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INSTRUCTIONS FOR MODELS

106, 106-L, 106-LED
109, 109-L, 109-LED

ELEMENTARY COMPOUND MICROSCOPES

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All models in this series have the same basic features, lenses, magnification and methods of operation. The only differences are:

106, 109:

106-L, 109-L:

106-LED, 109-LED:

106, 106-L, 106-LED:

109, 109-L, 109-LED:

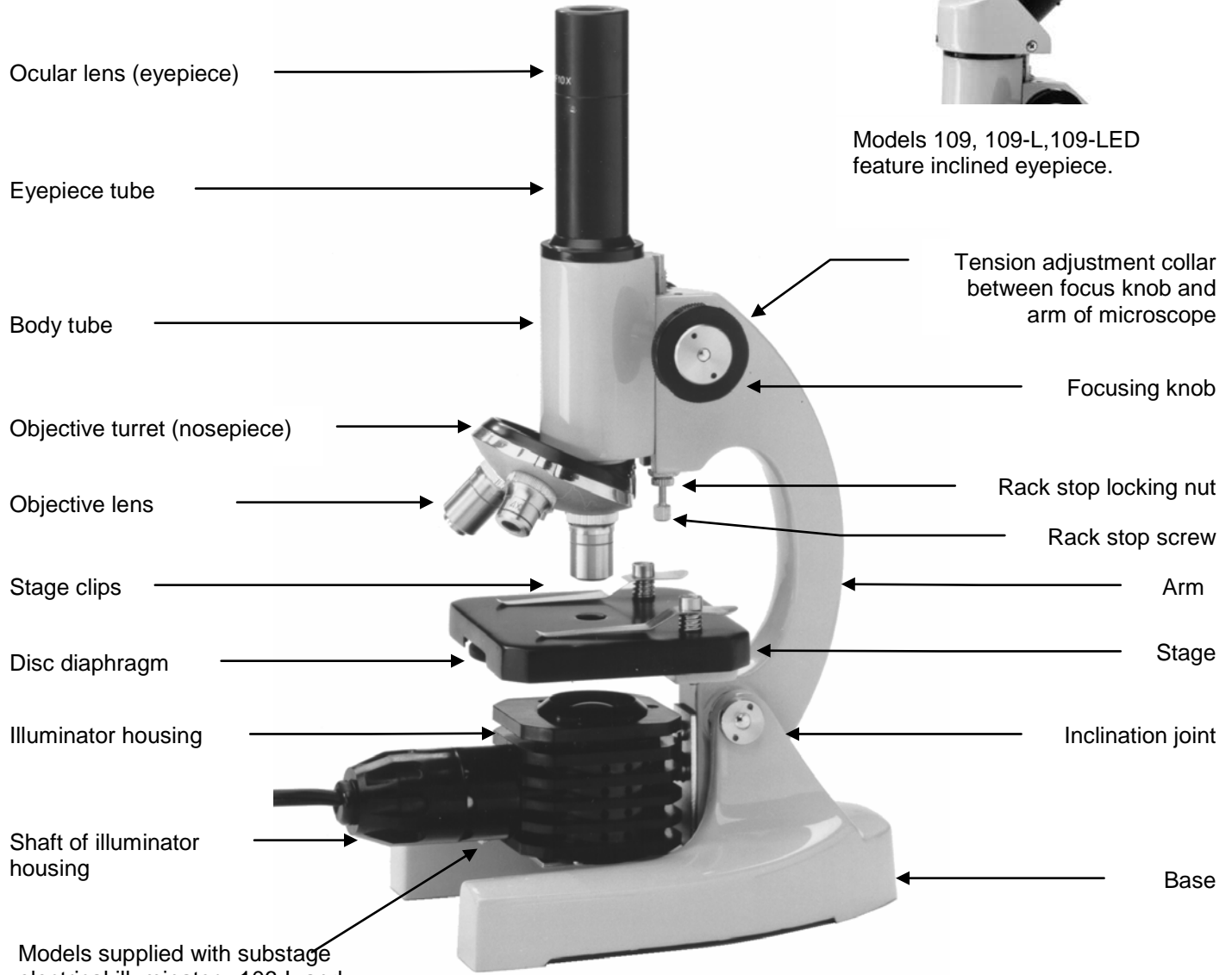
Illumination is supplied by a plano-concave mirror.

