Motic®

BA310E
Biological Microscope
Instruction Manual

Note If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

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MOTIC HONG KONG LIMITED

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We are constantly endeavoring 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 CORRECTED OPTICS

In this optical concept the light beams are parallel after leaving the objective in the direction of the eyepieces. A second optical element, the tube lens (normally located in the eyepiece tube) is used to converge the parallel beams, resulting in an intermediate image. The intermediate image is focussed by the eyepieces, to provide the real image for visual observation.
The implementation of a tube lens gives the opportunity to minimize chromatic aberrations and other “optical defects”. Further, in “Infinity Optics” the distance between the objective and tube lens is not as strictly fixed as in the (historically older) “Finite Optics” of 160mm tube length.
This allows additional optical components to be inserted between the objective and tube head. Fluorescence attachments, discussion bridges, eye level risers and other options can be added without affecting the image quality.
In general “Infinity Optics” provides flexibility and the opportunity to add additional optional features.

MICROSCOPE TERMINOLOGY

Abbe Condenser

A two-lens sub-stage condenser located below the stage of a microscope and functions to collect light and direct it onto the object being examined. Its high numerical aperture makes it particularly suited for use with most medium- and high-magnification objectives.

Aperture, Numerical (N.A.)

The numerical aperture is an important factor determining the efficiency of the condenser and objective. It is represented by the formula: (N.A. = **ηsinα**), where **η** is the refractive index of a medium (air, water, immersion oil etc.) between the objective and the specimen or condenser, and **α** is half of the maximum angle at which light enters or leaves the lens from or to a focused object point on the optical axis.

Cover Glass Thickness

Transmitted light objectives are designed to image specimens that are covered by a thin cover glass (**cover slip**). The thickness of this small glass piece is now standardized at 0.17 mm for most applications.

Diaphragm, Condenser

A diaphragm, which controls the effective size of the condenser aperture. A synonym for the condenser illuminating aperture diaphragm.

Magnification

The number of times by which the size of the image exceeds the original object. Lateral magnification is usually meant. It is the ratio of the distance between two points in the image to the distance between the two corresponding points in the object.

Micrometer: *um*

A metric unit of length measurement
= $1x10^{-6}$ meters or 0.000001 meters

Nanometer (nm)

A unit of length in the metric system equal to 10^{-9} meters.

Phase–contrast (microscopy)

A form of microscopy, which converts differences in object thickness and refractive index into differences in image amplitude and intensity.

Real Viewfield

The diameter in millimetres of the object field.

$$\text{Real Viewfield} = \frac{\text{Eyepiece Field of View}}{\text{Objective Magnification}}$$

Diopter adjustment
The adjustment of the eyepiece of an instrument to provide accommodation for the eyesight differences of individual observers.

Depth of Focus
The axial depth of the space on both sides of the image plane within which the image is sharp. The larger the N.A. of objective, the shallower the depth of focus.

Field of View (F.O.V.)
That part of the image field, which is imaged on the observer's retina, and hence can be viewed at any one time. The field of view number is now one of the standard markings of the eyepiece.

Filter
Filters are optical elements that selectively transmit light. It may absorb part of the spectrum, or reduce overhaul intensity or transmit only specific wavelengths.

Immersion Oil
Any liquid occupying the space between the object and microscope objective. Such a liquid is usually required by objectives of 3-mm focal length or less.

Resolving Power
A measure of an optical system's ability to produce an image which separates two points or parallel lines on the object.

Resolution
The result of displaying fine details in an image

Total Magnification
The total magnification of a microscope is the individual magnifying power of the objective multiplied by that of the eyepiece.

Working Distance
This is the distance between the objective front lens and the top of the cover glass when the specimen is in focus. In most instances, the working distance of an objective decreases as magnification increases.

X–axis
The axis that is usually horizontal in a two-dimensional coordinate system. In microscopy X-axis of the specimen stages is considered that which runs left to right.

Y–axis
The axis that is usually vertical in a two-dimensional coordinate system. In microscopy Y-axis of the specimen stages is considered that which runs front to back.

