JSM-6360, JSM-6360LV
Scanning Electron Microscope

Instruction manual

No.ISM6360/6360LV-2

Printed in Japan

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- 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 the environment, especially radio communications.
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MANUFACTURE

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For servicing or inquires, please contact your JEOL service office.

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, it 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 sings.

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 warning

- 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 follow 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.

! CAUTION

■ 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 automatically. When the water supply is restored, restart the instrument.
- Since the electron optical column is placed on the frame via an anti-vibration mount, the electron optical 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 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 electron optical 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 electron optical column

- When it becomes necessary to perform maintenance that requires disassembling and cleaning of the electron optical column or replacement of parts other than those specified in maintenance, contact your local service office.
- When you clean electron optical column components, use 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.

■Notes and Cautions concerning Personal Computer (PC)

PC: A personal computer (PC), whose operating system (OS) is Windows2000, must have FlashPoint 3D on the VideoCapture Board.

Hardware

- Never modify the hardware settings and also never install additional boards. If you do, the PC or the SEM may not work normally.
- Never connect devices other than the recommended ones. If you do, the PC or the SEM may not work normally.
- Make sure not to locate a motor in the vicinity of the electron optical column. If you do, the fluctuation of stray magnetic fields may disturb SEM images.

Software

- Never install application software other than the recommended software. If you do, the PC or the SEM may not work normally.
- Never delete application software or files which have been installed. If you do, the SEM control software may not work normally.
- When an error message appears while operating the SEM control software, close Windows, switch off the PC and reset the SEM, and then switch on the PC again. If the SEM control software has not finished

normally, the present SEM data vanishes.

OS

- Never upgrade the OS or driver software. If you do, the PC or the SEM may not work normally.
- Never change the settings of the desktop in the property display screen while the SEM control software is being executed. If you do, SEM images may not be displayed or the PC may hang up.
- Never change the settings of the color palette or font size in the window that appears when you click the set button of the property display screen. If you do, the SEM control software may not work normally.
- If the setting of the desktop in the property display screen is changed, the settings of the color palette and refresh sheet may vary automatically.
- If the setting of the refresh sheet in the property display screen is changed, the SEM images may be disturbed.
- The display is normally set as follows:

Desktop area:	1,024 × 768 pixels
Color palette:	True Color
Font size:	Small font
Refresh frequency:	70 Hz

- Do not activate the screen saver. If the screen saver becomes active when the SEM control software is being executed, SEM images may not be displayed and the PC may hang up.
- Never display the security screen, that is, never press **Ctrl**, **Alt**, and **Delete** keys at the same time when the SEM control software is being executed. If the security screen is displayed when the SEM control software is being executed, the SEM image cannot be displayed and the PC hangs up.
- When the [**Make Mouse Pointer Shadow Effective**] setting box in the **mouse property pointer** is checked, the shadow of the mouse pointer is displayed in magenta.
- When the [**Animate Menus and Hints**] set box is checked in the **effect of property dialog** screen, the SEM images may be disturbed.

Display of SEM Images

- A wave-like noise sometimes appears in displayed SEM images, and the margin of a SEM image looks like a mosaic. If this happens, close Windows, switch off the PC and then switch on the PC again.
- When SEM images are being displayed, never overlap an application software using magenta such as Paint software on the displayed SEM image. If you do, the part of the image in magenta may disappear.

Contents

Chapter 1 General, specifications and composition

Chapter 2 Name and explanation of each part

Chapter 3 Explanation of GUI

Chapter 4 Operation

Chapter 5 Maintenance

1

General, specifications and composition

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

1.1 General

The main characteristics of this device…

- New electron optical system (EOS) is realized the ×8 (WD48mm) at minimum magnification. (In Acc.V 10kV or less, ×5～×7 can be set which is easy to use for searching the field of view.)
- A resolution is 3.0nm of this class maximum.
- New Graphical User interface (GUI) which enriched various observation support functions and easy operation.

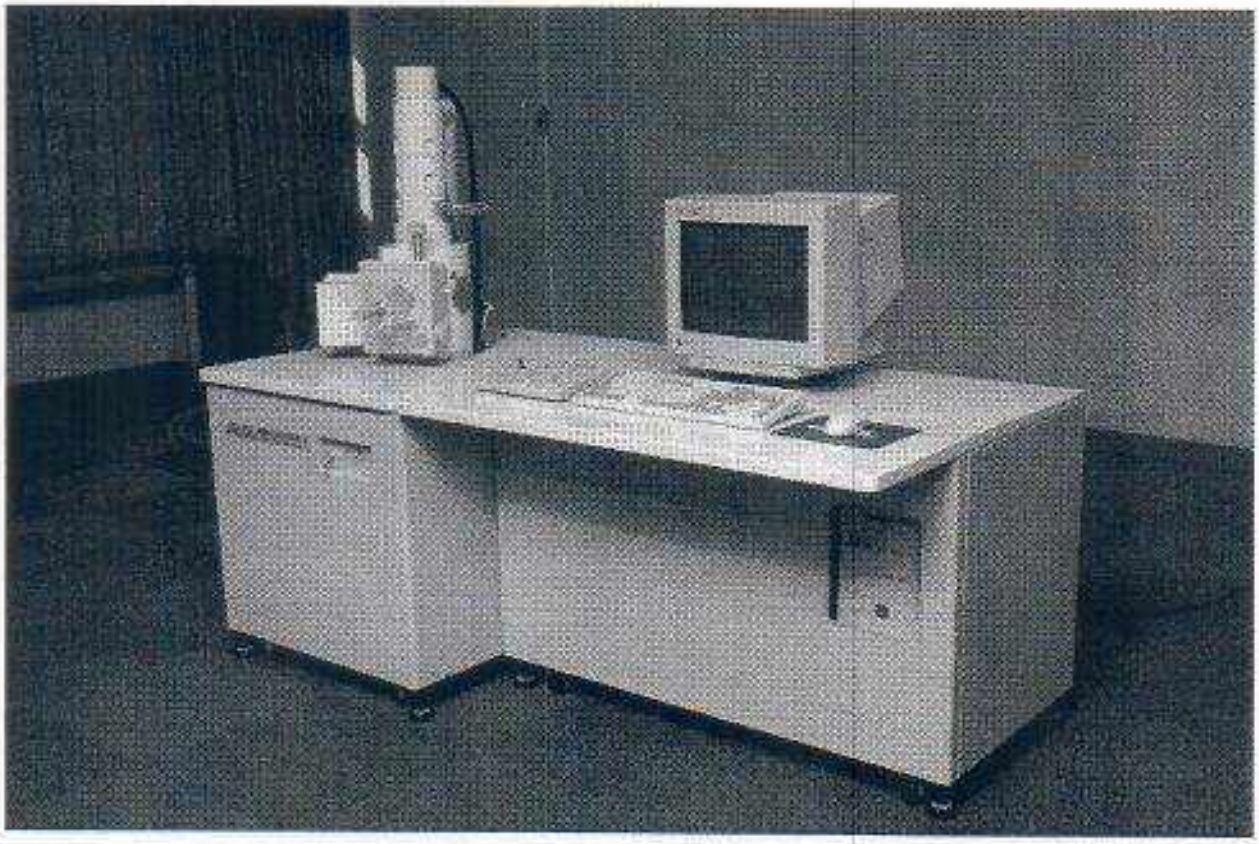
It is PC-SEM which can operate to the image observation the record from the control of the SEM by using a mouse of the personal computer.

The meaty automatic-functions, recipe function and simplified DTP function are provided. Thus, full use of the personal computer makes all SEM tasks, from image observation to report preparation easy and efficient.

An optional EDS becomes an analysis position WD10mm and X-ray extraction angle 35° , in the X-ray analysis.

(WDS can also be attached)

It is high-performance scanning electron microscope (SEM) which can operate the good analysis of the efficiency and mapping in the low magnification on the condition which the same as high resolution observation.



1.2 Specifications

1.2.1 JSM-6360

1.2.1.a Performance

Resolution (SEI)	3.0 nm guaranteed (Acc V 30kV, WD 8mm)
Magnification	8× (WD 48mm) to 300,000× (146 steps, digital indication) 5× to 7× settable (It is effective only when the condition is set to WD48mm and Acc.V 10kV or less) Automatically corrected for Acc V and/or WD changes Instantaneously changeable to an optionally preset magnification from any current magnification
Image mode	SEI, BEI (detected by the SE detector)
Probe current	1 pA to 1 μA

Notes:

SEI:	Secondary-electron image
BEI:	Backscattered-electron image
Acc V:	Accelerating voltage
WD:	Working distance

1.2.1.b Electron Optical System (EOS)

Electron gun

Accelerating voltage	0.5 to 30kV (55 steps) (0.5 to 3kV; 100V steps, 3 to 30kV; 1 kV steps)
Filament	Precentered tungsten hairpin filament
Bias voltage	Automatic bias (linked to Acc.V)
Alignment	Electromagnetic 2-stage deflection type
Automatic gun alignment	Automatic gun control provided (automatic filament-heating current setting and automatic gun alignment) Note: Automatic gun alignment is available only in the H-Vac mode.
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 (automatic focusing) provided Manual focusing possible
Focus link	Provided for Acc V change
Dynamic focus	Provided for specimen tilt Linked to Acc V and magnification
Automatic magnification correction	Provided for Acc V and/or WD changes
OL aperture	3-step variable with click-stop mechanism Fine position adjustment in X and Y directions
Wobbler	Provided for OL aperture alignment, Linked to magnification
Stigmator (astigmatism correction)	Electromagnetic 8-pole (Precentered X-Y adjustment type)
Stigma memory	Provided (Linked to Acc V and magnification)
Automatic stigmator	Provided (Manual correction possible)
Scan coil	Electromagnetic 2-stage deflection type
Image fine shifter	Approx. ±50 μ m in X and Y directions (AccV 30kV, WD10mm) Approx. ±150 μ m in X and Y directions (AccV 30kV, WD48mm)

1.2.1.c Specimen Stage

Type	Eucentric (T-and R-axes with eucentric function)
Specimen movements	
	X movement 80mm
	Y movement 40mm
	Z movement 43mm (WD5 to 48mm continuously variable)
	Tilt (T) −10 to + 90°
	Rotation(R) 360° (endless)
Specimen holder	10mm diameter × 10mmH 32mm diameter × 10mmH (with an adapter for mounting four 10mm-diameter specimens)
Maximum specimen size	6-inch (152.4mm) diameter loadable
	125mm diameter full coverage with rotation movement
Specimen exchange	Stage draw-out type (specimen holder slide-in/out type)

1.2.1.d Electron Detector

Secondary-electron detector	Collector, scintillator, light guide and photomultiplier tube

1.2.1.e Display System

Display tube

Display tube	17-inch color monitor

Scan system

Scanning mode	Full-frame scan, Half-size reduced scan

Scan speed

	Horizontal (ms)	Vertical (s)	Pixels
VIEW	0.284	0.142	640×480
SCAN1 (EMP OFF)	0.284	0.071	320×240
SCAN2 (EMP OFF)	0.284	0.142	640×480
SCAN3 (EMP OFF)	20 (16.7)	10 (8.33)	640×480
	20 (16.7)	20 (16.7)	640×480
SCAN4・PHOTO Selectable	80 (66.7)	80 (66.7)	1280×960
	160 (133.3)	160 (133.3)	1280×960
	80 (66.7)	160 (133.3)	2560×1920

Note: Line frequency: 50Hz [Values in brackets: 60Hz]

Frame memory

Capacity	1280 × 960 × 8 bits
Number of pixels	640 × 480, 1280 × 960, 2560 × 1920(option)

Image processing

Averaging	1 to 255 frames
Look-up table	Contrast enhancement Contrast attenuation γ -correction Multi-level cording Partial enhancement Inverse contrast Histogram
Pseudo color image	16 colors
Multiple display	Display of 2 or 4 images in one frame
Digital zoom	Display of arbitrary area at 2× or 4×

Text display

Display position	36 columns × 24 lines in an image
Text	Alphanumeric characters, symbols
Background	Black or image can be selected
Text-entry device	Keyboard

Data display	
Display position	Horizontal at the bottom of the screen
Contents	Accelerating voltage, Magnification, Micron marker with micron value, Film number (4 digits), Alphanumeric comment (10 characters) Notes: Display of each item can be turned on or off. Ten alphanumeric characters can be changed to date, WD, spot size or image mode.
Background	Black or image can be selected.
File saving	
Format	BMP, TIFF or JPEG
Media	Floppy disk, MO-disk etc., and hard disk

1.2.1.f Operation System

Basic System	
Computer	IBM PC/AT compatible computer
Operation System (OS)	Windows®2000* Windows®2000 is a trademark of Microsoft Corp.
Operation	
Operation method	Graphical user interface, mouse and operation keyboard Note: Operation keyboard is optionally available.
User registration	Number of users can be freely registered according to the hard disk capacity. User files (SEM status file, recipe file and stage file) for individual user can be saved.
Recipe function	Saving and loading of images and observation condition (various condition of EOS, a stage position, vacuum mode) for each specimen. "Custom" and "Standard" are prepared to recipe function. "Custom" for individual user can be saved. "Standard" for all users can be used. Number of custom recipes can be freely registered according to the hard disk capacity.

Automatic functions

Automatic gun alignment (AGC):	Provided (in H-Vac mode only)
Automatic filament saturation (AFS):	Provided
Automatic focusing (AFD):	Provided (Combination with ACB possible, linked to photo recording and accelerating voltage change)
Automatic astigmatism correction (ASD):	Provided (Combination with ACB and AFD possible)
Automatic contrast/brightness (ACB):	Provided (Linked to photo recording and accelerating voltage change)

Support functions for image observation ※

Click center	An arbitrary position on the image display area can be moved to the center of the image by double-clicking. (Snap shot image display area available)
Click center zoom	An automatically 15-steps zooms in the magnification of the image moved by the click center function. (Snap shot image display area possible)
Drag	The image can be moved by dragging an arbitrary position on the image.
Drag and zoom	An automatically 15-steps zooms in the magnification of the image moved by the drag function.
Frame feed	The image can be moved a specified fraction of the field of view.
Snap shot	The two frozen images can be pasted on the snap shot area and enables stage control.
Scan rotation	Always corrects the X/Y movement direction by the SRT ON.

※The motor drive stage (option) is necessary to move the stage.

User setting

Mouse control	The Mouse control operation can be changed to up/down or left/right.
Movement of stage※	The direction of the movement of the stage can be changed on the Live or stored image display area. **※The motor drive stage (option) is necessary to move the stage.**

1.2.1.g Vacuum System

System control	Fully automatic	
Ultimate pressure in gun chamber	0.1mPa order	
Evacuation time	Approx. 2 minutes 30 seconds	
Oil rotary pump	100 L/min,	one
Oil diffusion pump	4-inch 420 L/s with water cooling baffle,	one

1.2.1.h Safety Devices

Devices to protect against vacuum, water, power failures, and leakage current are provided.

1.2.1.i Others

EDS port	one	
An angle for extracting the X-ray	35 degree (WD10mm; However, when WDS is attached simultaneously, WD becomes 15mm)	
WDS port	one	
An angle for extracting the X-ray	35 degree (WD15mm)	
Service receptacles	100 V AC, 8 A, 100 V AC, 5 A,	two two
NTSC video outputs	BNC-R connector	one

1.2.2 JSM-6360LV

1.2.2.a Performance

High-vacuum mode (H-Vac)

Resolution (SEI)	3.0 nm guaranteed (Acc V 30kV, WD 8mm)
Magnification	8× (WD 48mm) to 300,000× (146 steps, digital indication) 5× to 7× settable (It is effective only when the condition is set to WD48mm and Acc.V 10kV or less)
	Automatically corrected for Acc V and/or WD changes
	Instantaneously changeable to an optionally preset magnification from any current magnification
Image mode	SEI, BEI (detected by the SE detector)
Probe current	1 pA to 1 μA

Low vacuum mode (L-Vac)

Resolution (BEI)	4.0 nm guaranteed (Acc V 30kV, WD 5mm)
Vacuum pressure in the specimen chamber	
Adjustable pressure	10 to 270 Pa
Lowest pressure	1 Pa
Image mode	Three kinds of backscattered electron images (composition image, topographic image and stereoscopic image)

Notes:

SEI:	Secondary-electron image
BEI:	Backscattered-electron image
Acc V:	Accelerating voltage
WD:	Working distance

1.2.2.b Electron Optical System (EOS)

Electron gun

Accelerating voltage	0.5 to 30kV (55 steps) (0.5 to 3kV; 100V steps, 3 to 30kV; 1 kV steps)
Filament	Precentered tungsten hairpin filament
Bias voltage	Automatic bias (linked to Acc.V)
Alignment	Electromagnetic 2-stage deflection type
Automatic gun alignment	Automatic gun control provided (automatic filament-heating current setting and automatic gun alignment)
	Note: Automatic gun alignment is available only in the H-Vac mode.

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 (automatic focusing) provided Manual focusing possible
Focus link	Provided for Acc V change
Dynamic focus	Provided for specimen tilt Linked to Acc V and magnification
Automatic magnification correction	Provided for Acc V and/or WD changes
OL aperture	3-step variable with click-stop mechanism Fine position adjustment in X and Y directions
Wobbler	Provided for OL aperture alignment, Linked to magnification
Stigmator (astigmatism correction)	Electromagnetic 8-pole (Precentered X-Y adjustment type)
Stigma memory	Provided (Linked to Acc V and magnification)
Automatic stigmator	Provided (Manual correction possible)
Scan coil	Electromagnetic 2-stage deflection type
Image fine shifter	Approx. ±50 μ m in X and Y directions (AccV 30kV, WD10mm) Approx. ±150 μ m in X and Y directions (AccV 30kV, WD48mm)

1.2.2.c Specimen Stage

Type	Eucentric (T-and R-axes with eucentric function)
Specimen movements	
	X movement 80mm
	Y movement 40mm
	Z movement 43mm (WD5 to 48mm continuously variable)
	Tilt (T) −10 to +90°
	Rotation(R) 360° (endless)
Specimen holder	10mm diameter × 10mmH 32mm diameter × 10mmH (with an adapter for mounting four 10mm-diameter specimens)
Maximum specimen size	6-inch (152.4mm) diameter loadable
	125mm diameter full coverage with rotation movement
Specimen exchange	Stage draw-out type (specimen holder slide-in/out type)

1.2.2.d Electron Detector

H-Vac mode

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

L-Vac mode

Backscattered-electron detector:	Semiconductor (P-N junction) detector

1.2.2.e Display System

Display tube	
Display tube	17-inch color monitor
Scan system	
Scanning mode	Full-frame scan, Half-size reduced scan

Scan speed

	Horizontal (ms)	Vertical (s)	Pixels
VIEW	0.284	0.142	640×480
SCAN1 (EMP OFF)	0.284	0.071	320×240
SCAN2 (EMP OFF)	0.284	0.142	640×480
SCAN3 (EMP OFF)	20 (16.7)	10 (8.33)	640×480
	20 (16.7)	20 (16.7)	640×480
SCAN4・PHOTO Selectable	80 (66.7)	80 (66.7)	1280×960
	160 (133.3)	160 (133.3)	1280×960
	80 (66.7)	160 (133.3)	2560×1920

Note: Line frequency: 50Hz [Values in brackets: 60Hz]

Frame memory

Capacity	1280 × 960 × 8 bits
Number of pixels	640 × 480, 1280 × 960, 2560 × 1920(option)

Image processing

Averaging	1 to 255 frames
Look-up table	Contrast enhancement Contrast attenuation γ -correction Multi-level cording Partial enhancement Inverse contrast Histogram
Pseudo color image	16 colors
Multiple display	Display of 2 or 4 images in one frame
Digital zoom	Display of arbitrary area at 2×or 4×

Text display

Display position	36 columns × 24 lines in an image
Text	Alphanumeric characters, symbols
Background	Black or image can be selected
Text-entry device	Keyboard

Data display	
Display position	Horizontal at the bottom of the screen
Contents	**H-Vac mode** Accelerating voltage, Magnification, Micron marker with micron value, Film number (4 digits), Alphanumeric comment (10 characters) Notes: Display of each item can be turned on or off. Ten alphanumeric characters can be changed to date, WD, spot size or image mode. **L-Vac mode** Same as that for the H-Vac mode except that the vacuum pressure (Pa) in the specimen chamber is indicated instead of the image mode
Background	Black or image can be selected.
File saving	
Format	BMP, TIFF or JPEG
Media	Floppy disk, MO-disk etc., and hard disk

1.2.2.f Operation System

Basic System	
Computer	IBM PC/AT compatible computer
Operation System (OS)	Windows®2000* Windows®2000 is a trademark of Microsoft Corp.
Operation	
Operation method	Graphical user interface, mouse and operation keyboard Note: Operation keyboard is optionally available.
User registration	Number of users can be freely registered according to the hard disk capacity. User files (SEM status file, recipe file and stage file) for individual user can be saved.
Recipe function	Saving and loading of images and observation condition (various condition of EOS, a stage position, vacuum mode) for each specimen. "Custom" and "Standard" are prepared to recipe function. "Custom" for individual user can be saved. "Standard" for all users can be used. Number of custom recipes can be freely registered according to the hard disk capacity.

Automatic functions

Automatic gun alignment (AGC):	Provided (in H-Vac mode only)
Automatic filament saturation (AFS):	Provided
Automatic focusing (AFD):	Provided (Combination with ACB possible, linked to photo recording and accelerating voltage change)
Automatic astigmatism correction (ASD):	Provided (Combination with ACB and AFD possible)
Automatic contrast/brightness (ACB):	Provided (Linked to photo recording and accelerating voltage change)

Support functions for image observation ※

Click center	An arbitrary position on the image display area can be moved to the center of the image by double-clicking. (Snap shot image display area available)
Click center zoom	An automatically 15-steps zooms in the magnification of the image moved by the click center function. (Snap shot image display area possible)
Drag	The image can be moved by dragging an arbitrary position on the image.
Drag and zoom	An automatically 15-steps zooms in the magnification of the image moved by the drag function.
Frame feed	The image can be moved a specified fraction of the field of view.
Snap shot	The two frozen images can be pasted on the snap shot area and enables stage control.
Scan rotation	Always corrects the X/Y movement direction by the SRT ON.
	※The motor drive stage (option) is necessary to move the stage.

User setting

Mouse control	The Mouse control operation can be changed to up/down or left/right.
Movement of stage※	The direction of the movement of the stage can be changed on the Live or stored image display area.
	※The motor drive stage (option) is necessary to move the stage.

1.2.2.g Vacuum System

System control	Fully automatic	
Ultimate pressure in gun chamber	**H-Vac mode**	0.1mPa order
	L-Vac mode	1mPa order (when the vacuum pressure in the specimen chamber is 27Pa)
Evacuation time	**H-Vac mode**	Approx. 1 minutes 40 seconds
	L-Vac mode	Approx. 1 minutes 30 seconds
Oil rotary pump	100 L/min,	two
Oil diffusion pump	4-inch 420 L/s with water cooling baffle,	one
Foreline trap	Cartridge type (built in)	
Orifice holder	Removable type (always mounted)	
Orifice	400μm diameter	
Control valve	Fine metering valve type	
Specimen chamber pressure gauge	Pirani gauge	

1.2.2.h Safety Devices

Devices to protect against vacuum, water, power failures, and leakage current are provided.

