LAXCO
MICROSCOPES REDEFINED

LMC2P Pro Series Upright Microscope

Version 2.0

User Manual

Contents

Introduction

Disclaimer

Safety Conventions

SYMBOL	DESCRIPTION
	STOP! Damage may occur
	Read the manual before use. Unsuitable operation would lead to injury or instrument failure
	Switch is on
	Switch is off

Introduction

Prior to use

Fig. 1

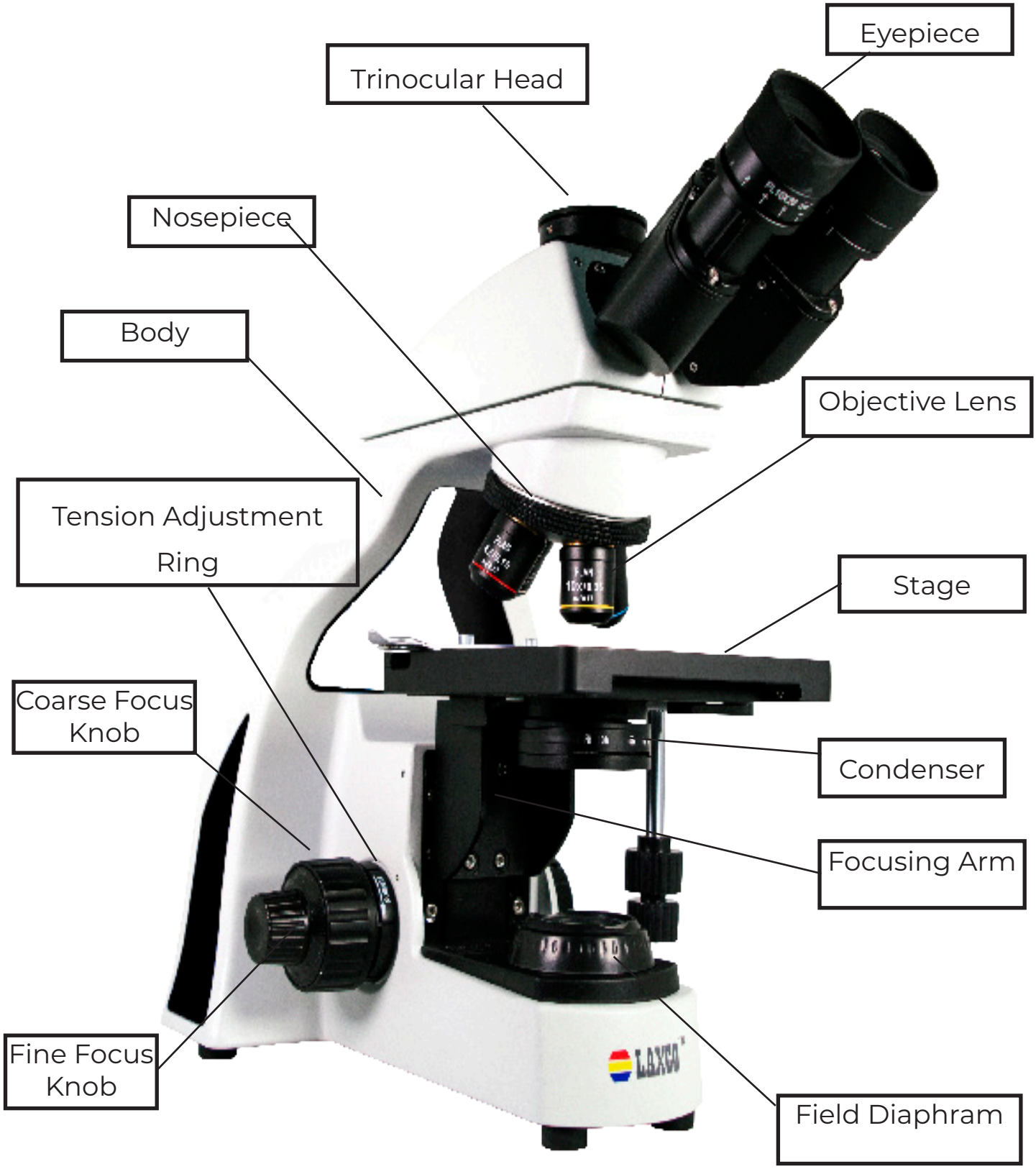
1. The microscope is a precision instrument. Please operate properly avoiding vibration or sudden jolting the microscope during operation.
2. Do not operate the microscope in direct sunlight, high temperature, high humidity, dusty environment, or close to sources of vibration. Ensure the work surface is level and flat.
3. When lifting or carrying the microscope, use one hand to hold the carrying handle of the microscope (1) and another hand to carry the front base (2) (see Fig. 1).

   The microscope will be damaged if the stage, focus knobs, or head are held when moving.
4. Ensure the microscope is properly grounded to avoid electric shock.
5. Ensure the power switch is in the “O” (off) position and wait until the lamp cools completely before replacing the bulb or fuse.
6. The input voltage is clearly marked on the back of the microscope. Ensure the power supply voltage is in this range.

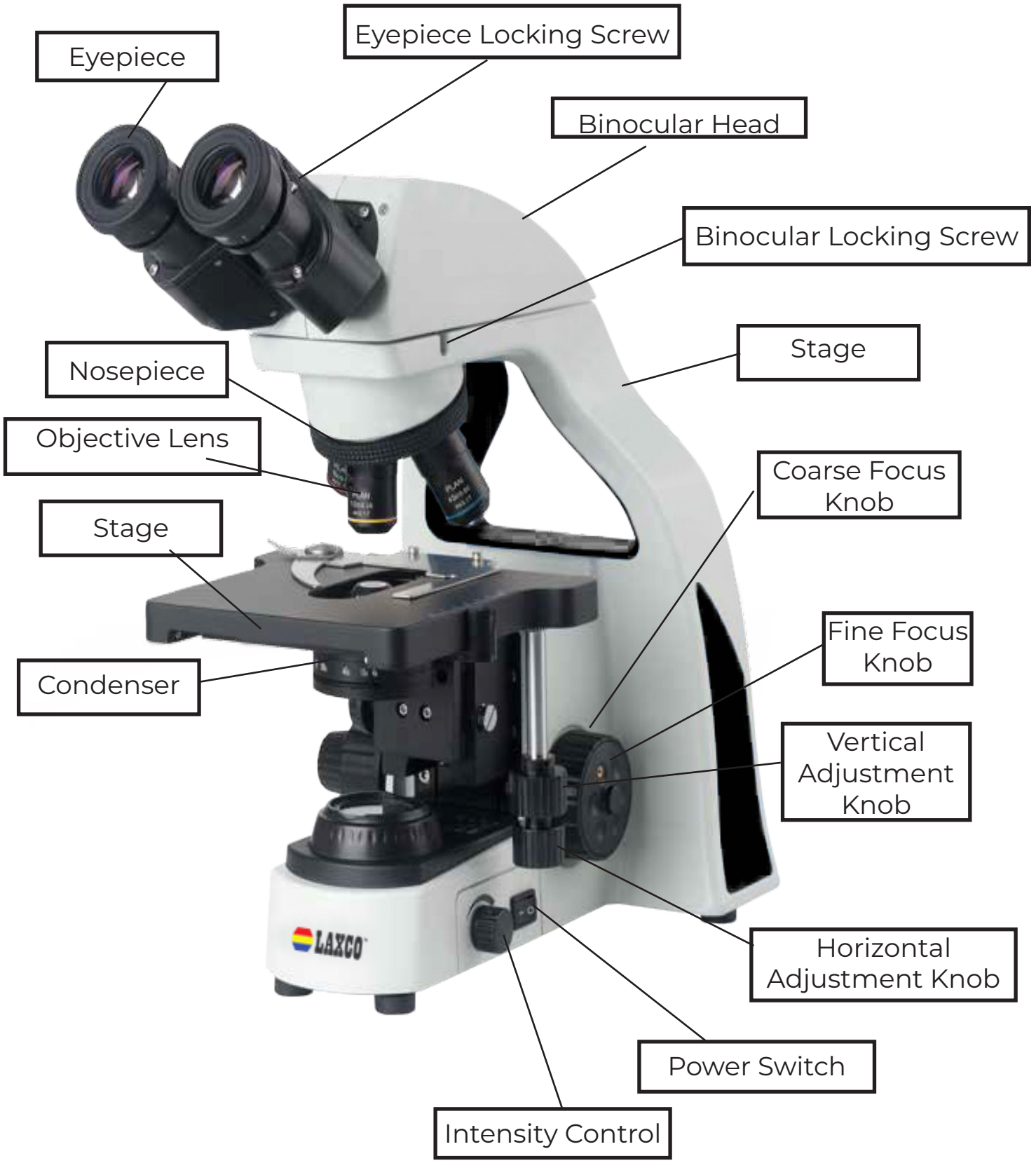
Maintenance

1. Utilizing a lens tissue moistened with a small amount of lens cleaning solution, gently wipe the objective lens removing all oil and fingerprints on the objective surfaces. Lens cleaning solution may be flammable. Turning on or off electronic devices (including the microscope) may produce a spark which could ignite the lens cleaning solution. Use these chemicals in a well-ventilated area.
2. Don’t use organic solutions to wipe the surfaces of the other components. Please use a neutral detergent if necessary. If the microscope is exposed to liquid during operation, power it off immediately and wipe it dry. Never disassemble the microscope, the performance may be affected or the instrument may become damaged.
3. Cover the microscope with a dust cover when it is not in use.

