S-3000N Instruction Manual
(Tentative supplementation version)

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Thank you very much for having Hitachi scanning electronic microscope S-3000N purchased at this time.

Making the manual of this instrument is late, and a formal version is not in time in the product at this time. The manual of the S-3500N of a similar product was going to be appended provisionally, and I was going to describe the matter concerning the difference with the S-3000N etc. to this tentative supplement version manual. In this connection, please have seeing the content of the S-3500N manual and this book, and have this instrument used. Because a formal version will be sent when the formal version manual is completed; It humbly asks for the pardon though the inconvenience is put during till then.

Moreover, there is a part where a part of expression is S-3500N in the HELP function. It is a part concerning the explanation of the BSE detector and the specimen stage. It is possible to have it in this part referring to this book. A HELP function will correspond later by the version up of the HELP file.

Moreover, please report it to the charge sales of the nearest when there are an uncertain point etc.

Content of this manual

1. Main difference between S-3500N and S-3000N
2. Specification of S-3000N
3. Solid type semiconductor BSE detector
4. Specimen stage
5. EDX Integration Kit (option)

1. Main difference between S-3500N and S-3000N

A main difference between S-3000N and S-3500N is explained as follows.

1.1 BSE detector

The S-3500N uses the Robinson type for a standard BSE detector. In the signal selection dialog menu, it is allocated in BSE1. A standard BSE detector uses the semiconductor type divide into four in the S-3000N. In the signal selection dialog menu, it is allocated in BSE2. Moreover, please refer to the place of the handling explanation of the BSE detector in this book for the semiconductor type BSE detector because the operation is different from the Robinson type (It has three kinds of observation modes, etc.).

1.2 Specimen stage

The range of movement/tilt of the specimen stage changes in S-3000N as the BSE detector changes. Please refer to the place of the handling explanation of the specimen stage in this book.

1.3 Software function options

Some software functions are the options in S-3000N against S-3500N. In the manual of S-3500N, please understand becoming of the undermentioned item in S-3000N to the option correspondence.

1) Ultra high resolution image memory (2560x1920 pixels)
   The ultra high resolution image memory of 2560x1920 pixels becomes an option treatment. The capture is possible in the standard by the high resolution image memory (1280x960 pixels) or a standard resolution image memory (640x480 pixels).
2) Image data filing (Image Manager)
   The image data filing (image manager) is an option treatment. The function of filing the image (edit, search, and the thumbnail image list etc.) cannot be executed by the standard. (Save to the file and open of the image by the BMP format are possible)
3) X-ray mode function
   The X-ray analysis mode function is an option treatment. The analysis mode of the line, the spot, and the area analysis cannot be executed by the standard.

1.4 Keyboard rack

Though S-3500N has the keyboard rack by which the keyboard is stored; There is no keyboard rack in S-3000N. The keyboard is set up on the display table.

2. SPECIFICATIONS

2-1 Resolution

Secondary electron image resolution 3.5nm guaranteed (high vacuum mode)
Backscattered electron image resolution 5.5nm guaranteed (VP mode)

2-2 Magnification

15 to 300,000× (65 steps)
(Minimum and maximum magnifications vary with accelerating voltage, WD and scanning speed)

2-3 Optics

(1) Filament : Tungsten hairpin type, precentered
(2) Gun Bias : Self bias selection + Fixed bias continuously variable
(3) Accelerating voltage : 0.3 to 30 kV
0.3 to 9.99 kV (in 10 V steps)
10 to 30 kV (in 0.1 kV steps)
(4) Probe current : 10^{-12} to 10^{-7}A
(5) Gun alignment : 2-stage electromagnetic deflection
(6) Condenser lens : 2-stage electromagnetic
(7) Objective lens : Super conical lens
(8) Objective lens aperture : 4-opening, movable
(9) Stigmator : Octopole electromagnetic type (x, y)
(10) Image shift : ±20 um (WD = 15 mm)

2-4 Specimen stage

Selectable from the following five.

1) Super eucentric stage

Movement range	32 mm × 32 mm
Specimen tilt	-90 to +90°
Specimen rotation	360°

2) Standard stage

Movement range	80 mm × 40 mm
Specimen tilt	-20 to +90°
Specimen rotation	360°

3) Large-sized eucentric stage

Movement range	100 mm × 50 mm
Specimen tilt	0 to +60°
Specimen rotation	360°

4) Cool stage20

Movement range	15 mm × 15 mm
Specimen tilt	-45 to +45°
Specimen rotation	Not provided
Temperature range	+10 to -20°C

2-5 Image presentation

1) Image presentation
Secondary electron image (only in high vacuum mode)
Backscattered electron image (Quadrant semiconductor type)
2) Scanning modes
TV scan
Slow scan (4 steps)
Reduced area scan
Waveform monitor scan

Signal monitor scan

Photo scan (4 steps)

Split

Dual mag

3) Scanning speed

TV

Slow 1 : 0.35sec (X=0.7ms, Y=480 lines)

Slow 2 : 2sec (X=4ms, Y=480 lines)

Slow 3 : 10/8sec (X=20/16.7ms, Y=480 lines)*

Slow 4 : 20/24sec (X=40/50ms, Y=480 lines)*

Reduced area 1 : 70ms(F/S) (X=0.45ms, Y=160 lines)

F: 1-stage filter, S: 2-stage filter

Reduced area 2 : 320ms(S) (X=2ms, Y=160 lines)

Photo 1 : 40/30sec(X=20/16.7ms, Y=1920 lines)*

Photo 2 : 80/100sec(X=40/50ms, Y=1920 lines)*

Photo 3 : 200/200sec(X=100/100ms, Y=1920 lines)*

Photo 4 : 400/400sec(X=200/200ms, Y=1920 lines)*

* Synchronized with power supply (50/60 Hz)

4) Signal processing (analog system)

Image polarity inversion

image differentiation

gamma control

5) Data display

Accelerating voltage, magnification, micron bar, micron value, film no., WD value, date, vacuum degree, photographing magnification, detector

6) Data entry

Full keyboard (alphanumerics, special symbols)

Graphic input

7) VCR signal output

NTSC monochrome signal (BNC)

2-6 Frame memory

1 screen for display (640 × 480 pixels)

1 high definition screen (1280 × 960 pixels)

1 ultra high definition screen (2560 × 1920 pixels) (Option)

Memory Function :

Scan conversion

Recursive filter

- Applicable modes; TV, Slow 1, Slow2

Frame integration (2 to 1024 frames)

- Applicable modes; TV, Slow 1~4

Contrast conversion

- Intermediate level emphasis, gamma control, N value, image inversion

Pseudo color

Histogram

Display divided into four

Digital zoom

2-7 Automatic functions

Auto image brightness and contrast control (ABC)

Auto focus control (AFC)

Auto stigma and focus control (ASF)

Auto filament saturation (AFS)

Auto gun alignment (AGA)

Auto start (HV-ON → AFC → ABC)

Auto photo (1. AFC → ABC → PHOTO, 2. ABC → PHOTO)

Full auto mode (1. AFS → AGA → AFC → ABC, 2. AGA → AFC → ABC)

2-8 Operation assist functions

Operation system : Graphic user interface, English menu (Windows 95)

Console : Mouse, exclusive rotary knob, full keyboard

Magnification preset (optionally settable)

Wobbler for axial alignment

Condition memory (15 conditions, unlimited)

Focus search

Focus memory

Setting of brightness for ABC

Film sensitivity (ISO) correction

Photographing magnification correction

Setting of brightness exclusive for photographing

Scan point indication

Filament image

Status list indication

2-9 X-ray mode function (option)

Signal input terminal (2 systems each)
- For x-ray rate meter signal (0 to +10 V)
- For mapping signal (TTL)

Scanning mode
Line,Spot and Selected area analysis
Analytical position
WD = 15 mm , X-ray take-off angle (TOA) = 35°

2-10 Vacuum system

System : Full automatic pneumatic valve control system
Vacuum gauge : Pirani gauge
Indication High/Low lamp, menu
Ultimate vacuum : 1.5×10^{-3} Pa
Low vacuum mode :
Low vacuum range : 1 to 270 Pa
Vacuum setting : Menu input system(25 steps)
Vacuum pump :
Oil diffusion pump (DP) : 570 L/sec (for high vacuum)
Oil rotary pump 1 (RP1) : 160 L/min (exclusive for DP back-pressure evacuation)
Oil rotary pump 2 (RP2): 160 L/min (for pre-evacuation and low-vacuum setting)

2-11 Safety devices

Provided against water and power-failure

2-12 Standard Equipment

- Main unit 1
- Display unit 1
- PC unit 1
- Oil rotary pump 2
- Compressor 1
- Standard tools ..... 1 set
- Spare parts and consumables ..... 1 set
- Instruction manual 1

3. Quadrant Type Semiconductor BSE Detector

This detector detects the BSE from the specimen with the semiconductor device divided into four. Moreover, by operating and processing the obtained signal; It can observe the image in three kinds of mode (COMPO modes (composition), TOPO modes (topography), and 3D modes (solid)).

In the **COMPO mode (composition)**, it can observe the composition image by the effect of an atomic number which darkens in a light element the BSE signal and lightens in heavy element. Moreover, each detection element divided into four is possible in this mode the image observation by which the ON/OFF selection of the signal and reversing and non-reversing selection of the signal polarity are individually done.

In the **TOPO mode (topography)**, the topography image can be observed by taking out a signal difference which is upper and lower or right and left. Moreover, an easily upper and lower or right and left direction can be selected in this mode.

In **3D mode (solid)**, it can obtain the observation image to which the solid feeling which topography information mixed with composition information on the surface of the specimen by changing the position of the detector.

⚠ **CAUTION**: Be careful please not to place the finger between moving element and the stopper when you insert the detector.

⚠ **CAUTION**: This detector uses the semiconductor detector. Please defend the limitation of a movable range in the stage for the breakage prevention of the detector. Please confirm each knob working area in the stage by using the gate so that the specimen should not hit the detector when you insert the specimen.

⚠ **CAUTION**: Please use Z (W.D.) by 7 mm or more to prevent the contact of the specimen and the detector.

IMPORTANT: Please draw out the detector from the specimen chamber, and protect the detector when you do not use this detector.

⚠ **CAUTION**: Neither this detector nor other BSE detectors can be inserted at the same time. Please note that the warning buzzer rings when insertion is detected simultaneously enough when you insert the detector.

