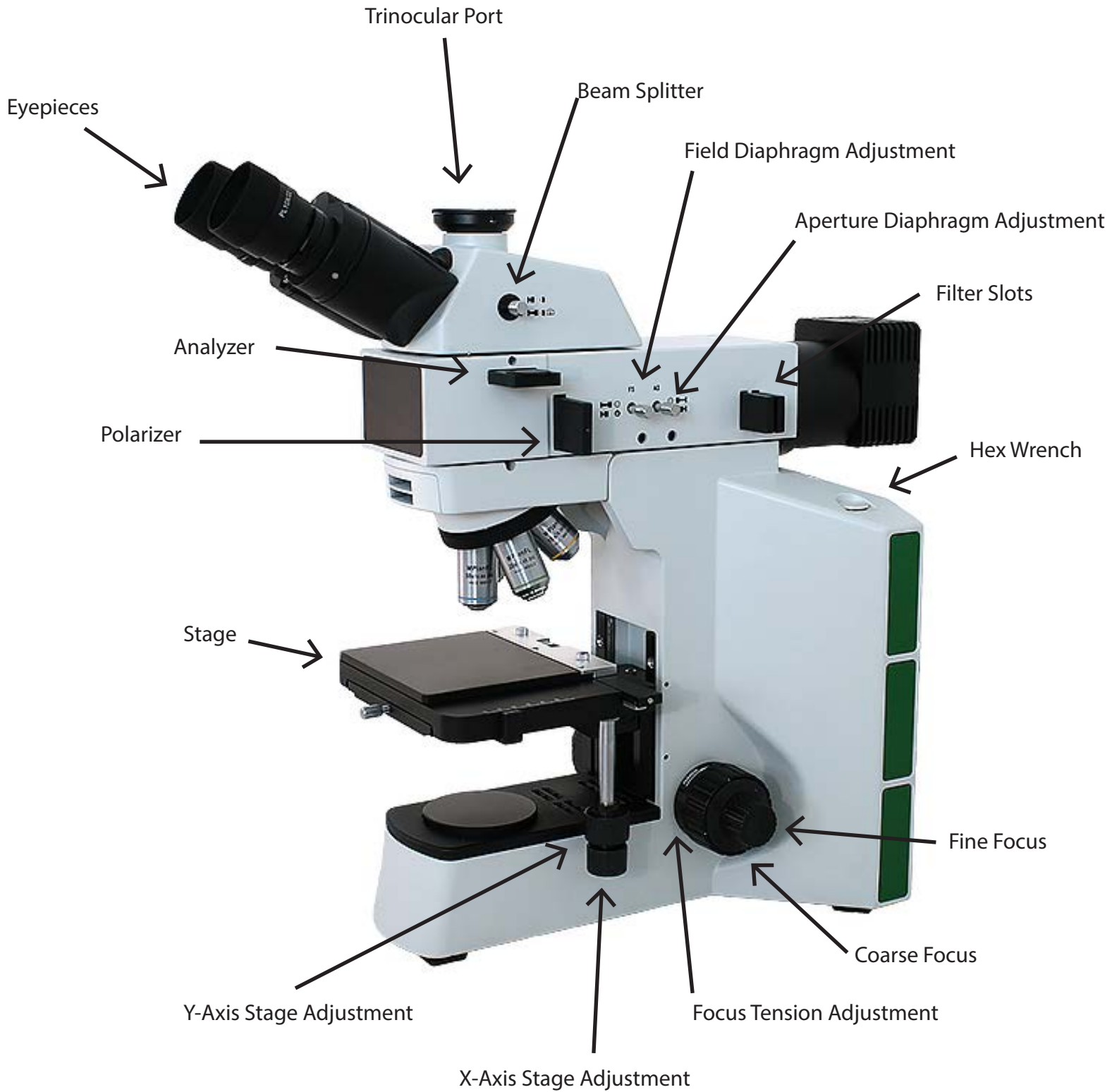


M40 Microscope User's Manual

for M40 and M40RT

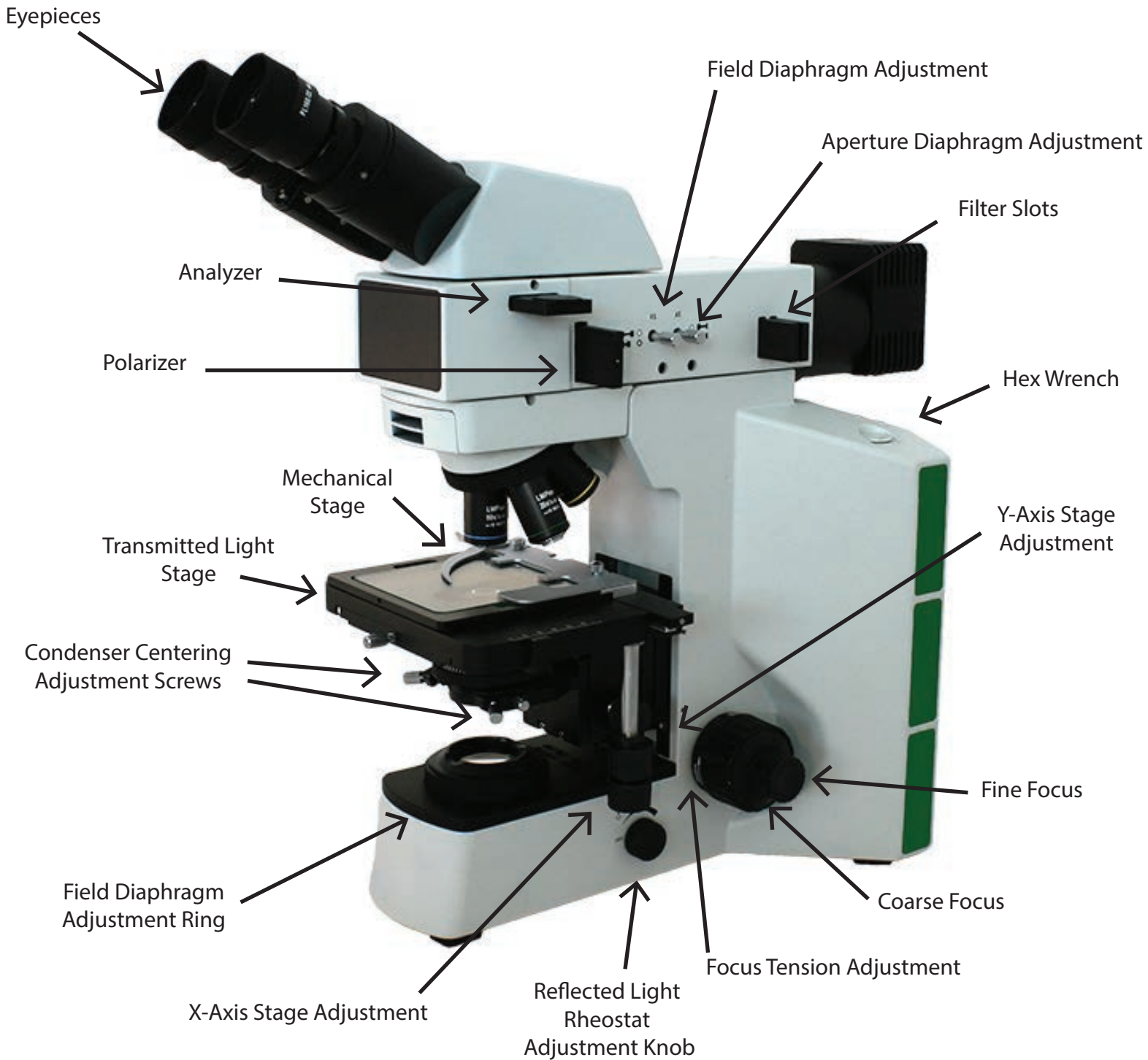


Microscope Components:



M40 Reflected Light Metallurgical Microscope

Microscope Components:

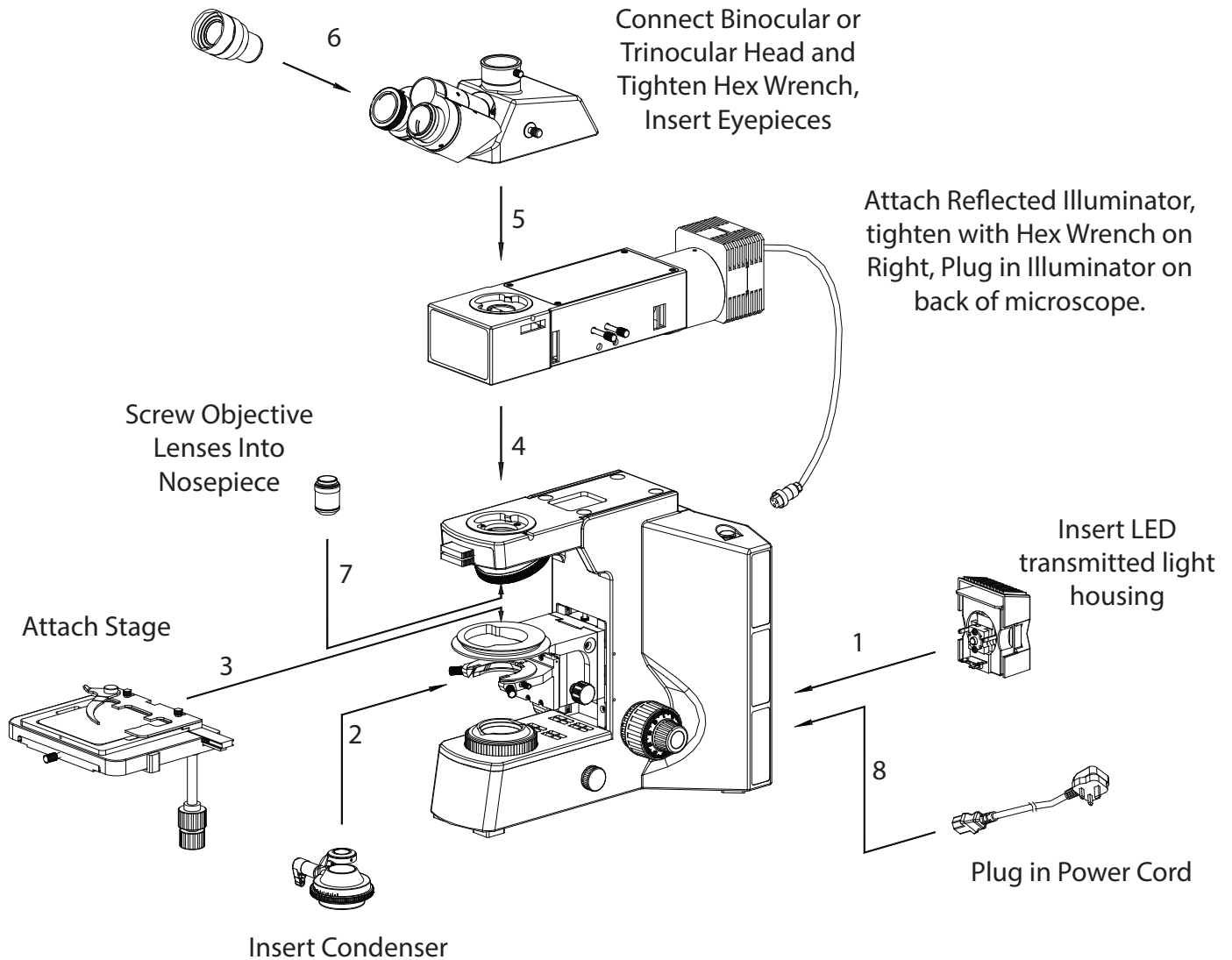


M40RT Reflected & Transmitted Light Metallurgical Microscope

Microscope Assembly:

Follow the numbered diagram below when assembling the microscope.

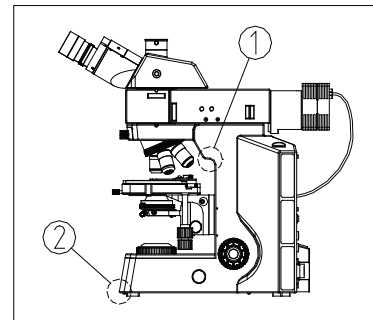
If assembling the M40 (reflected light only) microscope, omit steps 1 and 2.



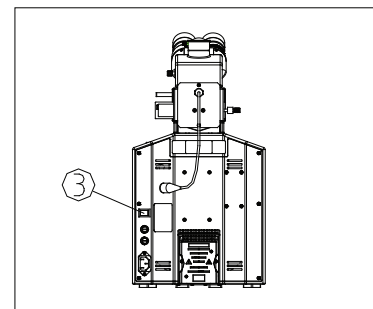
Before Use:



Do not shake or drop the microscope. Do not expose the microscope to direct sunlight or store in high temperature, damp or dusty areas. Make sure the workspace is horizontal. Indoor temperature should be between 41-104°F with a maximum relative humidity 80%. When moving the microscope, use one hand to hold the arm (1) and the other hand to hold the front of the base (2). Do NOT hold the microscope by the stage, focusing knob, head or light source when carrying it.



When working, make sure the light source has enough room for any heat to dissipate. Before replacing the fuse, make sure the power switch (3) is in the "O" (off) position. Voltage range of 100~240V is supported. Make sure voltage is in this range. Only use the power cord supplied with the microscope.



Microscope Maintenance:



Wipe lenses gently with a soft tissue. Carefully wipe off fingerprints on the lens surface with a tissue moistened with a small amount of 3:7 mixture of alcohol and ether or dimethylbenzene, or a microscope cleaning solution.



Do not use organic solution to wipe the surfaces of other components. If needed use neutral detergent.



If the microscope becomes wet, power it off immediately and wipe all surfaces dry. Do not disassemble the microscope.

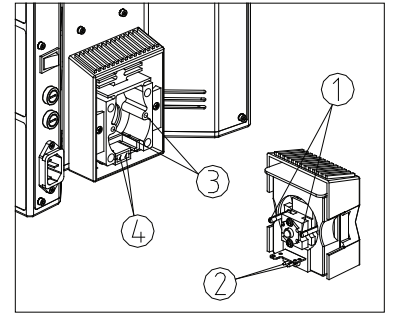


When not in use, cover the microscope with the dust cover.

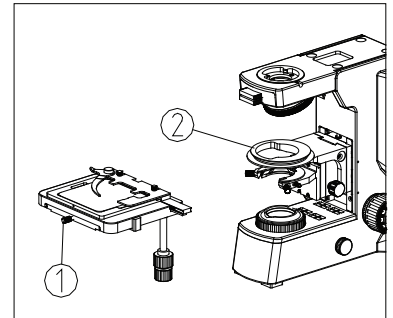
Microscope Assembly:



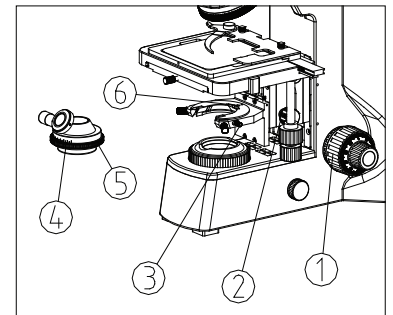
M40RT Only: Connect the transmitted LED light housing by matching the guide pins (1) and power supply pins (2) of the light source group with the guide receptacles (3) and the power socket (4) of the base, and push the light source group into the base thoroughly.



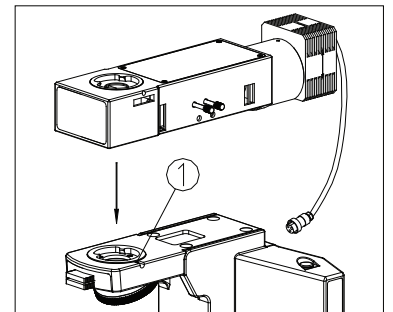
Assemble the stage by fully loosening the set screw (1) on the front of the stage. Place the "V" notches on the bottom of the stage into the "V" notches in the rounded groove (2) for the stage, then retighten the set screws (1).



