



# Metallurgical Microscope


**Model: BS-6022RF/TRF**  
**User Manual**



It is recommended strongly that you study this manual thoroughly before using the microscope. Retain this manual in an easily accessible place near the work desk for future reference.

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**I. Safety note**

1. Carefully open the box, avoid the accessories, like lens, dropping to ground and being damaged.
2. Do keep the instrument out of direct sunlight, high temperature or humidity, dusty and easy shaking environment. Make sure the stage is smooth, horizontal and firm enough.
3. When moving the instrument, please use two hands to grip with the two sides of the microscope body.
4. When running, the lamp house and nearby parts will be very hot. Please ensure there is enough cooling room for them.
5. Always ensure that the grounding terminal of the microscope and that of the wall outlet are properly connected. If the proper power cord is not used, product safety performance cannot be warranted.
6. For safety, be sure the main switch is in “O”(off) state before replace the halogen lamp or the fuse, then cut off the power, and do the operation after the lamp bulb and the lamp house completely cool. **(Specified Lamp:  G6.35 24V100W halogen lamp)**
7. Use the factory supplied power cord, please.

**II. Maintenance**

1. All the lenses have been well checked and adjusted. It is forbidden to disassemble them yourself.
2. The nosepiece and coarse/fine focus unit have a compact and precise frame, please don't disassemble them as possible as you can.
3. Keep the instrument clean, wipe dust regularly, and be attention to avoid contaminating the optical elements especially.
4. The contaminations on the prism, as finger mark and oil, could be gently wiped with a piece of soft cloth or tissue paper, gauze which has been immersed in pure alcohol or xylene. **(note that the alcohol and the xylene are all burned easily, do not let them near the fire, and use them in a drafty room as possible as you can.)**
5. Don't use organic solvent to wipe the non-optical elements, when you need to clean, use the soft detergent, please.
6. When using, if the microscope is splash by liquid, cut off the power at once, and wipe up the moisture.
7. Do not disassemble any parts of the microscope. That will affect the function or decline the performance of the microscope.
8. Place the instrument in a cool, dry position. After using the microscope, remember to cover it

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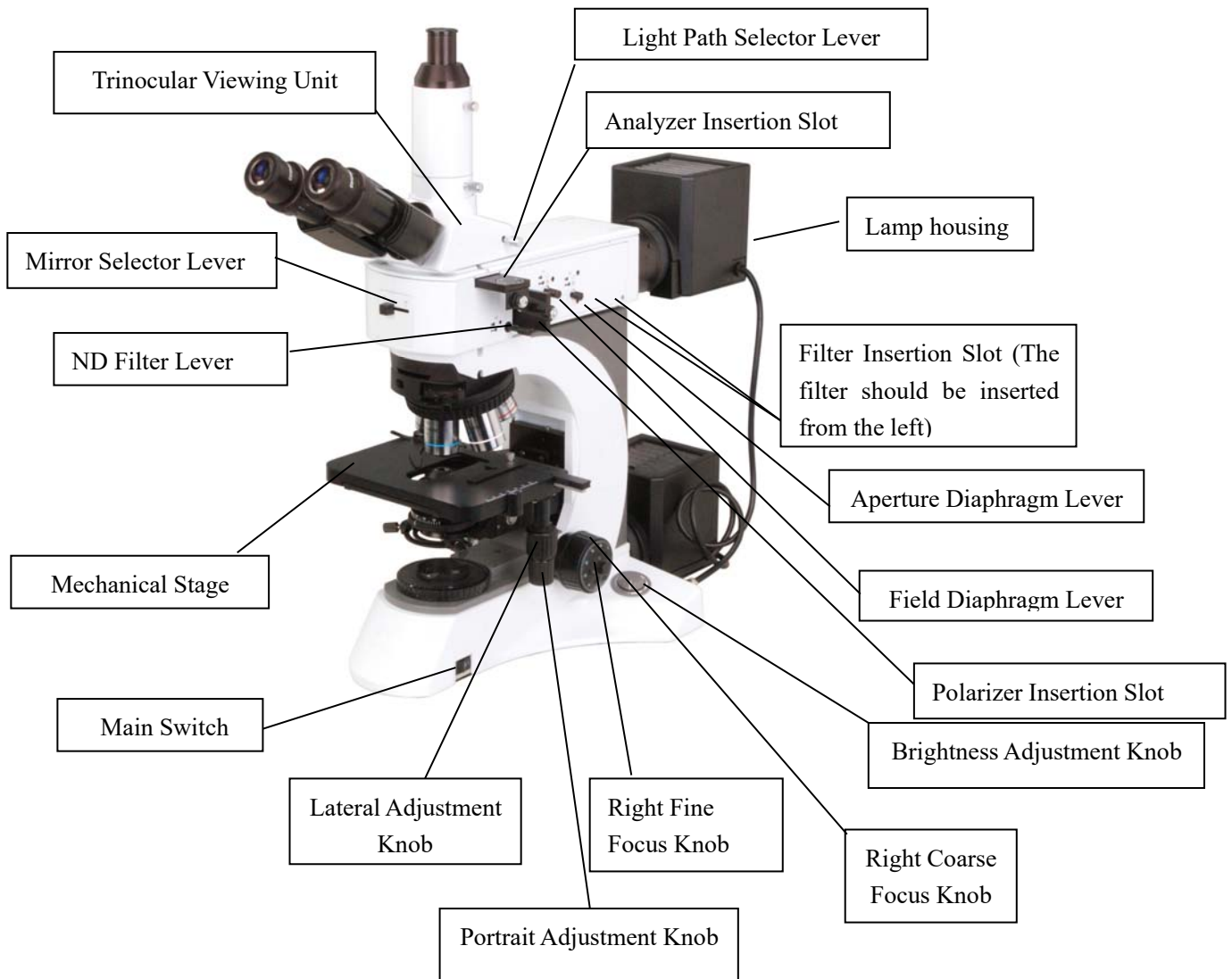
with dust helmet. Do wait for the lamp house cooling completely before cover.