3.1 Specifications

Detector : Si PN junction type semi-conductor detector, quadrant type

Resolution : 5.5nm

Video amplifier : Four channels (pre-amplifier + main-amplifier)
Polarity of each channel,
and ON/OFF switch (+,OFF,-),
adjustment of brightness and contrast (ABC operable)

Observation mode : COMPO (composition) mode,
TOPO (topography) mode,
3D (solid) mode

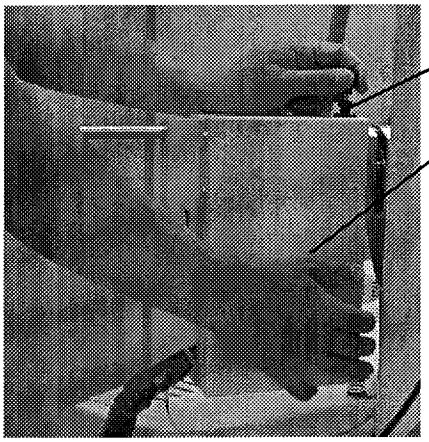
3.2 Name and function of each part

3.2.1 Name and function of each part

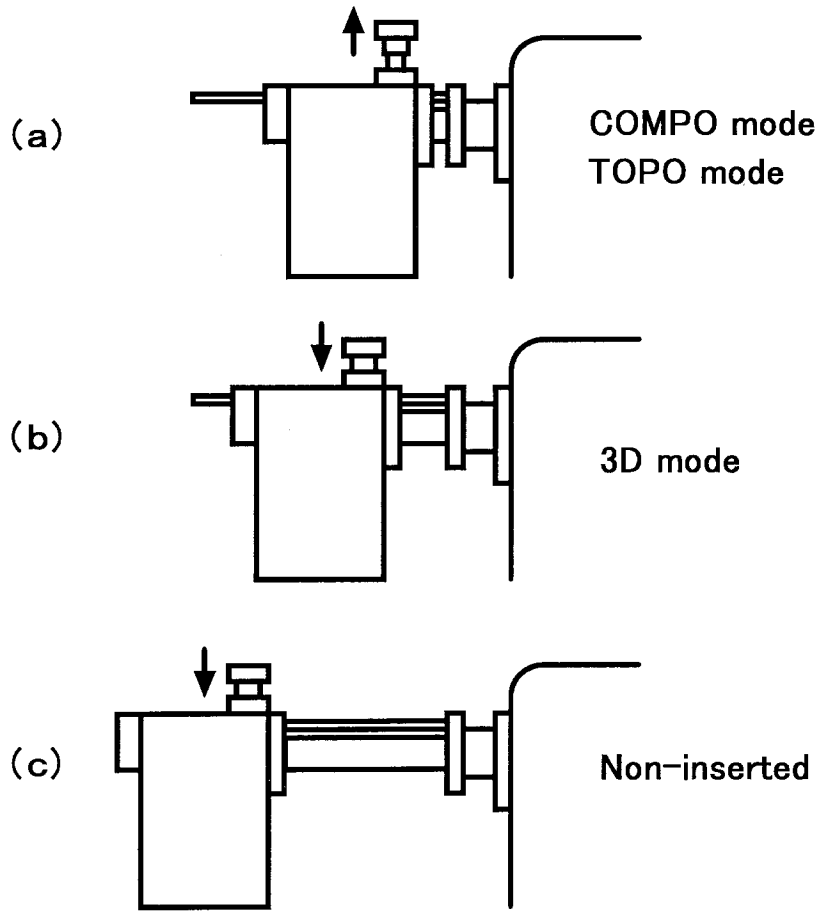
(1) **BSE detector**

Please put the BSE detector in and out slowly while gripping the detector position fixation knob and the detector case.

⚠ **CAUTION** : When the detector position fixation knob is pulled up, the detector is drawn in to the specimen chamber by the negative pressure when the specimen chamber inserts this detector in the state of the high vacuum. At this time, be careful please not to place the hand.

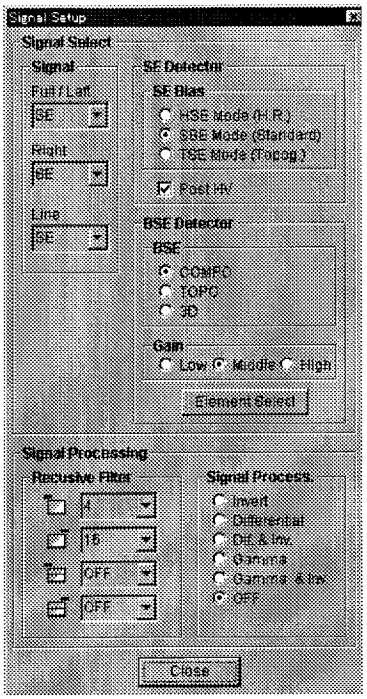


BSE detector position	The objective
(a)	When observing it in the composition mode/ the topography mode
(b)	When observing it in 3D mode
(c)	When not observing it with this detector



(2) Operation menu

It is possible to set it from the **Signal Setup** dialog of a **Setup** dropdown menu concerning the type semi-conductor detector.



① **Signal Setup** dialog

The type semi-conductor detector is selected by selecting BSE2 by the **Signal** of this dialog. Moreover, the detector is selected the quality and the gain etc. can be selected with the **BSE Detector** section.

BSE Detector

≪ BSE ≫

The COMPO mode (composition), the TOPO mode (topography) or 3D mode (solid) is selected.

In the **COMPO mode (composition)**, it can observe the composition image by the effect of an atomic number which darkens in a light element the BSE signal and lightens in heavy element. Moreover, each detection element divided into four is possible in this mode the image observation by which the ON/OFF selection of the signal and reversing and non-reversing selection of the signal polarity are individually done.

In the **TOPO mode (topography)**, it can observe the topography image by taking out a signal difference which is upper and lower or right and left. Moreover, an easily upper and lower or right and left direction can be selected by clicking the element change button with this mode selected.

In **3D mode (solid)**, it can obtain the observation image to which the solid feeling which topography information mixed with composition information on the surface of the specimen by changing the position of the detector.

≪ Gain ≫

Low, Middle, and High are selected.

NOTICE : The level of brightness and the contrast changes greatly by elements such as setting the accelerating voltage, the movable aperture No., and the beam current and setting the filament current. For instance, to the way when the beam current is enlarged, please lower and set the gain when you obtain neither proper brightness nor the contrast by brightness's remarkably lightening.

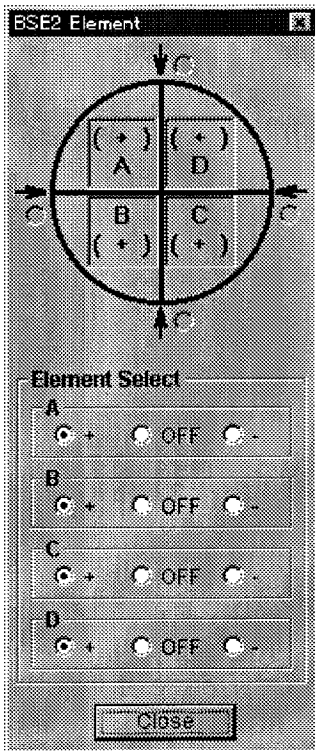
≪ Element Select ≫

It comes to be able to select polarity (+/−) of each detection part and ON/OFF by clicking this button when the BSE detector is COMPO mode (composition).

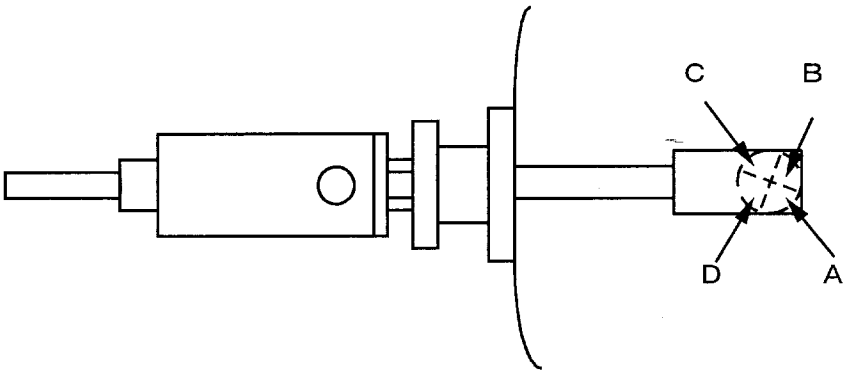
Moreover, it comes to be able to select it easily by clicking this button when the BSE detector is TOPO mode (topography) from among the direction where it seems to have irradiated light which is upper and lower and right and left.

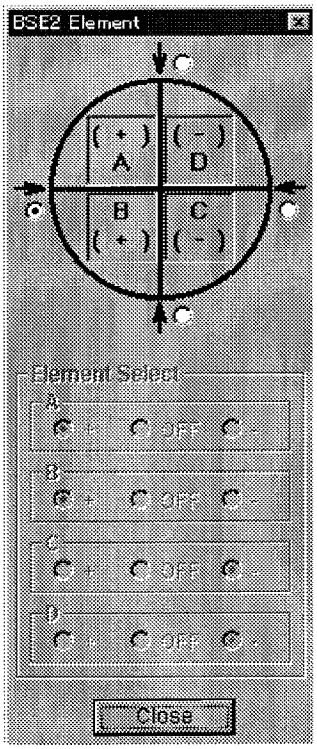
② **Element Select** dialog

When the BSE detector is COMPO mode (composition), polarity (+/−) of each detection part (A–D) and ON/OFF can be selected.



The polarity of each detection part and ON/OFF are selected by this dialog. The figure below shows the position of the detection part to A–D of the dialog. The image to which the signal of each detection part is added is displayed at the same time as obtaining the image to which light and shade reverses by switching each detection part of A–D to + and −. Moreover, the signal of the corresponding detection part is adjusted to 0 by the thing to select turning off.





When the BSE detector is TOPO mode (topography), it becomes an observation image which irradiates light from one direction. In this dialog, it is possible to select it easily from among the direction which is upper and lower and right and left.

3.3 Operation

(1) The specimen is set in the specimen stub.
(Please refer to the paragraph of the specimen exchange of Chapter 4 for the method of the set of the specimen)

(2) It confirms the position of each knob of the stage is at the position where the specimen does not hit the detector before inserting the stage in the specimen chamber by using the gate. (Refer to 4.4 Usage of gates)

(3) The detector position fixation knob is pulled up once, the lock is removed, the detector case is pushed, and it inserts the detector in the specimen chamber slowly.

(4) When the vacuum goes high, the image can be observed.

⚠ CAUTION: Please insert it with Z (W.D.) = 7–35 mm and T = 0° when you insert the stage in the specimen chamber with this detector inserted.

⚠ CAUTION: When the detector position fixation knob is pulled up, the detector is drawn in to the specimen chamber by the negative pressure when the specimen chamber inserts this detector in the state of the high vacuum. At this time, be careful please not to place the hand.

(5) To the **Signal** in the **Signal Setup** dialog of a **Setup** dropdown menu in selecting BSE2; The Quadrant Type Semiconductor BSE Detector is selected. Moreover, when the vacuum mode is changed from the high vacuum to VP–SEM (N–SEM), BSE2 is automatically selected.

(6) It selects the BSE Detector from the COMPO mode (composition), the TOPO mode (topography) or 3D mode (solid) according to the observation purpose.
At this time, because the BSE detection position is different in the COMPO mode (composition), the TOPO mode (topography), and 3D mode (solid); Please move the position of the detector according to the selected BSE Detector. (Refer to 3.2.1(1) BSE detector)

The BSE detection element select button is clicked when the COMPO mode (composition) or the TOPO mode (topography) is selected, and it can display the **Element Select** dialog. (Refer to 3.2.1(2) ③ Element Select dialog)

(7) The manual or ABC is executed and brightness and the contrast of the image are adjusted.
At this time, the gain is changed to the Low, Middle or High when neither proper brightness nor the contrast are obtained, it adjusts again, and it makes it to proper brightness and the contrast.
Moreover, the manual or AFC is executed and the focus is adjusted.

NOTICE : In a TV scan and a fast Slow scan, when it is selected by the gain to High or Middle, the observation image does not become clear.

