Motic®

BA310Met / BA310Met-T

Metallurgy Microscope
Instruction Manual

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MOTIC INCORPORATION LTD.

We are constantly endeavouring to improve our instruments and to adapt them to the requirements of modern research techniques and testing methods. This involves modification to the mechanical structure and optical design of our instruments.

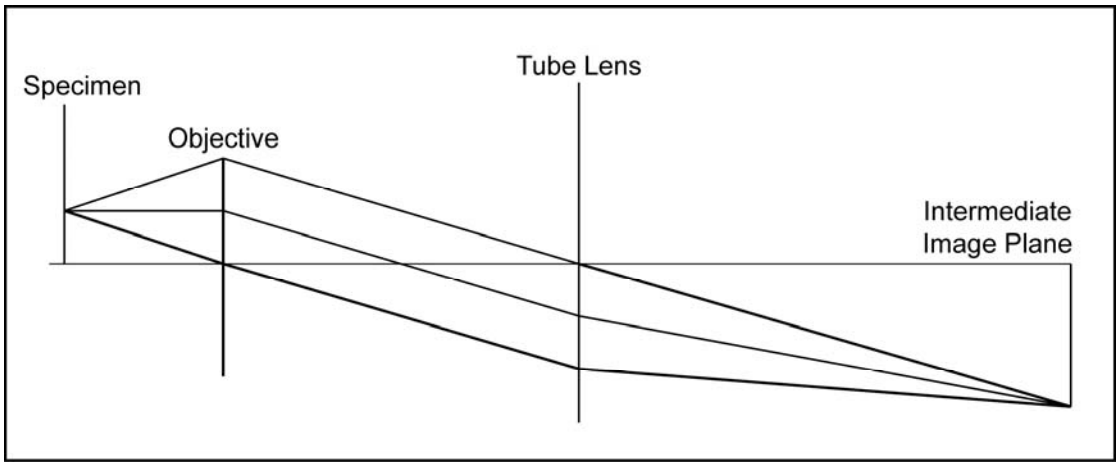
Therefore, all descriptions and illustrations in this instruction manual, including all specifications are subject to change without notice.

INFINITY OPTICAL SYSTEM

An optical configuration (in which the specimen is located at the front focal plane of the objective) gathers light transmitted through or reflected from the central portion of the specimen and produces a parallel bundle of rays projected along the optical axis of the microscope toward the tube lens.

A portion of the light reaching the objective originates from the periphery of the specimen, and enters the optical system at oblique angles, moving forward diagonally but still in parallel bundles toward the tube lens. All of the light gathered by the tube lens is then focused at the intermediate image plane, and subsequently enlarged by the eyepiece.

The real merit of the infinity based system lies in its ability to accommodate modular accessories in the optical path and produce a flexible design.



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I. DESCRIPTION

1. Application:

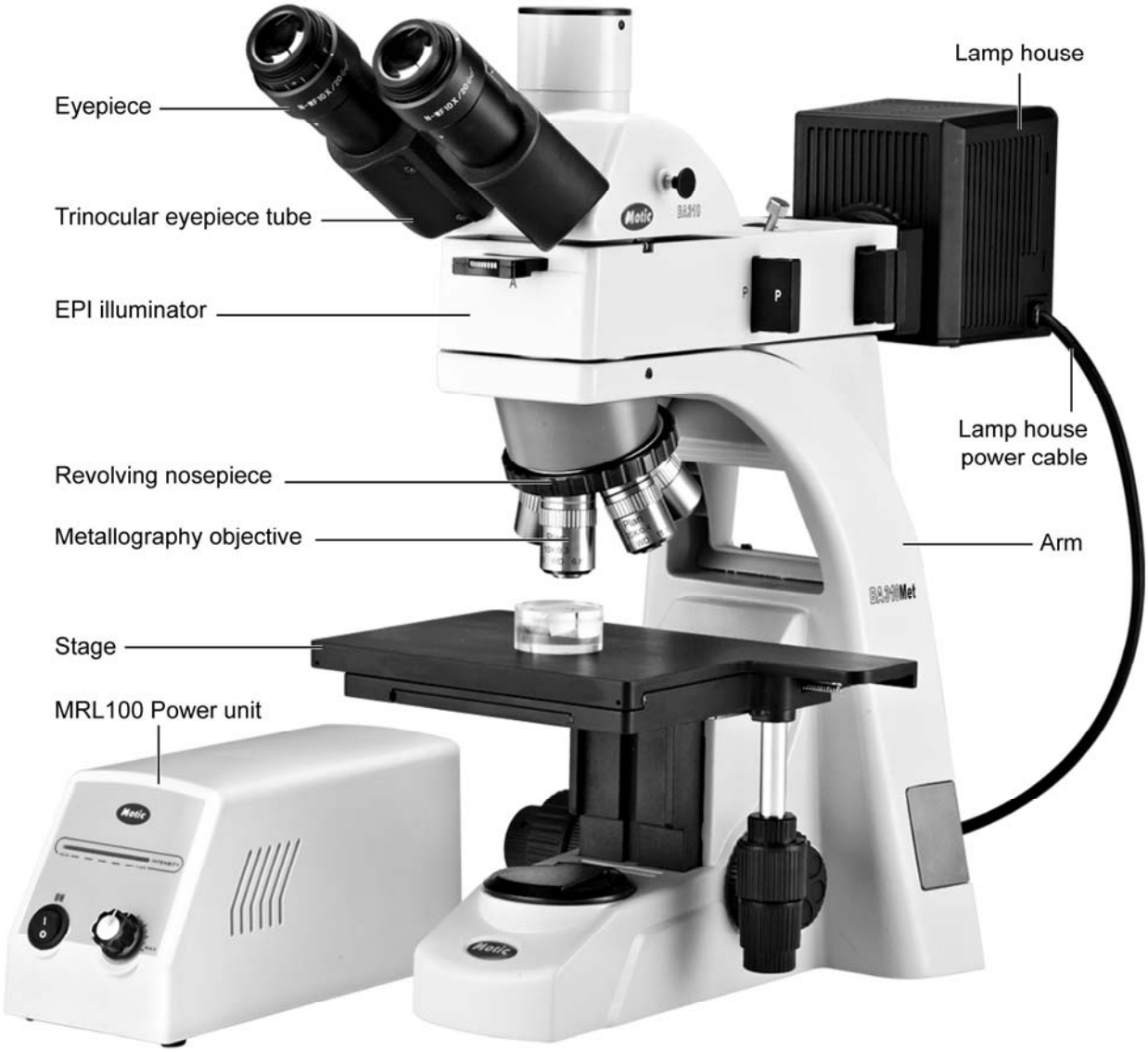
The Motic BA310Met and BA310Met-T are suitable for use in all areas of research and industry observing opaque material, e.g. in