**III. Electrical Parameters:**

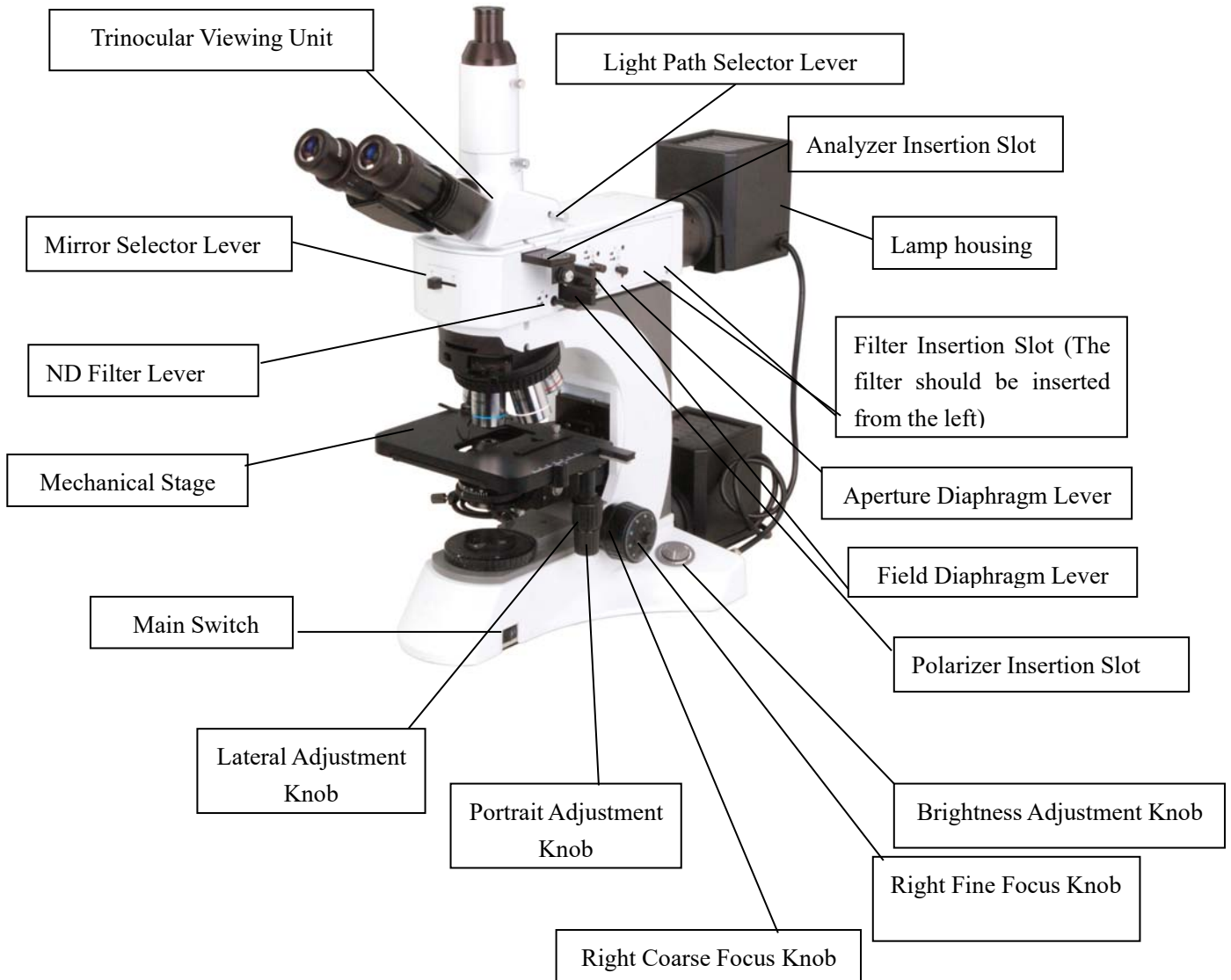
1. Voltage Rating: 100-240V AC, 50/60HZ
2. Power Rating: 200VA
3. Fuse specs.50T T5AL250V
4. Lamp: 24V100W

1. Name of Components

BS-6022RF/TRF



Components Name of BS-6022TRF



**Components Name of BS-6022RF**

2. Installation

BS-6022RF/TRF

2-1 Installation Diagram

The following figure shows the installation sequence of the components take BS-6022TRF for example. The number in the figure show the installation steps.

- ★ Before installing, be sure every components is clean, do not score any parts or glass surface.
- ★ Keep well with the supplied hexagon wrench. When changing the components, you will need it again.