NOTICE : The level of brightness and the contrast changes greatly by the No. of a movable aperture, setting the beam current, setting the filament current, and the specimen, etc. Please set each element to obtain proper brightness and the contrast.

4. SPECIMEN GONIOMETER STAGE

The Specimen goniometer stage is selectable among the super eucentric stage, standard stage and large-size eucentric stage. Movable range and restriction on it vary with type of specimen stage, condition of BSE (introduced or pulled out), etc.
So reference should be made to the description of each stage.

NOTICE : W.D. indicates a distance from the upper surface of specimen to the bottom of objective lens. Please adjust height because W.D. changes in proportion to the thickness of the specimen.

⚠ CAUTION: When changing W.D. or specimen tilt with the BSE detectorintroduced, take care not to damage its end.

4.1 Super Eucentric Stage

4.1.1 Standard Specifications

Traverse	X ····· ±16 mm Y ····· ±16 mm Z ····· 5 to 35 mm ⊿Z(eucentric control) ····· ±5 mm T(tilt) ····· ±90° R(Rotation) ····· 360° (continuous)
Specimen size	125 mm (dia.) max.
Specimen stub size	15 mm (dia.) 32 mm (dia.)
Specimen exchange	Air introduction system

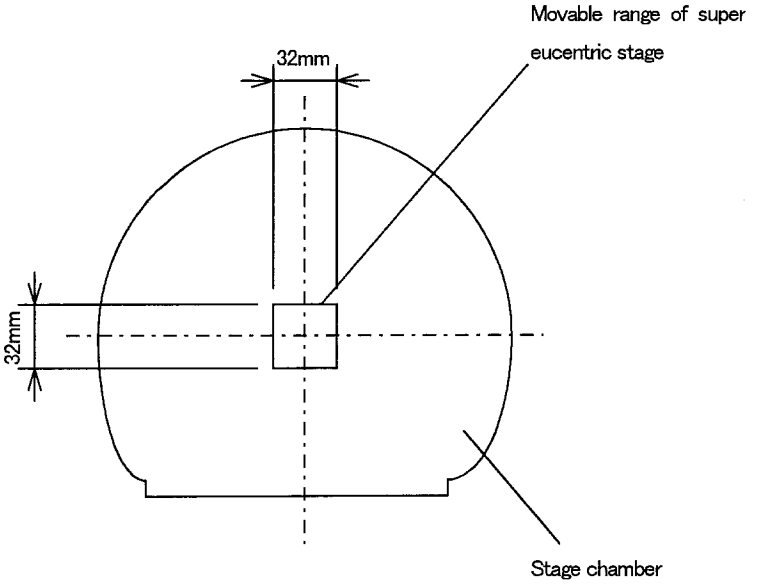


Fig. 4-1 Movable Range of Super Eucentric Stage

4.1.2 Control Knobs

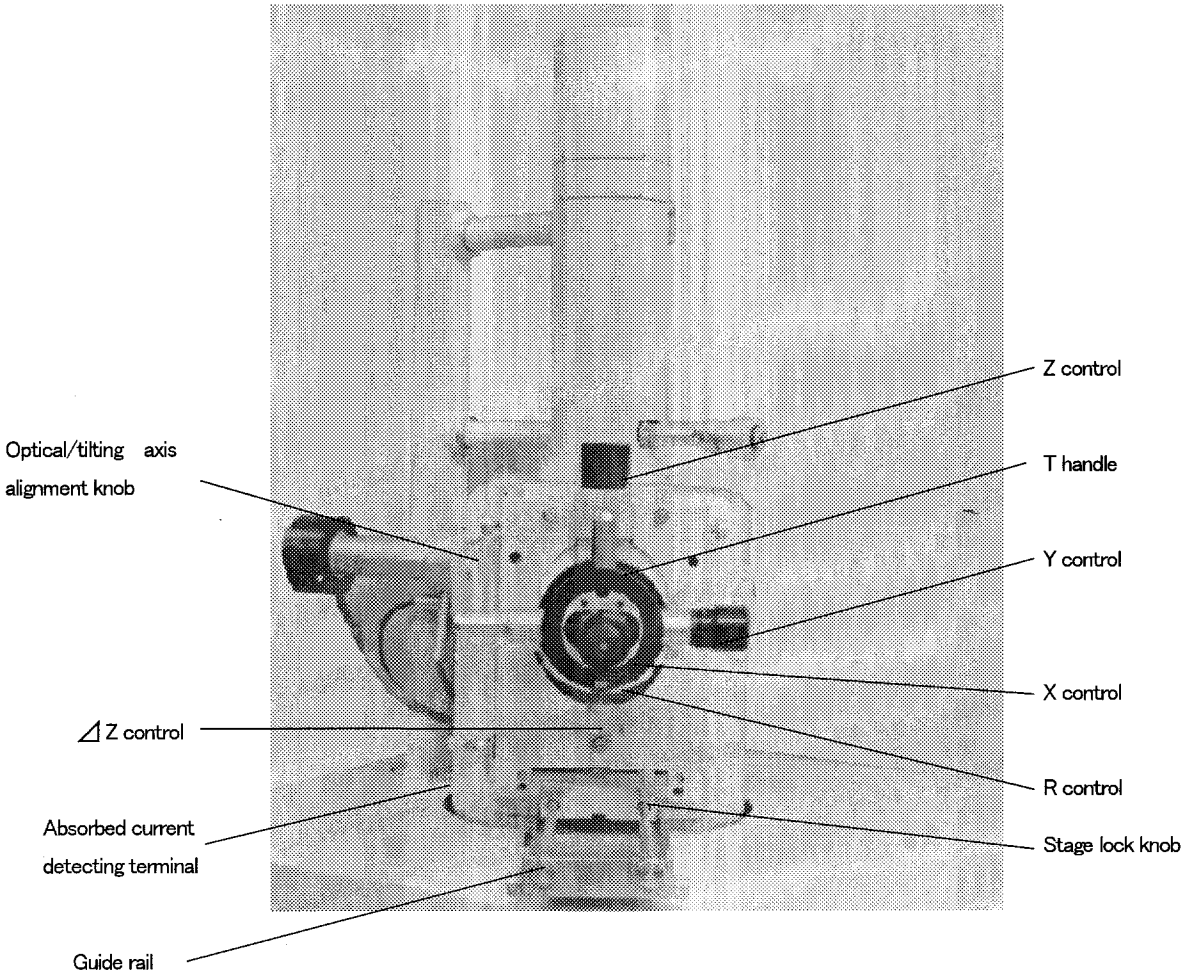


Fig. 4-2 Super Eucentric Stage

X control : Moves the specimen in the longitudinal direction facing the main unit (±16 mm).

Y control : Moves the specimen in the lateral direction facing the main unit (±16 mm).

Z control : Moves the specimen in the Vertical direction facing the objective lens (W.D. = to 35 mm).

T handle : Tilts the specimen (±90°)

R control : rotates the specimen (±360° continuous)

⊿Z control : Used to align the specimen surface with the tilting axis (eucentric control)(±5 mm)

Optical/tilting axis alignment knob :
Used to align the tilting axis with the optical axis (factory-adjusted).

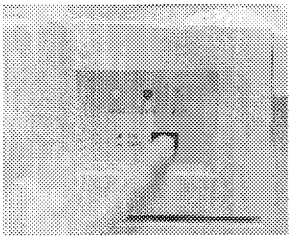
Stage lock knob : Used to temporarily fasten the stage in pulled-out condition.

Absorbed current detecting terminal :
BNC terminal for detecting the absorbed current or specimen current.

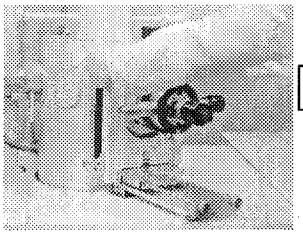
Guide rail : Used to introduce or take out the stage.

4.1.3 Specimen Exchange

(1) Click **HV** in the exclusive switch menu to turn off accelerating voltage.



(2) Turn the **EVAC/AIR** switch on the evacuation control panel to **AIR**.(Wait until the column is vented to AIR condition.)



(3) Pull out the super eucentric stage.

IMPORTANT : Be sure to set the super eucentric stage controls as follows beforehand:

X·····0mm T·····0°
Y·····0mm R·····Free
Z····· 15mm

(4) Remove the specimen stub.

NOTICE : The specimen stub is removed by turning it counterclockwise by the right hand while holding the bevel gear in the rotating section of the specimen stub by the left hand. To use the instrument in the best condition, wear vinyl gloves for the purpose of eliminating contamination through bare hands.

(5) A new specimen must be mounted on the specimen stub as instructed below.

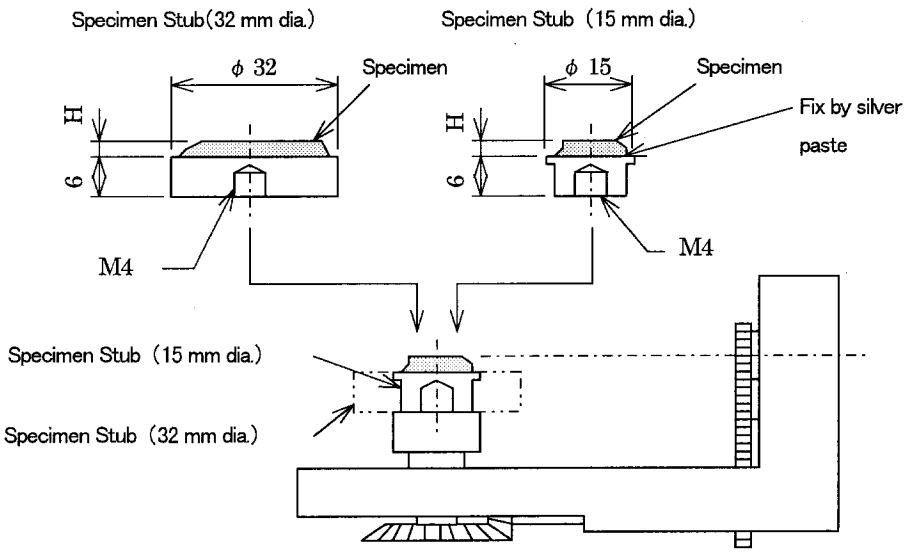
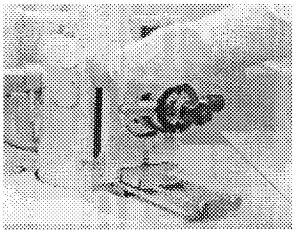


Fig.4-3 How to Mount Specimen Stub

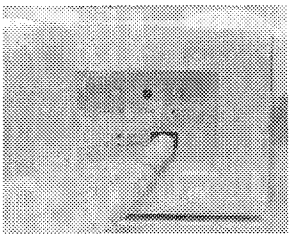
2 kind of specimen stubs having a diameter of 32 or 15 mm have been prepared as a standard accessory. Use them depending on the size of a specimen.
The eucentric adjustment of specimen height H is possible within a range of 6 mm.

IMPORTANT : Caution on low vacuum mode (VP-SEM)
Moist, oily or outgas-rich specimens should be set in the smallest size possible.



(6) Return the super eucentric stage to the specimen chamber. Set the **EVAC/AIR** switch on the evacuation control panel to **EVAC**.