Assemble the condenser by rotating the coarse focus knob (1) to raise the stage to its highest position. Rotate the condenser height knob (2) to move the condenser holder to its lowest position. Loosen the condenser set screw (3). Swing out the front lens of the condenser (4) with the scale facing forward. Align the alignment pin (5) line up with the groove (6) in the condenser holder. Push the condenser into the holder as far as it will go. Tighten the condenser set screw (3) and raise the condenser (4) to its highest position with the condenser height knob (2).

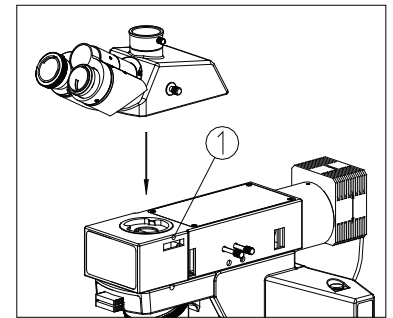


Assemble the reflected light source by loosening the set screw (1), and slotting the illuminator into the hole in the microscope body. Retighten the set screw (1) when finished.



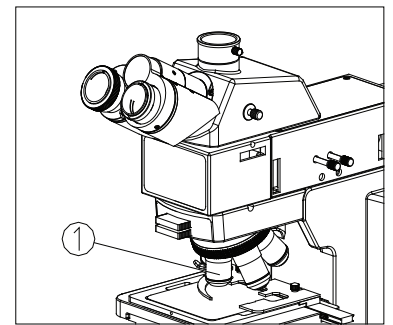


Assemble the head by loosening the set screw (1), inserting the head onto the reflected light illuminator, and then tightening the set screw (1) again when finished.

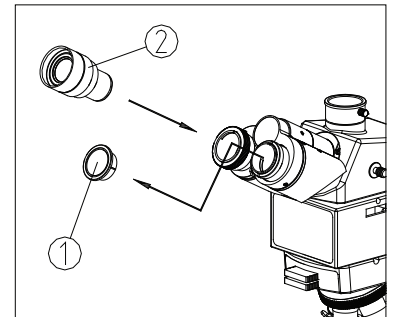


Rotate the focusing knob to lower the stage. **Install the objective lenses (1)** into the nosepiece from the lowest magnification to the highest magnification in a clockwise direction.

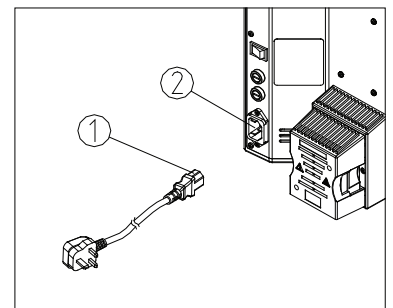
When viewing a sample start with the lowest magnification and once in focus, move up to a higher magnification. When rotating to a new objective lens make sure the objective clicks into place.



Remove the eyepiece cover from the eyetube (1) and **insert the eyepiece (2)** into the eyetube until it touches at the bottom of the tube.



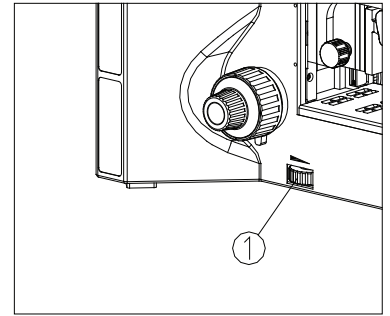
Make sure the power switch is set to "O" off position. Insert the end of the **power cord (1)** into the microscope socket (2). Insert the other end of the power cord into the power supply. Only use the power cord supplied with the microscope.





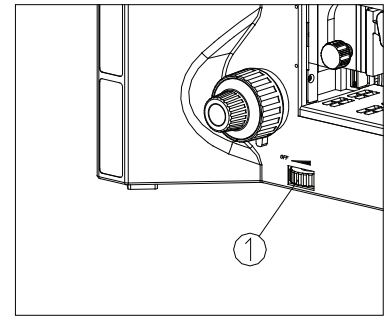
M40 (Reflected Light Only)

Turn the power supply on the back of the microscope to “-” On. **Adjust the light rheostat control (1)** until the illumination is lighting the sample. Rotate the control clockwise to increase brightness and counterclockwise to decrease brightness.



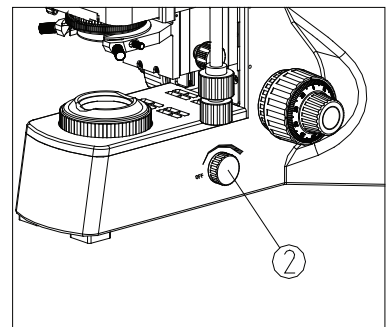
M40RT (Transmitted Light)

Turn the power on the back to “-” On. For transmitted illumination, rotate the **light rheostat control (1)** counterclockwise to increase magnification and clockwise to decrease magnification.



M40RT (Reflected Light)

For reflected illumination, rotate the **rheostat control knob (2)** clockwise to increase brightness and counterclockwise to decrease brightness.



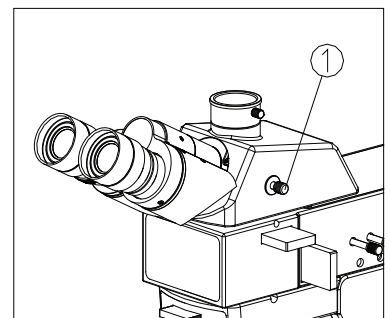
Using the lights at a lower brightness extends bulb life.



On trinocular models (with a camera port) the **beam splitter (1)** controls the amount of light traveling to the eyepieces and/or the camera.