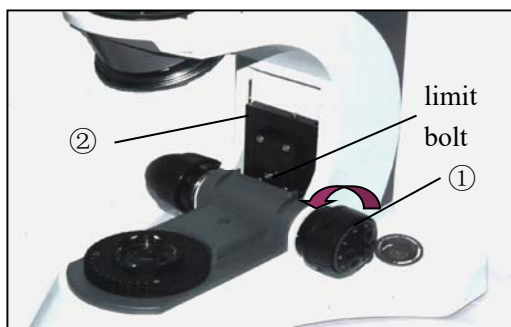


Fig.1



Fig.2

### 2-2-1 Installing the Mechanical Stage Support Device

1. Before installing the device, be sure to adjust the coarse focus knob ①. Make the guide board ② down to the lowest position, so you can install the mechanical stage support device easily.
2. Hold on the mechanical stage support device (Fig. 2), place it from the top of the guide board (Fig.1), let the device (Fig.2) falling free until it reach the limit bolt. Use the hexagon wrench screw down the locking block ③, make the stage support device and the guide board fixed together(Fig.3).

★ Fig.1, Fig.2 show the installation sequence of the components which take BS-6022TRF for example. For BS-6022RF, there are two limit bolt holes with different height on the guide board ② to meet with sample which have different thickness: the upside hole is for sample with 0~30mm thickness, the underside hole is for sample with 20~50mm thickness.

★ The mechanical stage ⑤ have been adjusted horizontally and fixed together before leaving factory. Do not disassembly unless necessary, that may affect the observation precision of the instrument.





Fig.4

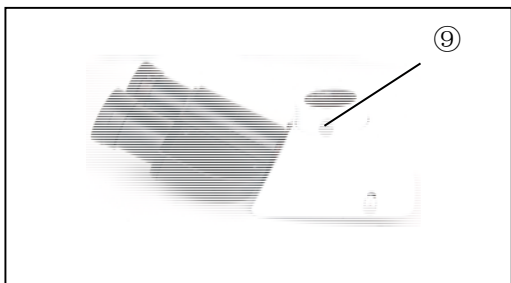


Fig.6

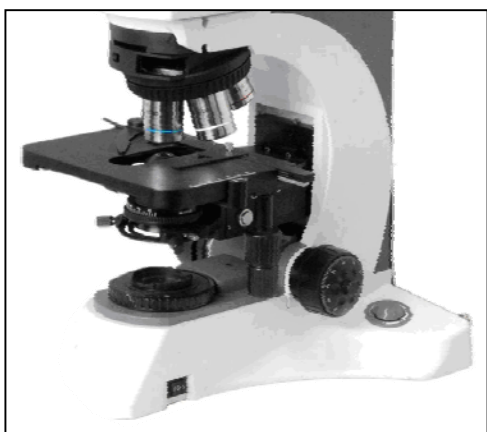


Fig.7

### 2-2-2 Installing the reflected light brightfield/darkfield illuminator

1. Installing the reflected light illuminator (Fig.4) on the head of microscope body(Fig. 5), and turn to a proper position, then screw down the bolt ⑥to fix it.

### 2-2-3 Installing the Video Port

1. Insert the video port (Fig.6) into the illuminator (Fig. 4), then screw down the bolt to fix it.

### 2-2-4 Installing the Objective

1. Adjusting the coarse focus knob until the support device of the mechanical stage reach its low limit position.  
 2. Wresting the lowest magnification objective onto the nosepiece from the left or the right side, then push the nosepiece clockwise, then place other objectives by the sequence of low to high magnification (Fig.7).

✧ Installing objective this way will make the change of magnification to be easier while in using.

★ **Clean the objective regularly, the objective of the inversed microscope is very sensitive to dust.**

★ **When replacing the objective, slowly turning the nosepiece until you hear “clicked”, that means the objective enter the required position--the light path center.**



Fig.8

### 2-2-5 Installing the Video Port (optional)

Insert the video port (Fig. 8) into the trinocular unit (Fig. 6), then screw down the bolt ⑨ to fix it.

### 2-2-6 Installing the Eyepiece

Insert the eyepiece (Fig.9) into the eyepiece tube until they are against each other.



Fig.9

### 2-2-7 Installing the Lamp Housing

1. Pushing the lamp holder (Fig.10) into the illumination kits(Fig. 4) gently until they are against each other, turn to a proper position, then screw down the bolt ⑧ to fix it.

2. Insert the power plug ① into the power jack of the microscope ②, and screw down the bolt to fix it. The result in show in Fig. 12.



Fig.10

© When using transmitted light illuminator, remove the dust cap first, then pushing the lamp holder (Fig.10) into the jack on the back of the microscope (Fig.11) gently and turn to a proper position, then screw down the bolt ④. Insert the power plug ① into the power jack of the microscope ③, and screw down the bolt to fix it.

