MAGUS LUM D400L
FLUORESCENCE DIGITAL MICROSCOPE

USER MANUAL

MAGUS

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Before using the microscope, please read this user manual carefully to study the instrument design, operation modes and procedures, operational limitations, and safety precautions.

Due to the continuous improvements in the microscope design, this manual may not reflect minor design changes that do not affect the microscope performance and operation procedures.

SAFETY PRECAUTIONS

Microscope

1. To avoid electric shock or fire, switch off and unplug the microscope before assembling the microscope, replacing the bulb or fuse.
2. Do not disassemble the microscope, except for the removable parts specified in this manual. This can seriously damage its performance. In case of malfunction, please contact a qualified service center.
3. Make sure that the input voltage of the microscope matches that of the local power supply. Using the power supply with the wrong input voltage may cause a short circuit or fire.
4. Using an incorrect bulb, fuse, or power cord may damage the microscope or cause a fire. The power cord must be grounded reliably.
5. In order to avoid a short circuit or any other malfunction, do not expose the microscope to high temperatures or humid or moist environments for a long period of time.
6. If water splashes on the microscope, immediately switch the power off, unplug the power cord, and wipe off the water with a dry cloth.
7. The microscope light bulb generates high temperatures during operation. To avoid burns, do not touch the collector lens or the bulb itself for 10 minutes after the lights have been switched off. To prevent fire, do not place paper or flammable or explosive materials near the air vents on the underside of the base.
8. The microscope employs a coaxial coarse/fine focusing mechanism. Do not turn the left/right coarse/fine focusing knobs in opposite directions. When the limit is reached, you should no longer rotate the coarse focusing knob.
9. Do not expose the microscope to direct sunlight or other light sources. Do not expose the microscope to high temperatures, humidity, or dust; otherwise, it may cause condensation, mold growth, or contamination of the optical parts.
10. Do not use any other oily substance instead of proper immersion oil made specifically for the given purpose, as this will degrade the image quality and damage the lenses.

11. Do not touch the lens surfaces with your fingers. Use a brush and special lens-cleaning solution to keep the lenses clean.
12. Bulb installation. This microscope employs LED bulbs as a light source. The bulbs should be replaced by the equipment vendor or in a qualified service center. If you replace the LED yourself, the illumination function may be impaired.

Camera

1. Never view the sun, another bright source of light or a laser through a camera – THIS IS DANGEROUS FOR YOUR EYESIGHT!
2. Do not disassemble the camera yourself.
3. Keep the camera away from moisture and do not use it in the rain.
4. Protect the camera from shocks, excessive stress from other objects.
5. Store the camera away from corrosive environments, household and car heaters, switched-on light bulbs and open flames.
6. If there is dirt on the optical surfaces, first blow off dust and small particles or brush them off with a soft brush, then clean the surface with a soft, clean cloth moistened with alcohol or ether.
7. If any instrument part or power component has been swallowed, seek medical attention immediately.

CONTENTS

MAGUS Lum D400L Fluorescence Digital Microscope has been designed and tested in accordance with the international safety standards. If properly used, the microscope is safe for the customer's health, life, property, and the environment. Proper maintenance of the microscope is a prerequisite for its reliable and safe operation.

1 DESCRIPTION OF THE MICROSCOPE

PURPOSE

The microscope is used for observing specimens in reflected light using the fluorescence technique and in transmitted light using the brightfield, darkfield, polarization, and phase-contrast techniques. The microscope can be used to examine stained and unstained biological objects, such as smears and sections.

The fluorescence technique is based on the ability of substances to emit light when excited by light of a certain wavelength. The wavelength of the emitted light is longer than the wavelength of the excitation light. The wavelength difference underlies the fluorescence microscopy observations. The technique employs the excitation with ultraviolet, violet, blue or green light. The specimen glows blue, cyan, green-yellow, or red light, respectively.

The microscope is used in biomedical laboratories, biotechnology, material science, pharmaceutical research, agriculture, environmental studies, and forensics. The microscope can be used for scientific purposes, laboratory diagnosis, and education.

The microscope design allows for capturing and displaying specimen images in real time on the computer screen using a special camera.

SPECIFICATIONS (TABLE 1)

Microscope	
Magnification, x	40–1000 (1250, 1500, 2000, 2500)**
Tube length	Infinity (∞)
Microscope head	Eyepiece diameter: 30mm, Trinocular, Gemel head (Siedentopf, 360° rotatable) 30° inclined Interpupillary distance: 48–75mm Diopter adjustment (left barrel): ±5dp Microscope head magnification: 1x
Eyepieces, magnification, x/field, mm	10x/22mm 10x/22mm with a scale*, scale division value: 0.1mm 12.5x/14mm*, 15x/15mm*, 20x/12mm*, 25x/9mm*
Revolving nosepiece	5 objectives
Optical design	Infinity plan achromatic and fluo objectives, parfocal distance: 45mm
Objectives, magnification, x/aperture	PL 4x/0.10 PL 10x/0.25 PL FL 40x/0.85 (spring loaded) PL 100x/1.25 (spring loaded, oil) PL FL 10x/0.35* PL 20x/0.40* PL 60x/0.80*
Stage	Rackless XY mechanical stage Stage size: 180mm×150mm Moving range: 75mm×50mm
Condenser	Abbe condenser (N.A. 1.2). Centerable. With adjustable aperture diaphragm Height-adjustable. Dovetail mount
Field diaphragm	Adjustable iris

Focusing mechanism	Coaxial coarse & fine focusing knobs on both sides Focusing range: 21mm Coarse focusing travel: 39.8mm/circle Fine focusing scale value: 2μm Coarse focusing lock knob Coarse focusing tension adjusting knob
Transmitted light source	3W LED
Reflected light source	Four 5W LEDs of different wavelengths
Power supply	AC voltage 85–265V, 50/60Hz Fuse specifications: 250V, 3.0A
Fluorescence filters: filter type, excitation wavelength / dichroic mirror / emission wavelength	Ultraviolet (UV), 320–380nm / 420nm / 435nm Violet (V), 380–415nm / 460nm / 475nm Blue (B), 410–490nm / 505nm / 515nm Green (G), 475–550nm / 580nm / 595nm
Phase-contrast device*	Phase-contrast turret condenser Phase-contrast objective (10x, 20x, 40x, 100x) Centering telescope
Darkfield condenser*	Darkfield condenser Oil darkfield condenser Darkfield slider
Polarizer/analyzer set*, installation method	Polarizer – installed on the collector in a frame Analyzer – installed in the slot above the revolving nosepiece
Operating temperature range	+5... +35°C
Operating humidity range	20...80%

Camera

Number of megapixels	2.3
Sensor	SONY Exmor CMOS
Color/monochrome	monochrome
Maximum resolution, pix	1920x1200
Sensor size	1/1.2" (11.25x7.03mm)
Pixel size, μm	5.86x5.86
Light sensitivity	1016mV with 1/30s
Signal/noise ratio	0.15mV with 1/30s
Exposure	0.244ms... 2s
Video recording	+
Frame rate, fps at resolution, pix	120@1920x1200
Image format	*.jpg, *.bmp, *.png, *.tif
Video format	*.wmv, *.avi, *.h264 (Win 8 or above), *.h265 (Win 10 or above)
Spectral range, nm	380–650 (with IR filter and anti-glare filter)
Shutter type	Global shutter
White balance	auto/manual
Exposure control	auto/manual
Software features	image size, brightness, exposure
Port	USB 3.0, 5 Gbps
System requirements	Windows 8/10/11 (32 and 64 bit), Mac OS X, Linux, up to 2.8GHz Intel Core 2 or higher, minimum 2GB RAM, USB 3.0 port, CD-ROM, 17" or larger display

Software	MAGUS View
Mount type	C-mount
Body material	metal
Power supply	DC 5V from the USB port of the computer
Dimensions without package (WxHxD)	237mm×502mm×427mm
Package dimensions (WxHxD)	302mm×780mm×452mm
Weight	12.3kg
Weight with package	14.8kg

*** Not included in the kit, available on request.**
**** The magnification of the microscope can be increased by using additional (optional) eyepieces and objectives.**

The manufacturer reserves the right to make changes to the product range and specifications without prior notice.

MICROSCOPE KIT

The microscope kit includes the following main components:

— stand with a built-in power supply, transmitted light source, focusing mechanism, stage, condenser, and revolving nosepiece
— reflected light illuminator with LED lamphouse
— trinocular head
— set of objectives and eyepieces
— digital camera
— set of spare parts and accessories
— packaging
— user manual.

See Section 8 of the User manual for a full kit contents.
The general view of the microscope is given in Fig. 1,2, and 3.