a. Metallography
b. Mineralogy
c. Mechanical engineering
d. Electronics

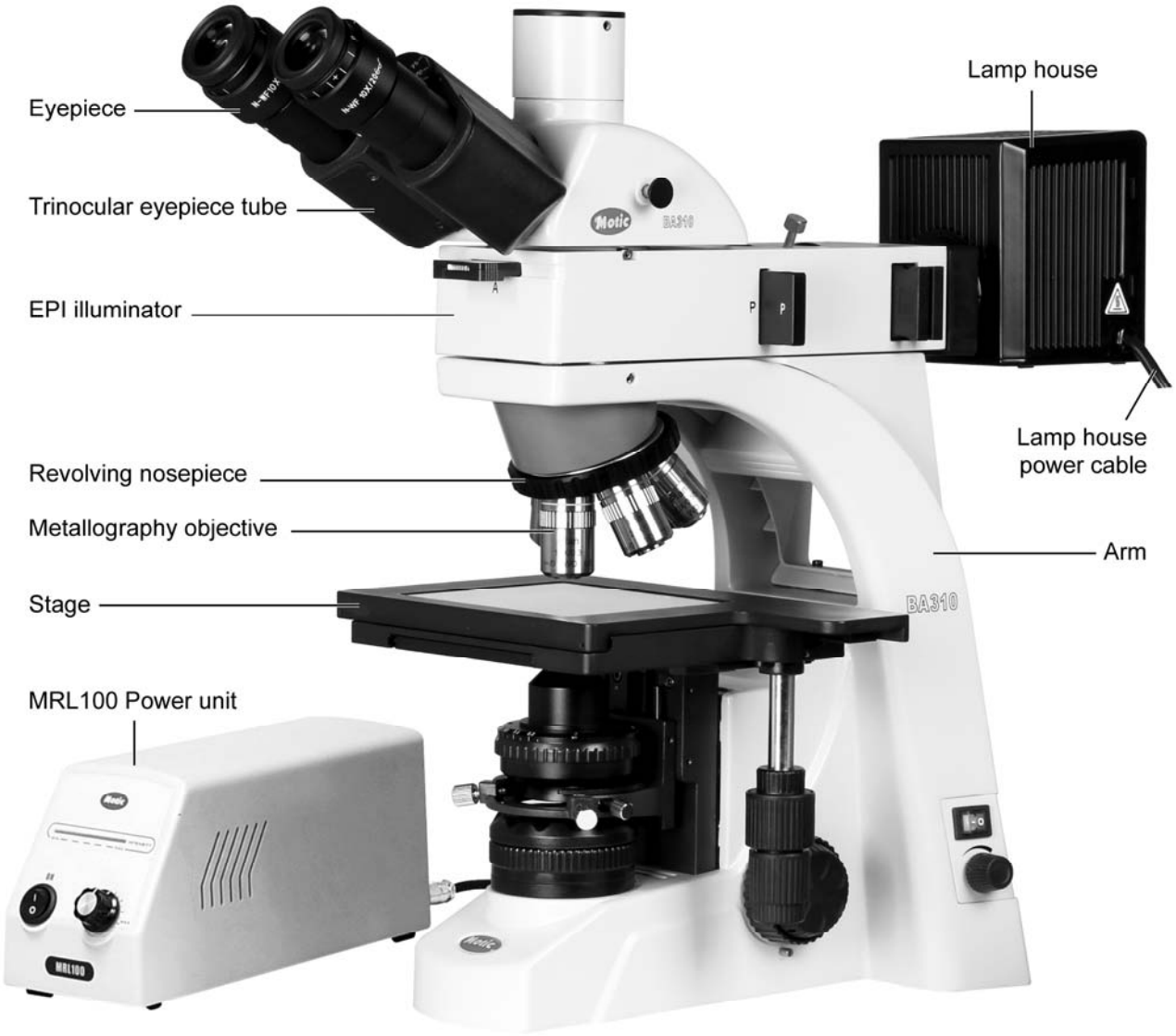
Except bright field observation, BA310Met and BA310Met-T are also used for polarized light observation. BA310Met and BA310Met-T can be installed with digital camera, video camera for photomicrography.