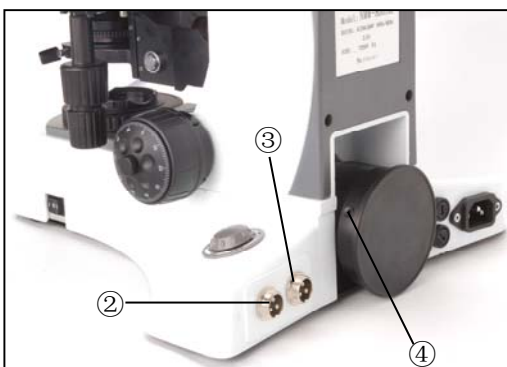


Fig.11



Fig.12



Fig.13



Fig.14

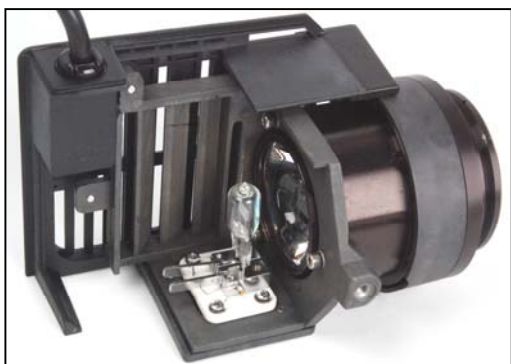


Fig.15

### 2-2-8 Attaching the Halogen Bulb

The applicable lamp bulb is the 24V100W HAL.

1. Fully loosen the clamping screw ① at the top of the lamp housing using the provided hexagon wrench.
2. Remove the lamp housing ② by lifting it up.
3. Tilt the bulb socket by 90° (Fig. 14)
4. While pushing down the bulb clamping levers, hold the halogen bulb with gloves or a piece of gauze, insert the bulb pins into the sections as far as they will go.

Then return the lamp clamping lever gently back to the original position to clamp the bulb.

#### **Caution for Bulb Replacement During or Right After Use**

When using, or soon after it is turned off the lamp, the lamp house and nearby parts will be very hot and will cause serious burns. Please turn the main switch on “O” (off), pull out power plug, and make sure the bulb, the lamp room and periphery are all cool. Then, you can do your replacing.

★ Please insert the lamp gently, or it will be damaged by excessive extrusion.

★ Do not touch the Halogen bulb with your bare hands. It will shorten the service life or cause it to burst. If you leave finger marks on the surface carelessly, clean it with a dry soft cloth.

⚠ When using, the temperature of the lamp housing surface will be very hot, please pay attention to the warning written on the Warning board.



Fig.16



Fig.17



spanner

### 3-1 Turning on the Lamp

Connect the power, press the main switch ① to the “I”(on) position.

⊙ When using transmitted light illumination, fixing the lamp holder into the jack on the back of the microscope (Fig.11), and insert the power plug into the power jack of the microscope (③ in Fig.11). Then press the main switch ① to the “||”(on) position.

### 3-2 Adjust Brightness

Turning the brightness adjustment knob ② clockwise, the voltage raise, and the brightness strengthen; turning with the anti-direction, the voltage decline, and the brightness weaken.

✧ Using the lamp in a low voltage condition, will prolong the use life.

### 3-3 Adjust the Tension Adjustment Collar with Spanner

★ The tightness of the tension adjustment collar has adjusted before leaving factory, if finding it's losing (the mechanical stage drop itself because of deadweight), please turning the tension adjustment collar ③ until the tightness is in order.

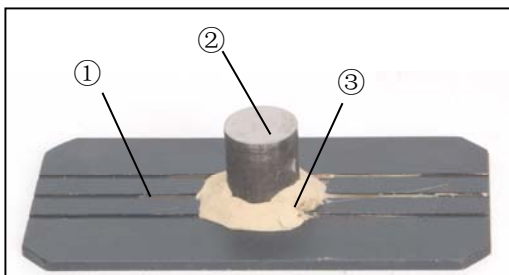


Fig.18



Smoothing presses



Fig.20



Diopter adjustment ring

Fig.21

### 3-4 Placing Specimen

1. Fix the specimen ② on the sample board ① by plasticine ③, be sure that the specimen surface is parallel to the sample board. It is conveniently to use smoothing presses to flatten the specimen (Fig. 19)

2. Place the slide on the mechanical stage. Use the stage clips to clamp the slide gently.

3. Turn the portrait and lateral adjustment knob of the mechanical ruler, move the specimen onto the required position.

★ Be careful when changing the objective. If you finish the observation with the short working distance objective, and want to change another one, be careful of not letting the objective touch the specimen.

### 3-5 Adjusting the Inter-pupillar Distance

The inter-pupillar distance range: 48mm ~ 75mm. When observing with two eyes, hold on the left and right prism holder, turn around the axis(Fig.28), adjust the inter-pupillar distance until the left and right fields of view coincide completely.

### 3-6 Adjusting the Diopter

The right ocular tube is fixed. So by turning the left diopter ring after the right ocular focus on the specimen, the operator who's left and right eye has different eyesight can obtain a comfortable focus position with both eyes.

### 3-7 Focus

#### When not using the video set



Fig.22

1. Push in the light path selector lever ① completely, then observe with both eyes. Use the 10×objective focus, to avoid the objective touch with the specimen, you should raise the mechanical stage at first, let the specimen close to the objective, then slowly separating them to focus.

2. The operator can converse turn the coarse focus knob to get the specimen down ,and search images in the 10×ocular simultaneously, then use the fine knob to focus. At this moment, you can replace other magnification objectives safely, and focus without the risk of destroying the specimen.