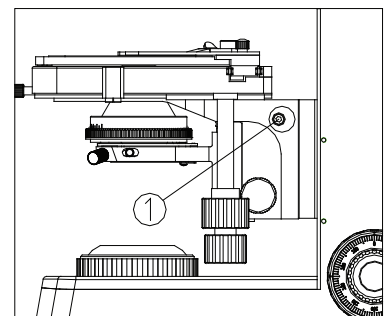
When the beam splitter is pushed all the way in, 100% of the light is directed to the eyepieces.

When the beam splitter is pulled out, 50% of the light travels to the eyepieces and 50% to the camera.



The microscope has been set up for samples below 27mm in height. If you wish to view a **sample 27-33mm in height**, loosen the bracket set screw (1) with the hex wrench. Move the bracket down to the appropriate position and tighten the bracket set screw.

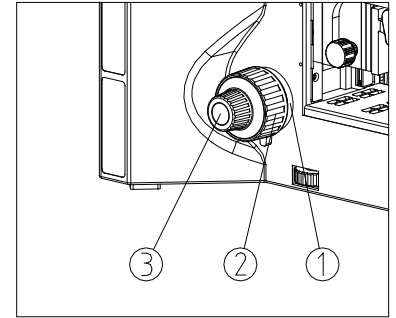
Hold the bracket when loosening the set screw to keep it from falling.



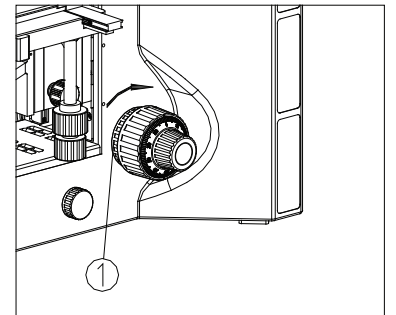


To **adjust the focusing**, make sure the upper limit lock (1) is loosened then adjust the coarse focusing knob (2) until the image is in the field of view. Re-lock the upper limit lock (1) and adjust the image by focusing with the fine focus knob (3) for a clear image.

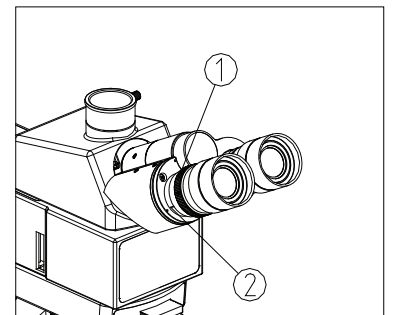
The upper limit lock can prevent the objective from running into the sample when focusing.



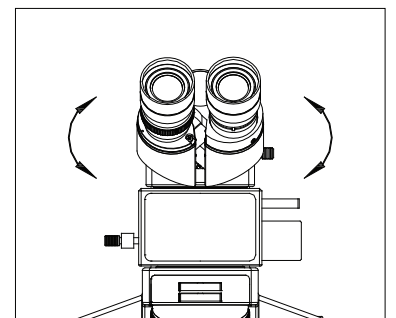
If the focusing knob is hard to turn or the stage drifts and the sample falls out of the field of view, the **focus tension ring** (1) should be adjusted. Rotate the focus tension adjustment ring to loosen or tighten the focus knob.



Adjust the diopter by viewing a clear image through the right eyepiece. Observe the left eyepiece and if the image is not clear, rotate the diopter adjustment ring (1) until the image is in focus. There are +/-5 diopters on the diopter adjustment ring. The value on the scale once adjusted matches your eyes and should be noted if multiple people are using the microscope for faster transitions.



Interpupillary distance can be adjusted to match the distance between your eyes. Hold the left and right base of the eyetubes and rotate them around the axis to adjust the interpupillary distance so it is comfortable for observation. You can note the setting for your specific interpupillary adjustment. The eyepieces are adjustable from 50~76mm.





M40RT Only:

Center the condenser (for transmitted illumination) by rotating the condenser height knob (1) so the condenser is in the highest position. Rotate the lever (2) to move the front lens into the light path. (This lens will be used with objectives higher than 20x).

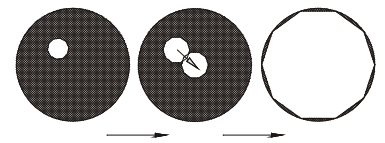
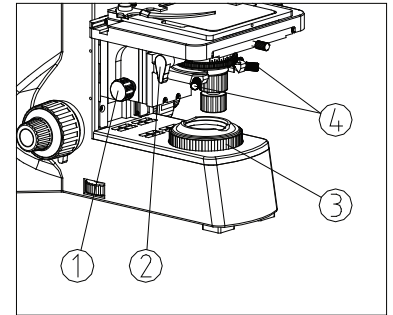
Move the 20x objective into the light path and focus.

Rotate the field diaphragm adjustment ring (3) to close the field diaphragm to the smallest position so the field iris diaphragm can be viewed through the eyepiece.

Rotate the condenser height knob to adjust the image so it is clear. Adjust the condenser centering screws (4) to place the image in the center of the field of view (shown at right).

Open the field diaphragm gradually. If the image is in the center and remains in the center, the condenser has been centered properly.

When using the microscope, open the field diaphragm slightly so the image is circumscribed in the field of view.



Adjust the field diaphragm. By limiting the diameter of light entering the condenser, the field diaphragm can strengthen image contrast. When the image is on the edge of the field of view the objective obtains the clearest image.