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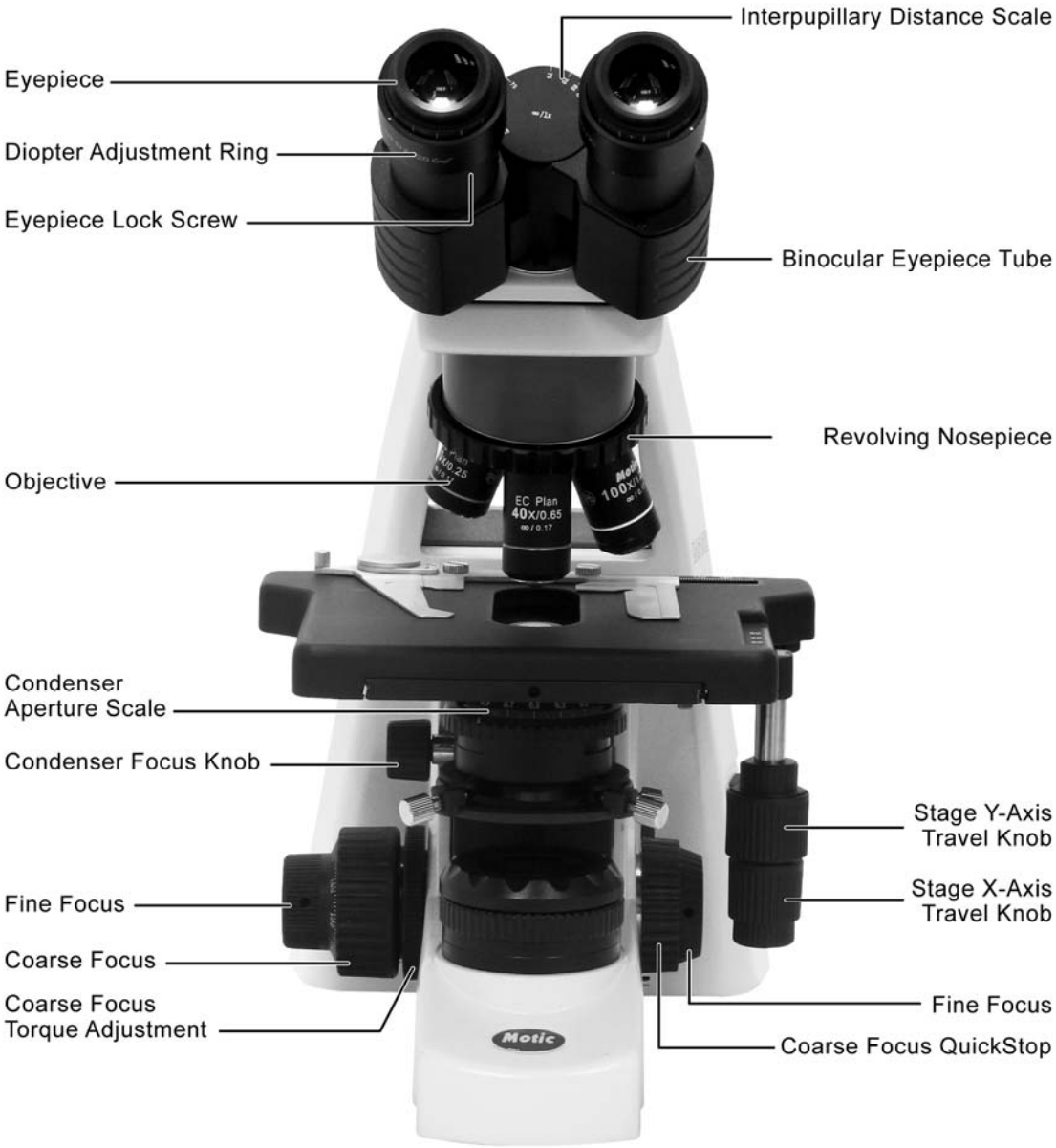
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