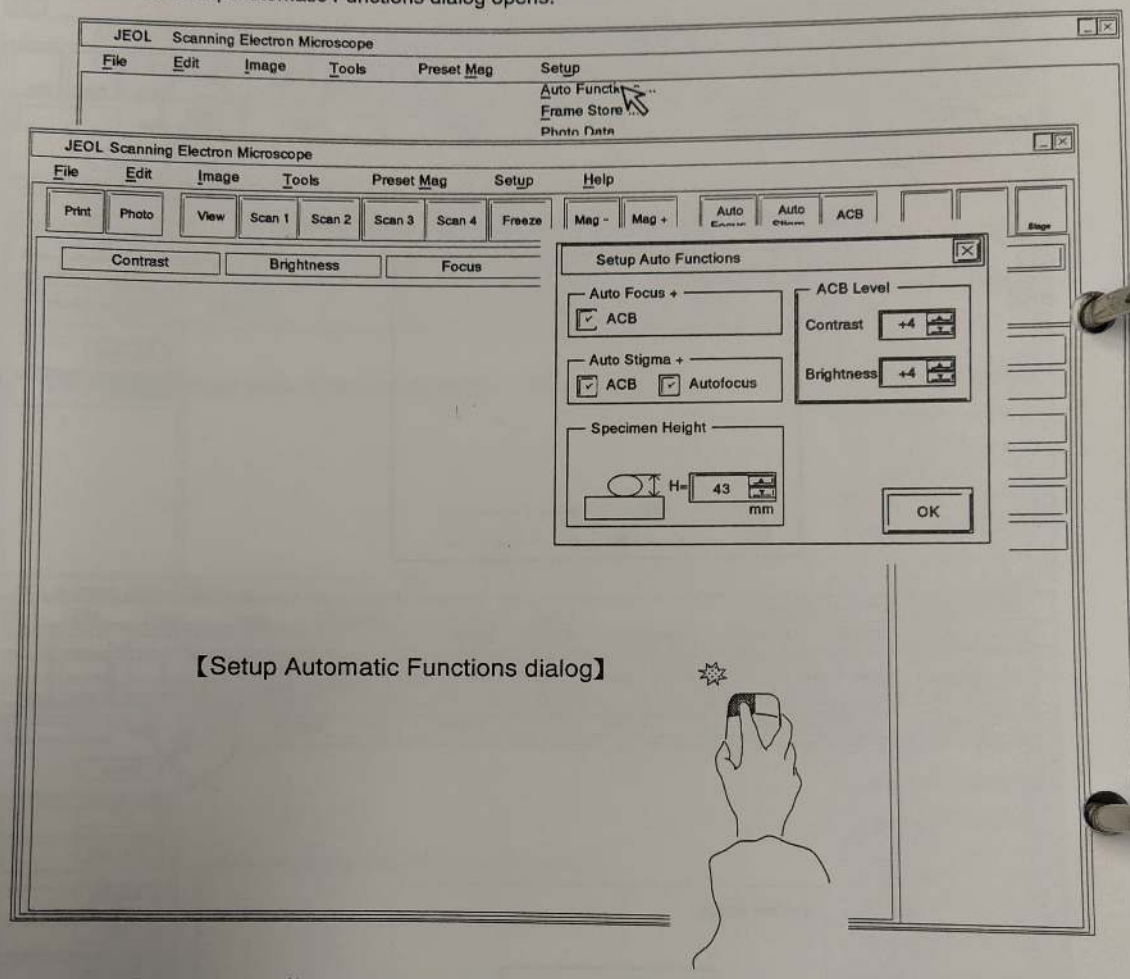


3.7.13 Setting Automatic Functions

1 Open [Setup] on the menu bar.

2 Click [Auto Functions ...].

The Setup Automatic Functions dialog opens.



【Setup Automatic Functions dialog】

Auto Focus + : If you check the [ACB] check box in advance, ACB operates linked to auto focus.

Auto stigma +: If you check the [ACB] or [Auto focus] check box in advance, ACB or auto focus operates linked to auto stigma.

ACB level : You can set the level of contrast and brightness to ±4 steps when you operate ACB.

Specimen Height: If the observation face of the specimen protrudes above the top face of the specimen holder, you can reduce the auto focusing time by entering the amount of protrusion (H = 0 ~43mm) in advance.

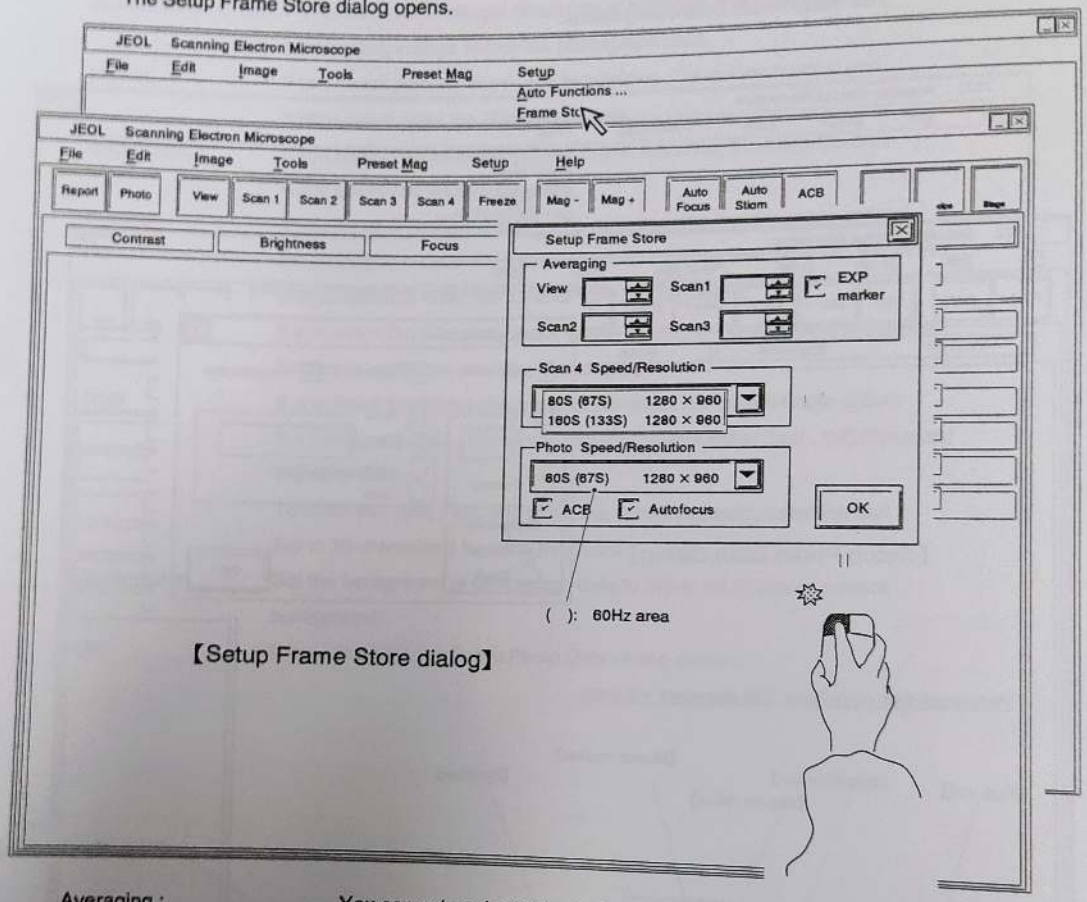
OK: If you click [Cancel], the Setup Automatic Functions dialog closes.

3.7.14 Setting the Frame Store Function

1 Open [Setup] on the menu bar.

2 Click [Frame Store ...].

The Setup Frame Store dialog opens.



【Setup Frame Store dialog】

Averaging : You can set each of [View], [Scan 1], [Scan 2] and [Scan 3] to between 1 and 255.

EXP marker: If you check the EXP marker check box in advance, the EXP marker appears when you click [Scan 1].

Scan 4 Speed/Resolution: Set the scanning speed/resolution of [Scan 4]. Click the desired scanning speed/resolution in the list box. (Selectable)

Photo Speed/Resolution: Set the scanning speed/resolution to be used for photographing. Click the desired scanning speed/resolution in the list box. If you check the [ACB] or [Autofocus] check box in advance, ACB or auto focus takes place linked to the photographing process.

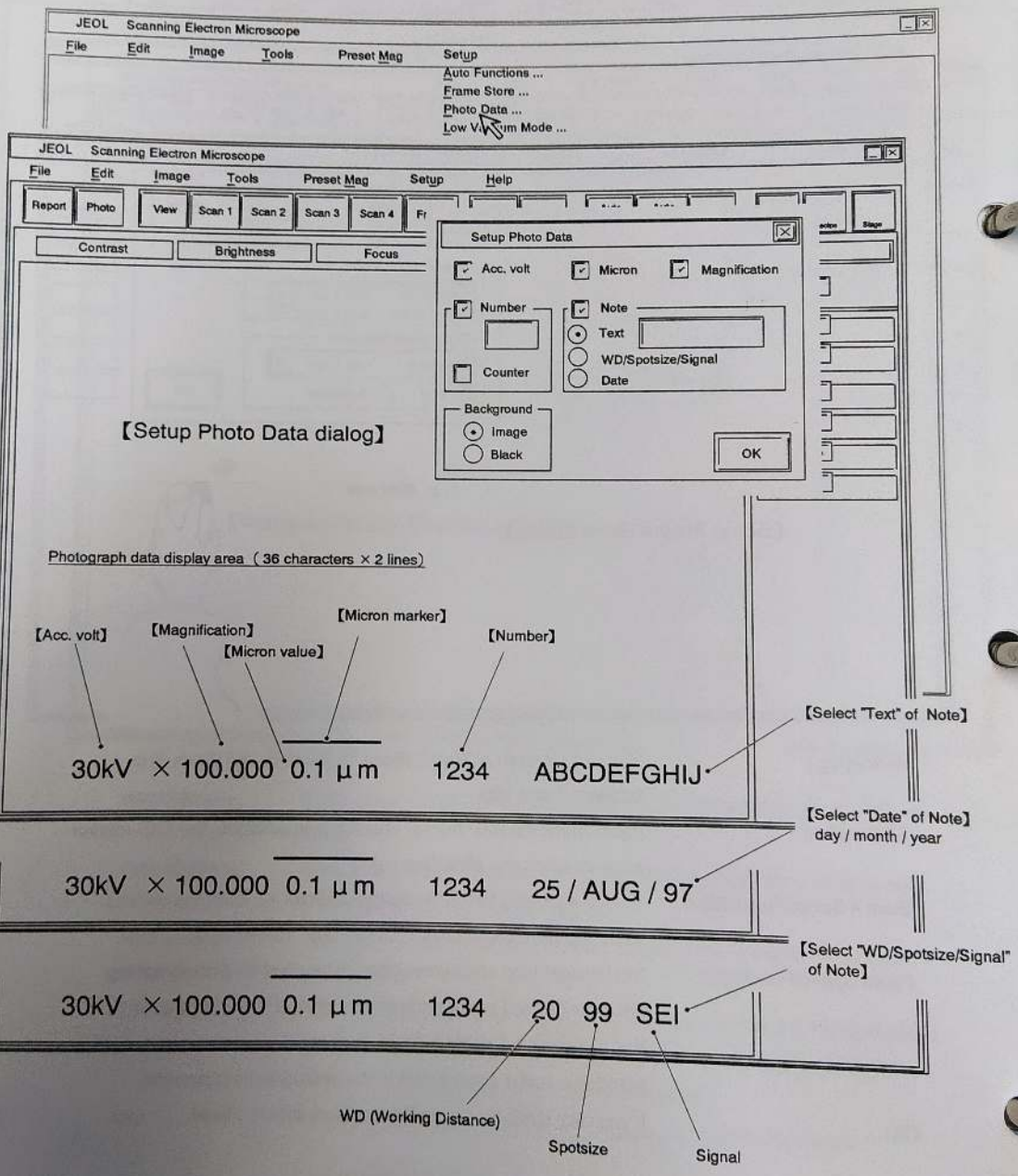
OK: If you click [OK], the Setup Frame Store dialog closes.

3.7.15 Setting Photograph Data

1 Open [Setup] on the menu bar.

2 Click [Photo Data ...] .

The Setup Photo Data dialog opens.



Accelerating voltage: If you check [Acc voltage] check box in advance, the value of the accelerating voltage enters the photograph data.

Micron: If you check [Micron] check box in advance, the micron marker and micron value enter the photograph data.

Magnification: If you check [Magnification] check box in advance, the magnification value enters the photograph data.

Number: If you check [Number] check box in advance, the input number enters the photograph data. To enter a number, click Number box, and when the cursor appears, enter the number from the keyboard.
If you check the [Counter] check box in advance, the value of the number increases each time you take a photograph.

Note: If you check the [Note] check box in advance, the entered note enters the photograph data. For a note, you can select either Text , WD/Spotsize/ Signal or Date.
To enter text, click Text, and when the cursor appears, enter the text (up to 10 characters) from the keyboard.

Background: Set the background of photograph data to either an image or a black background.

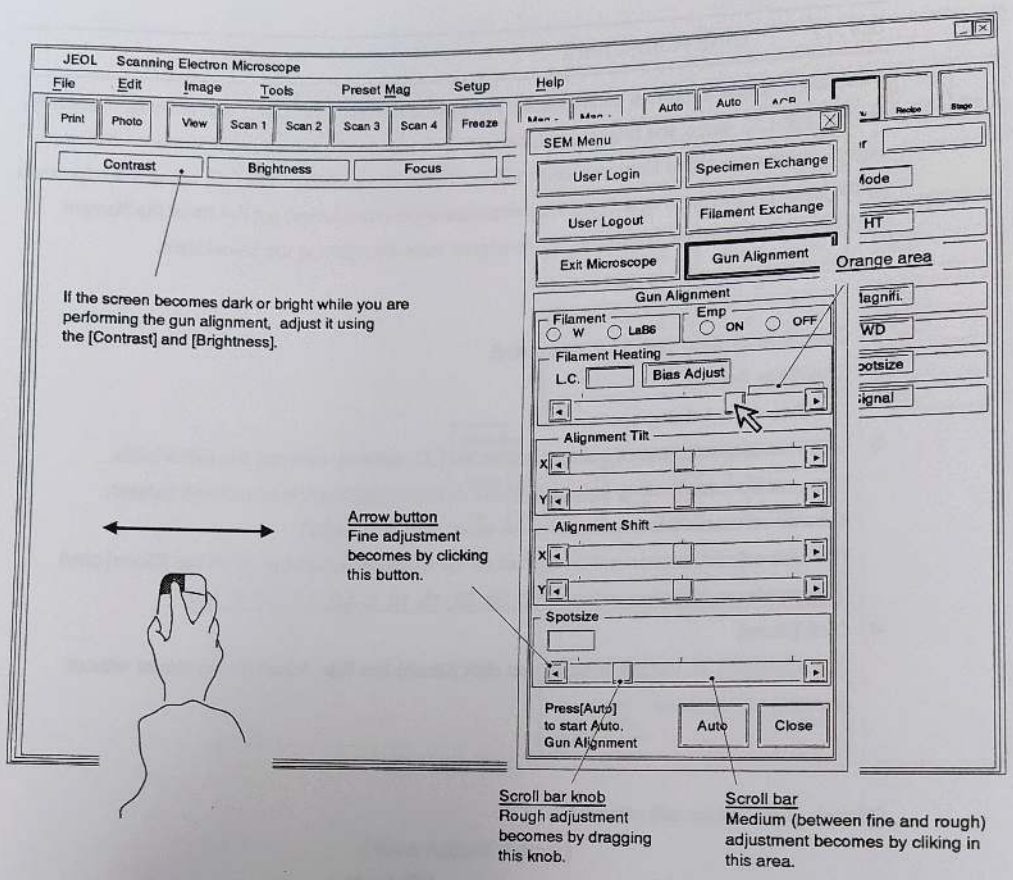
OK: If you click [OK], the Setup Photo Data dialog closes.

3.7.16 Gun Alignment

If the filament heating is insufficient or the electron beam is deviate from the optical axis, it may be impossible to obtain a sharp image even if the lens is focused. Perform the gun alignment and the bias adjustment (refer to 3.7.17). If you wish to use the Spotsize of [under 50], carry out the following steps 1~6. If you wish to use the Spotsize of [above 50], carry out the following steps 1~10.

1 Open [Menu], then click [Gun Alignment].
2 Set the [X] and [Y] Alignment Tilt and Shift scroll bar knobs near the respective center positions.
3 Set the Filament Heating scroll bar knob to a point in front of the orange area.
When the filament is broken or the load current of higher than 150 μA is flowed to the filament, message dialog appears.
Close the message dialog, the Filament Exchange menu automatically opens.
Replace the filament or check the tip of the filament according to the Filament Exchange menu. (refer to Chapter 4)
4 Adjust the [X] and [Y] Alignment Tilt scroll bar knobs so as to obtain the maximum screen brightness.
5 Return the Filament Heating scroll bar knob to the left end.
6 Set the Filament Heating scroll bar knob to a point immediately before saturation occurs.
Slowly drag the scroll bar knob to the right. When it reaches a point near the center, the screen momentarily becomes bright. (1st peak)
As you continue to drag the knob to the right, an image appears, and once the knob reaches a certain point the brightness of the image no longer changes. (2nd peak: Saturation point)
Set the scroll bar knob slightly to the left of the saturation point.
If you set the scroll bar knob to the right of the saturation point, an overcurrent will occur, causing the life of the filament to be reduced.
When the grainy image is obtained even if the gun alignment is completed, adjust the bias (refer to 3.7.17) or refer to the Section 3.14.

7 Click [Tools], then click [Lens Reset].
8 Adjust the [X] and [Y] Alignment Shift scroll bar knobs so that the brightness of the screen becomes maximum.
9 Adjust the [X] and [Y] Alignment Tilt scroll bar knobs so that the brightness of the screen becomes maximum.
10 Repeat steps 7~9 several times to maximum the brightness of the screen.
When the grainy image is obtained even if the gun alignment is completed, adjust the bias (refer to 3.7.17) or refer to the Section 3.14.



Filament, Emp	If the LaB6 electron gun (option) is not installed, these items cannot be selected.
Filament Heating	Adjusts the filament heating current (load current).
L.C.	Displays the load current value (μA).
Bias Adjust	Adjusts L.C. value. (refer to 3.7.17)
Alignment Tilt	Adjusts the X and Y alignment tilt current to adjust the tilt of the electron beam.
Alignment Shift	Adjusts the X and Y alignment shift current to shift the electron beam in the horizontal direction.
Spotsize:	Adjusts the spotsize value (0~99).
Auto	If you click [Auto], auto gun alignment starts.
Close	If you click [Close], the SEM Menu closes.

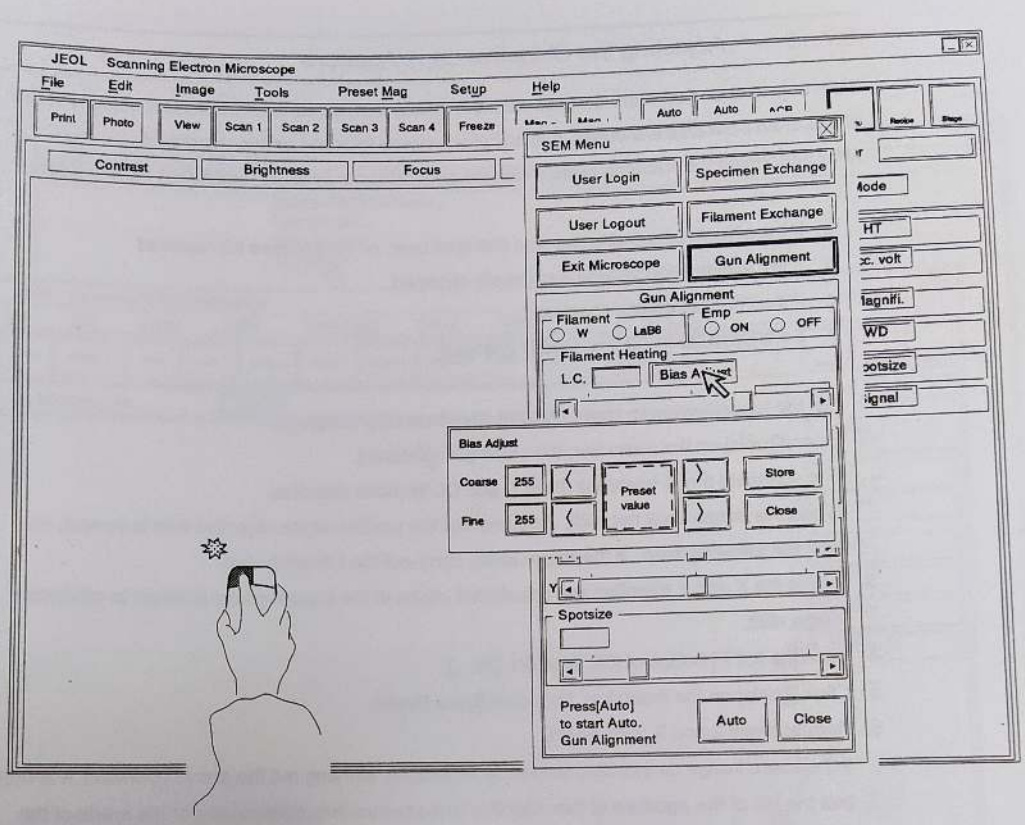
3.7.17 Bias Adjustment

The Bias Adjustment can be controlled the filament heating current (L.C. , load current). Generally, for the high L.C. value, the brightness of the electron gun goes up and the performance becomes higher, but the life of the filament makes short. That is to say, for the low L.C. value, the brightness of the electron gun goes down and the performance becomes lower, but the life of the filament makes long. Therefore, adjust the L.C. to proper value by referring the below table.

1 Open [Menu], then click [Gun Alignment].
2 Click [Bias Adjust].
The Bias Adjust dialog opens.
3 Using the bias adjustment buttons, adjust the L.C. value by referring the below table.
If you set the accelerating voltage to 2.0kV or less, using the fine adjustment buttons.
(Coarse adjustment buttons can not be used, gray out display)
The bias adjustment can not be carried out by accelerating voltage. (use the [Close] only)
(Adjustable accelerating voltage: 30, 25, 20, 15, 10, 5, 3.0, 2.5, 2, 1.5, 1kV)
4 Click [Store].
The adjusted L.C. value stores. If you click [Close], the Bias Adjust dialog closes without anything taking place.

【Rough guide to bias adjustment】

Accelerating voltage (kV)	L.C. (μA)
30, 25, 20, 15	Approx. 85
10	Approx. 75
5	Approx. 60
3.0, 2.5	Approx. 50
2.0, 1.5	Approx. 45
1.0	Approx. 40



【Bias Adjust dialog】

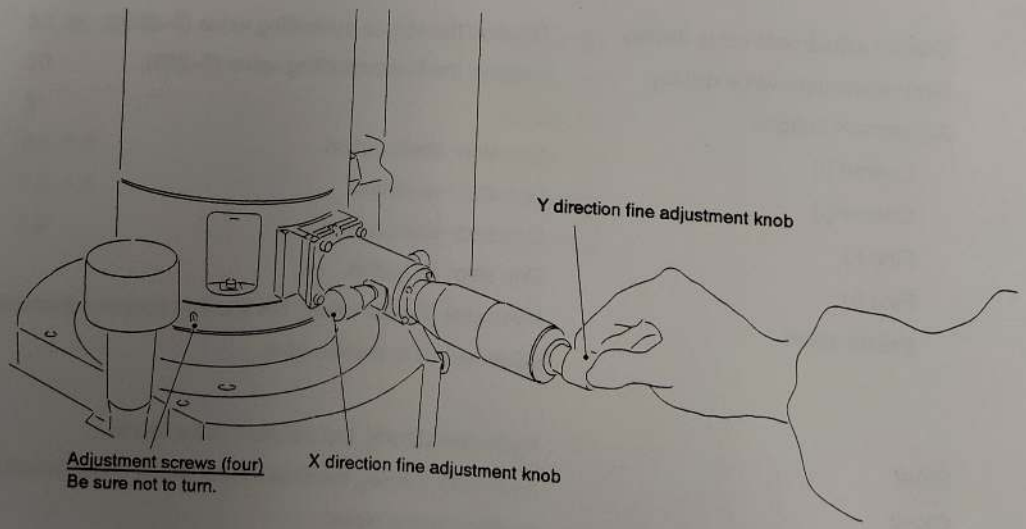
Coarse adjustment value display	Displays the coarse controlling value (0~255).
Fine adjustment value display	Displays the fine controlling value (0~255).
Adjustment buttons	
Coarse [‹]	One step-down button.
Coarse [›]	One step-up button.
Fine [‹]	One step-down button.
Fine [›]	One step-up button.
Preset value	If you click [Preset value], the fine and coarse adjustment value returns to preset value.
Store	If you click [Store], the adjusted value stores.
Close	If you click [Close], the Bias Adjust dialog closes without anything taking place.

3.7.18 Adjusting the Objective Lens Aperture

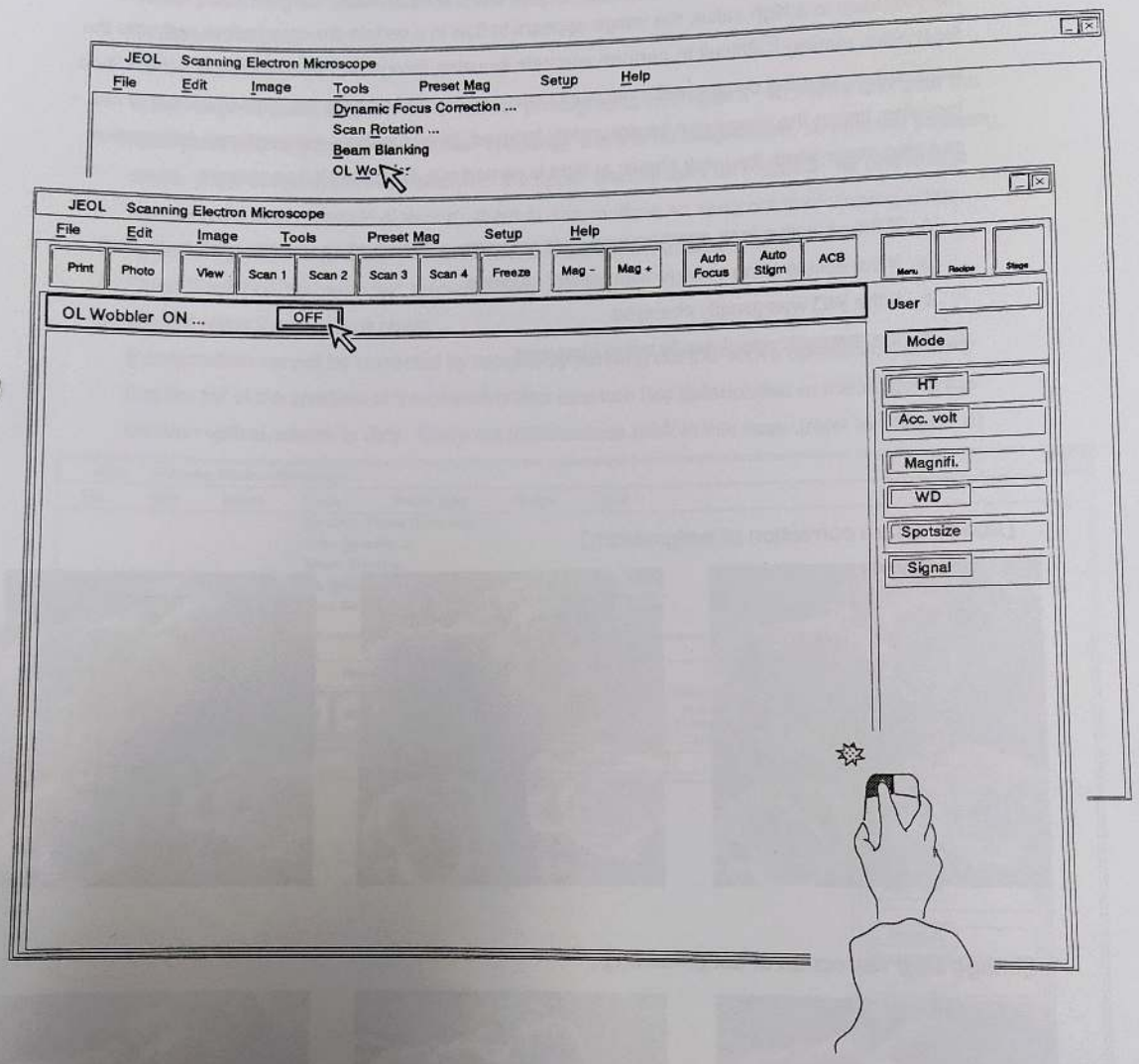
If the objective lens aperture deviates from the optical axis, it may be impossible to obtain a sharp image even if the lens is focused, or a limitation may be imposed on the visual field.
After performing the following work, check the objective lens aperture, and adjust it if necessary.

a If the objective lens aperture was changed over, or the aperture foil replaced
b If the accelerating voltage was greatly changed
c If the WD was greatly changed
d If the Spotsize value was greatly changed

1 Set the magnification to about x10,000, then focus the image.
2 Open [Tools] on the menu bar, then click [OL Wobbler].
The scanning mode becomes Scan 1, and OL Wobbler operates.
When the image does not shift, it means that the position of the objective lens is correct, so omit the following step. If the image shifts, carry out the following step.
3 Adjust the X and Y direction fine adjustment knobs of the objective lens aperture to minimize image shift.
4 Click the [OFF] button of [OL Wobbler ON ...].
5 Click [Tools] on the menu bar, then click [Lens Reset].
6 Repeat steps 2 and 3 once again.
If the sharp image cannot be obtained by repeatedly carrying out the above operation, it is likely that the foil of the aperture of the objective lens aperture has deteriorated or the inside of the electron optical column is dirty. Carry out maintenance work in this case. (Refer to Chapter 4)



【Objective Lens Aperture】



OL Wobbler: Periodically changes the OL current.

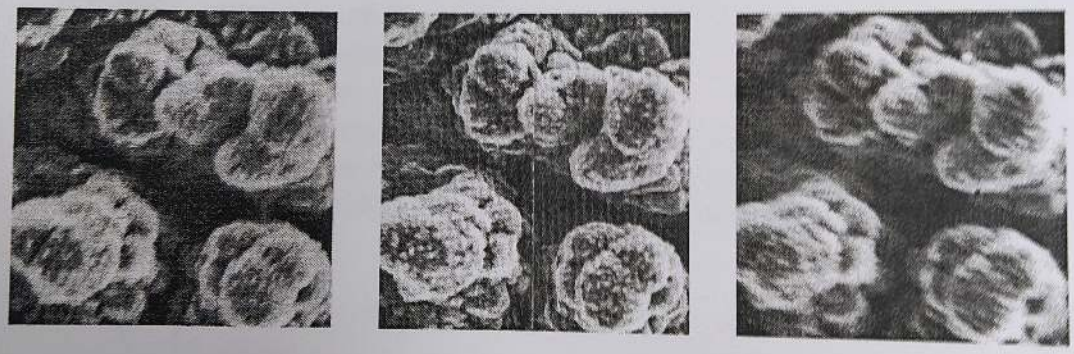
Lens Reset: Removes the hysteresis (magnetism) from the OL and CL lenses. If you click [Lens Reset], the image disappears for about 2 seconds.

3.7.19 Astigmatism Correction

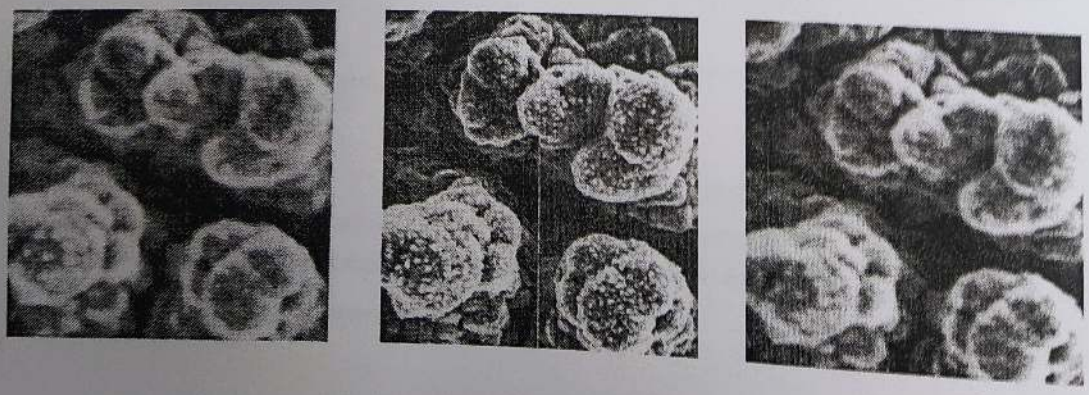
Astigmatism is not noticeable at low magnifications (of about x1,000), however if you raise the magnification to a high value, the image appears to flow in a certain direction before and after the focal point, making it difficult to perform accurate focusing (image with astigmatism). If there is no astigmatism, blurring occurs uniformly in all directions before and after the focal point due to mis - focusing, hence the image can be accurately focused. (image without astigmatism) Astigmatism can also occur when the work shown at right is carried out, so correct it if necessary.

a If the objective lens aperture was changed over, or the aperture foil was replaced
b If the accelerating voltage was greatly changed
c If the WD was greatly changed
d If a magnetic specimen is being observed

【Image before correction of astigmatism】



【Image after correction of astigmatism】



Under-focused ← Just focus → Over-focused

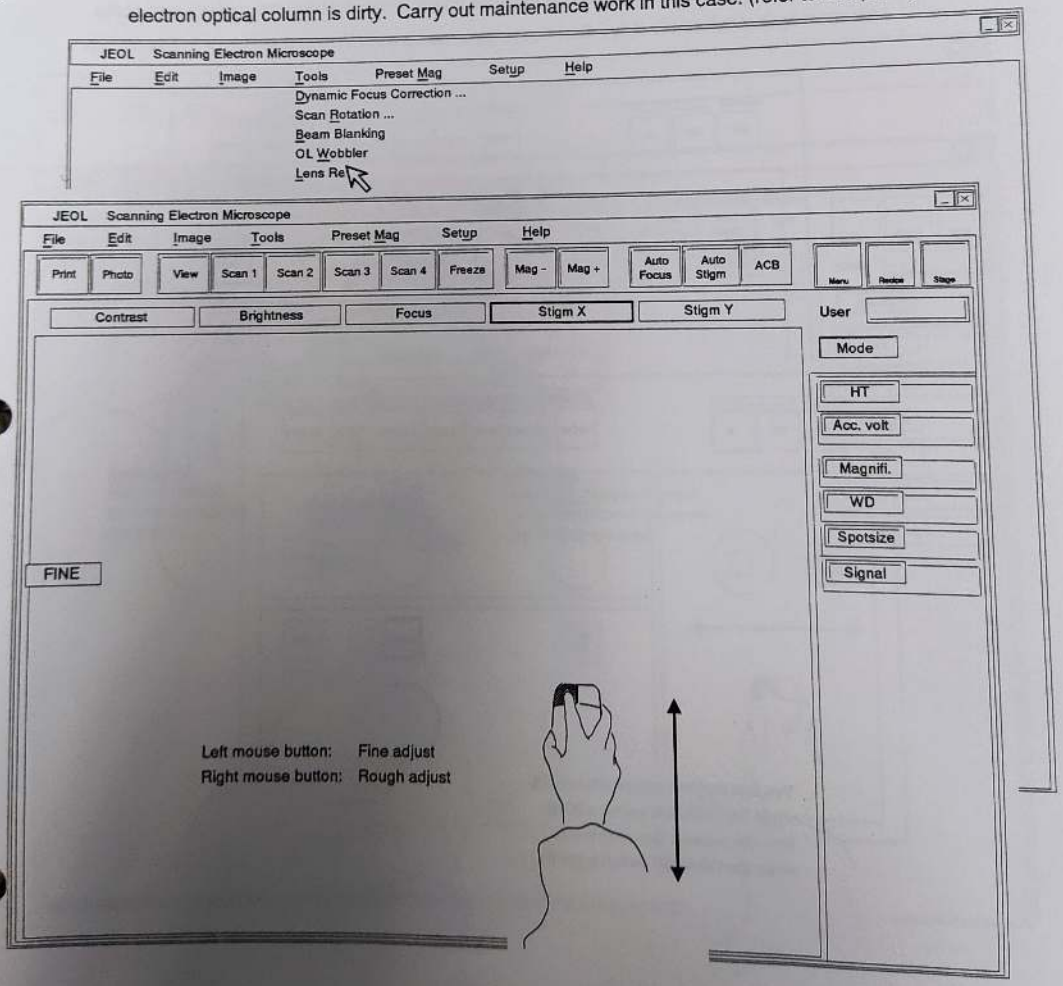
1 Set the magnification to a value slightly higher than the magnification used for the current observation.
When performing an observation at a low magnification, set the magnification to between about 5,000 and 10,000.

2 Focus the image.
If the image appears as shown in the lower photographs on Pages 3-42 before and after the focal point (blurring occurs due to mis-focusing), there is no astigmatism, so omit the following steps. If the image appears as shown in the upper photographs on Pages 3-42 (the image appears to flow in a certain direction), there is astigmatism, so carry out the following steps.

3 Adjust [Stigm X] and [Stigm Y] so as to obtain the sharpest image.

4 Open [Tools] on the menu bar, then click [Lens Reset].

5 Repeat steps 2 and 3 once again.
If astigmatism cannot be corrected by repeatedly carrying out the above operation, it is likely that the foil of the aperture of the objective lens aperture has deteriorated or the inside of the electron optical column is dirty. Carry out maintenance work in this case. (refer to Chapter 4)



When using an operation keyboard (optional)

1 Set the magnification to a value slightly higher than the magnification used for the current observation.

When performing an observation at a low magnification, set the magnification to between about 5,000 and 10,000.