M40RT (Transmitted Illumination):

Rotate the field diaphragm adjustment ring (3 from image at top right) clockwise to enlarge the field, counterclockwise to decrease it.

M40 & M40RT (Reflected Illumination):

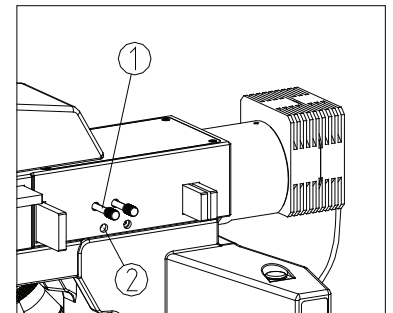
Push the field diaphragm adjustment pole (1) in all the way to minimize the field diaphragm.

The field diaphragm image can be observed by looking through the eyepieces.

Adjust the two field diaphragm centering screws (2) on both sides of the illuminator with the hex wrench until the image is centered.

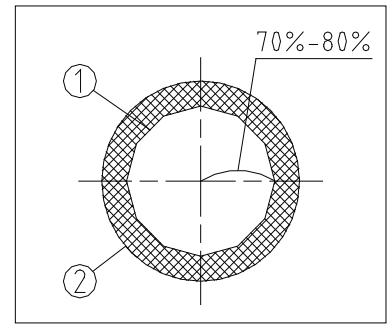
Open the field diaphragm gradually and if the image is inscribed within the field of view, then the field diaphragm is centered correctly.

When using the microscope enlarge the field diaphragm slightly.



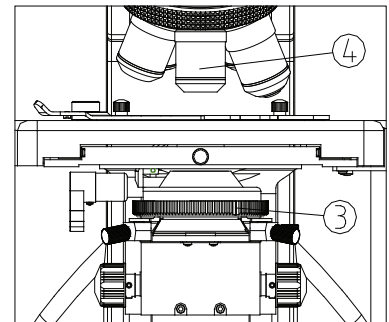


The **aperture diaphragm** decides the numerical aperture (NA) of the illumination system. If the NA of the illumination system matches the NA of the objective lens, the microscope will obtain better resolution and contrast and increase depth of field. Adjust the condenser aperture diaphragm so it is 70-80% of the NA of the objective. When using the microscope adjust the aperture diaphragm according to the light of the samples for the best contrast.



M40RT (Transmitted Illumination):

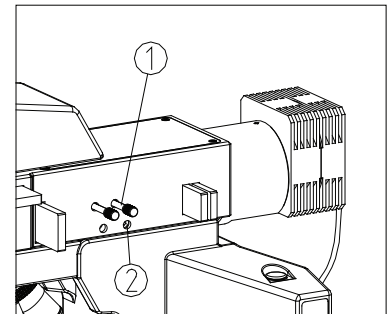
Adjust the aperture diaphragm adjustment ring (3) to control the size of the diaphragm. Remove the eyepiece if necessary when making this adjustment until you see the image shown above. (1) is the aperture diaphragm and (2) is the edge of the objective. Set the scale on the condenser NA to 80% of the value of the NA of the objective lens.



For example, if using a 50x objective, NA 0.55, set the scale of the aperture diaphragm to $0.55 \times 0.8 = 0.44$.

M40 or M40RT (Reflected Illumination):

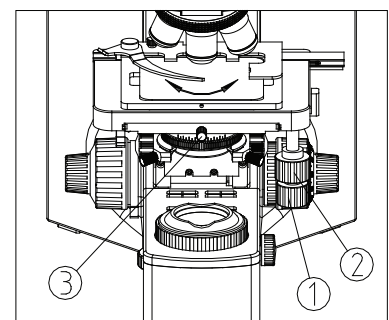
Changing the direction of the aperture diaphragm is the same as the field diaphragm. Adjust the aperture diaphragm with the diaphragm adjustment pole (1). Adjust the two aperture diaphragm adjusting screws (2) on both sides of the illuminator with the hex wrench to move the image of the aperture diaphragm to the center of the field of view. The eyepiece can be removed to observe through the eyetube. Adjust the aperture adjustment pole until the image at top right is observed.



The aperture diaphragm for the reflected illuminator is centered at the factory and typically users do not need to adjust this.



Adjust the stage by rotating the X-Axis (1) and Y-Axis (2) adjustment knobs. If the direction the stage is moving is different from the image seen through the eyepieces, rotate the stage to adjust it.



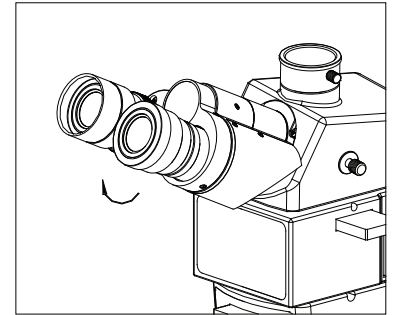
Loosen the set screw (3).

Rotate the stage slightly until the stage movement direction is the same as the image seen through the eyepieces. Retighten the set screw.





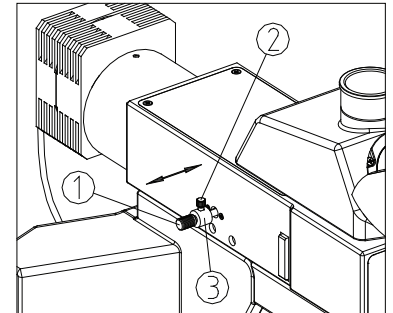
The **eye shields** can be used if the user wears glasses to prevent the glasses touching the eyepieces and avoid damaging either. The eye shields will also prevent stray light from disturbing observation for any user.