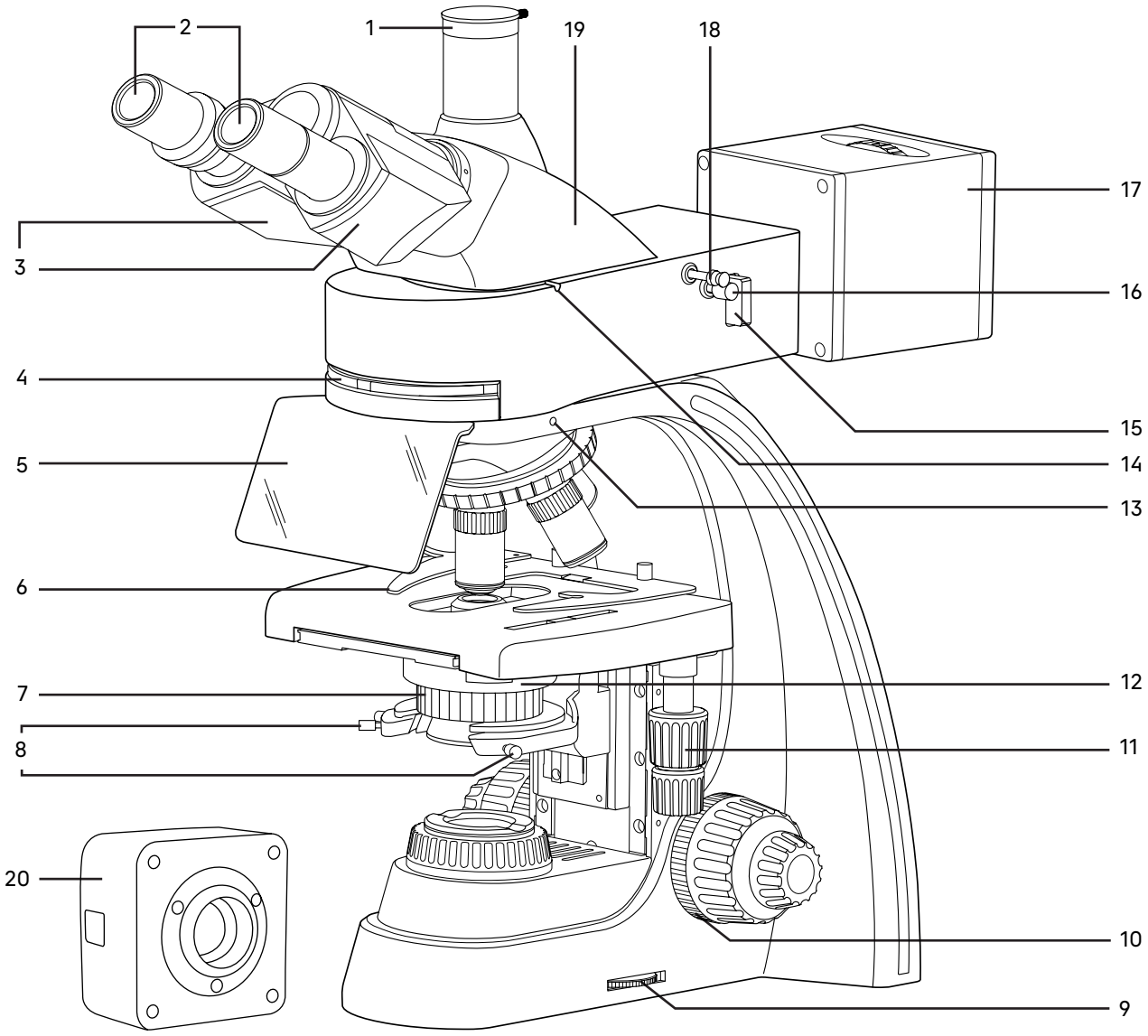


Fig. 1. MAGUS Lum D400L Fluorescence Microscope. View from the right

1. Trinocular tube
2. Eyepieces
3. Eyepiece tubes
4. Reflected light illuminator
5. UV shield
6. Specimen holder
7. Transmitted-light aperture diaphragm ring
8. Abbe condenser centering knobs
9. Transmitted and reflected light brightness adjustment ring
10. Coarse focusing tension adjusting ring
11. X/Y stage control knob
12. Abbe condenser
13. Reflected light illuminator locking screw
14. Head locking screw
15. Filter slider (shutter/neutral density filter/free slot)
16. Field aperture centering knob of the reflected light illuminator
17. Lamphouse with LEDs
18. Diaphragm adjustment knob of the reflected light illuminator
19. Microscope head
20. Digital camera

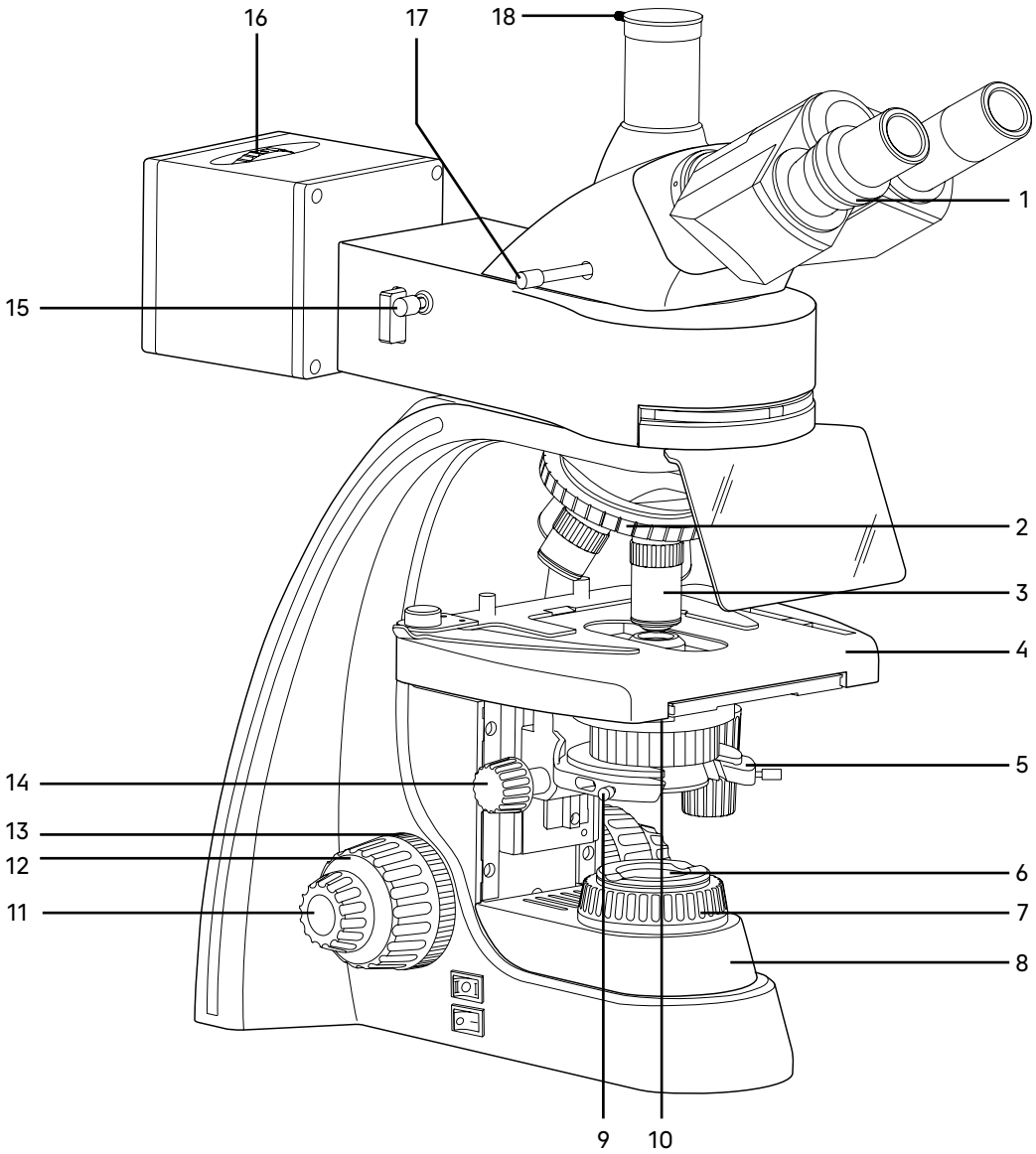


Fig. 2. MAGUS Lum D400L Fluorescence Microscope. View from the left

1. Diopter adjustment ring
2. Revolving nosepiece
3. Objective
4. Stage
5. Transmitted-light condenser mount
6. Collector
7. Transmitted-light field diaphragm ring
8. Stand and base
9. Condenser locking screw
10. Abbe condenser slot for darkfield and phase-contrast slider
11. Fine focusing knob
12. Coarse focusing knob
13. Coarse focusing lock knob
14. Condenser focus knob
15. Field diaphragm centering knob
16. LED switching ring
17. Beam splitter lever
18. Camera (dust cover) locking screw

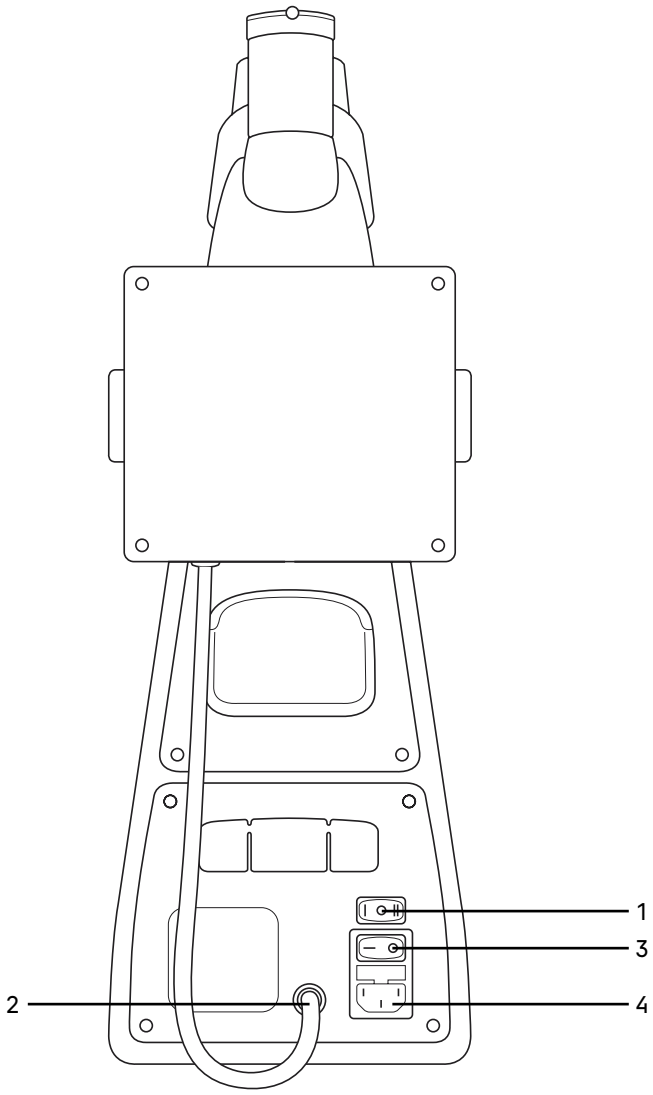


Fig. 3. MAGUS Lum D400L Fluorescence Microscope. Rear view

1. Transmitted and reflected light illuminator switch
2. Connector for the power cord of the reflected light illuminator
3. ON/OFF switch
4. Connector for the microscope power cord

2 MICROSCOPE PARTS

STAND

The stand 8 (Fig.2) is a one-piece structure with the base. The base has Y-shaped stable ergonomic design.