2. Components



2. Components



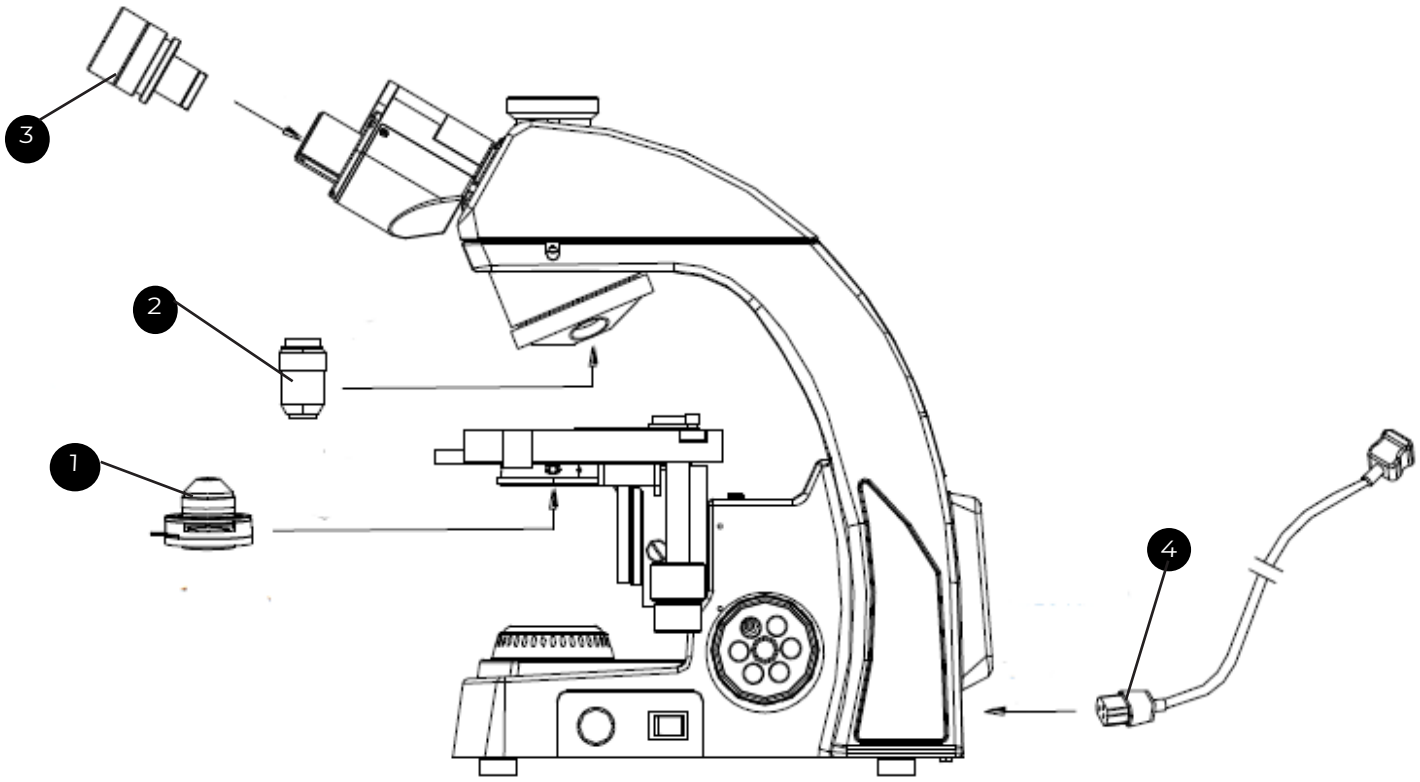
3. Assembly

3.1 Assembly Precautions

Following are the recommended assembly steps with each step numbered denoting the assembling order.

⚠ Before assembling, make sure there is no dust, dirt or other materials which will effect the operation. Assemble carefully while avoiding contact with any glass surfaces.

3.2 Assembly Steps



3. Assembly

3.2 Assembly Steps

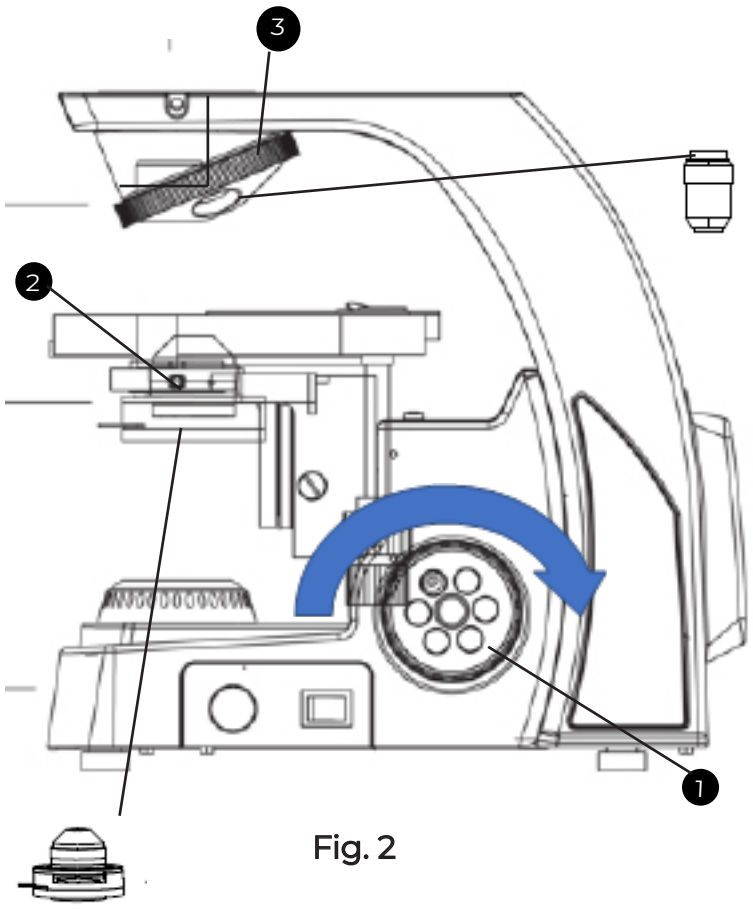


Fig. 2

3-2-1 Install the Condenser (if not factory installed)

1. Figure 2 shows condenser factory installed.
2. Rotate the coarse focusing knob 1 clockwise according to the direction shown in the figure, to raise the stage to the highest position (see Fig. 2).
3. Fully loosen the condenser lock-screw 2.
4. Insert the condenser into the condenser mount, aligning the arrowhead until the condenser is aligned with the base.
5. Rotate the condenser until the handle faces forward.
6. Tighten the condenser lock-screw 2

3-2-2 Install Objectives (if not factory installed)

1. Rotate the coarse focusing knob 1 to lower the stage to a suitable position (see Fig. 2).
2. Then install the objectives into the nosepiece 3 from the lowest to highest magnification in clockwise direction.

⚠ When operating, use the lowest magnification objective (4X or 10X) to search for specimen and focus, and then replace with the desired magnification objective for observation.

⚠ When changing objective magnification, rotate the objective nosepiece until it seats into the detent to assure the objective wanted is in the center of optical path.