1.2.2.i Others

EDS port	one	
An angle for extracting the X-ray	35 degree (WD10mm; However, when WDS is attached simultaneously, WD becomes 15mm)	
WDS port	one	
An angle for extracting the X-ray	35 degree (WD15mm)	
Service receptacles	100 V AC, 8 A, 100 V AC, 5 A,	two two
NTSC video outputs	BNC-R connector	one

1.3 Installation requirements

■ **JSM-6360 and JSM-6360LV commonness**

Power: 100 V ±10%, 50/60 Hz, 3.0kVA (Voltage drop should be within 3 %.at 3.0kVA)

Grounding terminal: 100 Ω or less, one

Cooling Water

- Faucet: 14 mm outer diameter or ISO 7/1 Rc1/4, one
- Drain: At least 25 mm inner diameter or ISO 7/1 Rc1/4, one
- Flow rate: 2 L/min
- Pressure: 0.05 to 0.2 MPa (gauge pressure)
- Temperature: 15 to 25℃

Environment

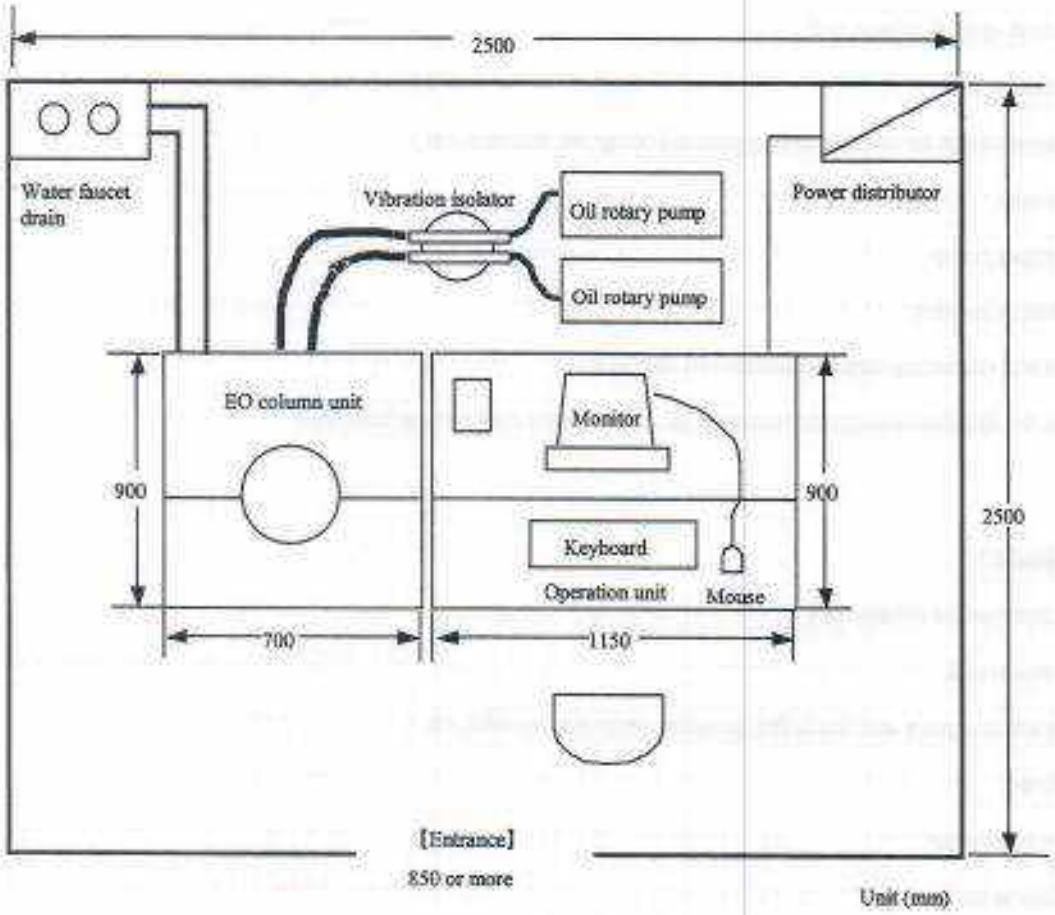
- Temperature: 15 to 25℃
- Humidity: 60% or less
- Stray AC magnetic field: 0.3μT(p-p) or less, AC (50/60Hz sine wave, WD15 mm; Acc V, 30kV)
- Floor vibration: 2μm(p-p) or less at sine wave of over 5Hz frequency
- Floor space: 2,500 (W) × 2,500 (D) × 1,800 (H) mm or more
- Door width: 850 mm or more
- Dimensions and Weight

JSM-6360／JSM-6360LV

	Width (mm)	Depth (mm)	Height (mm)	Weight (kg)
EO column unit	750	960	1,365	Approx.260
Operation unit	1,150	900	750	Approx.195
Oil rotary pump ※	460	175	255	Approx.23 ※
Vibration isolator	270	200	200	Approx.10

※ For JSM-6360LV; weight of one set

1.3.1 Installation layout example



- This above figure shows a typical installation layout for a LV-SEM. An oil rotary pump (one) is removed in the case of the standard SEM.
- 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 rods, 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 Composition

■JSM-6360

- Electron optical column unit ····· 1 set
- Operation unit ····· 1 set
- Personal computer unit (including personal computer, monitor, 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

■JSM-6360LV

- Electron optical column unit ····· 1 set
- Operation unit ····· 1 set
- Personal computer unit (including personal computer, monitor, etc.) ····· 1 set
- Software ····· 1 set
- Oil rotary pump ····· 2 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

1.5 Instrument warranty

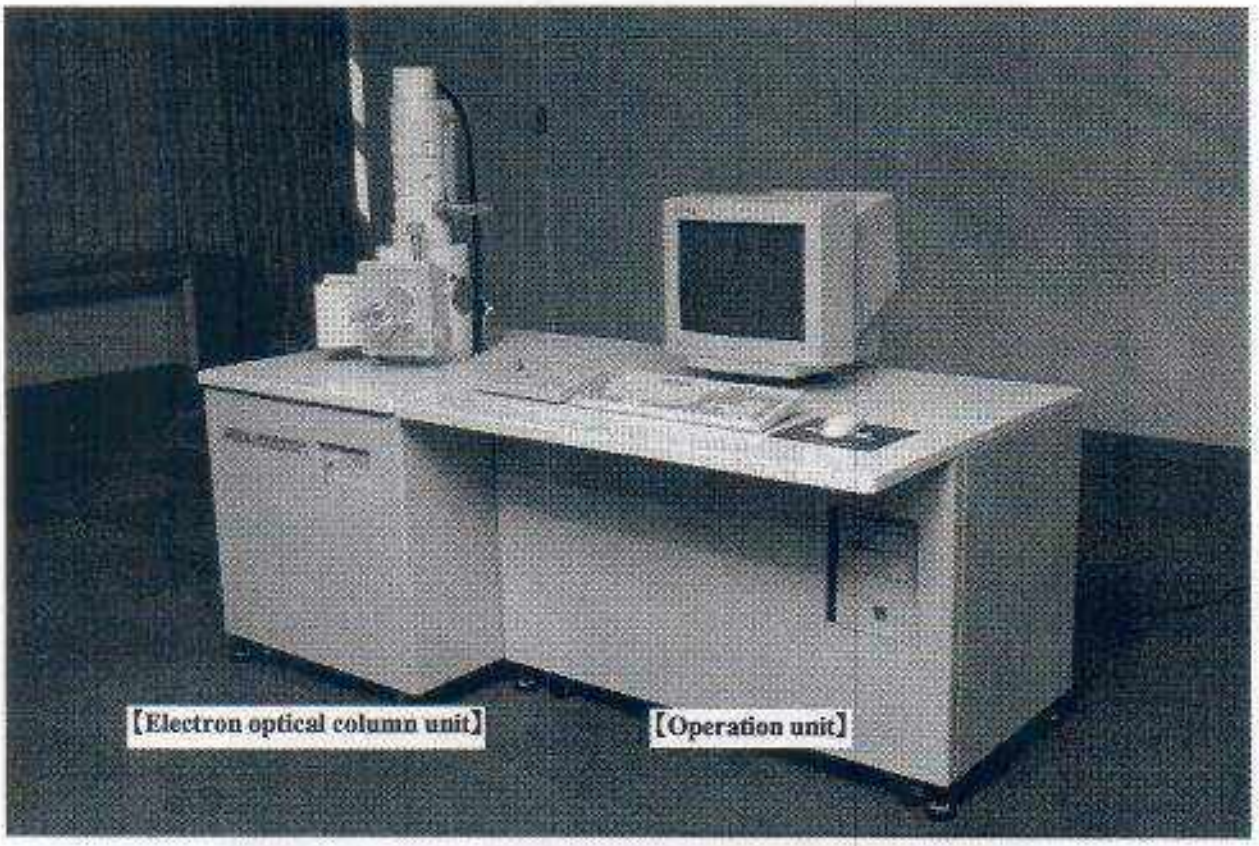
This instrument is guaranteed for one year from the date of installation. We undertake to repair it free of change in the event that it breaks down within this period, except in cases where the breakdown is the result of a force majeure or careless handling.

2

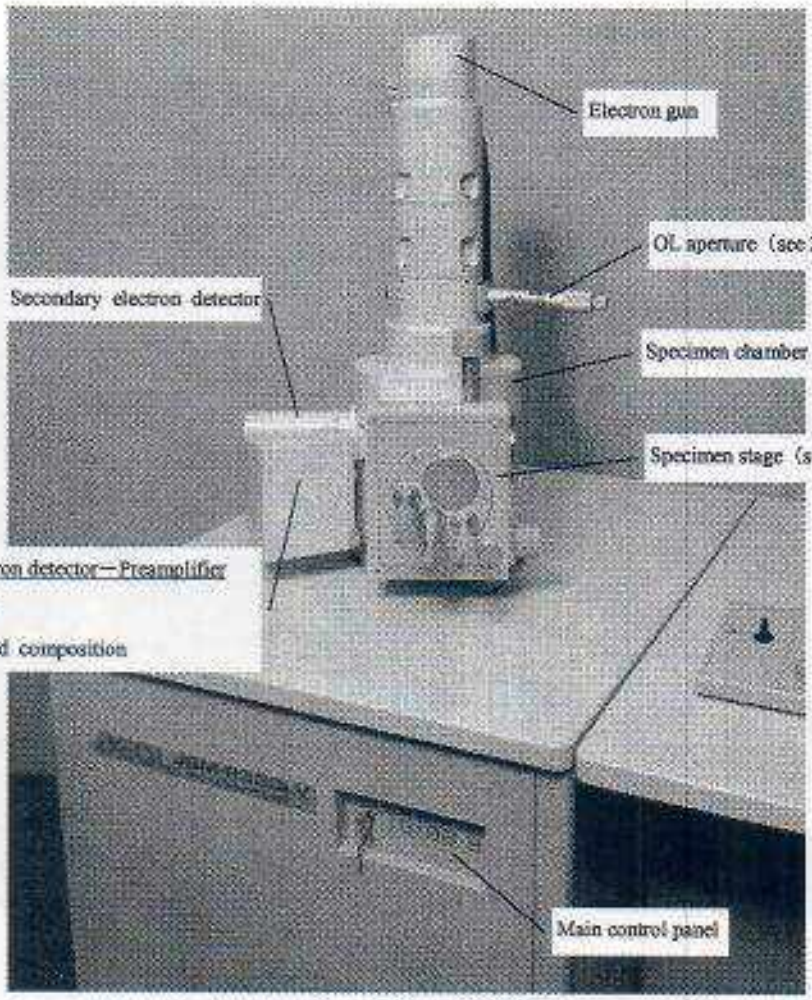
Name and explanation of each part

2.1 Exterior of instrument

"JSM-6360／LV Scanning Electron Microscope" is composed of [Electron optical column unit] and [Operation unit].



2.2 Electron optical column unit

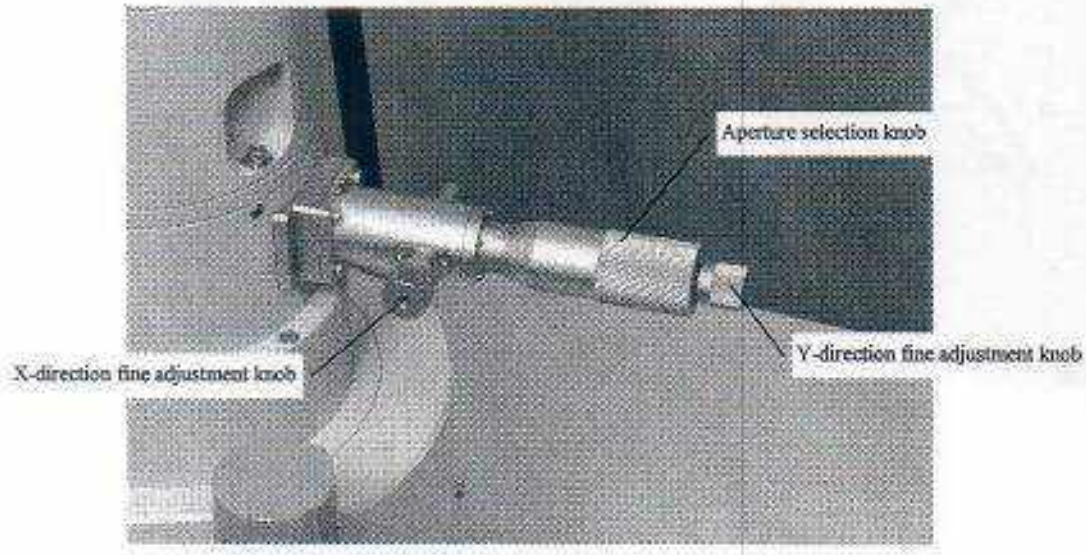


2.2.1 Objective lens (OL) aperture

! CAUTION

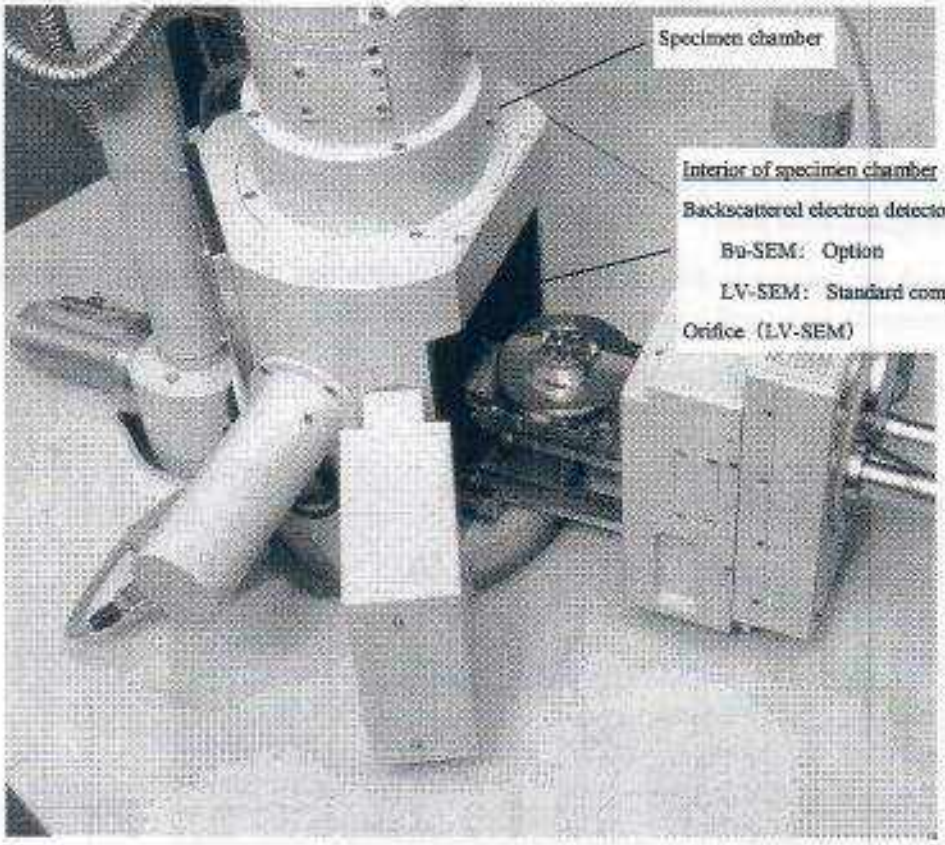
When selecting the aperture of the OL aperture, be careful not to get your fingers caught in the grip.

- 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.

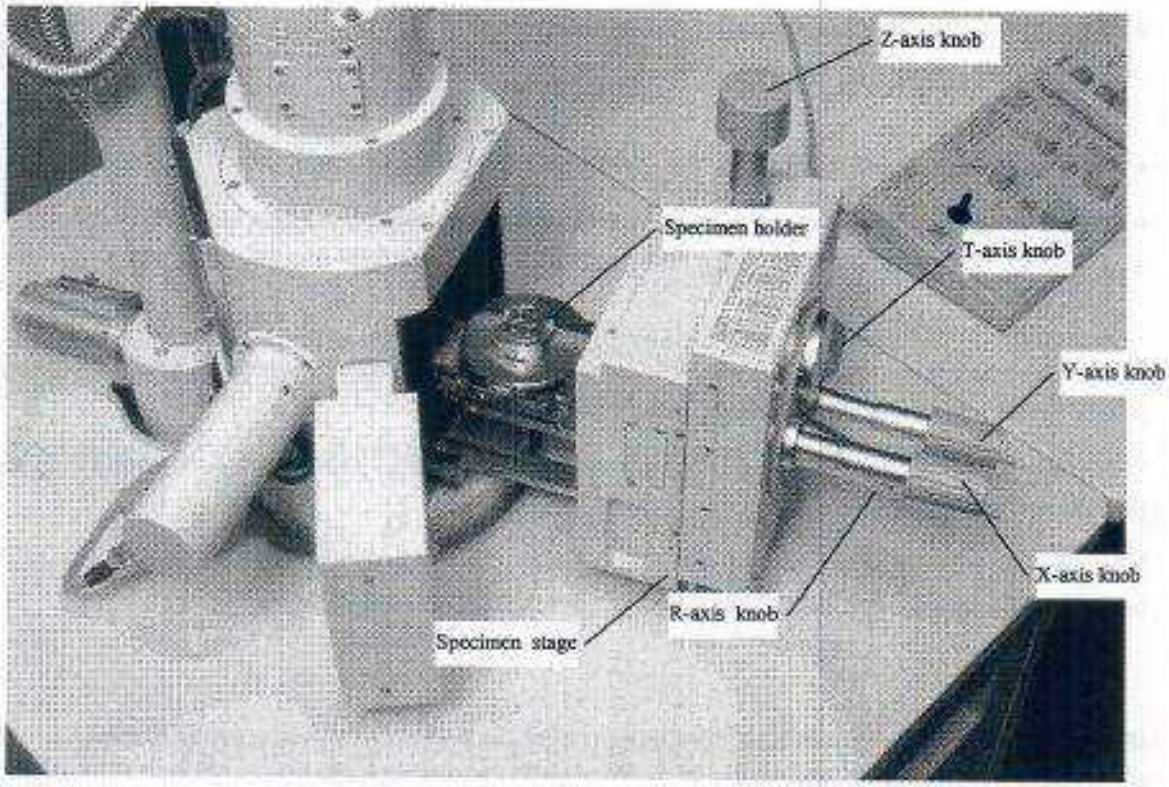


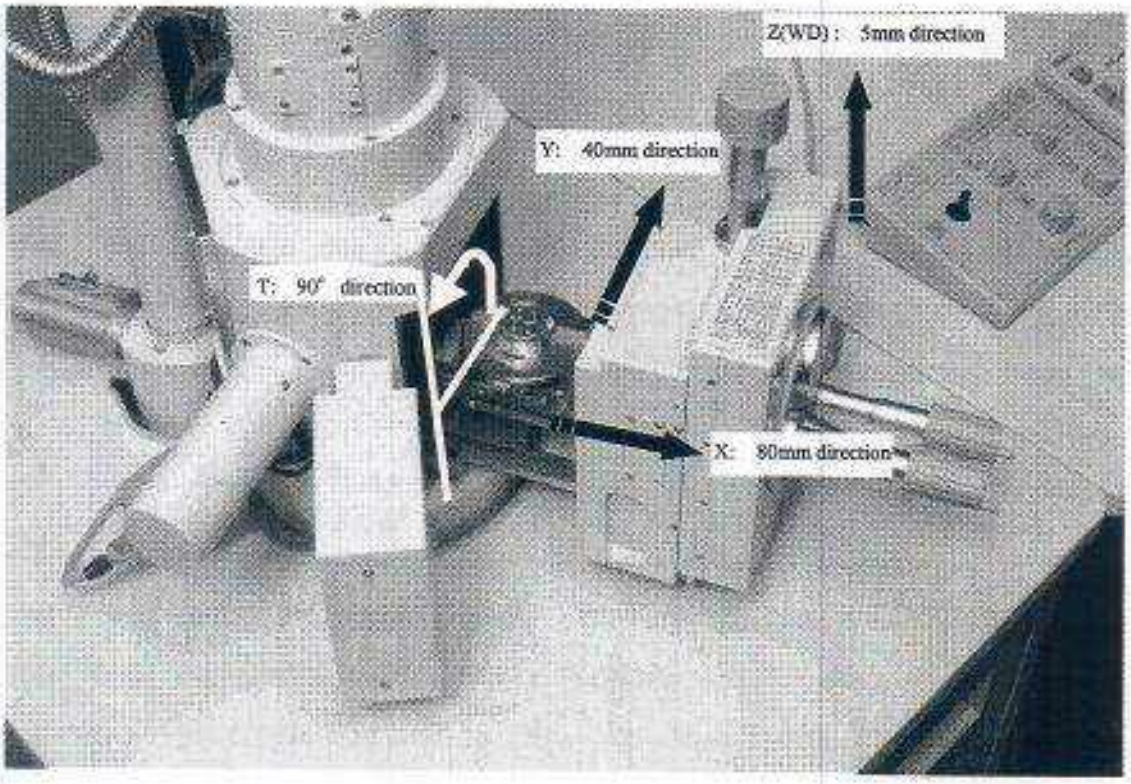
Scale	Aperture (μ m dia.)	Purpose of use
3	100	Use when a large current is necessary such as using WDS.
2	30	Used for normal observation
1	20	Used for high resolution observation
0	None	Use for maintenance work

2.2.2 Specimen chamber



2.2.3 Specimen stage





【Moving of the stage】 R=360° endless

2.2.3.a Range of movement of the stage

! CAUTION

- **Be sure to move the stage within the movement range.**
  When it exceeds a range, the stage or holder touches the bottom of objective lens, and it is likely to be damaged.
- **The following movement range does not taken sample size into consideration.**
- **The following movement range is based on a sample is not protruded above the holder surface.**
  If a sample protrudes above the holder surface, the following movement range does not secure.

Y-axis movement range about the 10mm or 32mm dia. specimen hokder is indicated as the following table. X-axis can be moved with the whole range [0 to 80mm].

"○" mark shows that the Y-axis can be moved with the whole range. "×" mark shows that it is outside the safe movement range.

When the stage is set in accordance with the following table, the distance between the bottom of OL (objective lens) and the specimen holder surface is coming to be kept to 3 to 5mm.

■10mm diameter specimen holder (X-axis can be moved with the whole range [0 to 80mm].)

Z (mm) / T (°)	8	10	15	20	30	40	48
0	○	○	○	○	○	○	○
10	○	○	○	○	○	○	○
20	○	○	○	○	○	○	○
30	0 to 23	○	○	○	○	○	○
40	0 to 21	0 to 25	○	○	○	○	○
50	0 to 20	0 to 23	0 to 30	○	○	○	○
60	0 to 19	0 to 21	0 to 27	0 to 35	○	○	○
70	×	×	0 to 10	0 to 25	○	○	○
80	×	×	×	0 to 3	0 to 15	0 to 30	○
90	×	×	×	×	0 to 7	0 to 17	0 to 25

■32mm diameter specimen holder (X-axis can be moved with the whole range [0 to 80mm].)

Z (mm) / T (°)	8	10	15	20	30	40	48
0	○	○	○	○	○	○	○
10	○	○	○	○	○	○	○
20	○	○	○	○	○	○	○
30	0 to 9	○	○	○	○	○	○
40	0 to 7	0 to 10	○	○	○	○	○
50	0 to 6	0 to 9	0 to 16	○	○	○	○
60	0 to 6	0 to 8	0 to 14	0 to 20	○	○	○
70	×	×	0 to 10	0 to 18	0 to 29	○	○
80	×	×	×	0 to 3	0 to 15	0 to 30	○
90	×	×	×	×	0 to 7	0 to 17	0 to 25

Moving an image on the screen

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

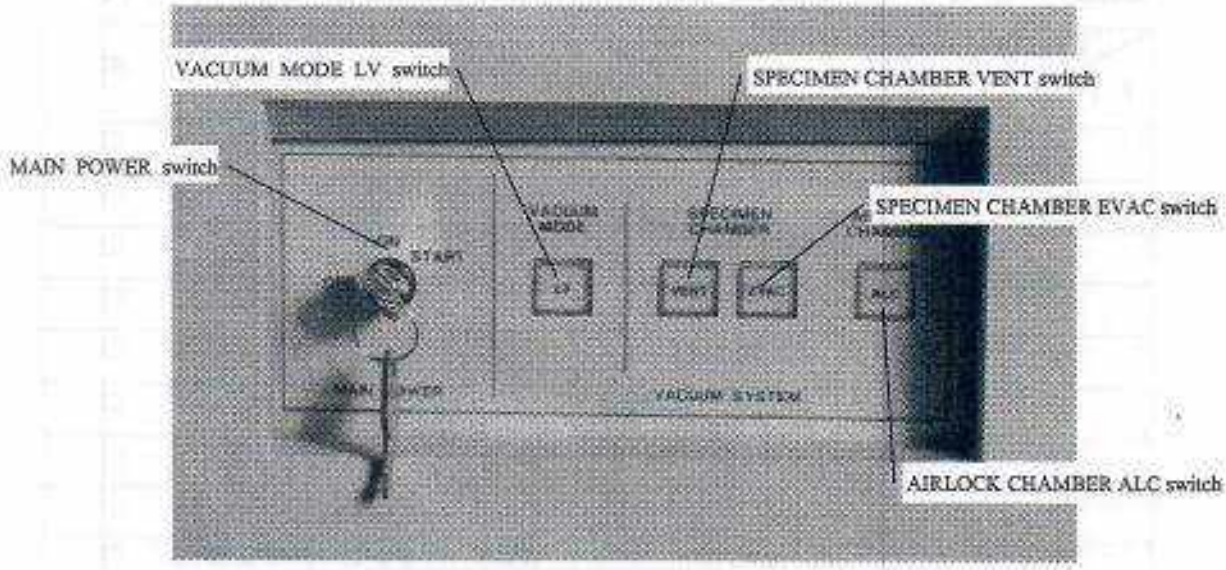
A Y-direction is moved in the WD 20mm neighborhood through the X direction to top and bottom right and left.

It is taken in becoming shorter WD (8mm direction) than WD20mm, and view turns…to the counterclockwise direction a little.

It is taken in becoming longer WD (48mm direction) than WD20mm, and view turns…to the clockwise direction a little.

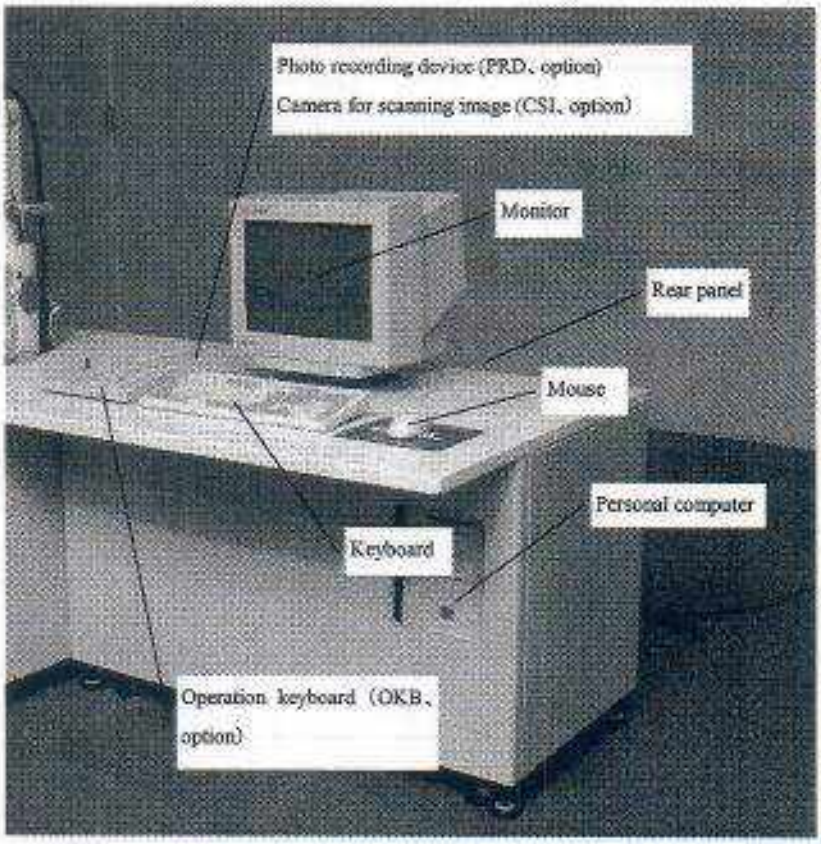
When the specimen holder except the above followings is used, see to the instruction manual of an optional specimen holder to move the stage.