2 Focus the image.

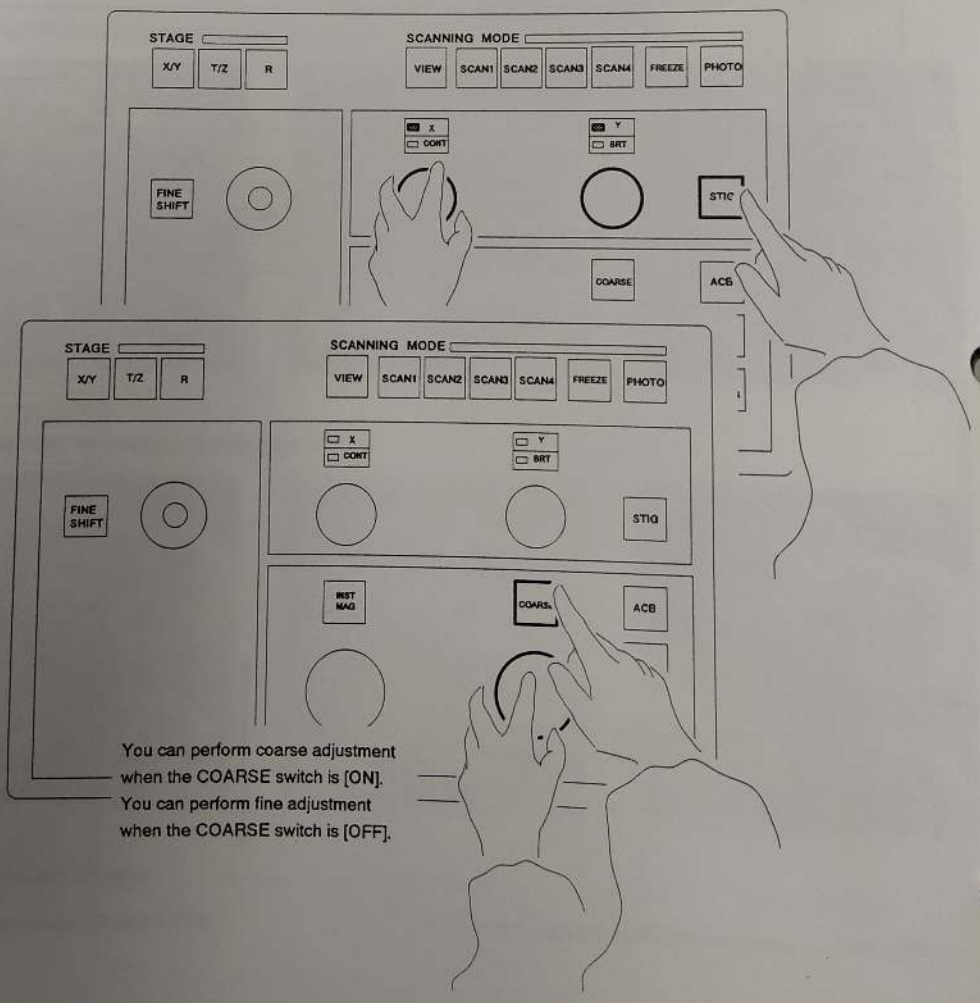
If the image appears as shown in the lower photographs on Pages 3-42 before and after the focal point (blurring occurs due to mis-focusing), there is no astigmatism, so omit the following steps. If the image appears as shown in the upper photographs on Pages 3-42 (the image appears to flow in a certain direction), there is astigmatism, so carry out the following steps.

3 Set the STIG switch to ON, then adjust the control knob so as to obtain the sharpest image.

4 Open [Tools] on the menu bar, then click [Lens Reset].

5 Repeat steps 2 and 3 once again.

If astigmatism cannot be corrected by repeatedly carrying out the above operation, it is likely that the foil of the aperture of the objective lens aperture has deteriorated or the inside of the electron optical column is dirty. Carry out maintenance work in this case. (refer to Chapter 4)

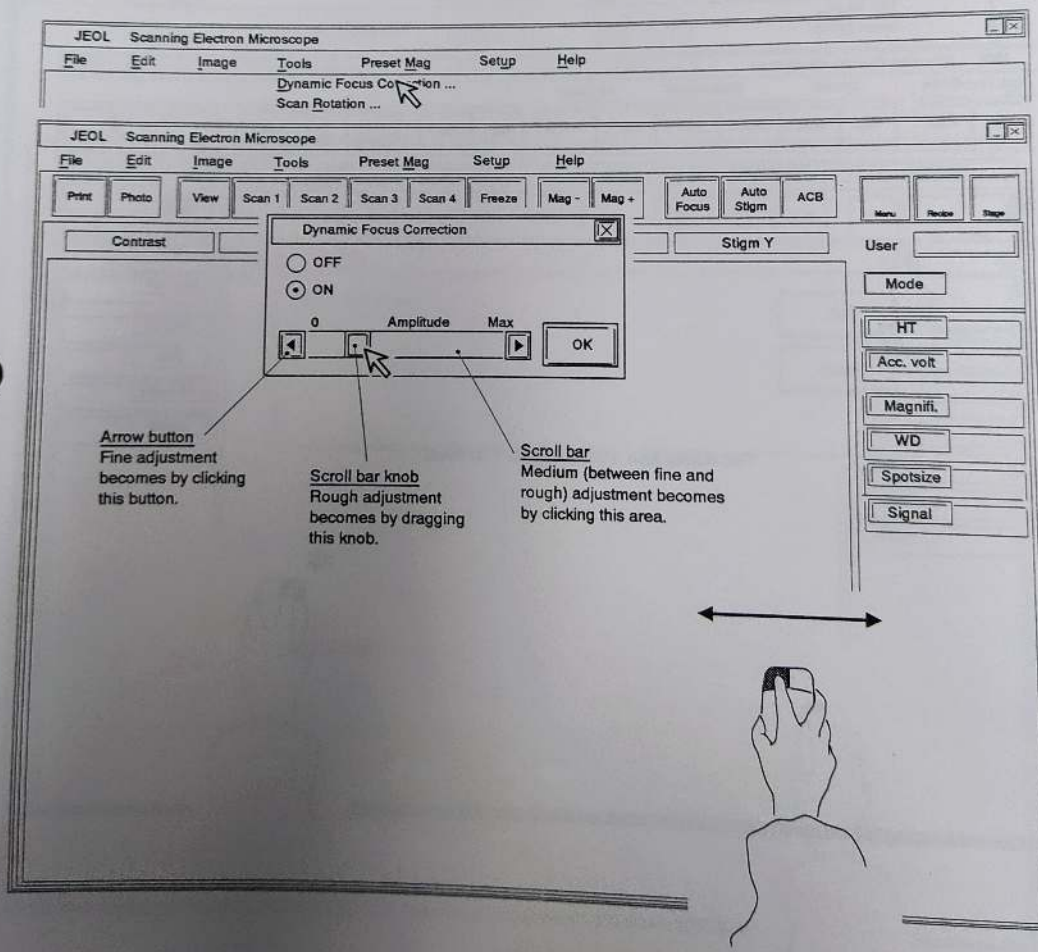


You can perform coarse adjustment when the COARSE switch is [ON].
You can perform fine adjustment when the COARSE switch is [OFF].

3.7.20 Dynamic Focusing

Use dynamic focus correction when the specimen is placed obliquely at a high angle, but the upper and lower edges of the image are not in focus.

1 Focus the live image at the center.
2 Open [Tools] on the menu bar, then click [Dynamic Focus Correction].
The Dynamic Focus Correction dialog opens.
3 Click [ON] of the OFF/ON button, then click [Scan 3] or [Scan 4] on the SEM control button.
4 Using the scroll bar, perform correction so that the entire screen is in focus.
Once correction has taken place, the amount of correction remains stored in the memory until the instrument is switched off, even if you set the OFF/ON button to [OFF].
5 Click [OK].
The Dynamic Focus Correction dialog closes. To saving the displayed image, perform the operation of 3.10.1.



3.8 Text Input/Editing

1 Display a frozen image, then click [Edit] on the menu bar.

2 Click [Text Editor].

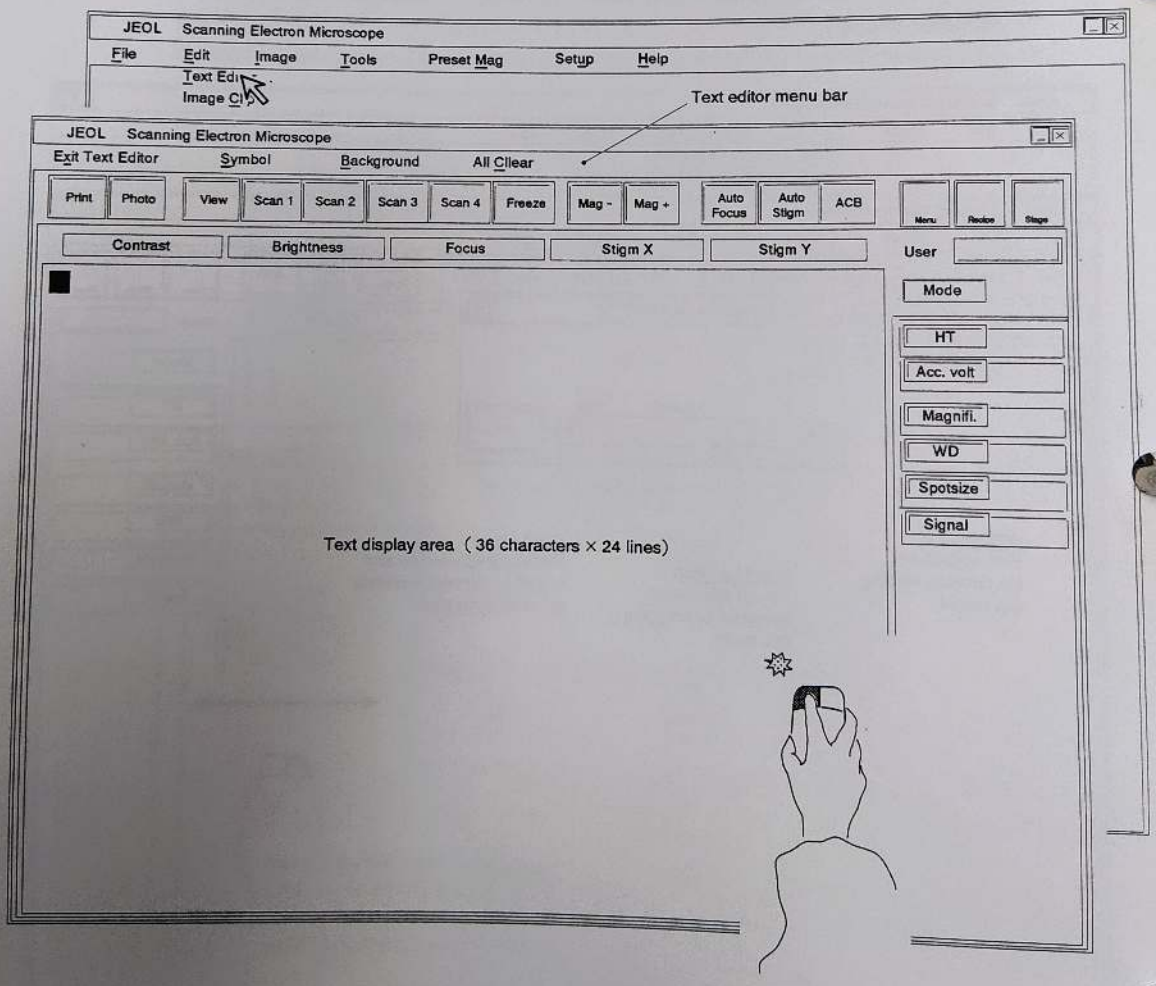
The text editor menu bar appears, and the cursor appears at the top left of the screen.

3 Enter the text from the keyboard.

To enter the special characters/symbols, open [Symbol] on the text editor menu bar, then click the desired special character or symbol from a dialog box.

4 After entering the text, click [Exit Text Editor].

The text editor menu reverts to the original menu bar, and the entered text is displayed on the frozen screen.

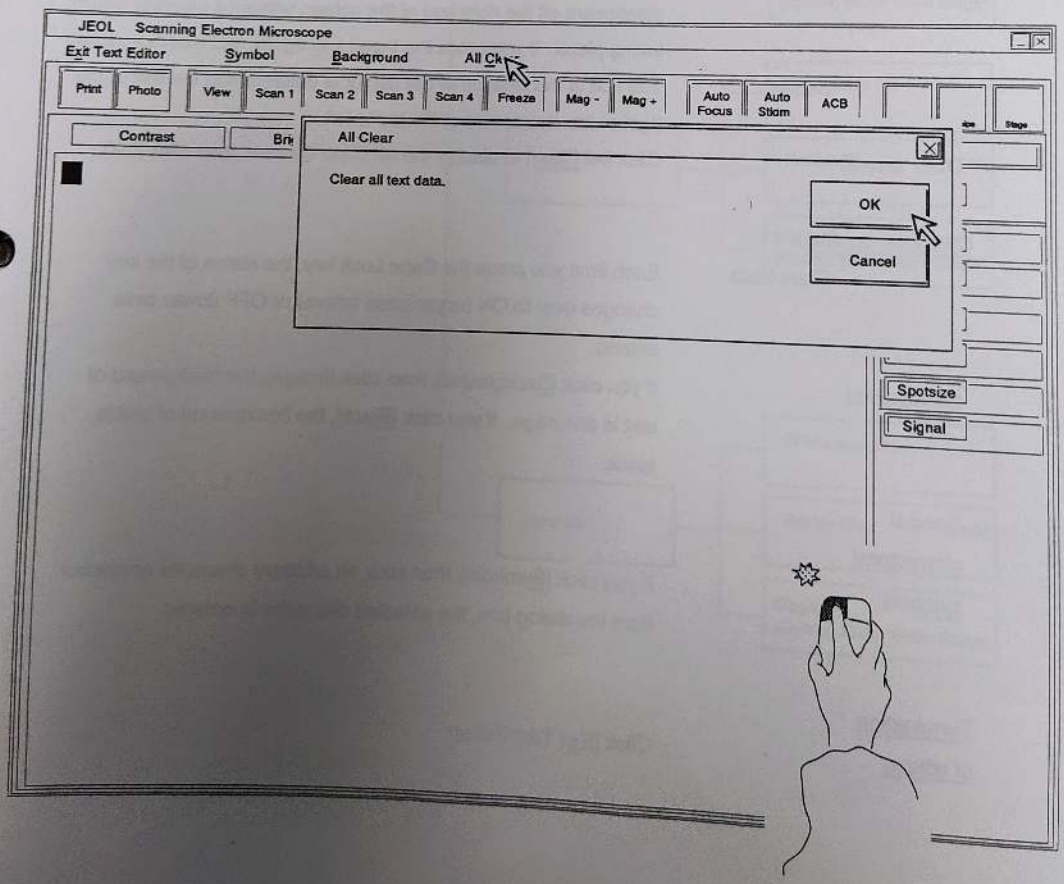


Text editor menu

Exit Text Editor:	The system exits the text editor, and the text editor menu closes.
Symbol:	Special characters and symbols are displayed on a dialog box, so click the desired special character or symbol.
Background:	Backgrounds (image, and black) are displayed on a pull-down menu, so click the desired kind of background.
All Clear:	The All Clear window is displayed. If you click [OK], all text data on the screen is cleared. If you click [Cancel], the All Clear window closes without anything taking place.

Kinds of text that can be entered

- Upper case letters: ABCDEFGHIJKLMNOPQRSTUVWXYZ
- Lower case letters: abcdefghijklmnopqrstuvwxyz
- Numbers: 123456789
- Symbols: !@#$%^&()_–´ {}[]:|;' <>?,./
- Special characters/symbols: α β γ λ μ φ Ω° ♂♀←→↑↓

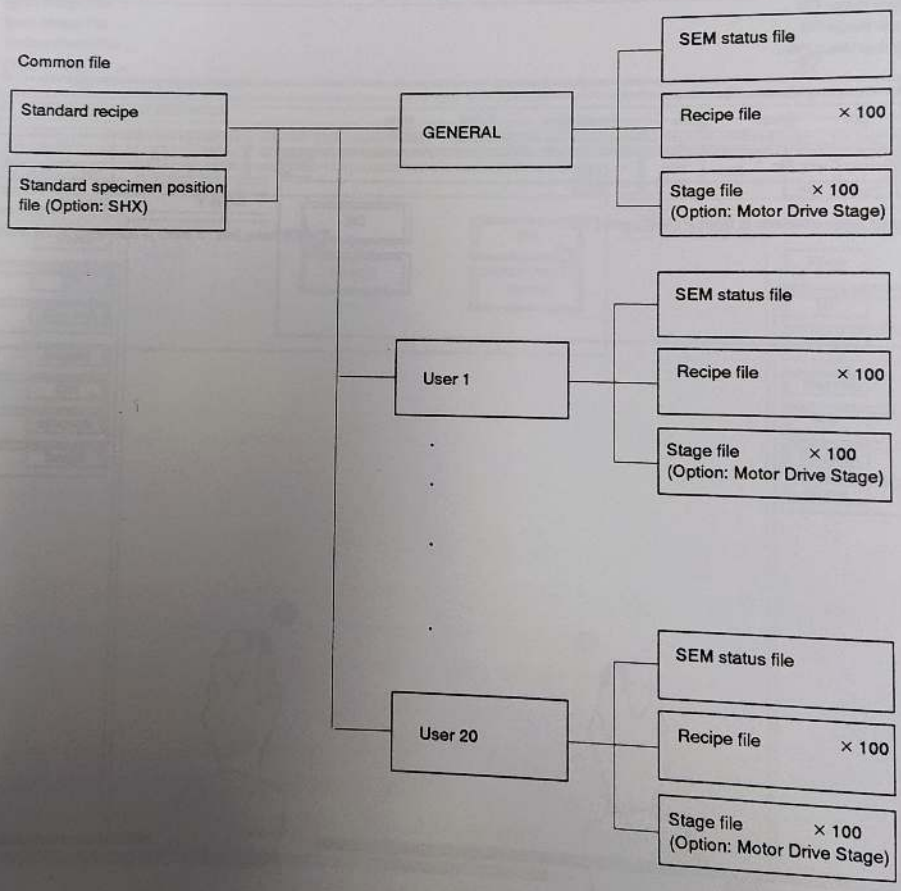


3.8.1 Text Input/Editing List

Function	Key operation	Remarks
Edit start		Select [Edit] on the menu bar, then click [Text Editor].
Cursor shift		
	↑ ↓ ← →	The cursor moves up, down, left or right. The cursor stops at the top, bottom, left or right end without a carriage return taking place.
	End	The cursor moves to the right end of the line in which it is located.
	Home	The cursor moves to the left end of the line in which it is located.
	Backspace	The cursor moves back to the left. Text over which the cursor passes is deleted.
	Enter	The cursor moves to the left end of the next line.
Insertion/Deletion		
	Insert	Text is inserted at the location of the cursor. The text to the right of the cursor shifts to the right. If the text shifts to the right end, it disappears off the right end of the screen without a carriage return taking place. If you press the Insert key again, text insertion ends.
	Delete	The text at the location of the cursor is deleted, and the text at the right of the cursor side shifts to the left.
Clear screen		Click [All Clear] to display the All Clear window, then click [OK].
Character control		
	Caps Lock	Each time you press the Caps Lock key, the status of the key changes over to ON (upper case letters) or OFF (lower case letters).
Background		If you click [Background], then click [Image], the background of text is an image. If you click [Black], the background of text is black.
Special characters/ symbols:		If you click [Symbols], then click an arbitrary character or symbol from the dialog box, the selected character is entered.
Termination of editing		Click [Exit Text Editor].

3.9 User File Management

The instrument corresponds to multi-user, and you can register up to 20 user.
Ordinary, the SEM status of every user is managed as user file, and saved to the hard disk of the personal computer.
The contents of user file is a SEM status and custom recipe, then stage file (when the optional Motor Drive Stage is installed) made by logged-out user.
A user file can be backed up in the BMP or TIFF format to a floppy disk, and so even if you delete or damage the user file by mistake, you can install using the backup disk.

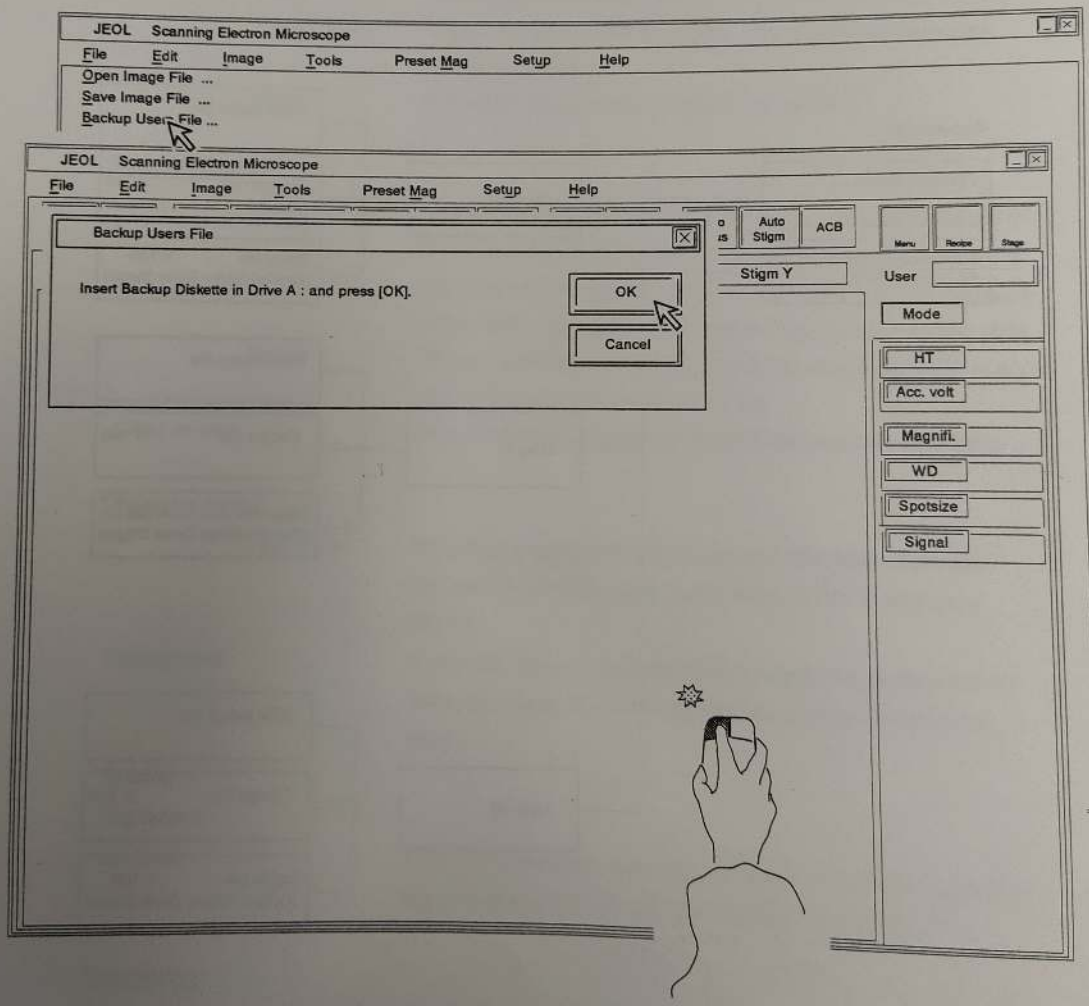


3.9.1 Backing Up User Files

1 Open [File] on the menu bar, then click [Backup Users File ...].
The Backup Users File dialog opens.

2 Insert a floppy disk in the floppy disk drive of the personal computer.
Purchase a commercially available MS-DOS - formatted disk.

3 Click [OK].
Recipes and other files (SEM status) made by the currently logged-in user are backed up.
If you click [Cancel], the Backup Users File dialog closes without anything taking place.



3.9.2 Installing User Files

1 Open [File] on the menu bar, then click [Install Users File ...].

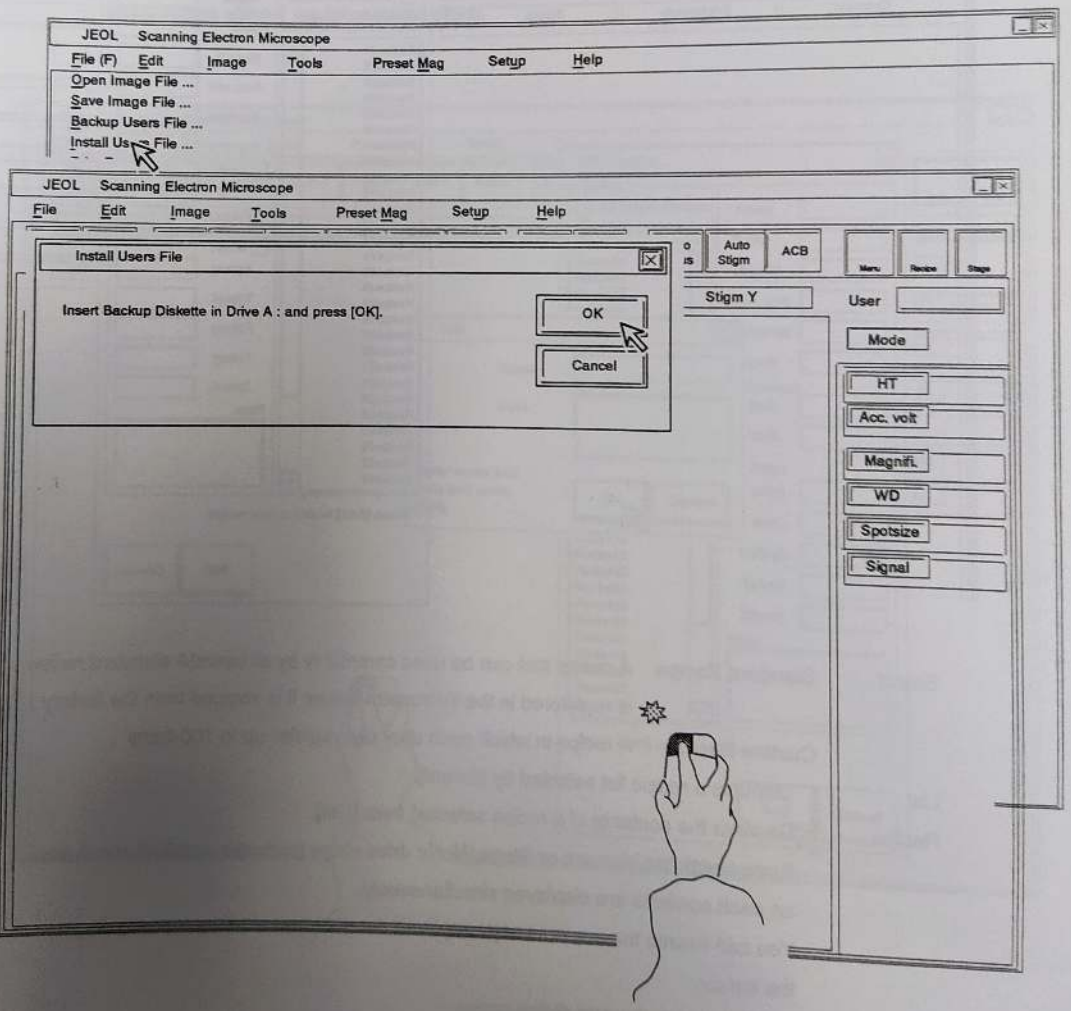
The Install Users File dialog opens.

2 Insert the backup disk in the floppy disk drive of the personal computer.

3 Click [OK].

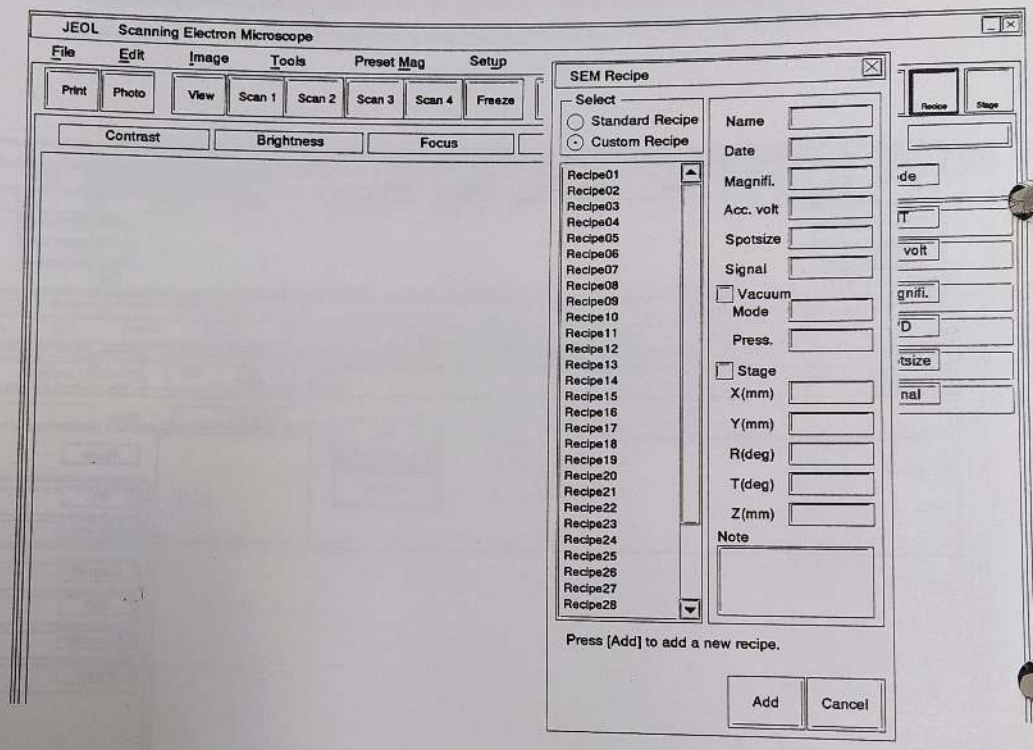
The user files are installed to the hard disk of the personal computer.

If you click [Cancel], the Install Users File dialog closes without anything taking place.



3.9.3 Recipe File

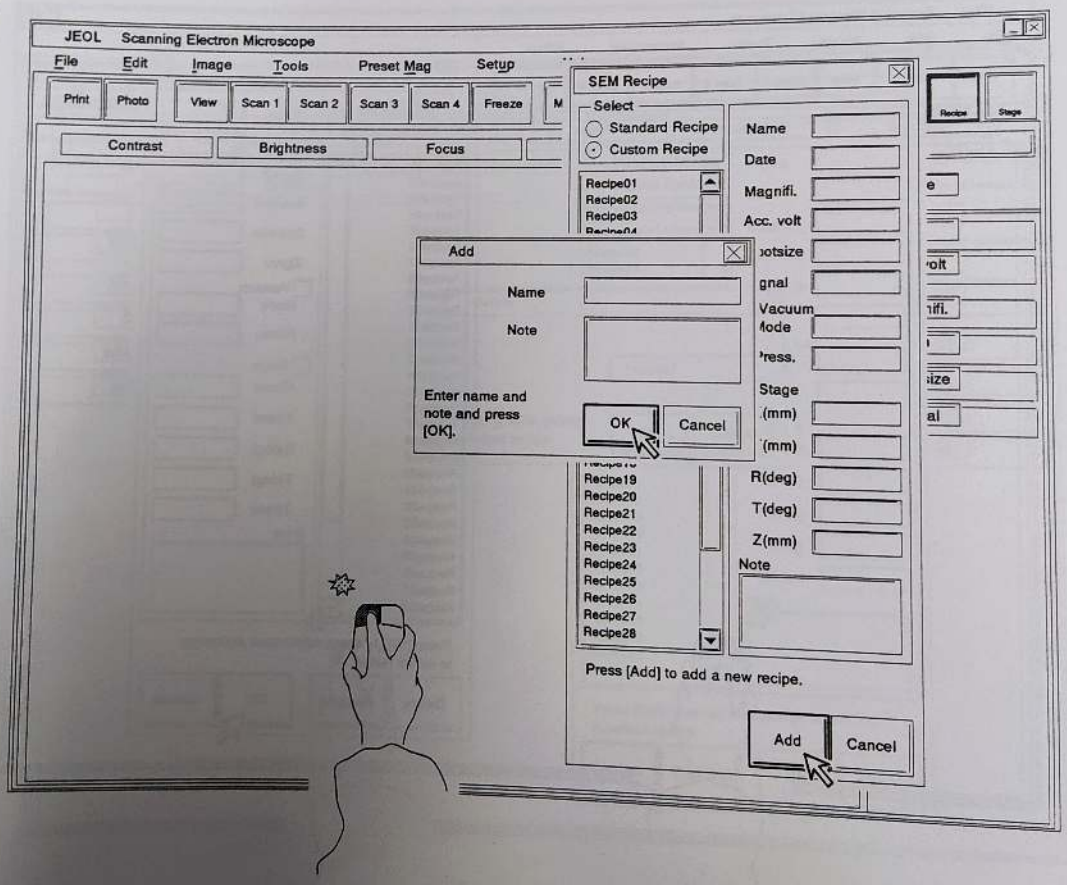
Ordinary, when observing the specimen, you must be set the observation conditions that corres - ponds to the specimen. The instrument is registered "Standard recipe (typical observation condition for SEM)". The standard recipe that enables you to easily set the instrument for optimum observation conditions. Each user can register up to 100 items in a custom recipe that corres - ponds to the various condition of specimen. The standard recipe or custom recipe can be reproduced every time.



Select	Standard Recipe	A recipe that can be used commonly by all users(A standard recipe is registered in the instrument before it is shipped from the factory.)
	Custom Recipe	A recipe in which each user can register up to 100 items
List	Displays a recipe list selected by [Select].	
Recipe	Displays the contents of a recipe selected from [List]. If you check the Vacuum or Stage [Motor drive stage (option)is installed] check box, an each contents are displayed simultaneously. You can rewrite the contents of [Note] by clicking the inside of the frame to display the cursor.	
Add	If you click [Add], the Add dialog opens.	
Cancel	If you click [Cancel], the SEM Recipe window closes without anything taking place.	

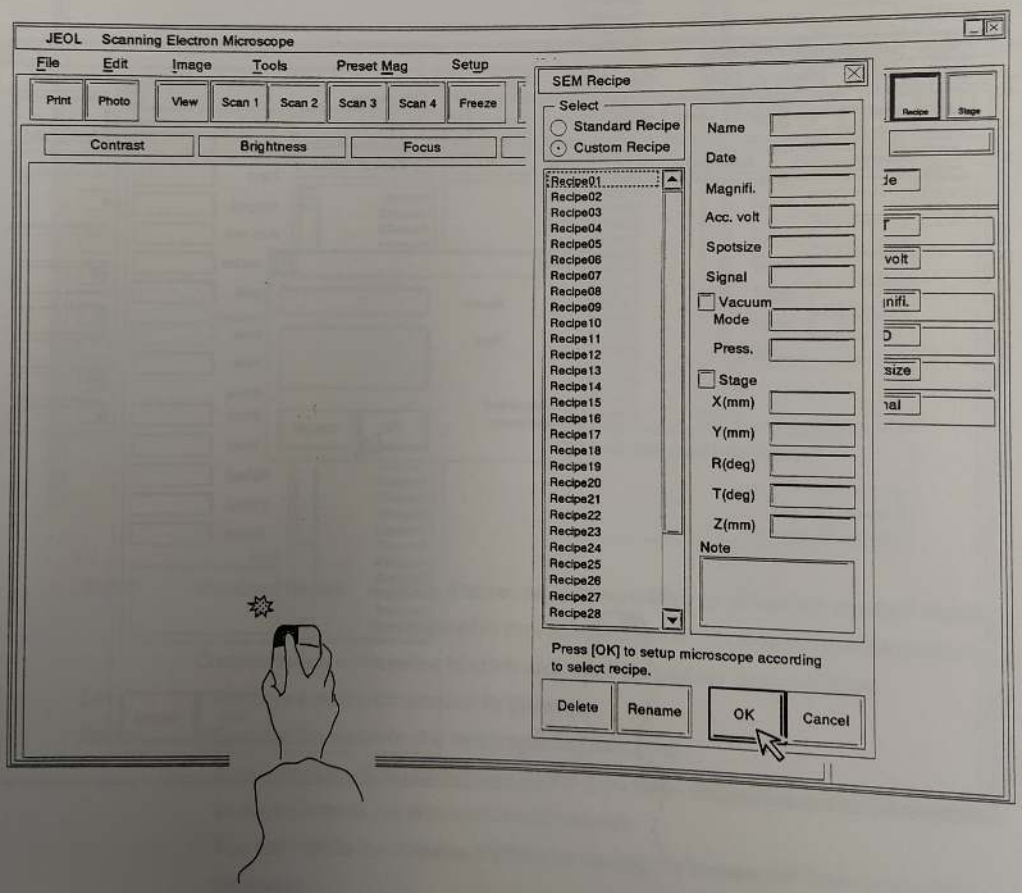
3.9.3a Registering a recipe file

1 Open [Recipe].
2 Click [Custom Recipe].
3 Click [Add].
The Add dialog opens.
4 Enter the recipe Name and Note from the keyboard, then click [OK].
The currently displayed recipe is registered to Custom recipe. (Each user can register up to 100 items in a custom recipe.)
Enter the recipe name using up to 8 alphanumeric characters. If you click [Cancel], the Add dialog closes without anything taking place.



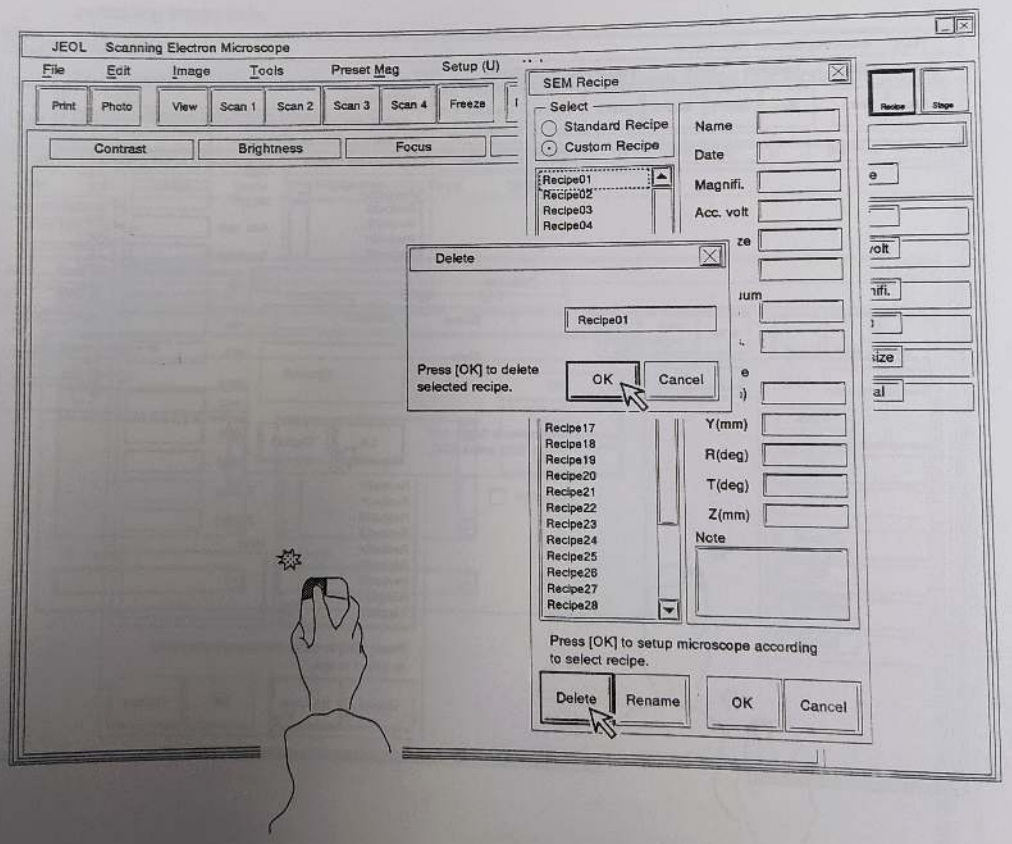
3.9.3b Reproducing a recipe file

1 Open [Recipe].
2 Click [Standard Recipe] or [Custom Recipe].
3 Click the recipe that you wish to reproduce from the list.
The contents of the list are displayed.
4 Click [OK].
The contents (observation condition of the SEM) of the recipe are set.
If you click [Cancel], the SEM Recipe window closes without anything taking place.