Parts attached to the microscope stand:

— revolving nosepiece 2 (Fig. 2) with objectives 3 (Fig. 2)

— stage 4 (Fig. 2)

— condenser mount 5 (Fig. 2)

— collector with field diaphragm 6 (Fig. 2).

Inside the stand is the focusing mechanism and the power supply of the transmitted and reflected light illuminator. The power supply converts AC voltage to the voltage suitable for LEDs.

The ON/OFF switch is located on the back of the microscope stand. The power is on when the switch is in "–" position. The power is off when the switch is in "0" position. The transmitted/reflected light illuminator switch is also located on the back of the microscope stand. The transmitted light illuminator is on when the switch is in "|" position. The reflected light illuminator is on when the switch is in "||" position.

The ring 9 (Fig. 1) is used to adjust the supply voltage of the transmitted and reflected light source.

The back panel of the microscope stand contains a fuse holder and a connector for the AC power cord, which connects the microscope to an AC outlet.

There is a handle on the back of the stand which makes it easy to carry the microscope.

FOCUSING MECHANISM

The focusing mechanism is located inside the microscope stand. The mechanism has coaxial design – coarse and fine focusing knobs, coarse focusing tension adjusting knob, and coarse focusing lock knob are mounted on the same axis.

Focusing on the specimen is achieved by adjusting the height of the stage 4 (Fig. 2). Coarse focusing is performed by rotating the coaxial knobs 12 (Fig. 2) on both sides of the microscope stand.

Fine focusing is performed by rotating the knobs 11 (Fig. 2) on both sides of the microscope stand. Fine focusing allows for precise focusing on the specimen and re-focusing the microscope to get an accurate image resolution when changing objectives and specimens.

The coarse focusing tension adjustment is performed by the ring 10 (Fig. 1) between the stand and the coarse focusing knob on the right side. The ring adjusts the coarse focusing tension so that the tension is comfortable for the user, but the stage does not lower spontaneously during operation.

The coarse focusing lock knob 13 (Fig. 2) is located on the left side. Once the coarse focusing is completed, we recommend rotating the knob clockwise as far as it will go. This secures the coarse focusing position to allow for rapid re-focusing after the specimen is changed.

The coarse and fine focusing range is at least 21mm. Coarse focusing travel: 39.8mm/circle.

Fine focusing scale value: 2μm.

The stopper in the stand is used to set the limit of the stage height to prevent accidental damage to the specimen.

To prevent the focusing mechanism from damage:

— do not turn the left/right coarse/fine focusing knobs in opposite directions

— do not rotate the coarse focusing knob after the knob reaches its limit.

MICROSCOPE HEAD

The microscope head is trinocular.

The microscope head 19 (Fig. 1) provides the visual observation of the specimen image. It is installed in the mounting hole of the top flange of the reflected light illuminator 4 (Fig. 1) and secured with the clamping screw 14 (Fig. 1). When installing the microscope head, turn the eyepieces towards the stage.

The interpupillary distance is adjusted by rotating the eyepiece tubes 3 (Fig. 1) in the range of 48–75mm. The distance between the eyepieces matching the observer's interpupillary distance is marked on the adjustment scale.

For convenience, the microscope head is inclined at 30°.

Microscope head magnification: 1x.

Eyepiece diameter: 30mm.

The eyepiece diopter adjustment is intended to compensate for the observer's ametropia. It is located on the left eyepiece tube – ring 1 (Fig. 2). The second eyepiece tube is fixed.

The Gemel head design allows for the 360° rotation of the tubes, adjusting the eyepoint height for the convenience of users of different heights. With an interpupillary distance being 64mm, a 180° rotation changes the eyepoint height by 50mm.

A C-mount 1x adapter is installed in the trinocular tube 1 (Fig. 1) of the microscope head to fix the camera. The camera is used to transmit the image to a computer screen or monitor/TV. You can switch the light path to the trinocular tube using the lever 17 (Fig. 2). The lever has two positions: 100/0 and 0/100.

EYEPIECES

The microscope kit includes eyepieces 2 (Fig. 1). The eyepieces have high eye relief and are designed to work with or without glasses.

Eyepiece diameter: 30mm.

Eyepiece magnification: 10x. Field of view: 22mm. Eye relief: 10mm.

The 10x eyepiece with a scale and 0.1mm scale value, 12.5x/14mm, 15x/15mm, 20x/12mm, 25/9mm eyepieces are not included in the kit and are optional.

REVOLVING NOSEPIECE

Revolving nosepiece 2 (Fig. 2) allows for the installation of five objectives 3 (Fig. 2). Objectives are changed by rotating the knurled ring of the revolving nosepiece until the objective fits into place.

Do not rotate the revolving nosepiece by holding the objectives.

The revolving nosepiece rotates clockwise and counter-clockwise.

The revolving nosepiece is mounted to the upper part of the microscope stand. The objectives are screwed clockwise into the revolving nosepiece in order of increasing magnification. For convenience, the objectives are turned "away from the observer".

OBJECTIVES

Objectives 3 (Fig. 2) are designed for the infinity-corrected tube length. Parfocal distance – 45mm, linear field of view – 22mm. They are designed to observe the specimen with the 0.17mm coverslip or without a coverslip. The microscope is equipped with 4x, 10x, 40x (fluorescence), 100x plan achromatic objectives. Optional plan achromatic 20x and 60x objectives and a plan achromatic fluorescent 10x objective are available.

The optics of a special plan achromatic fluorescent objective (fluo) is made of fluorescent-free grades of optical glass and glued with a special fluorescent-free adhesive. These objectives have the "PL FL" inscription. A 40x objective is typically used in the fluorescence microscopy. The microscope kit includes a 40x fluo objective. In rare cases, a 10x objective is used. The 10x fluo objective is not included in the kit and is optional.

Each objective has the following inscriptions: "PL FL" or "PL" correction type, linear magnification, numerical aperture, "∞" tube length, "0.17" or "–" coverslip thickness, magnification color code according to the international standard. Objectives with the "∞/0.17" inscription may be used with specimens with 0.17mm thick coverslips. Objectives with the "∞/–" inscription may be used for use with specimens with or without coverslips. The "oil" inscription on the 100x objective means that the objective is designed to work with the oil immersion.

The specifications of the objectives (Table 2):

Objective identification	System	Magnification	Numerical aperture	Working distance, mm	Coverslip, mm	Color marking
PL 4x/0.10 ∞/–	dry	4x	0.10	19.8	–	red
PL 10x/0.25 ∞/–	dry	10x	0.25	5.0	–	yellow
PL FL 10x/0.35 ∞/–	dry	10x	0.35	2.3	–	yellow
PL 20x/0.40 ∞/0.17	dry	20x	0.40	8.8	0.17	green
PL FL 40x/0.85 ∞/0.17	dry	40x	0.85	0.4	0.17	light blue
PL 60x/0.80 ∞/0.17	dry	60x	0.80	0.4	0.17	blue
PL 100x/1.25 oil ∞/0.17	oil immersion	100x	1.25	0.3	0.17	white

The 40x, 60x, and 100x objectives have a spring-loaded mount to prevent mechanical damage to the front lens and the object.

If objectives are damaged, we recommend repairing them in the service center.
Special non-fluorescent immersion oil must be used with oil immersion objectives.

CONDENSER

The basic microscope kit comes with the oil immersion brightfield N.A. 1.25 Abbe condenser. The microscope can be optionally equipped with an oil or dry darkfield condenser and a darkfield slider.

The condenser 12 (Fig. 1) is installed using the mount 5 (Fig. 2) under the microscope stage. It features a dovetail mount. The condenser is mounted using the guides with the specimen stage raised and the mount lowered. You can move the condenser along the optical path of the microscope using the condenser focus knob 14 (Fig. 2) located on the left of the observer under the stage. The condenser focusing range: at least 33mm.

The condenser has a slot 10 (Fig. 2) for darkfield and phase-contrast sliders.

The condenser mount has a spring-loaded holder which allows for centering the condenser in the optical path using two screws 8 (Fig. 1). The condenser is secured in the holder by the screw 9 (Fig. 2).