Fig.23

#### When using the video set

Pull out the light path selector lever ① , observe with both eyes, when the image is sharp, you can see the pictures directly on the video screen which connected by the microphotograph system through the video mount.

★ **If you need to fix the stage on a vertical position to make the observation become more convenience, take use of the locking set②.**



Fig.24



Fig.25

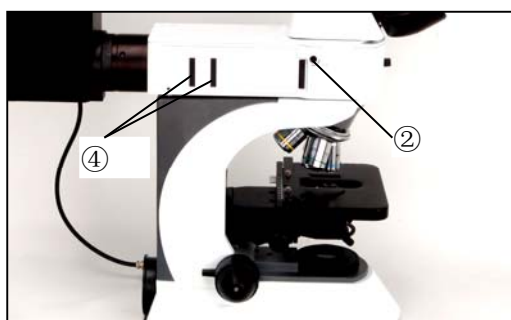


Fig.26

### 3-8 Using the ND Filter Knob

1. The ND Filter is interlocked with brightfield (BF) light path switching so it can be engaged or disengaged according to the mirror selector lever ①. The ND filter makes it possible to reduce the glare when darkfield (DF) is switched to brightfield (BF).

#### Releasing interlocking

- ◎ The ND filter knob has been interlocked at the factory. If brightness is not enough during brightfield, DIC or other observation, the interlocking can be released.
1. Loosen the screw interlocking the ND filter by inserting the Allen screwdriver into the hole ② on the left side of the reflected light illuminator.
  2. Now the interlocking is released and the ND filter knob (Fig. 17) is active. Pull the lever out to disengage the ND filter from the light path.

### 3-9 Using the Filters

- ◎ Engage the optimum filter sliders for the purpose of observation in the two filter insertion slots ④. Be sure to engage from the left side.
- ◎ The first click position is the idle position and the second click engages the filter in the light path.

Usable Filters	Applications
Color temperature conversion filter	Turns the illumination light into daylight. Used in general observations and color photography.
Green filter	Enhanced contrast in monochrome observation. Used in monochrome photography
Yellow filter	Contrast filter for observation of semiconductor wafers
Frost filter	Reduces irregularity in the illumination field, but also reduces the brightness
ND25	Adjusts the brightness of the light source. (Transmittance: 25%)
ND6	Adjusts the brightness of the light source. (Transmittance: 6%)



Fig.27

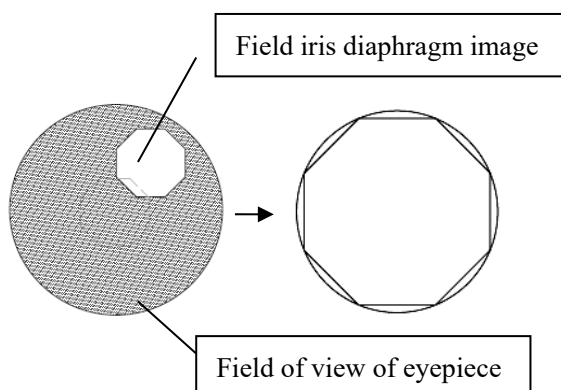


Fig.28

### 3-10 Selecting the Light Path of the trinocular Tube

- Slide the mirror selector lever ① toward the indication of the mirror for the desired observation method.

BF: Reflected light brightfield observation

DF: Reflected light darkfield observation

- ◎ Be sure to slide the mirror selector lever until it contacts the stopper.

### 3-11 Centering the Field Iris Diaphragm (FS)

- Slide the mirror selector lever ① to "BF".
- Engage the 10X objective by rotating the revolving nosepiece, place the specimen on the stage and adjust approximate focusing.
- Pull out the FS knob ④ on the reflected light illuminator to reduce the aperture iris diaphragm a little.
- Rotate the two FS centering screws ② using the Allen screwdriver to adjust so that the field iris image becomes concentric with the field of view.
- While pushing in the FS knob ④, open the field iris diaphragm until the field iris image inscribes the field of view. If the image is found to be eccentric, adjust the centering again.
- Open the field iris so that its image is almost the same size as (Fig. 28 subscribes) the field of view.

#### Using the Field Iris Diaphragm

##### ● In reflected light brightfield observation

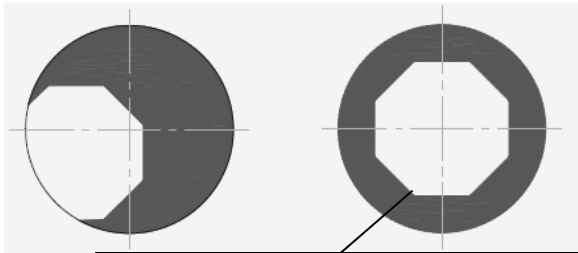
The field iris diaphragm adjusts the illuminated area to obtain an image with high contrast.

According to the objective in use, adjust the FS knob ④ of the reflected light illuminator until the iris image circumscribes the field of view to block unnecessary light.

##### ● In reflected light darkfield observation

The field iris diaphragm must be opened by pushing in the FS knob.