3. Assembly

3.2 Assembly Steps

3-2-3 Install the Eyepieces

1. Remove the eyepiece cover ❶ (not shown).
2. Insert the eyepiece ❷ into the eyepiece tube, until it touches the surface.
3. Tighten eyepiece with M2.5 inner hexagon lock-screw ❸ (see Fig.3).

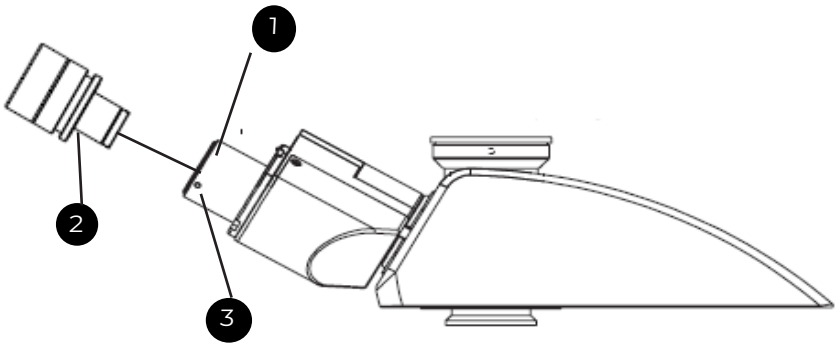


Fig. 3

3-2-4 Connect the Power Cord

⚠ Do not force the power cord when connecting. Bending or twisting may cause damage

1. Make sure the power switch ❶ is in the “O”(OFF) position before connecting the power cord.
2. Insert the connector ❷ of power cord into the power socket , making cetrain it’s inserted completely (see Fig.4).
3. Insert the opposite end of the power ❸ cord into the socket of power supply, making certain it’s inserted completely.

⚠ Use only the cable supplied by Laxco. If it becomes damaged or lost, a cable with the same specifications must be used.

⚠ A Wide range of voltages is supported (100V~240V).

⚠ To assure proper operation, connect the power cord to an appropriate grounded wall outlet.

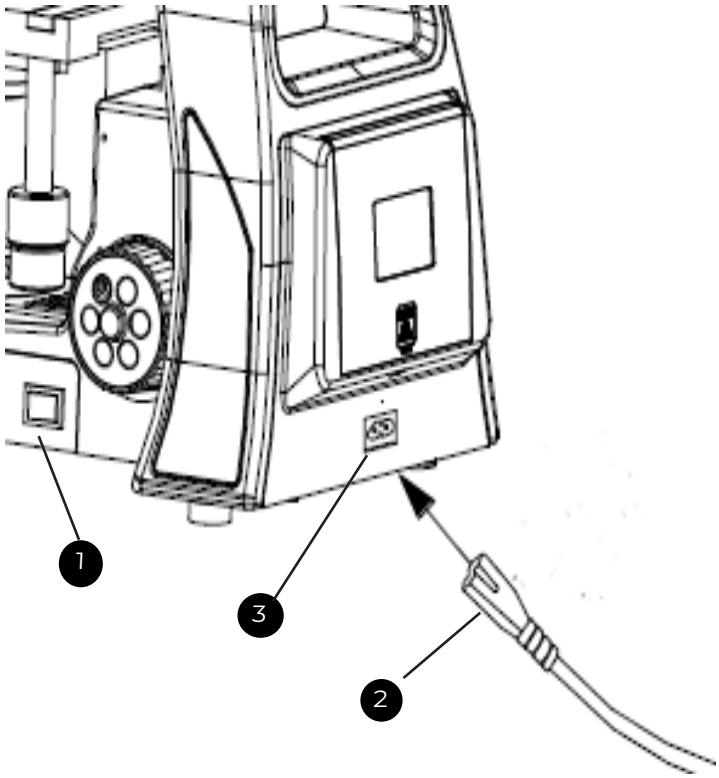


Fig. 4

3. Assembly

3-2-4 Installation of Camera (Trinocular Systems Only)

1. Loosen the lock-screw ❶ on the trinocular head and remove the dust-cap ❷ from the photo port (See Fig. 5).
2. Remove the dust-cap from the camera adapter ❸

   NOTE: Camera adapters are sold separtely and come in various magnification. Make sure you the the appropriate adapter to meet your needs.

3. Insert the appropriate camera adapter ❹ into the trinocular port. Tighten lock-screw ❶
4. Attach camera to camera adapter.

   NOTE: It may be easier to attach the camera to the adapter prior to attaching it to the microscope in step 3.

5. If the image is not in focus, rotate the focus adjustment ❺ until it is in focus (See Fig. 5).

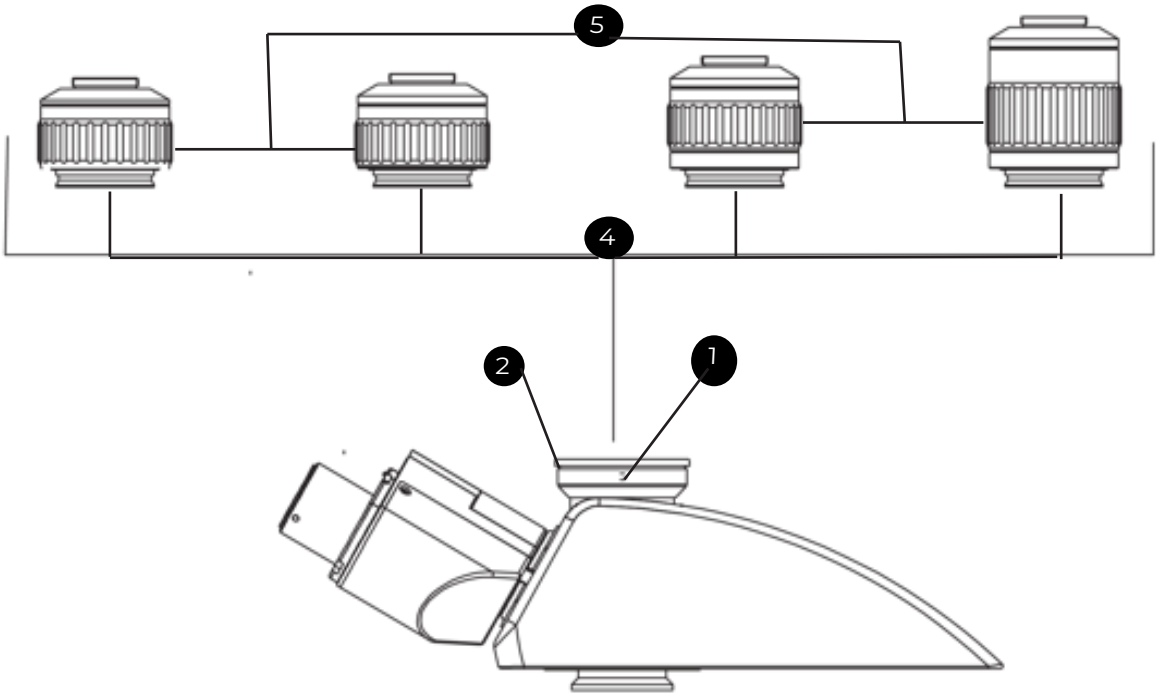


Fig. 5

4. Operation

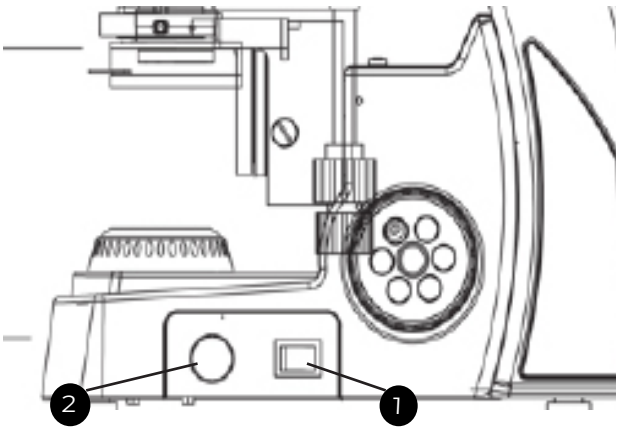


Fig. 6

4-1 Set Illumination

1. Turn on the power to the microscope by moving the main power switch 1 to the on position (“—”) (See Fig. 6).
2. Adjust the light intensity by rotating the adjustment knob 2 to a comfortable level (See Fig. 6).

NOTE: Rotating the light intensity adjustment knob in clockwise direction will increase brightness and rotating it in a counterclockwise direction will lower brightness (See Fig. 6).