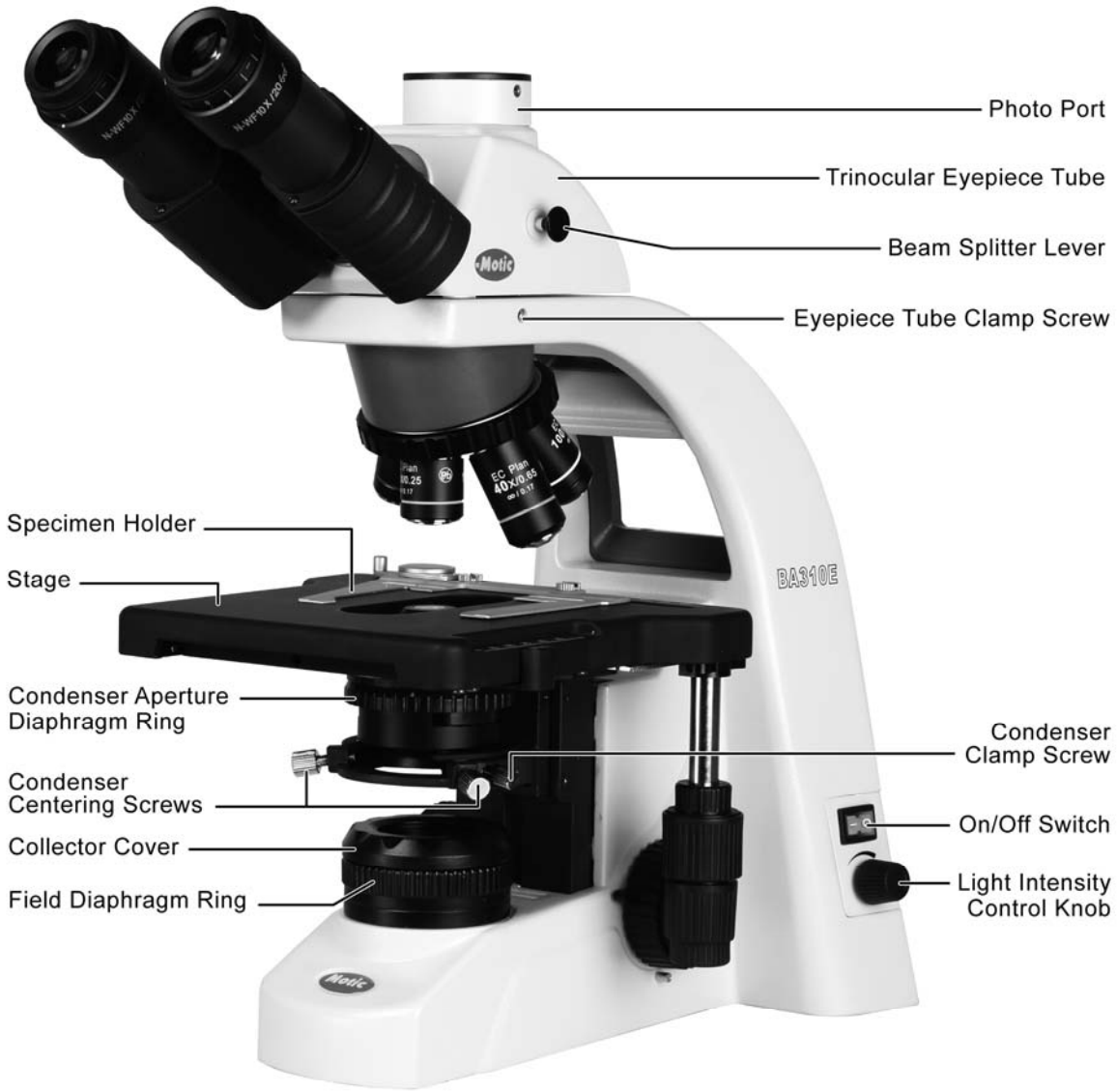
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1. NOMENCLATURE