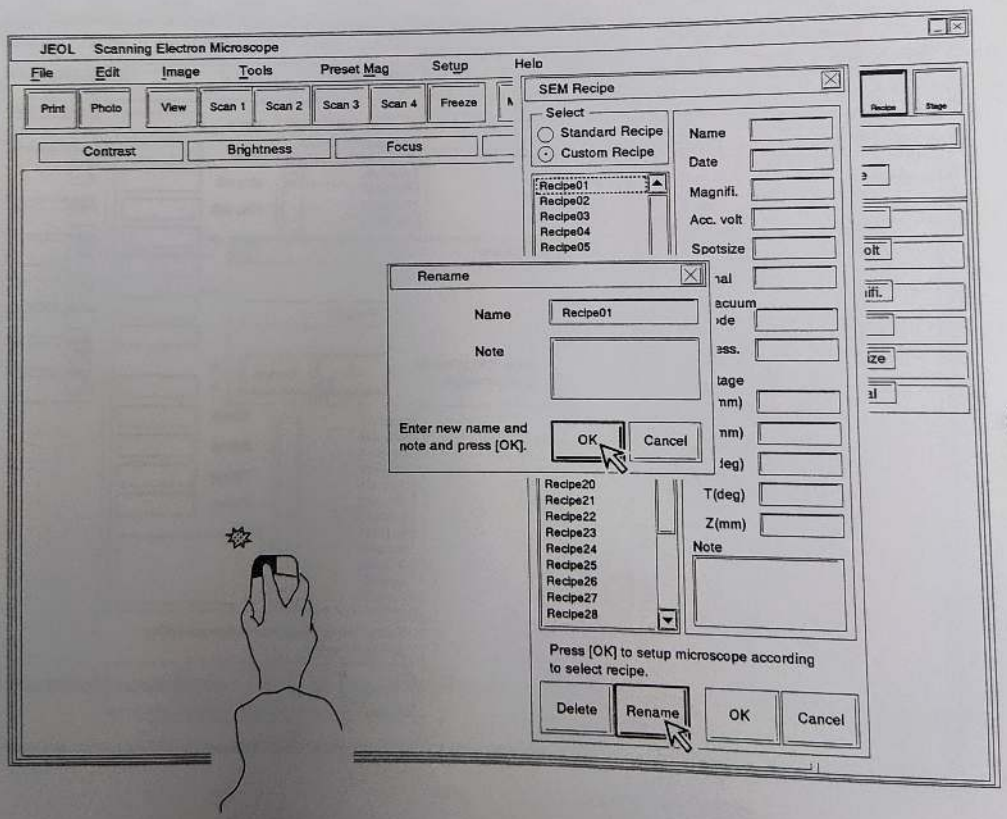
3.9.3c Deleting a recipe file

1 Open [Recipe].
2 Click [Custom Recipe].
3 Click the recipe that you wish to delete from the list.
4 Click [Delete].
The Delete dialog opens.
5 Click [OK].
The recipe that you selected from the list is deleted. If you click [Cancel], the Delete dialog closes without anything taking place.



3.9.3d Changing a recipe file name

1 Open [Recipe].
2 Click [Custom Recipe].
3 Click the recipe name that you wish to change from the list.
4 Click [Rename]
The Rename dialog opens.
5 Enter the new recipe Name and Note from the keyboard, and click [OK].
The recipe name that you selected from the list is changed. (Enter the recipe name using up to 8 alphanumeric characters. If you click [Cancel], the Rename dialog closes without anything taking place.

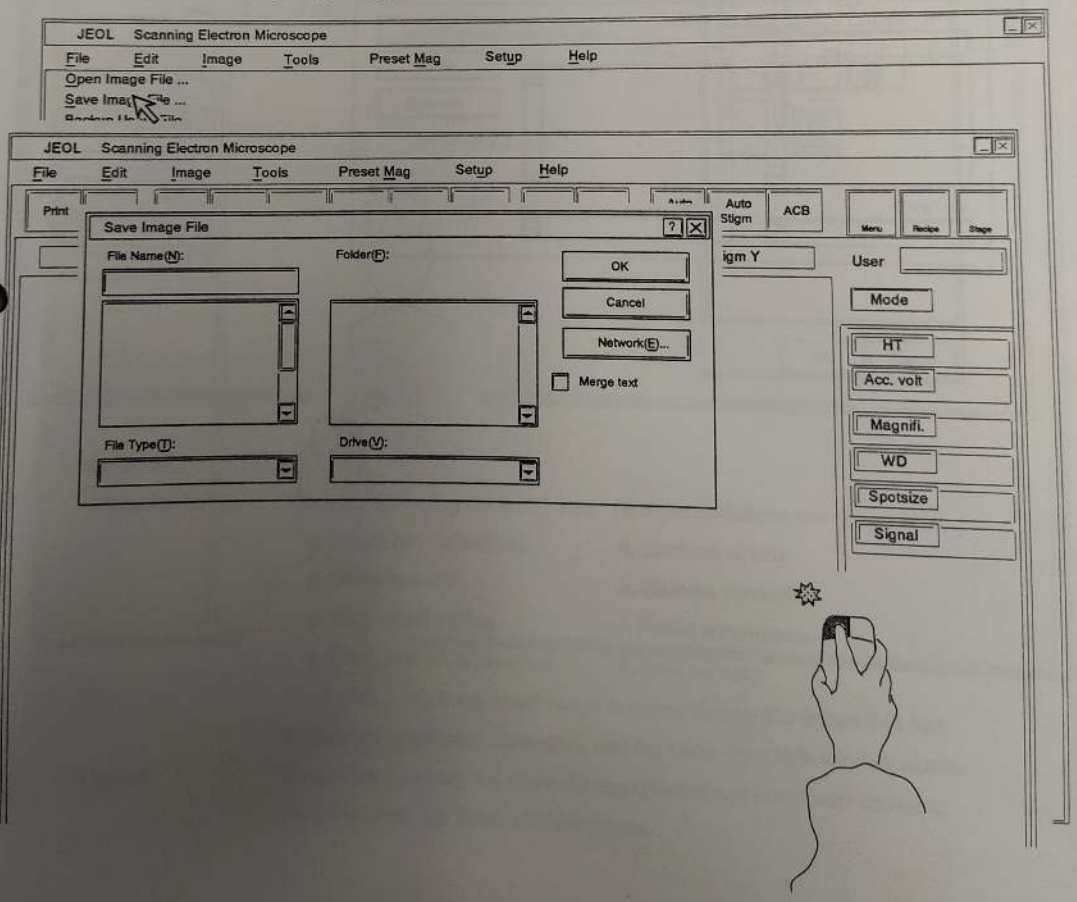


3.10 Managing Image Files

3.10.1 Saving an Image

The frozen image or overwritten image by the Section 3.11 is saved to the hard disk of the personal computer.

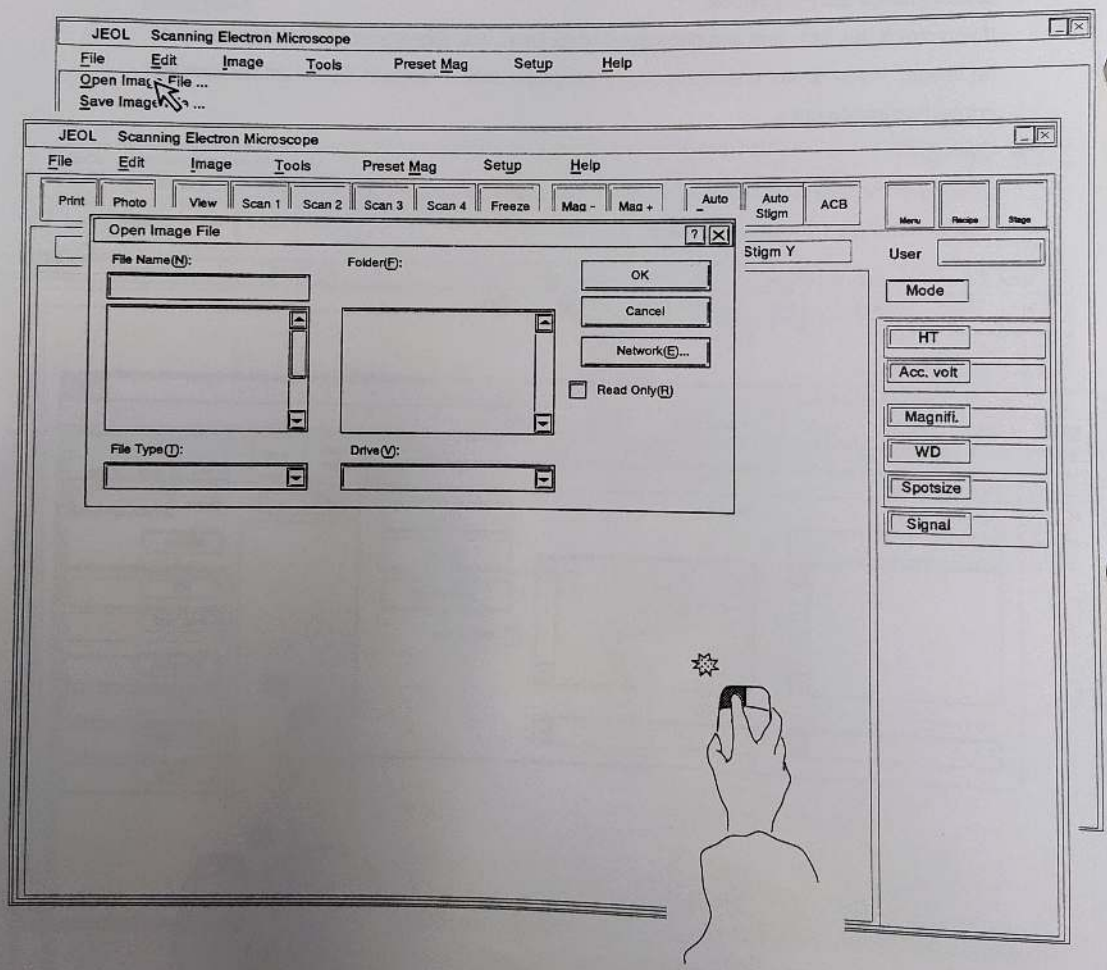
1 Display the image that you wish to saved.
2 Open [File] on the menu bar, and click [Save Image File ...].
The Save Image File window opens. (Based on Windows)
3 Specify the location where the file is to be saved, then enter the filename.
4 Check [Merge text] check box.
If you check this box, text and photograph data (Acc. volt, Magnification, etc.) are saved as an image. If you do not check this box, photograph data is saved in a different file from that containing image data.
5 Click [OK].
The currently displayed image is saved. If you click [Cancel], the Save Image File window closes without anything taking place.



3.10.2 Opening an Image File

1 Open [File] on the menu bar, then click [Open Image File ...].
The Open Image File window opens. (Based on Windows)

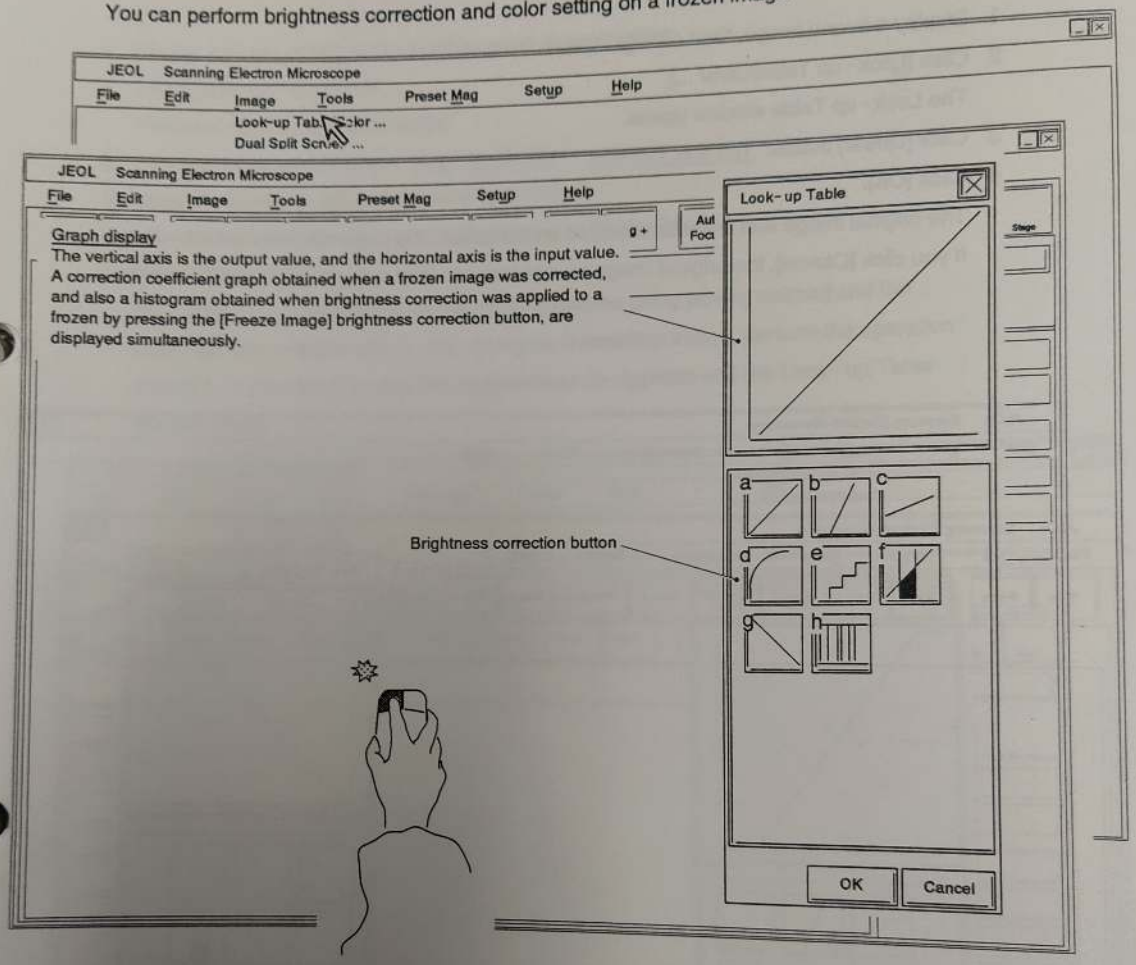
2 Select a file, then click [OK].
The selected image is loaded, and displayed. If you click [Cancel], the Open Image File window closes without anything taking place.



3.11 Image Operations

3.11.1 Look-up Table/Pseudo Color

You can perform brightness correction and color setting on a frozen image.



Brightness correction button: Used for correcting the brightness. (Multiple selections are not possible.)

- a. Linear (no correction)
- b. Contrast strong
- c. Contrast weak
- d. Gamma correction
- e. Multi-level coding
- f. Partial enhancement
- g. Black and white reversal
- h. Pseudo color

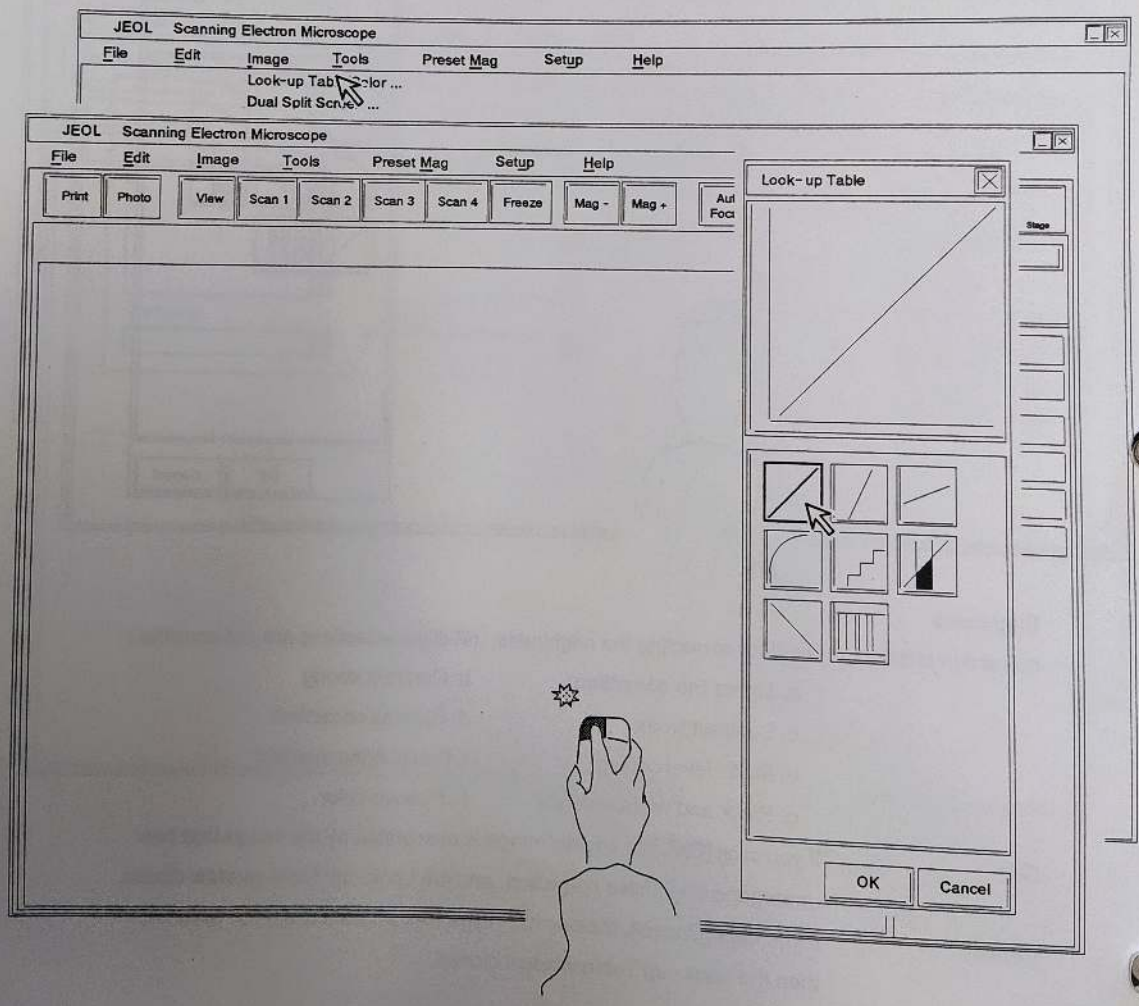
OK: If you click [OK], the original image is overwritten by the image that has undergone brightness correction, and the Look-up Table window closes.

Cancel: If you click [Cancel], the original image (before correction) re-appears, then the Look-up Table window closes.

3.11.1a Linear

You can display a frozen image with linear (no-correction).

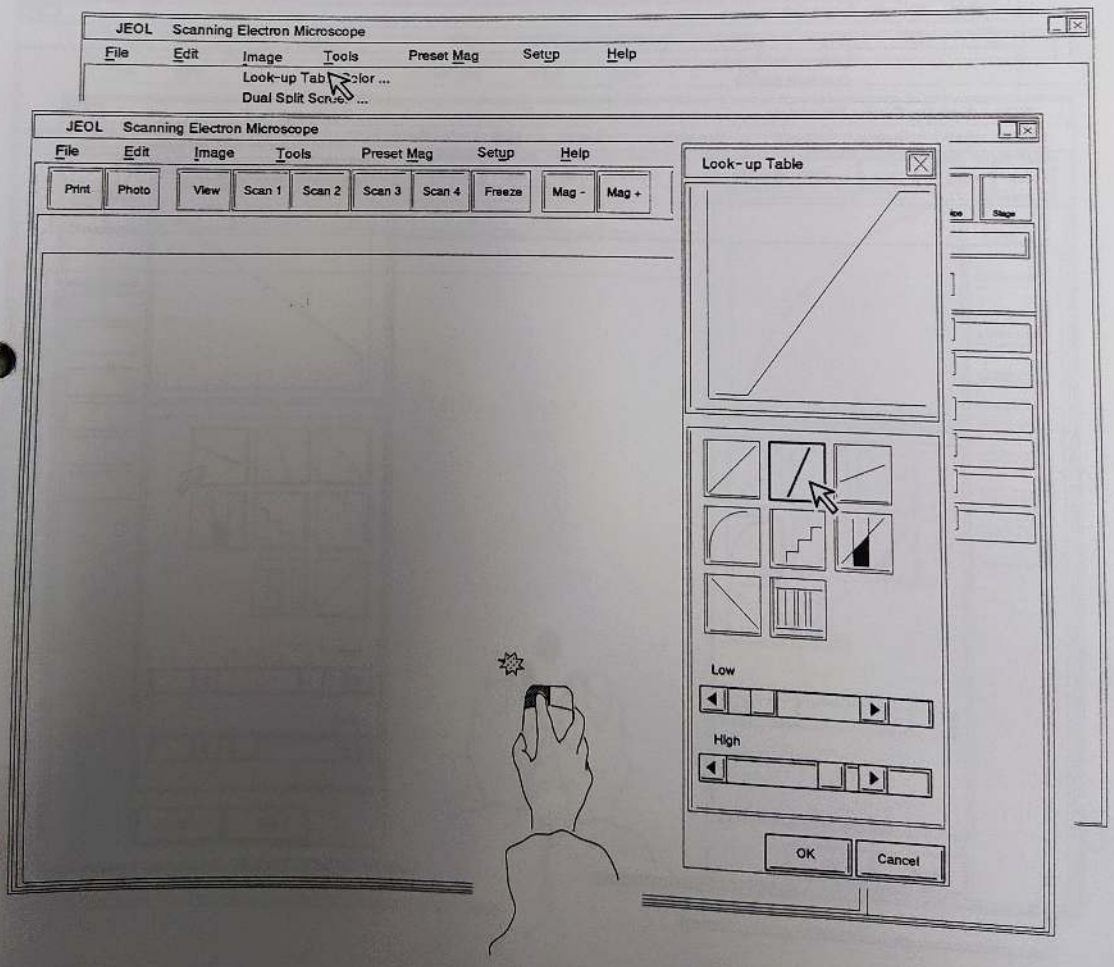
1 Display a frozen image, then click [Image] on the menu bar.
2 Click [Look-up Table/Color ...].
  The Look-up Table window opens.
3 Click [Linear] button. Top line, Left end
4 Click [OK].
  The original image with linear is displayed on the screen, the Look-up Table window closes.
  If you click [Cancel], the original image re-appears and the Look-up Table window closes.



3.11.1b Strong Contrast Correction

You can display a frozen image with strengthened contrast.

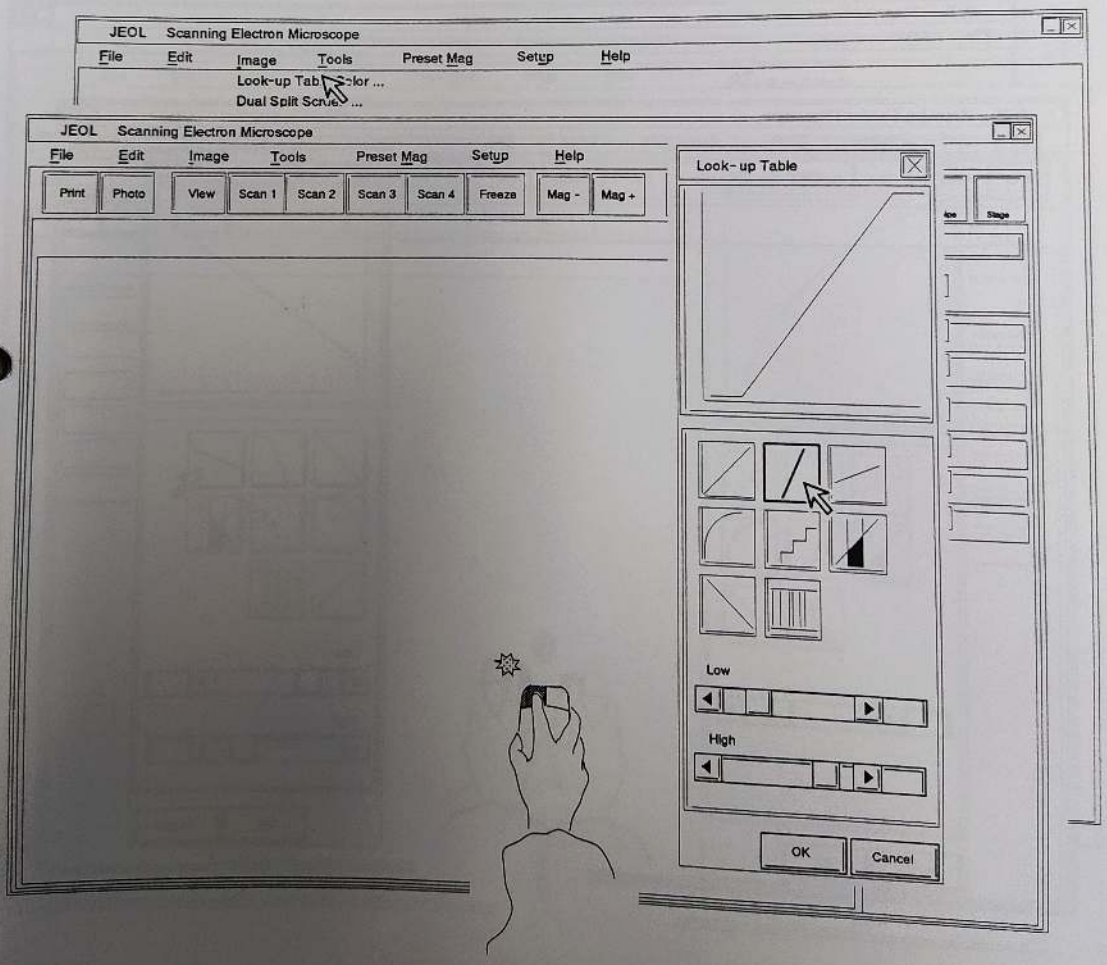
1 Display a frozen image, then click [Image] on the menu bar.
2 Click [Look-up Table/Color ...].
The Look-up Table window opens.
3 Click [Strong contrast] button. Top line, Center
4 Using the scroll bar, adjust the L level and H level.
The range of correction is 0~254 for [Low], and 1~255 for [High].
5 Click [OK].
The original image overwritten by the image corrected using [strong ontrast] and the Look-up Table window closes. For saving the overwritten image, perform the operation of 3.10.1. If you click [Cancel], the original image re-appears and the Look-up Table window closes.



3.11.1b Strong Contrast Correction

You can display a frozen image with strengthened contrast.

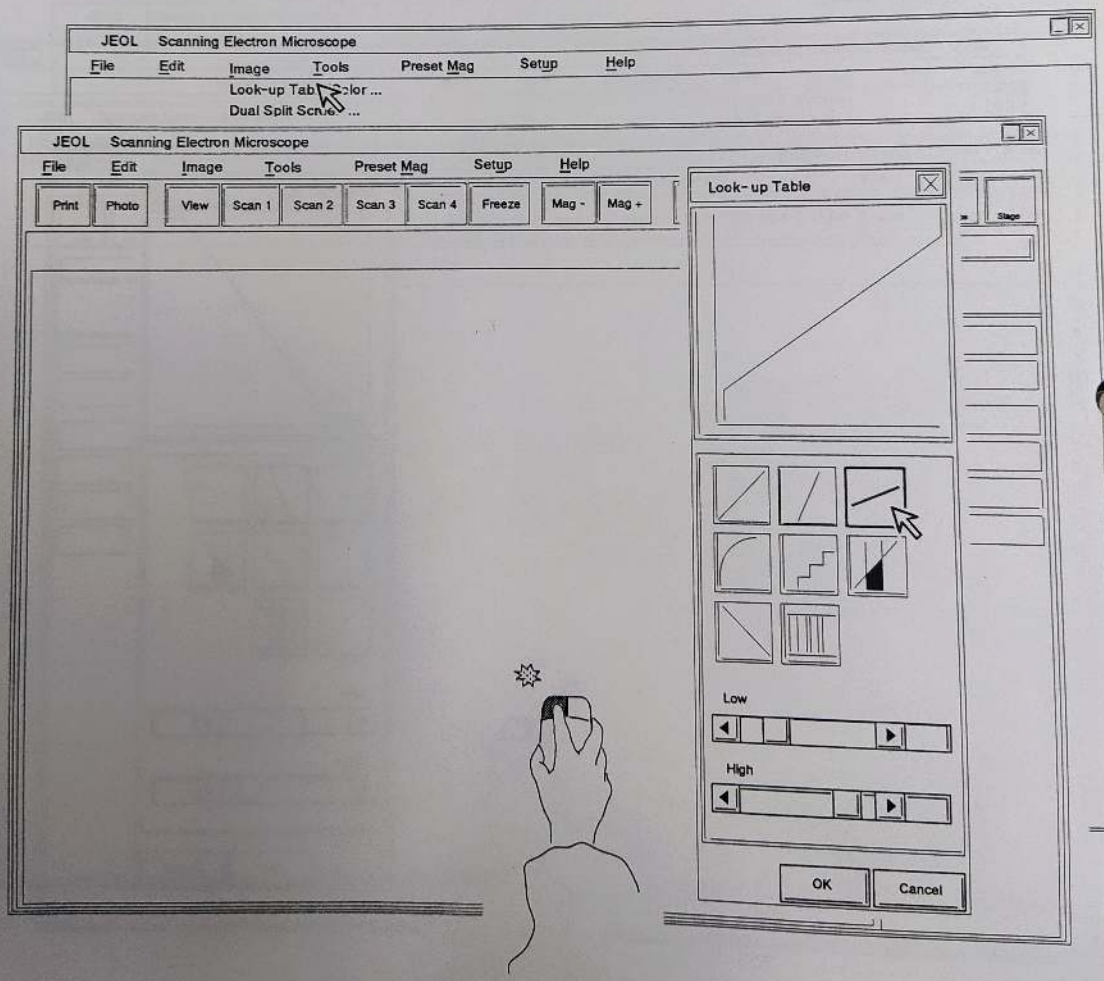
1 Display a frozen image, then click [Image] on the menu bar.
2 Click [Look-up Table/Color ...].
  The Look-up Table window opens.
3 Click [Strong contrast] button. Top line, Center
4 Using the scroll bar, adjust the L level and H level.
  The range of correction is 0~254 for [Low], and 1~255 for [High].
5 Click [OK].
  The original image overwritten by the image corrected using [strong ontrast] and the Look-up Table window closes. For saving the overwritten image, perform the operation of 3.10.1. If you click [Cancel], the original image re-appears and the Look-up Table window closes.



3.11.1c Weak Contrast Correction

You can display a frozen image with weakened contrast.

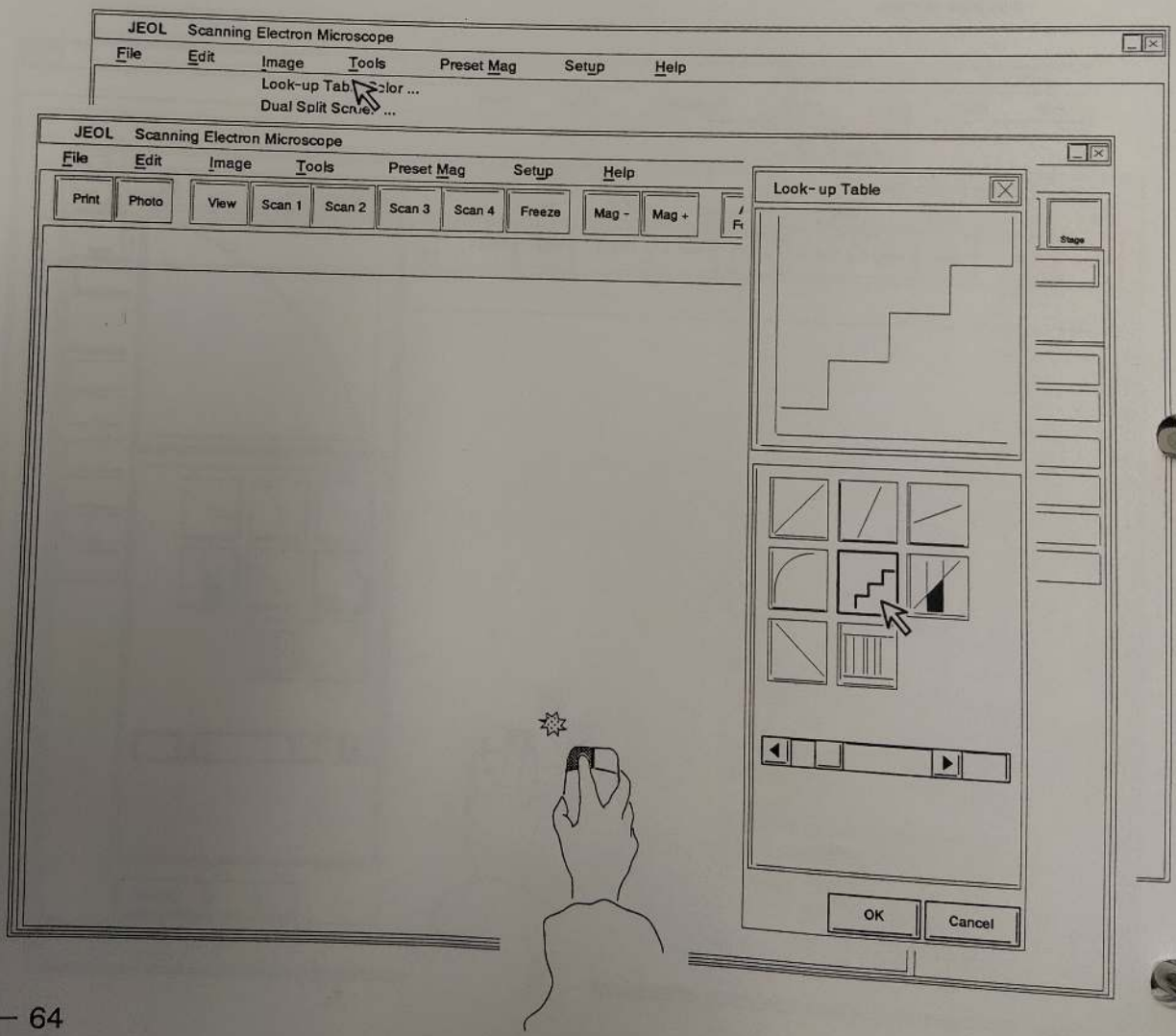
1 Display a frozen image, then click [Image] on the menu bar.
2 Click [Look-up Table/Color ...].
  The Look-up Table window opens.
3 Click [Weak contrast] button. Top line, Right end
4 Using the scroll bar, adjust the L level and H level.
  The range of correction is 0~254 for [Low], and 1~255 for [High].
5 Click [OK].
  The original image overwritten by the image corrected using [weak contrast], and the Look-up Table window closes. For saving the overwritten image, perform the operation of 3.10.1.
  If you click [Cancel], the original image re-appears and the Look-up Table window closes.



3.11.1e Multi-level Coding

You can display a frozen image that has been gray – scale – corrected.

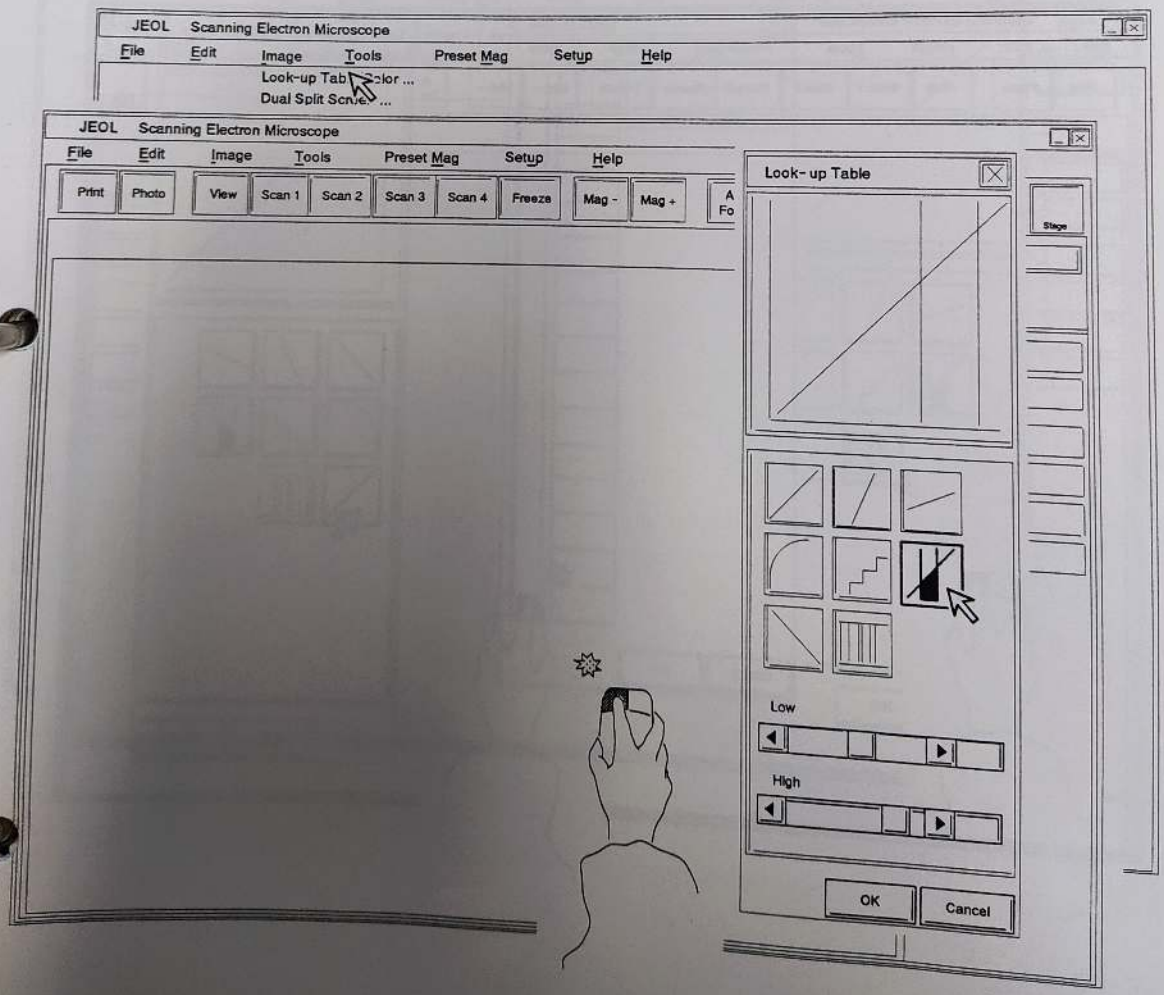
1 Display a frozen image, and click [Image] on the menu bar.
2 Click [Look-up Table/Color ...].
  The Look-up Table window opens.
3 Click [Multi-level Coding] button. Middle line, Center
4 Set a value using the scroll bar.
  The range of multi-level coding is 4, 8, 16, 32, 64 and 128.
5 Click [OK].
  The original image is overwritten by the image corrected using [Multi-level Coding], and the Look-up Table window closes. For saving the overwritten image, perform the operation of 3.10.1. If you click [Cancel], the original image re-appears and the Look-up Table window closes.