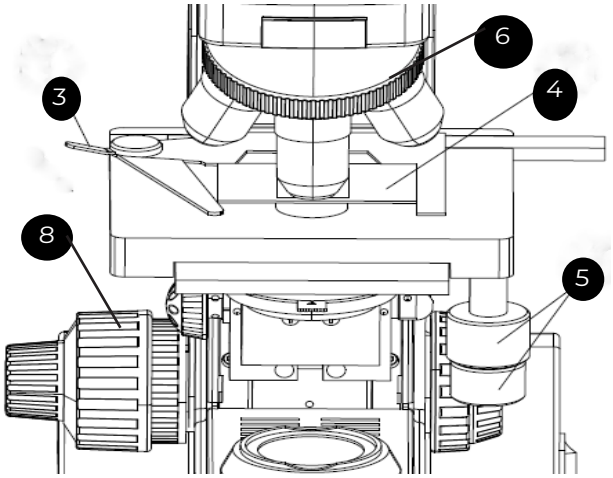


Fig. 7

4-2 Place Specimen Slide

1. Open slide holder by pushing lever 3 towards the rear of the scope (See Fig. 7).
2. Insert slide 4 into clips and slowly release lever 3 (See Fig. 7).
3. Use the X and Y-axis stage control knobs 5 to move the slide to the desired location (See Fig. 7).

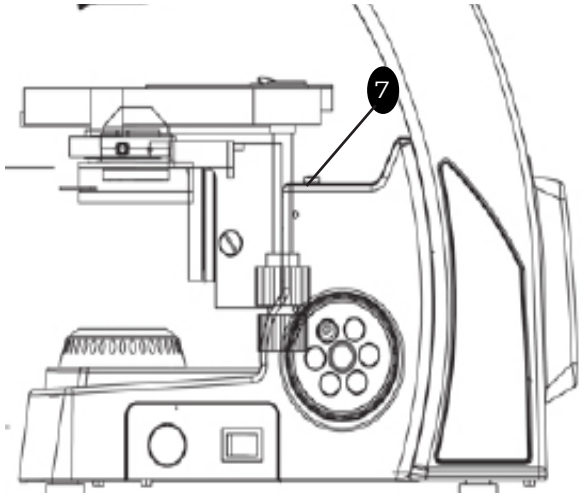


Fig. 8

4-3 Focusing the Image

1. Rotate the objective nosepiece 6 until the 4X objective is in the light path (See Fig. 7).
2. Adjust the stage limit screw 7 to the highest position, and rotate the coarse focusing knob 8 until the image appears. (See Fig. 7)
3. Rotate the fine focusing knob 9 until the image is in clear focus (See Fig. 7).
4. Lock the limit screw 7 (See Fig. 8).

NOTE: Limit screw can prevent the collision between objective and slide when focusing until the 4X objective to the light path.

4. Operation

4-4 Adjust Focusing Tension

If the coarse focus knob's tension is tighter than desired or the stage drifts down under normal observation, you can ajust the tension to resolve these issue by rotating the tension adjustment ring 1 (See Fig. 9).

NOTE: Rotating the tension adjustment ring clockwise increases the tension. Rotating the tension adjustment ring counterclockwise decreases the tension.

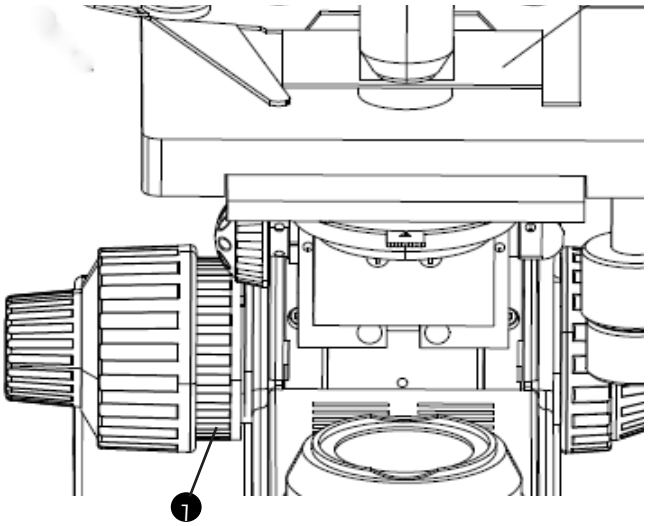


Fig. 9

4-5 Adjust Interpupillary Distance and Diopter

Note: Each user should adjust the eyepieces before using the microscope. Record your interpupillary and diopter settings for future reference.

Adjusting the Interpupillary Distance

1. Place a specimen on the stage bring it into focus.
2. While looking through both eyepieces, move eyepieces together or apart until the field appears as one.

NOTE: Adjustable range 47~75mm.

Adjusting the Diopter

1. Adjust diopter by setting a flat specimen on the stage plate
2. Using the coarse focus knobs bring the image to near focus.
3. Close your weaker eye, focus the image sharply.
4. Adjust the diopter on your dominant-side eyetube by rotation the diopter ring 2 until the image is clear and in focus (See Fig. 10)
5. Close your dominant eye and repeat the process for your weaker eye.

NOTE: When each eyetube focuses sharply, the diopter is properly set.

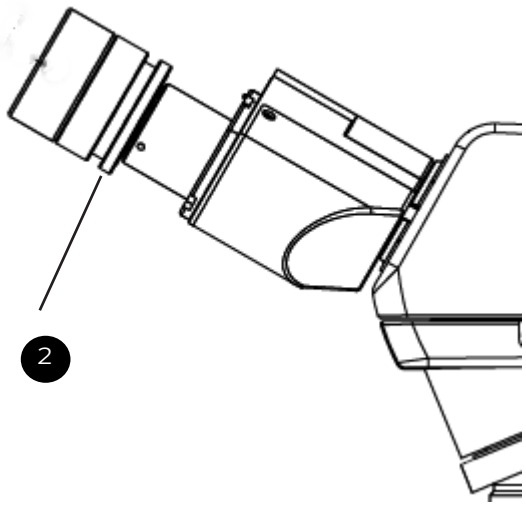


Fig. 10

4. Operation

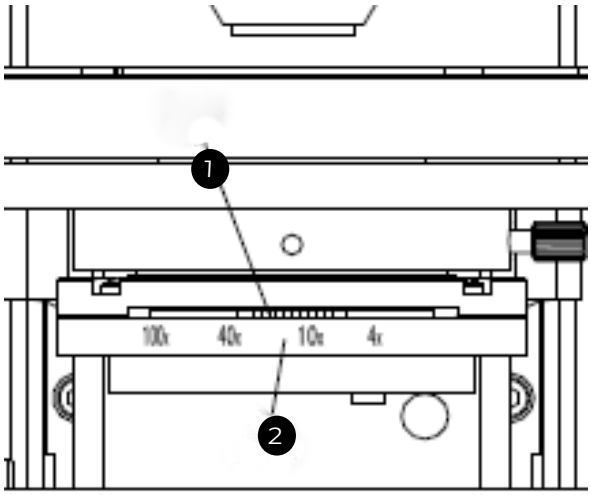


Fig. 11

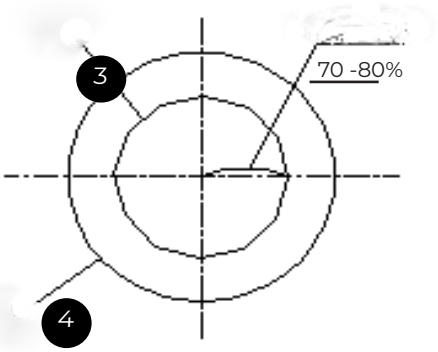


Fig. 12

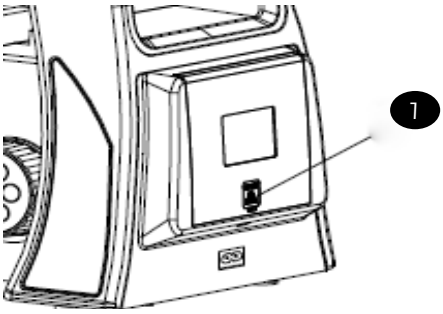


Fig. 13

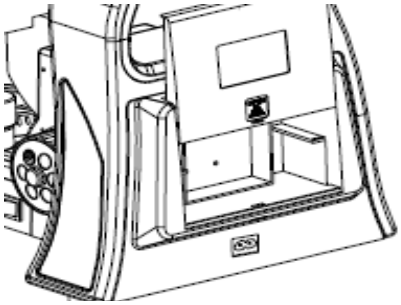


Fig. 14

4-6 Setting Aperture Diaphragm

1. The aperture diaphragm determines the numerical aperture of the system.
2. When the numerical aperature of illumination system matches the numerical aperature of the objective, optimum resolution and contrast are obtained along with an increase in the depth of field.
3. If the contrast of your sample is low, adjust the condenser diaphragm towards the objective magnification indicated on the condenser 1, i.e., adjust the numerical 2 aperture of the condenser 70%-80% of the objectives numerical aperture (See Fig. 11)
4. If necessary, you can remove the eyepiece to observe from the eyetube. Adjust the condenser diaphragm until you obtain an image similar to Figure 12, Inner ring 3 is the image of the aperture diaphragm, 4 is the outside edge of the objective.