2.2.4 Main control panel

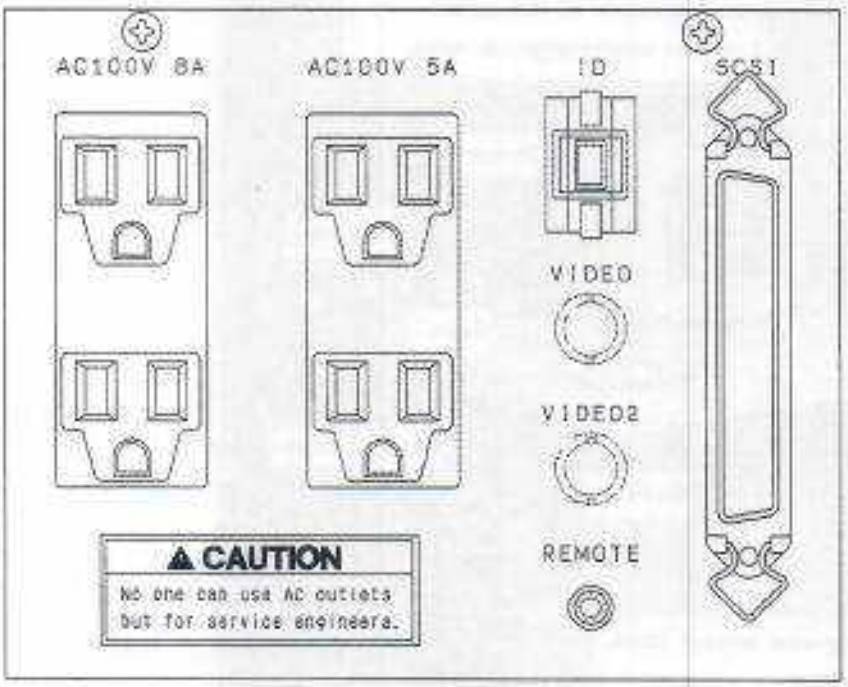


Name	Explanation
MAIN POWER	Key switch used to set the status of the main power supply to OFF or ON
VACUUM MODE LV It is effective with LV-SEM	Switch used for changing over the active data display [HV] or [LV]. When this switch is ON (switch lamp is lit), the Vac. mode is set to [LV]. When this switch is OFF, the Vac. mode is set to [HV].
SPECIMEN CHAMBER VENT	Switch used for 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 atmosphere pressure, the VENT switch lamp lights.
SPECIMEN CHAMBER EVAC	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 ALC It is effective when the airlock chamber (option) is attached.	Switch used for evacuating the airlock chamber.

2.3 Operation unit



2.3.1 Rear panel



Name	Explanation
AC100V 8A／AC100V 5A	Service outlet
ID	ID number
VIDEO	Connect to personal computer
VIDEO2	Connect to personal computer （The printer is necessary）
REMOTE	Connect to video printer （The video printer is necessary）
SCSI	Connect to personal computer

2.4 Option

2.4.1 Oeration keyboard(OKB)

The SEM is operated basically using a mouse. This operation Keyboard is provided for an operator, who is not familiar to mouse operation, to operate the microscope with switches and knobs.

Critical operations, such as focusing in a high magnification range and astigmatism correction, can be performed easily by conventional manner.

Purpose of use／Name	Explanation
Stage control The motor drive stage (option) is necessary	
X／Y switch	When this switch is ON, if you move the joystick left or right, the X-axis is driven. If you move the joystick to front or rear, the Y-axis is driven. When this switch is ON, if you tilt the joystick, the X-and Y-axes are driven simultaneously.
T／Z switch	When this switch 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) When this switch is ON, if you move the joystick to the left or right, the T-axis is driven. (Left: T minus side, Right: T plus side)
R switch	When this switch is ON, if you move the joystick left or right, the R-axis is driven. (Left: R minus side, Right: R plus side)
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.)
Fien shift	
FINE SHIFT switch	Uses it by fine shift of the observation field When this 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 this switch is ON, if you press it once again, the fine shift is reset, and the image returns to the center. (Shift distance is approx. ±50 μ m at an Acc.volt of 30kV and WD of 10mm)
Select scanning mode	
VIEW switch	Uses when you want to look the whole sample. When this switch is ON, the magnification is set to the minimum value for the WD used, and the scanning speed becomes SCAN2. When 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 this switch ON, the switch goes OFF, and the original magnification

	and scanning speed are canceled. The VIEW switch enables you to set an averaging coefficient.
SCAN1 to 4 switch	SCAN1 switch, uses when adjusting the image quality. SCAN2 switch, uses when selecting the field of view. SCAN3 switch, uses when confirming the fine-structure of the sample after selecting the field of view. SCAN 4 switch, uses when checking the photograph condition. The SCAN 1 to 3 switches enable you to set an averaging coefficient. The Scan 4 switch enables you to set the scanning speed and number of pixels. If you press the SCAN 1 switch, a small screen and exposure marker appears. A live image appears in the small screen, and a frozen image appears outside it.
FREEZE switch	Uses when you want to look the frozen image. 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 that one frame has been acquired. In the SCAN 4 mode, if you set the FREEZE switch to ON, a frozen image surely appears after that one frame has been acquired. When this switch is ON, if you press it once again or press one of the VIEW and SCAN 1 to 4 switches, the switch goes OFF, and changes to a live image (image acquisition starts).
PHOTO switch CSI and PRD (option) are necessary	Uses when you want to photograph. If you press one of VIEW and SCAN 1 to 4 while photographing is taking place, photographing is canceled.
Focusing, contrast and brightness adjustments, and astigmatism correction	
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. Tuning the FOCUS knob counterclockwise results in under-focusing, and turning it clockwise results in over-focusing.

Contrast and brightness adjustments	When the STIG switch is OFF (the CONT and BRT lamps 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 lamps 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.
Changing magnification	
MAGNIFICATION knob	Turning this knob counterclockwise lowers the magnification, while turning it clockwise raises the magnification.
INST MAG switch	When this switch is ON, the magnification changes using [Preset Mag] on the menu bar (the magnification displayed in the bottom list box) is selected. When this switch to OFF, the original magnification is restored. When this switch is ON, if you change magnification using the MAGNIFICATION knob or press the VIEW switch, the switch goes OFF.
Automatic button	
ACB switch	When this switch is ON, ACB (auto contrast and brightness) starts and optimum image of contrast and brightness appears for a several second later.
AUTO STIG switch	When this switch is ON, Auto stigma starts and stigmator corrected of astigmatism image appears for a several second later.
AUTO FOCUS switch	When this switch is ON, Auto focus starts and focused image appears for a several second later.

2.4.2 Photo recording device (PRD)

9-inch high resolution non-persistence CRT is intended to be mounted on the operation base, and used in combination with a CSI.

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

2.4.3 Camera for scanning image (CSI)

This device is combined with the photo recording device (PRD: option), and it takes pictures of the image of the monitor. "Photo magnification" is the thing of the magnification of which it actually takes pictures toward the image in screen.

■Specifications

Model	Lens	Aperture	Photo magnification	Film	Film sencitivily (ISO)
CSI1	F5.6 f=75mm	5.6、8、11、16、22	Approx. × 0.5	Brownie size film J120, 220	100
CSI2	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
CSI3	F2 f=50mm	2、2.8、4、5.6、8、11、16、22	Approx. × 0.25	35mm roll film	100
CSI5	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

CSI2 When using ISO 3000 film (Type 107, 667, or FP-3000B), you must separately purchase an ND4 filter (commercially available M37.5mm bore screw-in type).
When using ISO 800 film (Type 613), you must separately purchase an ND2 filter (commercially available M37.5mm bore screw-in type).

CSI3 A 35MM film camera power supply (option) is available for automatically winding up the film.

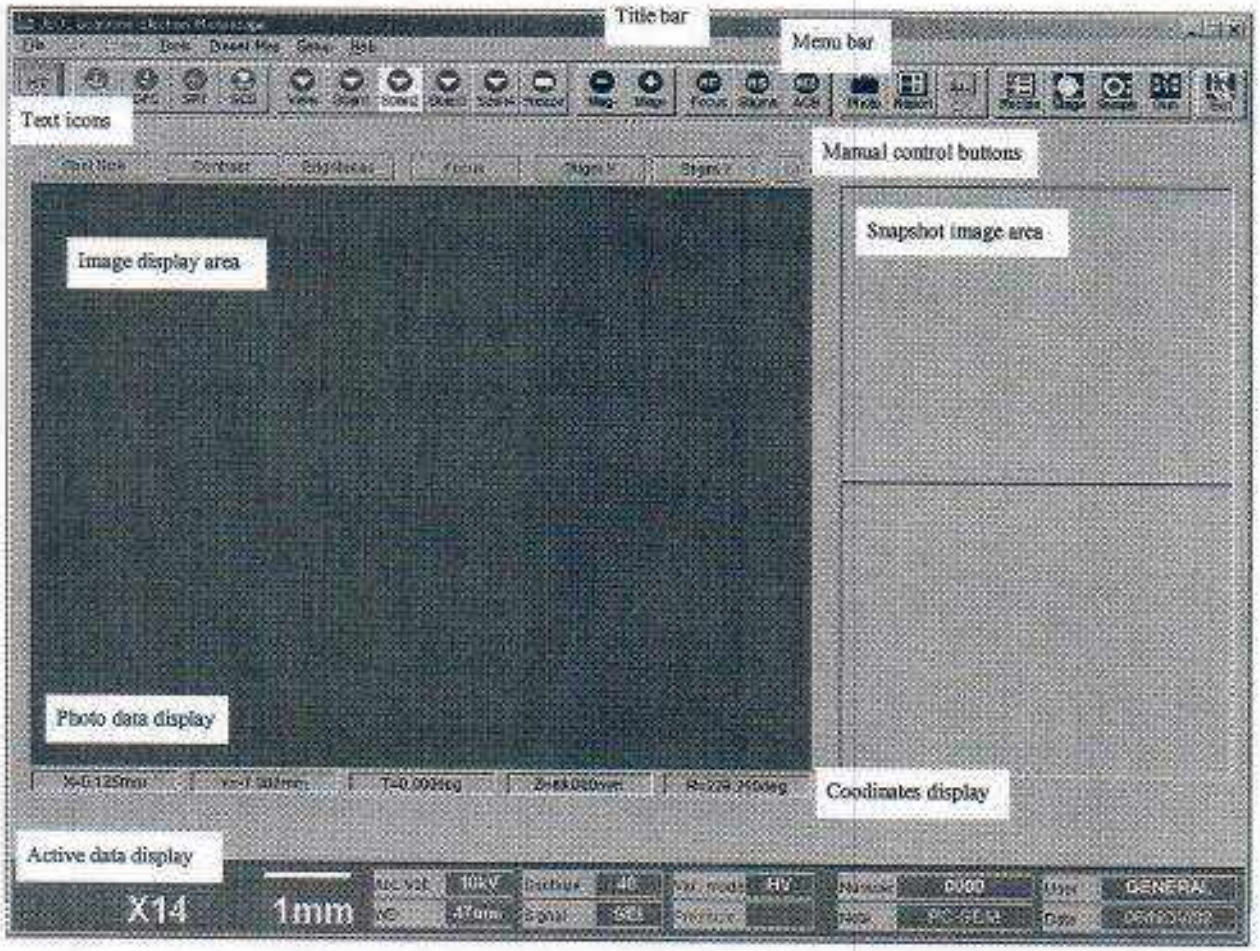
CSI5 When using ISO 3000 film (Type 57), you must separately purchase an ND4 filter (commercially available M37.5mm bore screw-in type)
When using ISO 800 film (Type 53, 553), you must separately purchase an ND2 filter (commercially available M37.5mm bore screw-in type).

3

Explanation of GUI

3.1 GUI layout

GUI (Graphical User Interface) is layouted as followings:



Title bar	[JEOL Scanning Electron Microscope] [(GUI minimum)] [(GUI closing)] are indicated. When the [ ] button is clicked, the SEM control program finishes.
Menu bar	When each menu is clicked, a pull-down menu is indicated. If you click a pull-down menu, the various operation and setup dialog can be executed and/or displayed. (see 3.1.1)
Text icons	When each icon button is clicked, switching of the scan mode, auto-function is started, or an operation window is displayed. (see 3.1.2)
Manual control buttons	Manual adjusting buttons (spotsize, contrast, brightness, etc.) and image size switching button are arranged. (see 3.1.3)
Image display area	A SEM image of 640 × 480 pixels can be displayed, and the image shift and stage movement can be controlled. (see 3.1.4)

Photo data display	The photo data (accelerating voltage, magnification, etc.) is displayed when the image is switched to freeze mode.
Coordinates display The motor drive stage (option) is necessary.	The current stage position is displayed.
Snap shot image area	Pastes file image or the current image on the image display area, and the stage can be moved. (see 3.1.5)
Active data display	This shows the present situation of the SEM. When each item is clicked, the dialog linked with the item opens. (see 3.1.6)

3.1.1 Menu bar

3.1.1.a File

Open Image File	Image opening window opens. (follow Windows)
Save Image File	Image saving window opens. (folllowWindows)
Video Print (option)	A live image／frozen image can be remote printed with video printer
Smile View(option)	The smile view program software starts
Report	The DTP program software starts. The DTP window opens (see 3.2.2.a)
Image Album(option)	The image filing program software starts
Stereo Image View(option)	The stereo image view program software starts
Backup Users File	Users File backup window opens
Install Users File	Users File install window opens
Exit Scanning Electron Microscope	The SEM control program finishes

3.1.1.b Edit

Only selectable a freeze mode

Text Editor	The text editor menu appears
Image Clip	The frozen image is copied on the clipboard, and it can be pasted to other application software.
Image Copy	The frozen image is copied. Uses for pasting the copied image on a snap shot image area, an image filing software (option) or DTP
Image Paste	Uses for pasting the copied image by using the IFS or DTP on a live or frozen image

3.1.1.c Image

Only selectable a freeze mode

Look-up Table／Color	The Look-up Table window opens.
Dual Split Screen	The Dual Images menu appears.
Quad Split Screen	The Quad Images menu appears.
Digital Zoom	The Digital Zoom menu appears.
Dual Magnification (option)	The Dual Magnification menu appears.
Scaler (option)	The Scaler menu appears.
Multi Point Measurement (option)	The Multi Point Measurement menu appears.
Beam Controller (option)	The Beam Controller menu appears.

3.1.1.d Tools

Scan Rotation (option)	The Scan Rotation window opens.
Dynamic Focus Correction	The Dynamic Focus Correction window opens.
Beam Blanking	The beam blanking works. When the beam blanking is made to work, a specimen does not irradiate an unnecessary electron beam, and specimen damage is prevented. Beam blanking automatically works when the frozen imageis displayed, and specimen damage is reduced.
OL Wobbler	Uses for adjusting the OL (objective lens) aperture, and it is the function to change periodically an OL current. An image moves in every direction greatly when an electron beam deviates from the optical axis.
Lens Reset	The image is switched to freeze mode, and the lens reset takes place. It can be used SEM with the best condition for cleaning the hysteresis of the lens. It is not necessary by the usual observation.
Stigma Reset	The memorized astigmatism condition (the most suitable condition in shipping) is reproduced. Use it when an image shifts in the oblique direction even if you adjust the focus of the image. It is effective when an original image cannot be reproduced again after the astigmatism correction.
Probe Current Detector(option)	It is effective to measure the electron beam current to irradiate the sample. The device is necessary when the sample current is regulated and a condition is unified for executing the X-ray analysis (EDS／WDS).
Neutralizer Signal [SEI] only. An accelerating voltage can be used with[0.5kV to 30kV]	It is effective in reducing halation (the image be veiled in haze of white) of the image. It cannot be used with signal [REF] or vacuum mode [LV].

3.1.1.e Preset Mag

×100,000	Set the magnification to [×100,000] (It can be set up in an arbitrary magnification)
×10,000	Set the magnification to [×10,000] (It can be set up in an arbitrary magnification)
×1,000	Set the magnification to [×1,000] (It can be set up in an arbitrary magnification)
×100	Set the magnification to [×100] (It can be set up in an arbitrary magnification)
×8	Set the magnification to [×8] (It can be set up in an arbitrary magnification) The [×8] corresponds to INST MAG switch on the OKB(option) When it clicks, magnification changes, and the part of the indication changes to the magnification just before clicking. When it clicks again, the magnification is returned to original.
Preset	The Preset Mag window opens. (see 3.2.1.d)

3.1.1.f Setup

Standard Setup	The standard setup window opens. The various setup of [Scan] [Auto Function] [Photo Data] [Preset Mag] [Stage Initialize] and [Action] can be performed. (see 3.2.1)
Setup Ext Scan The ESITF (option) is necessary	The Setup Ext Scan window opens.  The ON／OFF of the external scan permits only when the external control signal is inputted. When the TTL signal_Low level is inputted to the SEM, external scan is set to [ON]. When the TTL signal_High level is inputted to the SEM, external scan is set to [OFF]. When the external control signal is inputted to the SEM, the port can be selected.

3.1.1.g Help

Contents	The PC-SEM Help window opens.
About	The SEM program version information window opens.

3.1.2 Text icons

Text icons	Explanation
	Uses for observing the image.
(option)	Probe current detector
	The Dynamic Focus Correction window opens.
(option)	The Scan Rotation window opens.
(option)	Chamber scope.
	Uses when you wish to look the whole sample. (The field of view searching)
	Uses when adjusting the image quality.
	Uses when selecting the field of view.
	Uses when confirming the fine structure of the sample after selecting the field of view.
	Uses when checking the photograph condition.
	Uses when you wish to look the frozen image.
	Uses when you want to down the one step current magnification. When it keeps pressing it, continuous variability is done to the lowest magnification.
	Uses when you want to up the one step current magnification. When it keeps pressing it, continuous variability is done to the highest magnification.
	Uses when you want to focus an image automatically.
	Uses when you want to correct an astigmatism the image automatically.
	Uses when you want to adjust the image contrast and brightness automatically.

(option)	Uses for photographing the image.
	The DTP window opens. Uses for cleating the report. (see 3.2.2.a)
(option)	The EDS program software starts.
	The SEM Recipe window opens. (see 3.2.2.b)
(option)	The Stage control window opens.
	The Specimen Exchange window opens. (see 3.2.2.c)
	The Gun Alignment window opens. (see 3.2.2.d)
	Exit Microscope Program window opens. (see 3.2.2.e)

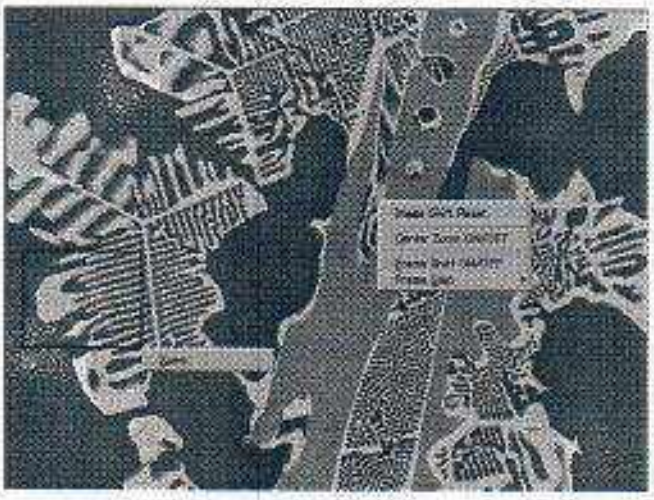
3.1.3 Manual control buttons

Coarse and fine adjustment of [Spot Size], [Contrast], [Brightness], [Focus], [StigmX] and [StigmY] are operated.

The image size can be switched.

3.1.4 Image display area

- A live image, frozen image or file image is displayed.
- The image shift and stage movement can be controlled. (except image file)
- The motor drive stage (option) is necessary to move the stage.
- The following menu is displayed when clicking the right mouse button or dragging the right mouse button.



Click the right mouse button	
Image Shift Reset	The image can be returned to the original position after being moved.
Center Zoom ON／OFF	Changes function to [click center] or [Click center zoom].
Frame Shift ON／OFF	Changes function to [frame shift] or [image shift].
Frame Step	Selects the step (10 to 100%) of frame shift function.
Drag the right mouse button	
Zoom	The image in the rectangle area is moved to the center of the image display area, and it can be displayed with full size. (The motor drive stage is necessary)

3.1.5 Snap shot image area

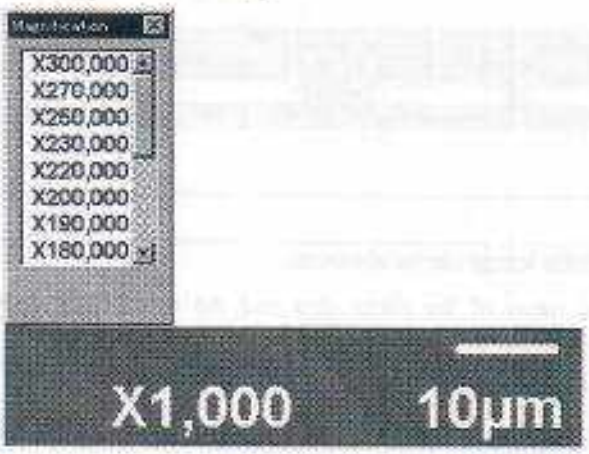
- The snap shot image or file image is displayed. (Up to 2-image can be displayed)
- The image shift and stage movement can be controlled.(except image file)
- The motor drive stage (option) is necessary to move the stage.
- The following menu is displayed when cliking the right mouse button.

Click the right mouse button	
Snap Shot	The frozen image pastes and enables stage control. (The motor drive stage is necessary)
Open Image File	Selects the image file and pastes it. (The stage cannot be controlled)
Image Paste	The copied image pastes. (The stage cannot be controlled)
Clear	The marker erases.
All Clear	The pasted image and marker erases.

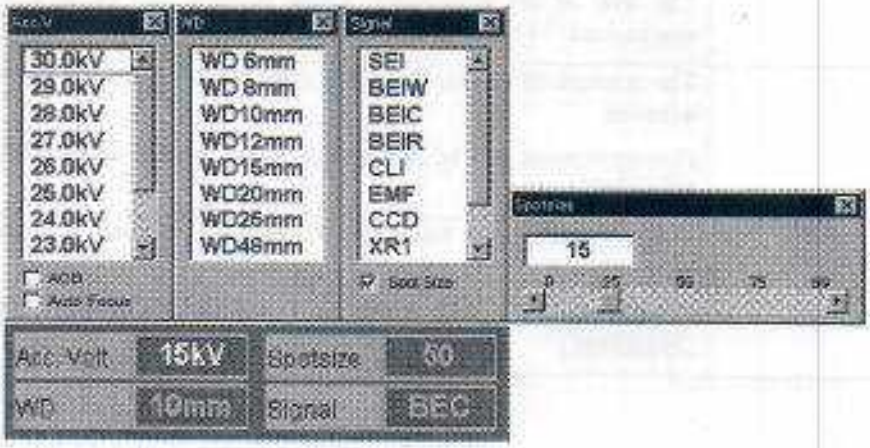
3.1.6 Active data display

When each item is clicked, the dialog linked with the item opens.

■ **Magnification dialog**



■ **Acc.V, WD, Spotsize or Signal dialolg**



■ **BEIW menu**

When double-cliking the[BEIW]of the signal dialog, the BEIW menu is displayed. (Bu-SEM : When BEIW is installed, LV-SEM: standard)

Button for switching signal	
Topo	The topgraphy image can be observed. The signal name of the photo data and the active data display switches to [BEC].
Compo	The composition image can be observed. The signal name of the photo data and the active data display switches to [BET].
Shadow	The stereoscopic image can be observed. The signal name of the photo data and the active data display switches to [BES]. The level of the stereoscopic image (stereoscopic vison) can be emphasized. (1 to 10)
Contrast	The contrast of the backscattered electron image can be coarsely adjusted. Fine-adjustment can be performed by the manual control button [Contrast].
Brightness	The brightness of the backscattered electron image can be coarsely adjusted. Fine-adjustment can be performed by the manual control button [Brightness].

■ **Vacuum Mode dialog** (It is effective with LV-SEM)

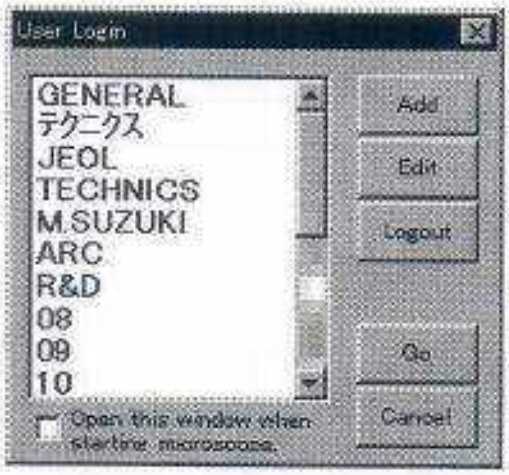
OK	When the [OK] button is clicked, the vacuum mode is switched to [HV] (High vacuum mode) or [LV] (Low vacuum mode)
Cancel	The Vacuum Mode dialog closes.

■ **Low Vacuum Control dialog** (It is effective with LV-SEM in LV mode)

Pressure setting list	Pressure values which can be set are listed up.
Pressure	The pressure selected from the list is displayed and is flicking during operation. When the pressure setting is finished, flickering stops.
START	The pressure setting starts. The button display is changed to [STOP] during operation. When the [STOP] button is clicked, the pressure setting is interrupted.
Adjust	The pressure is finely adjusted manually. When you click the [▲] button, the pressure increases, and when you click the [▼] button, the pressure decreases.