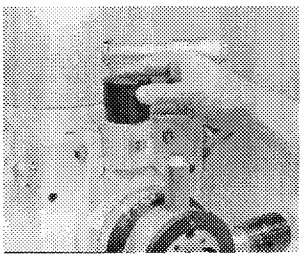
⚠ CAUTION : When the BSE detector is inserted, the stage should be set under the following conditions; Z (W.D.) = 10 to 35 mm and T = 0° .



(7) Wait about 3 to 4 minutes until the vacuum level indication in the status bar changes from red to green and then to **HV**.

(8) Click HV in the button to apply accelerating voltage and observe an image.

4.1.4 Working Distance

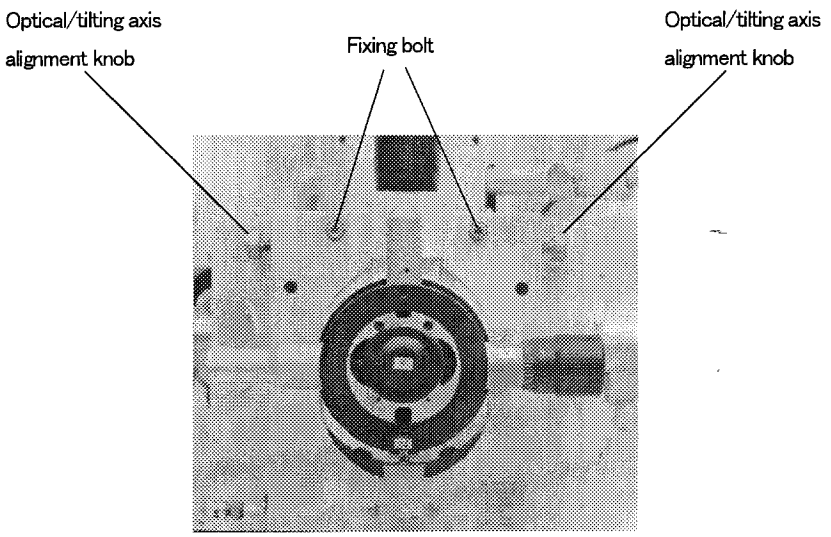


(1) Working distance (W.D.) is mechanically indicated on the W.D. scale. It is also presented in the data display area on the monitor menu for reference.

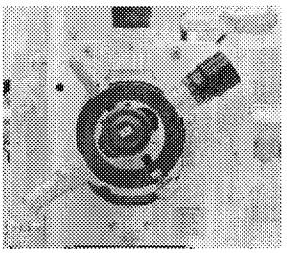
⚠ CAUTION : Take care not to bring the stage into contact with the BSE detector particularly when changing W.D. while a specimen is tilted with the detector introduced.

4.1.5 Super Eucentric Control

With the super eucentric specimen stage, image focus will not be affected upon shifting the field of view by the X/Y controls.
Besides, image escape on CRT is only slight when tilting a specimen at the center of its visual field. For this tilting method, two conditions must be met as detailed below. One is to align the specimen tilting axis with the electron-optical axis.
This axial alignment is unnecessary because the optical/tilting axis alignment knob has been factory-adjusted. Avoid tampering with the knob though it has been fixed. Should the knob be moved due to some reason contact the servicemen.

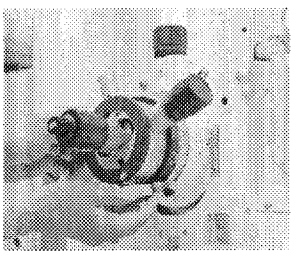


The other condition is to align the specimen surface with the tilting axis, which is done in the following procedure.



(1) Form an image at a low magnification and gradually tilt a specimen up to ±45° while performing step (2) to minimize image escape on CRT.

⚠ CAUTION : Take care not to bring the stage into contact with the BSE detector particularly when changing W.D. while a specimen is tilted with the detector introduced.



(2) In the course of tilting, the image on CRT will continue escaping in a direction. So, gradually turn the eucentric control knob in a direction permitting the image to return to the original location. Repeat this step until image escape is minimized. (Whenever manipulating the eucentric control knob, the image will blur. During this step, therefore, it must be brought into focus repeated.

(3) Increase magnification and repeat steps (1) and (2) until image escape is minimized at a desired magnification.

NOTICE : In case the eucentric control is not employed, the above steps (1) through (3) are unnecessary.

4.1.6 Tilt Range with BSE Detector Pulled Out

Table 4-1 and 4-2 shows tilt angle (T) in each Z (W.D.) in the state of pulled out the BSE detector.

Important : Please put the tilt after moving Z (W.D.) to the position which can tilt when tilting. Please move Z (W.D.) after it returns oppositely based on the tilt when you move Z (W.D.).

Table 4-1 Z (W.D.) and tilt angle (T) when ϕ 15mm specimen stub is used

Z(W.D.)(mm)	T(°)
5~6	−20~20
6~7	−25~25
7~8	−30~30
8~9	−35~35
9~10	−40~40
10~12	−45~45
12~14	−48~48
14~16	−50~50
16~18	−55~55
18~20	−58~58
20~22	−62~62
22~24	−65~65
24~25	−70~70
25~26	−85~85
26~35	−90~90

Table 4-2 Z (W.D.) and tilt angle (T) when ϕ 32mm specimen stub is used

Z(W.D.)(mm)	T(°)
5~6	−20~20
6~7	−25~25
7~8	−30~30
8~9	−35~35
9~10	−40~40
10~12	−45~45
12~14	−47~47
14~16	−50~50
16~18	−52~52
18~20	−55~55
20~22	−57~57
22~24	−60~60
24~26	−62~62
26~30	−65~65
30~33	−70~70
33~34	−78~78
34~35	−90~90

4.1.7 Tilt Range with BSE Detector Introduced

Table 4-3 and 4-4 shows tilt angle (T) in each Z (W.D.) in the state of introduce the BSE detector.

Table 4-3 Z (W.D.) and tilt angle (T) when ϕ 15mm specimen stub is used

Z(W.D.)(mm)	T(°)
7～8	0～3
8～9	−2～5
9～10	−4～10
10～12	−7～15
12～14	−12～22
14～17	−16～28
17～19	−25～35
19～21	−30～40
21～23	−36～44
23～25	−42～48
25～27	−48～51
27～29	−58～58
29～30	−68～68
30～31	−78～78
31～35	−90～90

Table 4-4 Z (W.D.) and tilt angle (T) when ϕ 32mm specimen stub is used

Z(W.D.)(mm)	T(°)
7～8	0～3
8～9	−1～5
9～10	−3～10
10～12	−5～15
12～14	−8～22
14～16	−12～28
16～18	−16～34
18～20	−20～38
20～22	−23～42
22～24	−27～46
24～26	−32～50
26～28	−36～53
28～30	−41～55
30～32	−45～57
32～33	−51～59
33～34	−54～60
34～35	−57～61

⚠ CAUTION : The BSE detector is inserted below the objective lens. So if the specimen is tilted at a short W.D., the specimen stage may interfere with the detector. Carry out specimen tilting in accordance with the above tables showing tilt angle and W.D..

4.2 Standard Stage

4.2.1 Standard Specifications

Traverse	X ····· 0 to 80 mm Y ····· 0 to 40 mm Z ····· 10 to 35 mm Tilt (non-eucentric) ····· −20° to 90° R (Rotation) ····· 360° (continuous)
Specimen size	150 mm (dia.) max.
Specimen stub size	15 mm (dia.) 60 mm (dia.) 125 mm (dia.)
Specimen exchange	Air introduction system

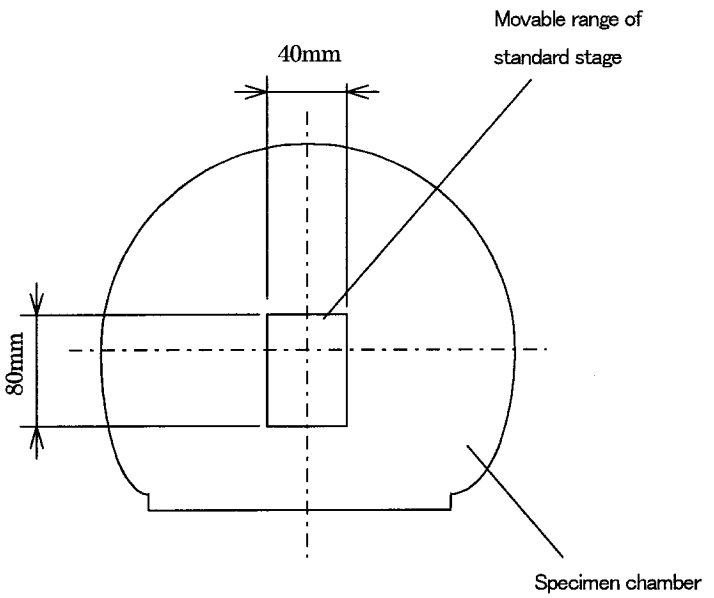


Fig.4-5 Movable Range of Standard Stage

4.2.2 Control Knobs

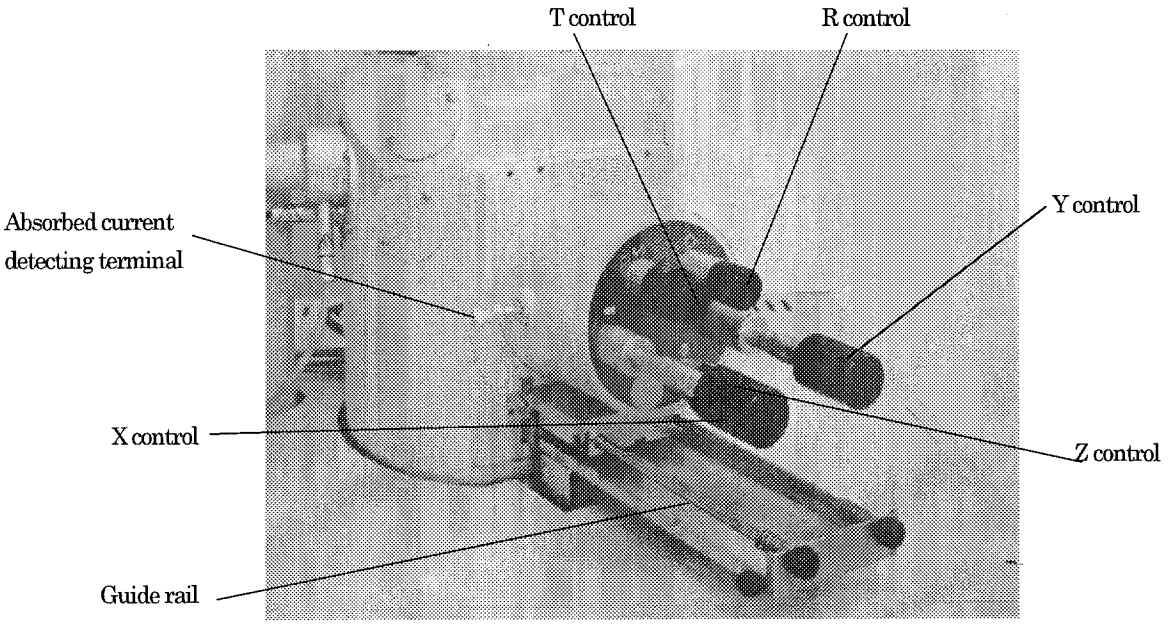


Fig. 4-6 Standard Stage

X control : Moves the specimen in the longitudinal direction facing the main unit (0 to 80 mm).