2. Nomenclature

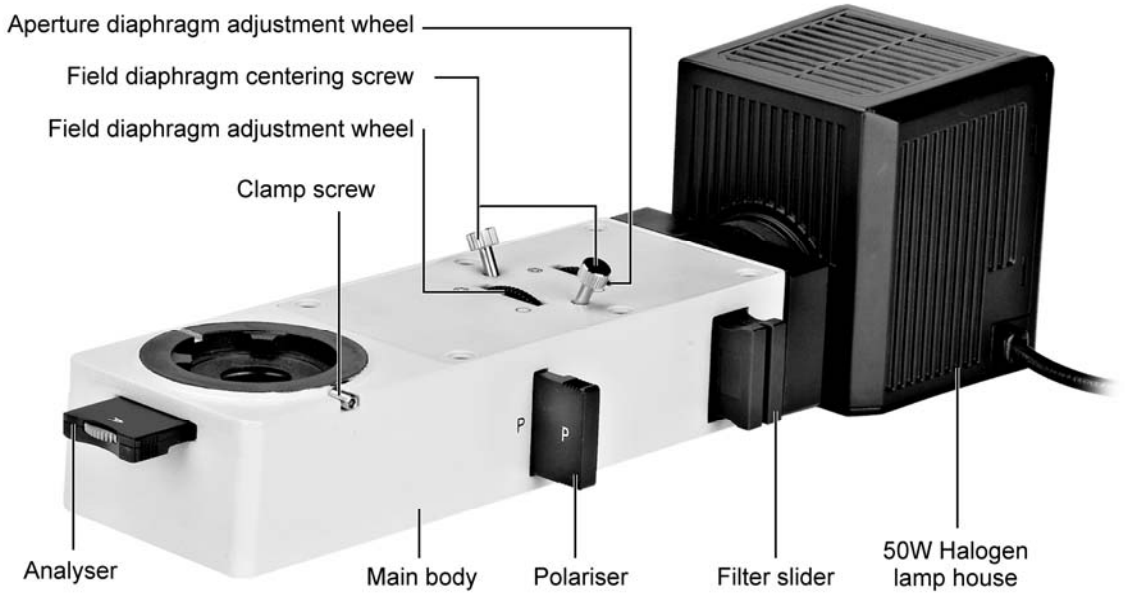
2.1 BA310Met



2.2 BA310Met-T



2.3 Epi Illuminator



II. SETTING UP THE INSTRUMENT

Avoid placing the instrument in locations exposed to direct sunlight, dust, vibration, high temperature, high humidity and where it is difficult to unplug the power supply cord.

1. Operating environment

- Indoor use
- Altitude: Max 2000 meters
- Ambient temperature: 5°C to 40°C
- Maximum relative humidity: 75% for temperature up to 31°C decreasing linearly to 50% relative humidity at 40°C
- Supply voltage fluctuations: Not to exceed ±10% of the normal voltage.
- Pollution degree: 2 (in according with IEC60664)
- Installation / Overvoltage category: 2 (in according with IEC60664)
- Air pressure of 75kPa to 106kPa
- No hoar frost, dew, percolating water, rain

III. ASSEMBLING THE MICROSCOPE

1. Input voltage

- The automatic voltage selection works with a broad range of settings. However, always use a power cord that is rated for the voltage used in your area and that has been approved to meet local safety standards. Using the wrong power cord could cause fire or equipment damage.
- In case of using the extension cord, use only a power supply cord with a protective earth (PE) wire.
- In order to prevent electric shock, always turn the power switch on the power supply off before connecting the power cord.

- Epi-illuminator Electrical Specifications:
  Input: 115/ 230V~, 60/ 50Hz, 200VA
  Bulb: 12V ⎓ 50W Halogen or 12V ⎓ 3W LED module
  Fuse: 250V T2.5A (If the original fuse is blown, please replace with specified fuse)
- Transmitted Illumination Electrical Specifications:
  Input: 100-240V~, 80VA, 50-60Hz
  Bulb: 6V ⎓ 30W Halogen or 6V ⎓ 3W LED module
  Fuse: 250V T2.5A (If the original fuse is blown, please replace with specified fuse)

2. Illumination

- Halogen lamp
  The quartz halogen lamp, used as a light source, has higher luminance and color temperature than conventional tungsten lamps. The luminance is approximately four times greater.
  As long as the lamp voltage is kept constant, the halogen lamp maintains the same level of brightness and color temperature regardless of whether it is new or nearing the end of its life.

- LED module
  The LED module is specially designed to be inserted into halogen bulb socket directly converting halogen illumination to LED illumination. LED is more economical and environmental friendly and combines the advantages of low heat and long life span.

3. Stage

- Attaching the stage:
  Lower the substage completely with the coarse focus knob
  Place the stage on the substage and fix it with the four M4 screws that are attached with the stage.
- The 3” x 2” stage comes with a glass plate as standard for BA310Met-T.
  And when a slide glass is used for observation of the specimen, an optional slideglass holder must be attached in place of the glass plate.
- The 6” x 4” stage comes with a glass plate as standard for BA310Met-T and a wafer holder is optional.

4. Objectives

Lower the stage completely. Screw the objectives into the revolving nosepiece so that clockwise rotation of the nosepiece brings the next higher magnification objective into position**.**

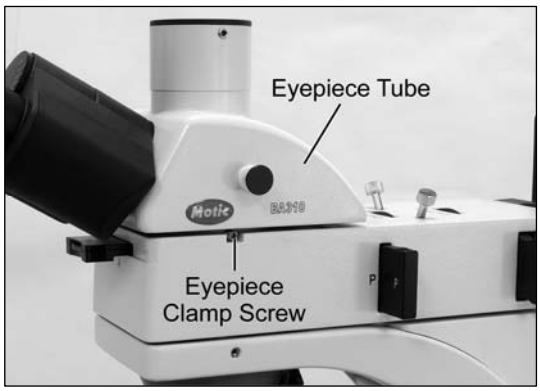
5. Condenser for BA310Met-T

- Raise the stage by turning the coarse focus knob.
- Completely lower the condenser carrier by turning the condenser focus knob.
- Insert the condenser into the dovetail mount with aperture scale facing forward towards the user. Secure it with the condenser clamp screw.
- Turn the condenser focus knob to raise the condenser as far as it will go.