■**Setup (Photo Data) window** (Number、Note、Date: see 3.2.1. c)

■**User Login window**

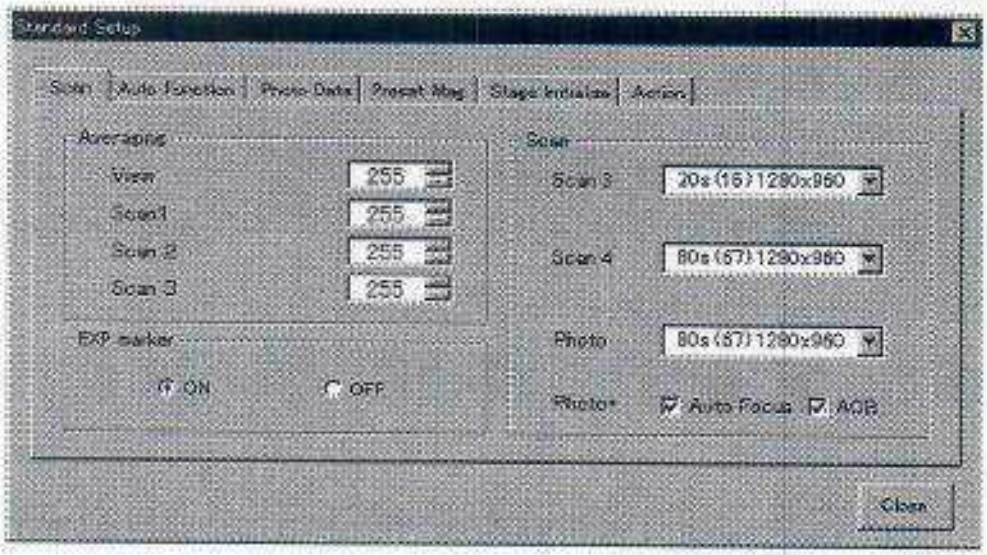


Users list	The registered user name is displayed with list.
Add	Uses for registering the new user.
Edit	Uses for changing the user name, or deleting the user.
Logout	The system logs into [GENERAL].
Go	The system logs into the selected user from the list.
Cancel	The User Login window closes
Open this window when starting microscope	When you check it, the User Login window appears when the SEM-GUI is opened.

3.2 Others

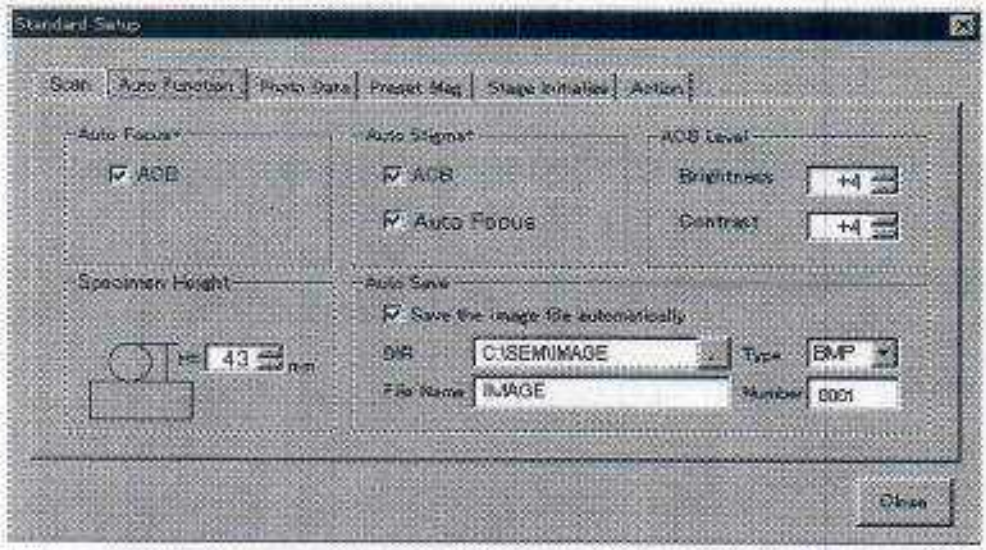
3.2.1 Menu bar [Setup／Standard Setup]

3.2.1.a Scan



Averaging	The averaging can be set to between 1 and 255 of each scan mode.
EXP marker	Select [ON], the exposure marker is displayed on the [Scan 1].
Scan	Set the scanning speed／resolution of [Scan 3], [Scan 4] and [Photo].
Photo+	Auto Focus and／or ACB takes place linked to the photographing process.
Close	Closes the Standard Setup window.

3.2.1.b Auto Function

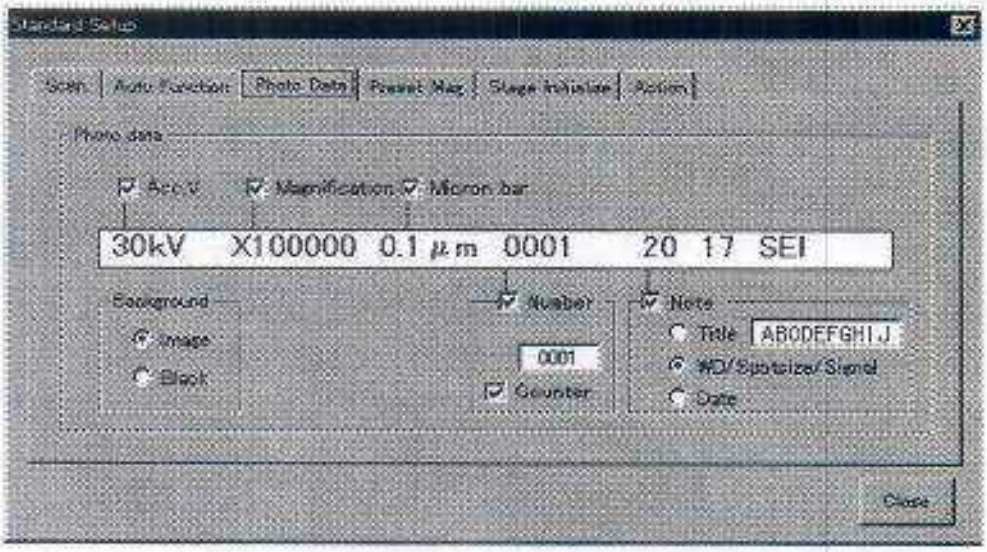


Auto Focus[+]	
ACB	When the [AF] button is clicked, ACB is also activated.
Auto Stigma[+]	
ACB, Auto Focus	When the [AS] button is clicked, ACB and automatic focusing are also activated.
ACB level	
Contrast	When [ACB] button is clicked, the respective levels of contrast can be set in 4-stage in the increasing and decreasing directions. When you increase the number, the contrast becomes stronger, and vice versa.
Brightness	When [ACB] button is clicked, the respective levels of brightness can be set in 4-stage in the increasing and decreasing directions. When you increase the number, the brightness becomes higher, and vice versa.
Specimen Height	When the specimen observation surface is protruded abovethespecimen holder surface, input the amount of correction (H=0 to 43mm) beforehand. The operation time required for automatic focusing can be shortened. When you input value of [1mm or more] for correcting, [Stage Initialize] cannot be performed. (When the motor drive stage is installed.)

Auto save	
Save the image file automatically	An image file is automatically saved after photographing.
DIR	When ... button is clicked, the window for designating directory opens, so you can designate the file to save images. (Initial value [SEM Image])
File Name	You can change the file name by clicking the file name boxand inputting a new name. (Initial value [Image])
Type	You can select an image file format to automatically save the images. The choices are BMP, TIFF, and JPEG formats.
Number	A number is displayed in an image file. It is incremented by 1 each time a file is saved. The initial number can be arbitrary selected and set to between 0001 and 9999.
Close	Closes the standard setup window.

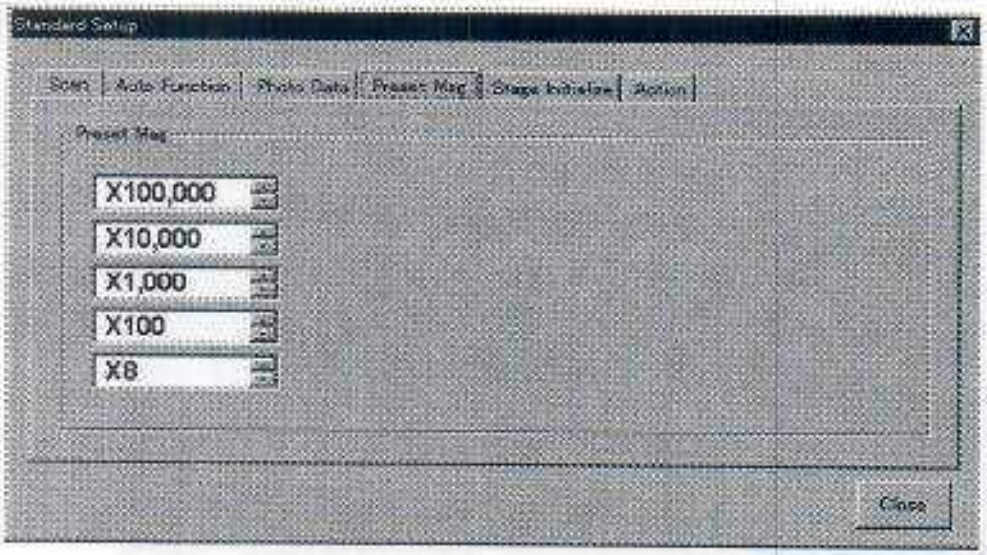
3.2.1.c Photo Data

All have been checked as default. Checked／not checked status is interlocked with active data display and photographic data.



Accelerating voltage	The accelerating voltage is displayed in the photographic data.
Magnification	The magnification is displayed in the photographic data.
Micron bar	The micron value and micron-marker are displayed in the photographic data.
Background	
Image	Photographic data is displayed in white superimposed on the image.
Black	Photographic data is displayed in white on a black background.
Number	The number is displayed in the photographic data. (Range : 0000 to 9999) When [Counter] has been checked, the number counts up each time a photograph is taken.
Note	A note is displayed in the photographic data. [Title／WD/Spotsize/Signal／Date]can be selected. When the title display box is checked, a title can be input. (20 alphanumerical characters) When the LV-SEM, [WD/Spotsize/Signal] is displayed as [WD/Spotsize./Pressure].
Close	Closes the standard setup window.

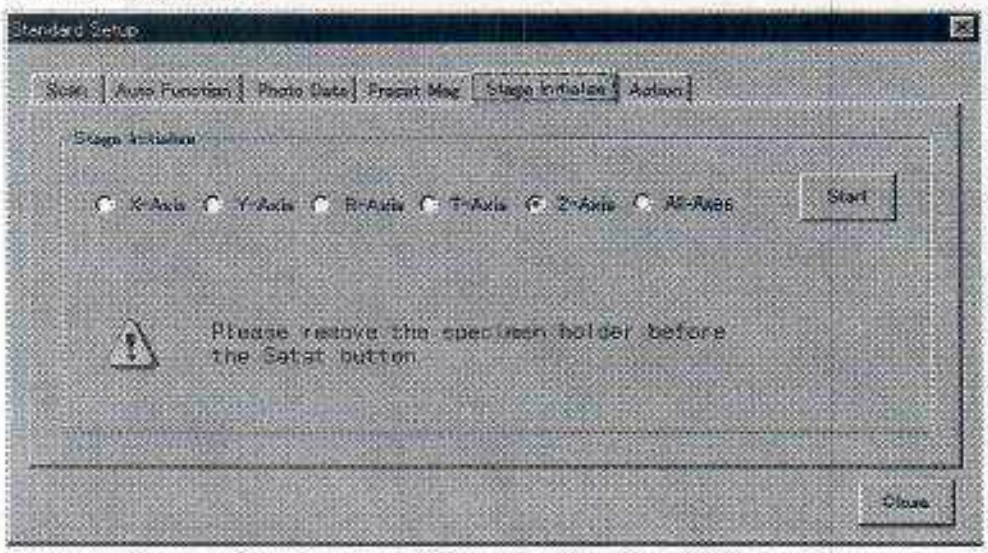
3.2.1.d Preset Mag



[▲]	When the [▲] button is clicked, the magnification value increases by one-step.
[▼]	When the [▼] button is clicked, the magnification value decreases by one-step.
Close	Closes the standard setup window.

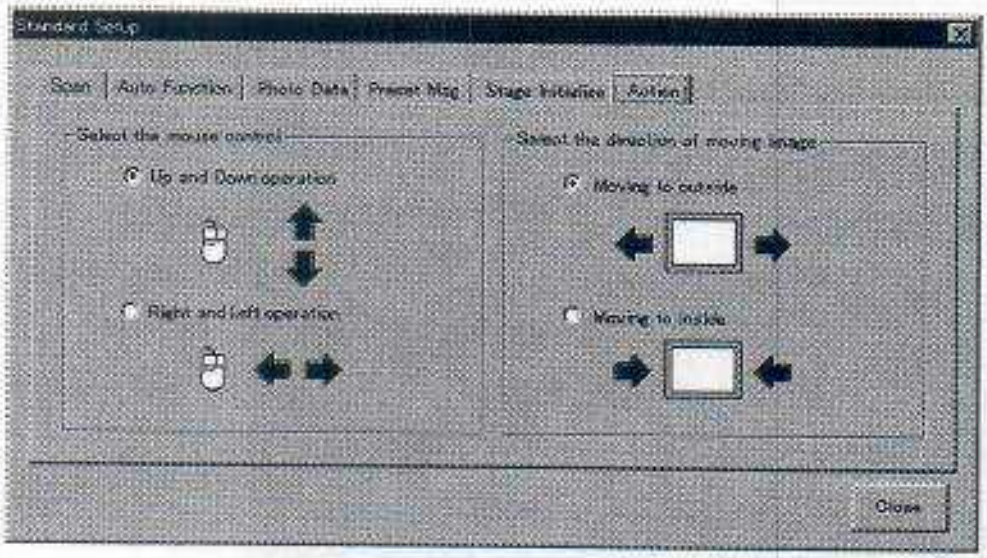
3.2.1.e Stage Initialize

It is effective when the motor drive stage (option) is attached. However, the possible axis of initialization varies in the stage type.



X-Axis	When [X-Axis] is selected, the initialize of X-axis can be performed.
Y-Axis	When [Y-Axis] is selected, the initialize of Y-axis can be performed.
T-Axis	When [T-Axis] is selected, the initialize of T-axis can be performed.
Z-axis	When [Z-Axis] is selected, the initialize of Z-axis can be performed.
R-axis	When [R-Axis] is selected, the initialize of R-axis can be performed.
All-Axes	When [All-Axes] is selected, the initialize of All-axes can be performed.
Start	Performs the stage initialize. The stage initialize cannot be interrupted after clicking [Start] button.
Close	Closes the standard setup window.

3.2.1.f Action

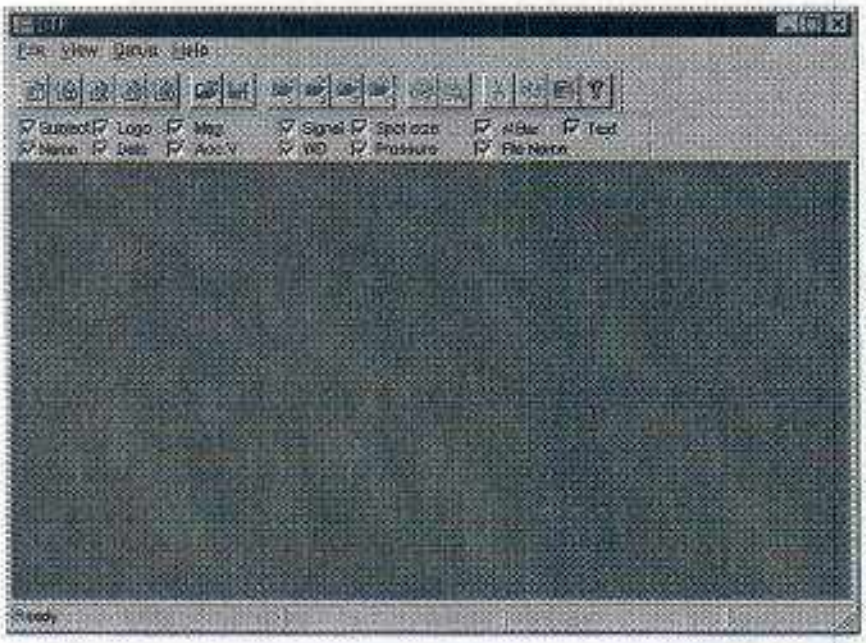


Select the mouse control	
Up and Down operation	Changes mouse control to up and down operation.
Right and Left operation	Changes mouse control to right and left operation.
Select the direction of moving image	
Moving to outside	Changes direction of moving image to outside. (It is effective when the motor drive stage is attached)
Moving to inside	Changes direction of moving image to inside. (It is effective when the motor drive stage is attached)
Close	Closes the standard setup window.

3.2.2 Text icons

3.2.2.a Report

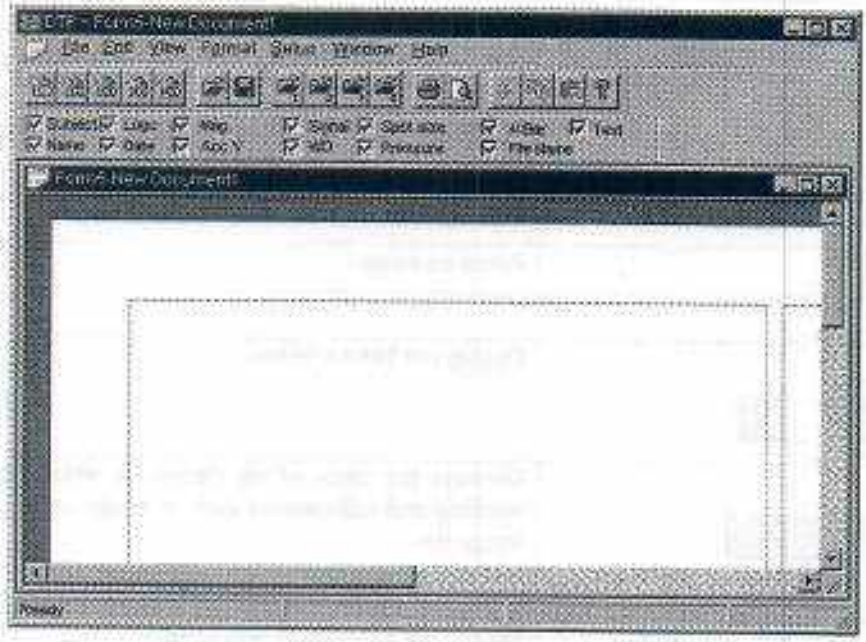
■ **Immediatery after the DTP startup**



File	
New ( )	Selects a document.
Open ( )	Open the dialog to open a file.
Print Margin	Displays the print margin setting dialog.
Recent	Clicking the file name opens the file. (Stores up to 8-file)
Exit	Closes the DTP window.
View	
Tool bar	Displays or hides tool bar.
Status bar	Displays or hides status bar.
Check bar	Displays or hides SEM information. Not displayed/printed if not checked. Can display or hide check bar.

Setup	
Standard style	Displays a standard style window.
Text memory	Displays a text memory window.
Help	
About ( )	Displays the version information dialog.

■ **DTP being actuated**



File	
New ( )	Let you select a format.
Open ( )	Displays a dialog that opens an existing DTP file.
Close	Closes the DTP file on which you are working.
Save	Saves the DTP file on which you are working.
Save as ( )	Displays the save dialog to let you assign a name to the file.
Image File Open ( )	Displays the file opening dialog. (file is in bmp. type)

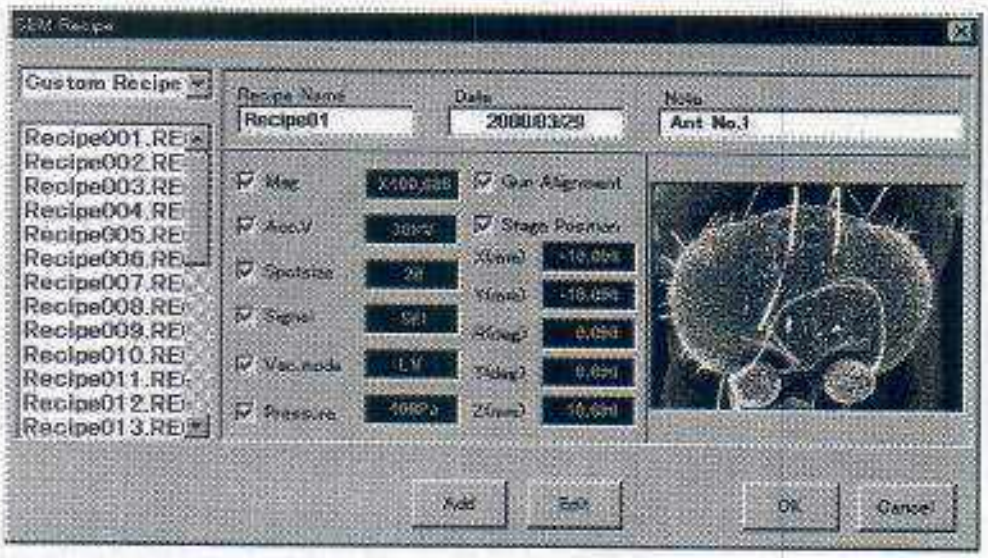
Print ()	Displays standard printer dialog.
Print Preview ()	Changes to print-preview screen.
Margin	Displays the print margin setting dialog.
Recent File	Clicking the file name opens the file. (Stores up to 8-file)
Exit	Closes the DTP window.
Edit	
Undo	Restores the preceding action. This selection is grayed out when image is pasted.
Cut ()	Cuts text.
Copy ()	Copies text.
Paste ()	Paste a text. (This selection is in effect when Cut, Copy or Select All is selected.)
Select All	Selects the entire text.
Image Paste	Pastes an image.
View	
Tool bar 	Displays or hides tool bar.
Status bar 	Displays the status of the format on which you are working and information such as image number and image size. Displays or hides status bar.
Check bar 	Displays or hides SEM information. Not displayed/printed if not checked. Can display or hide check bar.

Format	
Title Font	Displays the font dialog for designating.
Text Font	Displays the font dialog for designating.
Setup	
Standard Style	Displays a standard style window.
Text Memory	Displays the text memory window.
Window	
Cascade	Overlays multiple formats on the display.
Tile	Displays multiple formats side by side.
Arrange Icons	Arranges minimized formats.
Active Document	Displays file name. The file name that is checked is the active document.
Help	
About ()	Displays the version information dialog.

■ **Details of format**

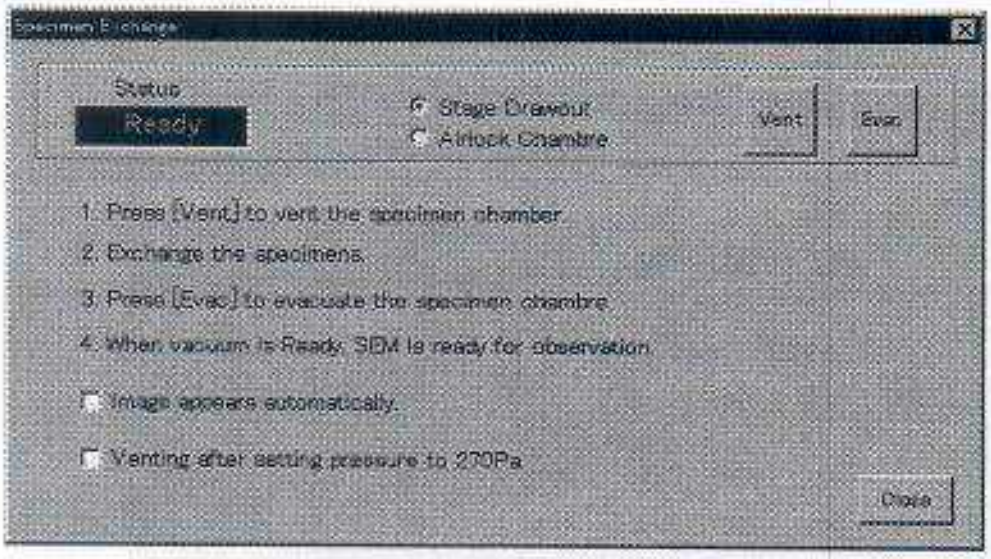
Type of document	Explanation
Document 1	One-image is printed within a sheet of A4 size／letter paper. SEM information included. A title and comment can be entered, and a logo (.bmp image) can be pasted. The one-image size is 128.0mm×96.0mm The printing direction is vertical.
Document 2	Two-image is printed within a sheet of A4 size／letter paper. SEM information included. A title and comment can be entered, and a logo (.bmp image) can be pasted. The one-image size is 128.0mm×96.0mm The printing direction is vertical.
Document 3	One-image is printed within a sheet of A4 size／letter paper. SEM information included A title can be entered, and a logo (.bmp image) can be pasted. The one-image size is 163.2mm×217.6mm The printing direction is horizontal
Document 4	One-image is printed within a sheet of A4 size／letter paper. The one-image size is 208.0mm×156.0mm The printing direction is horizontal
Document 5	4-image is printed within a sheet of A4 size／letter paper. The one-image size is 120.0mm×90.0mm The printing direction is horizontal

3.2.2.b Recipe



Custom Recipe／Standard Recipe	Slects with [▼] button.
Custom Recipe	Each user can record a custom recipe. (Freely)
Standard Recipe	A standard recipe thtat can be used in common by allusers (including GENERAL).
Recipe	Displays the contens(observing conditions)of the recipes selected with list, and conditions checked in the check box are alive. However, the [Vacuum mode] (it is effective with LV-SEM), [Pressure] (it is effective with LV-SEM) and [Stage Position] (it is effective when the motor drive stage is attached) are only displayed and are not actually alive.
Recipe image	Displays the image of recipe selected with list.
Add	Uses when recording a new recipe.
Edit	Uses when changing a recipe name or deleting a recipe.
OK	Uses when the recorded recipe conditions are desired to be alive again.
Cancel	Closes the recipe window.