3.11.1f Partial enhancement

You can display a frozen image that has been partial enhanced.

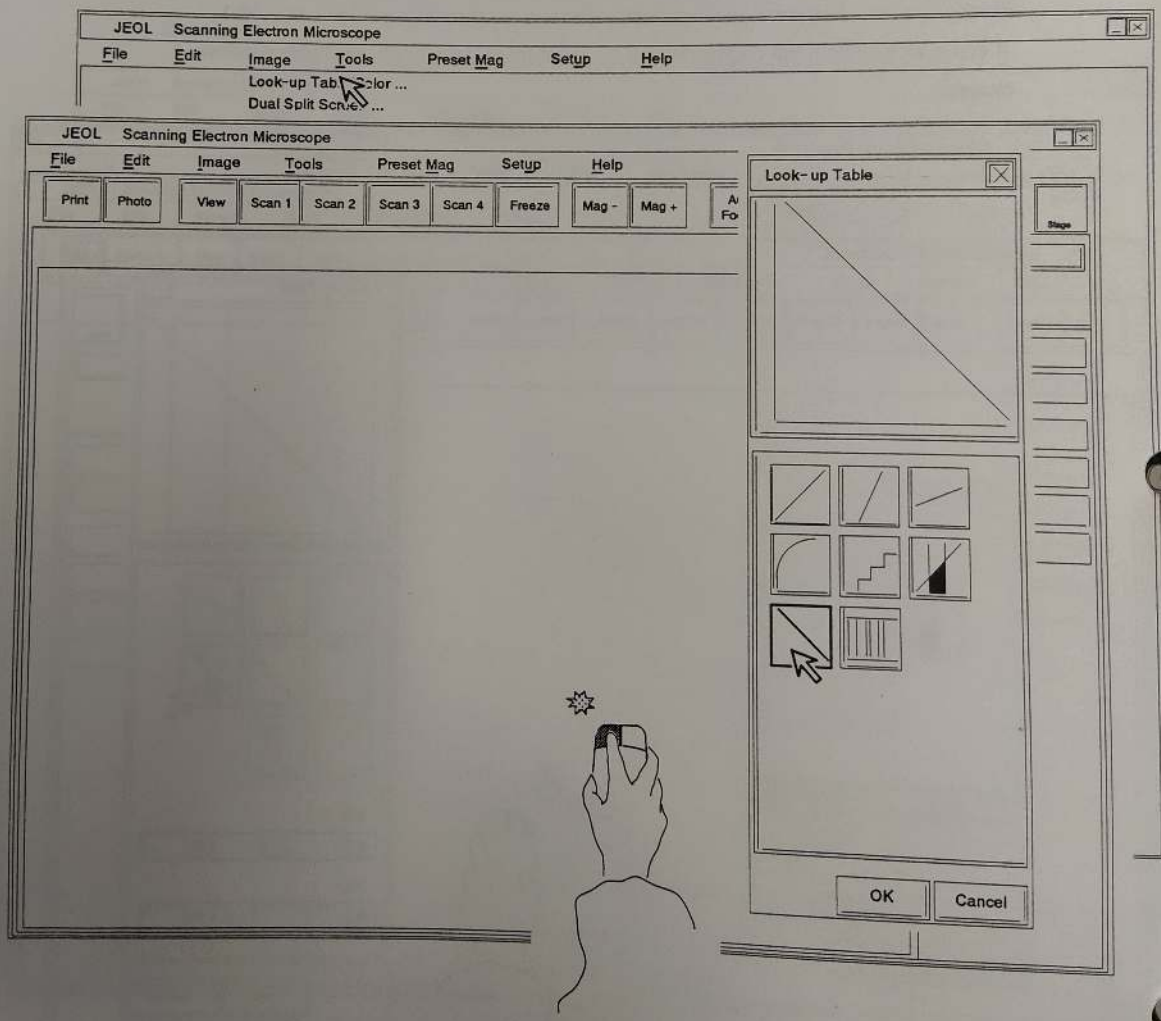
1 Display a frozen image, and click [Image] on the menu bar.
2 Click [Look-up Table/Color...].
The Look-up Table window opens.
3 Click [Partial Enhance] button. Middle line, Right end
4 Using the scroll bar, adjust the L level and H level.
The level range is 0~254 for [Low], and 1~255 for [High]. The level bounded by the two lines is displayed in green, and other parts are displayed in monochrome.
5 Click [OK].
The original image is overwritten by the partially enhanced image, and the Look-up Table window closes. For saving the overwritten image, perform the operation of 3.10.1.
If you click [Cancel], the original image re-appears and the Look-up Table window closes.



3.11.1g Black and white reversal

You can display a black and white reversed frozen image.

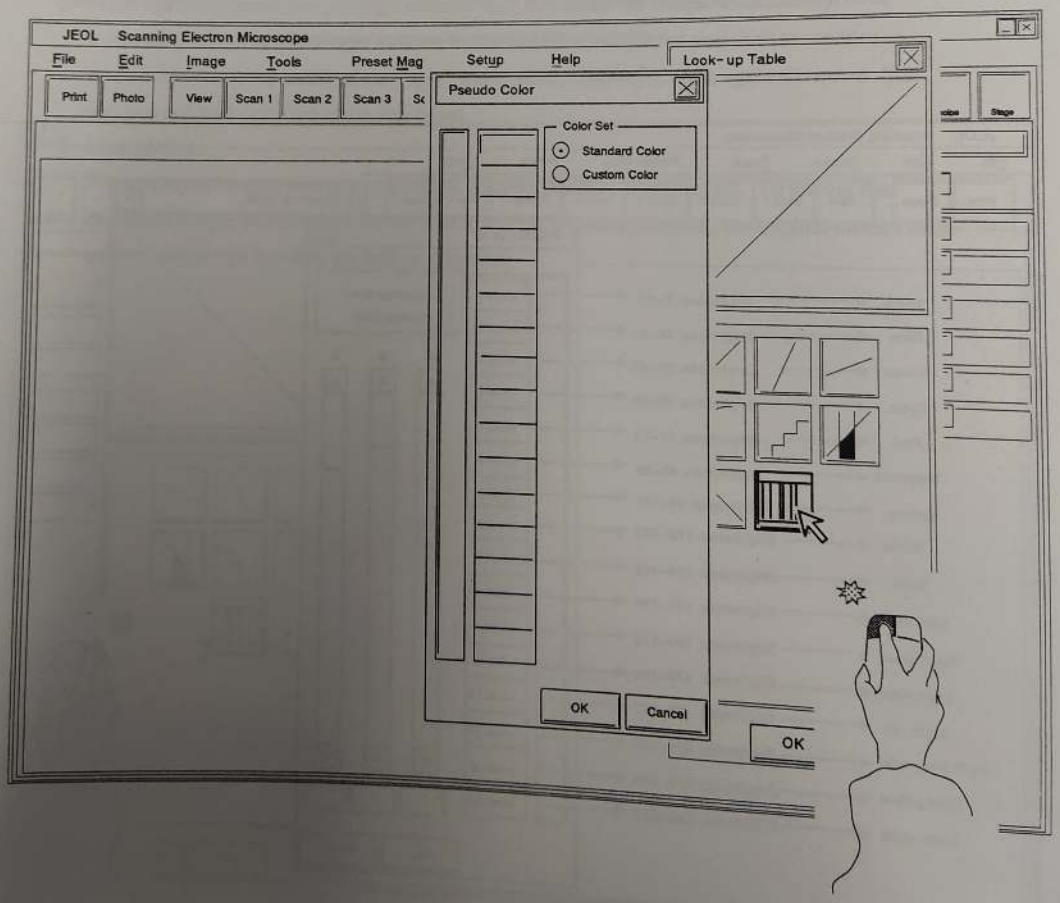
1 Display a frozen image, click [Image] on the menu bar.
2 Click [Look-up Table/Color ...].
  The Look-up Table window opens.
3 Click [Black and White reverse] button. Bottom line, Left end
4 Click [OK].
  The original image is overwritten by the black and white reversed image, and the Look-up Table window closes. For saving the overwritten image, perform the operation of 3.10.1.
  If you click [Cancel], the original image re-appears and the Look-up Table window closes.



3.11.1h Pseudo color: Standard Color

You can display a frozen image that has been corrected by pseudo color (standard or custom).

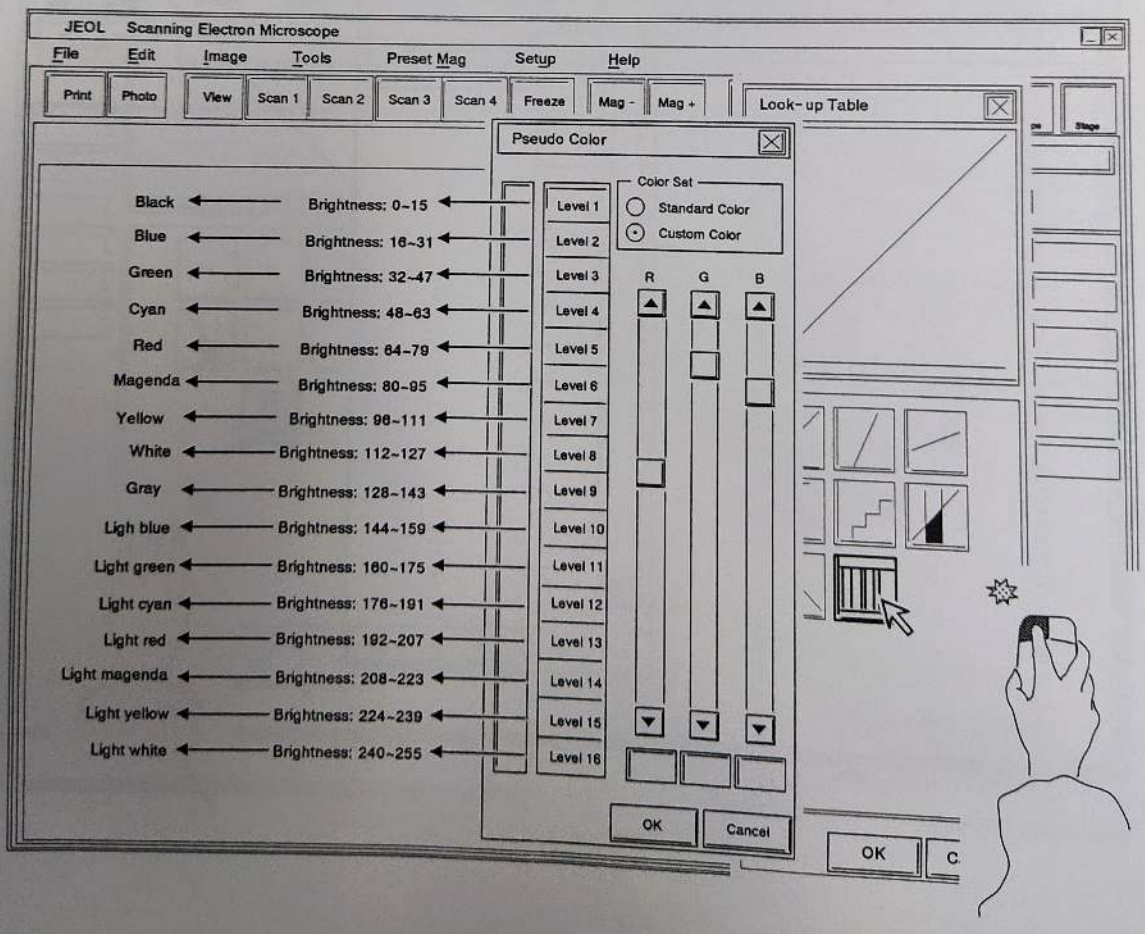
1 Display a frozen image, click [Image] on the menu bar.
2 Click [Look-up Table/Color ...].
3 Click [Color] button. Bottom line, Right end
The Pseudo Color dialog opens.
4 Check [Standard Color] on the Color Set.
5 Click [OK].
The original image is overwritten in the standard colors, and the Pseudo Color window closes.
For saving the overwritten image, perform the operation of 3.10.1.
If you click [Cancel], the original image re-appears and the Pseudo Color dialog closes.



3.11.1i Pseudo color: Custom Color

1 Display a frozen image, click [Image] on the menu bar.
2 Click [Look-up Table/Color ...].
3 Click [Color] button. Bottom line, Right end
4 Check [Custom Color] on the Color Set.
The Pseudo Color dialog opens.
5 Select each color level 1~16, then adjust each of the R, G, and B scroll bars.
The range of correction can set each color between 0 and 255.
6 Click [OK].
The original image is overwritten by the set color level, and the Pseudo Color window closes. For saving the overwritten image, perform the operation of 3.10.1. If you click [Cancel], the original image re-appears and the Pseudo Color window closes.

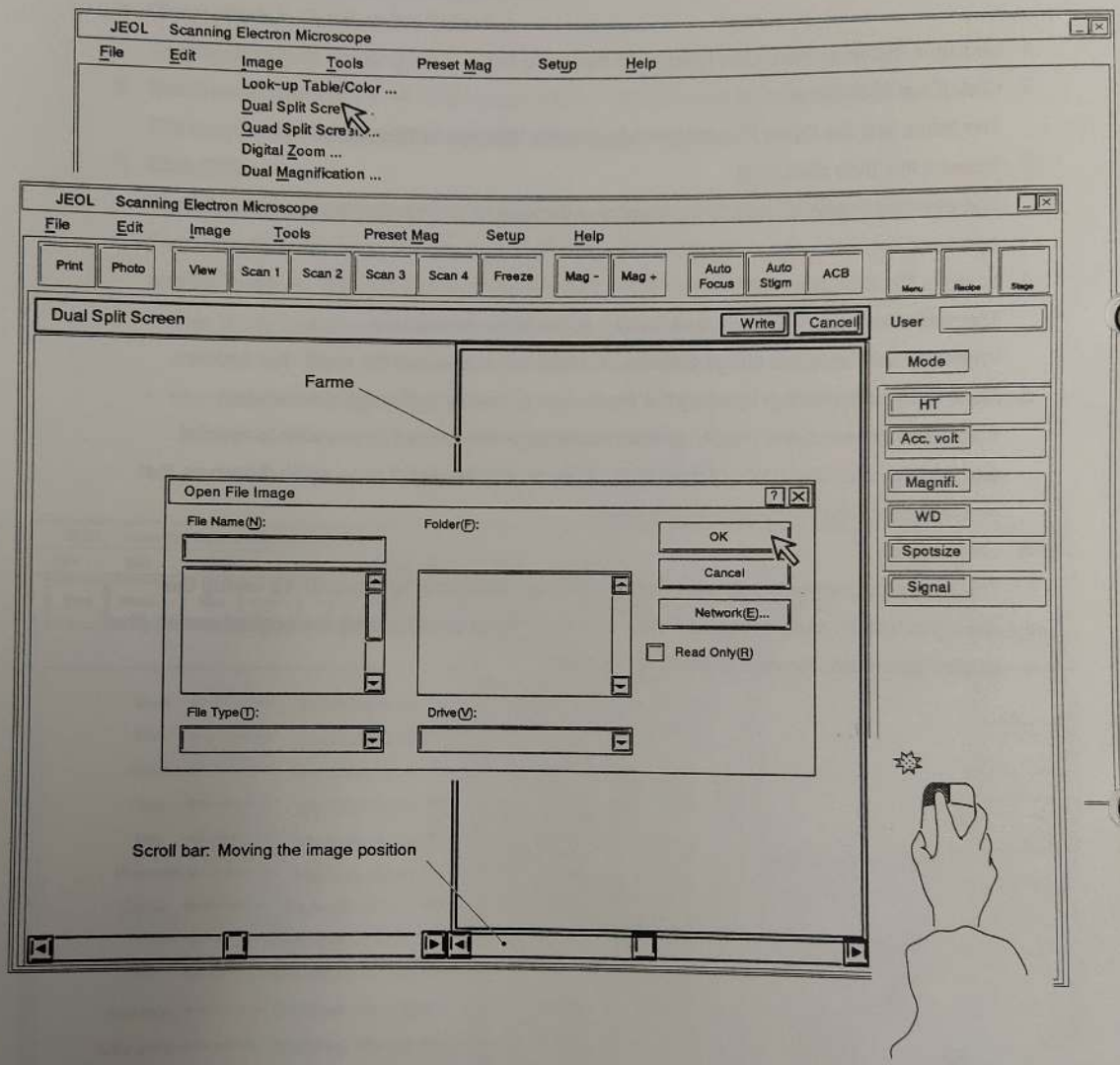
- When 16 color levels are set — The colors set in [Level 1] to [Level 16] are reflected in the range in which the brightness is divided into 16 equal parts.
- When 5 color levels are set — The brightness of an image whose brightness levels are set is displayed in the set colors, and the brightness of an image whose brightness levels are not set is displayed in black.



3.11.2 Dual Split Screen Display

This function can be used only on BMP (bit map) files. It enables you to combine and display two BMP files.

1 Display a frozen screen, click [Image] on the menu bar.
2 Click [Dual Split Screen ...].
The frame and the Open File Image dialog opens. (Based on Windows)
3 Select a file, then click [OK].
The selected image is loaded, and display at the right on the screen, then frame is shifted to the left.
4 Select a file, then click [OK].
The selected image is loaded, and display at the left on the screen.
When the two-selected image displays, a dialog box closes and the scroll-bar appears
5 Move the image position by using the scroll-bar, or rewrite the image, if necessary.
If you wish to rewrite the image, shift the frame (click the image that you wish to rewrite) and double-click the inside of the frame. Then repeat the step 3 once again (however, that you can not load continuously in this case).
6 Click [Write].
The displayed images become one image, and this function is terminated. To saving the displayed image, perform the operation of 3.10.1. If you click [Cancel], the original screen (that existed before this function started) re-appears.

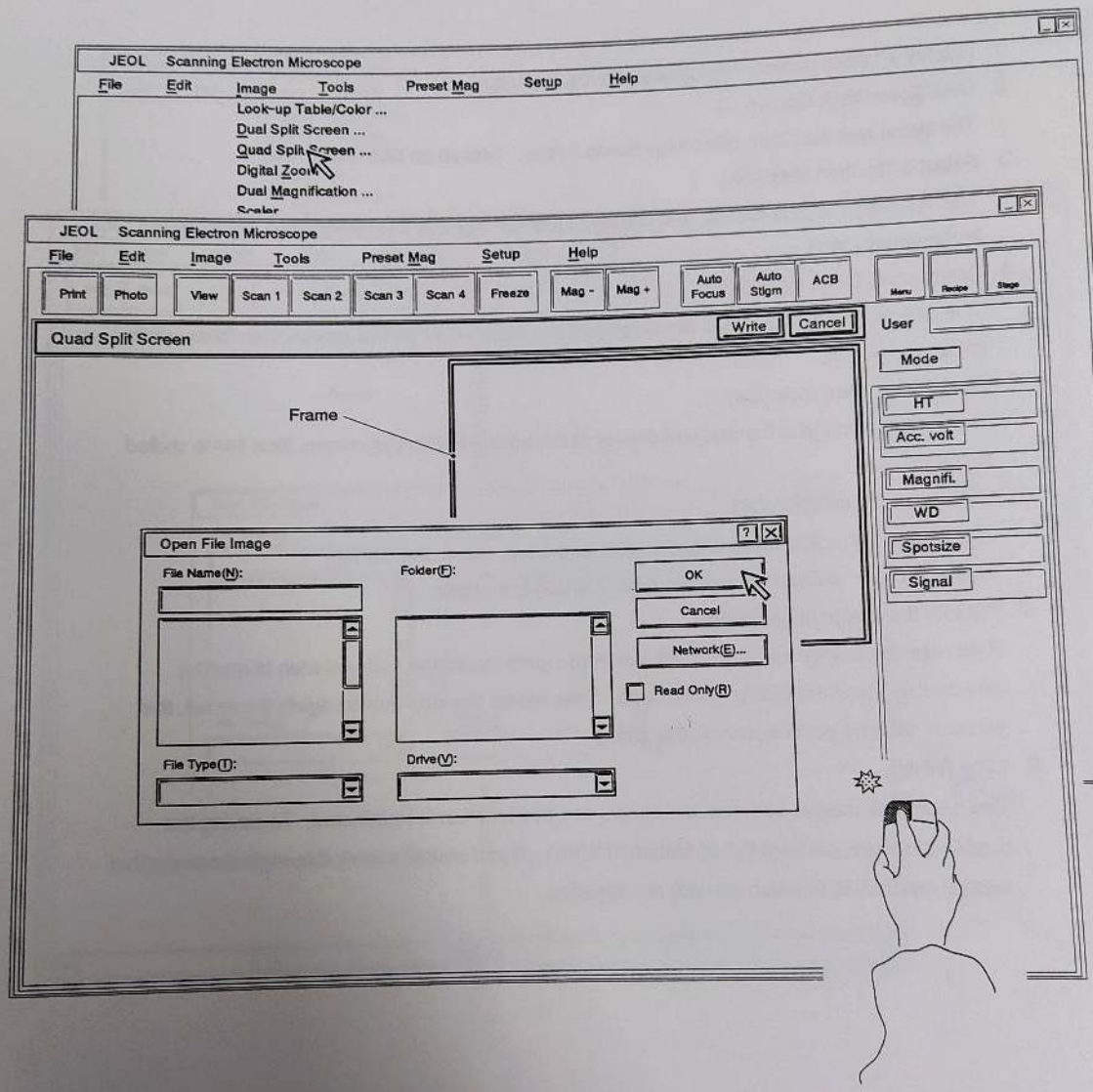


【Dual Split Screen】

3.11.3 Quad Split Screen Display

This function can be used only on BMP (bit map) files. It enables you to combine and display four BMP files.

1 Display a frozen screen, click [Image] on the menu bar.
2 Click [Quad Split Screen ...].
The frame and the Open File Image dialog opens. (Based on Windows)
3 Select a file, then click [OK].
The selected image is loaded, and display at the top-right on the screen, then frame shifted to the under-right.
4 Select a file, then click [OK].
The selected image is loaded, and display at the under-right on the screen, then frame shifted to the under-left.
5 Select a file, then click [OK].
The selected image is loaded, and display at the under-left on the screen, then frame shifted to the top-left.
6 Select a file, then click [OK].
The selected image is loaded, and display at the top-left on the screen.
When the four-selected image displays, a dialog box closes.
7 Rewrite the image, if necessary.
If you wish to rewrite the image, shift the frame (click the image that you wish to rewrite) and double-click the inside of the frame. Then repeat the step 3 once again (however, that you can not load continuously in this case.)
8 Click [Write].
The displayed images become one image, and this function is terminated. To saving the displayed image, perform the operation of 3.10.1. If you click [Cancel], the original screen(that existed before this function started) re-appears.

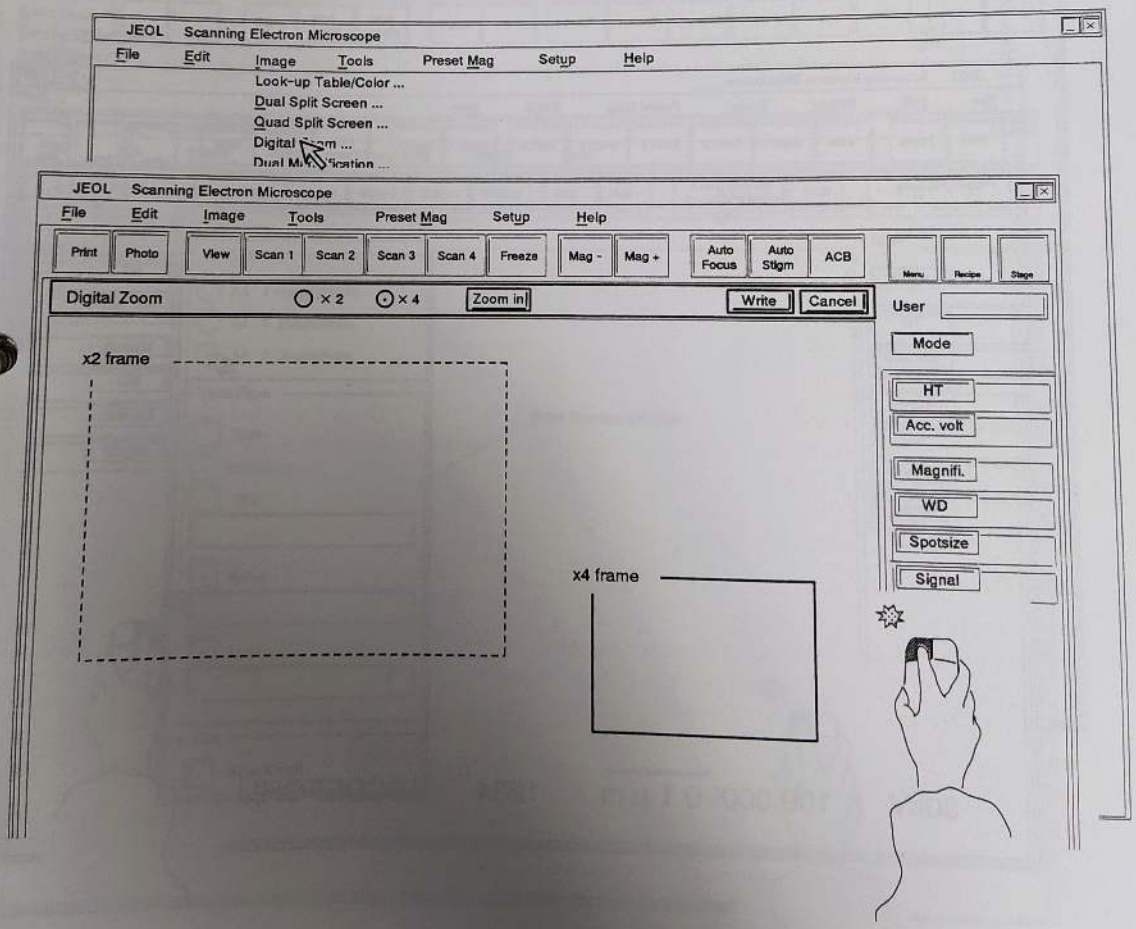


【Quad Split Screen】

3.11.4 Digital Zoom

This function is intended to be used on frozen images and BMP (bit map) files. It enables you to enlarge the area inside the frame by a factor of 2 or 4 and display it.

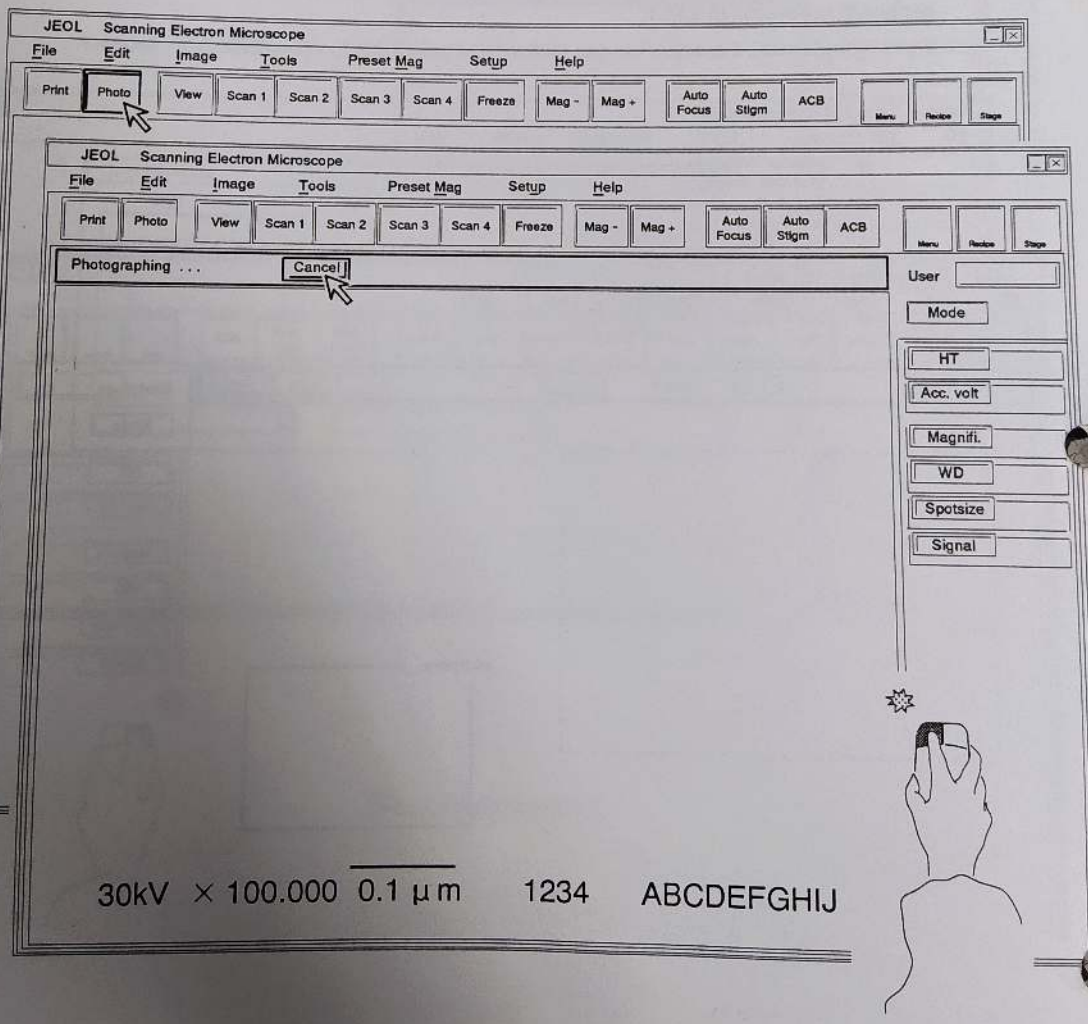
1 Display a frozen screen or a BMP file (refer to 3.10.2), then click [Image] on the menu bar.
2 Click [Digital Zoom ...], then select [× 2] or [× 4].
3 Drag the frame, and determinate the position to be enlarged.
4 Click [Zoom in].
The same operation takes place if you double-click the image. The inside of the range frame enlarges to fill the entire screen. [Zoom in] changes over to [Zoom out]. If you click [Zoom out], the original image re-appears.
5 Click [Write].
The original image is overwritten by the displayed image. To saving the displayed image, perform the operation of 3.10.1.
If you click [Cancel], the original screen (that existed before this function started) re-appears.



3.12 Photographing the Images (CSI, PRD; Option)

In order to photograph images, it is necessary to use a Camera for Scanning Image (CSI: optional) and Photorecording Device (PRD: Optional).

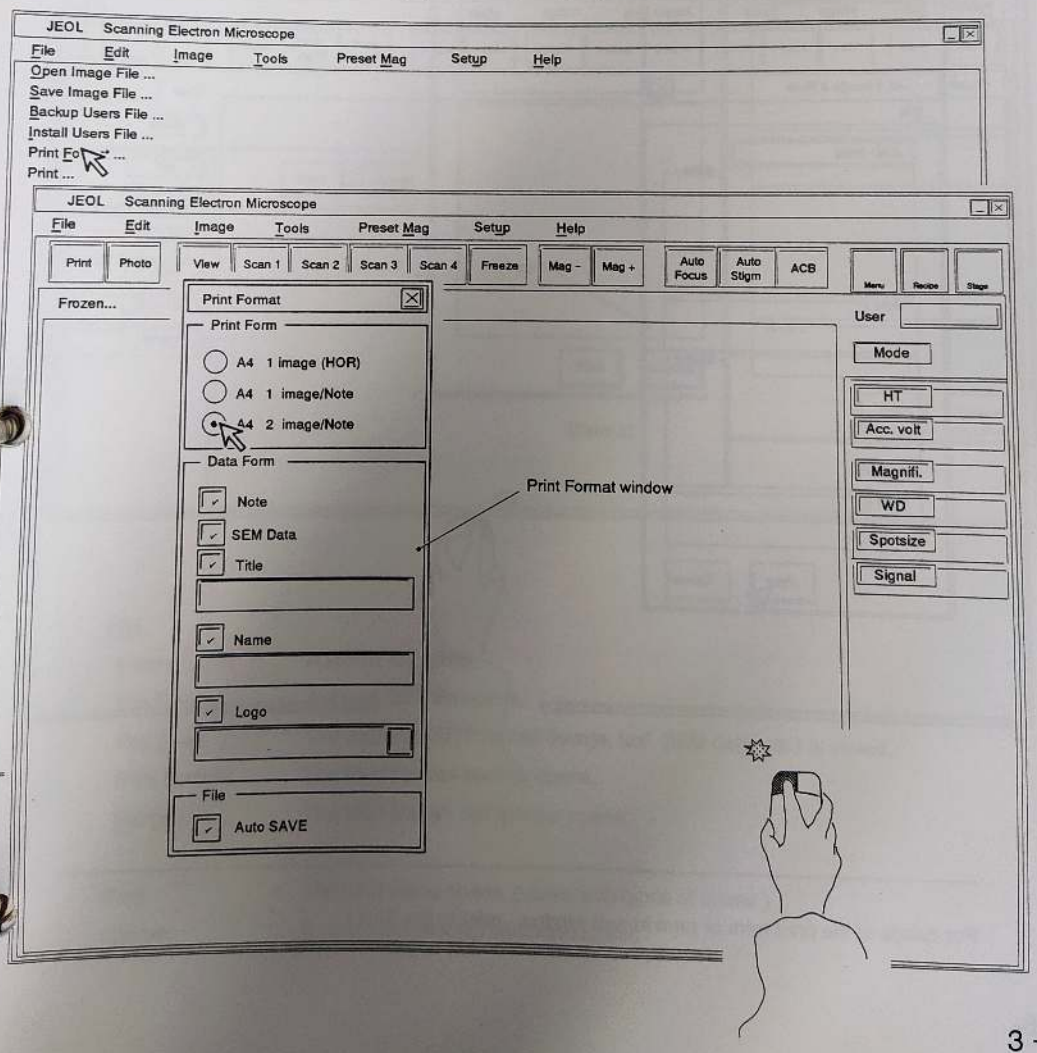
1 Prepare the camera so that it is ready for use. (Refer to the instruction manual for CSI)
2 Display an image that you wish to photograph (live image, frozen image or image file).
The image file can be displayed by referring to 3.10.2 .
3 Enter text (refer to 3.8) and set the photograph data (refer to 3.7.15).
4 Select the photographing speed (refer to 3.7.14).
5 Click [Photo] on the SEM control button.
If you click [Cancel], the photographing interrupts.



3.13 Printing the Images (Simplified DTP)

This is a simplified DTP function which is intended to output images, SEM data and text to a general purpose printer. (please prepare the printer separately.)
The printable image is frozen image and file image, then you can select one of print form 1 to 3.
This section describes only the [Print Form 3].

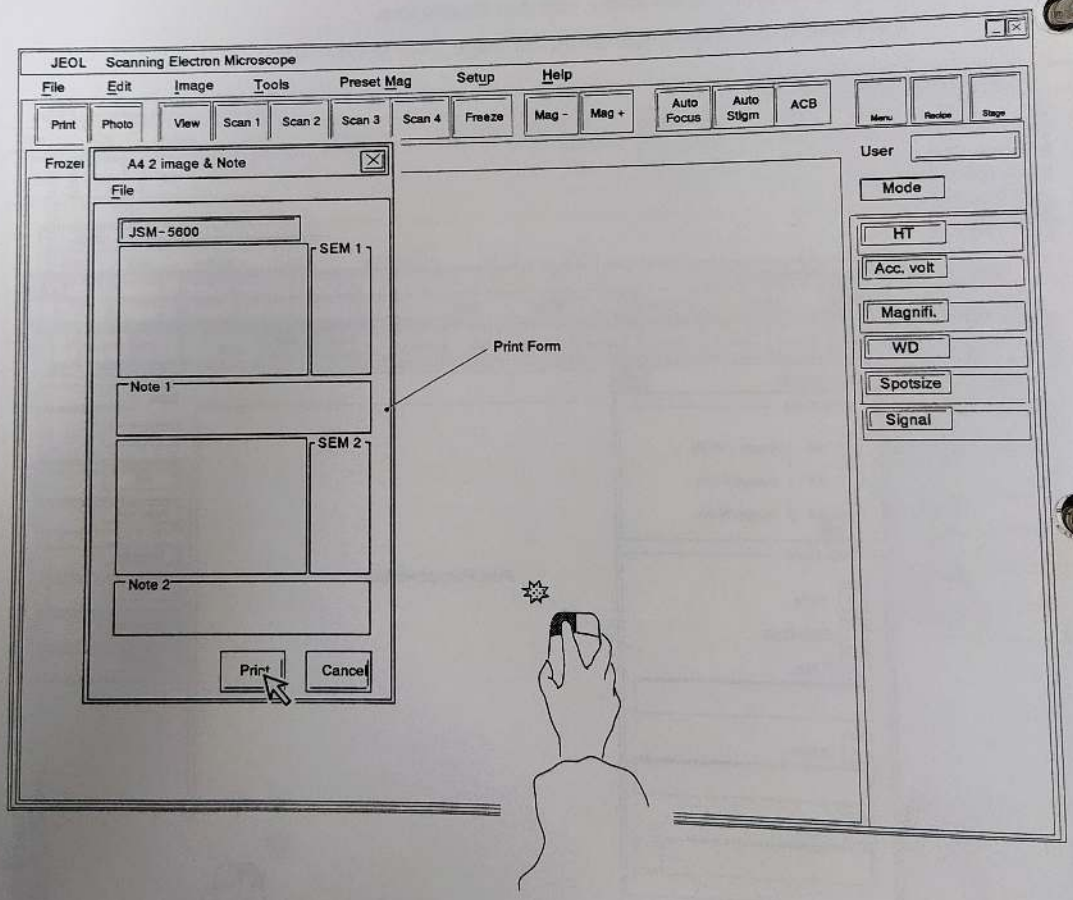
1 Display a frozen screen, click [File] on the menu bar.
2 Click [Print Format ...].
3 Select [A4 2 images/Note] of print format then close the print format window.
4 Click [Print] on the SEM control button.
A [Print Form 3] opens, and frozen image appears in the form.
If you wish to print a frozen image, omit the following step.
If you wish to print a file image, call the file image. (refer to the 3.13.2)



5 Open the Print Format window, then set the data form.
To enter a text, title, name and logo, refer to the 3.13.3~3.13.5.
To setting the print position, refer to the 3.13.6.