Y control : Moves the specimen in the lateral direction facing the main unit (0 to 40 mm).

Z control : Moves the specimen in the Vertical direction facing the objective lens (W.D. = 10 to 35 mm).

T handle : Tilts the specimen (−20 to 90°)

R control : rotates the specimen (±360° continuous)

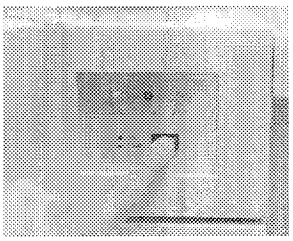
Absorbed current detecting terminal :

BNC terminal for detecting the absorbed current or specimen current.

Guide rail : Used to introduce or take out the stage.

4.2.3 Specimen Exchange

(1) Click **HV** in the exclusive switch menu to turn off accelerating voltage.



(2) Turn the **EVAC/AIR** switch on the evacuation control panel to **AIR**. (Wait until the column is vented to AIR condition.)

(3) Pull out the stage.

IMPORTANT : Be sure to set the stage controls as follows beforehand:

X····· 30 mm T····· 0°
Y····· 20 mm R····· Free
Z····· EX

(4) Remove the specimen stub.

Notice : The specimen stub is removed by lifting it while holding its edge by the fingers.To use the instrument in the best condition, wear vinyl gloves for the purpose of eliminating contamination through bare hands.

(5) Remove the specimen stub for the previous observation from the specimen holder.

(6) Mount a new specimen on the specimen stub.

(7) Fix the specimen stub on the specimen holder securely as shown below.

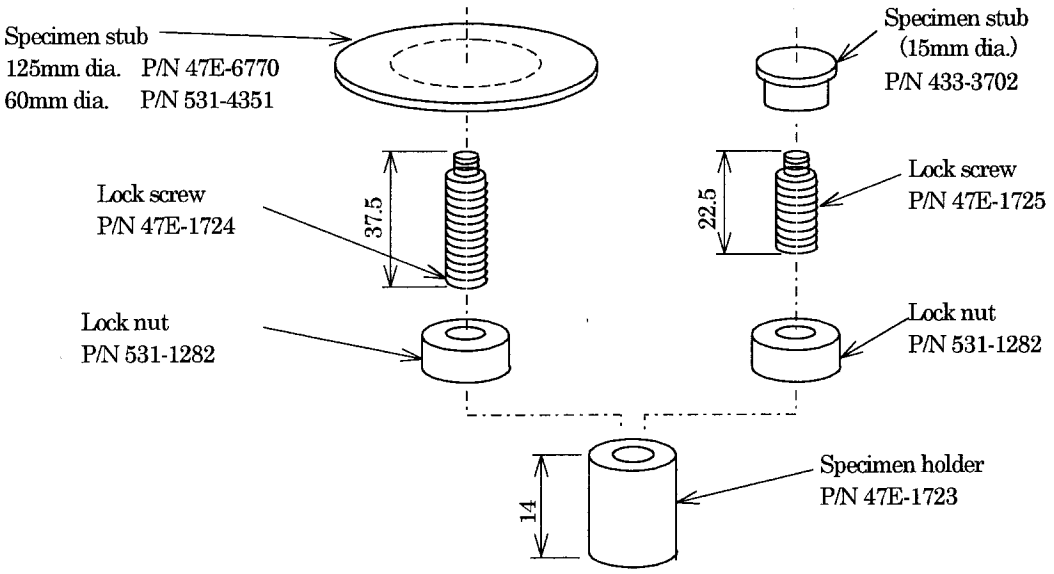


Fig.4-7 How to Fix Specimen Stub (standard stage)

(8) Loosen the specimen holders, adjust the specimen height to the gauge and fasten according to Figures 4-8 and 4-9.

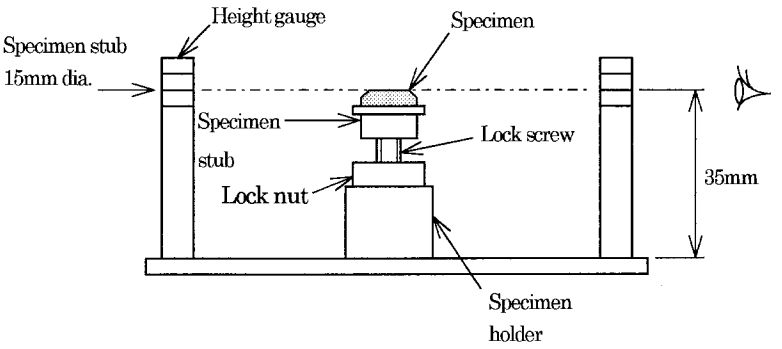


Fig.4-8 Specimen Height Adjustment (specimen stub 15 mm dia.)

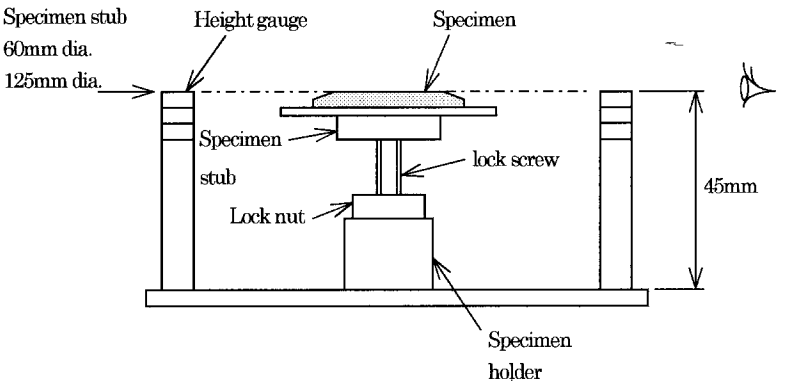
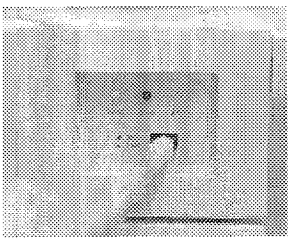


Fig.4-9 Specimen Height Adjustment (specimen stub 60 mm dia., 125 mm dia.)

(9) Mount the specimen holder to the stage and push in the specimen holder until it stops.

IMPORTANT: Caution on low vacuum mode (VP-SEM)
Moist, oily or outgas-rich specimens should be set in the smallest size possible.



(10) Return the stage to the specimen chamber. Set the **EVAC/AIR** switch on the evacuation control panel to **EVAC**.

⚠ CAUTION: When the BSE detector is inserted, the stage should be set under the following conditions; Z (W.D.) = 10 to 35 mm and T = 0° .

(11) Wait about 3 to 4 minutes until the vacuum level indication in the status bar changes from red to green and then to **HV**.

(12) Click **HV** in the button to apply accelerating voltage and observe an image.

4.2.4 Working Distance

W.D. is mechanically indicated on the W.D.scale.
It is also presented in the data display area on the monitor menu for reference.

⚠ CAUTION: Take care not to bring the stage into contact with the BSE detector particularly when changing W.D. while a specimen is tilted with the detector introduced.

Case of the motor drive is not installed.

The Z control has the scale shown in Figure 4-10a
Read the scale(white character) at the reference point corresponding to the specimen stub used.

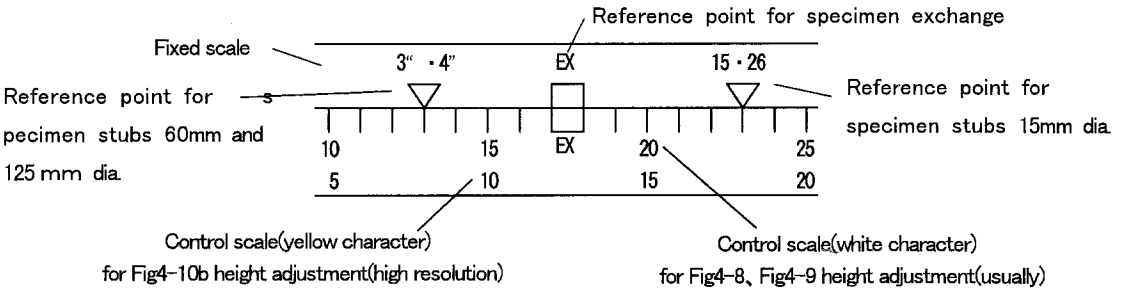


Fig4-10a Z control scale (Without motor drive)

Moreover, W.D. can be close to 5mm by the Figure 4-12b specimen height adjusting. However, there are a lot of limitations and adjusts only for demands higher resolution as the performance of the SEM confirmation etc. Read W.D in this case with the control scale"yellow character" of Fig.4-12a.
It is usually adjustment of the height of the specimen shown in Figure 4-10 and Figure 4-11(minimum WD:10mm),

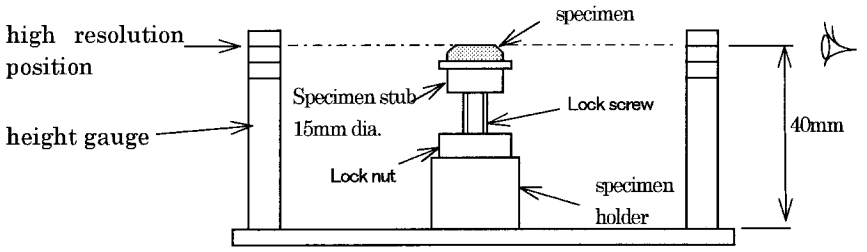


Fig. 4-10b Specimen Height Adjustment (High resolution)

IMPORTANT : Please use only 15mm dia. specimen stub, and draw out the BSE detector when you set the specimen height of a high resolution .

Case of the motor drive is installed.

The Z control has the scale shown in Figure 4-10c
Read the scale of corresponding to the specimen stub used at the reference point.

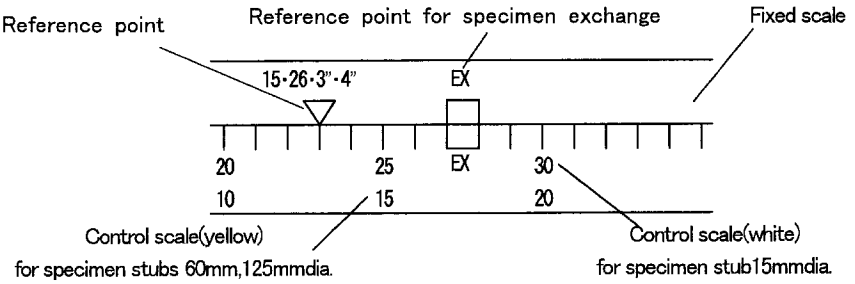


Fig4-10c Z control scale (With motor drive)

4.2.5 Tilt Range with BSE Detector Pulled Out

Table 4-5 to 4-7 shows the relation between each Z scale (W.D. in the horizontal state) and tilt angle (T) in the state of pulled out the BSE detector.

IMPORTANT : Please put the tilt after moving Z (W.D.) to the position which can tilt when tilting. Please move Z (W.D.) after it returns oppositely based on the tilt when you move Z (W.D.).

IMPORTANT : When tilt from the horizontal state, the gap might be caused in the focus because this stage is non-eucentric tilting stage. Moreover, viewing image runs away on CRT occasionally. The following tables show the range of can the tilt to the scale value of Z knob it.