6. Eyepiece tube

- Loosen the eyepiece clamp screw. (Fig.1)
- Insert the dovetail adapter on the eyepiece tube (Fig.2) into the dovetail mount on the microscope arm.
- Tighten the eyepiece tube clamp screw (Fig.2) to secure the eyepiece tube in place.

(Fig.1)



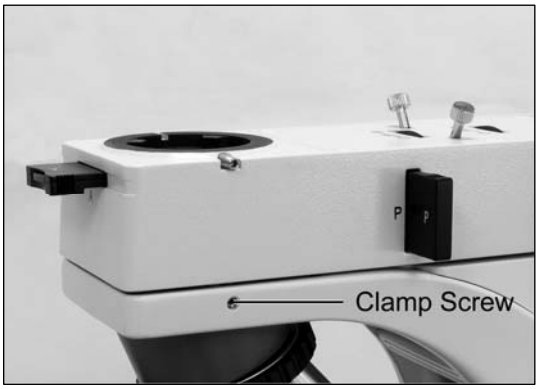
(Fig.2)

7. Eyepieces

Use the same magnification eyepieces for both the eyes.
Insert each eyepiece into the eyepiece sleeve, and tighten the clamp screws.

8. Epi Illuminator

- Loosen the arms clamp screw (Fig.3). Insert the round dovetail adapter on the Epi illuminator into the dovetail mount on the microscope arm.



(Fig.3)

- Plug the power cord from lamp house to the outlet on the rear panel of the microscope.

(Fig.4)

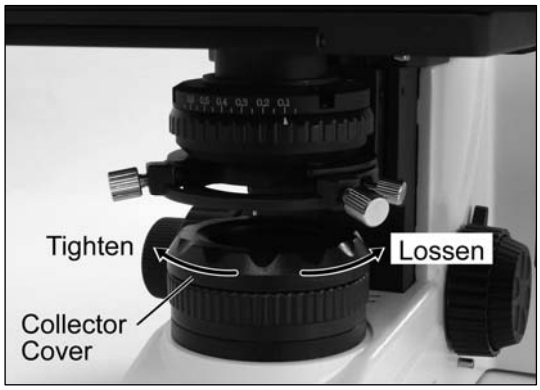
- For the best image quality, install the Epi illuminator horizontally.

9. Filters for Epi illuminator

- Pull out the slider on Epi illuminator
- Place the filter and/or ground glass in the filter holder on the slider and make sure the frosted side of ground glass is faced to the lamp.
- Push the slider to make sure the filter/ground glass stay in the optical path.

10. Filters for transmitted illumination

- Remove the collector cover (Fig.5) and place the filter in the filter holder located around the field lens, then screw the cover. Take care that dust, dirt and fingerprints do not get on the filter and the field lens.



(Fig.5)

- Filter selection:

Filter	Function
ND2 (T=50%)	For brightness adjustment in photomicrography
ND4 (T=25%)	
ND16 (T=6.25%)	
Blue filter (colour balance filter)	For routine microscopy and photomicrography
Green interference (546nm)	For phase contrast and contrast adjustment with black and white film
HE (didymium filter)	For colour photomicrography of HE stained specimen with tungsten type film

- A diffuser is built into the base of the microscope.

11. Power cord

Connect the socket of the of the power cord to the AC inlet on the rear of the base of the microscope. Plug in the other end of the cord to an AC outlet with ground conductor.

IV. MICROSCOPY

1. Illumination brightness adjustment

- Turn the brightness adjustment knob fully counterclockwise to the low brightness position.
- Set the power switch to “I” (**ON**).
  The green line control lamp in the switch must light up.
  The halogen lamp 12V/50 W in the Epi illuminator must light up.
- When the Brightness adjustment knob is turned clockwise to the high brightness position, the light intensity increases.

MRL100 Power Unit

2. Coarse and fine focusing

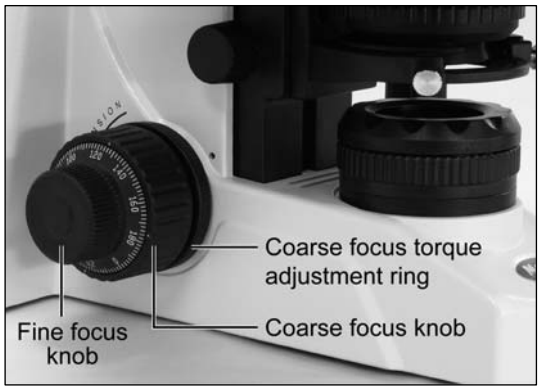
- Focusing is carried out with the coarse and fine focus knobs at the left and right of the microscope stand.
- The direction of vertical movement of the stage corresponds to the turning direction of the focus knobs.
- One rotation of the fine focus knob moves the stage 0.2mm. The graduation on the fine focus knob is 2 microns.

Never attempt either of the following actions, since doing so will damage the focusing mechanism:

- Rotate the left and right knob while holding the other.
- Turning the coarse and fine focus knobs further than their limit.