3.2.2.c Specimen



Status	The present state of the vacuum system is displayed. Ittakesabout 20 minutes to change from [**Wait**] to [**Ready**].
Wait	The oil diffusion pump (DP) oil is being pre-heated. (Warm-up time period)
Vent	The specimen chamber and column are under atmospheric pressure.
Pre Evac	The specimen chamber and column are being pre-evacuated.
Evac	The specimen chamber and column are being evacuated.
Ready	High voltage can be applied to the electron gun.(SEM image can be observed.)
Stage Drawout／Airlock Chamber	Displays the operation guide.
Vent	When [Vent] button is clicked, it can be vent the specimen chamber and column to atmospheric pressure.
Evac	When [Evac] button is clicked, it can be evacuated the specimen chamber and column.
Check box 1 [Image appears automatically]	When it is checked after a high vacuum has been activated, the window closes and high voltage (HT) is applied automatically. (Text icon [HT ON])
Check box 2 (It is effective with LV-SEM) [Venting after setting pressure to 270Pa]	When it is checked, evacuation status after the pressure set has been changed to 270Pa. Use this function for powder specimens or pressure-sensitive specimens. The pressure inside the specimen chamber rises to atmospheric pressure in about 1 minutes 30 seconds.
Close	Closes the specimen exchange window.

3.2.2.d Gun

Filament, Emp	They can be selected only when an optional LaB_6cathode electron gun is attached.
Filament Heating	Adjusts the filament heating current. A button is usually arranged in front of the orange area. It causes filament wrong point when it is arranged in the area. If you place the button within the orange-colored area, sometimes it may cause filament abnormality.
L.C	Displays the load current in μ A.
Auto(HV mode only)	Filament heating is automatically adjusted. Automatic adjustment is carried out principally at the precent accelerating voltage. However, when the precent accelerating voltage is below 5kV, automatic adjustment is carried out at 5kV, and then the original accelerating voltage is restored.
Alignment	
Tilt X, Y	Tilt of electron beam is adjusted by the tilt[X, Y]current in the Tilt[X, Y]alignment.
Shift X, Y	Parallel shift of electron beam is adjusted by the shift[X, Y] current in the Shift[X, Y]alignment.

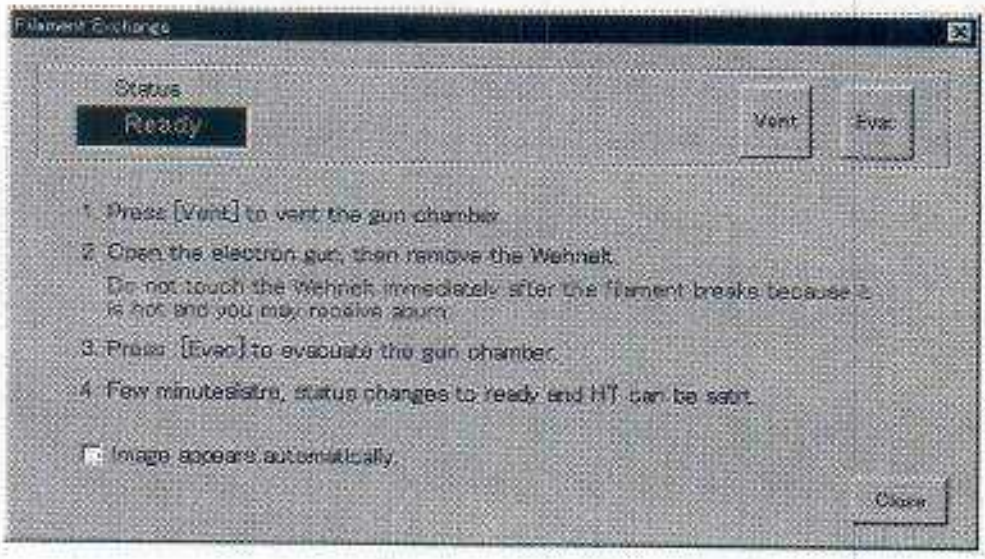
Auto (HV mode only)	Tilt and shift alignment of electron beam is automatically adjusted. Automatic adjustment is carried out principally at the precent accelerating voltage. However, when the precent accelerating voltage is below 5kV, automatic adjustment is carried out at 5kV, and then the original accelerating voltage is restored.
Auto Gun Alignment	It cannot be used when the signal is selected to[BEIW]
Full Auto	When [Start] button is clicked after [Full Auto] is selected, filament heating and filament alignment are automatically adjusted after setting the accerelating voltage to 30kV. After execution of the alignment, the original accerelating voltage is restored.
Semi Auto	When [Start] button is clicked after [Semi Auto] is selected, filament heating and filament alignment are automatically adjusted at the precent accelerating voltage. However, when the precent accelerating voltage is below 5kV, automatic adjustment is carried out at 5kV, and then the original accelerating voltage is restored.
Start (HV mode only)	When [Start] button is clicked, starts the auto gun alignment.
Set Bias	Displays the set bias window.
Filament Exchange	Displays the filament exchange window.
Close	Closes the gun alignment window.

■ **Bias set window**

Digital display of coarse adjustment value	The coarse adjustment value of the filament heating current is displayed in decimal digits. (0~255)
Coarse adjustment button	When the < button is clicked, the digital value is decremented by 1 step. When you keep pressing the button, the digital value goes down sequentially. When the > button is clicked, the digital value is incremented by 1 step. When you keep pressing the button, the digital value goes up sequentially.
Digital display of fine adjustment value	The fine adjustment value of the filament heating current is displayed in decimal digits. (0 to 255)
Fine adjusteat button	When the < button is clicked, the digital value is decremented by 1 step. When you keep pressing the button, the digital value goes down sequentially. When the > button is clicked, the digital value is incremented by 1 step. When you keep pressing the button, the digital value goes up sequentially.

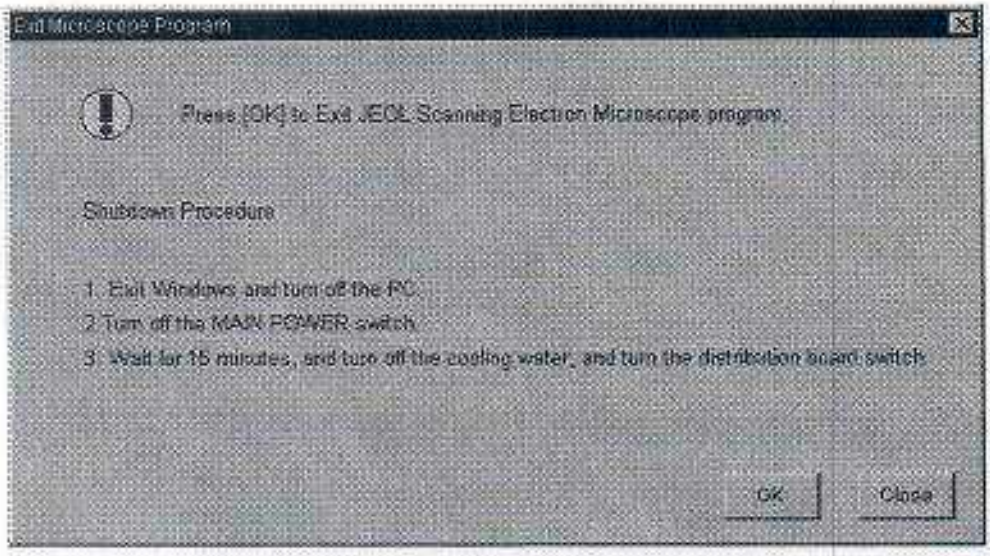
Preset	The value preset before the set bias window is opened become alive.
Save	The values after adjustment are saved and then the windows are closed.
☒	Closes set bias window.

■ **Filament exchange window**



Status	The present state of the vacuum system is displayed. It takes about 20 minutes to change from [Wait] to [Ready].
Wait	The oil diffusion pump (DP) oil is being pre-heated. (Warm-up time period)
Vent	The specimen chamber and column are under atmospheric pressure.
Pre Evac	The specimen chamber and column are being pre-evacuated.
Evac	The specimen chamber and column are being evacuated.
Ready	High voltage can be applied to the electron gun. (SEM image can be observed.)
Vent	When [Vent] button is clicked, it can be vent the specimen chamber and column to atmospheric pressure.
Evac	When [Evac] button is clicked, it can be evacuated the specimen chamber and column.
Check box [Image appears automatically]	When it is checked after a high vacuum has been activated, the window closes and high voltage (HT) is applied automatically. (Text icon [HT ON])
Close	Closes the filament exchange window.

3.2.2.e Exit



OK	The SEM control program finishes.
Close	Closes the exit microscope program window.

4

Operation

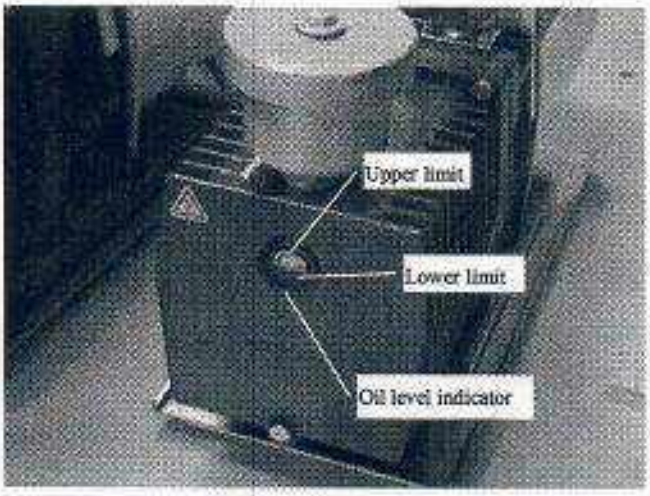
4.1 Pre-starting check

! CAUTION

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

Using the oil level indicator of the RP, check the reduction of the oil level and also whether or not the oil is contaminated.
Perform this check about once every three months, or at shorter intervals if the pump is used more frequency.

If it is necessary to replenish or replace the oil, contact your local JEOL service office.



4.2 Starting the instrument

1. Pass cooling water through the system. (Flow rate; 2.0L/min)
2. Turn ON the power board switch.
3. Turn ON the MAIN POWER switch on the main control panel.

   Insert the key in to the MAIN POWER switch, turn it to START, then take your hand away. The key returnsto ON, and power is supplied to the evacuation system.
4. Wai for about 10 second, switch on the personal computer and run Windows.
5. Click [Start/Program] on the desktop.
6. Click [JEOL SEM/SEM Main Menu]

   The starting screen appears, and when the software starts running, the screen changes over to SEM-GUI.

   The system log into [GENERAL] as the user.

7. When the [HT] button of the text icon becomes to [HT Ready], the image observation is possible.

4.3 Shutting down the instrument

1. Click [Exit] button of the text icon.
2. Click [OK] button of the Exit Microscope Program.
3. The SEM program finishes, and the screen returns desktop of Windows.
4. Click [Start] button on the desktop.
5. Exit Windows, then switch off the personal computer.
6. Turn OFF the MAIN POWER switch on the main control panel.
7. Turn OFF the power board switch and wait for about 15 minutes, then turn off the cooling water.

4.4 Restart the instrument

1. Click [Exit] button of the text icon.
2. Click [OK] button of the Exit Microscope Program.
3. The SEM program finishes, and the screen returns desktop of Windows.
4. Click [Start] button on the desktop.
5. Exit Windows, then switch off the personal computer.
6. Turn ON the MAIN POWER switch, and several seconds later, then switch on the personal computer.
7. When the text icon [HT] button becomes [HT Ready], SEM can be used again.

4.5 User management

4.5.1 User login

1. Click the active data display [User].

   The user login window is appeared.

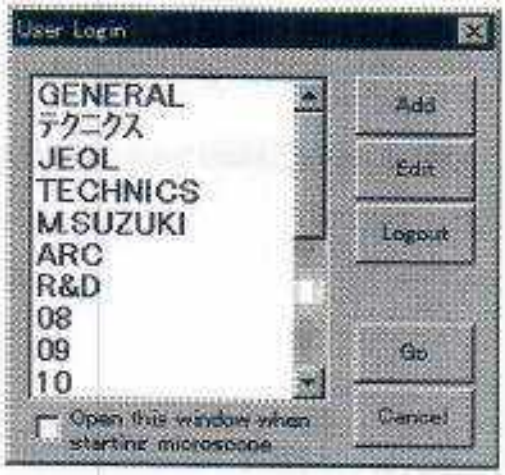
2. Select user name from the list and click the [Go] button.

3. The SEM working parameters (accelerating voltage, magnification and others) which the most recently user set reappear as the present parameters.

   When the user is registered, the SEM can be used with [GENERAL].

   If you check [Open this window when starting microscope], the user login window appears when the SEM-GUI is opened.

   When the [Cancel] button is clicked, the user login window closes.



4.5.2 Registering

1. Click the active data display [User].

2. Click the [Add] button, and input the user's name (within 8 characters).

3. Click the [OK] button. That completes registration of a new user's.

4. When the [Cancel] button is clicked, the Add dialog closes.

4.5.3 Edit

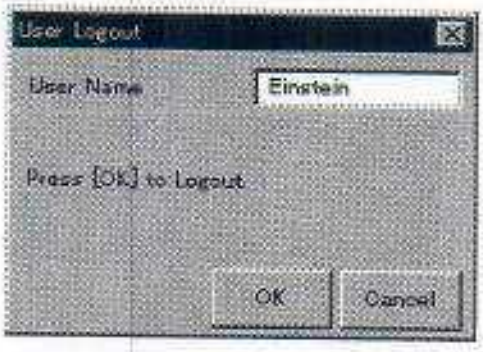
1. Click the active data display [User].
2. Click the [Edit] button, and input the user's name (within 8 characters).
3. Click the [OK] button. That completes registration of a new user's.
4. When the [Cancel] button is clicked, the Edit dialog closes.

4.5.4 Delete

1. Click the active data display [User].
2. Select user to delete from the list.
3. Click the [Edit] button, and click [Delete] button.
4. Click the [OK] button. The selected user is deleted.
5. When the [Cancel] button is clicked, the Delete dialog closes.

4.5.5 User logout

1. Clcik the active data display [User].
2. Click the [Logout] button, and click the [OK] button.
3. The SEM working parameters at the times are saved and the SEM returns to the normal operating conditions. (User name becomes [GENERAL])
4. When the [Cancel] button, the user logout dialog closes.



4.6 Exchange of sample

! CAUTION

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

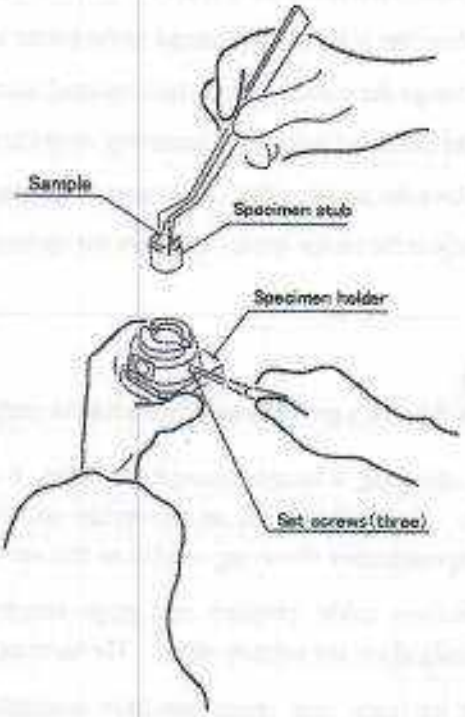
1. Click the text icon [HT] button to get [HT Ready].
2. Click the text icon [Sample] button.
3. Select [Stage Drawout] in the specimen exchange window, and click the [Vent] button.
4. After about 50 seconds, the pressure inside the specimen chamber rises to atmospheric pressure. Then, slowly withdraw the stage and remve the specimen holder.
5. To make a sample.

   Set a sample on the specimen stub and attach it on the specimen holder so that the position of the specimen surface to be observed coincides with that of the top face of the specimen holder.

   If the specimen observation surface is protruded above the specimen holder surface, [Specimen Height]. (See Chapter 3-2.2.1.b)

   Use a conductive paint in order to prevent electric charging for some specimens.

   Avoid specimen containing much moisture or oil. Such specimen would contaminate the inside of the electron optical column.



6. Attach the specimen holder to the stage.
7. After pushing the stage until it is in intimate contact with the specimen chamber, click the [Evac] button to evacuate the specimen chamber.
8. When the status in the specimen exchange window becomes [Ready] (Text icon [HT Ready]), you can observe specimen image.

4.7 Observation of secondary electron image

1. Initial setting

Accelerating voltage	About 20kV
Magnification	View
Working distance (WD)	20mm
Spotsize	20 to 30
Signal	SEI
OL aperture	2

2. Click the text icon [HT] button to get [HT ON].
3. Observe the image by using the automatic function (Text icon [ACB], [AF] and [AS] button).
4. Move the point of rough target to the center of image display area with [Click center] function.
5. Change the scanning mode (recommend Scan1), and find the point of target.
6. Get the target point with increasing magnification gradually.
7. Move the target point to the center of the image display area, and set it in necessary magnification.
8. Adjust the image quality to obtain the optimum by using the manual control button.

Makes a proper condition with the recipe function.

When observing a sample through the SEM, it is generally necessary to set observing conditions suited to the sample. This SEM let you set appropriate observing conditions simply by selecting a recipe suited to the specimen from representative observing conditions that are recorded on the standard recipe.

The vaccum mode, pressure and stage coordinate position (The motor drive stage is necessary) are only displayedand are not actually alive. The vaccum mode and pressure are effective only with LV-SEM.

It also lets each user create and save containing observing conditions for all types of specimens. Refer to [4.11.3.a] to register a recipe file.

1. Click the text icon [Recipe] button.
2. Select [Custom recipe] or [Standard Recipe].
3. Select recipe file from the list and click the [OK] button.
4. The recorded recipe conditions are desired to be alive again.

For observing at high magnification it is recommended to focus at low magnification first and then increase magnification gradually. Or, when you want to observe more high resolutions;
[Set to short working distance (WD)], [Set to high accelerating voltage] and [Set to small spotsize].

See [Observation condition] (4.7.1) for details.

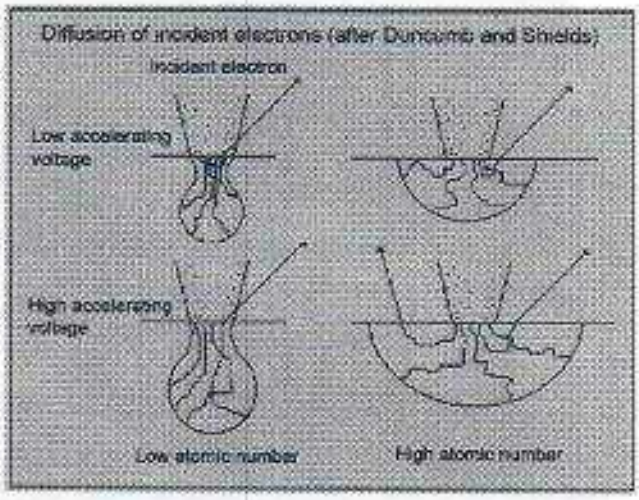
4.7.1 Observation condition

Conditions for observing a specimen, such as accelerating voltage, illumination current, objective lens aperture, and working distance (WD), must be selected most suitably. Also, sampling (specimen preparation) and tilting of specimen must be taken into consideration. Furthermore, brightness adjustment, astigmatism correction, focus adjustment and other adjustments are also important for achieving optimum image quality.

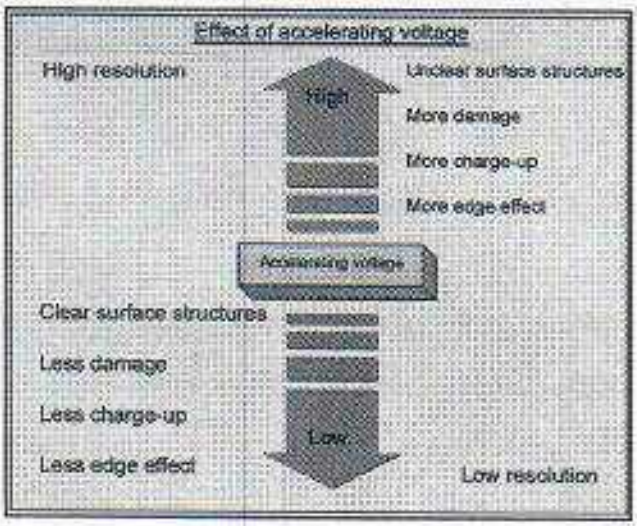
4.7.1.a Image quality depending on accelerating voltage

The electron probe diameter certainly becomes smaller, theoretically, as the accelerating voltage increases. However, some disadvantages as presented below appear as the accelerating voltage increases.

a. **The microscopic structure of the specimen surface tends to be broken**
b. **Edge effect becomes remarkable**
c. **Charge buildup tends to occur**
d. **Specimen damage tends to occur**

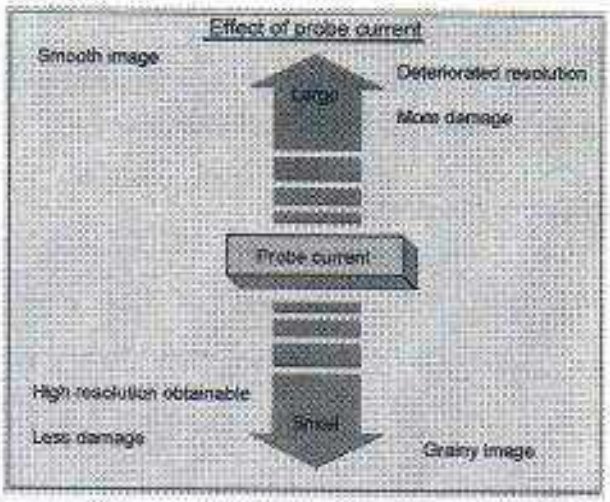


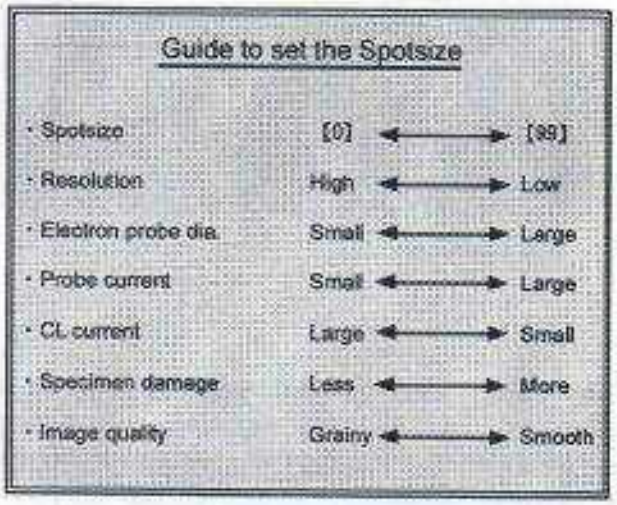
When you use a lower accelerating voltage, the details of microscopic structure of the specimen surface appear more clearly. When using a high accelerating voltage, the illuminating electrons can reach deeper inside the specimen and as a result, unnecessary signals generated from the inside of the specimen (backscattered electrons, for example) lower the contrast, thus hiding the details of microscopic structure of the specimen surface. For this reason, especially for observing a specimen of low-density material, a low accelerating voltage is desirable.



4.7.1.b Effect of illumination current

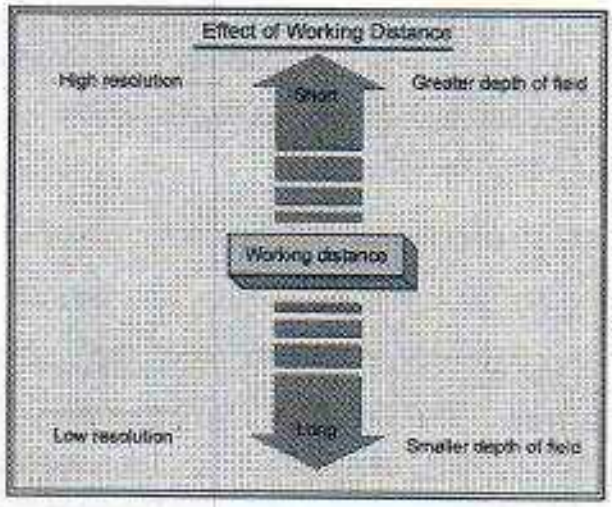
As the electron probe diameter (the spot size) becomes smaller, higher magnification and so higher resolution are obtained. However, image smoothness, that is, the S/N (signal/noise) ratio of the image, depends on the illuminating current. When you try to reduce the probe diameter, the probe current reduces as a result. Therefore, an appropriate illuminating current must be selected according to magnification, observation conditions (including accelerating voltage , tilting of specimen and others) and the specimen itself.





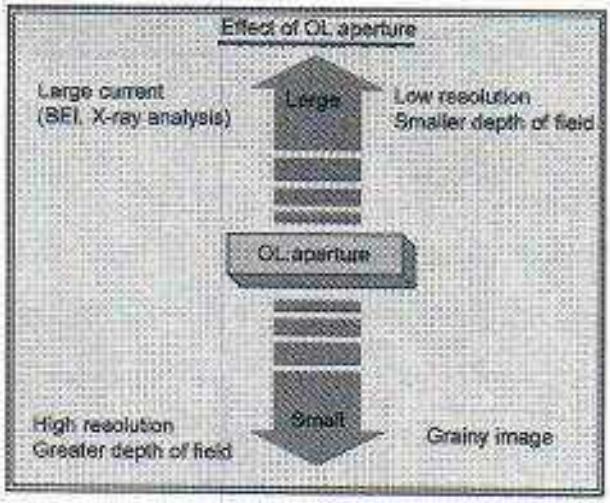
4.7.1.c Effect of working distance (WD) on image

With a short WD, high-resolution images can be obtained though the depth of field becomes shallow. On the other hand, with a long WD, the depth of field becomes deep though image resolution deteriorates. And, sampling and tilting of specimen must be taken into consideration along with WD in selecting the optimum observation conditions. Furthermore, brightness adjustment, astigmatism correction, focus adjustment and other adjustments are also important for optimum image quality.