BA310E (Binocular)



BA310E (Trinocular)

2. 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.

2.1 Operating environment

- Indoor use
- Altitude : Max 2000 metersn
- Ambient temperature : 15°C to 35°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 106 kPa
- Avoid frost, dew, percolating water, and rain

3. ASSEMBLING THE MICROSCOPE

3.1 Verifying 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.
- If using an 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.

- Electrical Specifications:

A. Halogen

Input: 90-240V~, 80VA, 50-60Hz

Bulb: 6V ⎓ 30W Halogen

Fuse: 250V T2.5A (If the original fuse is blown, please replace with specified fuse)

B. LED module

Input: 90-240V~, 80VA, 50-60Hz

LED: 3.4V ⎓ 3W

Fuse: 250V T2.5A (If the original fuse is blown, please replace with specified fuse)

- LED module high color temperature: 6000K ± 300K
- LED module low color temperature: 4500K ± 300K

3.2 Illumination

3.2.1 Halogen lamp

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

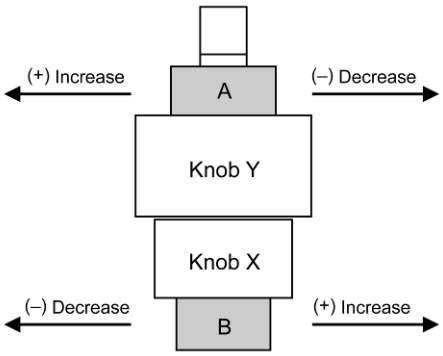
3.2.2 LED

- 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.

3.3 Rackless stage

- Remove specimen holder for fast hand scanning of slides.
- Left-handed and right-handed operation stages are available for option.
  Left hand operation stages is available for option. It should be used with the short stage knob for avoiding to interfere the fine focus knob.

- Torque adjustment



The torque of the y-axis and x-axis travel knobs can be adjusted by torque adjusting knobs.
For y-axis to (+) increase or (-) decrease the torque, turn Knob Y while holding A
For x-axis to (+) increase or (-) decrease the torque, turn Knob X while holding B

3.4 Specimen holder

- Attach the specimen holder, using the two mounting holes.

3.5 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**.**

3.6 Condenser

- 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.

3.7 Eyepiece tube

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



(Fig.1)

3.8 Eyepieces

- Use the same magnification eyepieces for both the eyes.
- To secure the eyepiece in the eyepiece sleeve, tighten the clamp screws.
- Twist the eyepiece (anti-clockwise or clockwise) with 20~30 degree (Fig.2) and pull the eyepieces gently out when removing the eyepiece. (Fig.3)



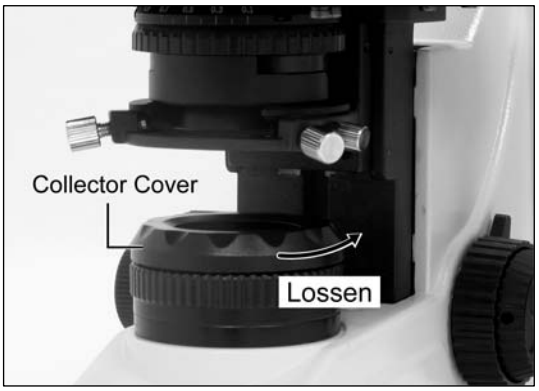
(Fig.2)



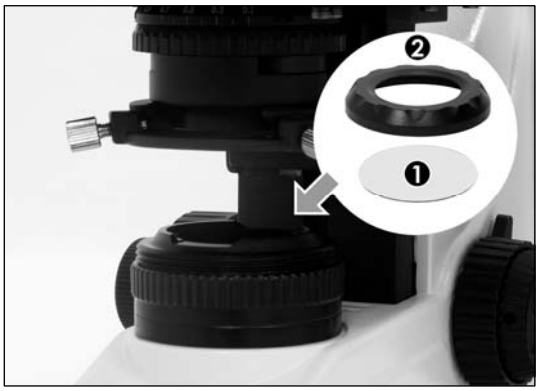
(Fig.3)

3.9 Filters

- Remove the collector cover (Fig.4) and place the filter in the filter holder located around the field lens (Fig.5.1), then screw the cover back (Fig.6). Take care that dust, dirt and fingerprints do not get on the filter and the field lens.



(Fig.4)



(Fig.5)



(Fig.6)

- 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.