4-7 Use the Storage Box

When the microscope is not in use, the power cord can be placed in the storage box. Press on the position shown as 1 of the storage box cover with thumb.
When you hear a click, push up and put the power cord and wrench into the storage box, and then close the back cover. (See Fig.13, 14)

4. Operation

4-7 Use the Oil Objective (100X)

1. Use the 4X objective to focus the specimen.
2. Place a drop of oil ❶ on the specimen observed (see Fig. 15).
3. Rotate the nosepiece counterclockwise until the oil objective (100X) is in the light path.
4. Then use the fine focusing knob to focus.

⚠ Make sure there are no air bubbles in the oil as these will affect the image quality.

- Remove one of the the eyepieces to examine for the presence of air bubbles.
- Open the aperture diaphragm fully and observe the edge of the objective from the tube to assure it is round and bright.
- You can rotate nosepiece slightly and swing the oil objective a couple of times to remove any air bubbles.

5. After use, wipe the objective lens with lens cloth and lens cleaning solution.
6. Clean oil from the slide.

⚠ Don't rotate another objective into the light path before wiping oil from the slide to avoid getting oil on a non oil objective.

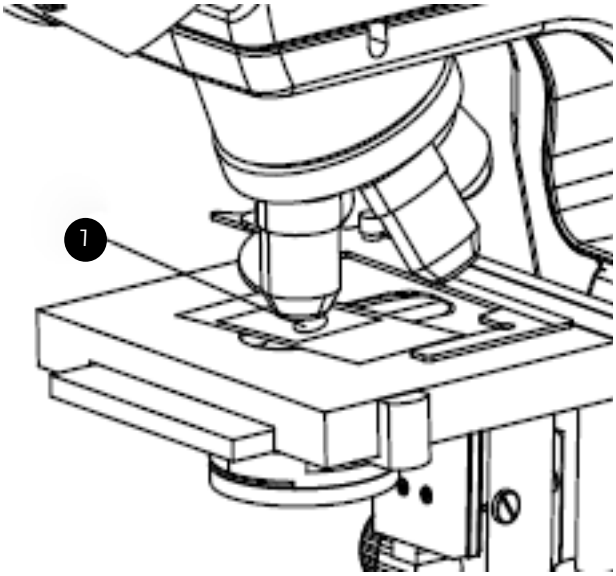


Fig. 15

4-8 Filters (Optional)

1. Filters can enhance and improve the background and increase the contrast (see Fig. 16).
2. Gently place the filter into the light well.

NOTE: There are four color filters available, blue, green, yellow and frosted.

⚠ Place the filter's rough side downward.

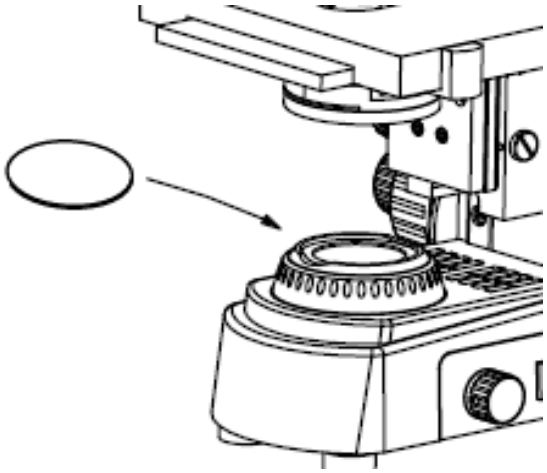


Fig. 16

5. Specifications

LMC2P Biological Microscope Specifications

OPTICAL SYSTEM	INFINTY CORRECTED
HEAD	BINOCULAR - 30° inclined, gemel binocular head, interpupillary distance 47mm-75mm TRINOCULAR - 30° inclined, gemel trinocular head, interpupillary distance 47mm-75mm, light splitting ratio 80:20
OBJECTIVES	Infinity plan achromatic objectives (4X, 10X, 40X, 100X oil) Infinity plan positive phase contrast objectives (4x, 10x, 40x, 100x oil)
EYEPIECES	High eye point wide field plan eyepiece PL 10X/20mm, with adjustable diopter. Can be locked in place with locking screws.
FIELD OF VIEW	20mm
FOCUS	Coarse and Fine - low position coaxial focusing mechanism, coarse range: 25mm, fine, precision: 0.002mm, with tension adjustment and upper limit
CONDENSER	N.A.1.25 EvenLIT™ condenser with plug-in phase contrast and dark field accessories interface, condenser preset and centered
KOEHLER	Fixed with Even Illumination Technology™ (EvenLIT™) system into the optical path providing improved the contrast rate and uniformity at the specimen surface, even at the edge of the field of view. This accomplishes what Koehler was designed to do by eliminating the need to continually adjust Koehler Illumination.
ILLUMINATION	3w LED, Built-in. Pre-centered, with continuous intensity control.
STAGE	Bacteria and fungi resistent, 150mm X 162mm double-layer composite mechanical moving stage, double slice clamps, moving range: 76mm x 50mm; accuracy: 0.1mm
NOSEPIECE	Reversed quadruple

NOTE: Specifications and appearances are subject to change without any notice or obligation on the part of the manufacturer

6. Troubleshooting

SYMPTOM	CAUSE	REMEDY
OPTICS		
The edge or side of the field of view is dark or uneven.	The nosepiece is not in the correct position.	Turn the nosepiece until correctly seated in the detent.
	Stain or dust has accumulated on one of the optical components (condenser, objective, eyepieces).	Clean optical surfaces.
Dirt and/or fingerprints are observed in the field of view.	Dirt and/or fingerprints have accumulated on the specimen.	Clean the specimen.
	Dirt and/or fingerprints have accumulated on the optics.	Clean the optics.
Image looks fuzzy or unclear.	No cover glass on the specimen slide.	Add the appropriate cover glass.
	The cover glass is not standard.	Use a standard glass cover slip with thickness 0.17mm.
	The cover glass faces down.	Assure the cover glass faces up toward the objective.
	Immersion oil has accumulated on a dry objective.	Clean thoroughly.
	Immersion oil is not used for oil for an oil objective 50X, 100X.	Use immersion oil.
	Air bubble in the immersion oil.	Remove all air bubbles.
	Using the wrong immersion oil.	Use only immersion oil specifically designed for microscope objectives.
	The aperture is not set correctly.	Adjust the aperture diaphragm as described above.
	Dust or moisture has accumulated on internal lenses.	Clean the lenses.
Uneven illumination with one side of the field of view dark or the image moves while focusing.	The specimen slide is not fixed.	Fix with clips.
	The nosepiece is not in the correct position.	Turn the nosepiece until correctly seated in the detent.
The right field of view doesn't superimpose with the left and/or the users experiences eye fatigue.	Interpupillary distance is wrong.	Adjust the interpupillary distance as described above.
	Diopter adjustment is wrong.	Adjust the diopter as described above.
	The eyepieces do not match.	Use only a matching set of eyepieces.