The iris aperture diaphragm is adjusted (opened/closed) by the ring 7 (Fig. 1). For best image quality, the aperture diaphragm of the brightfield condenser should be closed to approximately 1/3 of the objective exit pupil diameter.

Darkfield and phase-contrast condensers can be mounted in the condenser holder instead of the Abbe condenser.

STAGE

The X/Y stage 4 (Fig. 2) allows for moving the specimen in two mutually perpendicular directions using the knobs 11 (Fig. 1) located on the same axis.

Stage size: 180mm×150mm. Moving range: 75mm×50mm. Scale value: 1mm, vernier scale: 0.1mm.

The stage has no X-axis rack and pinion, which improves ergonomics. The belt-driven mechanism allows for smooth movement of the specimen. The specimen is fixed on the stage using the specimen holder 6 (Fig. 1), for which the holder is pulled aside. The specimen holder is secured to the stage with two screws. With the specimen holder removed, the specimen can be moved manually.

In the reflected light microscopy, a dark insert is installed in the stage to remove all stray light from transmitted light sources.

REFLECTED LIGHT ILLUMINATOR

The general view of the reflected light illuminator is given in Fig. 4.

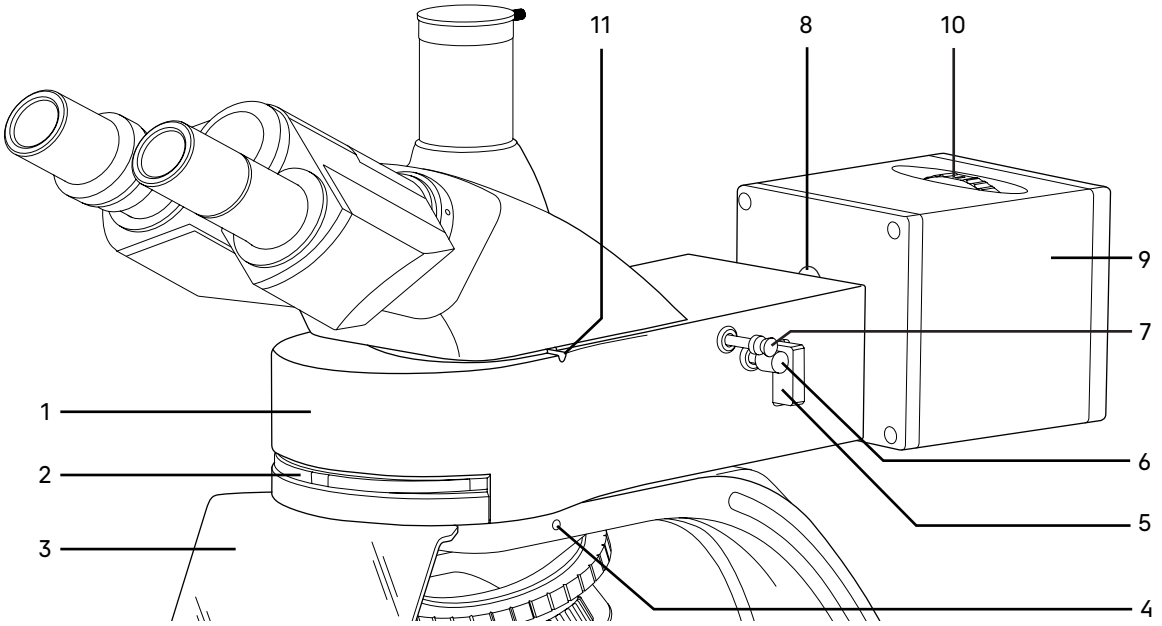


Fig. 4. Reflected light illuminator

1. Illuminator body
2. Turret wheel
3. UV shield
4. Illuminator locking screw
5. Filter slider
6. Field aperture centering knob of the reflected light illuminator
7. Diaphragm adjustment knob of the reflected light illuminator
8. Lamphouse locking screw
9. Lamphouse with LEDs
10. LED switching ring (B; G; V; UV)
11. Head locking screw

Illuminator body

The illuminator body 1 (Fig. 4) is installed in the mounting hole of the top flange of the stand and secured with the screw 4 (Fig. 4).

There is an adapter on the illuminator body 1 (Fig. 4) to connect the body to the LED lamphouse. The UV shield 3 (Fig. 4) is attached to the illuminator with two screws.

The metal plate of the filter slider 5 (Fig. 4) is installed in the slot of the illuminator body. The plate has three positions:

1) neutral density filter to reduce the intensity of light and cut off long wavelength ultraviolet rays

2) shutter to completely block the light flow

3) free slot.

There is a rotating turret inside the illuminator with four fluorescence filters. The turret is moved by rotating the wheel 2 (Fig. 4). The locked position of the knob under the symbol means that the corresponding filter is in the optical path.

The turret wheel can be locked in one of the five positions corresponding to one of the four filters mounted on the turret: blue (B), green (G), violet (V), and ultraviolet (UV), or the neutral position (0). The marking of each filter corresponds to the color of the excitation light and its symbol is inscribed on the wheel 2 (Fig. 4).

In the fluorescence microscopy, you should select filters based on the fluorochrome (fluorescent dye).

If the knob is under the "0" position, observations are made in transmitted light using the brightfield technique or other contrast techniques, provided that the appropriate equipment (phase-contrast slider, darkfield condenser or polarizer) is used.

The excitation spectrum range: 320–550nm.

The emission spectrum range: 435–700nm.

The specifications of the reflected light illuminator (Table 3):

Filter type	LED excitation wavelength, nm	Dichroic mirror wavelength, nm	Emission wavelength, nm
Ultraviolet (UV)	320–380	420	435
Violet (V)	380–415	460	475
Blue (B)	410–490	505	515
Green (G)	475–550	580	595

Lamphouse with LEDs

The lamphouse 9 (Fig. 4) contains the excitation light sources – LEDs. The microscope is equipped with LEDs of four wavelengths: blue (B), green (G), violet (V), and ultraviolet (UV). LEDs are installed in the turret inside the lamphouse. The LEDs are changed by rotating the ring 10 (Fig. 4). The LED names are printed on the front side of the ring.

The lamphouse is secured on the reflected light illuminator 1 (Fig. 4) by an Allen head screw 8 (Fig. 4). Inside the lamphouse, there is a collector that projects the image of the light source into the exit pupil of the objective.

While removing the lamphouse from the illuminator, make sure that the microscope power supply is off.

There is a power cable attached to the lamphouse. The cord is not removable.

CAMERA

The digital camera is intended for the fluorescence and darkfield observations. It features low noise and low heat dissipation.

The camera is mounted in the trinocular tube of the microscope head.

The camera is powered through the USB port of a computer.

3 UNPACKING AND ASSEMBLING THE MICROSCOPE

The assembly procedure is given in Fig. 5.

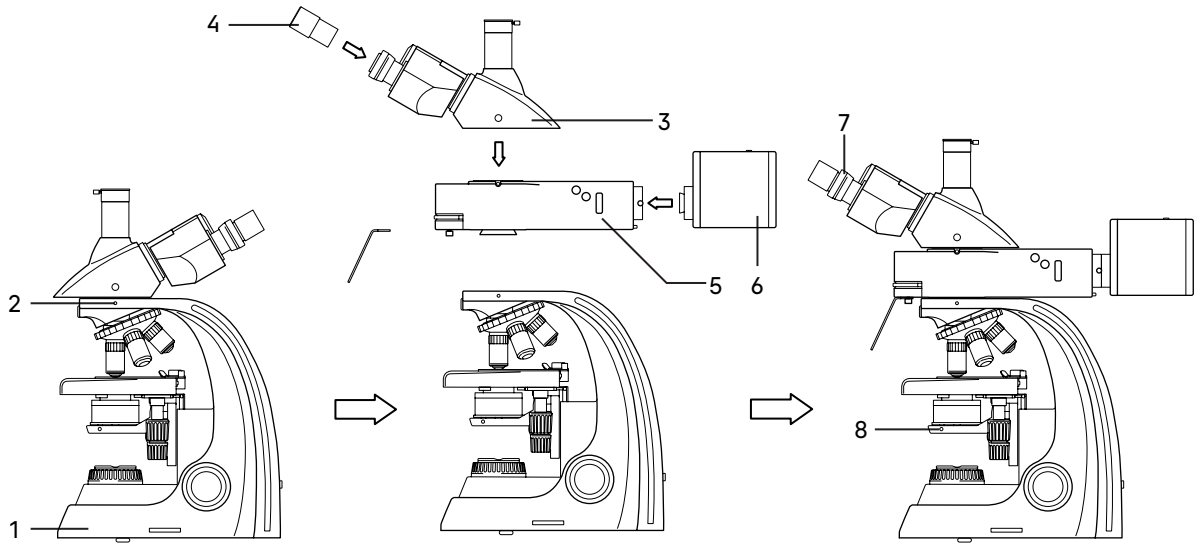


Fig. 5. Assembling the microscope

1. Remove the microscope from the package.
2. Check the scope of delivery using Section 8 of the User Manual.
3. Inspect the microscope and its components for damage.
4. Remove the stand **1** with the microscope head secured on it.
5. Loosen the attachment screw **2** using an Allen wrench. Remove the microscope head **3** from the stand.
6. Remove the reflected light illuminator **5** and the lamphouse with LEDs **6** from their packages. Remove dust covers from the reflected light illuminator.
7. Place the reflected light illuminator **5** on the microscope stand **1**. Secure it with the screw **2** using an Allen wrench. Secure the UV shield with two screws on the front of the reflected light illuminator.
8. Place the lamphouse with LEDs **6** on the reflected light illuminator **5**. Secure the attachment screw using an Allen wrench.
9. Insert the reflected light illuminator power cord into the corresponding socket on the back of the microscope stand.
10. Place the lamphouse with LEDs **3** on the reflected light illuminator **5**. Secure the attachment screw.
11. Remove the dust caps from the eyepiece tubes. Insert the eyepieces **4** into the eyepiece tubes. Rotate the eyepieces, making sure they are tightly seated in the tubes.
12. Mount the condenser **8** into the holder using the guides. Secure the condenser in the holder with the screw.
13. Connect the AC power cord to the connector on the back panel of the stand. Plug the power cord into an AC outlet.
14. Make sure that all the components are securely and safely mounted.
15. Check and sort the supplied accessories and tools in the correct order. Keep them in proper order to avoid confusion.
16. Keep the packaging should you need to transport the microscope.