Illumination is supplied by a substage electric illuminator (110v 15 watt).

Illumination is supplied by a substage LED illuminator.

Have standard coarse focusing only.

Have both coarse and fine focusing.

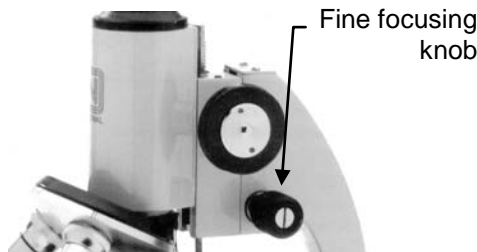


106-L Illustrated

Models supplied with substage electrical illuminator: 106-L and 109-L



Models 106 and 109 supplied with substage mirror.



Models 109, 109-L, 109-LED feature coarse and fine focusing.



LED illuminator for Models 106-LED and 109-LED

Thank you for your purchase of a National microscope. It is a well built, precision instrument and carefully checked to assure that it reaches you in good condition. It is designed for ease of operation and years of carefree use. The information in this manual probably far exceeds what you will need to know in order to operate and maintain your microscope. However, it is provided to answer questions, which might arise, and to help you avoid any maintenance expense that may be unnecessary.

Carefully read instructions before operating microscope. Nomenclature used to describe components and controls are identified on opposite page of the manual.

UNPACKING

Do not discard Styrofoam container or packing materials. Save in case instrument needs to be transported or shipped for repairs. Remove microscope and dustcover from container. Remove all tape and packing material used to protect microscope during shipment. Make certain lens surfaces do not come in contact with dirt, fingerprints or oil. Damage of lens surfaces occurs when they come in contact with such contaminants, and image quality is reduced.

DESCRIPTION OF COMPONENTS

- A. **OCULAR LENS** (eyepiece): Lens closest to the eye, magnifies the primary image formed by the objective lens
- B. **OBJECTIVE LENS**: Lens closest to the specimen, forms the first magnified image of the specimen.
- C. **OBJECTIVE TURRET** (nosepiece): Revolving turret designed to hold objective lenses, permits changes of magnification by rotating different powered objective lenses into optical path.
- D. **STAGE CLIPS**: Two locked-on clips hold specimen slide in place on stage.
- E. **STAGE**: Platform of the microscope where the specimen slide is placed on stage.
- F. **DISC DIAPHRAGM**: Rotating disc located below stage, with 6 holes of various apertures, designed to help achieve optimum resolution of the objective lens. Smaller apertures used for lower magnifications, and larger apertures used for higher magnifications.
- G. **SAFETY RACK STOP**: When properly adjusted, controls maximum downward travel of body tube while focusing, prevents higher power objectives from breaking specimen slides, prevents damage to objective lenses. This safety rack stop has been pre-adjusted at the factory.
- H. **FOCUSING KNOBS**: Focusing knobs located on each side of arm, when turned, raise or lower body tube to bring specimen into focus.
- I. Model 109 has coarse focus knobs described above, plus fine focus knobs (smaller knobs) located on both sides of arm right below coarse focus knobs. These permit precise adjustment for sharper focus of image.
- J. **ILLUMINATION**: Depending on model purchased, microscope is provided with either a plano-concave mirror or built-in electrical illuminator.
 - 1. Mirror provides illumination of specimen by reflecting light from an artificial source or natural light.
 - 2. Substage electrical illuminator provides constant, reliable pre-focused illumination.
 - 3. Sub-stage cordless LED illuminator provides illumination equal to 20 watt tungsten bulb. Features ON/OFF switch with rheostat intensity control, rechargeable AA Nickel Hydride batteries and auto recharger.