Table 4-5 Z scale (W.D.) and tilt angle (T) when ϕ 15mm specimen stub is used

Z(W.D.)(mm)	T(°)
10～11	−15～85
11～12	−20～87
12～35	−20～90

Table 4-6 Z scale (W.D.) and tilt angle (T) when ϕ 60mm specimen stub is used

Z(W.D.)(mm)	T(°)
7～8	0～13
8～9	0～15
9～10	−3～18
10～11	−5～22
11～12	−6～24
12～13	−8～28
13～14	−10～32
14～15	−12～38
15～16	−13～45
16～17	−15～60
17～18	−17～76
18～19	−19～78
19～20	−20～80
20～25	−20～90

Table 4-7 Z scale (W.D.) and tilt angle (T) when ϕ 125mm specimen stub is used

Z(W.D.)(mm)	T(°)
7～8	0～12
8～9	0～14
9～10	−1～16
10～12	−2～18
12～14	−4～21
14～16	−6～24
16～18	−7～27
18～20	−9～30
20～22	−11～33
22～24	−13～35
24～25	−15～38

4.2.6 Tilt Range with BSE Detector Introduced

Table 4-8 to 4-10 shows tilt angle (T) in each Z scale (W.D.) in the state of introduce the BSE detector.

Table 4-8 Z scale (W.D.) and tilt angle (T) when ϕ 15mm specimen stub is used

Z(W.D.)(mm)	T(°)
10～11	−10～68
11～12	−17～72
12～13	−20～75
13～14	−20～78
14～15	−20～80
15～16	−20～85
16～17	−20～88
17～35	−20～90

Table 4-9 Z scale (W.D.) and tilt angle (T) when ϕ 60mm specimen stub is used

Z(W.D.)(mm)	T(°)
7～8	0
8～9	0～2
9～10	−3～4
10～12	−5～6
12～14	−8～12
14～16	−12～18
16～18	−15～25
18～19	−19～30
19～20	−20～36
20～21	−20～42
21～22	−20～50
22～25	−20～90

Table 4-10 Z scale (W.D.) and tilt angle (T) when ϕ 125mm specimen stub is used

Z(W.D.)(mm)	T(°)
7～8	0
8～9	0～2
9～10	−1～4
10～12	−2～6
12～14	−4～10
14～16	−6～14
16～18	−7～17
18～20	−9～20
20～22	−11～23
22～24	−13～25
24～25	−15～28

⚠ **CAUTION** : The BSE detector is inserted below the objective lens. So if the specimen is tilted at a short W.D., the specimen stage may interfere with the detector. Carry out specimen tilting in accordance with the above tables showing tilt angle and W.D..

4.3 Large-size Eucentric Stage

4.3.1 Standard Specifications

Traverse	X ····· 0 to 100mm Y ····· 0 to 50mm Z ····· 5 to 40mm Tilt (eucentric) ····· 0° to 60° R (Rotation) ····· 360° (continuous)
Specimen size	150 mm (dia.) max.
Specimen stub size	15 mm (dia.) 50 mm (dia.) 125 mm (dia.)
Specimen exchange	Air introduction system

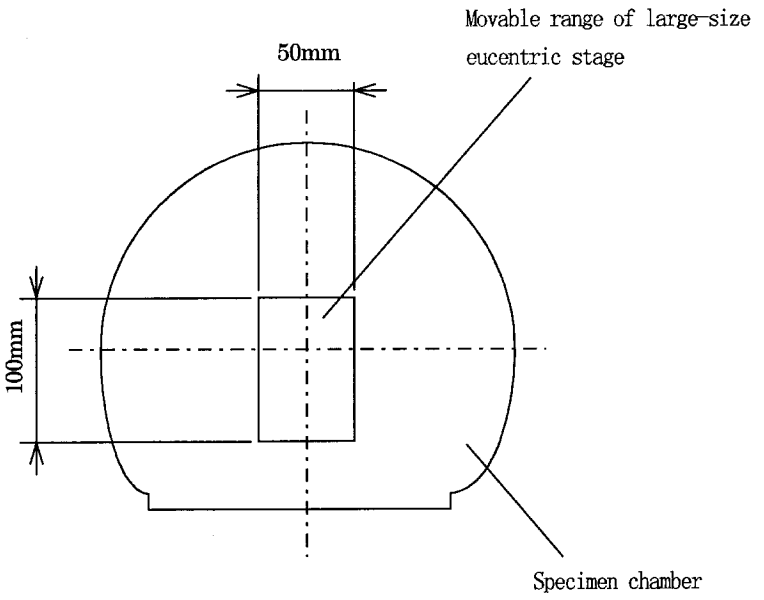


Fig.4-11 Horizontal Movable Range of Large-size

4.3.2 Control Knobs

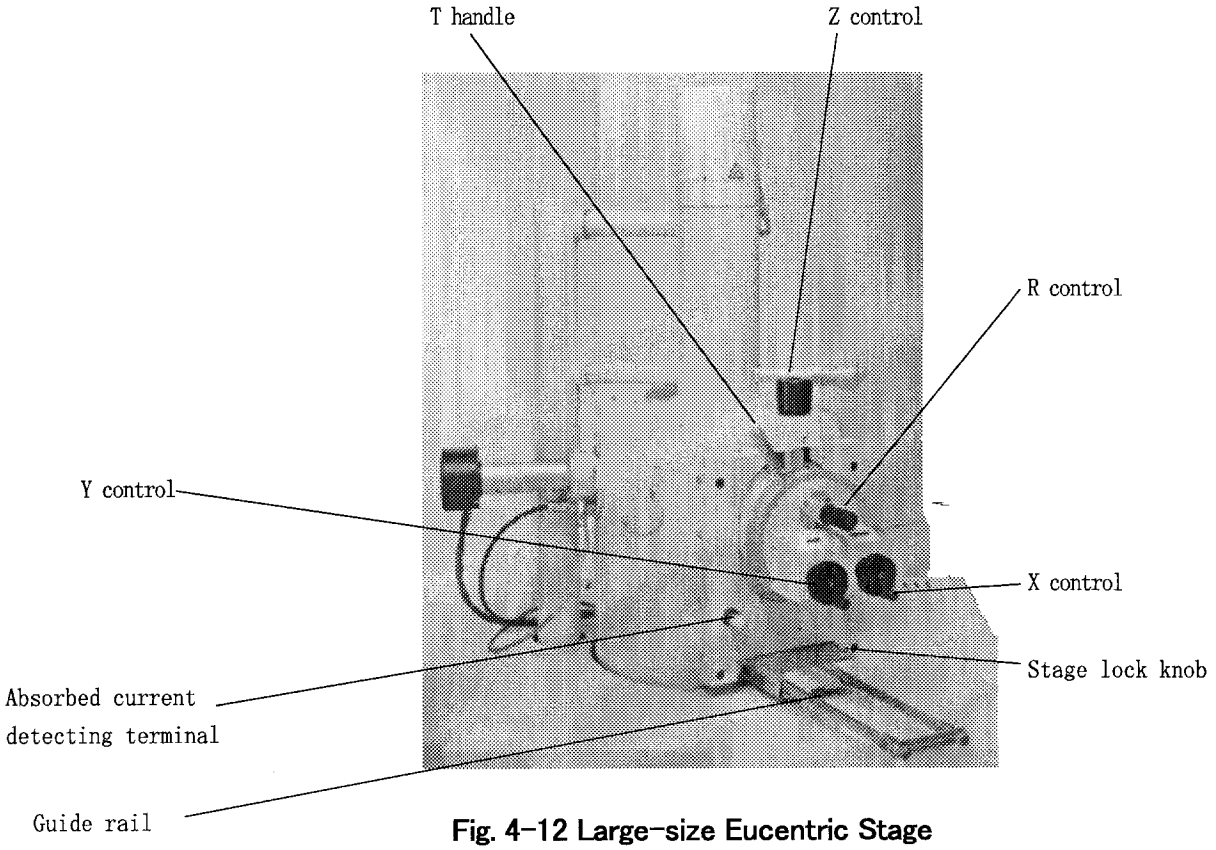


Fig. 4-12 Large-size Eucentric Stage

X control : Moves the specimen in the longitudinal direction facing the main unit (0 to 100 mm).

Y control : Moves the specimen in the lateral direction facing the main unit (0 to 50 mm).

Z control : Moves the specimen in the Vertical direction facing the objective lens (W.D.= 5 to 40 mm).

T handle : Tilts the specimen (0 to 60°)

R control : rotates the specimen (±360° continuous)

Stage lock knob:

Used to temporarily fasten the stage in pulled-out condition.

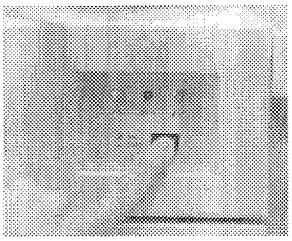
Absorbed current detecting terminal:

BNC terminal for detecting the absorbed current or specimen current.

Guide rail : Used to introduce or take out the stage.

4.3.3 Specimen Exchange

(1) Click **HV** in the exclusive switch menu to turn off accelerating voltage.



(2) Turn the **EVAC/AIR** switch on the evacuation control panel to **AIR**. (Wait until the column is vented to AIR condition.)

(3) Pull out the stage.

IMPORTANT : Be sure to set the stage controls as follows beforehand:

X····· 60 mm T·····0°
Y····· 25 mm R·····Free
Z····· 30 mm

(4) Remove the specimen stub.

NOTICE : The specimen stub is removed by lifting it while holding its edge by the fingers. To use the instrument in the best condition, wear vinyl gloves for the purpose of eliminating contamination through bare hands.

(5) Remove the specimen stub for the previous observation from the specimen holder.

(6) Mount a new specimen on the specimen stub.

(7) Fix the specimen stub on the specimen holder securely as shown below.

NOTICE : Please select the specimen holder, the lock nut, and the folder screw properly according to the height of the observed specimen.

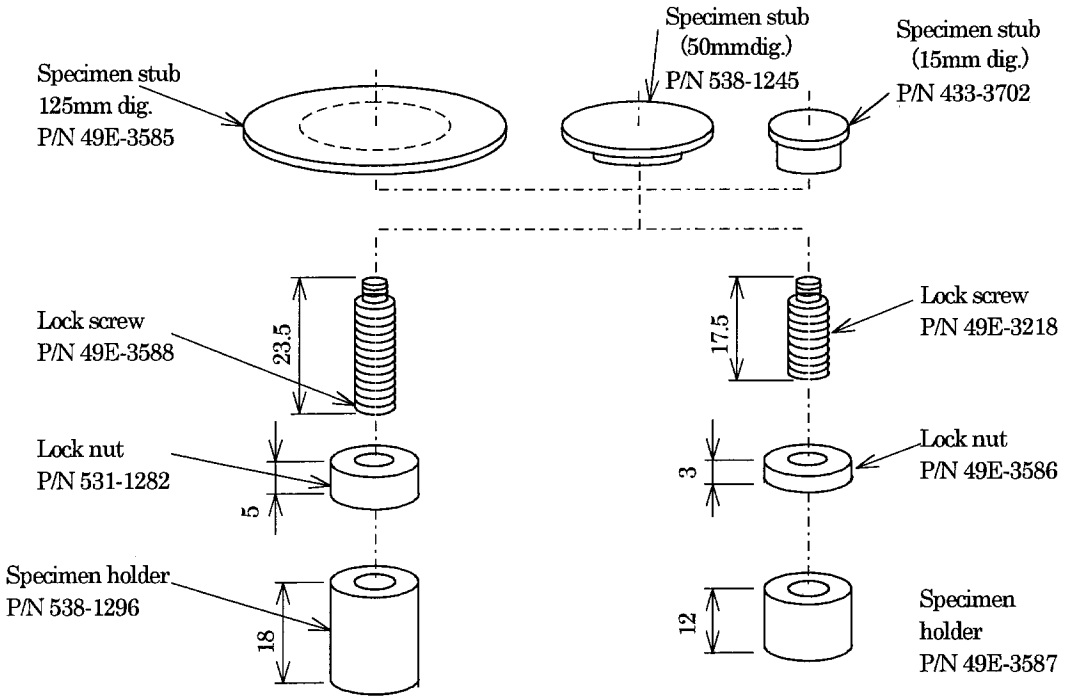


Fig.4-13 How to Fix Specimen Stub (large-size eucentric stage)

(8) Loosen the specimen holders, adjust the specimen height to the gauge and fasten according to Figures 4-14.