The image of aperture iris diaphragm

Fig.29



Fig.30

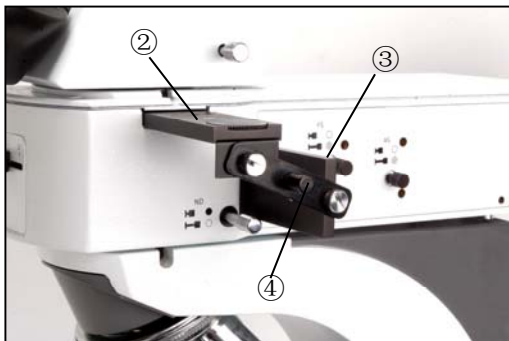


Fig.31

### 3-12 Centering the Aperture Iris Diaphragm (AS)

1. Slide the mirror selector lever to “BF”.
2. Engage the 10X objective by rotating the revolving nosepiece, place the specimen on the stage and adjust approximate focusing.
3. Remove the eyepiece, look into the eyepiece sleeve and pull the AS knob (5), so that the aperture is about 70%.
4. If the center of the iris diaphragm is deviated, center it by rotating the two AS centering screws (3 in Fig. 27) using the Allen screwdriver.

### Using the Aperture Iris Diaphragm

- In reflected light brightfield observation, optimum observation is generally possible by setting the aperture to between 70% and 80% of the aperture number of the objective (figure 29).
- In reflected light darkfield observation, the aperture must be fully opened by pushing in the AS knob.
- ◎ With some specimens, an image with high contrast and little flare may sometimes be obtained when the aperture is slightly closed. It is therefore recommended to also try a slightly closed aperture.

### 3-13 Setting the Analyzer and Polarizer

1. Insert the polarizer (Fig. 30) into the polarizer Insertion Slot (3) with the surface printing with Silk Screen towards you, then push the polarizer into the light path.
2. Remove the cover, then put the analyzer (Fig.30) in the insertion slot (2) in Fig.31).
3. Rotate the analyzer rotating dial (1) to find the position where the field of view is darkest.
4. When the analyzer and polarizer are coupled by using the coupling plate | provided with the polarizer and tightening the clamping knobs on it, the analyzer and polarizer can be engaged or disengaged in the light path together (Fig.31) .



Fig.32



Fig.33

### 3-14 Adjusting the Swing out Condenser (Fig. 32)

The center of the condenser and the light axes of the objective are coaxial. It has been adjusted before leaving factory, so the user needn't to adjust them by self.

The highest position of the condenser has been adjusted too. It also needn't any user's operation.

Turn the condenser focus knob to shift the condenser. It needs to raise the condenser when using the high magnification objective, and to decline when using the low magnification one.

#### 1. Using the Swing out Condenser

When using the low magnification objective, turn out the condenser, and let it away from the light path. While using the high magnification objective, turn it into the light path.

#### 2. Adjusting the Aperture Diaphragm

The aperture diaphragm is designed for the adjustment of the numerical aperture, not for the brightness. Generally, reducing the diaphragm opening to 70- 80% of the N.A. value of the respective objective will provide an image of acceptable quality. If you want to observe the image of the aperture diaphragm, remove one eyepiece and look through the tube. You will see a dark circle encroaching on the bottom of the tube.

### 3-15 Adjusting the Field Diaphragm (Fig. 33)

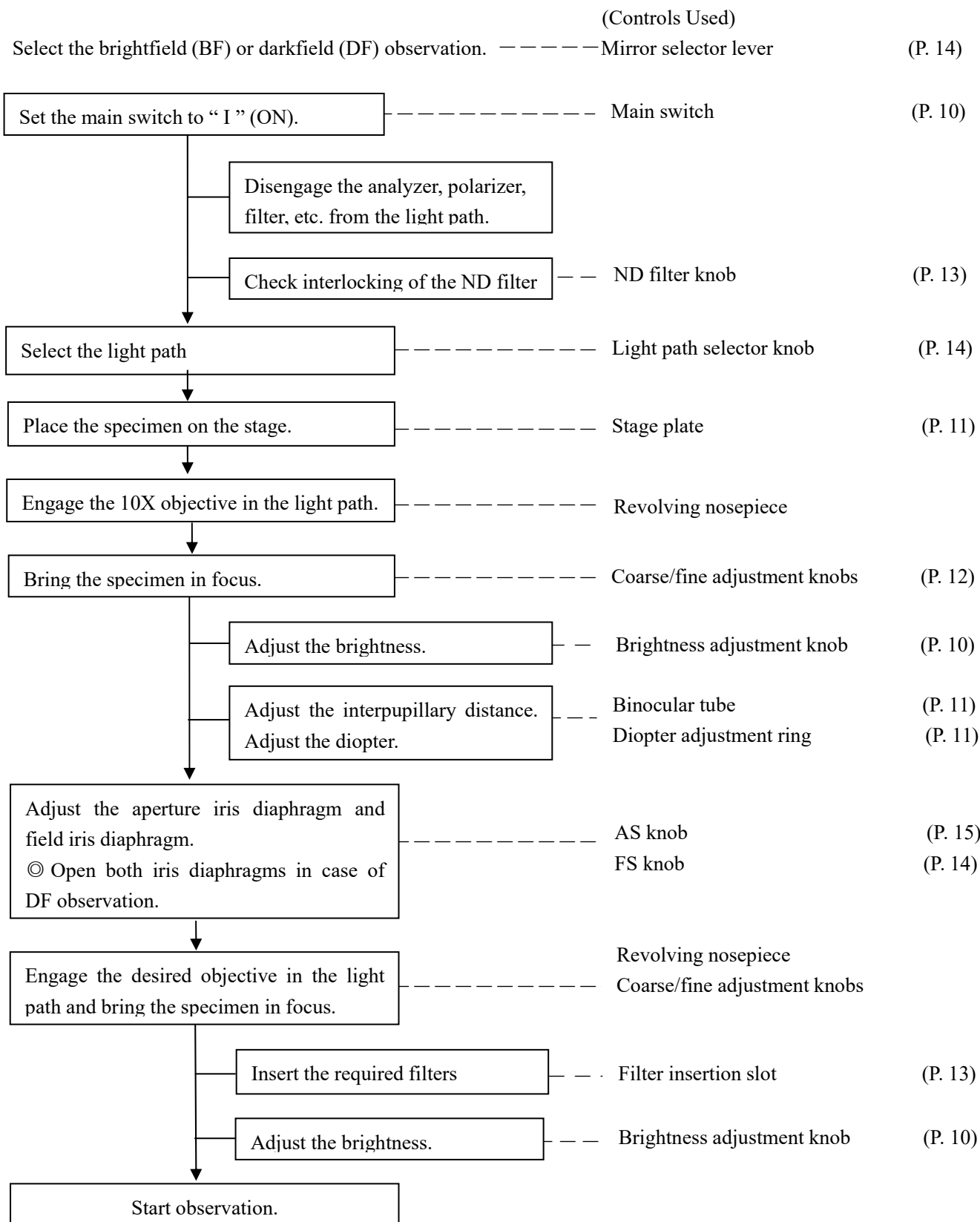
The control for the field diaphragm is a ring used for adjusting the area of field diaphragm. When using, turn the ring to reduce the field diaphragm, look into the field, if the diaphragm image is faintness, do the follow steps: first, turn the condenser focus knob, shift the condenser holder to the position where the observed image of the field of view is sharp; then open the field diaphragm, let the image full of the field of view, reduce the mixed light, improving the quality of the image.