3. Coarse focus torque adjustment

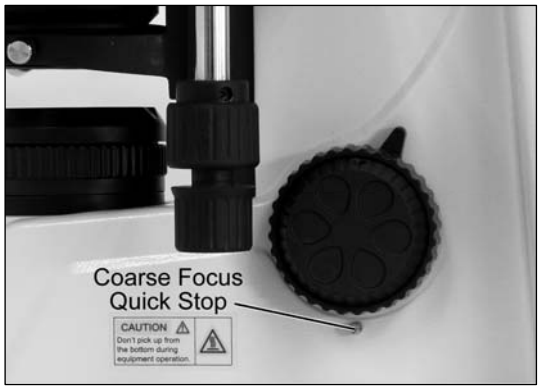
- To increase the torque, turn the torque adjustment ring (Fig.7) located behind the left-hand coarse focus knob in the direction indicated by the arrow. To reduce the torque, turn the ring in the direction opposite to that indicated by the arrow.



(Fig.7)

4. Coarse focus quick stop

- The coarse focus quick stop (Fig.8) makes the stage can fixed at any position at which the specimen is in focus i.e. by using the handle to lock the coarse focus knob.
- With the specimen in focus, turn the handle to fix the knob.
- When the coarse focus quick stop is in position, the stage cannot be raised from that position. However, the fine focus knob can move the stage regardless of the limit but will only lower the stage.
- Lower the stage by using the coarse focus knob.



(Fig.8)

5. Beam splitter lever

- The beam splitter lever of the trinocular eyepiece tube can be used to select the amount of light distributed between the trinocular eyepiece tube and the vertical phototube.
- When the lever is pushed in until it reaches the limit, 100% of the light enters the observation tube. When the lever is pulled out to the limit, the ratio of light entering the observation tube and phototube will be 20:80.

6. Interpupillary distance adjustment

- Before adjusting the interpupillary distance, bring a specimen into focus using the 10x objective.
- Adjust the interpupillary distance (Fig.9) so that both the right and left field of view become one
- This adjustment will enable the user to observe the specimen with both eyes

(Fig.9)

7. Diopter adjustment

- Diopter adjustment compensates for the differences in vision between the left and right eyes. In addition to making observation through both eyes easier, this adjustment also reduces the extent to which focusing is lost when the objective magnification is changed. In particular, this occurs when a low magnification objective is used.
- The left eyepiece has a separate focusing provision to compensate for slight differences in the focusing of each eye.
- Using the right eye only and viewing through the right-hand eyepiece, adjust the focus with the microscope fine or coarse adjustment until the image of the specimen is at its sharpest.
- Using the left eye only and viewing through the left-hand eyepiece with its independent diopter-focusing ring, focus until the specimen image is at its sharpest.
- The microscope should now be ready for binocular viewing.

(Fig.10)

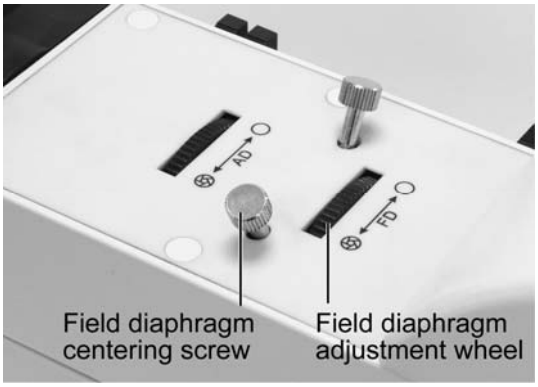
8. Polariser and Analyser of Epi-illuminator using

- Insert the polariser (marked with “P”) into the front slot of Epi.
- Insert the Analyser (marked with “A”) into the side slot of Epi.
- Analyser is rotatable and the color of specimen with polarization will be changed when rotating.

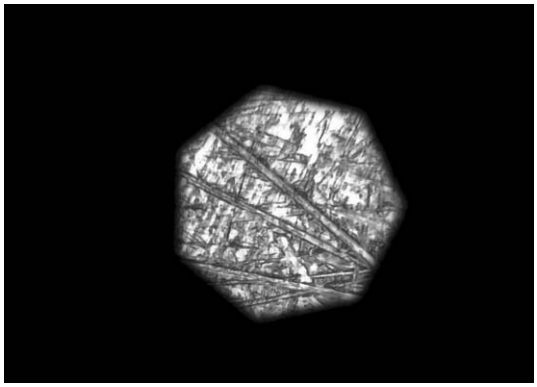
(Fig.11)

9. Field diaphragm of Epi-illuminator centering

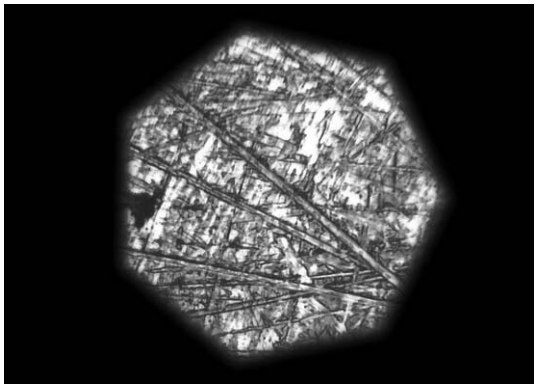
- Clear diaphragm image can be obtained after the specimen is in focus.
- Adjust the aperture diaphragm until aperture diaphragm is 2/3 of field then center the aperture diaphragm via the knurled knob on the top of Epi illuminator.
- Set the aperture diaphragm slightly bigger than the field of view by turning the adjustment wheel.