OPERATION

- A. Always carry microscope by grasping arm with one hand and placing other hand under base.
- B. Place microscope directly in front of you in a manner which permits you to comfortably look into the eyepiece. Position the microscope with the arm facing you so that focusing knobs are most convenient to reach, and you do not block light if using a model that has a mirror for illumination.
- C. Note that model 106 can be tilted at the inclination joint to provide comfortable viewing angle. Model 109 has a special inclined eyepiece so that it is not necessary to tilt microscope at inclination joint.

D. First, assure that light is available for illuminating the specimen.

1. Mirror models

- a. Assure that there is a good nearby source of light (overhead light, tabletop lamp or reasonably bright natural light).
- b. Position the concave (curved) side of mirror upward.
- c. Look through eyepiece and tilt the entire mirror (tilts on either of two axis) until light appears to fill the entire field of view.

2. Electric illuminator models.

- a. Plug polarized 2 conductor plug into a standard 120 volt AC three-wire grounded outlet.
- b. Rotate switch located on cord to ON position.
- c. In case of equipment malfunction, see Trouble Shooting Procedure located at the back of this manual.

3. LED cordless illuminator models.

- a. Your microscope has special LED illumination that is powered by 3 rechargeable AA nickel metal hydride batteries (supplied). These batteries may be recharged, as required, using the recharger (supplied). Each set of batteries may be recharged approximately 1000 times before replacing, and each charge will provide up to 50 hours of microscope operation. The LED component (bulb) will last for up to 100,000 hours before replacement is required.

WARNING

DO NOT USE regular AA alkaline batteries. Use of other than rechargeable AA nickel metal hydride batteries could result in batteries exploding during recharge. ONLY USE THE SUPPLIED SWITCHING BATTERY RECHARGER WITH AUTOMATIC "TRICKLE CHARGE".

- b. It is recommended that you charge the batteries before initial use and after prolonged storage as the batteries may have discharged. Plug output cord from battery charger into DC recharging socket located on side of LED illuminator. Your automatic switching recharger operates on 100 to 240 volts AC 50/60 Hz. Plug recharger into your AC wall outlet. Battery recharger is also equipped with an automatic "trickle charge" feature, the red LED indicator lamp located on recharger will be illuminated when batteries are receiving maximum charge. After batteries are charged, the red LED indicator lamp will turn to green and charger automatically switches to "trickle charge". The charger can be left plugged in, but for safety reasons it is a good idea to disconnect the charger from the AC wall outlet and the output cord from recharging socket after 12 hours. Batteries and charger may feel warm when charging, and unplugging the recharger is a safety precaution.
- c. Turn illuminator "ON" by simply rotating the adjustable rheostat control knob located on side of illuminator. Rotating the rheostat control knobs varies the intensity of the LED illuminator.

Note that your microscope can be used during recharging.

E. Rotate focus knobs to move eyepiece tube up (away) from stage as far as possible.

F. Place specimen slide, cover slip facing up, on stage with specimen centered over hole in middle of stage.

G. Rotate disc diaphragm to position the largest aperture under the hole in center of stage.

H. Turn the objective turret until the 4x (smallest) objective lens clicks into position in the optical path.

I. Note that each time you change from one objective lens to another you should turn the turret until you hear the click, which indicates that the lens is properly indexed in the optical path.

J. While looking through the eyepiece, rotate focusing knobs until specimen comes into focus. If image does not appear in field of view, move specimen slide slightly on stage until image appears in field of view.

K. If using Model 109 which has both coarse and fine focus knobs, you can now adjust fine focus knobs to obtain optimum image sharpness.

L. Turn the disc diaphragm, observing that different apertures affect the sharpness of the image. Turn diaphragm until sharpest possible image is obtained. When turning the disc diaphragm, you should hear a click as each aperture comes

into proper position under the hole in center of stage. If aperture is not properly positioned, you will observe shadows in the field of view when looking through the microscope.