M40 & M40RT (Reflected Illumination):

The **oblique illumination** can be activated by pushing the rod (1) in all the way. When the rod is pulled out the microscope is using normal reflected observation mode.

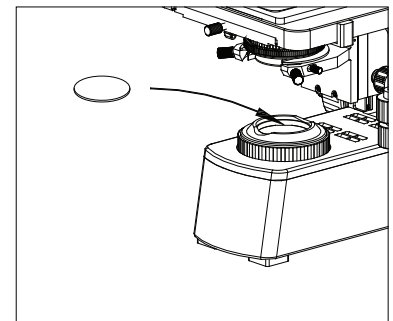
The position of the limit block (3) can be adjusted according to your specific sample observation requirements. When adjusting this limit block, first loosen the set screw (2) on the limit block (3), then move the limit block as shown in the image at right. When finished tighten the set screw (2).



Using the **color filter** can make the background more suitable and strengthen image contrast.

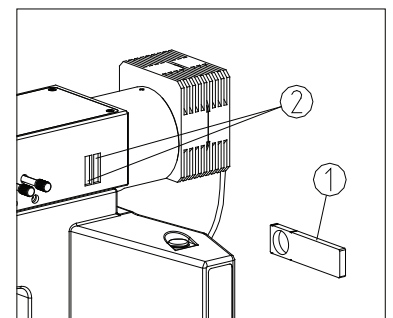
M40RT (Transmitted Illumination):

Insert the filter into the condenser groove, as shown at right. Place the rough surface of the filter so it is facing downward.



M40 or M40RT (Reflected Illumination):

Insert the color filter (1) into the filter slot (2) on the reflected illuminator. Insert the blank filter into the slot when a color filter is not being used.



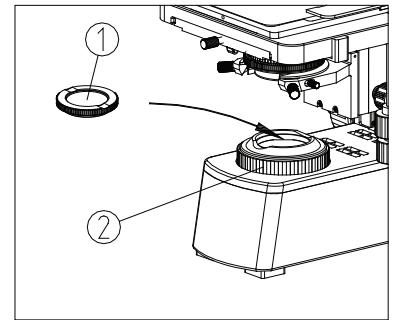
Polarization is obtained by using the simple polarizer and the analyzer. Remove the color filter when using polarization.



M40RT (Transmitted Illumination):

Place the polarizer (1) into the condenser groove (2). Insert the analyzer (3) fully into the analyzer slot (4) of the reflected illuminator arm.

The polarizer and analyzer are orthogonal when the 360° rotating analyzer is zero adjusted (or the fixed analyzer is used). Rotating the analyzer can change the orthogonal state of the polarized light.

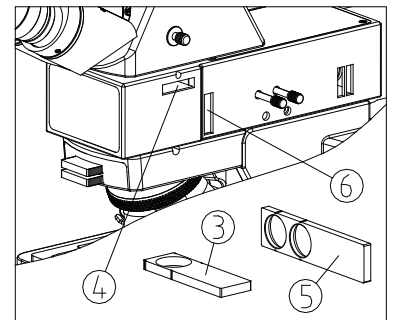


M40 (Reflected Illumination):

Insert the polarizer (5) into the polarizer slot (6) of the reflected illuminator arm.

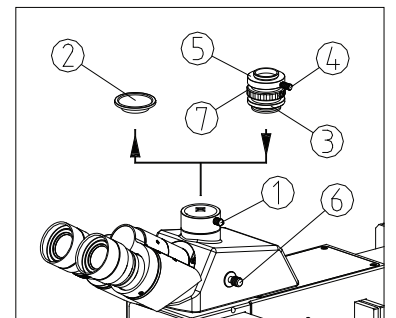
Insert the analyzer (3) fully into the analyzer slot (4) of the reflected illuminator arm.

The polarizer and analyzer are orthogonal when the 360° rotating analyzer is zero adjusted (or the fixed analyzer is used). Rotating the analyzer can change the orthogonal state of the polarized light.

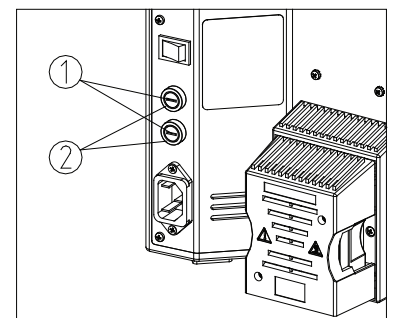


Connect the **c-mount adapter** by loosening the set screw (1) on the trinocular head and removing the dust cover (2). Remove the dust cover from the c-mount adapter (3). Insert the c-mount adapter into the trinocular port and retighten the set screw (1). Loosen the set screw (4) on the c-mount adapter. The c-mount interface (5) can be removed for connection to the c-mount camera and then re-attached to the c-mount adapter. Tighten the set screw (4) again when done.

For camera observation, pull the beam splitter (6) all the way out. If the camera image is not in focus when the eyepieces are in focus, adjust the c-mount focusing adjustment (7) until they are both in focus at the same time.