(Fig.12)



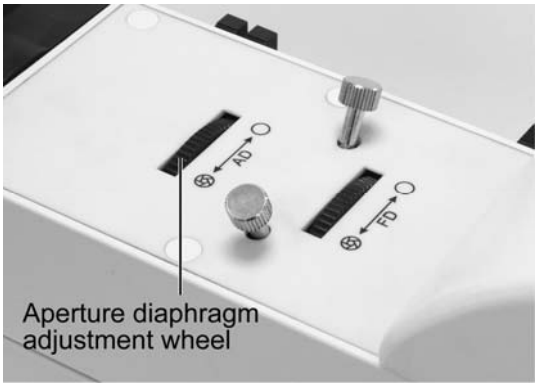
(Fig.13.a)



(Fig.13.b)

10. Aperture diaphragm of Epi-illuminator using

- The condenser aperture diaphragm is provided for adjusting the numerical aperture (N.A.) of the illuminating system of the microscope, it decides the resolution of the image, contrast, depth of focus and brightness.
- Stopping down will lower the resolution and brightness but increase the contrast and depth of focus.
- It is recommended that the aperture diaphragm is set at 2/3 of the objective N.A to get the best contrast and image quality.
- To adjust the aperture diaphragm:
  Adjust the condenser aperture diaphragm lever referring to the condenser aperture scale or by observing the diaphragm image visible on the exit pupil inside the eyepiece tube, or by using a centering telescope after removing one of the eyepieces and focusing on the aperture diaphragm.



(Fig.14)

11. Centering the condenser for BA310Met-T

- Fully open the field of view diaphragm and condenser aperture diaphragm.
- Set the specimen on the stage with the cover glass facing up.
- Bring the specimen image into focus, using the 10X objective.
- Close the field of view diaphragm to its minimum setting by means of the field diaphragm ring.
- Turn the condenser focus knob to bring the field diaphragm image into focus on the specimen plane.
- Adjust the condenser centering screws so that the image of the field diaphragm appears at the centre of the field of view. At this time, stopping the field diaphragm image, just short of the maximum field of view, may be convenient for centering.
- Adjust and centre the field diaphragm so that it is just outside the field of view for each magnification change.

12. Use of aperture diaphragm for BA310Met-T

- The condenser aperture diaphragm is provided for adjusting the numerical aperture (N.A.) of the illuminating system of the microscope, it decides the resolution of the image, contrast, depth of focus and brightness.
- Stopping down will lower the resolution and brightness but increase the contrast and depth of focus.
- An image with appropriate contrast can be obtained with an aperture setting that is 2/3 of the objective N.A.
- To adjust the aperture diaphragm:
  - adjust the condenser aperture diaphragm ring referring to the condenser aperture scale, or
  - by observing the diaphragm image visible on the exit pupil inside the eyepiece tube, or
  - by using a centering telescope after removing one of the eyepieces and focusing on the aperture diaphragm.

13. Use of field diaphragm for BA310Met-T

- The field diaphragm determines the illuminated area on the specimen. For normal observation, the diaphragm is set slightly larger than the field of view. If the illuminated area is set much larger than the field of view extraneous light will enter the field of view. This will create a flare in the image and lower the contrast.
- The thickness of the glass slide must be 1.7mm or less, otherwise the field diaphragm may not be focused on the specimen plane.
- The diaphragm does not have any effect when the condenser top lens is swung out of the optical path in the Swing-out type condenser. Fully open the field diaphragm, as the N.A. of the illuminating system will be reduced if the diaphragm is excessively stopped down.

14. Brightness and contrast adjustment

- Blue filter is used for color temperature adjustment in routine microscopy and photomicrography.
- Frost filter reduces irregularity in the illumination field, but also reduces the brightness.
- To ensure enough brightness, remove the frost filter out of light path when using the high magnification objectives and low reflectivity of sample.
  For the best contrast and image quality, adjust the condenser aperture diaphragm lever accordingly when the objective changed.

V. PHOTOMICROGRAPHIC PROCEDURE

- To ensure vibration free operation, set the microscope on a sturdy vibration free table or a bench with a vibration proof device.
- Pull the optical path selection lever of the trinocular eyepiece tube all of the way out to the limit, the ratio of light entering the observation tube and phototube will be 20:80.
- For the same total magnification, select a combination of the highest possible objective magnification and lowest possible projection lens magnification to achieve the utmost image definition and contrast.
- To ensure optimal illumination, check the position and centring of the lamp and position of the condenser.
- Select a blue filter for routine application. An additional colour-compensating filter can also be used depending on the colour rendition.
- Adjusting the field diaphragm is important for the purpose of limiting extraneous light that may cause flare and lower the contrast. Stop down the diaphragm to achieve an illuminated area slightly larger than that of the field of view.
- A change of depth of focus, contrast and resolution of image is attainable with an aperture setting that is 2/3 of the objective N.A.

VI. TROUBLESHOOTING TABLE

As you use your microscope, you may occasionally experience a problem.

The troubleshooting table below contains the majority of frequently encountered problems and the possible causes.

Optical

Problem	Possible Cause
Vignetting or uneven brightness in the field of view or field of view only partially visible	Lamp not installed properly
	Condenser not mounted correctly
	Condenser is set too low
	Aperture diaphragm closed too far
	Revolving nosepiece not clicked into position
	Trinocular eyepiece tube optical path selector lever in intermediate position
	Filter not in placed in properly
Dust or dirt in the field of view	Aperture diaphragm closed too far
	Condenser is set too low
	Dust or dirt on specimen surface
	Dust or dirt on field lens, filter, condenser or eyepiece
Poor image (low contrast or resolution)	Condenser is set too low
	Aperture diaphragm closed too far
	No cover glass
	Too thick or thin cover glass
	Immersion oil not used on immersion procedure
	Air bubbles in immersion oil
	Specified immersion oil used not used
	Immersion oil on dry objective
	Greasy residue on eye lens
	Incorrect illumination
Uneven focus	Specimen holder not fixed securely on stage
	Specimen not secured in position
	Specimen tilted on stage surface