6. Troubleshooting

SYMPTOM	CAUSE	REMEDY
MECHANICAL		
Cannot bring the specimen into focus.	The cover glass faces down away from the objectives.	Assure the cover glass faces up toward the objective.
	The cover glass is not standard.	Use a standard glass cover slip with thickness 0.17mm.
The objective touches the cover glass or slide while turning the nosepiece.	The cover glass faces down.	Assure the cover glass faces up toward the objective.
	The cover glass is not a standard thickness.	Use a standard glass cover slip with thickness 0.17mm.
Coarse focusing knob is too tight.	Focus tension knob is too tight.	Loosen focus tension knob slightly.
Stage drifts down.	Focus tension knob is too loose.	Tighten focus tension knob slightly.
Coarse focusing knob will not raise further.	The limit stop is engaged.	Disengage the limit stop.
The specimen slide does not travel smoothly.	The slide is not fixed correctly.	Adjust as described above.
	The movable specimen holder is not fixed properly.	Properly adjust.
ELECTRICAL		
The LED does not work.	Unit does not have power.	Check the connection of the power cable.
	The LED is burned out.	Factory replacement required.
The field of view is not bright enough.	Intensity adjustment knob is not properly adjusted.	Adjust correctly.

7. Care and Maintenance

General Concerns

IMPORTANT! Avoid touching any lens or glass surface. Handle the optics of the microscope (i.e. eyepieces, condensers, objectives, or any other lens) with special care to protect from scratches and contaminants.

- Service the microscope in a clean environment to avoid contaminating the optics.
- Work with clean hands to reduce the possibility of getting body oils or other contaminants into the optics.
- Clean lens surfaces using the lens cleaner supplied in the Cleaning Kit.

WARNING! When using cleaning fluid, wear goggles and rubber gloves to protect the skin and eyes.

- Always use a dust cover when the microscope is not in use to prevent airborne and incidental contamination.
- Switch off the LCD power when not in use.

Cleaning Materials

IMPORTANT! Do not use alcohol (methyl, ethyl, or isopropyl), acetone, or any other ketones directly on the microscope, as they may dissolve the sealers in and around the lenses. Instead, use a small amount of cleaning fluid applied to an optical-quality cleaning material.

- Non abrasive, silicone-free lens cleaners - used to clean optical surfaces without harming the coatings or softening the sealers and cements in the optics.
- Lint-free, nonabrasive cloths, wipes, and swabs. Do not use facial tissue; it will scratch the lenses.
- Clean, filtered compressed air or gas - used to blow particles away from the surfaces of the scope.

WARNING! Watch out for specks of broken glass around the stage area. Wear safety glasses when using compressed air.

Removing Common Contaminants

IMPORTANT! To prevent damage, never apply any cleaning fluid directly to any microscope part. Instead, moisten an optical-grade cloth, swab or lens paper with the appropriate cleaner.

Immersion Oil

Clean oil immersion objectives immediately after each use.

Technique: Use optical-grade materials to clean lens. Wipe excess moisture from the lens with a sheet of lens paper or lint-free tissue.

- Using a disposable, pre-moistened wipe: Apply light pressure in the center of the lens. Wipe in a circular motion to pull dirt off of the lens. Repeat to eliminate streaks or persistent oil residue.
- Using a lens wipe and cleaning fluid: Moisten a lens cloth with a few drops of lens cleaner. Wipe in a circular motion, working outward, to pull dirt off of the lens.

Dust

Dust is the most common contaminant; use a dust cover regularly to prevent excessive dust from gathering in the optics.

Technique: Use compressed air to blow away dust and other particles from surfaces.

1. Point the can away from microscope and spray briefly to clear any moisture or debris from the nozzle.
2. Hold the can approximately 1-2” from the surface and squeeze the trigger (press the nozzle) in short bursts to blow off any loose particles. Inspect the surface for visible dirt particles. If additional cleaning is necessary, follow the procedures below.

Fingerprints

Clean fingerprint oil and/or dirt as soon as possible to prevent staining or damaging the optics.

Technique: Use the compressed air cleaning technique as described above to remove large dirt particles. (Grit trapped under the lens cloth during cleaning may scratch the lens surface.) Next, clean the lens surface using a procedure below:

Using a disposable, pre-moistened wipe: Apply light pressure in the center of the lens. Wipe in a circular motion, working outward, to pull dirt off of the lens.

- Using a lens cloth and cleaning fluid: Moisten a lens cloth with a few drops of lens cleaner. Wipe in a circular motion, working outward, to pull dirt off of the lens.
- Using a lint-free swab: You can use a lint-free swab dry or moistened to clean edges, corners or hard to reach surfaces. Always wipe toward the outside edges of the lens.

7. Care and Maintenance

Cleaning the Microscope Optics Eyepieces

1. Slide the eyepiece out of the eyetube and clean both the inside and outside surfaces of the lens.

2. Replace the eyepiece in the eyetube and repeat the procedure with the other eyepiece.

Objectives

1. Carefully unscrew the objective from the turret.

2. Gently remove one eyepiece to use as a magnifier.

3. Grasp the objective in one hand with the tip side of the lens facing up. Hold the eyepiece upside down in the other hand.

4. Bring the eyepiece very close to your eye, and hold the objective lens about one inch away from it (do not let the lenses touch). Angle the objective so the ambient light reflects from its surface.

5. Bring the objective lens into focus and inspect the objective for scratches, nicks, cracks, deterioration of the seal around the lens, or oil seepage into the lens. Clean or replace objectives as needed.

Collector Lens

Clean the collector lens, field iris ring (if applicable), and any collector lens filters.

Condenser

1. Remove the condenser:
   a. Raise the stage to its uppermost position using the coarse focus knobs.
   b. Use the substage knob to lower the condenser to the bottom of its range.
   c. Loosen the condenser lock screw.
   d. Gently lift the condenser up and out of position or
   e. Gently pull the condenser down out of position.

2. Clean both condenser lens surfaces.

3. Replace the condenser and secure the condenser set screw. You may also need to realign the condenser iris (see “Align Condenser for Koehler Illumination” on page 9) after cleaning the condenser.

Maintenance Procedures
Semi-Annual Preventive Care Routine

Note: Use the "Microscope Maintenance Records" described in this manual to record routine procedures performed.

Before performing these procedures, clean the entire microscope. If you discover any mechanical problems that cannot be resolved by cleaning, re-greasing and inspecting the microscope, call a qualified service technician.

1. Re-Grease the Mechanical System
   - Use a manufacturer approved grease to protect the metal surfaces and maintain a smooth sliding action.
   - Do not disassemble the microscope for routine re-greasing. Only treat the surfaces accessible with normal movement of controls. Perform this procedure on the following mechanical systems:
     - Focusing mechanisms
     - Mechanical stage
     - Diopters
     - Interpupillary adjustment hinge

   a. Use the control to move the part to one end of its travel range, exposing the metal surfaces.
   b. Use a shop towel to remove existing grease from the gears and slide ways.

IMPORTANT! Do not use a solvent; it is not advisable to strip all grease from the surfaces.

   c. Use your fingers to apply a very small amount of silicone grease to the cleaned surface.
   d. Move the part to the other end of its travel range and repeat steps b and c.
   e. After applying the grease, use the control to move the parts back and forth throughout their travel range 6-8 times to spread the grease evenly.

2. Inspect the Mechanical System Check the microscope for any loose screws or bolts and tighten as needed by hand.

IMPORTANT! To prevent damage, be careful not to over tighten any screws or bolts.

7. Care and Maintenance

Recommended Preventive Maintenance Schedule

Daily	Monthly	Every Six Months
Wipe oil from surfaces of objectives, condenser and stage	Use compressed air to blow away dust. Clean objectives, eyepieces, condenser and collector lens	Thoroughly clean, lubricate, and inspect the microscope
Adjust dimmer to minimum setting	Remove stage clip from stage, clean stage, and stage clip	Service personel may perform this service
Turn power switch to off position	With a water-moistened tissue, wipe dust off the body of the microscope	Anually call a qualified technician for preventive service
Replace microscope dust cover	Clean the collector lens and all collector lens filters	

Statement of Limited Product Warranty

Laxco Limited Product Warranty is applicable to the United States and Canada. This warranty is subject to the following conditions:

1. Warranty of Laxco products extends to the original purchaser of the product and is not transferable.
2. Warranty Duration - LAXCO Inc. warrants LAXCO microscopes to be free of all defects in material and workmanship for a period of 60 months (5 years) from the date of original purchase to the original purchaser. Warranty for electrical items/components is 2 year from the date of original purchase.
3. Warranty Coverage - LAXCO Inc. will replace any system that fails within the first 30 days of receipt, repair or replace any components that fail within 90 days, and repair or replace, without charge to the customer, any instrument which under normal conditions of use that proves to be defective in material or workmanship thereafter. No charge will be made for labor or parts with respect to defects covered by this warranty, provided that the work is done by LAXCO Inc. Replacement or repairs furnished under this warranty are subject to the same terms and conditions of the original warranty.
4. Exclusions and Limitations - Excluded from this warranty are failures caused by abuse, neglect, misuse, improper operation, normal wear, accident, improper maintenance or modification. This warranty does not cover repair or replacement where normal use has exhausted the life of a part or instrument. All mechanical devices need periodic parts replacement and service to perform well.
5. Service - To obtain service under this warranty, please contact LAXCO Inc. at 425-686-3081, extension 2. Please be prepared to supply the following information:

    - Your name, return shipping address and telephone number
    - Catalog/Model number of the item(s) you are returning
    - Serial Numbers if applicable
    - Description of the product's problem or reason for the return
    - Date the item was purchased.