6 Put the printer in an output enable status. (Refer to the maker's instruction manual for printer)

7 Click [Print] on the print form.
The print menu opens, then carry out according to the print menu (varies with types of printer).
If you click [Cancel], printing is interrupted, and the print form closes.
If you check the [Auto Save] check box in advance, you can automatically save data in the DTP format. Once printing has ended, the save menu automatically opens, so attach a file name and specify the location where the file is to be saved.



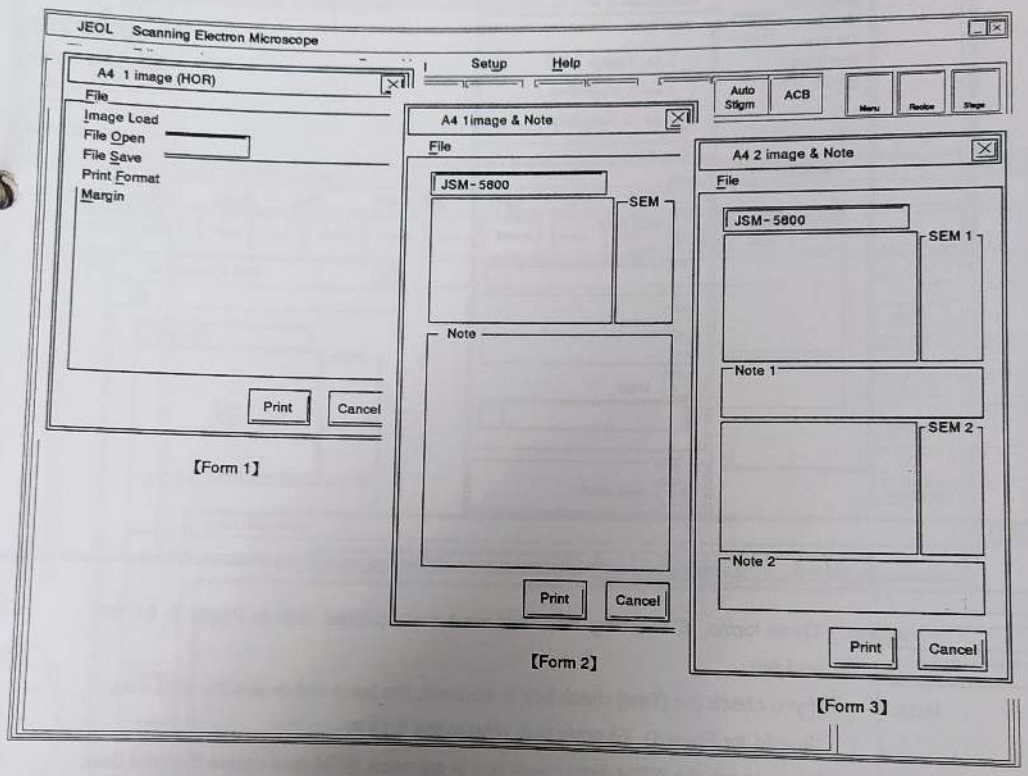
For details of the print form or print format window, refer to the 3.13.1.

3.13.1 Print Form, Print Format window

Print Form

To open the print form:

- Open [File] on the menu bar, then click [Print ...].
- Click [Print] on the SEM control button.

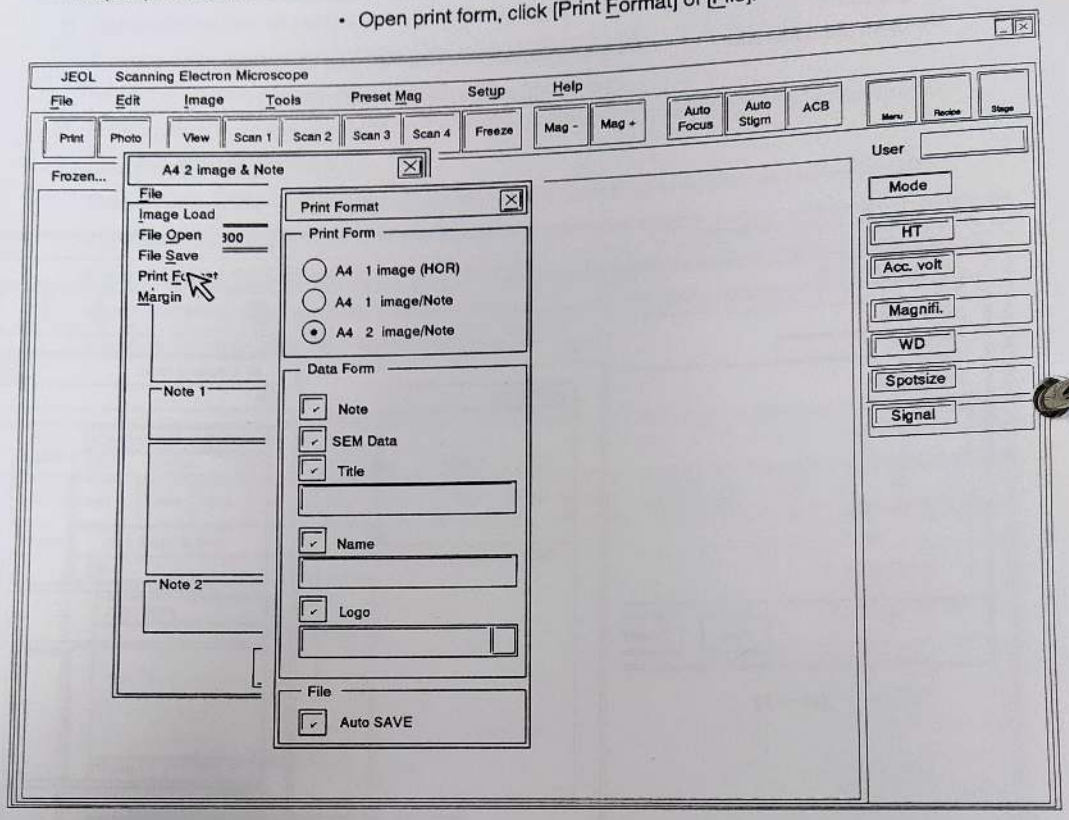


File

Image Load:	A stored file opens.
File Open:	A stored DTP file opens.
File Save:	The displayed DTP format (image, text, SEM data, etc.) is saved.
Print Format:	The Print Format window opens.
Margin:	The DTP Margin Set window opens.
Print:	The print menu opens. (varies with types of printer.)
Cancel:	If you click [Cancel], print form closes.

Print Format window

To open print format window:
- Open [File] on the menu bar, then click [Print Format ...].
- Open print form, click [Print Format] of [File].



Print form: Three forms. (Regarding forms that are actually printed, refer to Pages 3-84, 85 and 86)

Note: If you check the [Text] check box in advance, the input text enters the print data. (Invalid for Form 1) To enter text, refer to the 3.13.3.

SEM Data: If you check the [SEM data] check box in advance, SEM data enters the print data. (Invalid for Form 1)

Title: If you check the [Title] check box in advance, the input title enters the print data. To enter a title, refer to the 3.13.4.

Name: If you check the [Name] check box in advance, the input name enters the print data. Simultaneously, the print output data is also printed. To enter a name, refer to the 3.13.4.

Logo: If you check the [Logo] check box in advance, the input logo enters the print data. To enter a logo, refer to the 3.13.5.

FILE: If you check the [Auto Save] check box in advance, you can automatically save data in the DTP format.

3.13.2 Calling the file image

a) Double-click the image part on print form.

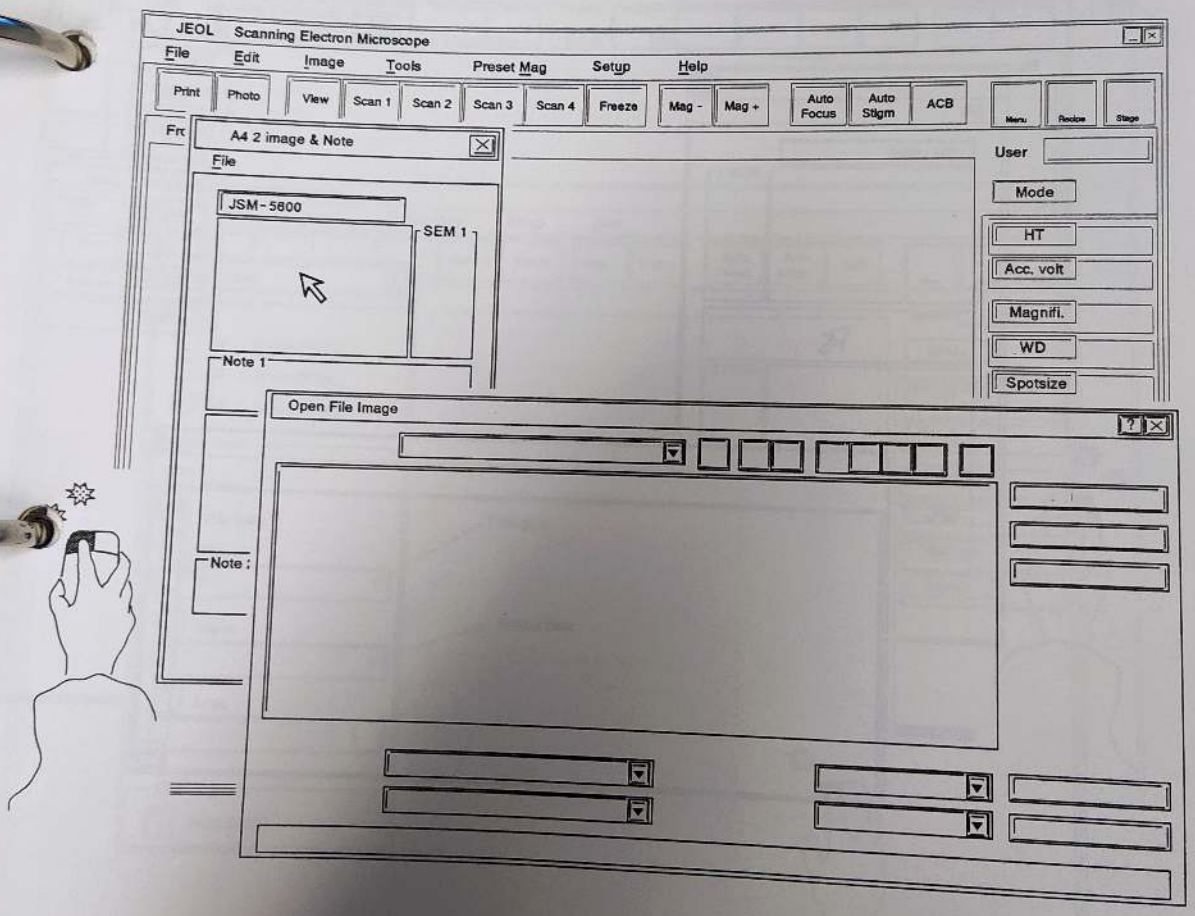
Select the file that you wish to print form the file menu. (Based on Windows)

The selected file is displayed on the image part of the print form.

b) Click [Image Load] of [File] on the print form.

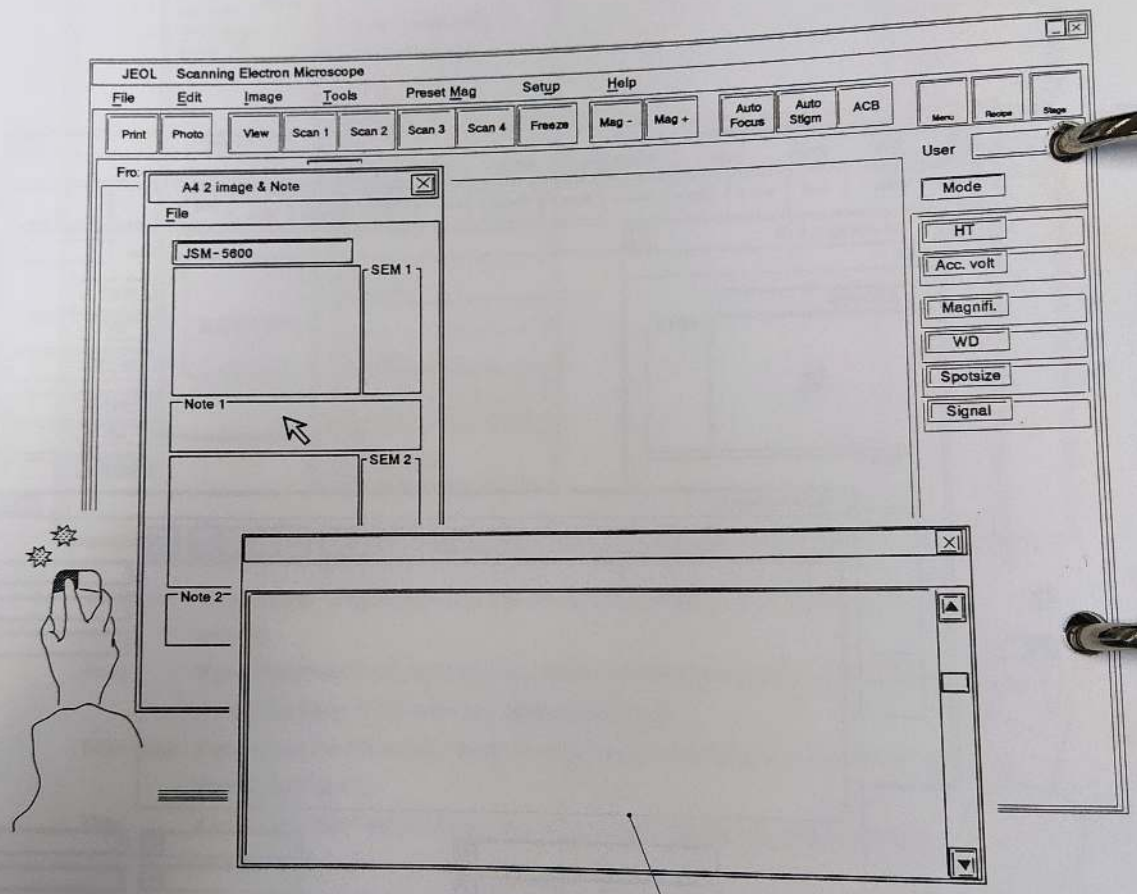
Select the file that you wish to print form the file menu. (Based on Windows)

The selected file is displayed on the image part of the print form.



3.13.3 Enter a text

1 Open Print Format window (refer to 3.13.1), then check the [Note] check box.
If you do not this check box in advance, text does not printed.
2 Open Print Form (refer to 3.13.1), then double-click the note part on the Print Form.
3 Enter the text from the keyboard according to the text input screen. (Based on Windows)



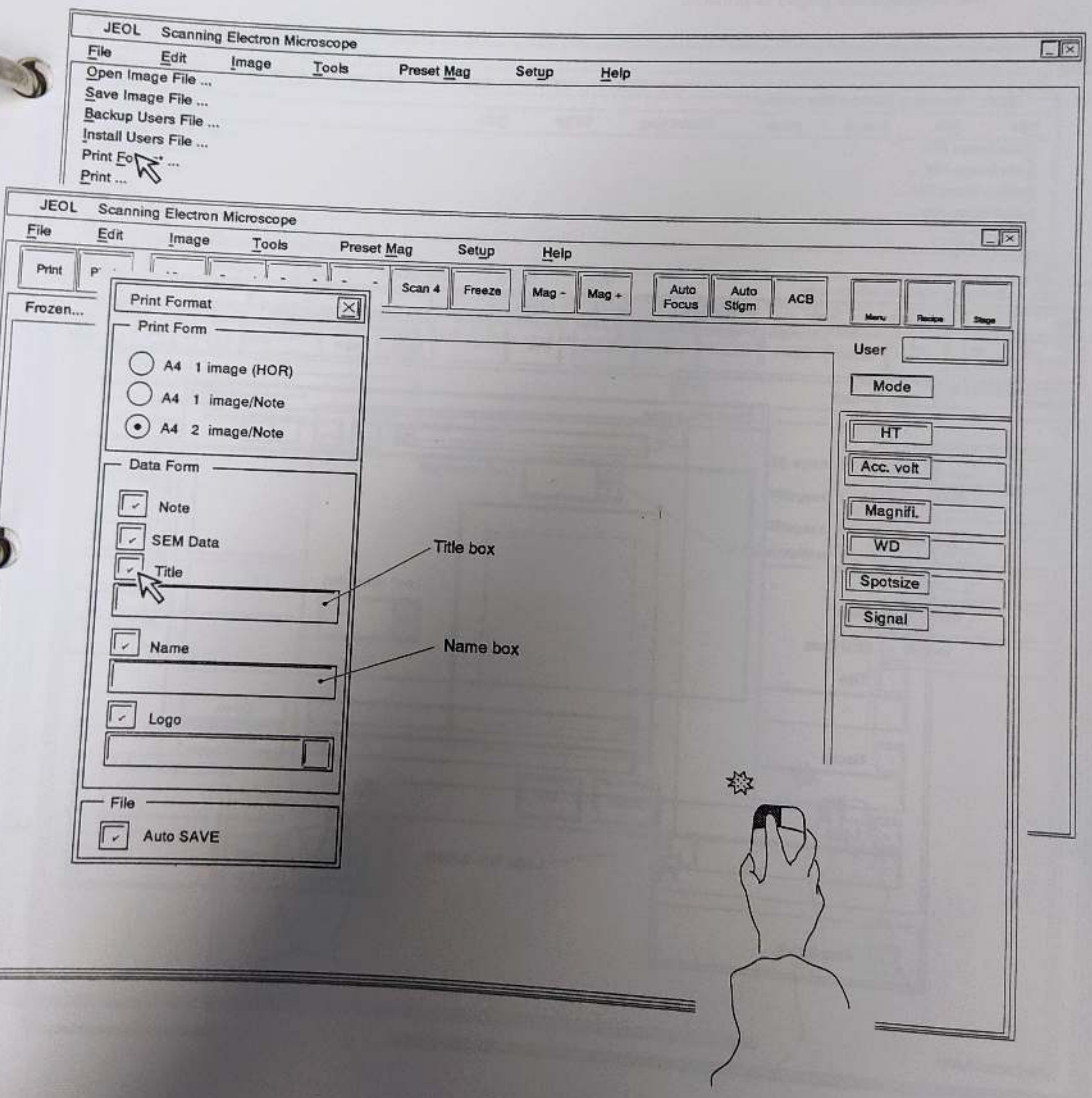
Text Input screen

3.13.4 Enter a title or name

1 Open Print Format window (refer to 3.13.1), then check the [Title] or [Name] check box.
If you do not check these check box in advance, the title or name does not printed.

2 Click title box or name box.

3 Enter the title or name from the keyboard.
Enter the title using up to 15 alphanumeric characters.
Enter the name using up to 10 alphanumeric characters.



3.13.5 Enter a logo

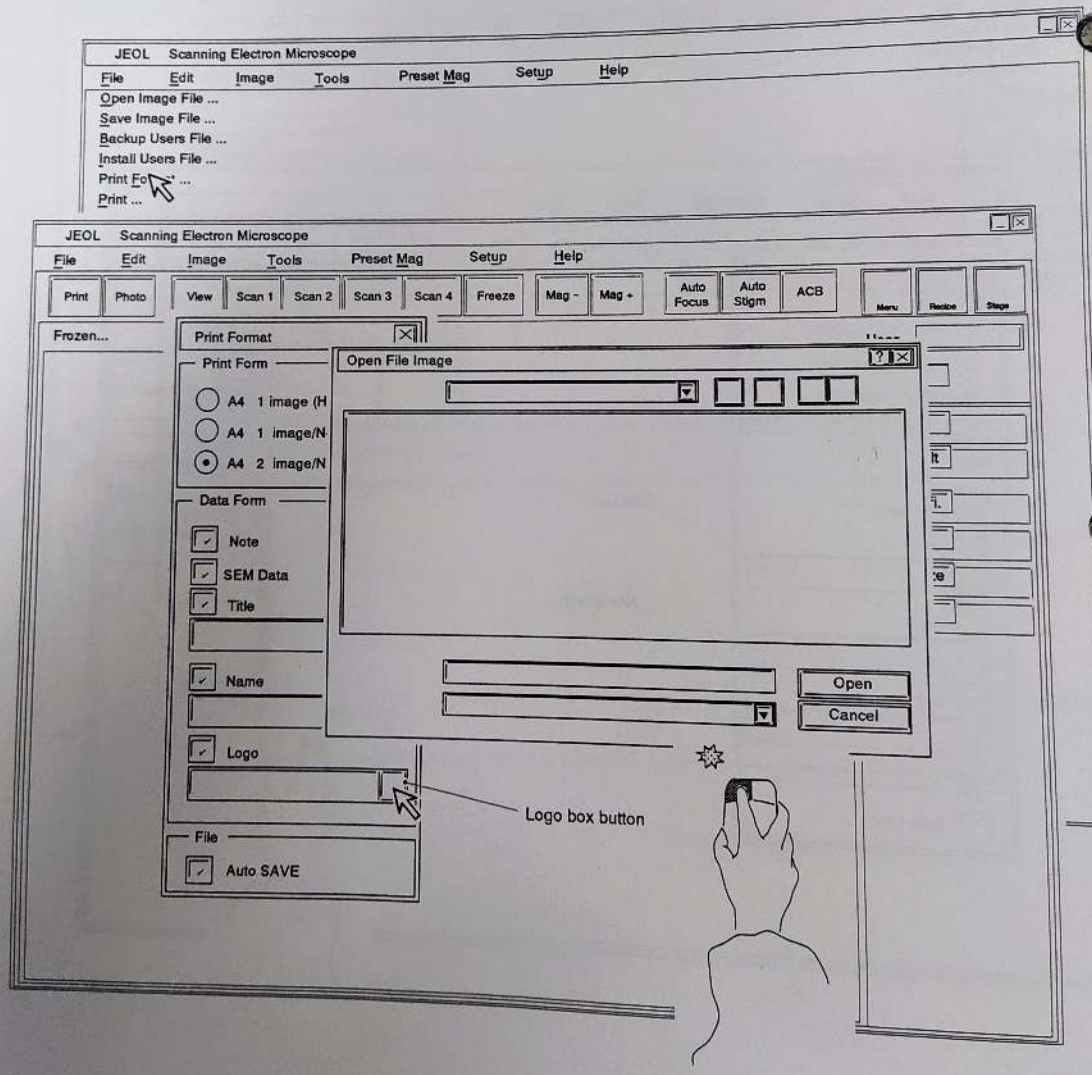
1 Open Print Format window (refer to 3.13.1), then click the [Logo] check box.
[JEOL] can be automatically printed. (Logo printing position, see Page 3-84, 85 and 86.)
If do not check this check box, [JEOL] does not printed. If you wish to enter a logo other than [JEOL], carry out the following steps 2~5.

2 Make the logo by the BMP form. (refer to the instruction manual provided with the computer)

3 Click the logo box button.

4 Select the file from Open File Image window. (Based on Windows)

5 Click [Open].
The selected file (logo) is printed.



3.13.6 Set a margin

1 Open Print Form (refer to 3.13.1).

2 Open [File] on the print form, then click [Margin].

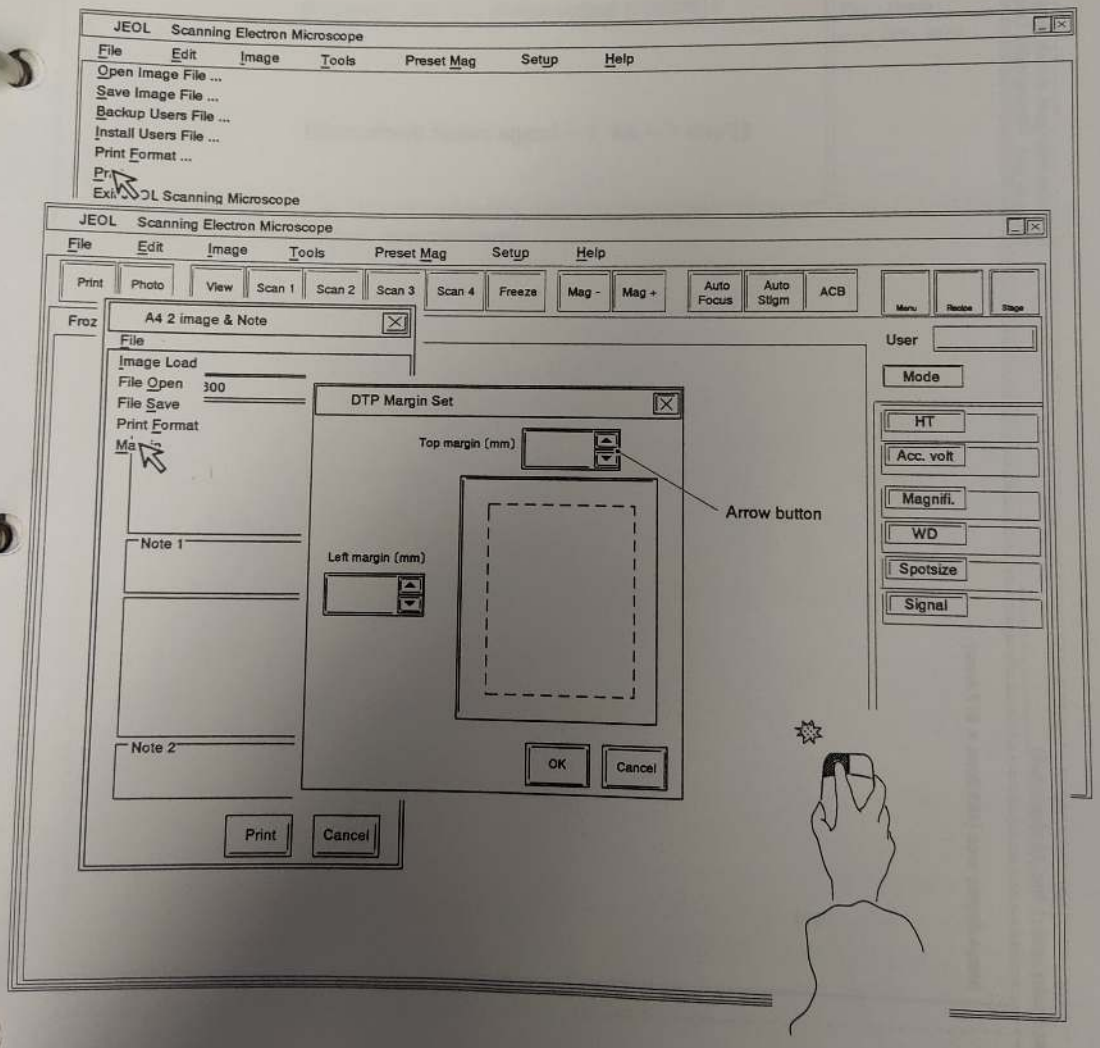
The DTP Margin Set window opens.

3 Set the desired margin value with arrow-button.

The same operation takes place if you enter the desired margin value from the keyboard.

4 Click [OK].

The set margin value is stored. If you click [Cancel], the DTP Margin Set window closes without anything taking place.



【Form 1 – A4 1 – image output (horizontal)】

Title display area (1 line, 15 characters)

Printing date (year, month, day)/
Name display area (Upper part: printing date, Lower part: Name 10 characters)

Image display area (128mm × 96mm)

【Form 2 – A4 1 – image output (vertical)】

SEM date display area

MAG : ×※※※※

Acc. V : ※※ kV

Signal : SEI

WD : ※※ mm

SS : ※※

Pa : ※※ Pa

——— :

※※ μ

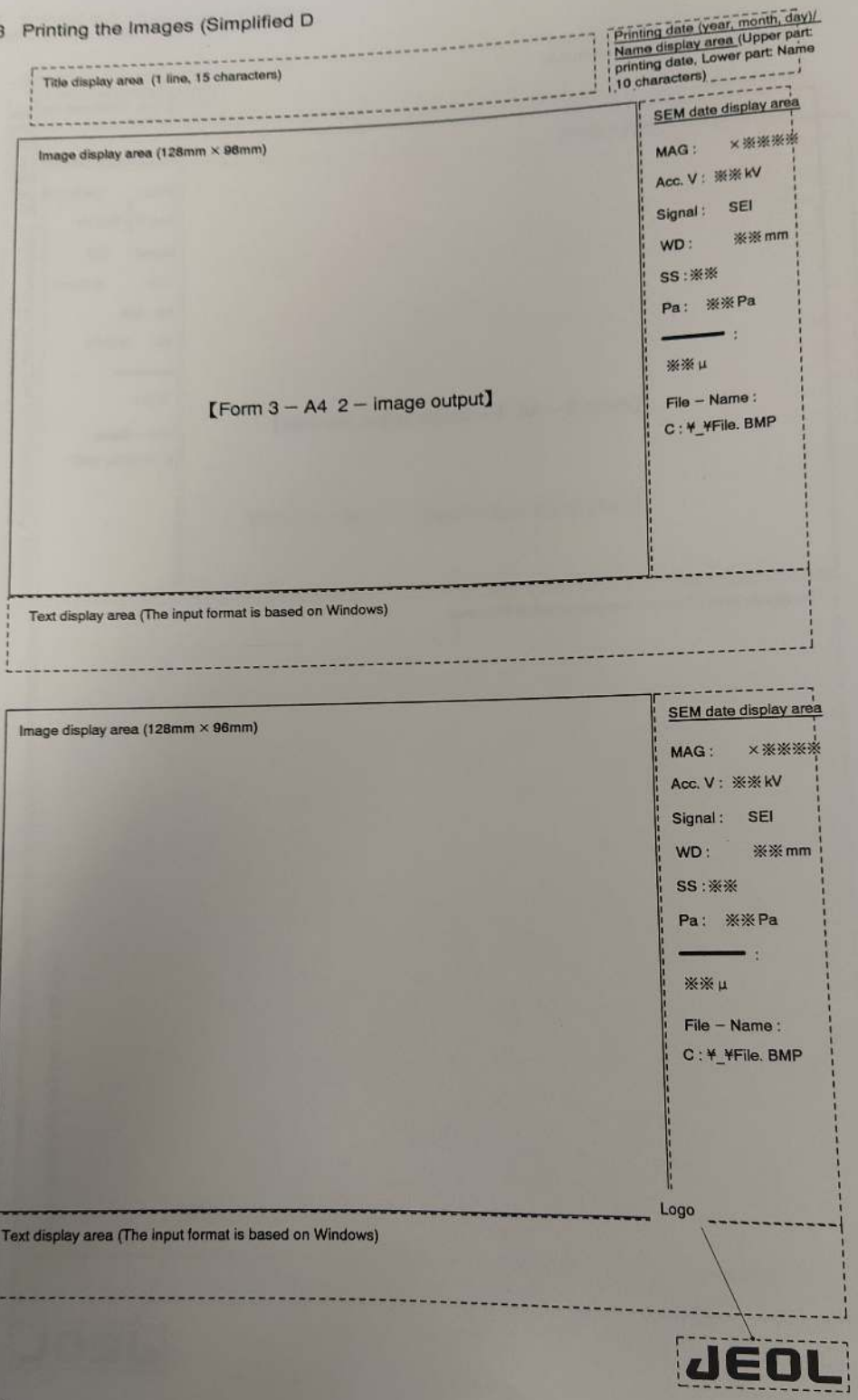
File – Name :

C : ¥_¥File. BMP

Text display area (The input format is based on Windows)

Logo

JEOL


Title display area (1 line, 15 characters)
Printing date (year, month, day)/ Name display area (Upper part: printing date, Lower part: Name 10 characters)
Image display area (128mm × 96mm)
SEM date display area
MAG : ×※※※※
Acc. V : ※※ kV
Signal : SEI
WD : ※※ mm
SS : ※※
Pa : ※※ Pa
——— :
※※ μ
File – Name :
C : ¥_¥File. BMP
【Form 3 – A4 2 – image output】
Text display area (The input format is based on Windows)
Image display area (128mm × 96mm)
SEM date display area
MAG : ×※※※※
Acc. V : ※※ kV
Signal : SEI
WD : ※※ mm
SS : ※※
Pa : ※※ Pa
——— :
※※ μ
File – Name :
C : ¥_¥File. BMP
Logo
Text display area (The input format is based on Windows)
JEOL

3.14 Troubleshooting

Regarding computer-related trouble, refer to the instruction manual provided with the computer.

Cause	Remedy
Power is not supplied to the evacuation system	
• The power board switch is OFF.	Turn ON the power board switch.
• 100V AC is not being supplied.	Check the 100V AC.
• The safety device operated because of a water failure, etc.	Restart the instrument after the water supply, etc. is restored.
Evacuation does not take place, or takes a long time to complete	
• Loose parts	Tighten up loose parts.
• A specimen containing a lot of gas or moisture is installed	Remove moisture from the specimen, or replace it.
• O-rings or packing are twisted, installed in the wrong positions, or are contaminated with dust.	Remove twists, or install in correct positions.
• O-rings or packing are torn.	Contact JEOL's service office.
• The Wehnelt has just been cleaned.	Wait for a while.
• The amount of RP or DP oil is insufficient, or the oil has deteriorated.	Contact JEOL's service office.
• The DP heater is broken, or the DP fuse has blown.	Contact JEOL's service office.
• The evacuation system is abnormal	Contact JEOL's service office.
The load current is unstable or abnormal	
(When the Bias Adjustment cannot be controlled)	
• The axis of the electron gun is mis-aligned.	Re-align the electron gun. (refer to 3.7.16)
• The filament has a whisker.	Replace the filament. (refer to Chapter 4)
• The filament is mis-centered.	Re-center the filament. (refer to Chapter 4)
• The Wehnelt is contaminated.	Clean the Wehnelt. (refer to Chapter 4)
• The Wehnelt has just been cleaned.	Wait for a while.

Cause	Remedy
An image does not appear	
• The HT is not [ON]	Turn ON the HT.
• An auto function, such as auto focus, does not operate	Turn ON the HT and try again.
• The signal is not [SEI]	Set the signal to [SEI] using the signal window.
• The image has insufficient contrast and/or brightness.	Adjust the contrast and/or brightness.
• The axis of the electron gun is mis-aligned	Re-align the electron gun. (refer to 3.7.16)
• The filament heating is insufficient	Align the electron gun, or adjust the bias. (refer to 3.7.16, 3.7.17))
• The axis of the objective lens aperture is mis-aligned.	Align the axis using the X and Y axis adjustment knobs of the objective lens aperture. (refer to 3.7.18)
• The filament is broken	Replace the filament. (refer to Chapter 4)
The image has no sharpness	
• The image has astigmatism.	Correct the astigmatism. (refer to 3.7.3 or 3.7.19)
• The image has insufficient contrast and/or brightness	Adjust the contrast and/or brightness.
• The Spotsize value is too large	Reduce the Spotsize value.
• The axis of the electron gun is mis-aligned	Re-align the electron gun. (refer to 3.7.16)
• The image is not in focus in the vertical direction	Either perform eliminate the tilt of the specimen, or using the Dynamic Focus Correction (refer to 3.7.20).
• The Acc. volt is low	Raise the Acc. volt. using the Acc. volt window.
• The objective lens aperture foil has deteriorated	Replace the aperture foil. (refer to Chapter 4)
• The inside of the electron optical column is contaminated	Contact JEOL's service office.

Cause	Remedy
There is noise, roughness, and distortion on the image	
• The specimen has acquired an electric charge.	Either re-evaporate the specimen, or reduce the Acc. volt.
• The Spotsize is too small	Increase the Spotsize value.
• The Acc. volt is unsuitable	Change the Acc. volt.
• There is astigmatism	Correct the astigmatism. (refer to 3.7.3 or 3.7.19)
• The image has insufficient contrast and/or brightness.	Adjust the contrast and/or brightness.
• The specimen is not properly fixed	Properly fix the specimen.
• Loose parts	Tighten up loose parts.
• External magnetic field	Keep the instrument away from magnetic fields.
• The load current varies	Clean the Wehnelt, replace the filament, and so on. (refer to Chapter 4)
• The objective lens aperture foil has deteriorated	Replace the aperture foil. (refer to Chapter 4)
• The inside of the electron optical column is contaminated	Contact JEOL's service office.
• The scintillator tip has deteriorated	Contact JEOL's service office.
Photographs cannot be taken	
• The camera connector is not connected	Connect the camera connector.
• The light blocking plate remains in place	Remove the light blocking plate.
• The camera aperture value is not correct	Use the correct aperture value.
• The film is not pulled up or wound up	Pull up or wind up the film.
• The contrast and/or brightness is not correct	Adjust the contrast and/or brightness.

4. Maintenance

4.1 Precautions in maintenance work

- Do not adopt an unreasonable posture when working for maintenance.

- Do not dismount, disassemble with bare hands. Be sure to ware polyethylene film gloves or the like. The internal parts are precision-machined. Use special care so as to prevent them from contamination.