4. Observation Methods

BS-6022RF/TRF

4-1 Reflected Light Brightfield/Darkfield Observation

©The following flow shows the basic operating procedure for reflected light brightfield or darkfield observation. Page



#### 4-2 Reflected Light Simplified Polarized Light Observation

1. Setting the Analyzer and Polarizer (Fig. 15).
2. Place the specimen on the stage and adjust the focus by moving the stage up or down.

Now simplified polarized light

Observation can be started.

3. Adjust the field iris diaphragm so that its image circumscribes the field of view.
4. The contrast may sometimes be enhanced by closing the aperture iris diaphragm slightly.

#### 4-3 Transmitted Light Observation

1. Installing the lamp housing . ( see page 8 :Installing the lamp housing when using transmitted light illuminator) .
2. Installing objective.
3. Installing the swing out condenser.
4. Set the main switch to “ II ” (ON).
5. Fix the specimen on the stage, adjust the focus to begin observation.

◎ At the Transmitted Light Observation, the method of condenser ,field iris diagram adjusting please refer to section 3-14 and 3-15.

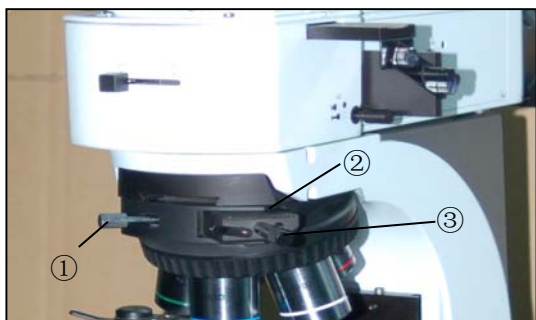
#### 4-4 DIC Observation (Difference Interference Contrast Observation)

##### 1. Setting the Nomarski slider

Loosen the mounting knob ① on the front of the DIC revolving nosepiece, insert the DIC slider② and clamp by tightening the mounting knob.

##### 2. Observation method

- 2.1 Place the specimen on the stage and adjust the focus by moving the stage up or down.
- 2.2 Adjust the field iris diaphragm so that its image circumscribes in the field of view.



##### 3. Adjust the DIC attachment

- 3.1 Adjust the background contrast by turning the slider movement knob ③ on the DIC prism as described below.
- 3.2 When the slider movement knob on the DIC prism is turned, the interference color at the background varies continuously from the gray sensitive color to magenta sensitive color (from -100 to 600 nm). Set the interference color which can provide best contrast with respect to the specimen.

- Selecting a dark background color enables dark field-type observation.
- Selecting a gray background color enables 3D-looking observation with high contrast thanks to the highest sensibility of the gray sensitive color.
- Selecting a magenta sensitive color allows even small phase variation to be observed as a change in color.