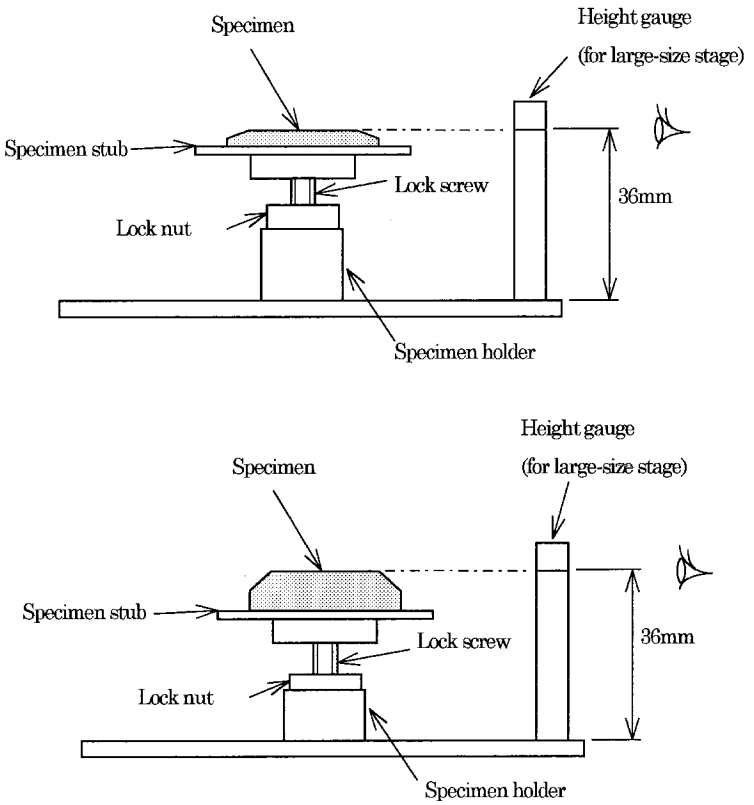
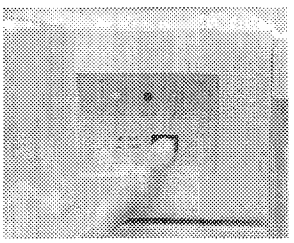


Fig. 4-14 Specimen Height Adjustment

(9) Mount the specimen holder to the stage and push in the specimen holder until it stops.

IMPORTANT : Caution on low vacuum mode (VP-SEM)
Moist, oily or outgas-rich specimens should be set in the smallest size possible.



(10) Return the stage to the specimen chamber. Set the **EVAC/AIR** switch on the evacuation control panel to **EVAC**.

⚠ CAUTION : When the BSE detector is inserted, the stage should be set under the following conditions; Z (W.D.) = 10 to 35 mm and T = 0°

(11) Wait about 3 to 4 minutes until the vacuum level indication in the status bar changes from red to green and then to **HV**.

(12) Click **HV** in the button to apply accelerating voltage and observe an image.

4.3.4 Working Distance

(1) Working distance (W.D.) is mechanically indicated on the W.D. scale. It is also presented in the data display area on the monitor menu for reference.

⚠ CAUTION : Take care not to bring the stage into contact with the BSE detector particularly when changing W.D. while a specimen is tilted with the detector introduced.

4.3.5 Tilt Range with BSE Detector Pulled Out

Table 4-11 to 4-13 shows tilt angle (T) in each Z (W.D.) in the state of pulled out the BSE detector.

IMPORTANT : Please put the tilt after moving Z (W.D.) to the position which can tilt when tilting. Please move Z (W.D.) after it returns oppositely based on the tilt when you move Z (W.D.).

Table 4-11 Z (W.D.) and tilt angle (T) when ϕ 15mm specimen stub is used

Z(W.D.)(mm)	T(°)
5~6	0~21
6~7	0~25
7~8	0~30
8~9	0~35
9~10	0~37
10~12	0~45
12~14	0~47
14~16	0~49
16~18	0~52
18~20	0~54
20~23	0~57
23~40	0~60

Table 4-12 Z (W.D.) and tilt angle (T) when ϕ 50mm specimen stub is used

Z(W.D.)(mm)	T(°)
5~6	0~21
6~7	0~25
7~8	0~30
8~10	0~35
10~13	0~45
13~17	0~47
17~20	0~50
20~23	0~53
23~25	0~55
25~27	0~57
27~29	0~58
29~40	0~60

Table 4-13 Z (W.D.) and tilt angle (T) when ϕ 125mm specimen stub is used

Z(W.D.)(mm)	T(°)
5~6	0~21
6~7	0~25
7~8	0~30
8~9	0~35
9~10	0~37
10~13	0~43
13~17	0~45
17~20	0~47
20~22	0~49
22~25	0~50
25~27	0~52
27~29	0~53
29~32	0~54
32~34	0~55
34~36	0~56
36~40	0~57

4.3.6 Tilt Range with BSE Detector Introduced

Table 4-14 to 4-16 shows tilt angle (T) in each Z scale (W.D.) in the state of introduce the BSE detector.

Table 4-14 Z (W.D.) and tilt angle (T) when ϕ 15mm specimen stub is used

Z(W.D.)(mm)	T(°)
7~8	0~3
8~9	0~5
9~10	0~10
10~11	0~15
11~12	0~17
12~13	0~22
13~14	0~25
14~15	0~28
15~16	0~30
16~18	0~34
18~20	0~38
20~22	0~42
22~24	0~46
24~26	0~50
26~28	0~53
28~30	0~55
30~33	0~57
33~40	0~60

Table 4-15 Z (W.D.) and tilt angle (T) when ϕ 50mm specimen stub is used

Z(W.D.)(mm)	T(°)
7~8	0~3
8~9	0~5
9~10	0~10
10~11	0~15
11~12	0~17
12~13	0~22
13~14	0~25
14~15	0~28
15~16	0~30
16~18	0~34
18~20	0~38
20~22	0~42
22~24	0~46
24~26	0~50
26~28	0~53
28~30	0~55
30~33	0~57
33~40	0~60

Table 4-16 Z (W.D.) and tilt angle (T) when ϕ 125mm specimen stub is used

Z(W.D.)(mm)	T(°)
7～8	0～3
8～9	0～5
9～10	0～10
10～11	0～15
11～12	0～17
12～13	0～22
13～14	0～25
14～15	0～28
15～16	0～30
16～18	0～34
18～20	0～38
20～22	0～42
22～24	0～46
24～27	0～50
27～31	0～52
31～36	0～54
36～40	0～56

⚠ **CAUTION** : The BSE detector is inserted below the objective lens. So if the specimen is tilted at a short W.D., the specimen stage may interfere with the detector. Carry out specimen tilting in accordance with the above tables showing tilt angle and W.D..

4.3.7 Stage Lock Mechanism

The large-size eucentric stage is equipped with the stage lock mechanism to obtain a higher quality of image in observation at high magnification. Described below is how to use this mechanism.

IMPORTANT : Avoid Z-axis traverse and tilting with the stage lock mechanism pulled into the specimen chamber to prevent damage to the stage lock mechanism.

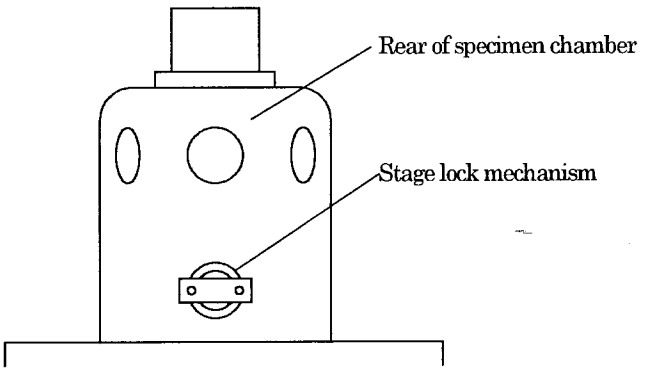


Fig.4-15 Stage Lock Mechanism Mounting Position

(1) For Observation of Image in Higher Quality at High Magnification

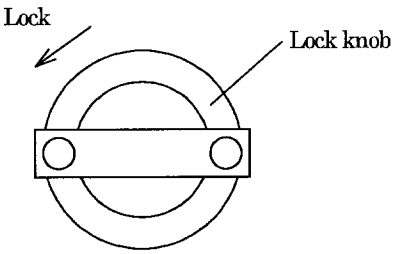


Fig.4-16 How to Make Stage Lock Mechanism Effective

In EVAC condition, rotate the lock knob so that the stage lock mechanism is as shown on above figure as viewed from the rear of the specimen chamber. The stage lock mechanism is then pulled into the specimen chamber and presses on the end of the stage to minimize image disturbance due to vibration.

(2) For Image Observation with Stage Lock Mechanism Pulled Apart

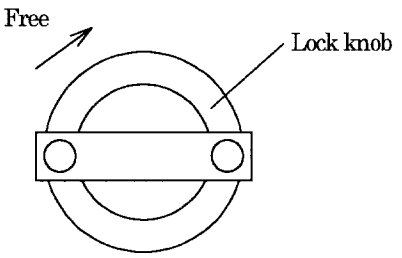


Fig.4-17 How to Make Stage Lock Mechanism Ineffective

In EVAC condition, rotate the handle so that the stage lock mechanism is as shown in the above figure as viewed from the rear of the specimen chamber. The stage lock mechanism is then pulled apart from the end of the stage. In this condition, Z-axis traverse and tilting are posible.

4.4 Usage of Gate

The gate for large-sized stage has been prepared as a standard accessory to prevent damage to the BSE detector. With the gate attached to the front of the specimen chamber as shown in Figure 5-18, the position of the gate can be regarded as that of the BSE detector virtually introduced under the objective lens. Use the gate to determine the movable range of the stage with the BSE detector introduced. The movable range can also be obtained from the figure given above.

With the gate, determine the restrictions visually.
After putting a specimen stub on the stage and before returning the stage into the specimen chamber, carry out the following steps (a) to (f).