4 BRIGHTFIELD OBSERVATIONS IN TRANSMITTED LIGHT

SWITCHING ON THE ILLUMINATION

Before switching on the ON/OFF switch, make sure that the input voltage of the microscope power supply matches the local mains voltage. If not, do not switch on the microscope. Improper input voltage may result in a short circuit or fire.

Set the filter turret wheel 2 (Fig. 4) to "0" position.

Set the plate 5 (Fig. 4) into a "shutter" position.

Make sure that the power cord is plugged into the connector on the back panel of the microscope stand.

Turn the ON/OFF switch **1** to "–" position (ON).

Adjust the brightness using the ring **2** so that the light brightness is 70% of full power.

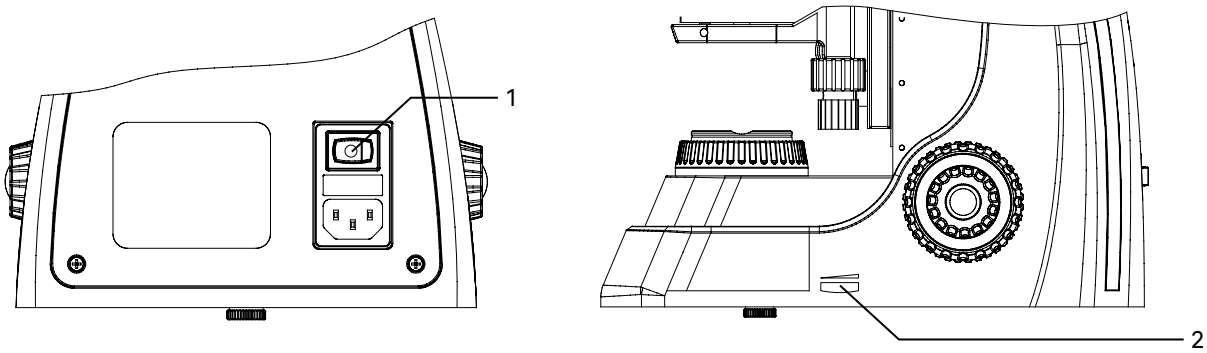


Fig. 6. Switching on the illumination and adjusting the brightness

Do not keep the brightness adjustment ring in the maximum brightness position for a long period. This may shorten the life of the bulb. Before switching off the microscope, reduce the light intensity to the minimum.

PLACING THE SPECIMEN

Place the specimen **1** on the stage. Adjust the image by moving the stage control knobs **2** and **3** so that the observed section of the specimen is directly under the objective.

The stage attachment features an XY control system. The control knobs are coaxial – they are located on the same axis.

The knob **2** controls Y-axis movement, the knob **3** controls X-axis movement. Moving range: 70mm in X-axis direction and 50mm in Y-axis direction.

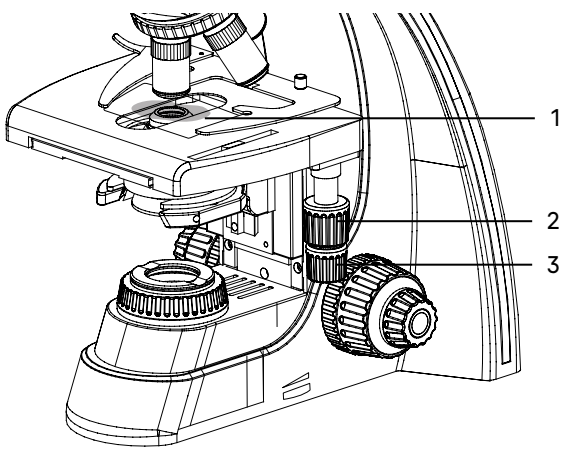


Fig. 7. Placing the specimen

FOCUSING ON THE SPECIMEN

Place the 4x objective into the optical path (we recommend starting with low and medium magnification objectives that have a sufficiently large field of view and working distance).

By turning the coarse focusing knob **2**, raise the stage carefully until the coverslip almost touches the objective front lens.

Looking into the right eyepiece (with the left eye closed) and lowering the stage slowly, bring the image into sharp focus using the coarse **2** and fine **1** focusing knobs.

The tension of the coarse focusing knob is adjustable and is preset by the manufacturer for convenient use. If you need to adjust the tension of the coarse focusing knob, rotate the coarse focusing tension adjusting knob **4**. By rotating it counter-clockwise, you tighten the tension, and by rotating it clockwise, you loosen it.

The rotary knob **3** is used to lock the coarse focusing. This function ensures that the stage is secured in the upper position. The coarse focusing lock knob is convenient for quick specimen change. When the stage is locked in the preset position, you can quickly bring the image to sharp focus after changing the specimen by rotating the coarse focusing knob as far as it will go and re-focus by a fine focusing knob.

Note that when the coarse focusing lock knob is locked in position, you should not rotate the coarse focusing knob after the stage has reached the stop. This may cause the focusing mechanism to break.

If a new specimen has a different slide thickness and you fail to focus on the object, unlock the coarse focusing lock knob.

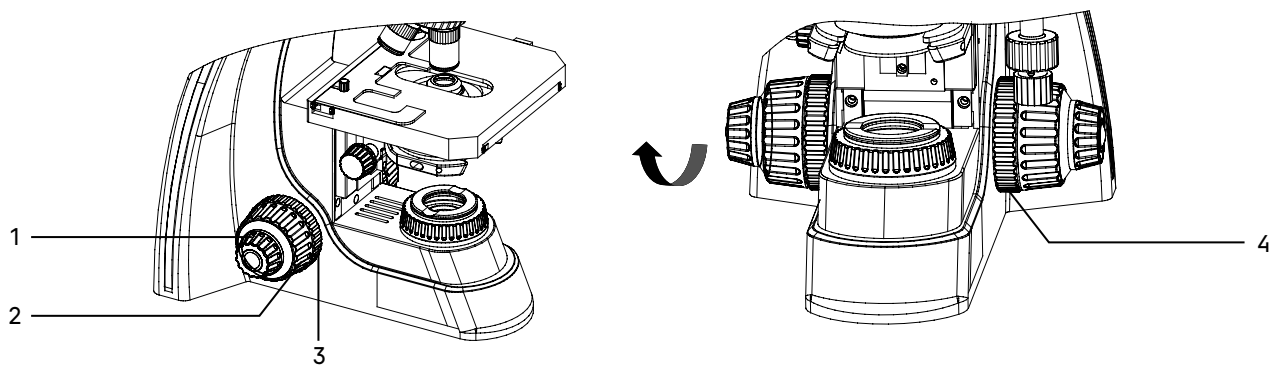
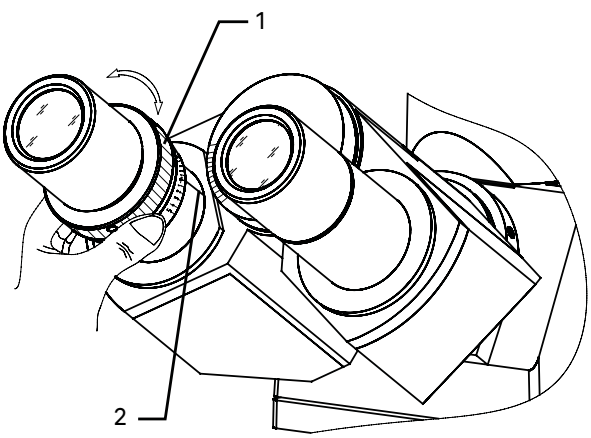


Fig. 8. Focusing on the specimen

ADJUSTING THE EYEPIECE TUBES

Use the diopter adjustment of the left eyepiece tube to compensate for the observer's ametropia. Start by setting the diopter adjustment to the zero. To do this, rotate the ring **1** to adjust the scale "0" to the indicator **2**.

While looking through the right eyepiece (with your left eye closed), bring the specimen into focus. While looking through the left eyepiece (with your right eye closed) and not touching the focusing knobs, bring the specimen into sharp focus in the left eyepiece by rotating the diopter adjustment ring **1**.



1. Diopter adjustment ring
2. Indicator

Fig. 9. Adjusting the diopter adjustment mechanism

The adjustment range is ±5 diopters. The number on the ring corresponds to the diopter adjustment of the eyes. The indicator on the side is used for marking.

We recommend memorizing your diopter adjustment value for future reference.

Adjust the distance between the eyepieces to your interpupillary distance by rotating the eyepiece tubes around the central axis until you see a single circular image when looking through the eyepieces with both eyes.