**\* Since the DIC observation has a high detection sensitivity, take care against contamination on the specimen surface.**

**5. Specifications**
**BS-6022RF/TRF**

		BS-6022RF	BS-6022TRF
Optical system	Infinite Optical System	●	●
Eyepiece (Ocular)	Exceed wide field ocular EW10X/22, tube $\Phi$ 30mm	●	●
	10 $\times$ /0.25/ $\infty$ /- (BF/DF) WD 10.0 mm	●	●
	20 $\times$ /0.4/ $\infty$ /0(BF/DF) WD 4.30mm	●	●
	40 $\times$ /0.65/ $\infty$ /0.17 WD 0.54 mm		●
	100 $\times$ /1.25/ $\infty$ /0.17 WD 0.13 mm		●
	5 $\times$ /0.12/ $\infty$ /0.17 WD 12mm	●	●
	50 $\times$ /0.75/ $\infty$ /0 WD 0.32mm	●	●
	100 $\times$ /0.8/ $\infty$ /0 (BF/DF) WD 2 mm	○	○
DIC	20 $\times$ , 100 $\times$	○	○
Upper limit Infinite plan achromatic	30mm		●
	50mm	●	
Viewing head	Compensation Free Trinocular Head, Inclined at 30°, Interpupillar distance: 48-75mm	●	●
Reflected light illumination	24V/100 W halogen bulb (pre-centered)	●	●
	Kohler Illumination, Aspheric collector	●	●
	Polarizer and analyzer	○	○
	Coupling plate	○	○
	Blue, green, yellow filter and frosted glass	●	●
Transmitted light illumination,	Swing out condenser NA0.9/0.25		●
	24V/100W halogen bulb, Aspheric collector		●
	Blue filter		●
Filter	ND25, ND6	○	○
Focusing system	Coaxial Coarse and Fine Focusing System, Sensitivity and Graduation of Fine Focus: 0.001mm, tension adjustment on coarse focus adjustment knob. Upper limit stopper.	●	●
Nosepiece	Backward Quintuple Nosepiece	●	●
Stage	Non-porous double layer mechanical stage 186 $\times$ 138mm/ 74mm $\times$ 50mm	●	
	Double layer mechanical stage 186 $\times$ 138mm/ 74mm $\times$ 50mm		●
	Specimen preparation plate		●
	Slide glass		●
Smoothing presses		○	○
Video accessories		○	○
Video Mount	C Mount 1 $\times$ , 0.5 $\times$	○	○

Note: ●Standard outfit, ○ Optional

**6. Trouble shooting**
**BS-6022RF/TRF**
**6.1 Optical Part**

PROBLEM	REASON FOR PROBLEM	SOLUTION
Bulb lights but the field of view is dark.	The aperture or field iris diaphragm is closed.	Open the aperture and field iris diaphragms.
	Analyzer and polarizer are engaged in light path.	Disengage them from light path.
	Light path selector knob of trinocular tube is positioned halfway.	Fully pull out the light path selector knob .
	Mirror selector lever is in an intermediate position	Set the knob correctly.
Field of view is obscured or not evenly illuminated	Light path selector knob of trinocular tube is in positioned halfway.	Set the light path selector knob to a click position according to the purpose.
	Mirror selector lever is in an intermediate position.	Set the knob correctly.
	Revolving nosepiece is not in a click position.	Set it in a click position.
	Field iris diaphragm is not centered.	Center the field iris diaphragm correctly and open it sufficiently.
	ND filter is not in a click position.	Set it in a click position.
	Lamp bulb is not installed correctly.	Push halogen bulb terminals all the way into stop position.
	Analyzer and/or polarizer not installed correctly	Engage analyzer and polarizer in light path.
Dirt or dust is visible in the field of view.	Dirt/dust on eyepiece	Clean thoroughly.
	Dirt/dust on specimen	
The image is defocus\low-resolution	Revolving nosepiece is not in a click position.	Set it in a click position.
	The surface of the objective lens is moldy or has contaminant	Clean thoroughly.
	Dirt/dust on specimen	
One side of image is blurred.	Objective is not correctly engaged in light path.	Make sure that revolving nosepiece clicks into place correctly.

**6.2 Mechanical Part**

<b>PROBLEM</b>	<b>REASON FOR PROBLEM</b>	<b>SOLUTION</b>
The coarse focus knob is hard to run	The tension adjustment collar is too tight	Loose properly
	Pre-focusing lever is locked.	Release pre-focusing lever.
Stage drifts down by itself or focus is lost during observation.	Tension adjustment ring is too loose.	Tighten ring to an optimum tightness
Specimen cannot be brought into focus.	Stage height adjustment is too low.	Raise stage holder height.
Image shifts when you touch stage	Stage is not properly mounted.	Clamp stage.
Specimen do not moving fluently	The slider holder do not fixed sufficiently,	Fix it sufficiently
Field of view of one eye does not match that of the other.	Interpupillary distance is incorrect.	Adjust it again.
The eyes overtire	Incorrect diopter adjustment.	Adjust diopter correctly
	Brightness uncomfortable.	Adjust the bulb voltage

**6.3 Electric Part**

<b>PROBLEM</b>	<b>REASON FOR PROBLEM</b>	<b>SOLUTION</b>
The lamp can't light	No power supply	Check the power cord, and connect them exactly
	the installation of the bulb is wrong	Install the bulb correctly
	The bulb burn out	Change a new bulb
	The connection of lamp housing power plug is incorrect.	Connect again follow the instructions
	The power opened incorrectly.	Press it to the appointed position follow the instructions
The bulb burn out in a high frequency	Not use the specified lamp	Use the required lamp
The height of the brightness is not enough	Not use a appointed lamp	use a appointed lamp
The light glimpse	The bulb is going to spoil	Change the bulb
	The power cord have a poor contact	Check the power cord, and connect them exactly