Replace the fuse by turning off the main power switch to "O". Remove the power cord. Screw out the fuse group (1) from the fuse base (2) with a flathead screw driver. Install a new fuse and screw it back into the fuse base.
Microscope fuse = 240V, 3.15A



Microscope Objectives:

Objective Type	Part # / Magnification	Numerical Aperture	Working Distance
LWD Plan Achromat	FMPLN5 / 5x	0.15	10.8mm
	FMPLN10 / 10x	0.30	12.2mm
	FMPLN20 / 20x	0.45	4mm
	FMPLN50 / 50x	0.55	7.9mm
Semi APO Brightfield	BF-SAPO-M5 / 5x	0.15	19.5mm
	BF-SAPO-M10 / 10x	0.30	10.9mm
	BF-SAPO-M20 / 20x	0.50	3.2mm
	BF-SAPO-M50 / 50x	0.80	1.2mm
	BF-SAPO-M100 / 100x	0.90	1mm



Optical Troubleshooting

Problem	Cause	Solution
LED light is bright, but field of view is dark.	Field diaphragm is not large enough.	Open the field diaphragm.
	Condenser is too low or not centered.	Adjust the condenser.
	Polarizer or analyzer blocking light.	Remove polarizer/analyzer.
	Beam splitter is pulled out.	Push the beam splitter in.
Side of the field of view is dark or uneven.	Nosepiece is not clicked into position.	Rotate nosepiece into place.
	Stain or dust has accumulated on the condenser, objective, eyepieces or light source.	Clean surfaces of condenser, objectives, eyepieces and light source.
	The filter, polarizer or analyzer is not in position.	Remove / reinsert filters and sliders.
	Beam splitter is not in correct position.	Adjust the beam splitter.
Dust is observed in the field of view.	Dust has accumulated on the specimen.	Clean the sample.
	Dust is on the objective or eyepiece.	Clean the objective and eyepieces.
Image is not clear.	A cover slip is being used.	Remove cover slip.
	The sample is not vertical to the objective.	Adjust sample.
	Aperture diaphragm not open.	Adjust aperture diaphragm.
	Stain or dust is on the lens.	Clean eyepiece / objective.
	Beam splitter is not in correct position.	Adjust beam splitter.
One side of field of view is dark or the image moves while focusing.	Specimen is not fixed.	Adjust sample on stage.
	Nosepiece is not clicked into position.	Click nosepiece into place.
	Condenser is not centered properly.	Center the condenser.
Eyes fatigue quickly during use or the right field of view doesn't match with the left.	Interpupillary distance is not set properly.	Adjust interpupillary distance.
	Diopter adjustment is not set properly.	Adjust the diopters.
	Different eyepieces are being used in the left and right eyetube.	Use the same eyepieces in each eyetube. Use the Fein Optic WF PL10x/22 Eyepieces.



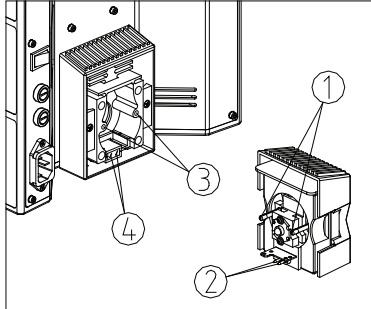
Mechanical & Electrical Troubleshooting

Problem	Cause	Solution
Mechanical Troubleshooting:		
Objective touches sample when moving from low magnification to high.	The stage is too high.	Lower the stage.
Coarse focusing knob is too tight.	Tension knob is too tight.	Loosen tension knob slightly.
Stage drifts or falls.	Tension knob is too loose.	Tighten tension knob slightly.
Coarse focusing knob won't raise higher.	The random upper limit knob is locked.	Loosen the random upper limit knob.
Coarse focusing knob won't lower far enough.	The base of the condenser is too low.	Raise the condenser.
Image jumps when stage is touched.	Stage is not fastened properly.	Reattach the stage.
Electrical Troubleshooting:		
Light does not work.	Power is not turned on.	Check power cable connection.
	Bulb is not installed properly.	Check light connection.
	Bulb is burned out.	Replace Bulb.
Bulb burns out quickly.	Incorrect bulb is being used.	Replace bulb with part # M40-002 (transmitted) or M40-001 (reflected).
Field of view is not bright enough.	Incorrect bulb is being used.	Replace bulb with part # M40-002 (transmitted) or M40-001 (reflected).
	Rheostat adjustment is turned down.	Adjust the rheostat control.
Bulb flickers or the brightness is not stable.	The connector pins or the wires for the bulb are not connected properly.	Check wire connections and connector pins for the bulb.
	The bulb needs to be replaced.	Replace bulb with part # M40-002 (transmitted) or M40-001 (reflected).

Bulb Replacement:



Replacement Bulb for M40 5W LED reflected light = M40-001
Replacement Bulb for M40RT 5W LED reflected light = M40-001
Replacement Bulb for M40RT 5W LED transmitted light house = M40-002



To **replace the transmitted light on the M40RT**, unplug the microscope and remove the light housing from the back of the microscope as shown at left. Take the new light house and line up the guide pins (1) and the power supply pins (2) with the guide receptacles (3) and power socket (4) on the back of the microscope.



To **replace the reflected light on the M40 or M40RT**, use the hex wrench to unscrew the bulb module from the back of the reflected arm illuminator as shown in **Step 1** at right.

Once the bulb module is removed, using an allen wrench, unscrew the two screws on opposite ends of the module as shown in **Step 2** below.

With the bulb module open use a screw driver to unscrew the light panel (white circular disc) from the housing (**Step 3**). Cut the wire on each side (taking note of the + and - on the disc). Place the new bulb in position so the + and - are in the same place as the previous bulb. Solder the wire connections together and reassemble the housing.