- Use tools in the proper way. Avoid using undue force to tighten screws. When you handle tools, use special care not to drop them on the parts and damage them. When parts is to be secured with two or more screws, screw all of them lightly in until they are blocked and them tighten one after another a little at a time. (even tightening)

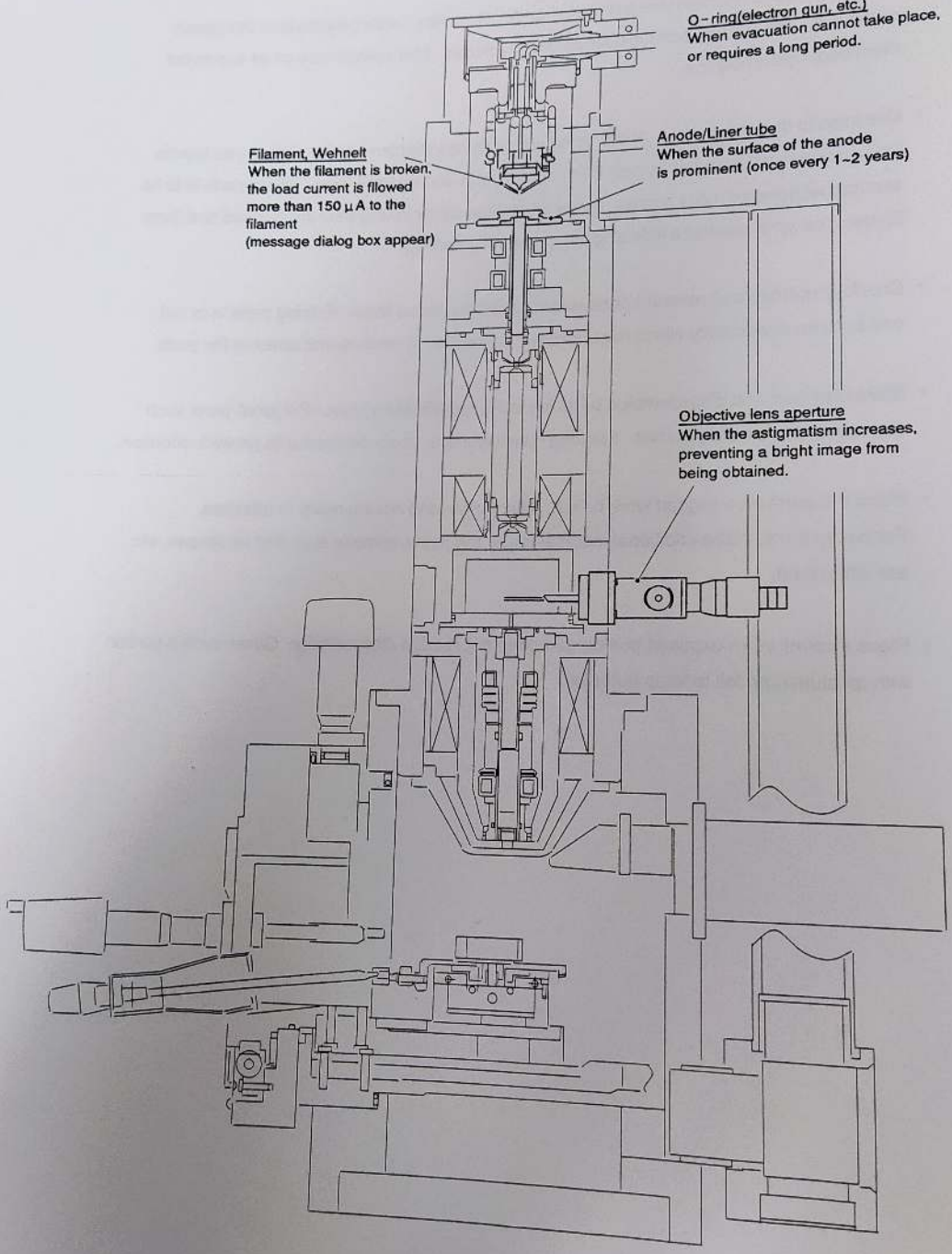
- Carefully remove and remount parts without exerting undue force. Forcing parts in or out could cause eccentricity which might make it impossible to remove and remount the parts.

- Store removed and disassembled parts is readily identifiable groups. Put small parts such as screws in laboratory dishes. For long-term storage, use a desiccator to prevent oxidation.

- Place the parts on a rugged work bench. Make mats and covers ready in advance. For heavy parts, place additional material under the mat and make sure that no screws, etc. are left behind.

- Place a cover or an exposed portion that does not require disassembly. Cover such a portion with an aluminum foil to keep out dust.

4.2 Parts that Must be Maintained, and a Rough Guide to Maintenance



4.3 Cleaning Materials

Cleaning liquid:	Use cleaning liquid that has high cleaning performance, is of high purity, nearly harmless to humans, non-flammable, and volatile. Follow the precautions indicated on the container of the cleaning liquid. Ensure that the room is adequately ventilated, and do not place your fingers in the liquid. (Be sure to wear working gloves.) Use cleaning liquid to remove common dust and abrasive. Normally, cleaning liquid is used by moistening a piece of gauze or a cotton stick with it. Small parts that have been cleaned can be effectively finished off by immersing them in a beaker filled with cleaning liquid. (You can obtain even better results by using an ultrasound cleaner.)
Work gloves:	Use polyethylene film gloves. This prevents parts from becoming soiled, and also protects the skin on your hands and fingers.
Gauze:	Use gauze that is clean and does not generate impurities when immersed in cleaning liquid. Use gauze for rubbing parts with an abrasive and also for wiping away dust and stains using cleaning liquid.
Cotton stick:	Use cotton sticks that are clean and do not generate impurities when immersed in cleaning liquid. Use cotton sticks for rubbing parts with an abrasive and also for wiping away dust and stains using cleaning liquid. (fine parts, holes, etc.)
Cotton wool, toothpick:	Use clean cotton wool after wrapping it around a toothpick. Use it for rubbing parts with an abrasive, and also for wiping away dust and stains using cleaning liquid. (fine parts, holes, etc.)
Metal abrasive:	Use a paste type abrasive that can be easily removed by cleaning liquid. Use it when dust and stains cannot be removed with cleaning liquid. Never use an abrasive on threaded parts or intricate parts. Also, take care that abrasive does not get onto parts that are not normally cleaned.
Beaker:	Use a stainless steel beaker. Do not use a glass beaker because it is liable to break. Pour cleaning liquid into the beaker and use it for finishing off fine parts that have been cleaned.
Hand blower:	You can also use a safe, clean container that enables inert gases to be blown out.
Tools:	Use the tool included among the accessories or commercially available tools. Replace screwdrivers and other tools that are visibly damaged.

4.4 Cleaning Method

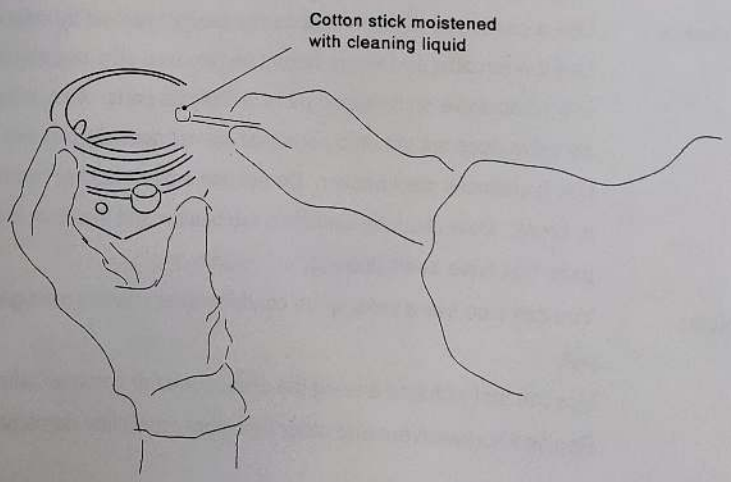
4.4.1 Wiping off dust and stains with Cleaning A cleaning liquid

Use Cleaning A cleaning liquid to clean parts that are not very dusty stainsy, or parts that cannot be rubbed.

Wipe flat surfaces and outside surfaces of parts, and also threaded parts, with a piece of gauze, or the like, moistened with cleaning liquid. Wipe dust and stains off the vicinity of holes and the inside surfaces of parts using a cotton stick (of a size that matches the area to be cleaned), or the like, moistened with cleaning liquid. Never clean parts made of plastic or other material that is likely to be dissolved by the cleaning liquid.

Clean oil and grease off small parts and also clean intricate parts by pouring the cleaning liquid into a beaker then immersing the parts. You can obtain even better results by using an ultrasound cleaner. Replace the cleaning liquid from time to time according to the extent to which it becomes contaminated. After cleaning the parts, remove them from the beaker and quickly remove any cleaning liquid adhering to them by using blower brush.

> ⚠ WARNING When handling cleaning liquid, be sure to use polyethylene film gloves. There is a risk of acquiring a skin disorder depending upon the particular kind of cleaning liquid used or the sensitivity of your skin, so be sure to read the precautions concerning cleaning liquid before using it.



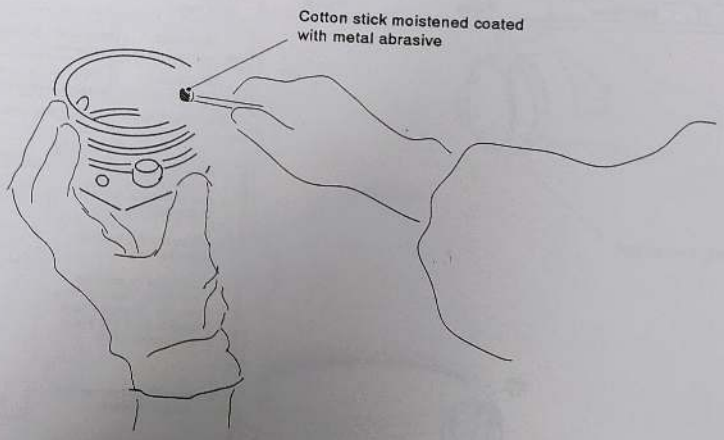
Example: Wehnelt

4.4.2 Rubbing with Cleaning B metal abrasive

Use Cleaning B metal abrasive on very dusty parts and also parts that can be rubbed.

Coat flat surfaces and outside surfaces of parts with a small quantity of abrasive using gauze, or the like. Rub the vicinity of holes and the inside surfaces of parts using a cotton stick (of a size that matches the area to be cleaned) or the like, coated with a small amount of metal abrasive. Do not use a lot of force when rubbing a part in the vicinity of a hole. Also, do not rub parts excessively. Never rub threaded parts with metal abrasive.

If you have done Cleaning B, repeat Cleaning A a couple of times to completely wipe all metal abrasive off.

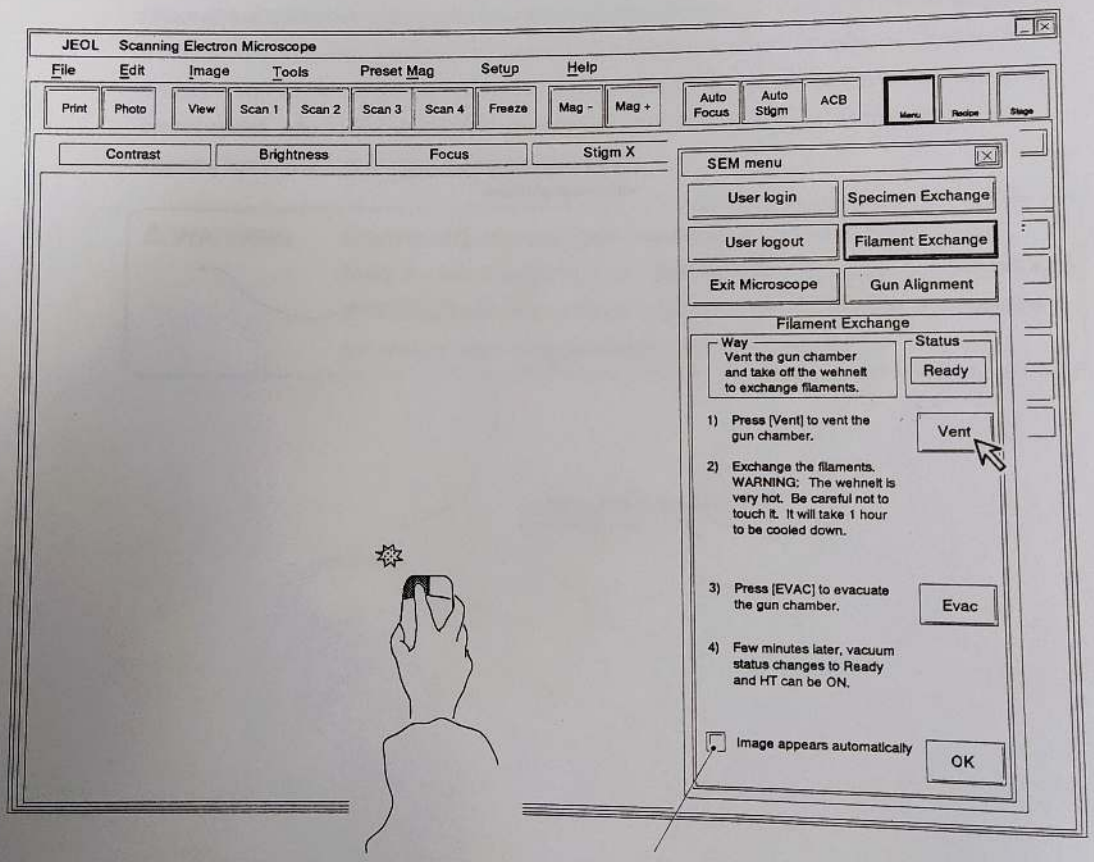


4.5 Filament Replacement and Cleaning

When the filament is broken or the load current of higher than 150 μA is flowed to the filament, the message dialog box appears. Perform the following maintenance work.

1 Click [OK], close the message dialog box.
When the message dialog box is closed, the Filament Exchange menu on the SEM menu appears.

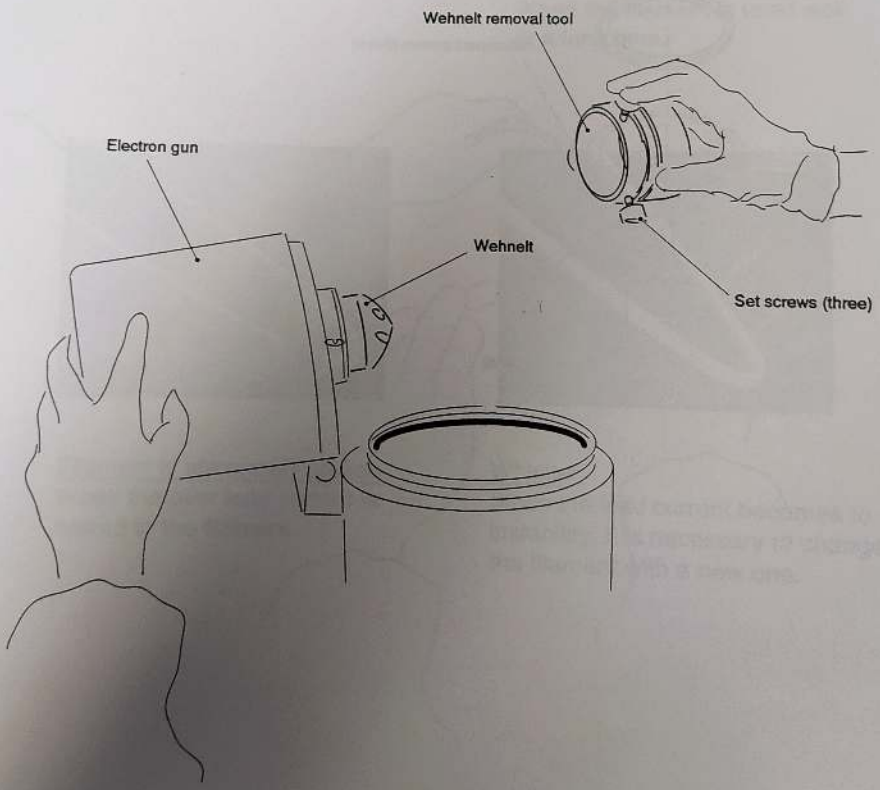
2 Click [Vent] for venting the electron optical column to atmosphere.
You can also do this by using the SPECIMEN CHAMBER VENT switch on the main control panel.



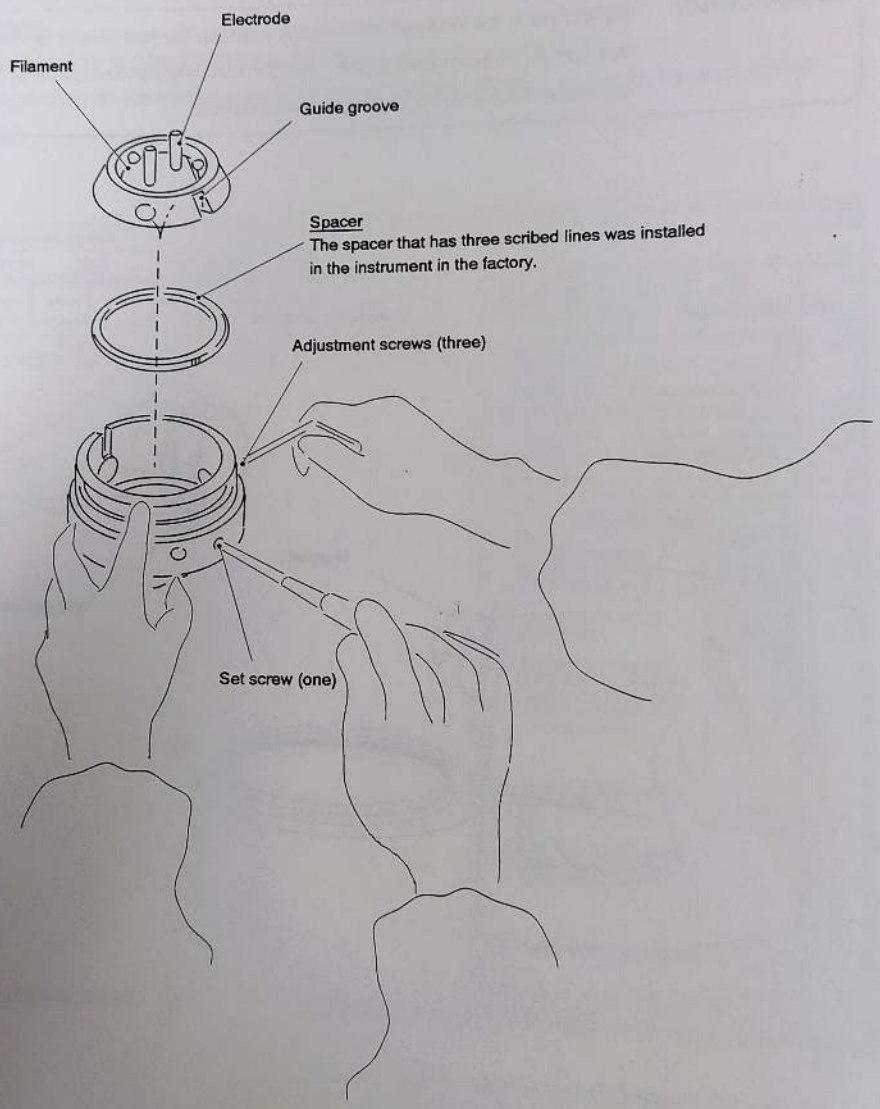
If you check [Image appears automatically] check box, omit the step [9] to [14]. (Page 4-13)

3 Open the electron gun, then remove the Wehnelt.
Set the Wehnelt removal tool in such a way that the three screws of the Wehnelt removal tool will align with the smooth faces on the sides of the Wehnelt and tighten the screws.
Pull the Wehnelt removal tool straight to remove the Wehnelt from the electron gun and then loosen the screws to remove the Wehnelt removal tool.

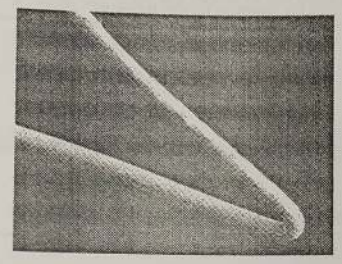
> ⚠ WARNING Do not touch the Wehnelt immediately after the filament breaks because it is hot and you may receive a burn. Before removing the Wehnelt, wait for about one hour, then remove it using a dedicated tool.



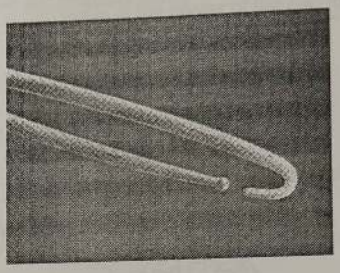
4 Remove the filament from the Wehnelt.
Slacken the stop screw and adjustment screws, then remove the filament and spacer.
Grasp the electrode of the filament and remove the filament.



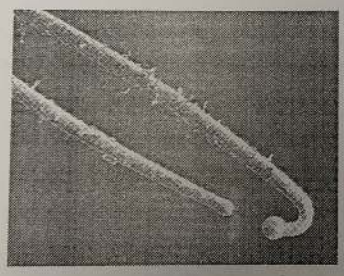
【Tip of the filament condition】



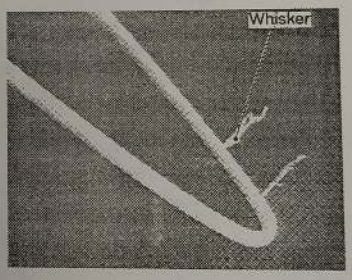
Unuse



Filament is ordinary broken
When the filament is used well at a long time.



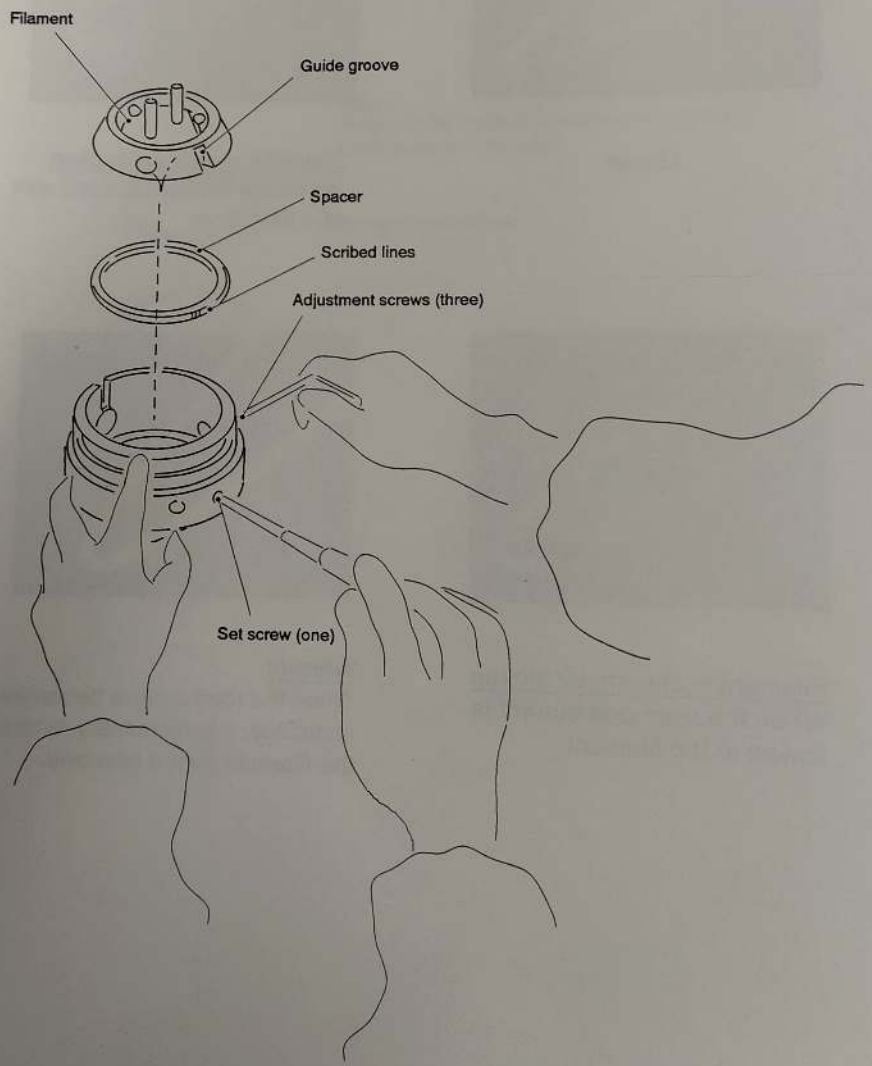
Filament is abnormaly broken
When the over load current is flowed to the filament.



Whisker
Since the load current becomes to instability, it is necessary to change the filament with a new one.

5 Clean the cap, and other parts, then install the filament.
Select the cleaning method according to the extent to which the parts are soiled.
Re-install the filament in the opposite sequence to removal.

⚠ CAUTION When installing the filament, take care not to touch the tip of the filament.

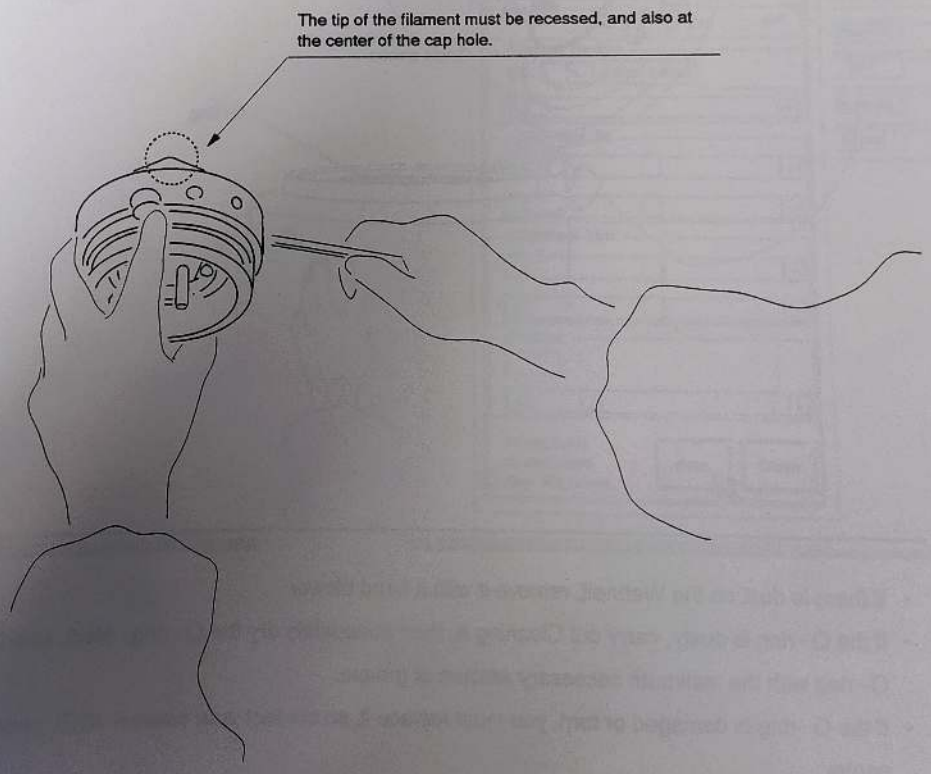


6 Adjust the filament position. (Centering)

- Temporarily fix the filament with the adjustment screws. (Tighten the screws uniformly.) Observe the Wehnelt from the side, and confirm that the tip of the filament is recessed slightly (approx. 0.2mm). If the tip of the filament is protruding, replace the spacer.
- Turn the adjustment screws so that the tip of the filament is at the center of the cap hole of the filament tip.

Relationship between the spacer and the filament

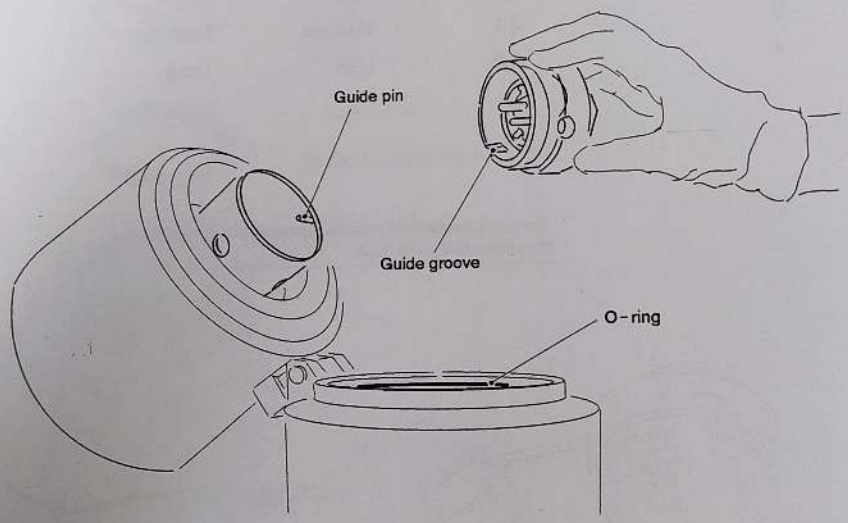
Number of scribed lines	Thickness (mm)	Brightness	Life of filament (h)
2	2.0	High	Short
3	2.1	Medium	Normal
4	2.2	Low	Long



7 Install the Wehnelt and close the electron gun.
Open the electron gun, align the guide groove on the Wehnelt with the guide pin on the electron gun, then push in the Wehnelt until it clicks into position.

8 Click [Evac] of the Specimen Exchange menu for evacuating the electron optical column.
You can also do this by using the SPECIMEN CHAMBER EVAC switch on the main control panel.

⚠ CAUTION
- When closing the electron gun, take care not to slip the O-ring out of position.
- When closing the electron gun, take care not to get your fingers crushed between the electron gun and electron optical column.



- If there is dust on the Wehnelt, remove it with a hand blower.
- If the O-ring is dusty, carry out Cleaning A, then adequately dry the O-ring. Next, coat the O-ring with the minimum necessary amount of grease.
- If the O-ring is damaged or torn, you must replace it, so contact your nearest JEOL service center.

9 Once the vacuum status becomes [HT Ready], click [HT] on the status display so that ON appears to the right of [HT].

10 Open [Menu], then click [Gun Alignment].

11 Turn the scroll bar knob of the [Filament Heating] to left end.

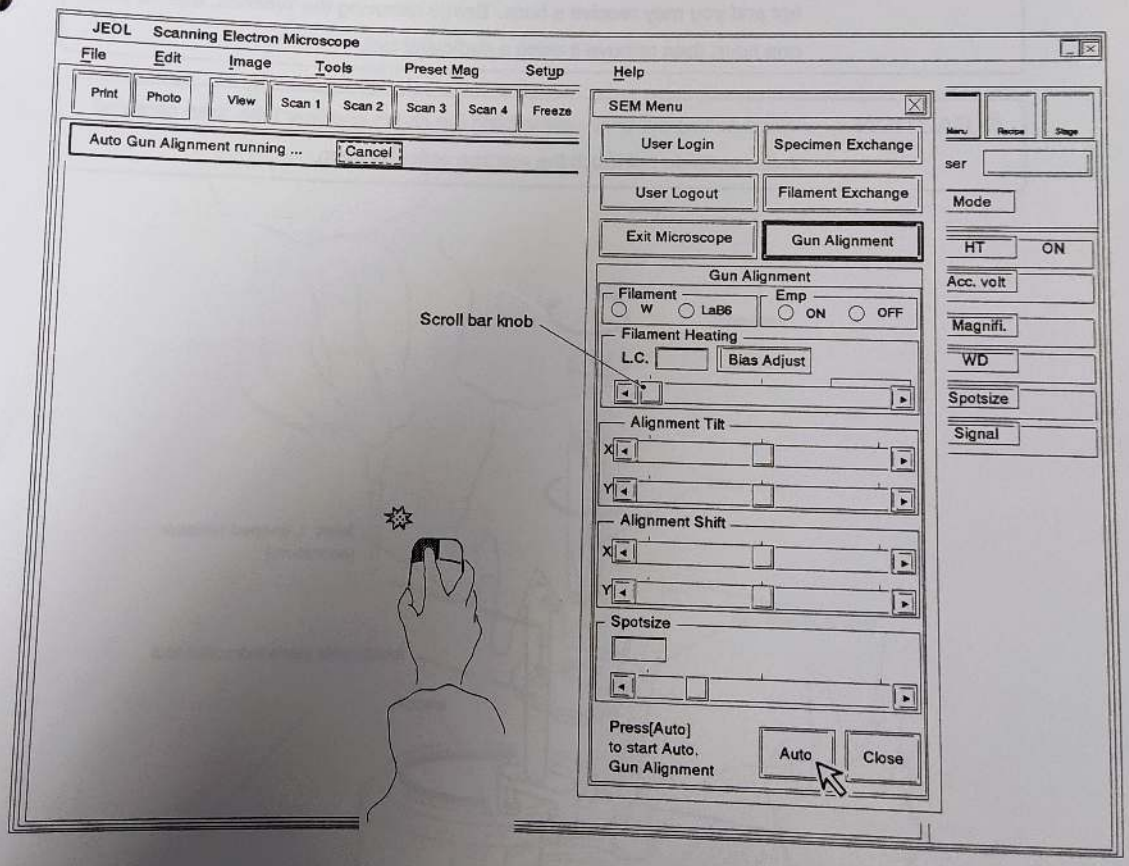
12 Turn the scroll bar knob of the [Alignment Tilt] and [Alignment Shift] to roughly the center position.

13 Set the [Spotsize] value to about 20.

14 Click [Auto].

To interrupt auto gun alignment, click the [Cancel] button [Auto Gun Alignment running ...].

If you wish to manually adjust the gun alignment, refer to the Chapter 3 – 3.7.16.



4.6 Cleaning the Anode and Liner Tube

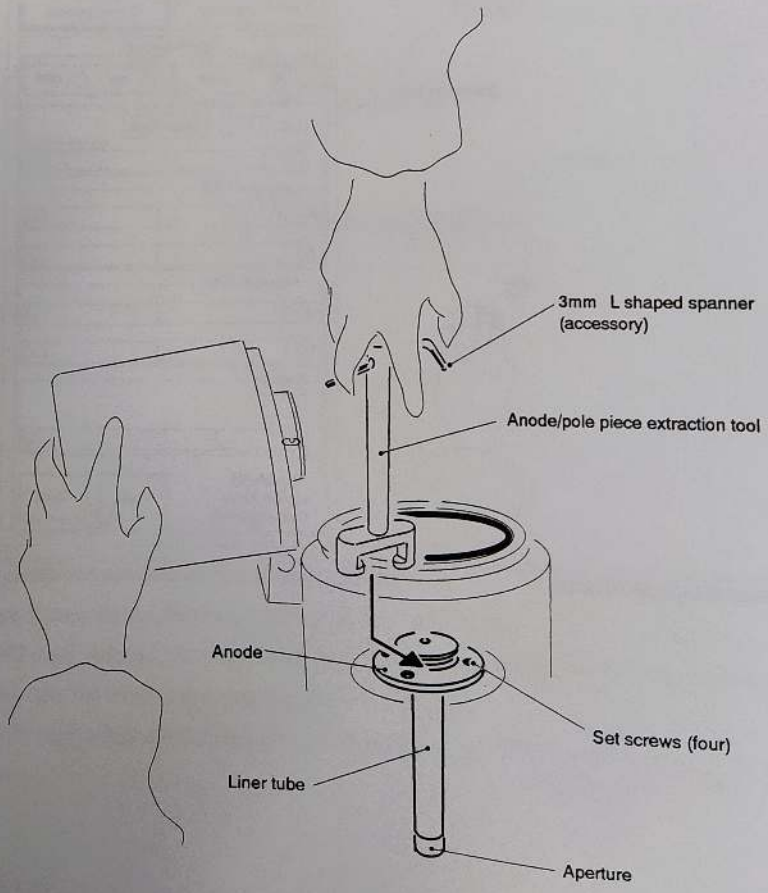
If the surface of the anode is prominent when replacing the filament, perform the following maintenance work. (Cleaning cycle: Once every 1–2 years)

1 Vent the electron optical column to atmosphere, then remove the Wehnelt.
Refer to 4.5. Store the removed Wehnelt in such a way that it is not exposed to dust.

2 Pull out the anode and liner tube.
Remove the set screws, align the extraction tool with the groove in the anode, then pull up the extraction tool vertically.

> ⚠ WARNING Do not touch the Wehnelt immediately after the filament is used because it is hot and you may receive a burn. Before removing the Wehnelt, wait for about one hour, then remove it using a dedicated tool.

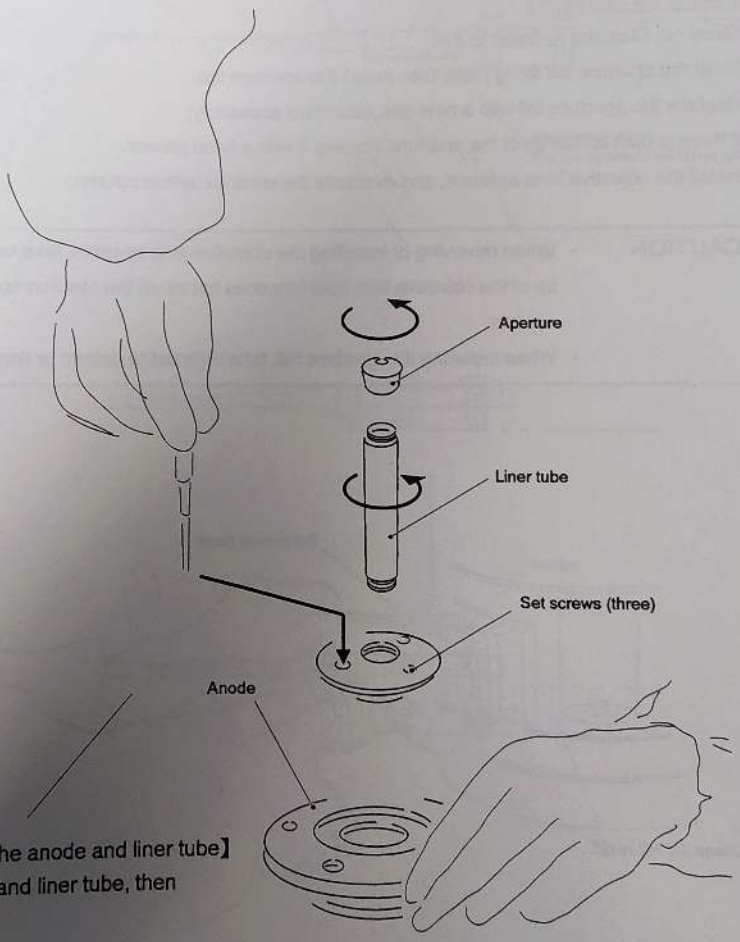
> ⚠ CAUTION When pulling out or re-assembling the anode and liner tube, take care that these parts do not touch the electron optical column.



3 Disassemble the anode and the liner, then clean these parts.
Reverse the directions of the anode and liner tube, and disassemble these parts as shown in the drawing. Select the cleaning method according to the extent to which these parts are soiled.

4 Re-assemble the anode and liner tube.
Perform re-assembly work in the opposite sequence to that in which you disassembled or pulled out the anode and liner tube.