3.10 Power cord

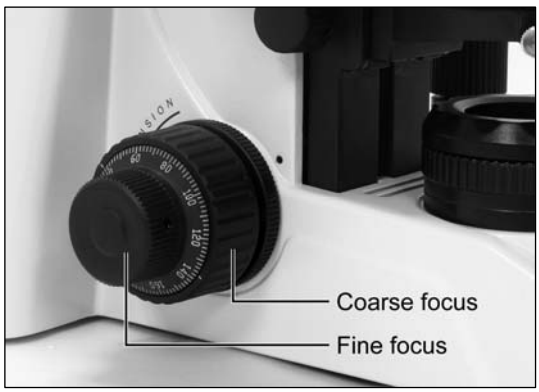
- Connect the socket of the of the power cord to the AC inlet on the rear of the base of the microscope. Plug in the other end of the cord to an AC outlet with ground conductor.

4. USAGE OF MICROSCOPE COMPONENTS

4.1 Coarse and fine focusing (Fig.7)

- 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.**



(Fig.7)



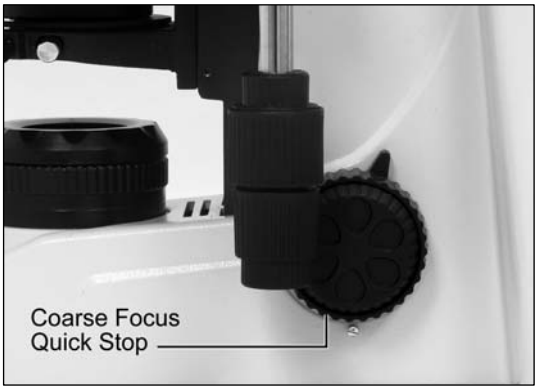
(Fig.8)

4.2 Coarse focus torque adjustment (Fig.8)

- To increase the torque, turn the torque adjustment ring 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.

4.3 Coarse focus quick stop (Fig.9)

- The coarse focus quick stop 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.9)

4.4 Stage upper limit stop adjustment (Fig.10)

(Upper Stage Limit is preset at the factory; please only adjust if necessary)

- The Stage Upper Limit stop marks the stage position at which the specimen is in focus i.e. by restricting the movement of the coarse focus knob.
- With the specimen in focus, turn the stage upper limit stop knurled ring clockwise until it reaches the stop.
- When the stage upper limit stop is in position, the stage cannot be raised from that position.
- Lower the stage by using the coarse focus knob anticlockwise



(Fig.10)

4.5 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 standard phototube will be 20:80.

4.6 Interpupillary distance adjustment

- Before adjusting the interpupillary distance, bring a specimen into focus using the 10x objective.
- Adjust the interpupillary distance 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
- Depending on the working environment and its demands, the BA310E has a solution. Each eyepiece tube allows a 360°swiveling movement (Fig.11) as well as a flexible adjustment of the interpupillary distance between 48 and 75mm. The “Butterfly mode” increase the viewing height by 40mm. (Fig.12)



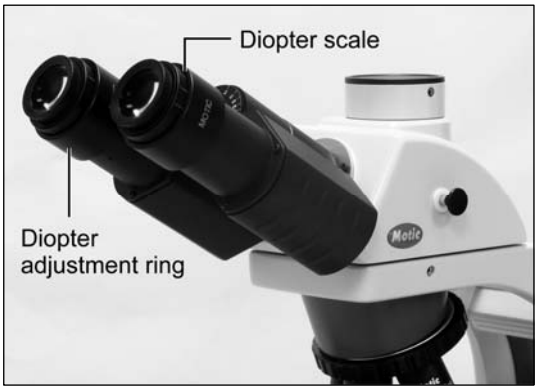
360°swiveling movement
(Fig.11)



Butterfly movement
(Fig.12)

4.7 Diopter adjustment

- Every human eye is different, to adjust the Instrument to best performance adjustment can be necessary.
- Set the diopter on both eyepieces to the “0” position.
- Change to 10x Magnification and focus the image of the specimen with one eye only.
- Use the Eye which is most convenient for first focusing.
- When the best focus position is reached, close this eye and use the other eye for the following steps.
  - Correct the focus for the second eye by using only the Diopter adjustment Ring (Fig.13), do not use the coarse / fine focusing knob!
  - Change to a higher magnification to verify the result and if necessary repeat the procedure to match the sharpness for higher magnification.
  - Keep this final diopter position for all magnification / lenses. The diopter position for each **user** can be recorded from the scale (Fig.13), so it can easily be reset.