Image tinged yellow	Lamp voltage is set too low
	Blue filter is not being used
Focusing is not possible with high magnification objectives	Slide is upside down
	Cover glass is too thick
High magnification objectives strike the specimen when changing over from low to high magnification	Slide is upside down
	Cover glass is too thick
	Eyepiece diopter not adjusted
Insufficient parfocality of objectives	Eyepiece diopter not adjusted
No cohesion of binocular image	Magnification or field of view of left and right eyepieces differ
	Interpupillary distance not adjusted
	Eyepiece diopter not adjusted
Eye strain or fatigue	Interpupillary distance not adjusted
	Diopter adjustment not made
	Field of view of left and right eyepiece differ
	Inadequate illumination

Electrical

Lamp does not light	Power supply not plugged in
	Lamp not installed
	Lamp burnt out
Inadequate brightness	Specified lamp not being used
Lamp blows out immediately	Specified lamp not being used
Lamp flickers	Connectors are not securely connected
	Lamp near end of service life
	Lamp not securely plugged into socket

VII. CARE AND MAINTENANCE

1. Do not disassemble

- Disassembly may significantly affect the performance of the instrument, and may result in electric shock or injury and will void the terms of the warranty.

- Never attempt to dismantle any parts other than described in this manual. If you notice any malfunction, contact your nearest Motic representative.

2. Cleaning the Microscope

A. Lenses and filters

- To clean lens surfaces or filters, first remove dust using an air blower. If dust still persists, use a soft/clean brush or gauze.
- A soft gauze or lens tissue lightly moistened with the mixture of alcohol and ether (ratio: alcohol : 3 and ether: 7) should only be used to remove grease or fingerprints.
- Use the mixture of alcohol and ether (ratio: alcohol : 3 and ether: 7) to clean immersion oil.
- Use the mixture of alcohol and ether (ratio: alcohol : 3 and ether: 7) only to remove immersion oil from objective lenses.
- Because the mixture of alcohol and ether (ratio: alcohol : 3 and ether: 7) is highly flammable, be careful handling around open flame.
- Do not use same area of gauze or lens tissue to wipe more than once.

B. Cleaning of painted or plastic components

- Do not use organic solvents (thinners, alcohol, ether, etc.). Doing so could result in discolouration or in the peeling of paint.
- For stubborn dirt, moisten a piece of gauze with diluted detergent and wipe clean.
- For plastic components, only moisten a piece of gauze with water and wipe clean.

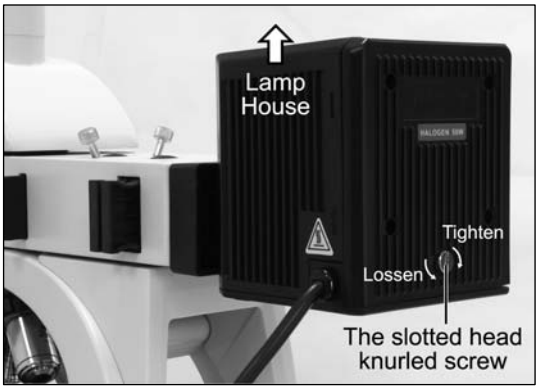
3. Bulb Replacement

- *To avoid potential shock hazard, always set the power switch to "**O**" (OFF) and disconnect the power cord before replacing the bulb.*
- *The bulb, lamp housing and areas near these will be extremely hot during and right after use. Please replace the bulb with a soft cloth during use or allow it cools down right after use*

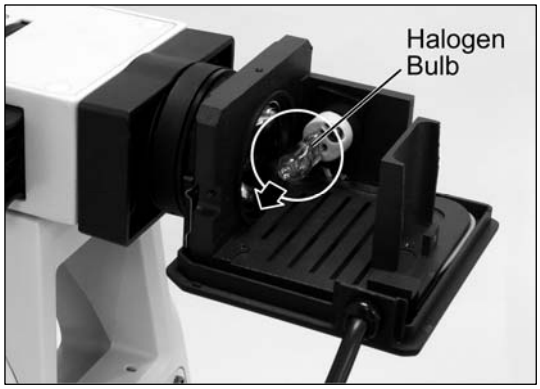
A. 12V/ 50W Halogen

The applicable halogen bulb of Epi-iluminator is the 12V/ 50W halogen long-life bulb.

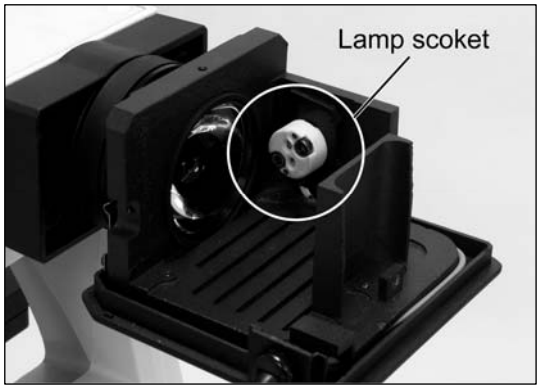
- Fully loosen the slotted head knurled screw (Fig.15) on the back of the lamp house.
- Lift the lamp house to remove. (Fig.15)
- Remove the old bulb (Fig.16) with a piece of gauze and insert the new bulb's pins all the way into the pin holes on the lamp socket. (Fig.17)
- Fit the lamp house from above and tighten the slotted head knurled screw.



(Fig.15)



(Fig.16)



(Fig.17)

B. 12V/ 3W LED Module

This is a Motic patent design to exchange12V/ 3W LED module and 12V/ 50W halogen bulb on the same socket directly.