M. Changing magnification

1. Note that each of the three objectives have a different color ring. This permits the teacher to instruct the class to switch magnifications by referring to the color of the ring.
2. Total magnification obtained with each objective lens is determined by multiplying the magnification of the eyepiece times the magnification of the objective. Keep in mind that as magnification is increased, field of view (area of the specimen seen when looking through the microscope) decreases. You will find that you use the lower magnifications at most times. Always use the lowest magnification (4x objective) when first focusing on a new specimen slide, as this low magnification provides the biggest field of view, there by making it easier to find and position the specimen within the field of view.

10x eyepiece x 4x objective = 40 times mag. (biggest field of view), red color code ring
10x eyepiece x 10x objective = 100 times mag. (smaller field of view), yellow color code ring
10x eyepiece x 40x objective = 400 times mag. (smallest field of view), blue color code ring

3. To change magnification:
 - a. Rotate revolving nosepiece to position 10x objective into optical path. Some slight adjustment of focusing knob may be required.
 - b. Rotate revolving nosepiece to position 40x objective into optical path. Some slight adjustment of focusing knob may be required.
4. Note: Take care when rotating 40x objective into place. This is the longest lens and has a spring retractable mechanism, which retracts slightly into its housing if the front of the lens comes in contact with the specimen slide while focusing the microscope. This prevents damage to the lens or slide.

MAINTENANCE

WARNING: For your own safety, when servicing models with electric and LED illuminators, turn switch to OFF position and remove plug from power source before maintaining microscope. If the power cord is worn, cut or damaged in anyway, have it replaced at once to avoid shock or fire hazard.

OPTICAL MAINTENANCE

- A. Do not attempt to disassemble any lens components. Consult an expert technical service company when repairs not covered by these instructions are needed.
- B. Prior to cleaning any lens surface, brush dirt and lint off lens surface with camel hair brush or compressed air. Use of air in a can, available at most computer stores, is good source of clean air.
- C. Do not remove eyepiece lens or objective lenses from microscope. Clean only the outer lens surface by breathing on lens to dampen surface, then wipe with lens paper or cotton swab. Avoid wiping lens surface while dry, as lenses are scratched very easily.

MECHANICAL MAINTENANCE

- A. Rack stop adjustment: Rack stop has been pre-adjusted at the factory, and should not require readjustment.
- B. Coarse focus tension adjustment: This adjustment prevents the body tube from drifting down on its own weight and causing the image to move out to focus during viewing.
 1. Tension adjustment collar is located between arm and coarse focus knob on left side of microscope.
 2. With a small jeweler's screwdriver, loosen the set screw located in one of the four holes located on tension adjustment collar.

3. To tighten tension, turn collar in clockwise direction. Use of wide rubber band will provide a better grip on the tension adjustment collar. It is advisable to leave controls as loose as possible, tightening only enough to keep body tube from drifting down and out of focus from its own weight.

C. Metal parts: Use a clean, damp cloth to remove dust or dirt from metal part followed by a dry cloth.

ELECTRICAL MAINTENANCE (for models with electric substage illuminator)

WARNING: For your safety, turn switch off and remove plug from power source before replacing bulb. Make sure that illuminator housing and lamp are cool before servicing.

- A. On the bottom of illuminator housing shaft, locate locking screw that secures shaft portion to main illuminator housing. Using screwdriver, remove completely.
- B. Pull straight out on shaft to remove from main illuminator housing.
- C. Note that lamp does not screw out. Remove by depressing lamp slightly and rotate in counter-clockwise direction until it pops up slightly.
- D. Replace with a 115-130v 15 watt lamp with double contact, medium bayonet base. This is a standard, commonly used microscope replacement bulb. It is also available from National, specifying replacement part #800-101. Do not use higher than 15 watt bulb. Depress lamp slightly and rotate in clockwise direction.
- E. Carefully wipe new lamp to insure that it is clean and free of all fingerprints. Gently depress lamp into socket and rotate counter clockwise.
- F. Insert shaft into main illuminator housing and secure with locking screw.

CORDLESS ILLUMINATOR (for models with rechargeable illuminators)

The extent of electrical maintenance, by other than a qualified technician, should be battery recharging and battery replacement. Before maintenance, be sure that recharger is not connected to microscope.