(Fig.13)

4.8 Centering the condenser

- 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.

4.9 Use of aperture diaphragm

- 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.

4.10 Use of field diaphragm

- 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.

4.11 Brightness and contrast adjustment

- Neutral density filters are used for brightness adjustment in routine microscopy and photomicrography.
- For phase contrast and contrast adjustment with black and white film, a Green interference filter (546nm) is recommended.
- An HE (didymium) filter for colour photomicrography, Haematoxylin, Eosin (HE) or Fuchsin stained specimen with tungsten type film is available.

5. 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 standard 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.
- For specific photomicrographic procedures, refer to the manual of the specific camera being used.

6. USING OIL IMMERSION OBJECTIVES

- Oil immersion objectives are labelled with the additional engraving “Oil” and are to be immersed in oil between the specimen and the front of the objective.
- The immersion oil supplied by Motic is synthetic, non-fluorescing and non-resining oil, with a refractive index of 1.515.
- Normally, cover glass must be used with oil immersion objectives with a few exceptions. Deviations from thickness are not important as a layer of immersion oil acts as compensation above the cover glass.
- The small bottle of oil supplied with every immersion objective facilitates application of the oil to the cover slip.
- Remove any air bubbles in the nozzle of the oil container before use.
- Immersion oil must be used sparingly. After the examination, the oil should be wiped off the objective with a lens cleaning tissue and the residual film removed with soft cloth moistened with petroleum benzene or absolute alcohol.
- Locate the field of interest with a lower magnification objective. Swing the objective out of the light path, and add one drop of immersion oil over the site of the specimen.
  Swing in the oil immersion objective. There should be a small column of oil from the cover slip to the objective lens. Use the fine focus to make the image sharp.
- Freedom from air bubbles must be ensured. To check for air bubbles, remove an eyepiece, fully open the field and aperture diaphragms, and look at the exit pupil of the objective within the eyepiece tube. Air bubbles are recognized by a surrounding black ring. Bubbles may often be dislodged by moving the slide to and fro or by slightly rocking the revolving nosepiece back and forth. If not successful in clearing the bubbles then the oil must be wiped off and replaced with a fresh drop.

7. 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.

7.1 Optical

Problem	Possible Cause
Vignetting or uneven brightness in the field of view or field of view only partially visible	Lamp not installed properly
	Lamp not centred
	Diffuser is in intermediate position
	Condenser not mounted correctly
	Condenser is not centred
	Condenser is set too low
	Condenser top lens not fully swung in/out
	Field diaphragm closed too far
	Aperture diaphragm closed too far
	Improper condenser objective combination
	Revolving nosepiece not clicked into position
	Trinocular eyepiece tube optical path selector lever in intermediate position
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 with oil immersion lens
	Air bubbles in immersion oil
	Specified immersion oil not used
	Immersion oil on dry objective
	Greasy residue on eyelens
	Incorrect illumination

Unequal focus	Stage installed on inclined plane
	Specimen holder not fixed securely on stage
	Specimen not secured in position
Image tinged yellow	Lamp voltage is set too low
	Blue filter is not being us
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

7.2 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

8. CARE AND MAINTENANCE

8.1 Do not disassemble

- Disassembly may significantly effect 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.

8.2 Cleaning the microscope

8.2.1 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 be used to remove grease or fingerprints.
- Use only a mixture of alcohol and ether (ratio: alcohol: 3 and ether: 7) 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.

8.2.2 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.

8.3 Disinfecting the Microscope

- Follow the standard procedures for your laboratory.

8.4 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 becomes 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 warranty may be void.
- To avoid getting wet, do not use the microscope near water.