5 Install the Wehnelt, then evacuate the electron optical column.



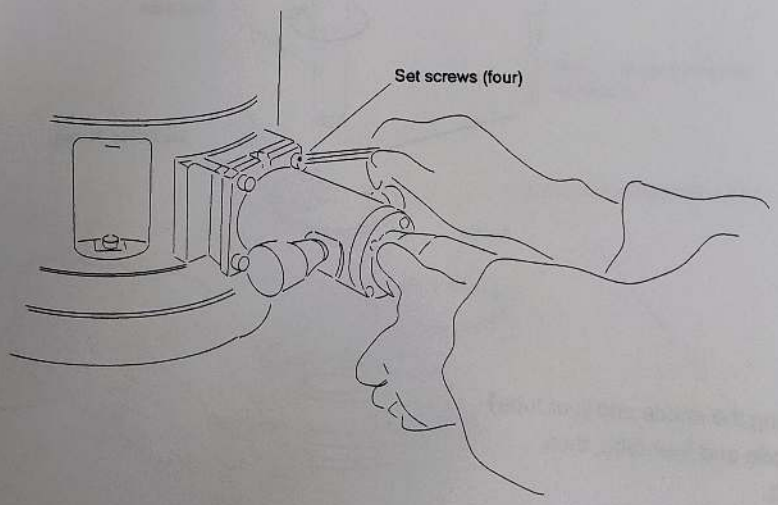
【Disassembling the anode and liner tube】
Invert the anode and liner tube, then disassemble it.

4.7 Cleaning the Objective Lens Aperture

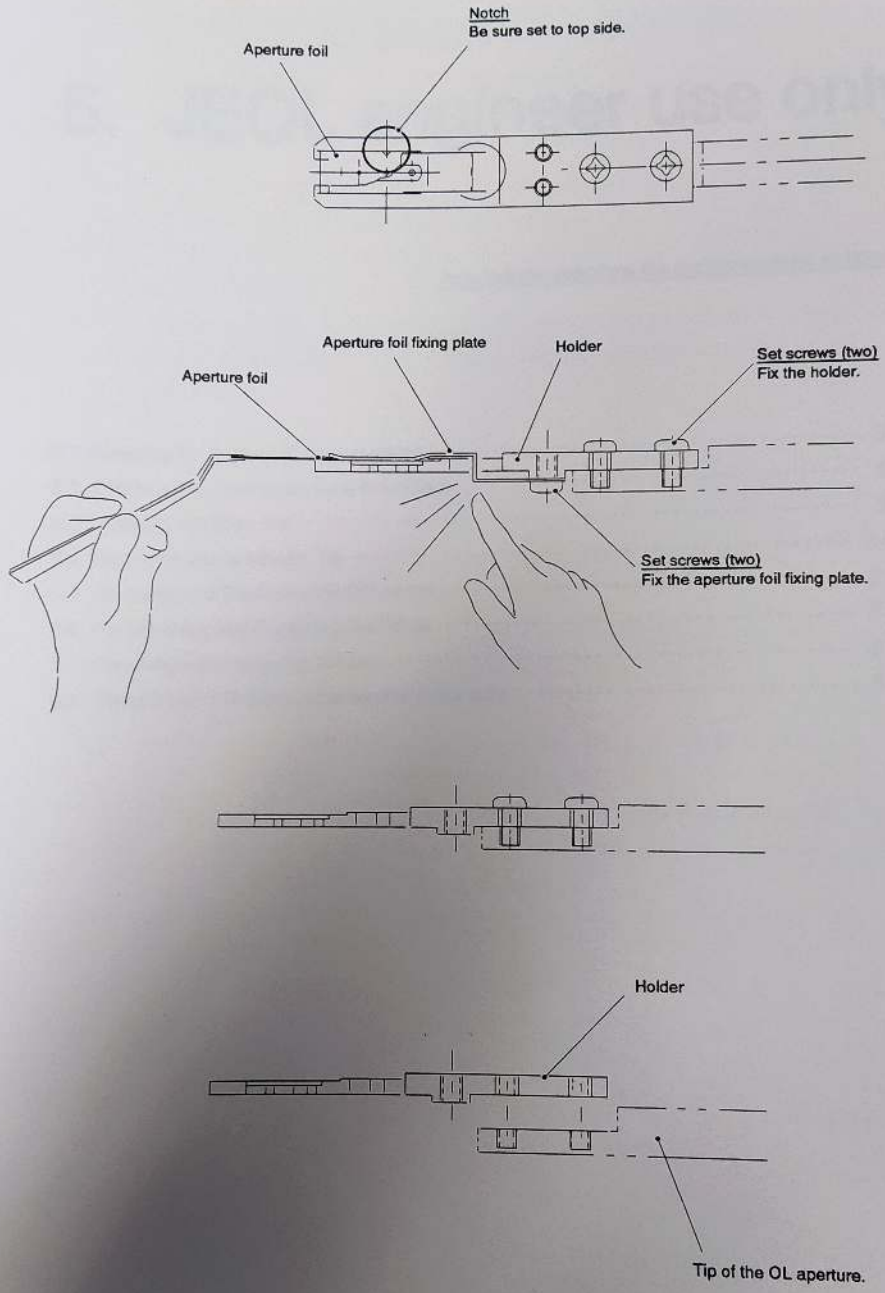
When the astigmatism increases or preventing a bright image from being obtained, perform the following maintenance work.

1 Set the objective lens aperture position to [0].
2 Vent the electron optical column to atmosphere, and remove the objective lens aperture.
Cover the mounting port of the objective lens aperture to prevent ingress of dust.
3 Push the aperture foil fixing plate, and take out the aperture foil.
When the tip of the objective lens aperture is very dusty, disassemble it and carry out Cleaning B (refer to 4.4). Reassemble the aperture in the opposite sequence to disassembly. (refer to the next page.)
4 Carry out Cleaning A. (refer to 4.4)
5 Push the aperture foil fixing plate, then install the aperture foil.
Replace the aperture foil with a new one. (standard accessory)
If there is dust on the tip of the aperture, remove it with a hand blower.
6 Install the objective lens aperture, and evacuate the electron optical column.

⚠ CAUTION
- When removing or installing the objective lens aperture, take care that the tip of the objective lens aperture does not touch the electron optical column.
- When installing the aperture foil, take care not to deform or damage it.



【Removing / Installing the OL aperture】



【Replacing the aperture foil, Disassembly the tip of the OL aperture】

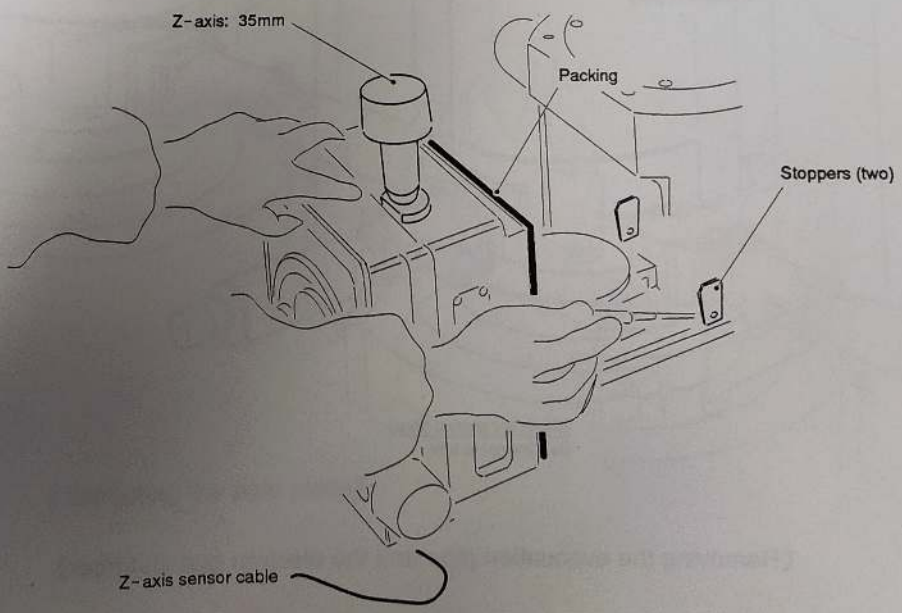
5. JEOL engineer use only

This chapter describes the maintenance for engineer.

5.1 Cleaning the Specimen stage packing

1 Set the specimen stage position to [X=0mm, Y=0mm, R=0° , T=0° , Z=35mm].
2 Vent the specimen chamber to atmosphere, then remove the Z-axis sensor cable of the specimen stage.
3 Withdraw the specimen stage, then set the rail stopper face upward.
4 Further, withdraw the stage and remove it while lifting the stage.
5 Place the stage on a rugged work bench.
6 Remove the packing, and clean it.
Carry out Cleaning A (refer to Chapter 4-4.4) and adequately dry the packing, then coat it with the minimum necessary amount of vacuum grease. If the packing is damaged or torn, you must replace it.
7 Re-install the packing to the original position of the stage.
8 Return the stage to the specimen chamber, and push down the rail stopper.
9 Push the stage until it is in intimate contact with the specimen chamber, then evacuate the specimen chamber.
Check that the vacuum status display becomes [HT Ready].
10 Stop the instrument, then turn OFF the POWER board switch.
11 Connect the Z-axis sensor cable to the stage and turn ON the POWER board switch.
12 Start the instrument, confirm that operation can be carried out normally.

⚠ CAUTION
- The specimen stage is heavy (about 21.5kg), so do not adopt an un-reasonable posture when removing it.
- When removing or installing the stage, do not grasp the X-, and Y-axes.
- When returning the stage, take care not to get your fingers caught between the stage and the specimen chamber.



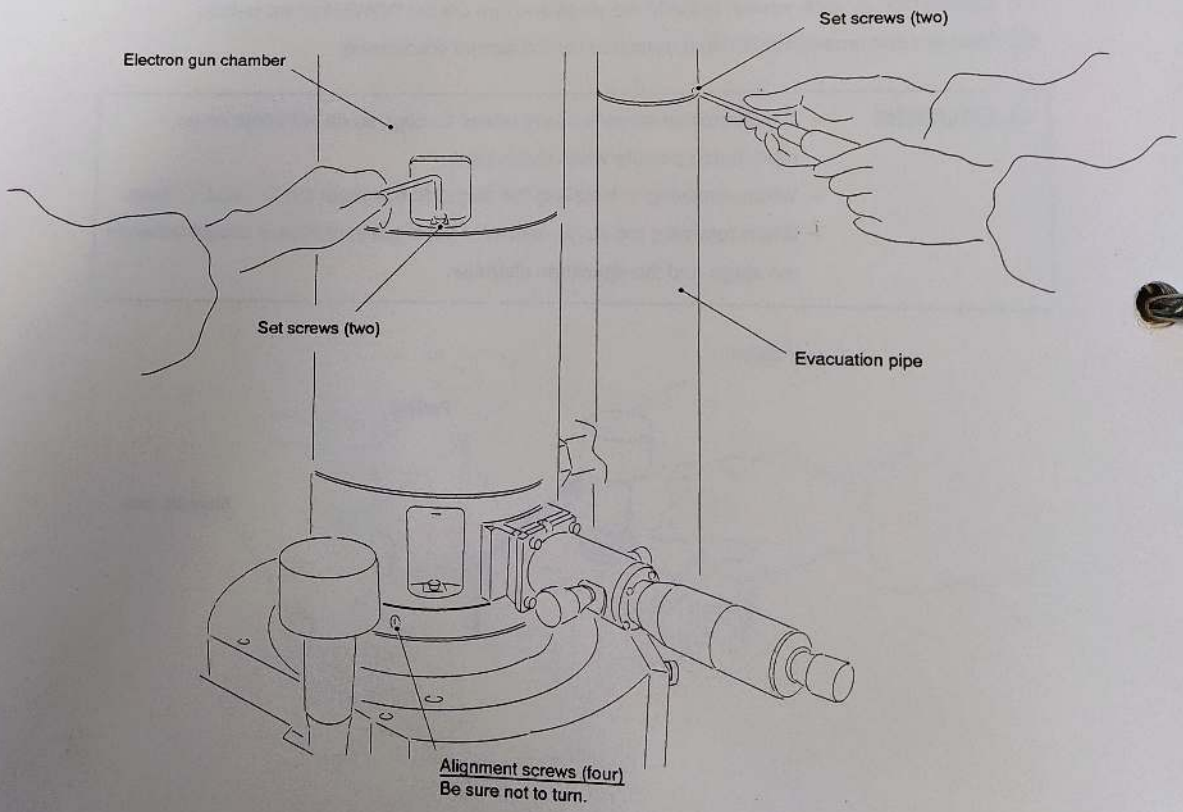
5.2 Cleaning the Condenser Lens Pole Piece

1 Vent the electron optical column to atmosphere, then turn the MAIN POWER switch OFF.

2 Remove the evacuation pipe.
Remove the set screws, then slightly push down the pipe.
Cover the removed evacuation pipe and pipe mounting hole to prevent ingress of dust.

3 Remove the electron gun chamber.
Remove the set screws, then remove it while lifting the electron gun chamber. Place the removed electron gun chamber on a horizontal surface on which aluminum foil, or the like, has been spread.

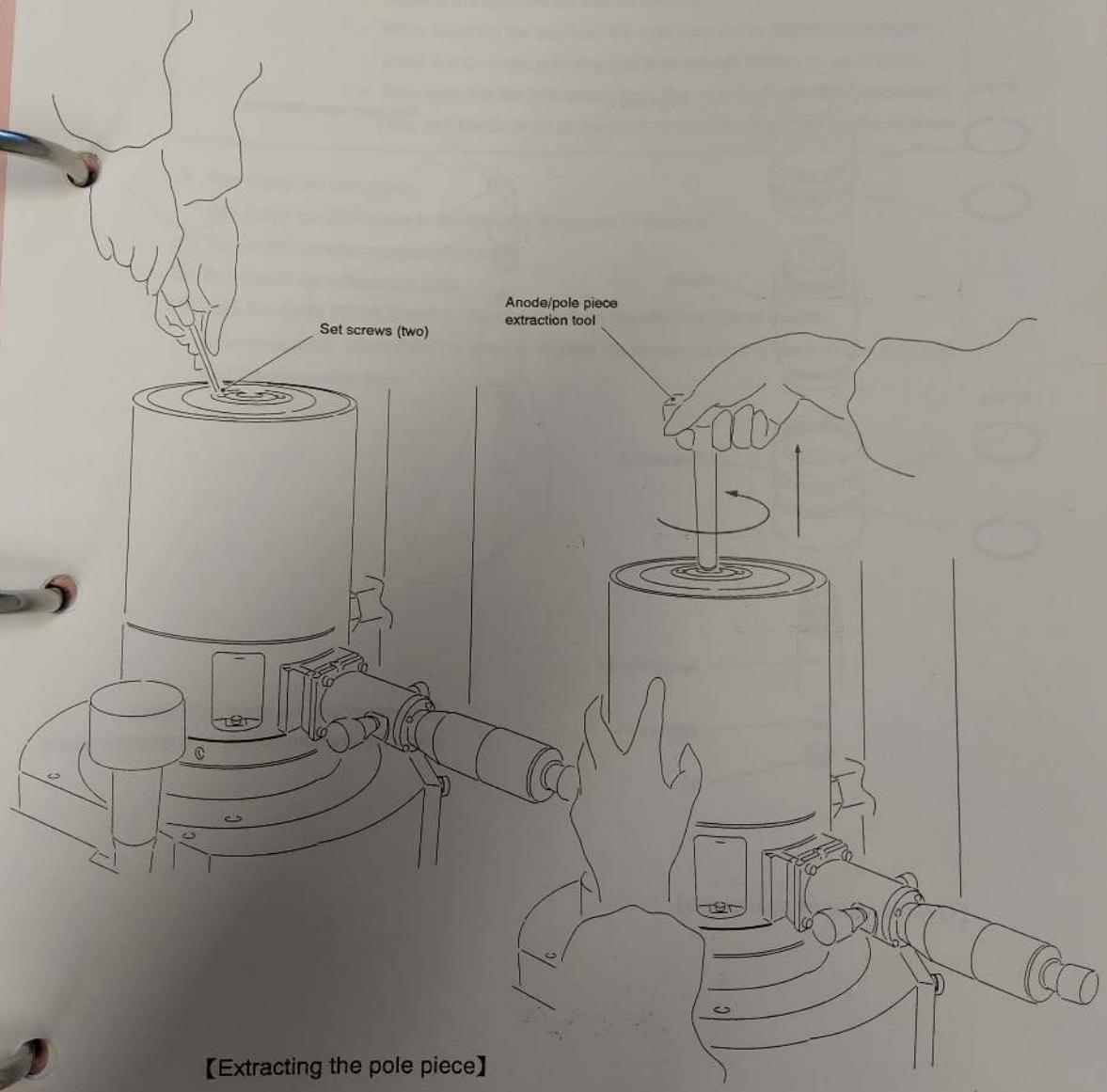
> ⚠ CAUTION
> - Be sure to turn the MAIN POWER switch OFF after venting the electron optical column to atmosphere. If you leave the MAIN POWER switch ON, there is a risk of the pole piece breaking when you pull it out because it is very heavy.
> - The electron gun is heavy (approx. 14.3 kg), so do not adopt an un − reasonable posture when removing it.



【Removing the evacuation pipe and the electron gun chamber】

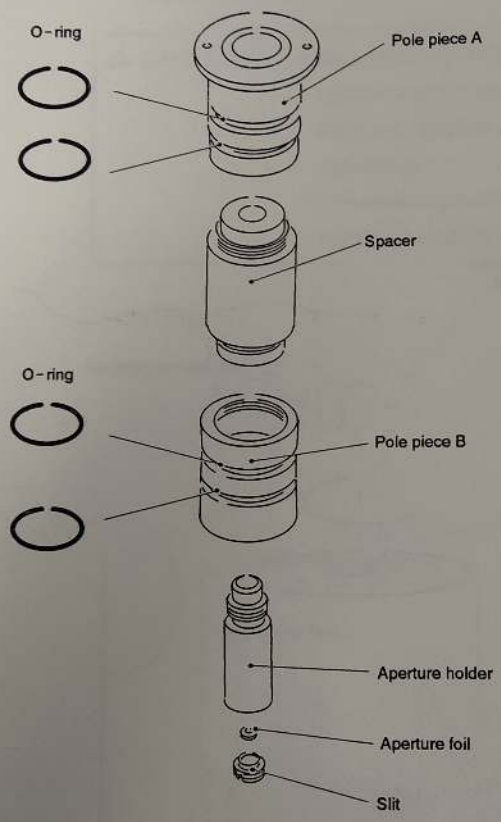
4 Pull out the pole piece.
Remove the set screws, install the extraction tool on the pole pieces, then rotate the pole piece counterclockwise and pull it out perpendicularly.

> ⚠ CAUTION When extracting or re-installing the pole piece, take care that the pole piece does not touch the electron optical column.

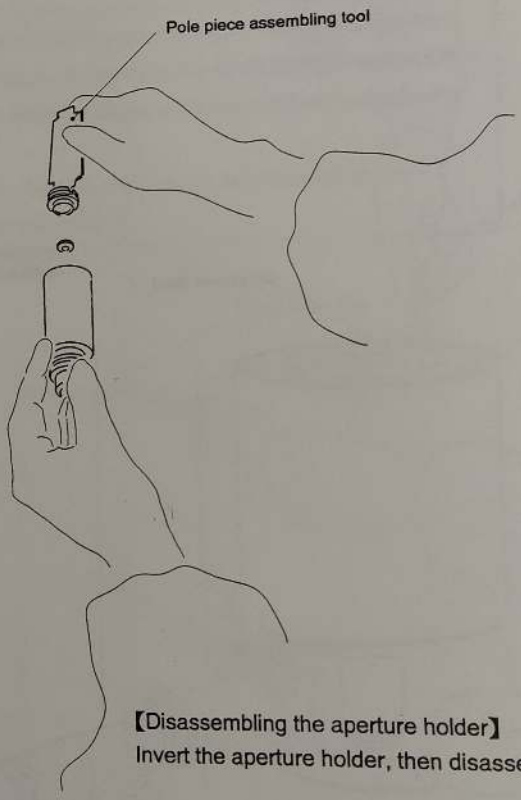


【Extracting the pole piece】

5 Disassemble the pole piece, then clean it (refer to Chapter 4 - 4.4).
Remove the O-rings, and store them in such a way that they are not exposed to dust.
If an O-ring is damaged or torn, you must replace it.



【Overall view of pole piece】



【Disassembling the aperture holder】
Invert the aperture holder, then disassemble it.

6 Re-assemble the pole piece.
Re-assemble the pole piece in the opposite sequence to removal.

⚠ CAUTION
- Assemble pole pieces A and B and the spacers, ensuring that they are facing the same direction as the direction they were facing prior to disassembly.
- Replace the aperture foil with a new one.
- When installing the aperture foil, take care not to deform or damage it.
- Install the O-rings, ensuring that they are not twisted or out of place.
- Take care that the evacuation pipe, the mounting hole of the evacuation pipe, and the O-rings of the electron optical column are not out of place.

7 Re-install the pole piece.
Re-install the pole piece in the opposite sequence to removal.
8 Re-install the electron gun chamber.
9 Re-install the evacuation pipe.
10 Turn the MAIN POWER switch ON, and evacuate the electron optical column.
If the evacuation noise does not stop, re-tighten the screws fixing the electron gun chamber and the evacuation pipe.

5.3 Cleaning the Scan coil

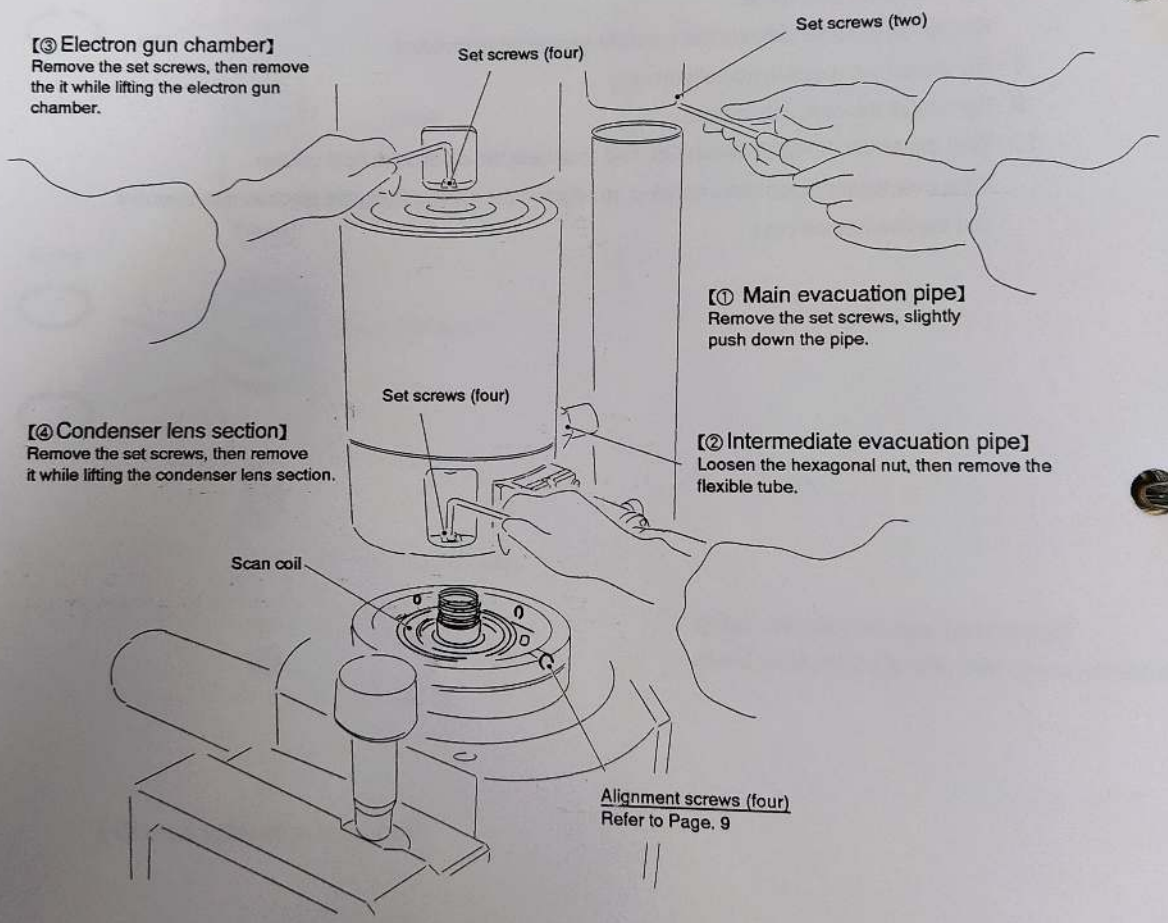
1 Vent the electron optical column to atmosphere, then turn the MAIN POWER switch OFF.

2 Reassemble an electron optical column.

Cover the removed pipes and the tubes mounting hole to prevent ingress of dust.

Place the removed electron gun chamber and the condenser lens section on a horizontal surface on which aluminum foil, or the like, has been spread.

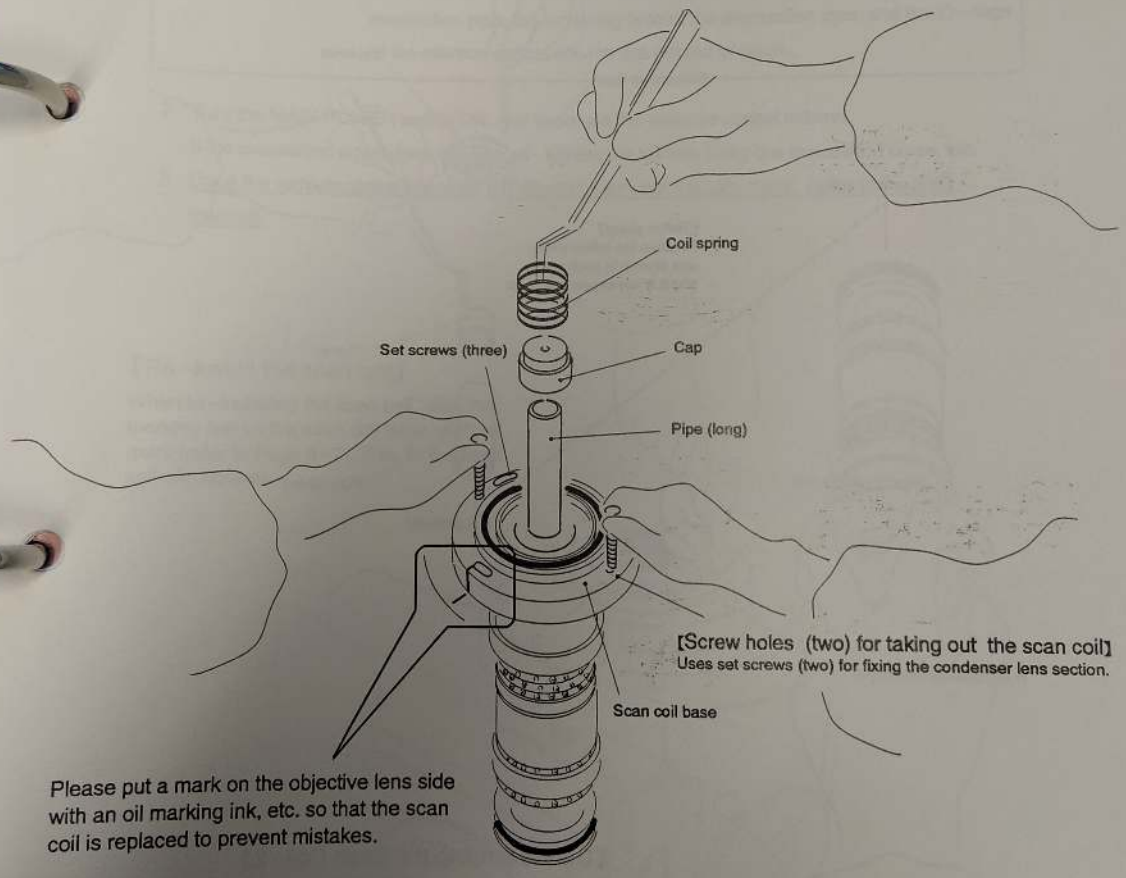
> ⚠ CAUTION The electron gun, condenser lens section is heavy (approx. 14.3kg, approx. 15kg) so do not adopt an unreasonable posture when removing it.



【Reassembly the electron optical column】

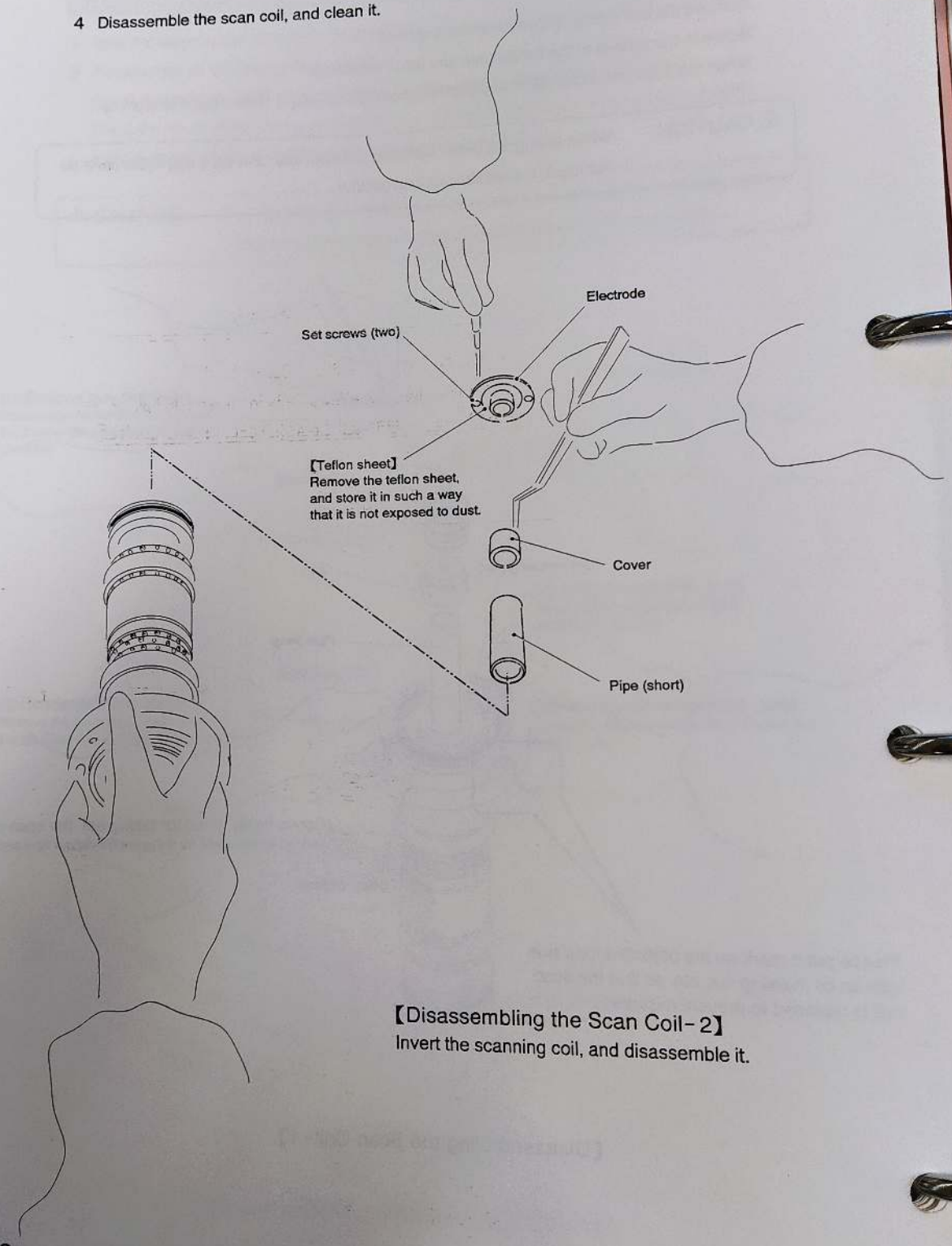
3 Take out the scan coil.
Remove the coil spring, cap, pipe and set screws.
Screw in the screws to the screw hole and turn it clockwise.
When the scan coil come up from electron optical column about 10mm, pull it straight up.

> ⚠ CAUTION When taking out or re-installing the scan coil, take care that these parts do not touch the electron optical column.



【Disassembling the Scan Coil-1】

4 Disassemble the scan coil, and clean it.



【Disassembling the Scan Coil-2】
Invert the scanning coil, and disassemble it.

5 Re-assemble the scan coil, then re-install it.
Re-assemble or re-install the scan coil in the opposite sequence to removal.

6 Re-assemble the electron optical column.
Re-assemble the electron optical column in the opposite sequence to removal.

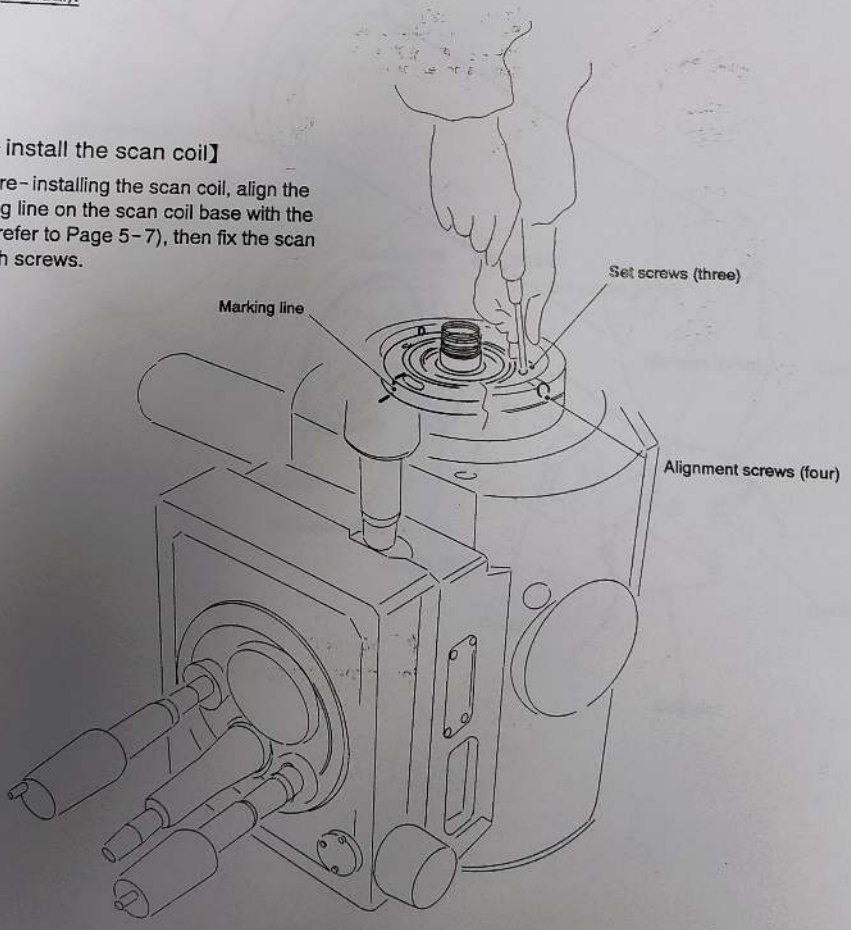
> ⚠ CAUTION
> - Be sure to mount the teflon sheet to the electrode.
> - Fix the scan coil with set screws (three) after meeting the marking line on scan coil to outside marking line.
> - Be careful not to let the lead wires get between them.
> - Take care that the condenser lens section, electron gun chamber, evacuation pipe, the mounting hole of the evacuation pipe, and the O-rings of the electron optical column are not out of place.

7 Turn the MAIN POWER switch ON, and evacuate the electron optical column.
If the evacuation noise does not stop, re-tighten the screws fixing the evacuation pipes, etc.

8 Once the vacuum status becomes [HT Ready], carry out the alignment. (refer to the SVC manual).

【Re-install the scan coil】

When re-installing the scan coil, align the marking line on the scan coil base with the mark (refer to Page 5-7), then fix the scan coil with screws.

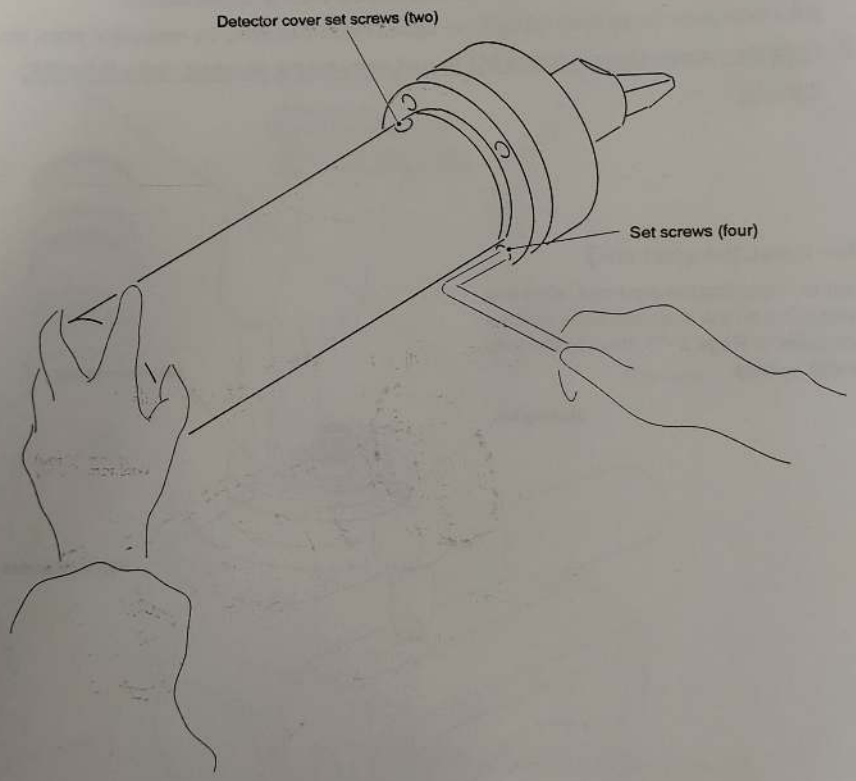


5.4 Replacing the Scintillator Tip

1 Vent the specimen chamber to atmosphere, then turn the MAIN POWER switch OFF.

2 Remove the detector, and stand it vertically.

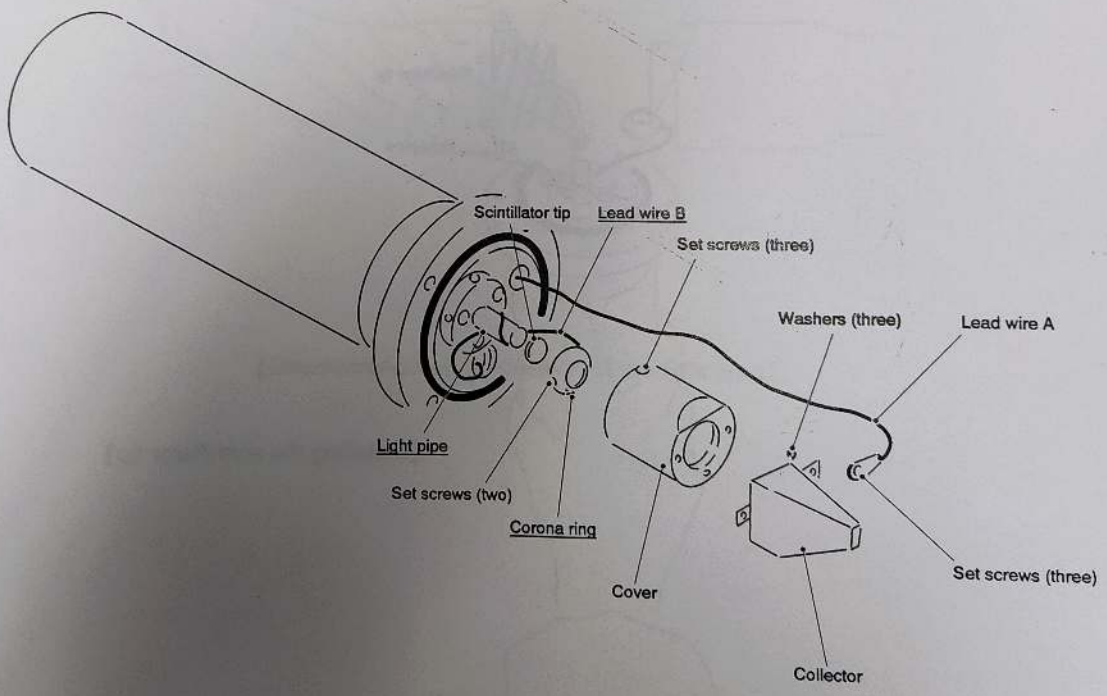
> ⚠ CAUTION
> - When removing or installing the detector, take care that the tip of the detector does not touch the specimen chamber.
> - Cover the detector mounting port to prevent the ingress of dust.