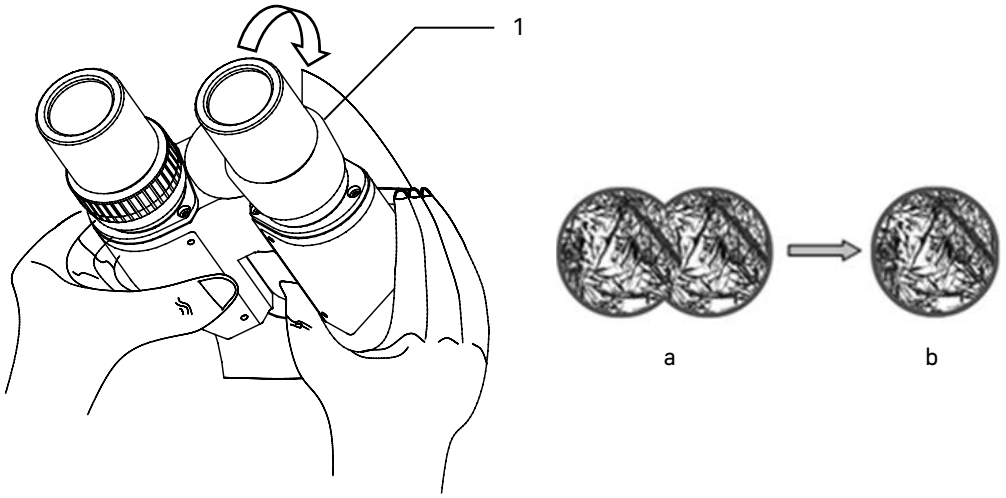


Fig. 10. Adjusting the interpupillary distance

We recommend memorizing your interpupillary distance for future reference.

The eyepiece tubes are 360° rotatable to change the eyepoint height for the users of different heights. With an interpupillary distance being 64mm, a 180° rotation changes the eyepoint height by 50mm.

SETTING UP KÖHLER ILLUMINATION

In the light optical microscope, the image quality depends equally on the optics and on the illumination system, so adjusting the illumination is an important preparatory step. The illumination system affects the image resolution, comfort during long observation, and photo quality when using digital cameras.

The Köhler illumination is one of the features of professional microscopes. Proper set-up of Köhler illumination offers the following benefits:

— the highest possible resolution on each objective

— focusing on the specimen image, removing the images of artifacts: dust on the illuminator or on the slide, glare

— even illumination of the entire field of view with no edge darkening.

Set up Köhler illumination as follows:

— Proceed as described above: switch on the illuminator, place the specimen on the stage **1**, focus, and adjust the eyepieces.

— Open the field diaphragm **3** and the condenser aperture diaphragm **2**, raise the condenser all the way up using the condenser focus knob **5**.

— While looking through the eyepieces, close the field **3** and aperture **2** diaphragms so that only the center of the field of view is illuminated (Fig. 11a).

— Move the image to the center of the eyepiece field of view using the condenser centering screws **4** (Fig. 11b).

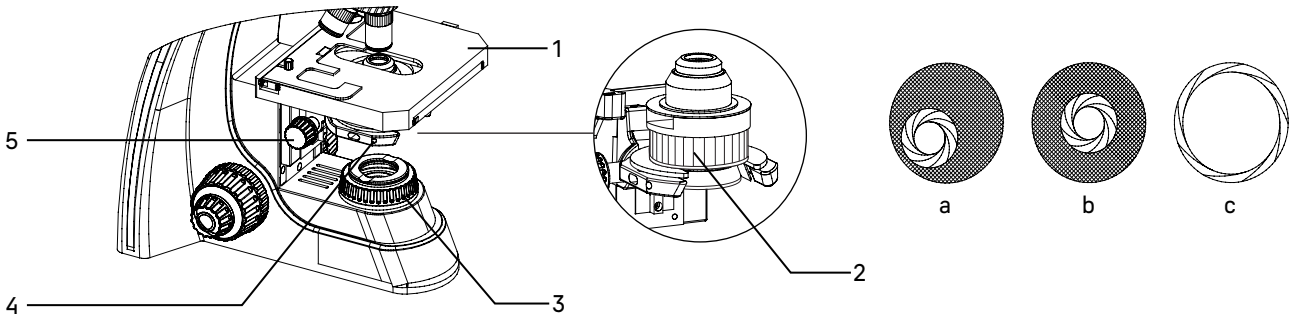
— Carefully moving the condenser up and down by rotating the condenser focus knob **5**, place the condenser into the working position. In this position, the edges of the octagon-shaped image of the closed field diaphragm are sharp and the diffracted blue-green color at the edge of the diaphragm is directed beyond the edge of the diaphragm and not into the field of view.

— Open the field diaphragm **3** until it just disappears outside of the field of view (Fig. 11c). Additional centering may be required.

— Remove the eyepiece from the right tube with no diopter adjustment and, while observing the objective exit pupil, open the aperture diaphragm to 2/3 of the objective exit pupil. This value will be slightly less than the objective aperture.

— Insert the eyepiece into the tube.

— Proceed to the brightfield observations.



1. Stage
2. Aperture diaphragm ring
3. Field diaphragm
4. Condenser centering knob
5. Condenser focus knob

Fig. 11. Centering the condenser

When you switch to the objectives of other magnifications, do not change the height of the condenser, only adjust the opening of the field and aperture diaphragms.

While adjusting the illumination, you should keep in mind that changing the size of the field diaphragm only affects the size of the illuminated field. For each objective, you should open the field diaphragm so far that its image is close to the edge of the microscope's field of view, not outside of the field. Magnification and field of view values are inversely proportional. High magnification will give a small field of view. Therefore, when you switch to higher magnification objectives, close the field diaphragm. When you switch to lower magnification objectives, open the field diaphragm.

The size of the aperture diaphragm affects the image contrast. Do not increase the image brightness by opening the aperture diaphragm, as this will result in loss of contrast and low resolution. The brightness is only adjustable with the brightness adjustment ring. The greater the magnification of the objective, the larger is its aperture, and the larger is the opening of the condenser diaphragm. The final opening of the aperture diaphragm depends not only on the objective but also on the specimen, so the aperture diaphragm is opened in such a way that the best contrast of the specimen image is produced.

Use 1–1.2mm thick slides to ensure proper operation of the illumination system.

USING OIL IMMERSION OBJECTIVES

Using the 40x objective, place the specimen section you want to observe in the center of the field of view. Place a drop of the immersion oil on the slide.

Do not use substitutes instead of special immersion oil as it may significantly worsen the image quality and cause malfunction of the objective.

Place the 100x oil objective into the optical path. Observing the gap between the objective and the slide from the side, raise the stage slowly using the coarse focus knob until the drop of oil on the slide comes in contact with the objective lens. This results in an immersion medium between the front lens of the objective and the slide. Use the fine focusing knob to sharpen the focus quality of the image. There should be no bubbles in the immersion medium. Otherwise, lower the stage to break with the oil drop and re-focus the microscope on the specimen.

When finished, remove the immersion oil with a clean cloth or cotton wool. Clean the surfaces, which were covered with immersion oil, with cotton wool rolled on a wooden stick and lightly moistened with special O-xylene mixture.

CALCULATING THE TOTAL MAGNIFICATION

The total magnification is the eyepiece power multiplied by the objective power.

For example, if the eyepiece is 10x/22mm, and the objective is 40x/0.85, the total magnification of the microscope is 10 x 40 = 400x.

CALCULATING THE FIELD OF VIEW

The field of view is calculated by dividing the eyepiece field number by the objective magnification.

For example, if the eyepiece is 10x/22mm, and the objective is 40x/0.85, the field of view of the microscope is 22mm/40x = 0.55mm.

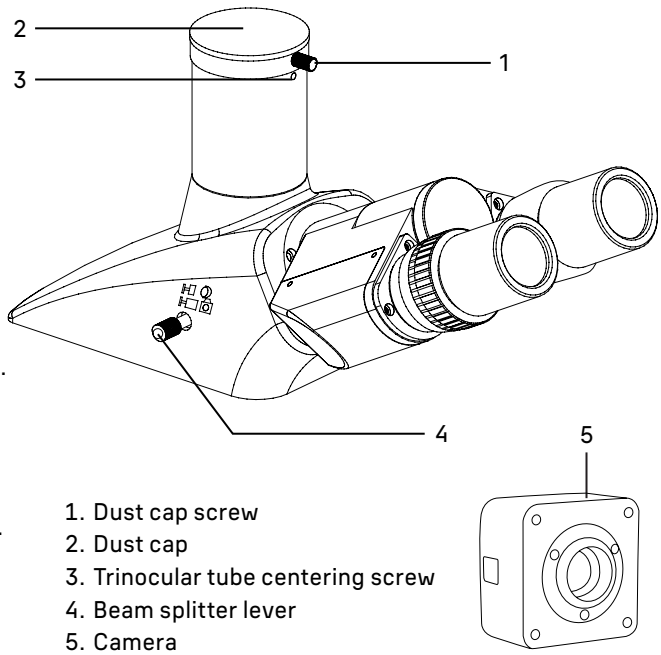
A stage micrometer (calibration slide) is used to accurately determine the field of view of the microscope.

USING THE CAMERA

The digital camera is equipped with a 2.3MP sensor producing a realistic image in 1920x1200 pixels. The camera is recommended to be used with 40x, 60x* (optional), and 100x objectives. The camera allows capturing more details with low magnification objectives.

The microscope is designed to observe a specimen through the eyepieces and to photograph the specimen. The trinocular tube is located on the top of the microscope head. When not in operation, it is covered with the dust cap **2**. You can switch to the trinocular tube using the knob **4**. The knob is located on the left side of the microscope head.