8.5 Bulb replacement

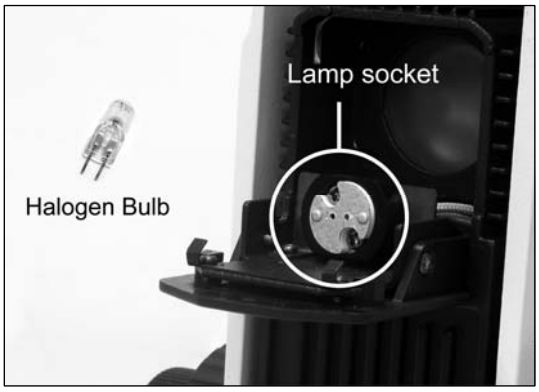
The lamp and the lamphouse become very hot during and after a period of operation.
Risk of burn – Do not touch the lamp during or immediately after period of operation.
Make sure the lamp has cooled sufficiently before attempting to replace the lamp.

8.5.1 30W Halogen

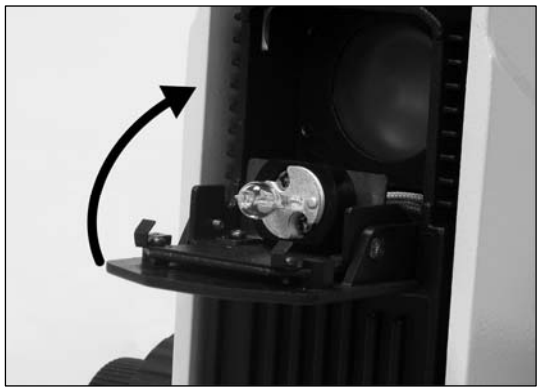
- In order to prevent electric shock always turn the power switch off and unplug the power cord before installing or replacing the bulb.
- Place microscope on its back and pull back the lamp house cover plate. (Fig.14)
- Firmly insert the bulb into the socket pinholes until it reaches the limit. Be careful not to tilt the bulb when mounting. (Fig.15)
- 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.16)



(Fig.14)



(Fig.15)



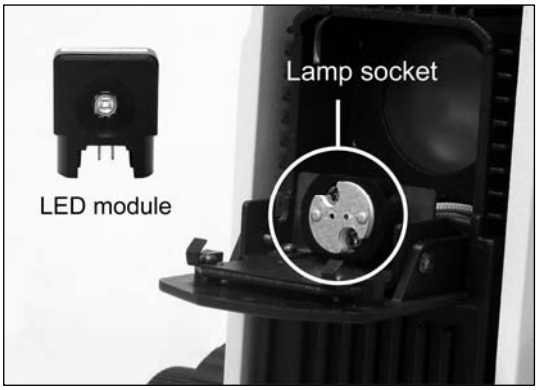
(Fig.16)

8.5.2 LED Module

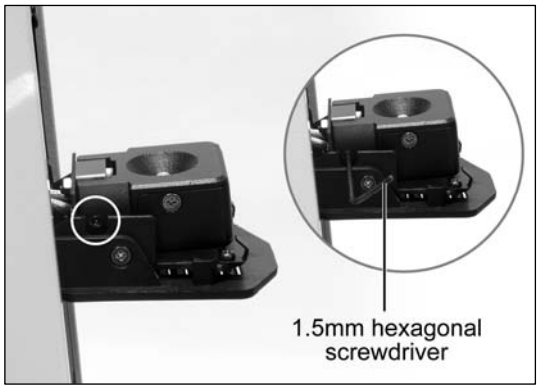
- In order to prevent electric shock always turn the power switch off and unplug the power cord before installing or replacing the bulb.
- Place microscope on its back and pull back the lamp house cover plate. (Fig.17)
- Firmly insert the LED module into the socket pinholes until it reaches the limit (Fig.18). 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.19)
- Close lamp house cover plate and secure until it snaps into position. (Fig.20)



(Fig.17)



(Fig.18)



(Fig.19)



(Fig.20)

9. 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.
	CAUTION! Risk of danger. Please consult documentation in all cases where this symbol is used.

The lamp and the lamphouse become very hot during and after a period of operation.
Risk of burn – Do not touch the lamp during or immediately after period of operation.
Make sure the lamp has cooled sufficiently before attempting to replace the lamp.

Don’t pick the microscope up from the bottom during equipment operation.

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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Design Change: The manufacturer reserves the right to make changes in instrument design in accordance with scientific and mechanical progress, without notice and without obligation.

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