3 Disassemble the detector, and take out the scintillator tip.

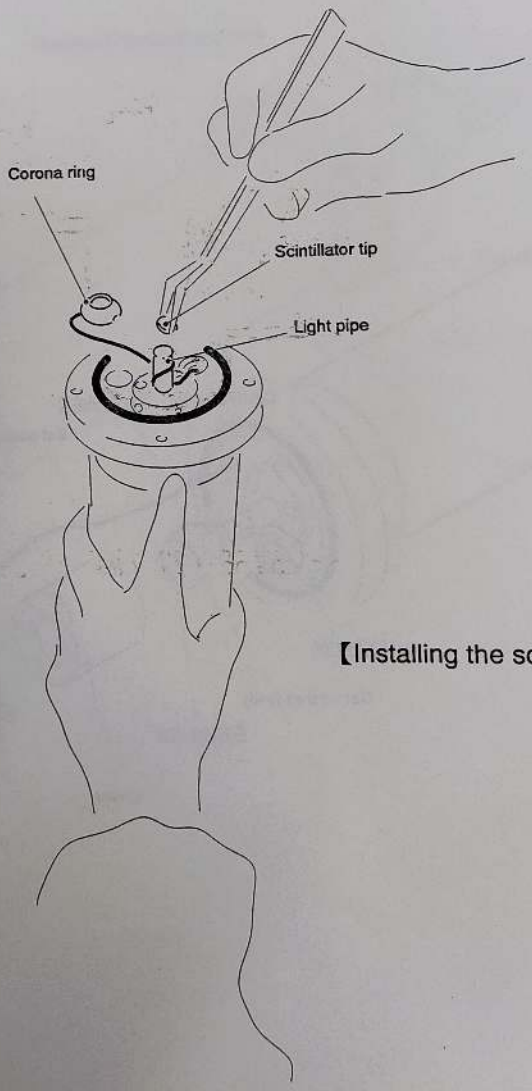
⚠ CAUTION

- When removing the scintillator tip, take care not to cut lead wire B.
- A high voltage (10kV) is applied to the corona ring, so never touch it with bare hands or cotton gloves. If oil from your skin or cotton particles adhere to the ring, an electrical discharge may occur.
- When removing the scintillator tip, take care not to damage the light pipe.
- When cleaning the light pipe, do not use any solvent other than alcohol.



4 Replace to a new scintillator tip, and assemble the detector.
Assemble the detector in the opposite sequence to removal.

⚠ CAUTION
- Take great care when installing a new scintillator tip. Place the tip on the light pipe with the aluminum sputtered surface face upward.
- Push the scintillator tip against the light pipe, then fix the corona ring in place.
- When removing dust from the detector using a hand blower, do not blow it directly onto the tip. This is because the sputtered surface of the tip will also be blown away as a result.



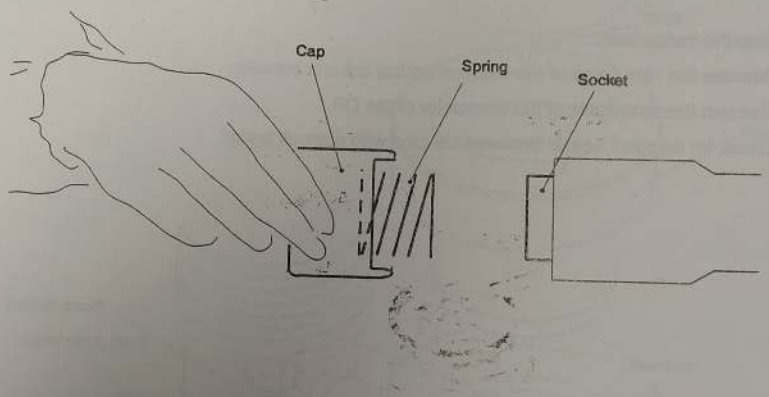
【Installing the scintillator tip】

5 Install the detector, and remove the cover from the detector.

6 Determine the position of the light pipe.
Remove the cover of the detector, then slacken the cap of the photomultiplier tube holder. Gently push in the socket of the photomultiplier, then push the light pipe until it can move no further. This completes positioning. Next, close the cap of the photomultiplier holder.

7 Install the cover on the detector.

8 Turn the MAIN POWER switch ON, and evacuate the specimen chamber.
Once the evacuation sequence becomes [HT Ready], maintain that status for about 30 minutes. Next, confirm that image observation can be carried out normally.



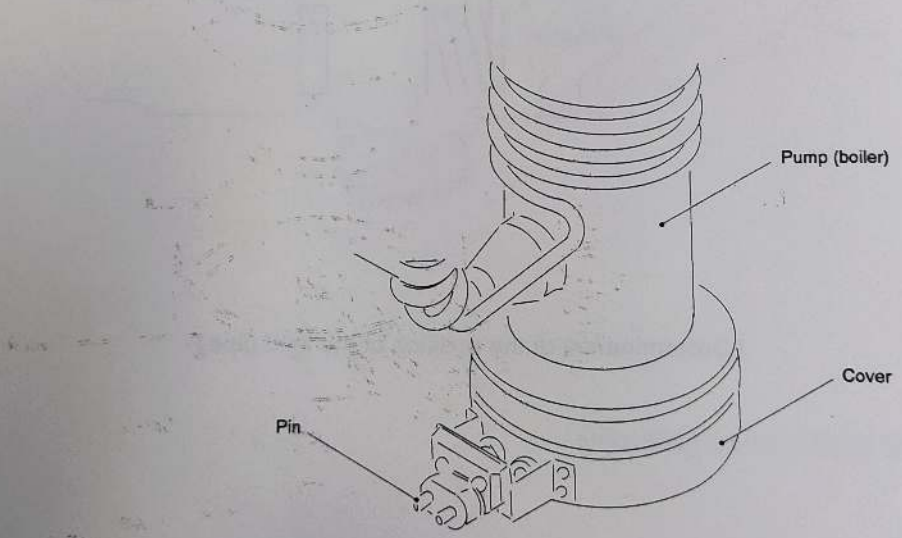
【Determination of the position of the light pipe】

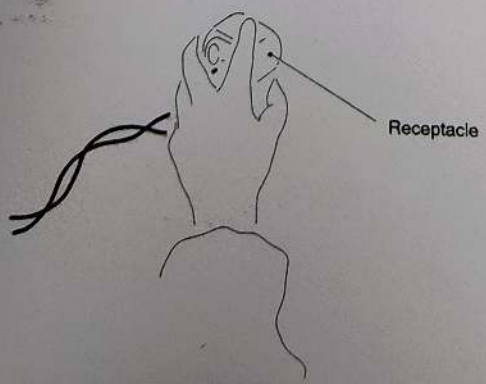
5.5 Checking and Replacing the DP heater

⚠ WARNING Be sure not to touch the boiler and cover of the DP immediately after its heater has broken. If you do so, you may suffer a burn as these parts are very hot (300℃).
To return the heated parts to room temperature, keep cooling water flowing for 30minutes or more.

⚠ CAUTION
- Turn OFF the MAIN POWER switch and POWER board before replacing the DP heater.
- When removing or installing the console cover, take care not to get your fingers hit at a corner of the console cover.

1 Stop the instrument.
2 Remove the rear cover of the electron optical column console.
3 Remove the receptacle of the connector of the DP.
4 Check for an open heater between the pins with a circuit tester.



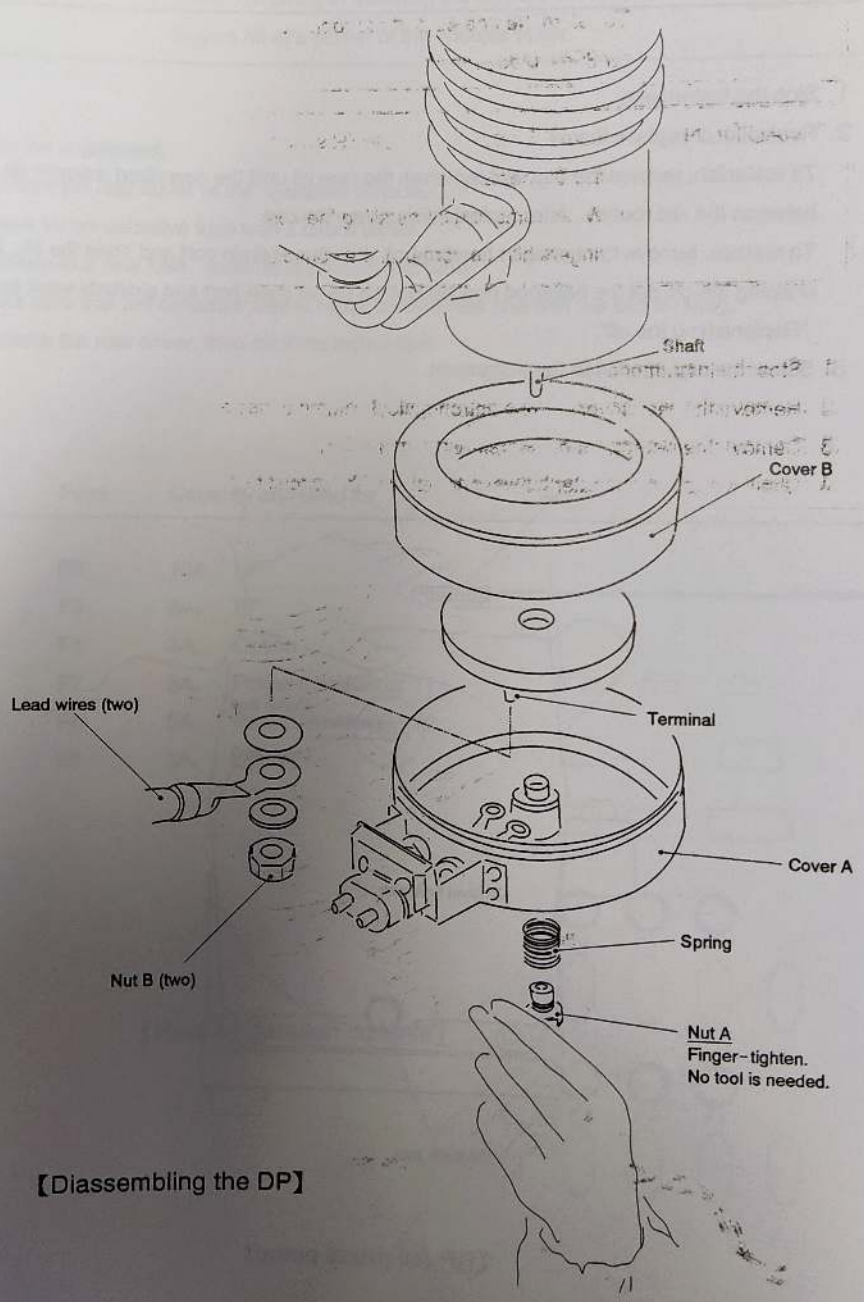


【DP (oil diffusion pump)】

5 Disassemble these parts as shown in the drawing, then replace to a new heater.

6 Assemble the DP in the opposite sequence to removal, then install the receptacle of the connector.

7 Replace the rear cover, the start the instrument.

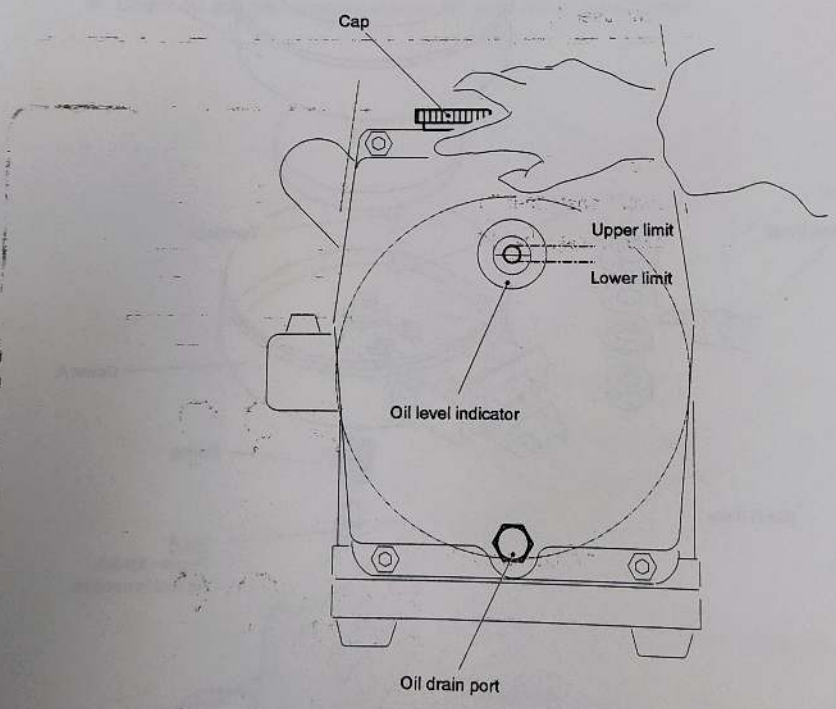


【Diassembling the DP】

5.6 Replenishing and Replacing the RP oil

⚠ CAUTION Do not let the oil level of the oil rotary pump fall below the lower limit. If the pump operates with only a small quantity of oil, some troubles can occur.

1 Stop the instrument.
2 Replenish or replace the oil.
To replenish, remove the cap and replenish the new oil until the described quantity (in between the red round). After replenishing, screw the cap.
To replace, remove the hexagon headed bolt from the oil drain port and drain the oil. After draining the oil, set the hexagon headed bolt on the oil drain port and similarly work as "Replenishing the oil".
3 Screw the cap, then start the instrument.



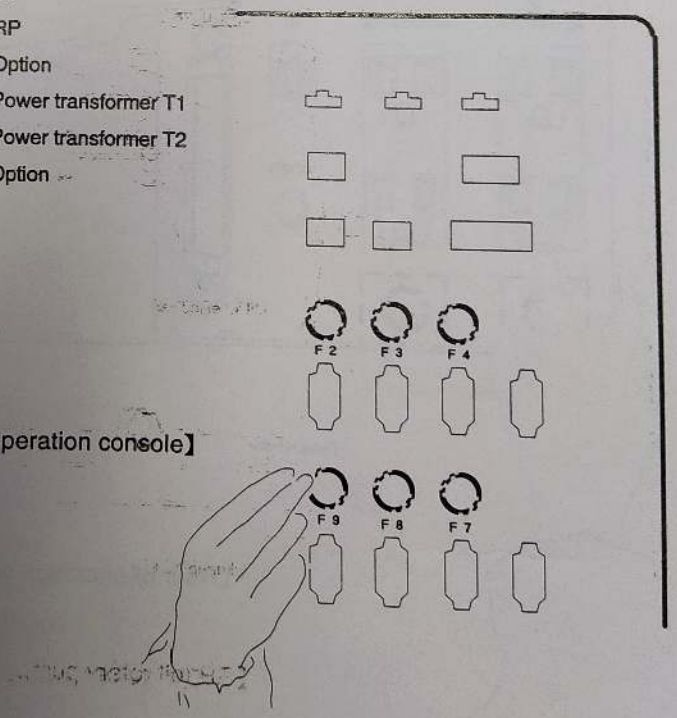
【RP (oil rotary pump】

5.7 Checking and Replacing the fuse

⚠ CAUTION
- Turn OFF the MAIN POWER switch and POWER board before replacing the fuse.
- When removing or installing the console cover, take care not to get your fingers hit at a corner of the console cover.

1 Stop the instrument.
2 Remove the rear cover of the operation console.
3 Check for an defective fuse with a circuit tester.
4 Replace to a new fuse. (refer to illustration and table)
Make sure that the defective fuse is replaced by a new one with the same rating.
5 Replace the rear cover, then start the instrument.

Fuse	Capacity and used for
F2	10A, DP
F3	8A, RP
F4	3A, Option
F7	8A, Power transformer T1
F8	5A, Power transformer T2
F9	3A, Option

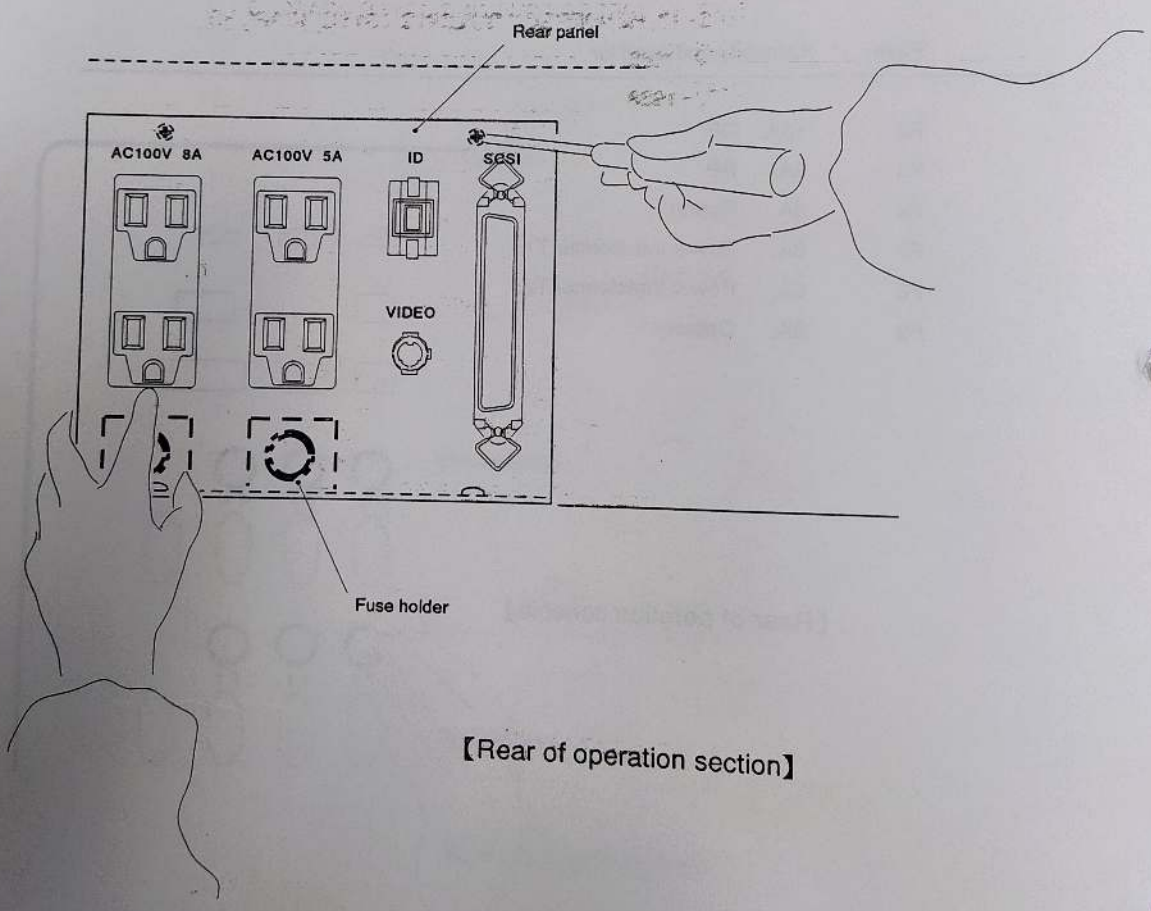


【Rear of peration console】

5.8 Checking and Replacing the service outlet fuse

⚠ CAUTION
- Turn OFF the MAIN POWER switch and POWER board before replacing the fuse.
- When removing or installing the rear panel, take care not to get your fingers hit at a corner of the rear panel.

1 Stop the instrument.
2 Remove the cables of the rear panel.
3 Check for an defective fuse with a circuit tester.
4 Remove the rear panel, then replace to a new fuse (8A or 5A).
Make sure that the defective fuse is replaced by a new one with the same rating.
5 Replace the rear panel, then connect the cables to the rear panel.
6 Start the instrument.



【Rear of operation section】

INSTRUCTIONS

MP-64070(BEIW)

Backscattered Electron Detector

No. IMP64070-2

JEOL

Serving Advanced Technology

Notice

- The information in this manual, which is based on specifications believed correct at the time of publications, is subject to change without notice due to improvements made in the instrument.
- In order to assist us in preparing future documentation, please advise your nearest JEOL service office if you find any errors in this manual.
- This manual has been prepared using a desktop publishing system in which photographs and drawings are read by the use of an image scanner.
  Therefore, details of some of the photos may not be as clear as those of the originals.
- In no event will JEOL Ltd. be liable for direct, indirect, incidental or consequential damages resulting from the use of software described in this manual.
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6-38 Musashino 2-Chome, Akishima-Shi, Tokyo, 196-0021 Japan

For servicing or inquires, contact your local service center.

Safety Precautions

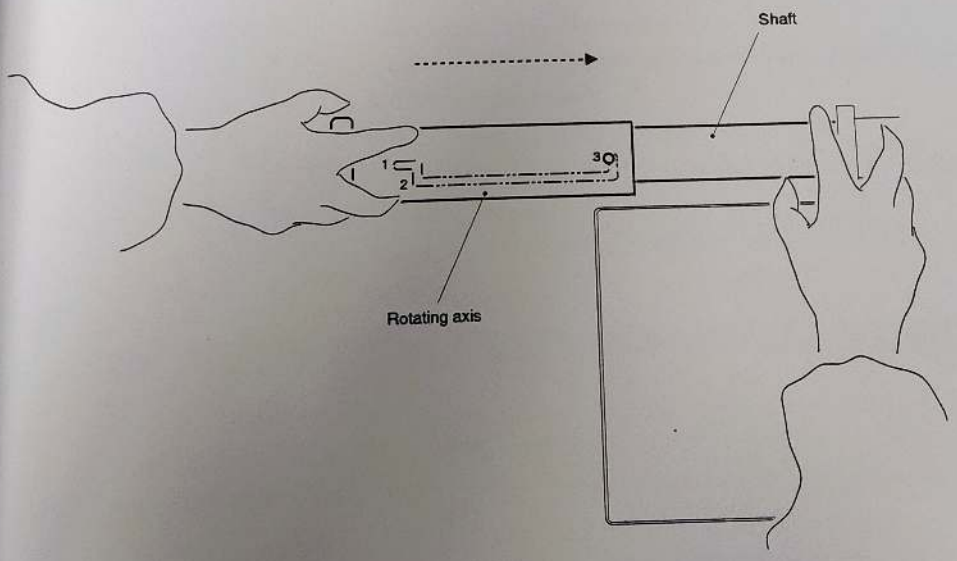
To ensure that you use this instrument correctly, read carefully the following safety precautions prior to starting operation or maintenance.
The descriptions below contain important information related to safety. Contact your local service center whenever you are unclear about an operation or maintenance.
Please keep the operation manual on hand so that you can consult it whenever necessary.
The safety definitions used in our company's operation manuals and their meanings are as follows:

⚠ CAUTION: A potentially hazardous situation which, if not avoided, may result in minor injury or material damage.

We request that you use the instrument in a proper manner and within the scope of the purposes and usages described in the brochures and operation manuals.
Never make modifications such as removing protective parts, replacing component parts and unlocking safety measures.

⚠ CAUTION

When inserting the backscattered electron detector, take care not to let your fingers be caught between the rotating axis and shaft.



Contents

Please note that the drawings given in this instruction manual are somewhat different from actual components.

1. General

This detector, installed in the specimen chamber of a scanning electron microscope, separately detects the backscattered electrons coming from the specimen surface by means of a paired annular type semiconductor device and a semiconductor device for shadow images, processes the signals obtained, and displays three types of images — the shadow image, composition image, and topography image.

2. Specifications

- Backscattered electron detector: Si P – N junction – type semiconductor detector
- Bandwidth: 1Hz to 120kHz
- Gain changeover: 2 – step continuous change – over by contrast control)
- Amplifier: Preamplifier and arithmetic unit
- Working distance (WD): 8 to 48mm
- Signal types: Three types of backscattered electron images
  - Shadow image (SHADOW)
  - Composition image (COMPO)
  - Topography image (TOPO)
- PN – J positions: 3 positions (manually selectable)
- Operation: Carried out by BEI adjustment panel opened by GUI and image adjustment tool (contrast and brightness) of GUI.
  When OKB (option) is available, contrast and brightness control can be made by using it.
- Auto functions: ACB (Auto Contrast & Brightness):
  - Interlocked with photographing and accelerating voltage change

  AFD (Auto Focus Device)
  - Can be used in combination with ACB
  - Interlocked with photographing and accelerating voltage change

  ASD (Auto Stigmator)
  - Can be used in combination with ACB and AFD

3. Components

- Backscattered electron detector (including transportation parts and fixing flanges) ..... 1 set
- Operational amplifier (cable) ..... 1 set

The above specifications and composition subject to change without notice.

4. Operating Principle

4.1 Formation of composition image and topography image

A lower figure is a block diagram showing the basic signal flow for image formation. The specimen surface is scanned by an incident electron beam to generate backscattered electron which have informations of the surface topography, physical and chemical properties of the specimen. These backscattered electrons with said informations are detected from different directions by semiconductor detecting elements A and B are arranged symmetrically at an optical axis, and the detected electrons with quantitative changes are converted into electrical signals.

The two signals thus obtained are amplified by the preamplifier, and fed into the operational amplifier.

The operational amplifier further amplifies the two signals, and at the same time, adds or subtracts these signals from detecting elements A and B.

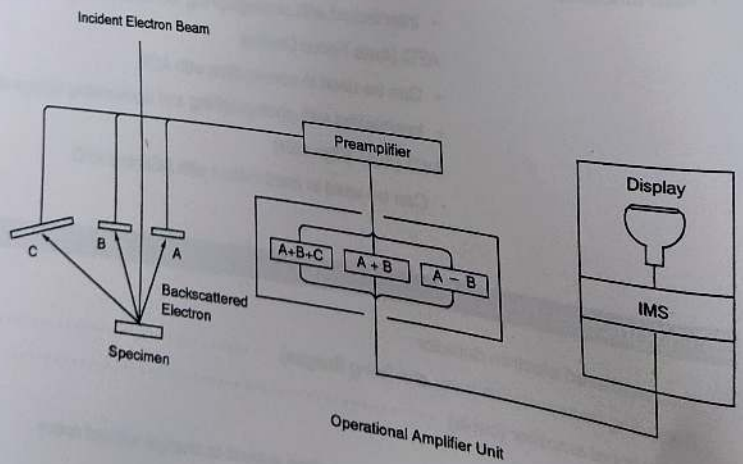
The adds signal is used as a video signal for displaying COMPO BEI, and the subtracted signal serves as a video signal for displaying TOPO BEI.

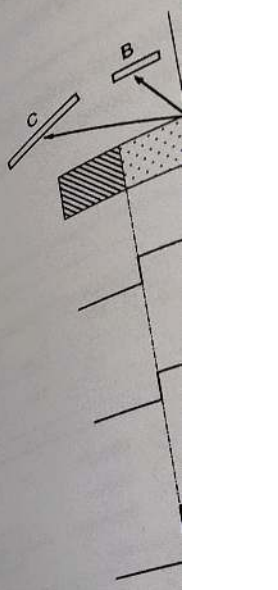
The desired video signal is selected by the IMS, and is fed to CRT for display. (refer to next page)

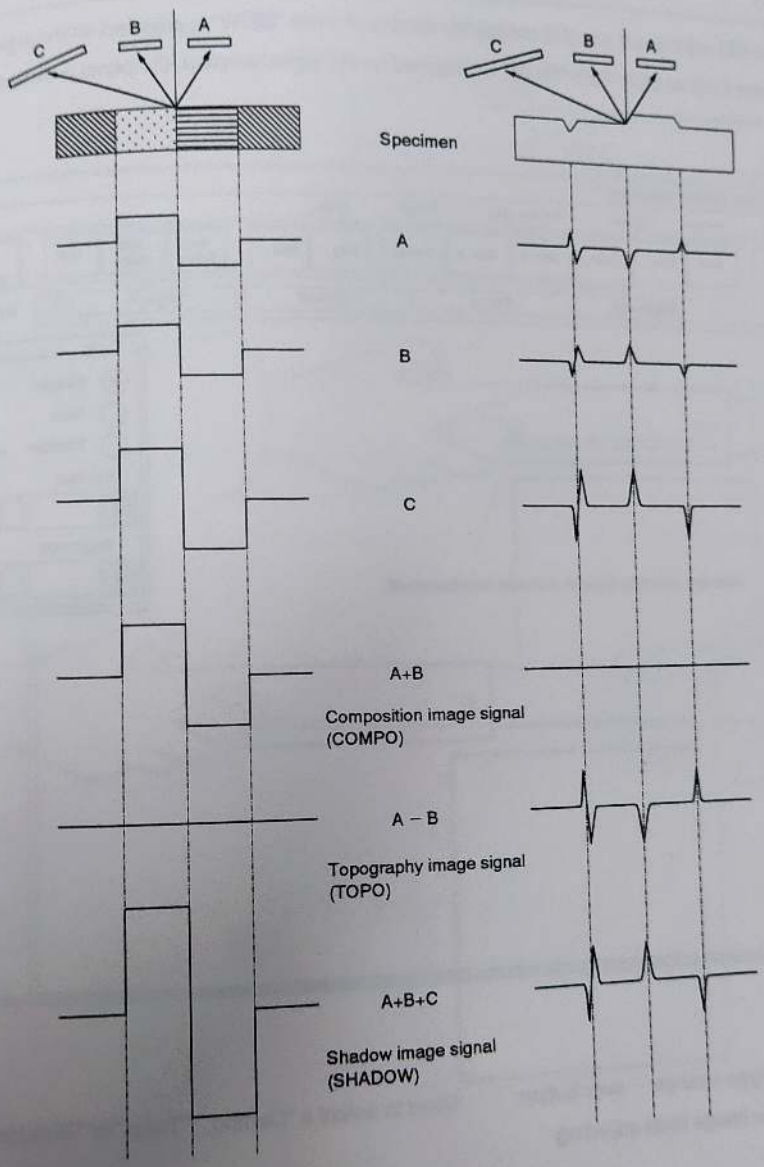
4.2 Formation of shadow image

The electrical signals of detecting elements A and B make are composition signal, and add this signal to obtained electrical signal by the detecting element C for SHADOW.

The consequence is that these signals are used as a video signal for displaying SHADOW BEI.



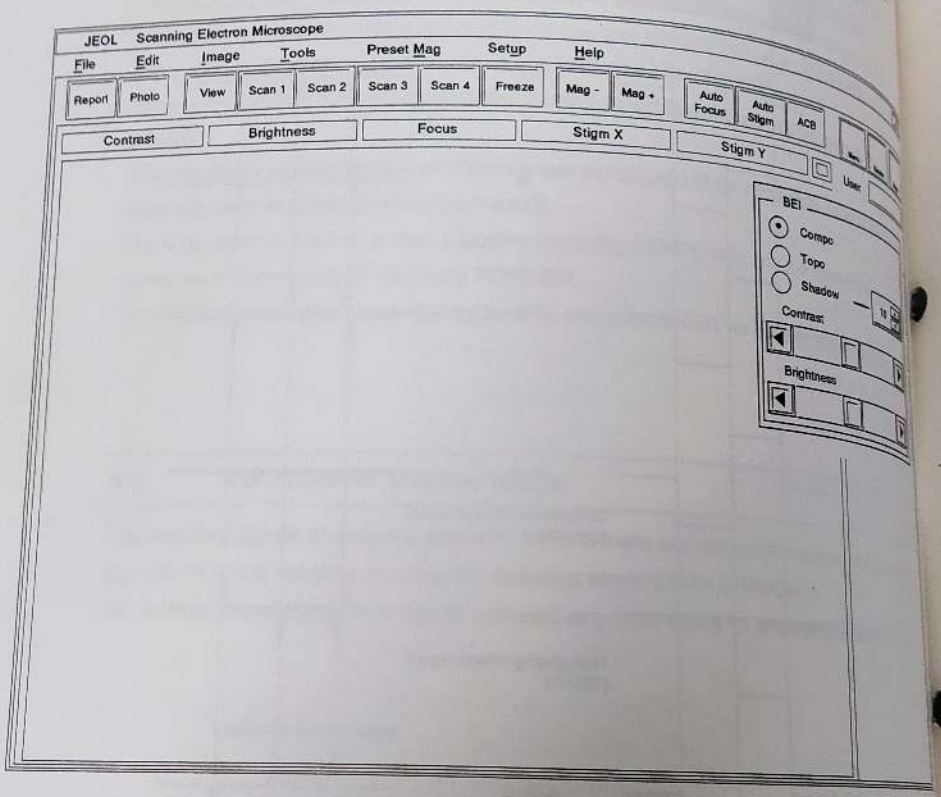



C
B
A
Specimen
A
B
C
A+B
Composition image signal
(COMPO)
A – B
Topography image signal
(TOPO)
A+B+C
Shadow image signal
(SHADOW)

5. Names and Functions of Individual Components

5.1 BEI adjustment panel

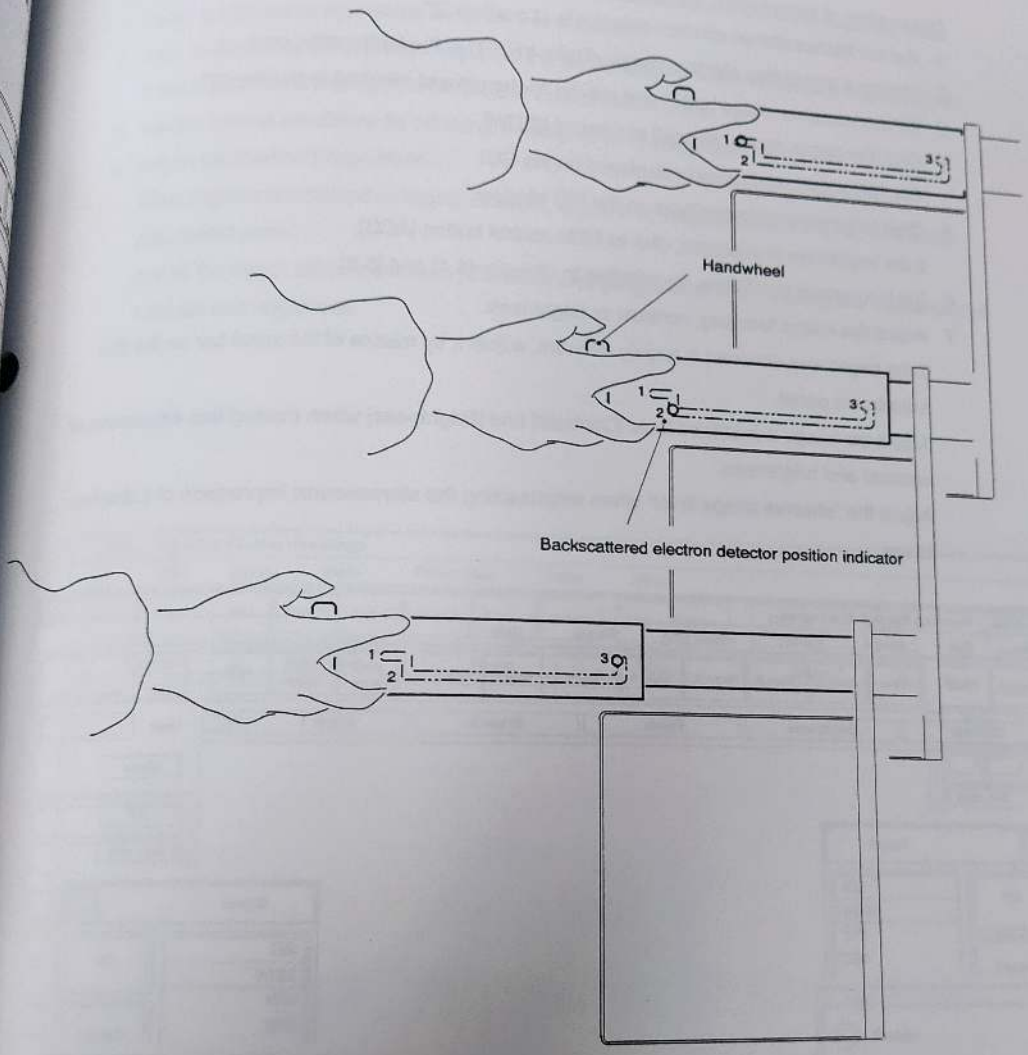
The BEI adjustment panel is constantly displayed while "BEIW" is selected on the signal window. When a signal other than "BEIW" is selected on the signal window, the panel is closed.



Signal type change – over button:	Used to select a "Compo," "Topo,"or "Shadow"
Shadow image level adjusting button:	Usable only when a "Shadow" is selected. The adjustment range is 1 to 10. The larger the value, the more stereoscopic is the image.
Contrast:	Used for rough adjustment of the contrast of the backscattered electron image by means of the scroll bar.
Brightness:	Used for rough adjustment of the brightness of the backscattered electron image by means of the scroll bar.

5.2 Backscattered Electron Detector

Use the handwheel for installing and removing the backscattered electron detector.



Detector position	Usage
1	Observing composition/topography/shadow images.
2	Observing shadow images. (Gives more stereoscopic images than when the backscattered electron detector is at "1.")
3	Observing no backscattered electron image.