- A. Recharging Batteries: Plug output cord from battery charger into DC recharging socket located on side of illuminator. Your automatic switching recharger operates on 100 to 240 volts AC 50/60 Hz, plug recharger into your AC wall outlet. The red LED indicator lamp located on recharger will be illuminated when batteries are receiving maximum charge. After batteries are charged, the red LED indicator lamp will turn to green and charger automatically switches to "trickle charge". The charger can be left plugged in, but for safety reasons it is a good idea to disconnect the charger from the AC wall outlet and the output cord from recharging socket after 12 hours. Batteries and charger may feel warm when charging, and unplugging the recharger is a safety precaution.
- B. Replacing Batteries: Your microscope includes 3 rechargeable AA nickel hydride batteries. These may be recharged up to 1000 times, but if you observe that a recharge is providing significantly less than 40 hours of operation, it is probably time to replace the batteries.

IMPORTANT WARNING: DO NOT USE REGULAR ALKALINE BATTERIES IN THIS MICROSCOPE. ANY ATTEMPT TO RECHARGE ALKALINE TYPE BATTERIES COULD RESULT IN BATTERIES EXPLODING.

Gently lay microscope on its side or back. Observe battery compartment cover located on bottom of illuminator. Using a small Phillips screwdriver, carefully remove the two Phillips screws that secure battery cover to bottom of illuminator. Slide battery cover straight back to remove and expose batteries. Remove all 3 batteries and replace with new rechargeable AA nickel metal hydride batteries, making certain to insert with correct polarity according to markings on battery holder. Replace battery cover and secure with the two Phillips screws.

Follow instructions on new battery packaging to determine if they are already charged, or if they should be charged before initial use. If recharging is required, following directions in "A." above.

- C. Replacing LED Element: Do not attempt to disassemble any "LED" bulb components. Consult an expert technical service company when the LED "bulb" needs replacement or return the illuminator to National for repair.

An LED "bulb" will last up to 100,000 hours, so you don't have to do this exercise very often.

TROUBLESHOOTING PROCEDURES

PROBLEM	REASON FOR PROBLEM	SOLUTION
No Illumination (All Models)	Disc diaphragm has not "clicked" into proper position and is blocking light source beneath stage	Turn disc diaphragm until it "clicks" into position
(Non illuminated models)	Mirror not properly positioned to direct light through microscope	Reposition mirror
(115 Volt Electric Models)	Outlet inoperative	Have qualified service technician repair outlet
	AC power cord not connected	Plug into outlet
	Lamp burned out	Replace lamp
(Rechargeable LED Models)	Batteries fully discharged	Recharge batteries
	Batteries will not hold a charge	Replace batteries
	On/Off rheostat control not turned far enough	Turn rheostat to On position and rotate to increase light intensity
	LED bulb burned out	Have qualified technical service company change bulb
Image does not remain in focus	Eyepiece tube drops under its own weight.	Adjust tension of coarse focus knob (see maintenance)
Image does not focus	Cover slip on specimen slide too thick.	Use 0.17mm thick cover slip. (No. 1 cover slip)
	Slide upside down.	Place slide on stage with cover slip facing up.
Poor resolution (image not sharp)	Objective lenses dirty.	Clean objective lenses.
	Eyepiece lens dirty.	Clean eyepiece lenses.
	Too much light.	Adjust disc diaphragm
Spots in field of view.	Eyepiece lens dirty.	Clean eyepiece lenses.
	Specimen slide dirty.	Clean slide.

OPTIONAL ACCESSORIES AND PARTS:

#800-101 Replacement bulb, 115v 15 watt, D.C. medium bayonet base for electric illuminator
#900 Replacement substage illuminator, 115v 15 watt
#906-LED Replacement substage LED illuminator for cordless operation

WARRANTY - 5 YEAR LIMITED WARRANTY

Please see our website, www.nationaloptical.com, for complete warranty details and exclusions.



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