It is important that you choose the proper camera to capture objects in the fluorescent light. You should pay attention to light sensitivity: the larger the pixel size and sensor size, the crisper and more realistic the image appears. When choosing between a monochrome and color camera with the same sensor, give preference to the monochrome camera as it has higher light sensitivity. When choosing between a global and rolling shutter, select the global one. A good fluorescence camera should have a cooling system. The wrong camera will not allow taking good quality pictures, which will distort the results of the observation.



1. Dust cap screw
2. Dust cap
3. Trinocular tube centering screw
4. Beam splitter lever
5. Camera

Fig. 12. Using the camera

To enable the camera:

— Loosen the screw **1**. Remove the dust cap **2** from the trinocular tube.

— The microscope kit includes a C-mount adapter. Connect the camera to the adapter.

— Fit the camera **5** into the trinocular tube and secure it with the screw **1**.

— Pull out the beam splitter lever **4** as far as it will go. The knob is in the pushed-in position when the trinocular tube is not used.

— Switch on the camera according to the manual, adjust the image.

— If the image is blurred, adjust the focus using the fine focusing knob to ensure an accurate and sharp image.

If there is a strict requirement to synchronize the image in the eyepieces and camera (coincidence between the image center and direction), you should adjust the camera image using three centering screws **3**. Do it as follows:

— Set the beam splitter lever **4** to the eyepiece position. While observing the specimen through the eyepieces, find a distinctive point in the field of view (an easily identifiable target, such as point S in Fig. 13a), move the specimen on the stage so that the point is in the center of the field of view, as shown in Fig. 13b. To do this, you should use a special calibration slide with a reticle instead of a specimen slide and an eyepiece with a reticle in place of an ordinary one.

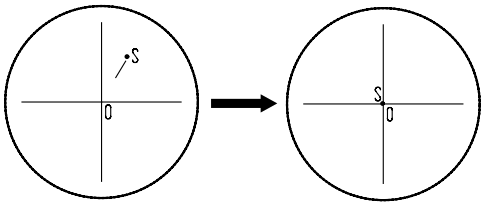


Fig. 13. Adjusting the camera image

— Pull out the beam splitter lever **4** to the camera position. Look at the specimen on a monitor or display screen and make sure that the image of the target is in the center of the field of view. If the image deviates from the center of the field of view, adjust three centering screws **3** on the trinocular tube to move the target towards the center.

— Move the specimen and check whether the image of the specimen on the monitor or display screen moves in the same direction as the specimen does. If the image moves in another direction, you should adjust the camera position. Loosen the lock screw **1**, rotate the camera to make the displayed image direction in line with the direction of stage movement, and then secure the screw.

5 FLUORESCENCE OBSERVATIONS

Before starting fluorescence observations, adjust the microscope to work in transmitted light using the brightfield technique, as described above.

Placing the specimen, focusing on the specimen and adjusting the microscope head for the fluorescence observations are done in the same way as for the transmitted light observations.

During fluorescence observations:

— In order to prevent the fluorescence of the prepared specimens from quenching, carry out observations under low light conditions as far as practicable – use dark curtains, switch off the overhead light.

— Microscopy observations are performed as soon as the specimens are stained with fluorescent dyes and dried. If immediate microscopy is not possible, it is recommended that specimens be stored in a cool place in an opaque container or wrapped in black paper. Storing specimens in a place exposed to direct sunlight or ultraviolet light will result in fluorescence quenching, and, consequently, false results.

— It is necessary that you select correct fluorescence filters suitable for the fluorochrome (fluorescent) dyes used to stain the specimen. For example, if you choose the green filter for the specimen stained by Auramine O, there will be no or too little fluorescence.

— The optical system must not contain self-illuminating objects. For example, if you use cedar wood oil as an immersion fluid, it will produce an extra turquoise glow. Use special immersion oil for the fluorescence microscopy.

— In order to prevent the fluorescence of the specimen from quenching due to excessive excitation, you should use the filter slider 5 (Fig. 4) and enable a neutral density filter. If you leave the free slot in the optical path, the specimen will burn out during focusing, leading to false results.

ADJUSTING THE REFLECTED LIGHT ILLUMINATOR

An essential part of the microscope is the assembly of fluorescence filters. The rotating turret of the reflected light illuminator accommodates four types of filters: blue (B), green (G), violet (V), and ultraviolet (UV). Marking is applied on the turret wheel 2 (Fig. 4). A filter type is selected to match the fluorochrome.

The excitation light source is an LED. The microscope kit includes LEDs of four wavelengths: blue (B), green (G), violet (V), and ultraviolet (UV). LEDs are installed in the rotating turret of the lamphouse 11 (Fig. 4). Marking is applied on the turret ring 12 (Fig. 4).

The light source is selected to match the filter type. The letters on the filter turret and the lamphouse turret must be the same when in operation.

USING THE REFLECTED LIGHT ILLUMINATOR

1. Switching on the illuminator

Place the UV shield **6** and secure it with the screws.

Make sure that the reflected light illuminator power cord is connected to the corresponding socket.

Turn the ON/OFF switch **3** to the "|" position (ON). Turn the transmitted/reflected light illuminator switch **1** to the "||" position (reflected light illuminator).

Rotate the knob **2** to adjust the intensity of the fluorescence light. Choose the required brightness based on the specimen under examination. Keep in mind that prolonged exposure to excessively bright excitation light may accelerate specimen fading.

Lower the Abbe condenser all the way down. Install the black plate **7** into the stage above the condenser. The plate protects the specimen from stray light that can affect the image quality and observation results.

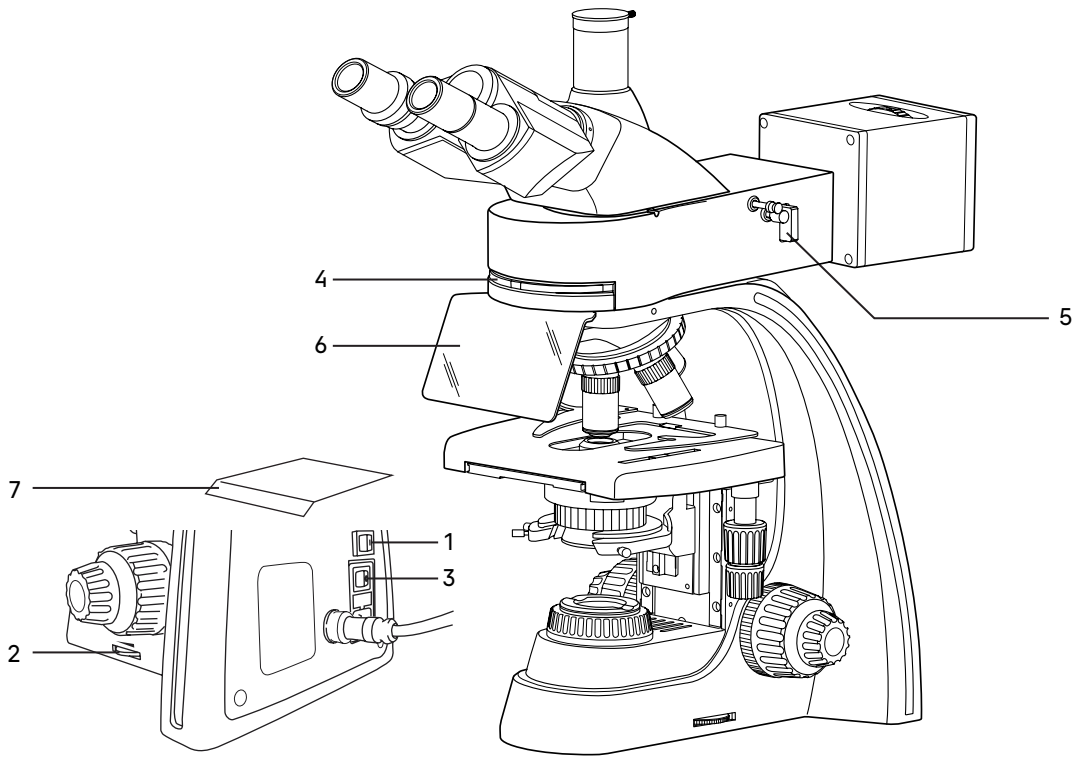


Fig. 14. Switching on the reflected light illuminator

2. Selecting the fluorescence filter

The rotating turret accommodates four fluorescence filters: blue (B), green (G), violet (V), and ultraviolet (UV). Rotate the ring **4** to select one of the filters in accordance with the used fluorochrome. The marking of each filter corresponds to the color of the excitation light and is inscribed on the wheel as a symbol. Select the corresponding LED in the lamphouse.

3. Using the filter slider

The filter slider **5** has three positions: neutral matt density filter, free slot, and shutter. Once inserted in the illuminator slot, the plate is locked in one of the three positions.

Use the "shutter" position when you have completed the observations or during a break in order to avoid excessive excitation light exposure and prevent the specimen from fluorescence fading.

Use the "neutral matt density" position in case of prolonged light exposure or under intense illumination of the specimen, which may distort the specimen configuration and affect the image quality and microscopy results.

Use the "free slot" position if you need to step up the intensity of the excitation light. The fluorescence lifetime may be shortened due to rapid fading.

4. Using the field diaphragm of the illuminator

The field diaphragm of the reflected light illuminator is pre-centered before shipping from the factory, but the adjustment may be lost during transportation. The centering of the field diaphragm should be checked.

— Place the 10x objective into the optical path.