4.7.1.d Effect of OL aperture diameter on image

Objective lens (OL) apertures with 20, 30, and 100μm diameters, respectively are provided as standard accessories. You must select the optimum aperture diameter for high resolution. You should not select too small an aperture because sufficient signals, as well as appropriate probe size, become necessary.



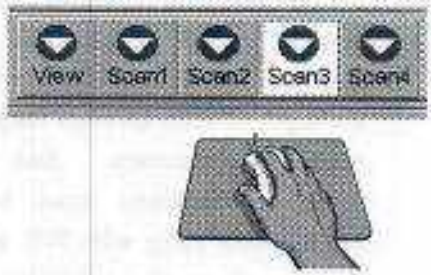
Typical suitable diameters for example are as follows.

For high resolution	**20 μm diameter**
For routine observation	**30 μm diameter**
For analysis or work with large probe currents	**100 μm diameter**

4.7.2 Selection of scanning speed

There are kinds of a live iage (image to be updated at contrast frequency) as following. Select each button according to purpose.

The aveaging, and scanning speed/resolution can be set. (see Chapter3-3.2.1.a)



Button	Explanation
View	Uses when you wish to look the whole sample. The averaging can be set (1 to 255)
Scan1	Uses when adjusting the image quality (displays exposure marker) The averaging can be set (1 to 255)
Scan2	Uses when selecting the field of view. The averaging can be set (1 to 255)
Scan3	Uses when confirming the fine structure of the sample after selecting the field of view. The averaging can be set (1 to 255) The scanning speed/resolution can be selected.
Scan4	Uses when checking the photograph condition. The scanning speed/resolution can be selected.

■ View

When the [View] button is clicked, the magnification switches to the lowest possible magnification at the present WD and the scanning speed changes to [Scan2].

When the [View] button is again clicked, the original magnification and original scanning speed are restored.

When the magnification and scanning speed are changed in view mode, the original magnification and scanning speed are canceled.

WD and minimum magnification

Minimum magnification	WD (mm)	Minimum magnification	WD (mm)
×40	4.4 to 5.4	×19	20.5 to 21.4
×37	5.5 to 6.4	×18	21.5 to 24.4
×35	6.5 to 7.4	×17	24.5 to 26.4
×33	7.5 to 8.4	×16	26.5 to 28.4
×30	8.5 to 11.4	×15	28.5 to 31.4
×27	11.5 to 13.4	×14	31.5 to 34.4
×25	13.5 to 15.4	×13	34.5 to 37.4
×23	15.5 to 16.4	×12	37.5 to 40.4
×22	16.5 to 18.4	×10	40.5 to 45.4
×20	18.5 to 20.4	×8	45.5 to
		×5	45.5 or less (Acc.V : 10kV or less)

■ Scan1

When the [Scan1] button is clicked, displays the exposure marker.

(However, it is necessary that the [Exposure marker] on [Scan] of the standard setup window is selected to [ON])

The cursor of the exposure marker moves in accordance with the adjustment of image contrast and brightness.

When the cursor is almost at the center of the screen, the image contrast and brightness become optimum. The relation differs a little depending on the specimen.

4.7.3 Adjustment of focus, contrast, brightness and astigmatism

4.7.3.a Focus

1. Automatic

   Click the text icon [AF] button. A sharply focused image appears in a few seconds.

2. Manual

   Point to manual control button [Focus].

   Drag it up and down using the right mouse button (for coarse adjustment) or the left button (for fine adjustment).

   [COARSE] for coarse adjustment or [FINE] for fine adjustment is displayed on the left part of the image display area.

   Dragging upwards makes over-focus, and dragging downwards under focus.

4.7.3.b Dynamic focus

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

1. Adjust the focusing the live image at the center.
2. Click the text icon [DFC] button.

   The dynamic focus correction window opens.
3. Select the OFF／ON button to [ON].
4. Click the text icon [Scan3] or [Scan4] button.
5. Correct the focusing with scroll bar button.

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].

When you focus the image in the high magnification, the image shows to flow in a certain direction before and after the focal point.

Observe it well before and after the focal point of the high magnification (×10, 000 over). If it shows that an image flows, the astigmatism correction is necessary. Proceed to [Daily maintenance].

4.7.3.c Contrast and brightness

1. Automatic

   Click the text icon [ACB] button. An image with optimal contrast and brightness appears in a few seconds.

2. Manual

   Point to manual control button [Contrast] or [Brightness].

   Drag it up and down using the right mouse button (for coarse adjustment) or the left button (for fine adjustment).

   [COARSE] for coarse adjustment or [FINE] for fine adjustment is displayed on the left part of the image display area.

   Dragging upwards makes contrast be stronger (brightness be brighter), and dragging downwards contrast be weaker (brightness be darker).

4.7.4 Selection of the field of view

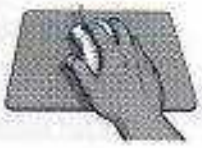
Click the right mouse button on the image display area. The pop-up menu appears, stage and image can be moved.

Function	Purpose	Operation
Drag and drop	The image can be moved an arbitrary position.	Remove the check mark from [Center Zoom ON/OFF]. Drag the image. The image doesn't move duing dragging. Image movement is begun after drops are done.
Image shift reset	The image can be returned to the original position after being moved (except center zoom)	Click [Image Shift Reset].
Click center	An arbitrary position can be moved to the center of the screen.	Remove the check mark from [Center Zoom ON／OFF]. Double-click the left mouse button.
Center zoom	Moves an arbitrary position to the center of the screen and automatically zoom up the observation magnification by 15-step.	Check [Center Zoom ON／OFF]. Double-click the left mouse button.
Frame shift (The motor drive stage is necessary)	The image can be moved a specified fraction of the field of view. (10 to100%) Ex.) If [50%] is specified as the frame-feed amount, the field of view will move half way, and if [100%] is specified, it will move all the way to the adjacent field.	Check [Frame Shift ON／OFF]. Specify [Frame Step] in percent. Move the mouse pointer to the edge of the image display area. Click the frame shift icon ⏮, ⏭. The image moves in the designated percentage of the field of view in the icon direction.

4.7.5 Setting the accelerating voltage

1. Click the active data display [Acc.V].
2. Double-click the desired value from the Acc.V dialog.

   If you check [ACB] and/or [Auto Focus], then changes over the accelerating voltage, ACB (Auto Contrast and Brightness) or auto focus operates according to the selected voltage.



4.7.6 Adjustment of spotsize

■Manual control button

1. Point to manual control button [Spot Size].
2. Drag it up and down using the right mouse button (for coarse adjustment) or the left mouse button (for fine adjustment)

   [COARSE] for coarse adjustment or [FINE] for fine adjustment is displayed on the left part of the image display area.

   Dragging upwards increases the spotsize (toward 99), and dragging downwards decreases the spotsize (toward 0).

■Active data display

1. Click active data display [Spotsize].
2. Adjust the spotsize value using the scroll bar of the spotsize dialog.

Set the spotsize value corresponding to the purpose.

For routine observation, set the spotsize value to about 30.

For high resolution, set the spotsize to a value smaller than 30.

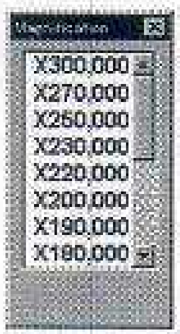
For analysis or work with a large probe current, set the spotsize to a value larger than 30.

4.7.7 Setting the magnification

4.7.7.a Setting the magnification

1. Click near 

of active data display.



2. Double-click desired magnification from the magnification dialog.

   The magnification indication range of the dialog changes at the SEM condition.

   WD45.5mm or less and accelerating voltage 10kV or less.

   ×5 to ×300,000

   Except above condition

   ×8 to ×300,000

3. When you wish to fine-adjust the current magnification, uses the text icon [Mag-][Mag+] button.

4.7.7.b The magnification switches instantaneously

When using [Preset Mag] of the menu bar, it can switch the magnification instantaneously. It is recommend present the magnification you use frequently in image observation beforehand using [Standard Setup].

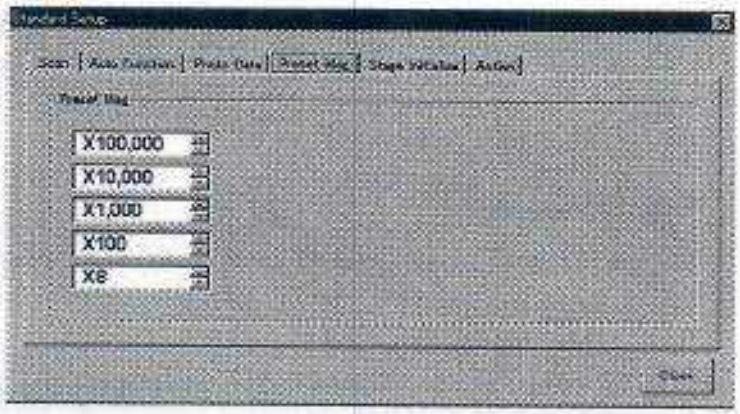
1. Click menu bar [Preset Mag].
2. Click the desired magnification from the pull-down menu. The magnification switches instantaneously.

■ **Registering the preset magnification**

1. Click menu bar [Preset Mag./ Preset].
2. Set the magnification using the [▲] or [▼] button in the list, or input numerical value directly in the magnification display box.

   If the magnification you have input is not based on the magnification provided, the set value is replaced to the nearest value provided.

   The bottom magnification in the list is linked with the INST MAG switch on the OKB (option).



3. Click [Close] button of the standard setup window.

4.7.7.c Others

■ Expansion/reduction of image size

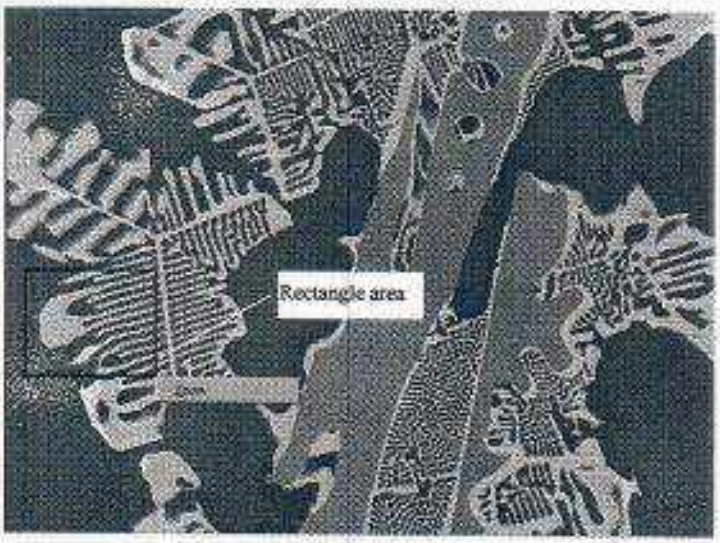
Cliking [▣] of the manual control button switches the displayed image size every time. (excepting View mode)

	Button display [▣]	Button display [□]
Scan1	320×240	160×120
Scan2	640×480	320×240
Scan 3	640×480	320×240
Scan 4	640×480	320×240
Freeze	640×480	320×240

■ Area zoom

A part of the image zoom in and it can be displayed with full size. However, the motor drive stage is necessary.

1. Drag the right mouse button to draw the rectangle area which you wish to zoom in the image display area
2. Click [Zoom].
3. The image in the rectangle area is moved to the center of the image display area, and it is displayed with full size.



4.7.8 Setting a focusing current that corresponds to the WD

When the WD is known, you can roughly focus rapidly using this function. And, when the same WD (Ex.10mm) is desirable in X-ray analysis, you can keep the same WD by performing image focusing using the Z-axis of the stage after clicking [10mm].

1. Click active data display [WD].
2. Double-clicking the desired WD from the WD dialog.

   The focus current corresponding to the double-clicked WD is set.

4.7.9 Selection of signal

1. Click active data display [Signal].
2. Double-click the desired signal from the signal dialog.

   If an optional detector corresponding to signal of the sialog is not attached, the signal indication becomes gray color and it cannot be selected.

   When [Spot Size] is checked, the spotsize of the signal selected last time is maintained even when the signal is switched over.

   When [Spot Size] is not checked, the spotsize for the respective detector is set.

4.7.10 Acquiring of the image

1. Click text icon [Freeze] button.

In the View or Scan1／2／4 mode, if you click [Freeze] button, a frozen image appears instaneously.

In the Scan3, if you click [Freeze] buton, a frozen image appears after that one frame has been acquired.

In the Scan4, if you click [Freeze] button, a frozen image surely appears after that one frame has been acquired.

When this button is [ON] (White color), if you click it once again or click [View] and [Scan1／2／3／4] buttons, the button goes [OFF], and changes to a live image.

2. The running message appears.

Button	Explanation
Zoom	A frozen image is displayed in the entire screen. Image Size An image is displayed corresponding to the size (a number of pixels) of the frozen image. If the image size is too large, the image cannot be displayed within screen. To view parts of the image that are outside the screen, drag the image using the left mouse button. The image moves in the direction in which the mouse was dragged. Display Size An image is displayed corresponding to the size of the CRT screen. When the image size is smaller than the screen, the blank space around it is displayed in black. Close The image returns to the original freeze state it had before the [Zoom] button was clicked.
Save	The frozen image can be stored.
Cancel	Image display returns to a live image.

4.8 Daily maintenance

Check the following items regularly for using the SEM under a stable condition, and perform the adjustment work if necessary.

Refer to [Trouble shooting], when an image is not improved even if you adjusted the following items.

Align the axis of electron beam (Gun alignment)
When a sharp image cannot be obtained to not align the axis of electron beam.

Bias adjustment
Set to proper value the filament current (L.C value), or perform it with the gun alignment.
Generally speaking, when the L.C value is high, the service life of the filament becomes shorten though brightness and performance rise. On the contrary, when the L.C value is low, brightness and performance deteriorate though the service life of the filament becomes longer.

Adjusting the OL aperture
When a sharp image cannot be obtained even when you have adjusted the focus by the greatly changing of observation condition (accelerating voltage, WD, spotsize)

Astigmatism correction
When the image appears to flow in a certain direction before and after the focal point for observing with the high magnification (×10,000 over)

4.8.1 Gun alignment

If filament heating is insufficient or if the electron beam is not aligned with the axis, a sharp image cannot be obtained even when you have adjusted the focus. In such a case, carry out the gun alignment.

4.8.1.a Auto gun alignment

The filament heating and alignment (Tilt／Shift) will be adjusted automatically.

1. Click text icon [Gun] button.
   The Gun Alignment window appears.
2. Select [Full Auto] or [Semi Auto] of the Auto Gun Alignment
3. Click [Start] button.

4.8.1.b Manual gun alignment

When you use a spotsize less than [50] in image observation, execute steps 1 to 9. When using [50] or more, further execute steps 10 to 14.

1. Click text icon [Gun] button.
   The Gun Alignment window opens.
2. Set the alignment－Tilt Shift [X, Y] scroll bar buttons to the vicinity of the center.
3. Set the filament heating scroll bar button in front of the orange-colored area.
4. Adjust the alignment－Tilt [X, Y] scroll bar button so that the image becomes as bright as possible.
5. Move the filament heating scroll bar button to the left edge.
6. When you slowly darg the scroll bar button to the right, the image becomes bright a moment in the vicinity of the scroll bar center. (The first peak)
7. Further drag this button to the right to display an image and stablize the load current (the image brightness will not change from a certain position onward). (The second peak : Saturation point)
8. Set the filament heating scroll bar button to just the left of the saturation point.
   If you set this button to the right of the saturation point (the orange-colored area), it causes over-currentand shorten the service life of the filament.

9. Adjust with [Set Bias] so that [L.C] value becomes appropriate.

Click [Set Bias] button and adjust the [L.C] value.

Accelerating voltage (kV) It cannot be adjusted in the accelerating voltage except for the followings.	L.C. (μ A)	Remarks
30, 25, 20, 15	Approx. 85	
10	Approx. 75	
5	Approx. 60	
3.0, 2.5	Approx. 50	
2.0, 1.5	Approx. 45	The coarse adjustment button cannot be used.
1.0	Approx. 40	Same as above

10. Select [Tools／Lens Reset] ou the menu bar.

The lens reset operates, and an image is displayed after several seconds.

11. Adjust the alignment－Shift [X, Y] scroll bar buttons to maximize the image brightness.

12. Adjust the alignment－Tilt [X, Y] scroll bar buttons so that the image becomes as bright as possible.

13. Repeat the step 10 to12 several times to maximize the image brightness.

About set bias

When the accelerating voltage is changed while the Bias Adjustment window is being opened, the window is closed and the value adjusted is stored.

4.8.2 Adjustment the OL aperture

If the OL 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 peforming the following work, confirm the OL aperture, and adjust it if necessary.

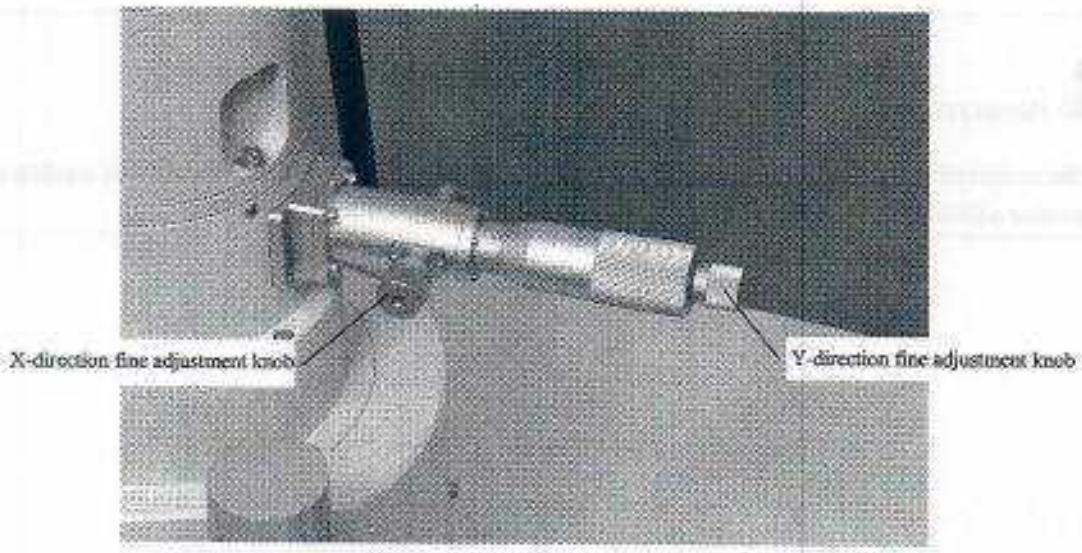
a. If the OL aperture was changed over, or the aperture foil replaced.

b. If the accelerating voltage was greatly changed.

c. If the WD was greatly changed.

d. If the spotsize was greatly changed.

1. Set the magnification to about ×10,000, then focus the image.
2. Select [Tools/ OL Wobbler] of the menu bar.
   The scanning mode becomes Scan1, and the running message appears.
3. At this time, an image is not shift, so omit the following step. An image shifts in every direction greatly, carry out the following step.
4. Adjust the X- and Y-direction fine adjustment knobs to minimize image shift.
5. Click running message [OFF] button.
6. Select [Tools/ Lens Reset] on the menu bar.
7. Repeat step 2 to 6 once again.



4.8.3 Astigmatism correction

Astigmatism is not noticeable at low magnification (about ×1,000), 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 OL 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 a magnetic sample is being observed.

【Image before astigmatism correction】

【Image after astigmatism correction】

1. Set the magnification to a value slightly higher than the magnification used for the current observation.
2. Focus the image using the manual control button [Focus].
3. If the image appears as shown in the lower photographs before and after the focal point (blurring occurs due to mis-focusing), there is no astigmatism, so omit the following steps.
4. Adjust manual control button [StigmX] and [StigmY] so as to obtain the sharpest image.
5. Select [Tools / Lens Reset] on the menu bar.
6. Repeat steps 2 to 5 once again.

4.9 Observation of backscattered electron image

4.9.1 Operating principle

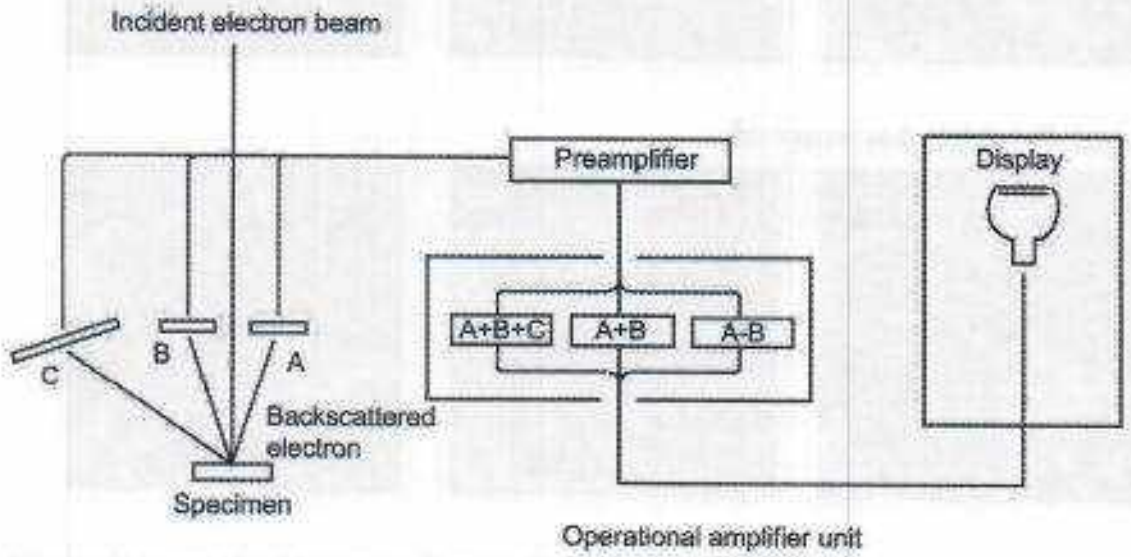
■Formation of composition image and topography image

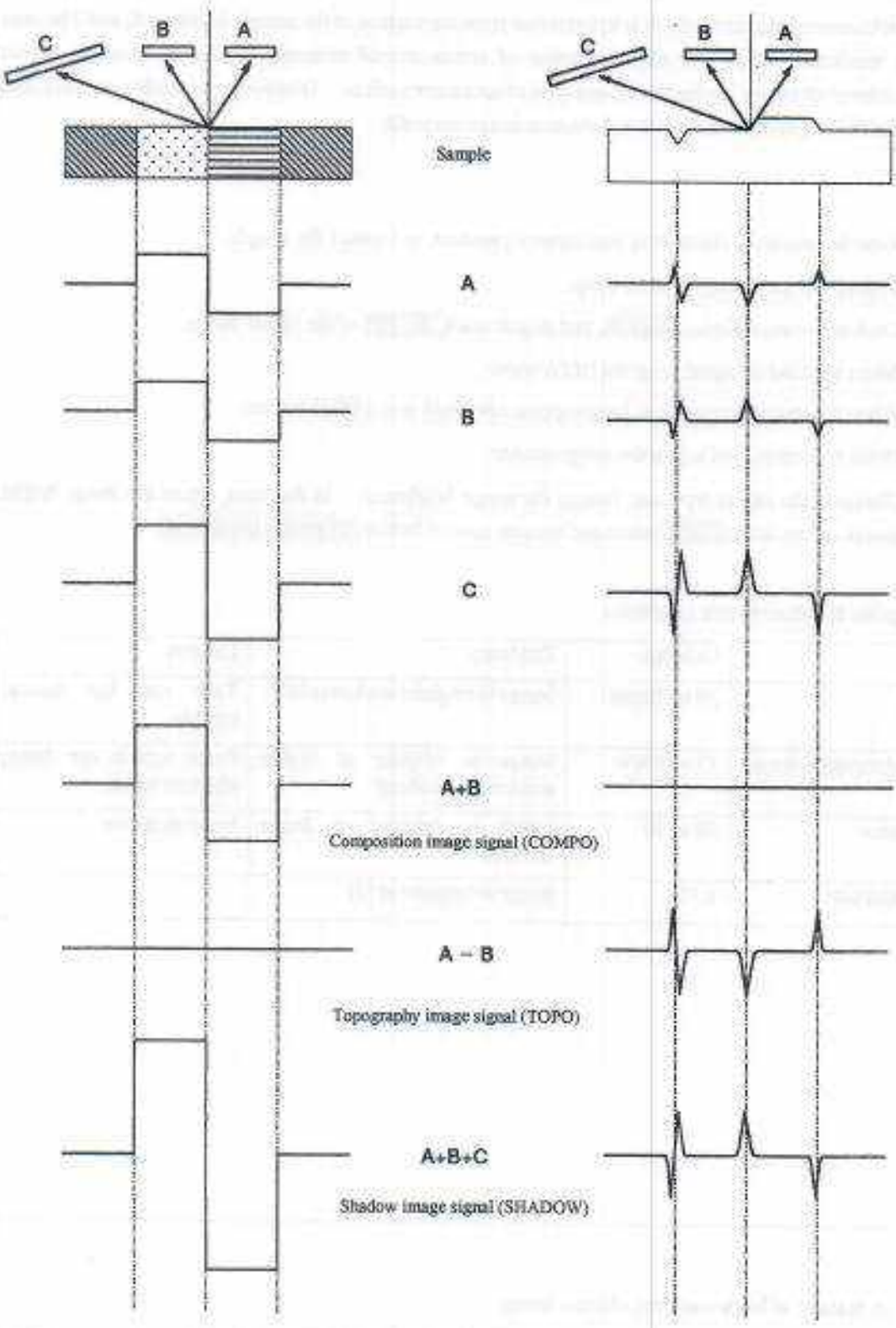
A lower figure is a block diagram showing the basic signal flow for image formation. The specimen surface is scanned by an incident electron beam to generate backscattered electron which have information of the surface topography, physical and chemical properties of the specimen. These backscattered electrons with said information are deleted 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 saves as a video signal for displaying TOPO BEI. The desired video signal is fed to CRT for display.