After verification of warranty enrollment, LAXCO Inc. will issue a return authorization number and provide additional information regarding the return and repair.

8. Customer and Technical Service

Returned Goods Policy

For Repair or Replacement Parts
To return goods for repair or replacement, please contact LAXCO Inc. Customer Service by one of the numbers above. Please be prepared to supply the following information:

- Your name, return shipping address and telephone number
- Catalog/Model number of the item(s) you
  are returning
- Serial Number(s), if applicable
- Description of the product's problem or reason for the return
- Date the item was purchased
- Distributor information, if applicable

A LAXCO representative will issue you a Return Materials Authorization (RMA) number. Please label the outside of your shipping container with the RMA number.

Microscope Packing Instructions

For more details on using specific controls, refer to the "Operation: Controls and Adjustments" section.
Whenever possible, ship the microscope in its original packaging. If the original packaging is not available, use appropriate shipping materials, including a heavy cardboard box and plenty of cushioning foam.

⚠ IMPORTANT! Improperly packed goods will not be insurable. Verify your carrier's requirements before packing and shipping.

1. For digital or video models, pack head separately.

2. Wrap the eyepieces with a plastic bag, secured with a rubber band at the base of the eyetubes.

3. Set the objective turret to the lowest magnification.

4. Use the coarse focus knob to lower the stage all the way to the bottom of its travel range.

1. Wedge a block of foam between the objectives and the stage to protect lenses from impact.

2. Tighten the condenser lock screw.

3. Use the substage knob to raise the condenser all the way to the top of its travel range.

4. Wedge a block of foam between the condenser and the collector lens.

5. Pack with a minimum of 3 inches cushioning all the way around the microscope. Use enough packing material to ensure the microscope will not shift within the box.

6. Tape the box securely and label the outside with your RMA number. Do not return the microscope before calling LAXCO Customer Service
for authorization.

9. Reference

Key Concepts

Magnification

Magnification increases the apparent size of an object you are viewing through the microscope. Magnification by itself does not provide more information about an object unless there is also adequate resolution and contrast. The objective lens and oculars (eyepieces) determine magnification.

Magnification = eyepiece value X objective lens value

Resolution

Resolution is the ability to distinguish small objects that are close together. Resolution becomes more difficult as objects become smaller and closer together. At some point, the objects will “fuse” together and become indistinguishable. This point is the resolution limit of the microscope.

Contrast

Contrast of an object relative to the background is also necessary in order to resolve it. Without adequate contrast, it is impossible to distinguish an object from its background even when magnification and resolution are adequate.

Resolution and Contrast are largely dependent upon specimen illumination. This involves using the illuminator (lamp),
field iris, condenser iris, and objective lens. Optimal lighting for most specimens is achieved through Koehler illumination
(page 9). Collector lens filters may also enhance image quality.

Field of View

The actual diameter of the observable field in the sample varies with the field number of the eyepiece and the magnification of the objective. It can be calculated by dividing the field number of the eyepiece by the magnification of the objective.

Example:

For an 18 mm field number eyepiece and a 10x objective, FOV = 18 mm/10=1.8 mm field of view

9. Reference

Glossary of Microscopy Terms

A

Abbe Condenser: A simple condenser comprised of two lenses; corrects for chromatic aberration.

Aberration: Term used to describe any inaccuracy in focusing of light; derived from physical limitations of lenses and optics.

Aberration, Chromatic: Inaccurate focusing of red, green and blue light.

Aberration, Spherical: Inaccurate focusing of light due to curvature of lens surface.

Achromat: A classification of microscope objectives with simpler lenses corrected for chromatic aberration by bringing red and blue light to the same point of focus.

Aplanatic Achromatic: A term describing the level of optical correction; typically used for condensers. This term indicates that the optical device is corrected to produce a flat field (aplanatic) as well as to accurately focus red, green, and blue light (achromatic).

B

Beam Splitter: An optical device that divides the incoming light beam. The beam can be divided either in terms of wavelength (for example, reflecting shorter wavelengths but transmitting longer wavelengths) or partial reflection (for example, from a partially mirrored surface or at the angled surface of a prism).

C

C-mount: A type of camera adapter typically used to connect video cameras to a microscope.

CCD: Type of video camera using electronic chips as the detector. CCD stands for charged-coupled device. Light falling on the chip creates an electrical charge at a specific location.

Centering Telescope: A special eyepiece fitted with a focusing mechanism and a longer-than-usual focal length, used for observing the back focal plane of an objective. The centering telescope can be used for aligning components for phase contrast.

Concave: Referring to a lens surface; bowing inward.

Condenser: The optical component located nearest the specimen but between the specimen and the light source; responsible for the placement and angle of light approaching the specimen.

Contrast: Visibility of an object or feature against its background.

Convex: Referring to the curve of a lens surface; bowing outward.

Coverslip Thickness: The thickness of a piece of glass used to protect and contain the sample on the slide. This value, usually 0.17 mm, is an optical requirement of the microscope, usually engraved on the barrel of the objective.

D

Depth of Field: The vertical distance in the sample through which features are simultaneously in focus. High numerical aperture objectives have a “shallow depth of field” and image only a very thin slice of information from the specimen.

Diffraction: Bending of light at the edges of features.

Diopter Setting: The focus of one eyepiece with respect to the other to compensate for differences in focus between the microscopist’s eyes. A critical setting to avoid eyestrain and headaches.

9. Reference

Glossary of Microscopy Terms

E

Eyepiece: The optical component that provides the second step in magnification.

Eyepoint: The back focal plane of the eyepiece; the location at which the cornea of the eye is placed so that the information from the microscope can be imaged on the retina of your eye.

Eyepoint,High: A special optical design in which the eyepoint is raised about 18 mm above the top surface to accommodate people who wear eyeglasses.

F

Field Aperture: The opening controlling the diameter of the field to be illuminated. The opening is controlled by an iris called a field iris.

Field Curvature: One of the optical distortions. When the center of the image is in focus and the edges fall out of focus, the field is said to “have curvature.” When the image is in focus from the center to the edges, the field is said to be “flat.” Plan objectives are corrected to produce flat fields.

Field Number: A number, usually engraved on an eyepiece, referring to the diameter of a baffle or raised ring inside the eyepiece. Determines the viewing field for the eyepiece. See also “Field of View.”

Field of View (FOV): The actual diameter of the observable field in the sample; varies with the field number of the eyepiece, magnification of the objective and other intervening optics.

Filter: A device that changes either the intensity or the wavelength of light interacting with it.

Flatfield: See “Field Curvature.”

Focal Length: Distance between the optical center of a lens and the point at which it will focus light coming from infinity.

Focal Plane: An imaginary, two-dimensional plane at right angles to the optic axis, comprised of an infinite number at focal points. Since an image can only be formed when light comes to a focus, the focal plane can be thought of as an imaginary “screen” on which the image is formed.

Focal Point: The point at which light comes to a focus to form an image. Lens systems have two major, on-axis focal points; one at the focal length, on the side of the lens from which the light is approaching (the front focal point), and the second at the focal length behind the lens (the back focal point). There are also an infinite number of focal points, both on-axis and
off-axis, determined by the relevant placement of the object and the curvature and composition of the lens system.

Field Aperture: The opening controlling the diameter of the field to be illuminated. The opening is controlled by an iris called a field iris.

Focus: The ability of a lens to converge light waves to a single point.

Focusing Eyepiece: An eyepiece fitted with a mechanism for adjusting the space between its lenses and therefore for adjusting focus.

Focusing Telescope: See "Centering Telescope."

FOV: See "Field of View."

Frame Grabber: An electronic device that captures an image digitally.

9. Reference

Glossary of Microscopy Terms

H

High Eyepoint: A design characteristic of eyepieces in which the back focal plane of the eyepiece is raised about 18 mm above the top of the eyepiece to accommodate microscopists who wear glasses.