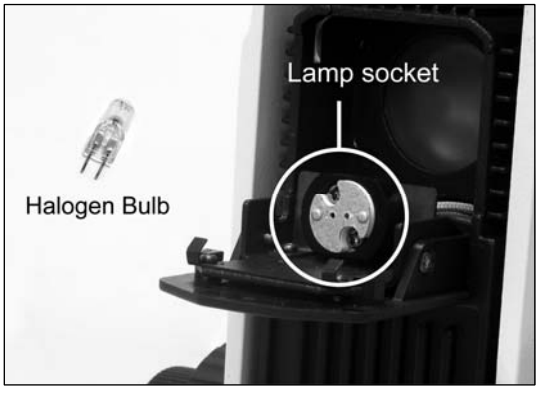
- Fully loosen the slotted head knurled screw on the back of the lamp house.
- Lift the lamp house to remove.
- Firmly insert the LED module into the socket pinholes until it reaches the limit.
- After the LED module installation, secure it with the clamp screw by 1.5mm hexagonal screwdriver supplied with the microscope.

C. 6V/ 30W Halogen

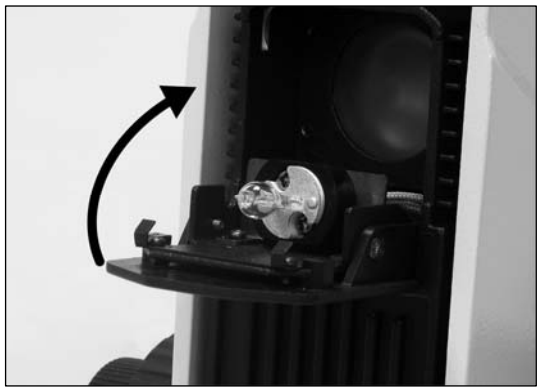
The applicable halogen bulb of transmitted illumination is the 6V/ 30W halogen long-life bulb.

- In order to prevent electric shock always turn the power switch off and unplug the power cord before installing or replacing the bulb.
- Place microscope on its back and pull back the lamp house cover plate. (Fig.18)
- Firmly insert the bulb into the socket pinholes until it reaches the limit. Be careful not to tilt the bulb when mounting. (Fig.19)
- When installing the bulb, do not touch the glass surface of the bulb with bare fingers.
  Doing so will cause fingerprints, grease, etc., to burn onto the lamp surface, reducing the illumination provided by the bulb. If the surface is contaminated, wipe it clean using lens tissue.
- Close lamp house cover plate and secure until it snaps into position. (Fig.20)

(Fig.18)



(Fig.19)

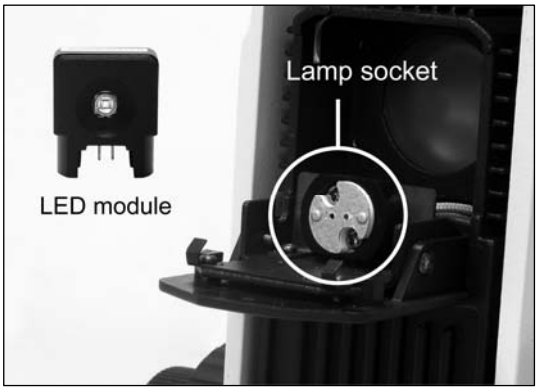


(Fig.20)

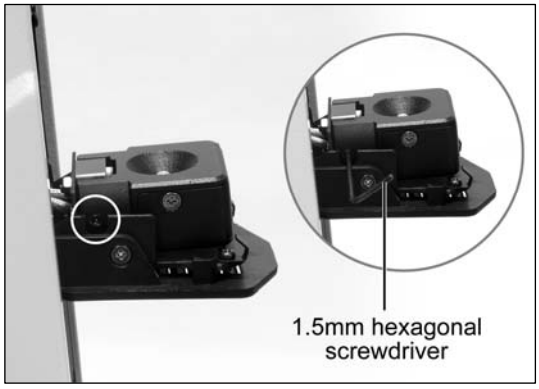
D. 6V/ 3W LED Module

- In order to prevent electric shock always turn the power switch off and unplug the power cord before installing or replacing the bulb.
- Place microscope on its back and pull back the lamp house cover plate. (Fig.21)
- Firmly insert the LED module into the socket pinholes until it reaches the limit (Fig.22).
  This is a Motic patent design to exchange LED module and halogen bulb on the same socket directly.
- After the LED module installation, secure it with the clamp screw by 1.5mm hexagonal screwdriver supplied with the microscope. (Fig.23)
- Close lamp house cover plate and secure until it snaps into position. (Fig.24)

(Fig.21)



(Fig.22)



(Fig.23)

(Fig.24)

4. Disinfecting the Microscope

- Follow the standard procedures for your laboratory.

5. When not in use

- When not in use, cover the instrument with vinyl dust cover and store in a place low in humidity where mould is not likely to form.
- Store the objectives, eyepieces and filters in a container or desiccator with drying agent.
- Proper handling of the microscope will ensure years of trouble free service.
- If repair become necessary, please contact your Motic agency or our Technical Service direct.

Note:

- If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
- To avoid getting wet, do not use the microscope near water.

VIII. WARNING LABELS

The following warning labels (or symbols) are found on the microscope, Study the meaning of the warning labels (or symbols) and always use the equipment in the safest possible manner.

Warning Label / Symbol	Explanation
	Indicates that the surface becomes hot, and should not be touched with bare hands.
	Indicates that the main switch is ON.
	Indicates that the main switch is OFF.
~	Indicates alternating current.

Proper handling of the microscope will ensure years of trouble free service.
If repair become necessary, please contact your Motic agency or our Technical Service directly.

Motic®

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