■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
Sample
A
B
C
A+B
Composition image signal (COMPO)
A − B
Topography image signal (TOPO)
A+B+C
Shadow image signal (SHADOW)

4.9.2 Observation of backscattered electron image

The backscattered electron, which is information from the surface of the sample is detected, and The unevenness of the specimen surface and the distribution of compositional elements can be observed by detecting the backscattered electrons having the information of specimen surface. Display the secondary electron image first, then you can display the backscattered electron image smoothly.

1. Vent the specimen chamber to atmospheric pressure, and install the sample.
2. Display the secondary electron image.
3. Click active data display [Signal], and double-click [BEIW] of the signal dialog.
4. Select the kind of signal from the BEIW menu.
   When the image brightness is inappropriate click text icon [ACB] button.
5. Focus the image, and adjust the image quality.
   Changing the signal type may change the image brightness. In that case, adjust the image brightness by means of text icon [ACB] button and manual control button [Contrast] [Brightness].

■A guide for observation condition

	Criterion	Tendency	Caution
WD	10 to 20mm	Image is brighter at shorter WD	Take care lest detector hits sample
Accelerating voltage	15 to 25kV	Image is brighter at higher accelerating voltage	Some sample are damaged by electron beam
Spotsize	30 to 60	Image is brighter at larger spotsize	Same as above
OL aperture	1／2	Image is brighter at [2]	

A feature of backscattered electon image

The lighter the element in a composition image, the darker is the image. The heavier element, the brighter is the image.

The Shadow image shows as if light was illuminated from the right side of the sample.
In case of convex portion, the right side appears bright and the left side dark. In case a concave portion, the above is reversed.

4.10 Image observation in LV mode

4.10.1 The dried sample

1. Vent the specimen chamber to atmospheric pressure, and install the sample (the dried sample such as paper, cloth and resign).
2. Switch the active data display [Vac. mode] to [LV], then eacuate the specimen chamber.
3. Click text icon [HT] button get to [HT ON].
4. Set the accelerating voltage to [15kV].
5. Set the pressure in specimen chamber to [30Pa].

   Select the numerical value from the list of Low Vacuum Control window, and click [START] button.

   The [Pressure] display starts blinking. When the pressure setting isfinished, the flickering stops. (It takes several minutes for completion of the pressure setting.)

   When the pressure setting is not finished after the elapse of five minutes or the valve is locked during the pressure setting period (the pressure setting is not finished), the pressure setting is interrupted and a message describing the interruption is displayed. Close the message and adjust the pressure once again.

6. Set the [Spotsize] of active data display to [30 to 60] and select [1] for the shadow level of the BEIW menu.
7. Click text icon [View] button.
8. Set the stage position to sample center. (X=23mm, Y= 25mm)
9. Observe the image using the automatic function (Text icon [ACB], [AF] button).
10. Switch over the scanning speed to [Scan1].
11. Adjust the manual control button so as to obtain the optimum image quality.
12. For assuming charging-up, increase the magnification by about four steps and observe the image.
13. When you observe the charged image, increase the pressure in the specimen chamber and/or adjust spotsize value so that charging vanishes.

■Reration between pressure-charging-up-brightness

Low ←	Pressure	→ High
Large ←	Charging-up	→ Small
Bright ←	Brightness	→ Dark

Charging-up?

A phenomenon where by part of the image becomes particularly bright as a result of the sample acquiring an electrical charge.

4.10.2 The sample containing moisture

1. Vent the specimen chamber to atmospheric pressure.
2. Install the sample not containing moisture (metals or others, a specimen holder itself) first to execute [Auto Gun Alignment].
3. Switch the active data display [Vac. mode] to [LV], then eacuate the specimen chamber.
4. Set the pressure in specimen chamber to [50 to 70Pa].

   Select the numerical value from the list of Low Vacuum Control window, and click [START] button.

   The [Pressure] display starts blinking. When the pressure setting isfinished, the flickering stops. (It takes several minutes for completion of the pressure setting.)

   When the pressure setting is not finished after the elapse of five minutes or the valve is locked during the pressure setting period (the pressure setting is not finished), the pressure setting is interrupted and a message describing the interruption is displayed. Close the message and adjust the pressure once again.

5. Vent the specimen chamber to atmospheric pressure, and install the sample (containing moisture, like a biological sample and botanical sample).
6. Evacuate the specimen chamber.
7. Click text icon [HT] to get [HT ON].
8. Adjust manual control butons so as to obtain the optimum image quality.
9. For assuming charging-up, increase the magnification by about four steps and observe the image.
10. When you observe the charged image, increase the pressure in the specimen chamber and/or adjust spotsize value so that charging vanishes.

4.11 Management of user file

This instrument is compatible with multi-users. The SEM operating conditions for each user are managed using user files and are usually saved on the hard disk in the computer.

The saved file contains the SEM conditions when the user logged out by, custom recipe files created by the user and stage files (option).

These files can be backed up on a disk (floppy disk, magneto optical disk, etc.), in a batch, so that if the file on the hard disk is damaged or erased, the back-up disk can be used to install the file.

4.11.1 Backing up users file

1. Select [File/ Backup Users File]on the menu bar.
2. Insert the media (floppy disk, magneto optical disk) in the personal computer.
   If you wish to use the floppy disk, purchase a commercially available MS-DOS formatted disk.
3. Select of the media of the place of the backup and a directory, and click [OK] button.
4. Custom recipes (including a recipe image) and other files (SEM status) made by the currently logged-in user are backed up, and dialog closes.
   If it is lack of capacity, a message dialog is opened and use file data cannot be backed up.

4.11.2 Installing users file

1. Select [File/ Install Users File] on the menu bar.
2. Insert the back-up disk in the personal computer, select directory and click [OK] button.
3. The user files are installed to the hard disk of the personal computer, and dialog closes.
   If it is lack of capacity, a message dialog is opened and use file data cannot be installed.

4.11.3 Recipe

When observing a specimen through the SEM, it is generally necessary to set observing conditions suited to the specimen. This SEM let you set appropriate observing conditions simply by selecting a recipe suited to the specimen from representative observing conditions that are recorded on the standard recipe. It also lets each user create and save containing observing conditions for all types of specimens. Also the created recipe can be copied to another recipe file at any time.

4.11.3.a Registering

1. Acquire the image that you want to register the observation condition. (display the frozen image)
2. Click text icon [Recipe] button.
3. Select [Custom Recipe], and click [Add] button.
4. Input recipe name (within 8 characters) and note, and click [OK] button.
5. The currently displayed recipe is registered to custom recipe and dialog closes.

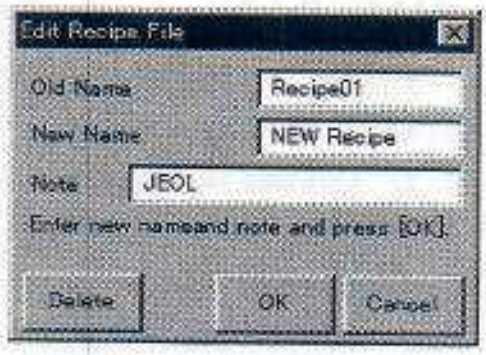
Image paste

When the [Image paste] is checked, the live image (except Scan1 mode) or frozen image is recorded andsaved in the recipe.

This [Image paste] reflects the image at the point when [OK] button was clicked. This means that the image whose entire area is not displayed may be saved and recorded. It is recommended not to use Scan3 and Scan4 in which the scanning speed is slow, but instead freeze image.

4.11.3.b Editing

1. Click text icon [Recipe] button, and select [Custom Recipe].
2. Select recipe file from the list and click [Edit] button.
3. Input recipe name (within 8 characters) and note, and click [OK] button.
4. The recipe file name is changed and dialog closes.



4.11.3.c Deleting

1. Click text icon [Recipe] button, and select [Custom Recipe].
2. Select recipe file from the list and click [Edit] button, then click [Delete] button.
3. Click [OK] button.
4. The selected recipe file is deleted and dialog closes.

4.12 Image operation

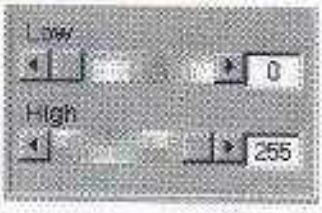
4.12.1 Brightness correction/color display

4.12.1.a Brightness correction

1. Freeze the display image.
2. Click menu bar [Image], and select [Look-up Table/Color].
3. Click the desired brightness correction button and adjust the correction level.
4. Click [OK] button.

   The original image replaced with the brightness corrected image.

■**Look-up table window**

Graph display 	The vertical axis represents the output value and the horizontal axis the input value. Displays the function graph when correction is made and the histogram when the correction function of the brightness correction button is appried.
Brightness correction button	Multiple buttons select is impossible.
	Linear button Makes it possible to display the image without correction.
	Contrast highlight button Highlights contrast of levels L-H on display. Range: Low-level (0 to 254), High-level (1 to 255) 
	Contrast reduce button Lowers contrast of levels L-H on display. Range: Low-level (0 to 254), High-level (1 to 255)
	Gamma correction button Corrects brightness with gamma curve on display. Range: 1 to 1.0, 1.1, 1.25, 1.5, 1.7, 2.0, 2.5, 3.0, 5.0, 10.0
	Multivalued processing button Displays after multivalued processing. Range: 4,8, 16, 32, 64, 128

	Partial highlight button Highlights a part in green color on display. Levels L-H are displayed in green color and others in monochrome. Range: Low-level (0 to 254), High-level (1 to 255)
	Brightness reverse button Reverses brightness on display.
	Pseudo-color button The pseudo-color dialog appears, and the standard-color image or custom-color image can be displayed.
OK	Closes the dialog, and the original image is overwritten by the image that has undergone brightness correction.
Cancel	Closes the dialog, and the original image re-appears.

4.12.1.b Color display

Using color dislay of the image allows a structure of interest to be emphasized.

1. Freeze the display image.
2. Click menu bar [Image] and select [Look up Table / Color].
3. Click  button and select [Standard Color] or [Custom Color].

   The standard color cannot be changed.

   To select [Custom Color], select the color level and set a numerical value (1 to 255) with RGB scroll bar.
4. Click [OK] button.

   The original image replaced with the color-processed image.

■ **Pseudo Color dialog**

Color Set	
Standard color	Color level (16-color) changing is impossible.
Custom color	Color level changing is possible.
Color level	Color level changing is possible only when the [Cutom Color] is selected. Select level and set the color with RGB (1 to 255).
OK	Closes the dialog, and the original image is overwritten by the image that has undergone color correction.
Cancel	Closes the dialog, and the Look-up table dialog re-appears.

■ **Abot color level**

When 16-color levels are set

The colors set at [Level 1 to 16] are replaced in a range in which brightness is divided into 16 equal points.

When 5-color levels are set

An image whose brightness level is set is displayed in the set color and others in black.

Level	Brightness	Color
Level 1	1 to 15	Black
Level 2	16 to 31	Blue
Level 3	32 to 47	Green
Level 4	48 to 63	Cyan
Level 5	64 to 79	Red
Level 6	80 to 95	Magenta
Level 7	96 to 111	Yellow
Level 8	112 to 127	White
Level 9	128 to 143	Gray
Level 10	144 to 159	Light blue
Level 11	160 to 175	Light green
Level 12	176 to 191	Light cyan
Level 13	192 to 207	Light red
Level 14	208 to 223	Light magenta
Level 15	224 to 239	Light yellow
Level 16	240 to 255	Light white

4.12.2 Dual split screen display

This function is compatible only with the image file. It can be used conveniently for comparison and observation of two different images because it can synthesize two image files on display.

1. Freeze the display image (click text icon [Freeze] button) and click menu bar [Image], then select [Dual Split Screen].
2. Select image file from the dialog, and click [OK] button.
3. The image displayed at the right and the frame moves to the left. Select another file and click [OK] button. The image is displayed at the right and left and the scroll bar appears. Use the scroll bar to move the image.
4. When it is desired to replace a recalled image with a different image, double-click the left mouse button on the image. Select an image file from the dialog and click [OK] button.
5. When the menu bar [Write] button is clicked, the currently displayed image is turned frozen.

4.12.3 Quad split screen display

This function is compatible only with the image file. It can be used conveniently for comparison and observation of four different images because it can synthesize two image files on display.

1. Freeze the display image (click text icon [Freeze] button) and click menu bar [Image], then select [Quad Split Screen].
2. Select image file from the dialog, and click [OK] button.
3. The image displayed at the upper-right and frame moves to the bottom-right. A file is selected in order of the bottom left, the upper left in the same way, and click [OK] button.
4. When it is desired to replace a recalled image with a different image, double-click the left mouse button on the image. Select an image file from the dialog and click [OK] button.
5. When the menu bar [Write] button is clicked, the currently displayed image is turned frozen.

4.12.4 Digital zoom

This function copes with frozen image and an image file. It is convenient when only a certain point is expanded and if wants to observe it because an image inside the frame is magnified two times or four times and it can be indicated.

1. Freeze the display image, or open the image file
2. Click menu bar [Image] and select [Digital Zoom].
3. Select [X2] or [X4].
4. Drag the frame and determinate the position to be enlarged, and click [Zoom in] button.
5. The inside of the range frame enlarges to fill the entire screen. To appear the original image, click [Zoom out] button.
6. When the menu bar [Write] button is clicked, the currently displayed image is turned frozen.

4.12.5 Text editor

When you wish to enter the text icon on the image display after showing the image, operate as followings. The entered text with the image can be saved.

1. Freeze the display image. (See 4.7.10)
2. Click menu bar [Image] and select [Text Editor].
   The text editor menu appears, and the cursor appears in the upper left corner of the image display area.
3. Enetr the text from the keyboard.
4. Exit the text editor.
   Click text editor menu [Exit] button.

■ **Text editor menu**

Background	
Image	The background becomes on the image.
Black	The background becomes on the black color.
Symbol	He symbol list window appears.
Clear	All texts entered can be cleared.
Exit	Exits text editor, and closes the menu.

■ **Operation list**

Function	Key	Remarks
Edit start		Select [Edit/Text Editor] on the menu bar.
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	Back space	The cursor moves back to the left. Text over which the cursor passes is deleted.
Line feed	Enter	The cursor moves to the left end of the next line.
Insertion	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.
Deletion	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 [Clear] button, and click [OK] button on the menu.
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		Select [Image], the background becomes on the image. Select [Black], the background becomes on the black color.
Symbols		Click [Symbol], select from the list window. Symbols cannot be entered with [Enter] key or [Space] key on the keyboard.
Termination of editing		Click [Exit] button.

About text editor

Some of SEM functions cannot be used during text editing.

Line cannot be fed with [Enter] key when the focus (active forefront screen) is in the symbol list window.
Press [Enter] key after clicking on the SEM screen.

4.12.6 Management of the image

4.12.6.a Saving an image

! CAUTION

Change and don't save the extension of the file name which has already been in the saving location.
If the extension (file type) is changed with the same existing filename and saved in the saving location, the SEM information (*. TXT) will be overwritten and the previous contents will be cleared. (no message inquiring if the information is to be overwritten will appear) Designate another location for saving or change the file name before saving.

1. Displays the frozen image or image that was rewritten by [Image operation.
2. Click menu bar [File] and select [Save Image].
3. Designate the location for saving (drive, folder) and enter the file name.
   When the [Paste Text] is checked, the text and photo data are saved as an image. Otherwise, the text and photo data will be saved in separate files.
4. Click [OK] button.
5. The image is saved and closes dialog.

4.12.6.b Opening the image file

1. Click menu bar [File] and select [Open Image File].
2. Select a file and click [Open] button.
3. The selected image is located and displayed, then closes the dialog.

4.13 Photographing the image

! CAUTION

For instruction on handling of instant film or developing solution for instant film, refer to the manufacture's instruction manual.

1. When using a CSI (CSI1,CSI5), in which a film holder is not incorporated, install the film holder beforehand.
2. Set the camera diaphragm according to the sensitivity of the film to use.

   Prepare other filters depending on the type of CSI and film being used. (refer to the instruction manual for CSI)
3. Install the PRD on the CSI and attach it with the latch.
4. Load the film holder with film.
5. Connect the connector of the CSI to [CAMERA] of the PRD.
6. Display an image to photograph.
7. Set the photo data ([Setup/Standard Setup/Photo Data]).
8. Set the photo speed ([Setup/Standard Setup/Scan]).
9. Click text icon [Photo] button.

   When you wish to stop the photographing, click [Cancel] button on the running message.

4.14 Creating the report

DTP (destop publishing) for printing images, SEM data and text on a general-purpose printer can be used for convenience in preparing reports.

Before using DTP, be sure to install the printer driver. Otherwise, an error will occur when DTP is used. Therefore, install the printer driver for Windows even if the printer will not be used. If the user's general-purpose printer is used, install its printer driver according to the instruction manual for the printer.

Flow of repor creating···Ex.)

Startup DTP

Select documnt (Open DTP file)

Paste image

Input comment and other information

Print

Save document

Exit DTP

4.14.1 Startup DTP

1. Freeze the display image and click text icon [Report] button.
2. The DTP program starts and the DTP window opens.

4.14.2 Exit DTP

1. Click menu bar [File] of the DTP window and click [Exit].
2. The DTP program ends and the DTP window closes.
3. If there is any DTP that is not saved, the message dialog will appear.
   When clicking [Yes] button, the file saving dialog will appear.
   When clicking [No] button, the DTP program ends and the DTP window closes.
   When clicking [Cancel] button, closes the message dialog.

4.14.3 Select document

1. Click one of  buttons in the DTP window.

4.14.4 Pasting the image

! CAUTION

If the image has been copied, the DTP program may not work.
When pasting the image, copy the image using GUI or IFS (option)

■Pasting currently displayed image

1. Copies the frozen image on the image display area using [File／Image copy] on the menu bar of SEM-GUI.
2. Startup DTP, and select the document.
3. Select [Edit／Image Paste] on the menu bar of the DTP window.

   The image is pasted to the image-display area of the selected document, and SEM information (magnification, accelerating voltage, etc.) of the image is displayed.

■Pasting image file

1. Startup DTP, and select the document.
2. Click one of  buttons on the DTP window.
3. Select an image file and click [Open] button.

   The image is pasted to the image-display area of the selected document, and SEM information (magnification, accelerating voltage, etc.) of the image is displayed.

   Repeat the above operation according to the selected document.

4.14.5 Input subject, comment, etc.

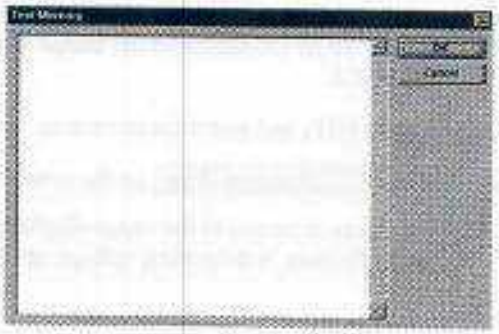
Ordinally, enter the subject, comment, etc. directly into the document.

To paste a logo (bmp. file), click the right mouse button the logo area of the document and use the pop-up menu.

If the same subject, comment, name and logo are used each time a new document is created, proceed as follows because they can be recorded. They are displayed in these areas and can be printed each time a new document is created.

4.14.5.a Registration of comment

1. Select [Setup/ Text memory] on the menu bar of the DTP window.
2. Click an area and click [OK] button after entering a comment.
3. The comment is recorded.

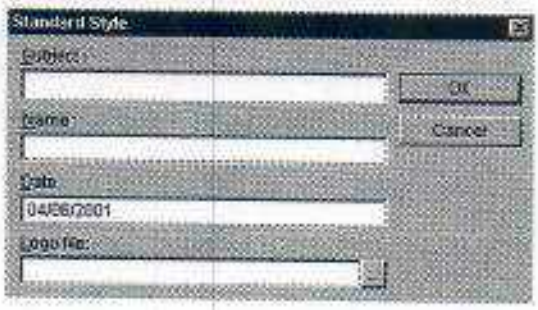


4.14.5.b Registration of subject, date, name and logo

1. Registration of title, date and name.

   Select [Setup/ Standard Style] on the menu bar of the DTP window.

   Click an area of [Subject], [Date] or [Name], and click [OK] button after entering them.



2. Registration of logo

   Enter the filename directly into [Logo file], or click [...] button and select file.

   Click [OK] button to record the logo. (Refer to the relevant menuals for instructions on logo creation and other)

The recorded subject and other information may not be displayed depending on the document.

The font and font-size of the subject and comment (text) can be altered.
Select [Format] on the ,emu bar of the DTP window.

4.14.6 Printing

1. Setup the printer to print. (Refer to the printer manual for more information)
2. Set the print margin.

   Select [File/Margin] on the menu bar of the DTP window.

   Select paper size and input a margin value (0 to 60), then click [OK] button.

3. Confirm the document layout by using the print preview.

   Click  button on the DTP window.

   Check the printing range, etc. using the [Zoom in] button and other. The [Print] button permits you to preview the document before printing it.

4. Select [File/Print] on the menu bar of the DTP window, and click [OK] button.

   To print the form you are now using, click  button.

! CAUTION

- **When a Mitsubishi digital color printer (CP770D or other) is used, set the print margin at both left and top to 0mm and the paper expantion factor in the property of the print window to 50% or less. Otherwise, the document will be printed off the paper.**
- **The printing range varies with the type of printer.**
  If the printer is changed, set it so that the print margin fits the printer.
- **Printout may differ from that checked on the screen and the actual one may not fit within the paper size.**

4.14.7 Savig and opening the document

■Saving the document

1. Click  button on the DTP window.
2. Select the driver and folders, enter a filename.
3. Click [Save] button.
4. The document is saved as a DTP file.

■Opening the document

1. Startup DTP and click  button on the DTP window.
2. Select the DTP file and click [OK] button.
3. The DTP file is displayed as a document on the DTP window.

4.15 Trouble shooting

4.15.1 Vacuum system

Symptoms	Cause	Countermeasures
Power is not supplied	The power board switch is OFF	Turn ON the power board switch
	100V AC is not being supplied	Verify the [100V AC]
	The safety device operated because of a water failure	1. Click [OK] button to close the message dialog 2. Exit SEM program and turn off the power to the personal computer 3. Turn off the MAIN POWER switch and wait until water supply is restored 4. Feed water and wait for about five minutes 5. Turn on the MAIN POWER switch to start the instrument.
	The safety device operated because of a power failue	1. Turn off the MAIN POWER switch and wait until power is restored 2. Make sure that water is being fed 3. Turn on the MAIN POWER switch to start the instrument
The RP (oil rotary pump) does not start when the instrument is started The VENT and EVAC switch lamp blink	The RP thermal protector operated because of the over-current	1. Turn off the MAIN POWER switch 2. Make sure that the room temperature is between 15 and 25℃ 3. Press the RP manual reset button to start the instrument
	The RP fuse blown out because of the over-current	 Shut down the instrument and call service center

When the RP has stopped while the instrument is running The VENT and EVAC switch lamp blink No-image is displayed Warning message is displayed	The RP fuse blown out or the thermal protector operated because of the over-current	Shut down the instrument and call service center
Evacuation does not take place, or takes a long time to complete	Loose parts	Tighten up loose parts
	A sample containing a lot of gas or moisture is installed	Remove moisture from a sample, or replace it
	Inferiority of O-ring or packing (Twist, wrong position, contaminated with dust, being torn)	Check the twist and wrong positions. Check whether a O-ring and packing are contaminated with dust. Adjust a twist. Return it in the right position. Remove dust. When the O-ring or packing is torn, call serivice center
	The wehnelt has just been cleaned	Wait for a while
	RP (oil rotary pump) or DP (oil diffusion pump) oil has deteriorated	Call service center

! WARNING

Do not touch the RP motor when the RP has stopped while instrument is running.
You may get burn in the hand because the RP motor is very hot.

4.15.2 Image observation

Symptoms	Cause	Countermeasures
L.C value (load current) is unstable	The electron gun mis-aligned	Re-align the electron gun
	The filament has a whisker	Replace the filament
	The filament is mis-centered	Re-center the filament
	The wehnelt is contaminated	Clean the wehnelt
	The wehnelt has just been cleaned	Wait for a while
L.C value is abnormal, or too small/too large	Bias adjustment is not perform	Perform bias adjustment
An image does not appear	The text icon [HT] button is [Ready] or [Wait]	Click text icon [HT] button to change [HT ON]
	An auto function does not operate	Click text icon [HT] button to change [HT ON] and try again (ACB, etc.)
	The signal is not [SEI]	Set the signal to [SEI]
	The image has excess or insufficient contrast and/or brightness	Adjust it with manual control button [Contrast] and [Brightness]
	The electron gun mis-aligned	Re-align the electron gun
	The filament heating insufficient	Align the electron gun, or adjust bias
	The OL aperture mis-aligned	Align the OL aperture
	The filament is burnt out	Replace the filament
An image does not appear in LV mode		1. Set the appropriate sample (specimen holder), and evacuate in HV mode 2. Set the Z-axis (WD) to [20mm] 3. Click text icon [HT] button to change [HT ON] 4. Select [Semi Auto] from the Gun Alignment window and click [Start] button 5. Click [HT] button to change the [Ready] 6. Try again with LV mode
An image has no sharpness	The image has astigmatism	Correct it with manual control button [StigmX] and [StigmY]
	The image has insufficient contrast and/or brightness	Adjust it with manual control button [Contrast] and [Brightness]
	The spotsize is too large	Reduce the spotsize
	The electron gun mis-aligned	Re-align the electron gun
	The accelerating voltage is too low	Raise the accelerating voltage
	The OL aperture foil has deteriorated	Replace the OL aperture foil

	The inside of electron optical column is contaminated	Call service center
The image does not focus in the vertical direction	The sample is set to high tilt angle	Eliminate the tilt of sample Click text icon [DFU] button to correct it
Threre is noise, roughness, and distortion on the image	The sample has acquired electric charge	Re-evaporate a sample Reduce the accelerating voltage Reduce the spotsize Fine-adjust the pressure in the specimen chamber (LV-SEM)
	The spotsize is too small	Increase the spotsize
	The accelerating voltage is unsuitable	Change the accelerating voltage
	The image has astigmatism	Correct it with manual control button [StigmX] and [StigmY]
	The image has excess or insufficient contrast and/or brightness	Adjust it with manual control button [Contrast] and [Brightness]
	The sample is not properly fixed	Properly fix the sample
	Loose parts	Tighten up loose parts
	External magnetic field	Keep it away from the instrument
	The OL aperture foil has deteriorated	Replace the OL aperture foil
	The inside of electron optical column is contaminated	Call service center
The image appears with poor brightness compared with the former time The image brightness changes in a cycle	The scintillator tip has deteriorated	Call service center

4.15.3 Photographs

Symptoms	Cause	Countermeasures
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	Correct the camera aperture
	The film is not pulled up or wound up	Pull up or winds up the film
	The contrast and/or brightness is not correct	Adjust the contrast and/or brightness

4.15.4 DTP

Symptoms	Cause	Countermeasures
DTP program stops	The printer driver is not installed	Install the Windows printer driver even when the printer is not to be used
	Pasting the image: The image to paste does not exist	Exit DTP program, and restart DTP program
Document is only partially printed	Print margin/paper size is not correctly set	Print margin/paper size is correctly set The print margin varies with the type of printer. Set it to fit to the printer
Text/Subject/Name/Date cannot be entered or pasted	The document is selected which cannot be entered or pasted	Select the document which can be entered or pasted, and create the new document
Logo cannot be pasted	The document is selected which cannot be pasted Logo is not created in the bmp. format	Select the document which can be pasted, and create the new document Create the logo in the bmp. format
Image cannot be pasted	The image to paste is not displayed in the freeze mode The image is saved except the BMP／TIFF／JPEG format	The image to paste is displayed in the freeze mode, and try again The image is saved with BMP／TIFF／JPEG format
SEM information is not displayed or printed	The check box is not make a check mark on the check bar The [Form4] or [Form5] is selected	The check box is checked on the check bar Create the new document with a [Form1], [Form2] or [Form3]

4.16 Running message list

When you perform the following operation, a running message is displayed on the screen.