I

Illumination, Axial: A contrast-enhancement technique for improving edge contrast. The condenser is closed most of the way, producing a highly coherent pencil of light.

Illumination, Phase Contrast: A contrast-enhancement technique used to image phase objects. Using a specifically designed annulus or ring placed at the front focal plane of the condenser, the zero-order background light is carefully placed into a special optical device (phase plate), mounted in the back focal plane of the objective. The phase plate has two functions: it reduces the intensity of the background light to approximately 15% of its original value and decreases its phase by one quarter of a wavelength. The light passing through a well-behaved phase-altering specimen (such as a cell) slows down by a quarter wave on that interaction, then another quarter-wave as it passes through the thickest part of the phase plate. As a result, when it meets the background light at the primary imaging plane, it is a half-wave out of step. The resulting destructive interference enhances contrast, making the object more visible against the background. Phase images often suffer from bright haloes at the edge of fine detail, partially due to the background light scattering when it hits the edge of the phase plate.

Image: The focusing of light in an organized fashion to reproduce information collected from the object. The more accurately the light is focused, the more accurately the object is represented in the image.

Image Analysis: Any type of measurement performed on the image, ranging from particle sizing and counting to determinations of motility or field-specific parameters such as orientation.

Immersion Medium: The material used between the uppermost surface of the sample and the objective. The immersion medium could be air, water, immersion oil, etc.

In Phase: A relationship between waves of light. When waves are “in phase,” the must be coherent (come from the same source, have the same wavelength, travel in the same direction, at the same point in time, vibrating in the same plane) and will reach their peak and fall to their trough at the same time. They are, literally, in step with each other. Phase annuli must be centered to produce in-phase images.

Infinity Corrected Optics: A special optical design involving at least two lenses in which the object is placed at the focal plane of the first lens, causing the imaging rays to emerge parallel to the optic axis or some principal ray. Since the emerging rays never focus to make an image, they are said to be carrying that information to “infinity.” The second lens then picks up the information as sets of parallel rays, and brings them into focus at its back focal plane. In a microscope, the objective is the first lens, the telan lens is the second.

Interpupillary Distance: The physical distance between centers of the pupils in the microscopist’s eyes; usually measured in millimeters.

Iris, Condenser: Iris controlling the angle at which light emerges from the condenser and approaches the sample; located at the front of the focal plane of the condenser.

Iris, Field: Iris controlling the size of the illuminated field in the sample. Usually located around the light port. Reducing the size of the field iris is one technique for controlling haze and glare.

9. Reference

Glossary of Microscopy Terms

K

Koehler Illumination: An approach to microscope alignment that separates the illuminating set planes from an imaging set. A major goal of this approach is to illuminate evenly the back focal plane of the objective for maximum resolution and evenly illuminated background.

L

Light, Polarized: Light in which the waves vibrate in only one direction, perpendicular to the direction of travel.

Long Working Distance (LWD): A term used for specially designed objectives and condensers providing more clearance between the surface near the sample and the sample itself. Especially useful for tissue culture and microtitre work.

M

Magnification: A mathematical relationship between the size of an image and the size of the original object. If the image is larger than the object, the term used is “magnification”; if the image is smaller than the object, the term used is “minification.”

Micron: A unit of length measurement. A micron (or micrometer) is 10-6 meters (0.000001 meters) or about 1/25,000 of an inch.

Microscope, Compound: A microscope providing magnification in two stages, the first through the objective and the second through the eyepiece.

Microscope, Inverted: A standard microscope configuration in which the sample is viewed from below. Especially useful when working with very thick samples such as tissue cultures and microtitre plates.

Microscope, Stereo: A standard microscope configuration based on two independent imaging paths, separated by approximately 10-12 degrees, resulting in a stereoscopic image characterized by great three-dimensionality and great depth of field. Frequently uses lower power (0.5 to 300x total magnification).

Microscope, Upright: A standard microscope configuration in which the sample sits face up on a stage, with the objectives mounted above it.

Microscopy: The art and science of making fine detail visible. The four major issues in microscopy today are magnification, resolution, contrast and measurement.

N

Neutral-DensityFilter: An amplitude object; an object that absorbs all colors of light equally.

Numerical Aperture (N.A.): A measure of information-collecting ability of a microscope optic. The numerical aperture is a product of the sine of half of the collecting angle and the refractive index of the immersion material. The greater the N.A., the better the resolving ability.

O

Object: The actual feature of interest or study under the microscope.

Objective: The optical component that gathers the information-bearing light from the specimen. Responsible for both the first step in magnification and for setting the limit of resolution for the entire system.

Optic Axis: The imaginary axis passing through an optical system, along which light travels.

Optics: Imaging components of the microscope. Examples include the objective, eyepiece and condenser.

9. Reference

Glossary of Microscopy Terms

P

Phase: A property of light in which waves are “in step” with each other. See also “In phase.”

Phase Contrast: A contrast-enhancement technique that detects phase objects. It uses a special ring, placed in the condenser to control location of the undiffracted light, and a matching phase plate, placed in the back focal plane of the objective. A wellbehaved phase sample will slow light by approximately one-quarter of a wavelength compared to the undiffracted background light. The phase plate is especially engineered to slow the diffracted light another quarter-wave. When the undiffracted light meets the diffracted light at the primary imaging plane to form the image, they will be out of step with each other by a half-wave, creating the condition of destructive interference and resulting in the darkening of the phase object and an improvement in contrast. Phase kits include a green filter (usually about 546 nm), which defines the wavelength for which the kit is optimized.

Photo Adapter: A special tube enabling cameras to be attached to the microscope.

Pixel: An electronic term used to describe the points of information used to map an image on a TV screen or computer monitor. Literally, a picture (“pix”) element (“el”). Each pixel carries at least the x,y location in the map and an intensity value (based on 256 gray levels).

Plan: An optical correction for objectives and condensers, indicating that the optical component has been corrected to produce a flat viewing field.

Primary Image: The first magnified image formed in the microscope.

Primary Image Plane: The location of the first magnified image formed by the objective.

R

Refraction: Bending of light as it passes, at an angle, across a boundary between materials of different refractive index; governed by Snell’s Law.

Refractive Index (n or ri): A number describing the relationship between the velocity of light in a material of interest compared to the velocity of light in a vacuum or air. The slower the velocity in the material, the higher the refractive index.

Resolution (R): The smallest distance by which two objects can be separated and still be imaged as two independent objects.

Reticle: A small disk with an engraved or photographic pattern such as a ruler or grid, placed in the eyepiece, in the primary image plane, so that the pattern will superimpose on the image of the specimen. Used for measurement (length, angle, counting, etc.).

S

Snell’s Law: The law governing refraction, relating to angles of approach and exit as light passes, at an angle, from one material to a second material of different refractive index. Snell’s Law states that light will bend toward the normal (an imaginary reference line drawn perpendicular to the surface at the point of entrance) as it passes from lower to higher refractive index.

9. Reference

Glossary of Microscopy Terms

T

Telan Lens: An auxiliary lens used in conjunction with an infinity corrected objective to bring light to a proper focus. In some systems, the telan lens will also correct the objective's residual chromatic aberration. See also "Tube lens."

Trinocular Port: A special eyepiece, usually narrower in design than conventional eyepieces, used in the photo tube of the microscope to project a real image to the film plane or detector of a camera system.

Tube Length, Fixed: An optical design approach in which the object is placed at some distance in front of the objective, causing the image to focus at a specific distance behind the objective. Typical distances for the mechanical tube length in these systems are either 160 mm or 170 mm.

Tube Length, Mechanical: The distance from the objective shoulder to the seat of the eyepiece. When replacing objectives, the mechanical tube lengths must match.

Tube Length, Optical: The distance between the back focal plane of the objective and the primary image plane.

Tube Lens: In infinity corrected optics, a lens that works along with the objective to form the image at the primary image plan. See also "Telan lens."

W

Wavelength: The distance along a wave from peak to peak or trough to trough. In microscopy, wavelength is often correlated to the color and energy of light.

White light: Light containing all three primary colors: red + green + blue.

LAXCO, Inc.
18303 Bothell-Everett Hwy
Suite 140
Mill Creek, WA 98012
www.laxcoinc.com

Contact us:
425-686-3081
sales@laxco.com

LMC-MKT-DOC-1700109(2)