(a) Attach the gate to the specimen chamber.
(b) Put a specimen stub on the stage.
(c) Move the stage to the position where the specimen stub is just below the gate.
(d) Determine one value among the working distance, tilt angle and Y traverse, then move the stage to the point where the bottom edge of the gate and the specimen stub are nearly in contact, and record the other two values.
(e) Pull the stage out a little, detach the gate and then return the stage into the specimen chamber.
(f) Carry out actual operation within the ranges recorded in step (d).

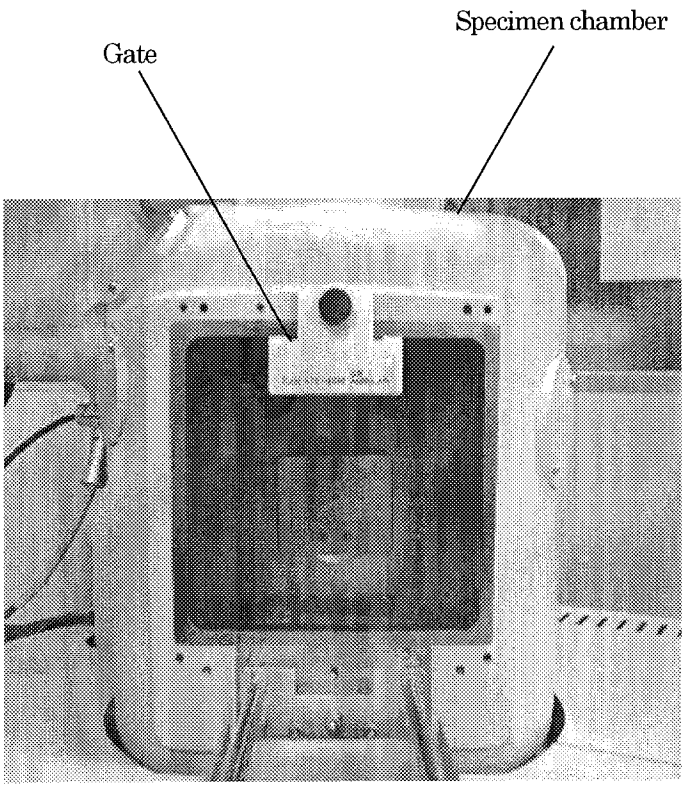


Fig. 4-18 Attachment of Gate

5. EDX Integration Kit

5.1 Outline

EDX Integration Kit is an option by which a function necessary to integrate the NORAN Instruments Inc.EDX(VantageCI)and S-3000N/H is made a kit.
Please refer to the instruction manual of EDX for the handling of the part EDX.

EDX Integration Kit contains the following.

a)Integration Rack
Refer this instruction manual.

b)Hi-mouse
Refer Hi-mouse instruction manual.

c)X-ray mode function
Refer the section of option of SEM.

d)DBC I/F cable

e)Anti-vibration Rubber

f)OBJ.Aperture(Ta.)

g)Monitor for EDX(option)
Refer monitor instruction manual.

Monitor for EDX is option. When it is prepared by local supplier or dearer,refer to the instruction manual of the monitor.

5.2 Composition of EDX integration part

Figure 5-1 shows the appearance of the EDX integration part.

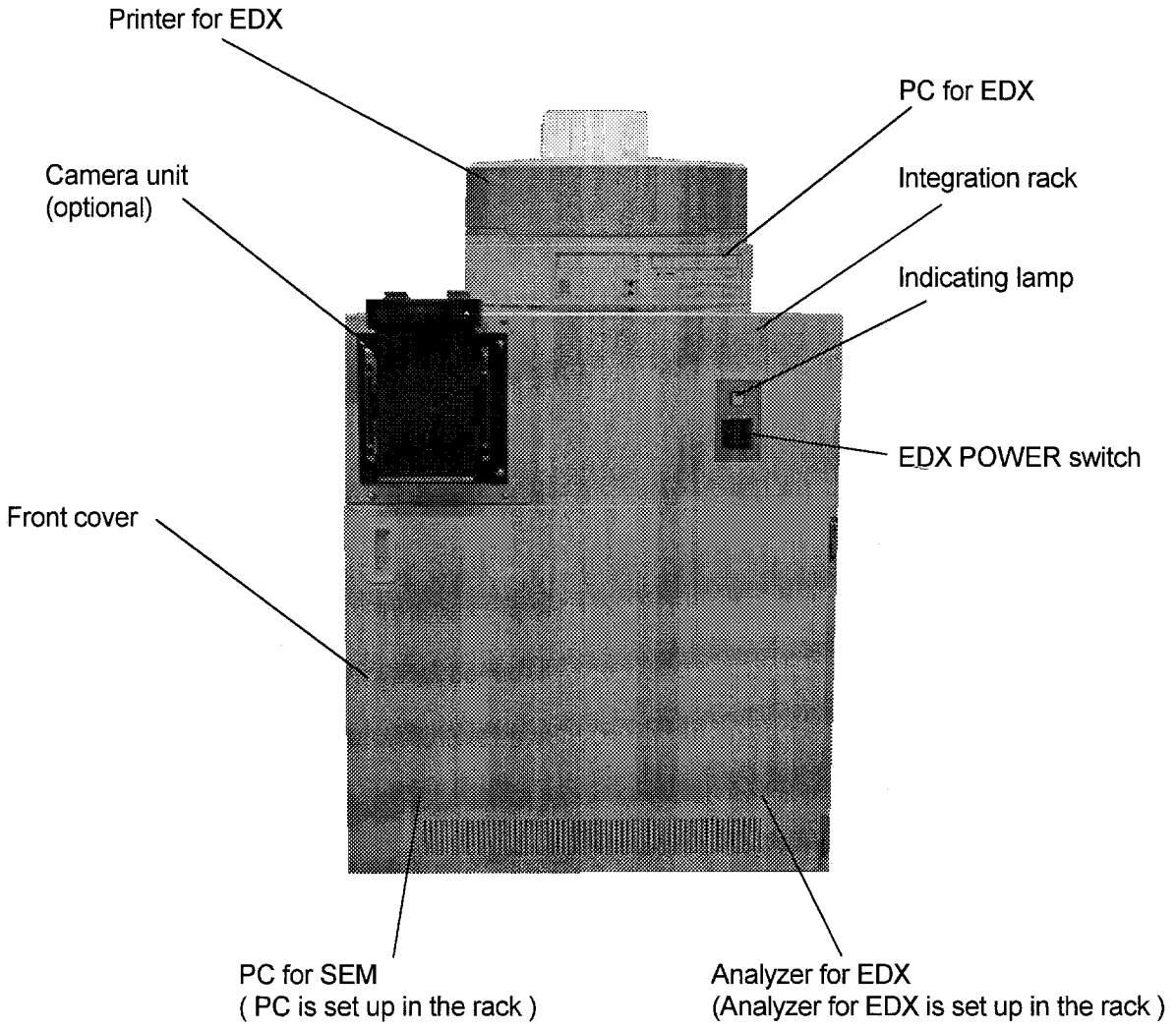


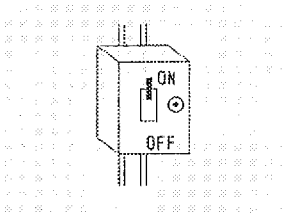
Fig 5-1 Appearance of the EDX integration part

NOTICE
●Please give PC neither vibration nor the impact. There are a weak parts to the vibration and the impact such as hard drives in PC. PC might break down when the vibration and the impact are given to PC. Please ask quietly when you close a front cover. ●When the EDX POWER switch is tur ned off,please turn off after the Windows termination of PC for edx is done,and it puts into the state that the power supply of the computer can be turned off. it causes the breakedown of PC. ●The EDX POWER switch supplies the power supply to PC for EDX, the anaiyzer the monitor for EDX, the printer,and the part of attachmento option for EDX.

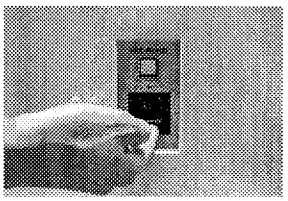
5.3 Basic operation

The start-up of the X-ray analysis device and the stop are done according to the following procedures.

5.3.1 Start-up

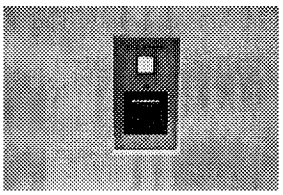


(1) Turn ON the power switch on the switchboard.



(2) Turn on the EDX POWER switch.
The indicating lamp lights when the switch is turned on.

Power supply switch of the analyzer and PC for EDX synchronizes with the EDX POWER switch and is useally set in turning on.



Therefore,EDX menu is automatically started.

(4) Operate the analysis operation after the startup referring to the manual of the X-ray analysis device.

Start up the SEM side beforehand when you take the image from SEM.

(Refer to the start operation of SEM for the operation method)

5.3.2 Insertion of detector

When the detector for X-ray analysis is inserted in the specimen chamber,operates according to the following procedures.

(1)The stage position of SEM is set as follows.

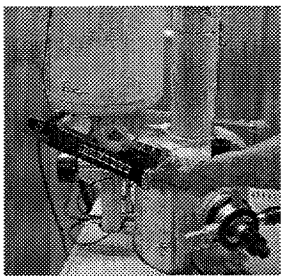
X,Y ——— Moves to the sample exchange position.
The sample exchange position is different depending on the kind of the stage.
Please reher to the plate at the specimen exchange position pasted side of the stage.

Z ——— 15mm(position for X-ray analysis)

T ——— 0° (horizontal)

R ——— free

(2)It is confirment that the Faraday cup device etc. are not inserted in the specimen chamber.
X-ray analysis is hindered when the Faraday cup device etc.have been inserted and pull out.



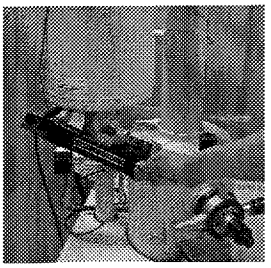
(3)To insert the detector for x-ray analysis in the specimen chamber,the knob of putting in and out of the detector is rotated right to the position where the rotation stops.

(4)X-ray analysis is done referring to the instruction manual of the X-ray analysis device.

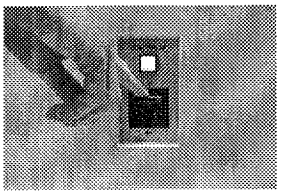
(5)After X-ray analysis ends,the knob of (3)is turned in the opposite direction and detector is pulled out.

5.3.3 Shutdown

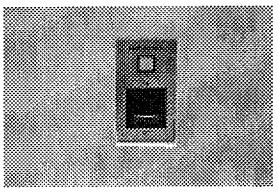
(1)To pull out the detctor for X-ray analysis from the specimen chamber,the knob of putting in and out of the detector is rotated left to the position where the rotation stops.



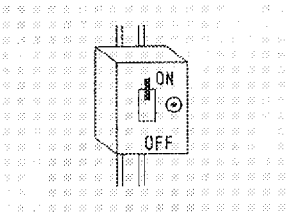
(2)Shutdown Windows® on the EDX side.



(3)Turn off the EDX POWER switch.



The indicating lamp is turned off when the switch is turned off, and the power supply of PC and analyzer for EDX stops.



(4)Turn off the switch of the switchboard.

NOTICE

- When the EDX POWER switch is turned off,please turn off after the Windows termination of PC for EDX is done,and it puts into the state that the power supply of the computer can be turned off. it causes the breakdown of PC.