Operation	Running message／Explanation
Click text icon [Photo] button	Photographing
Click text icon [Freeze] button	Frozen
Click text icon [AF] button	Auto Focus running
	Auto Focus＋ACB running When the [Auto Focus$^+$ ACB] on Auto Function of the Standard Setup window is checked
Click text icon [AS] button	Auto Stigma running
	Auto Stigma＋Auto Focus running When the [Auto Stigma$^+$ Auto Focus] on Auto Function of the Standard Setup window is checked
	Auto Stigma＋ACB running When the [Auto Stigma$^+$ ACB] on Auto Function of the Standard Setup window is checked
	Auto Stigma＋Auto Focus＋ACB running When the [Auto Stigma$^+$ ACB and Auto Focus] on Auto Function of the Standard Setup window is checked
Click text icon [ACB] button	ACB running
Click [Start] button on the Auto Gun Control of theGun Alignment window	Auto Gun Alignment running Filament heating and filament alignment (tilt and shift) are automatically adjusting
Click [Auto] button on the Filament Heating of the Gun Alignment window	Auto Filament Saturation running Filament heating is automatically adjusting
Click [Auto] button on the Alignment of the Gun Alignment window	Auto Gun Alignment running Tilt and shift alignment of electron beam is automatically adjusting
Click [Tools／Beam Blanking] of the menu bar. (There is a check mark)	Beam Blanking ON
Click [Tools／OL Wobbler] of the menu bar (There is a check mark)	OL Wobbler ON

4.17 Error message list

If the trouble occurs as follows, an error messages appears and beeps buzzer sound.

Message	Buzzer sound	Countermeasures
COOLING WATER FAILURE	Interrupts an evacuation system power supply, and beeps buzzer sound contiguously	Shut down the instrument and wait until water supply is restored Pass cooling water, and wait for about five minutes Re-start the instrument
DP TEMPERATURE LOW	Beeps buzzer sound…three times	Wait for a while When the DP temperature does not rise even if it waits for about 15 minutes, [DP HEATER FAULT] message appears.
DP HEATER FAULT	Beeps buzzer sound contiguously	 Shut down the instrument and call service center
EVACUATION FAILURE	Beeps buzzer sound…three times	Vent the specimen chamber to atmospheric pressure, and check the O-ring and/or packing (twist, wrong position, etc) Remove twist, correct position and re-evacuate the specimen chamber When the O-ring or packing is torn, call service center
RP STOPPED	Interrupts an evacuation system power supply, and beeps buzzer sound contiguously	Shut down the instrument and call service center
FILAMENT BURNT OUT	Beeps buzzer sound…three times	Replace the filament
HT OFF	Beeps buzzer sound…three times	Click text icon [HT] button to get [HT ON], and try again the auto-function (ACB, AF, AS)
FILAMENT ABNORMAL	Beeps buzzer sound…three times	Remove the filament from the wehnelt of the gun chamber. Check whether "Whisker" on the filament does not occur. If the whisker occurs, replace the filament because the instability of gun emission is caused.

VACUUM SYSTEM TROUBLE	Interrupts an evacuation system power supply, and beeps buzzer sound contiguously	Shut down the instrument and call service center
VENT ENABLE (When an optional VSITF is being used)	Beeps buzzer sound…three times	Cancel the [Vent-Lock signal], and try again
EXT SCAN ENABLE (When an optional ESITF is being used)	Beeps buzzer sound…three times	Connect the cable securely Input the external control signal

5

Maintenance

5.1 Parts the must be maintained

A JEOL engineer performs the maintenance work of [DP oil], [RP oil] and [Foreline trap] in the table. Please, call service center.

	Parts	Cleaning interval
1	Filament・Wehnelt	L.C value (load current) is unstable L.C value not rise with filament heating Error message appears
2	Anode・liner tube	Once every 1 to 2 years Cleaning is it toward the aperture (cap shaped) in the tip of the liner tube. Stop cleaning if trash and dirt don't seem to be conspicuous except for the liner tube.
3	OL aperture	When the astigmatism increases, preventing a bright image from being obtained
4	Orifice (LV-SEM)	When the astigmatism increases, preventing a bright image from being obtained
5	O-ring・packing	When evacuation cannot take place or requires a long period.
6	DP oil	Once every 3 to 5 years (Recommended)
7	RP oil	Once every 1 year (Recommended)
8	Foreline trap (Cartridge type (LV-SEM)	Once every 2 to 3 years (Recommended)

5.2 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 ware 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 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 grass 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.

! Precautions in maintenance work

- **Do not adopt an unreasonable posture when working for maintenance.**
  An unreasonable posture becomes the cause which a waist and so on hurts.

- **Do not use an organic liquid when wiping off the dust of exterior of the instrument.**
  Wipe off it with dried cloth after removing the dust. If it is very dirty, wipe it with wet cloth and then dry cloth.

- **Do not dismount, disassemble with bare hands. Be sure to use 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, and 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.**

- **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 disassembled parts on a rugged workbench covered with aluminum foil.**

- **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.**

5.3 Cleaning method

1 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 of the sensitivity of your skin, so be sure to read the precautions concerning liquid before using it.

■ 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 surface 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.

■ 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 surface 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 parts 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.

5.4 Filament replacement and cleaning

! WARNING

Do not touch the wehnelt immediately after the filament breaks because it is not you may receive a burn.
Before removing the wehnelt for about one hour, then remove it using a dedicated tool.

! CAUTION

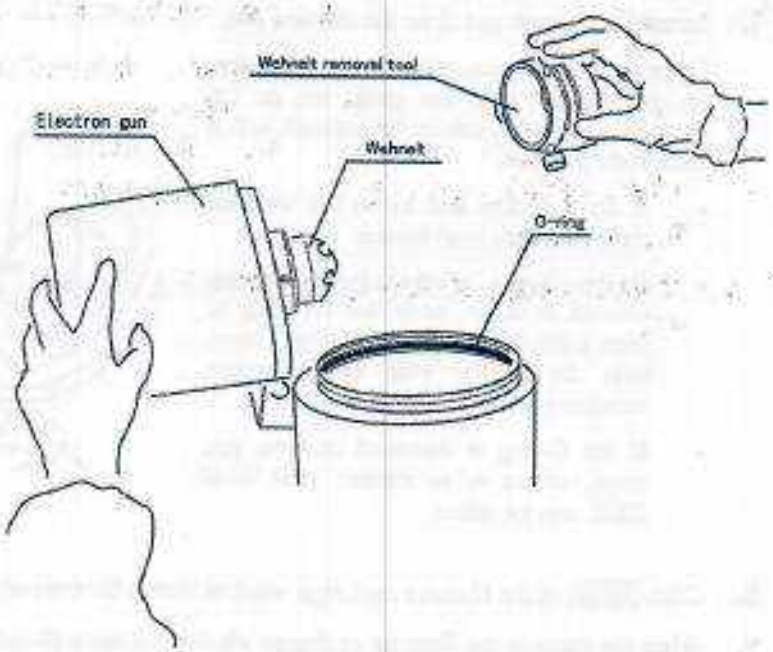
- **Do not open the electron gun except the maintenance work (filament replacement, etc.)**
  It has possibility that dust and so on goes into the electron optical column when the electron gun is opened unreasonably and that a trouble is caused.
- **When installing the filament, take care not to touch the tip of the filament.**
- **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.**

1. Click [OK] button for closing the message dialog.
2. Click [Vent] button of the filament exchange window for venting the electron optical column to atmospheric pressure.
3. Open the electron gun, and 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.

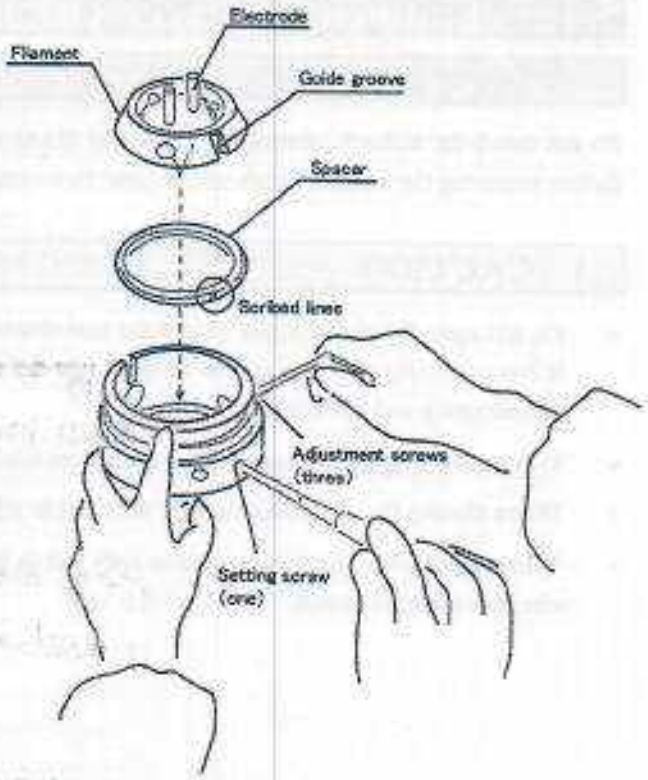
   Pull the wehnelt removal tool straight to remove the wehnelt from the electron gun and then loosen the screws to remove the wehnelt removal tool.

   Closes the electron gun after removing the wehnelt.



4. Disassemble the wehnelt, and remove the filament.

   Grasp the electrode of the filament when removing the filament.



5. Clean the cap, and other parts, then install a new filament.

   Re-install the filament in the opposite sequence to removal.

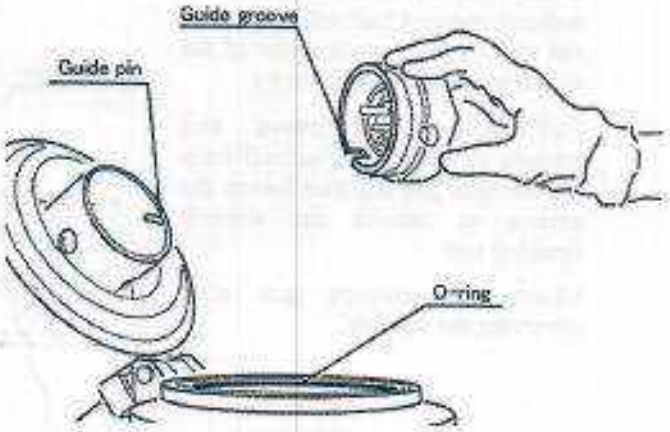
6. Check the filament position (centering).

   Show the wehnelt from the side, if the tip of the filament is protruding, replace the spacer.

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 unit it clicks into position.

   - If there is dust and so on the wehnelt, remove it with hand blower.
   - If the O-ring of the electron optical column 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 local JEOL service office.



8. Click [Evac] of the filament exchange window button for evacuating the electron optical column.
9. When the status in the filament exchange window becomes [Ready], click the text icon [HT] to get [HT ON].
10. Perform the auto gun alignment. (see Chapter4-4.8.1.a)

■ Tip of the filament condition

Tip of the filament condition	State
	Un-use
	Ordinary broken When the filament is used well at a long time.
	Abnormal 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.

■ Relation between the spacer and filament

Number of scribed lines	Thickness (mm)	Brightness	The life of filament
3	2.1	Medium	Normal
4	2.2	Low	Long

5.5 Cleaning the anode and liner tube

! WARNING

Do not touch the wehnelt immediately after the filament breaks because it is not you may receive a burn.
Before removing the wehnelt for about one hour, then remove it using a dedicated tool.

! CAUTION

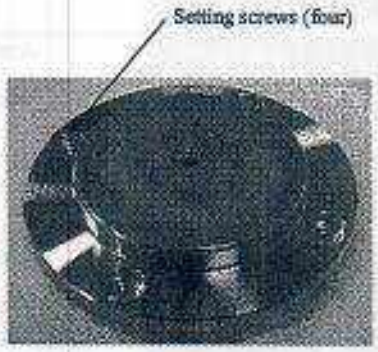
- **Turn OFF the MAIN POWER switch after venting the electron optical column to atmospheric pressure.**
- **When cleaning the electron gun, take care not to slip the O-ring out of position, or get your fingers crushed between the electron gun and electron optical column.**

1. Open the electron gun and remove the wehnelt.

   Stores the removed wehnelt in such a way that it is not exposed to dust.

2. Turn OFF the MAIN POWER switch, and remove the anode.

   Remove the setting screws. **Screw the suitable screw into the screw hole for removing the anode, and pull it out vertically.**



3. Remove the liner tube.

   Remove the setting screws (two). Screw the "liner tube extraction tool" and pull the tool vertically.

   As for important by operation step3, it is [pull the liner tube out slowly and vertically, and return it again]. A "slow" reason is to prevent two O-ring being torn to keep the vacuum of the liner tube.

   And, cleaning is it toward the aperture (cap-shaped) at the tip of the liner tube. Stop cleaning if you look through the liner tube and trash and dirt don't seem to be conspicuous.

4. Clean the anode and liner tube.

   Select the cleaning method according to the extent to which these parts are soiled.

5. 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.

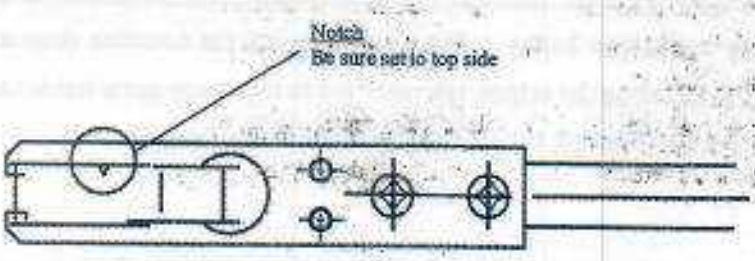
6. Install the wehnelt, then evacuate the electron optical column.

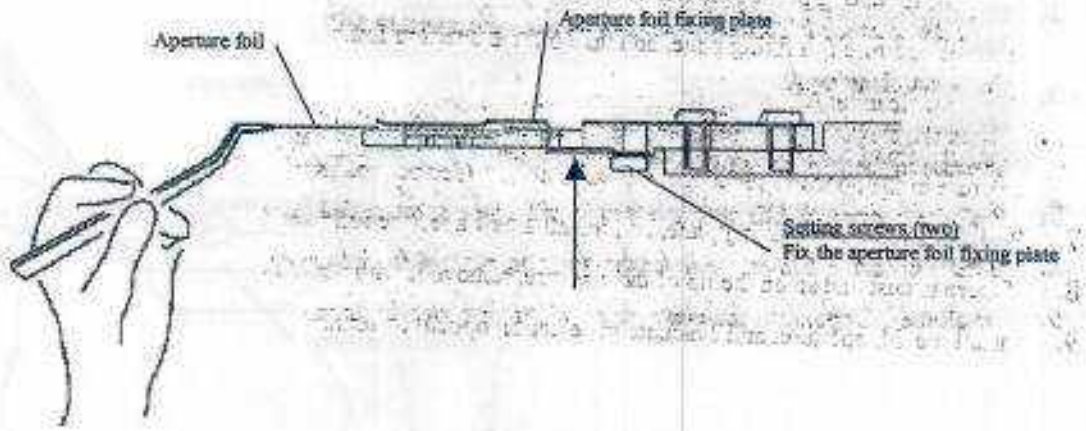
5.6 Cleaning the OL aperture

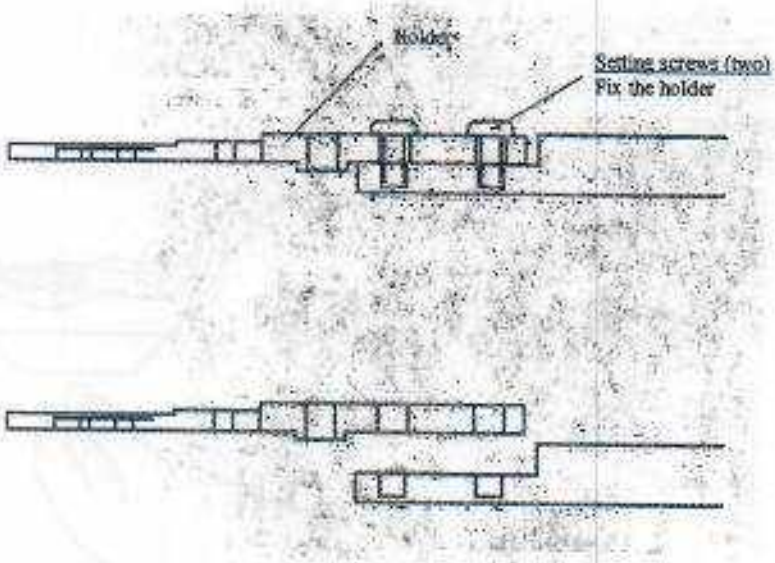
! CAUTION

- **When removing or installing the OL aperture, take care that the tip of the OL aperture does not touch the electron optical column.**
- **When pushing the aperture foil fixing plate, take care not to touch with bare hands.**
- **When installing the aperture foil, take care not to deform or damage it.**

1. Set the OL aperture position to [0].
2. Vent the electron optical column to atmospheric pressure, and remove the OL aperture.
3. Cover the mounting port of the OL aperture to prevent ingress of dust.
4. Push the aperture foil fixing plate, and take out the aperture foil.
5. Carry out cleaning A.
6. When the tip of the OL aperture is very dusty, disassemble it and carry out cleaning B. Re-assemble the aperture in the opposite sequence to disassembly. (see next page.)
7. Push the aperture foil fixing plate, and install a new aperture foil (standard accessory).
8. If there is dust and so on the tip of the aperture, remove it with hand blower.
9. Install the OL aperture, and evacuate the electron optical column.


Notch
Be sure set to top side


Aperture foil
Aperture foil fixing plate
Setting screws (two)
Fix the aperture foil fixing plate


Holder
Setting screws (two)
Fix the holder

5.7 Cleaning the orifice (LV-SEM)

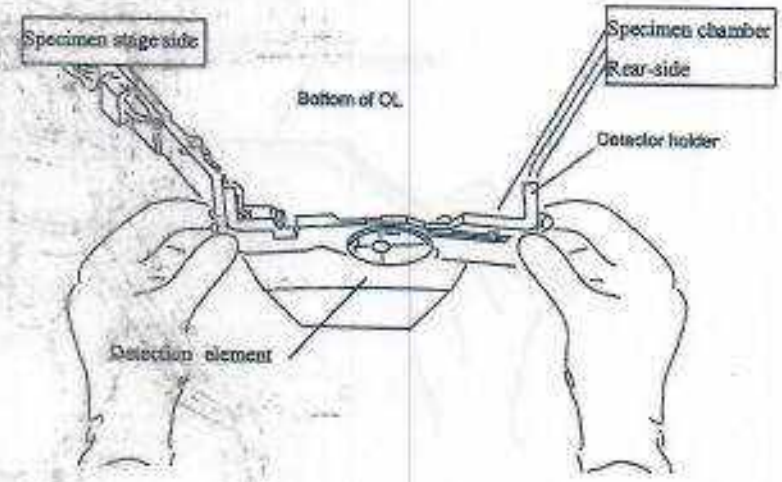
! CAUTION

- **When the moving the detector holder, take care not to touch the detection element.**
- **When removing or installing the orifice, take care not to touch any parts inside the specimen chamber.**
- **When installing the aperture foil, take care not to deform or damage it.**

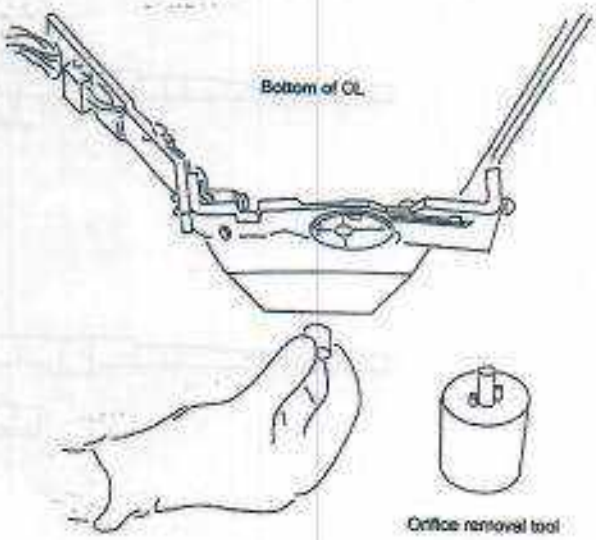
1. Vent the specimen chamber to atmospheric pressure and slowly withdraw the specimen stage.

   When an optional backscattered electron detector (BEIC or BEIR) is attached, pull the backscattered electron detector until it stops to the front.

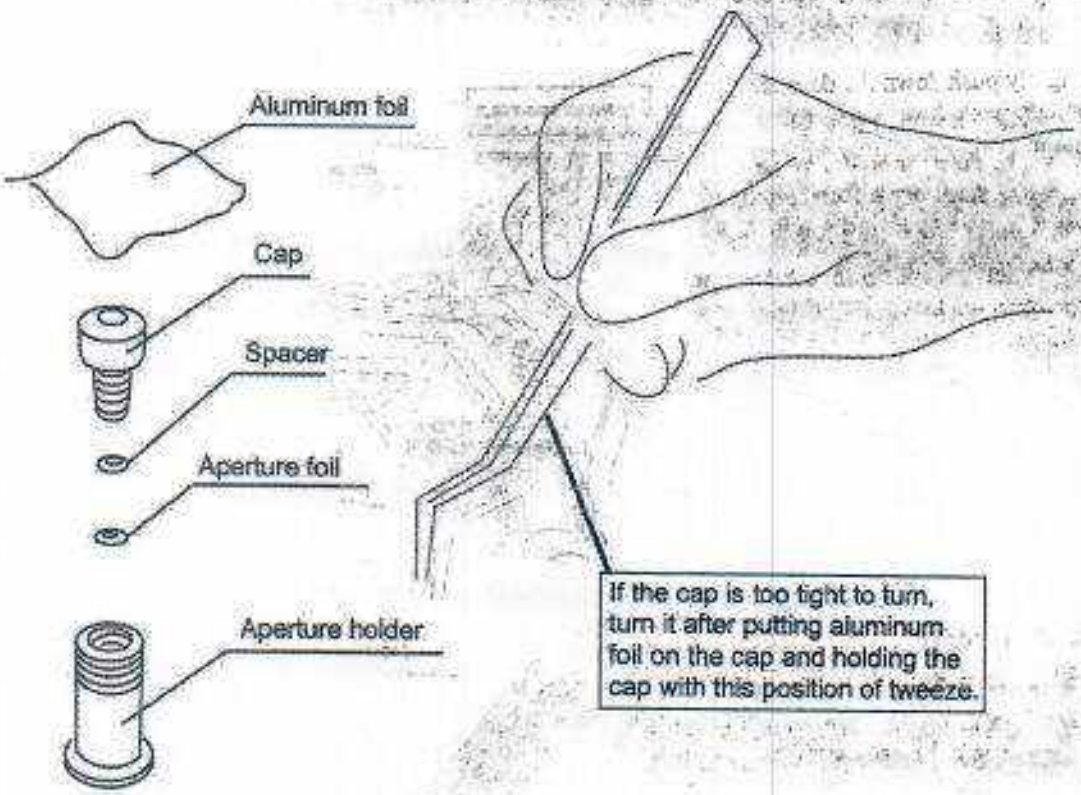
2. Slightly push down the detector holder.
3. Move the detector holder to the right side not to touch the bottom of OL as much as possible.
4. Slowly let go hands from the detector holder.



5. Attach the orifice removal tool to the orifice.
6. Viewing the tool from the underside, turn it counterclockwise and remove the orifice.



7. Disassemble the orifice, then clean these parts as shown in the figure.
8. Reassemble the orifice. Perform re-assembly work in opposite sequence to that in which you disassembled.
9. Reinstall the orifice, and set the detector holder to the original position.
10. **You must be set the detector holder so that a space may not be open between the detector holder and underside of OL. (The detector holder has a guide groove to set to the hole of OL.)**
11. Evacuate the specimen chamber.



Service offices

If you need to consult with JEOL about the instrument maintenance, please contact your nearest subsidiary company.
Or presume a JEOL homepage in such cases as the information about the product, the inquiry besides that if having an order in the center of the nearby service.

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