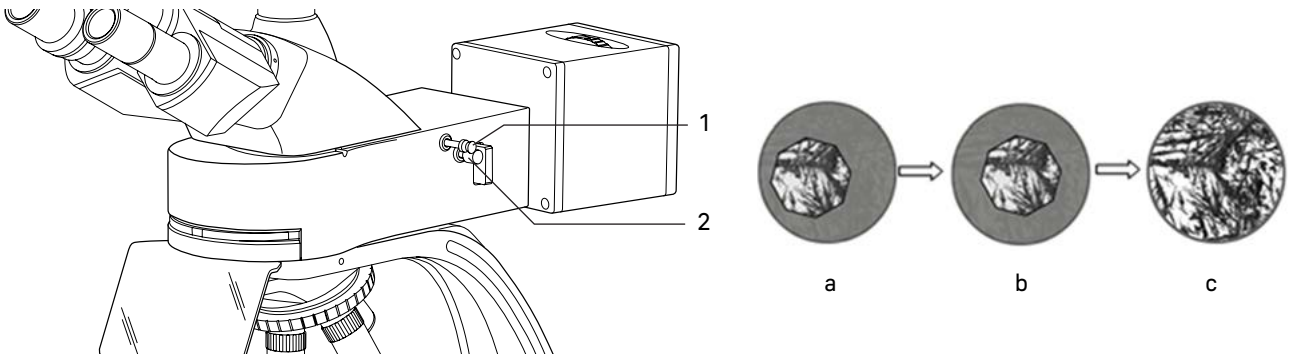


Fig. 15. Centering the field aperture of the reflected light illuminator

— Push the knob **2** as far as it will go to close the field diaphragm. A bright spot should be visible in the center of the field of view, as shown in Fig. 15b.

— If the bright spot is not in the center of the field of view, as shown in Fig. 15a, you will need to center the diaphragm. Use two centering screws **1** located on both sides of the illuminator to align the center of the diaphragm with the center of the field of view, as shown in Fig. 15b.

— Open the field diaphragm until its image fills the field of view, as shown in Fig. 15c.

6 USING OPTIONAL EQUIPMENT

DARKFIELD CONDENSER

The optional darkfield condenser is used in the darkfield microscopy technique. This technique is used to obtain the image of unstained transparent weakly absorbing samples and therefore invisible when observed in the bright field.

We recommend setting up the darkfield illumination with the oil condenser as follows:

— Raise the stage all the way up using the coarse focusing knob. Lower the condenser all the way down using the condenser focus knob. Loosen the screw of the brightfield condenser holder while leaving the centering screws untouched. Remove the Abbe condenser and install the darkfield condenser in the condenser mount instead. Secure it with a screw.

— Place a drop of immersion oil on the front lens of the darkfield condenser.

— Rotate the adjustment ring to increase the bulb intensity to maximum. Place the specimen on the stage.

— While observing the gap between the condenser front lens and the specimen slide from the side, use the condenser focus knob to raise the condenser so that the immersion oil contacts the slide.

— Place a drop of immersion oil on the coverslip, place the 100x objective into the optical path and focus on the specimen. You should see the darkfield effect in the field of view (brightly shining particles of the specimen on a dark background).

— For best darkfield illumination, carefully adjust the condenser height and center it with the screws.

For good darkfield performance, specimens with a slide thickness of no more than 1.2mm and a coverslip thickness of no more than 0.17mm should be used.

When using the darkfield technique with the immersion objective having a high aperture, the objective captures not only the light scattered by the specimen particles, but also the direct rays that create a light background and deteriorate the image contrast. Therefore, all unwanted light should be removed from the room, if possible.

When finished, remove the immersion oil with a clean cloth or cotton wool. Clean the surfaces, which were covered with immersion oil, with cotton wool rolled on a wooden stick and lightly moistened with special O-xylene mixture.

The darkfield illumination settings for using dry objectives with the N.A. 0.9 condenser are similar apart from the immersion oil.

DARKFIELD SLIDER

The darkfield slider is designed for the darkfield microscopy on objectives with apertures up to 0.9. The slider is a plate with two round openings. One opening is free for the brightfield technique. The second opening holds the darkfield diaphragm. The slider is inserted in the slot of the Abbe condenser 10 (Fig. 2). Make sure that the slider is inserted with the marks facing up. The condenser aperture diaphragm must be fully open. The slider makes it easy to switch from one observation technique to another.

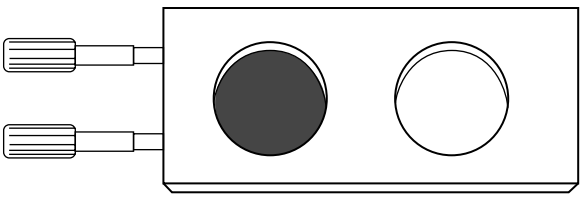


Fig. 16. Darkfield slider

PHASE-CONTRAST DEVICE

The phase-contrast device is designed for the study of low-contrast objects which are invisible in transmitted light of the brightfield microscopy. The phase-contrast technique allows for the observation of unstained low-contrast objects, colorless transparent specimens and living microorganisms. For example, it is used in medicine to calculate the number of platelets in clinical blood tests, visualize and count red blood cells in urine. It is also used in ecology to examine living organisms in water.

The phase-contrast device is installed in the condenser mount in place of the Abbe condenser. When using the phase-contrast device, refer to the specification and follow the device operation manual.

POLARIZER/ANALYZER SET

The polarization technique requires using the polarizer/analyzer set which consists of an analyzer and a polarizer.

1. Place the analyzer into the slot above the revolving nosepiece.
2. Place the polarizer on the collector.
3. Switch the light to maximum brightness.
4. Turn the polarizer to a position where the field of view in the eyepieces is the darkest.
5. Place the specimen on the stage. You can start observing in the polarized light.

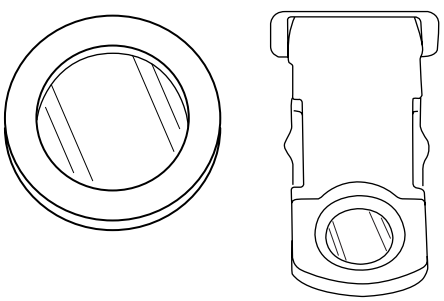


Fig. 17. Polarizer/analyzer set

USING THE EYEPIECE WITH A SCALE

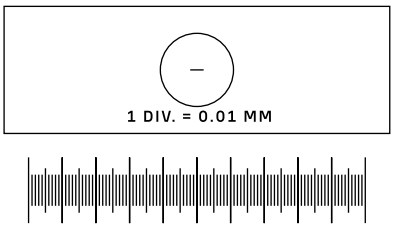


Fig. 18. Calibration slide

The eyepiece with a scale or reticle can be used to make comparative analysis of the linear dimensions of the individual components of an object. The scale is installed in the plane of the field diaphragm of the 10x eyepiece. The eyepiece with a scale is installed in the tube in place of the eyepiece of your microscope.

You should use a special stage micrometer (calibration slide) to determine the linear dimensions (in millimeters or microns).

The calibration slide is a transparent glass (of the same size as the specimen slide) that has a micrometer scale with a scale division of 0.01mm etched on the surface.

Place the calibration slide on the stage instead of the specimen. Using the scale of the calibration slide, calibrate the eyepiece scale for each objective that will be used for measurements. To do this, bring the image focus of the calibration slide scale into sharp focus in the plane of the eyepiece scale and rotate the eyepiece in the tube, setting the strokes of both scales in parallel. Determine how many divisions of the calibration slide fit in the eyepiece scale (with the medium and high magnification objectives) or how many divisions of the eyepiece scale are covered by the entire calibration slide (for low magnification objectives).

Work out the value for one eyepiece division using each objective by formula **E = TL/A**, where:

E – eyepiece division value

T – stage division value specified on the stage micrometer (0.01mm)

L – number of stage micrometer divisions

A – number of eyepiece divisions.

We recommend entering the obtained data in a size chart:

Objective magnification	Eyepiece division value
4	
10	
20	
40	
60	
100	

Using these data to determine the actual linear size of the specimen, you just need to count the number of divisions of the eyepiece scale aligned with the area of the specimen being measured, and multiply this number by the scale division value specified in this table.

USING THE CALIBRATION SLIDE WITH A CAMERA

The calibration slide (stage micrometer) is used to calibrate the image analysis software for measurements in actual units. In the calibration mode, you should capture an image of the micrometer scale with every objective magnification and indicate the known distance. That lets you establish a scale of the image in actual units (micrometer, millimeter, etc.). Calibration:

1. Place the calibration slide on the microscope stage.
2. Select the desired objective and set the maximum camera resolution.
3. Get a contrast image of the scale on the monitor screen and capture the image.
4. Select the "Calibrate" function in the software you are using.
5. Double-click on the maximum visible distance and enter the value in actual units.
6. Enter the calibration setting and check the result. The program will save the calibration factor.
7. You can select any measurement unit later, and all the results will be re-calculated in accordance with this selection.

7 TROUBLESHOOTING

Potential problems and remedies (Table 4):

Problem	Cause	Remedy
	ELECTRICAL COMPONENTS	
No illumination in the field of view	The ON/OFF switch is off	Switch on the ON/OFF switch
	The fuse has blown	Replace the fuse
	The circuit board connector has poor contact	Have the connector repaired by a qualified electronics technician
	OPTICS AND IMAGE REPRODUCTION	
Darkened edges of the view field and uneven illumination of the field of view	The revolving nosepiece is not clicked in the observation position (the objective is not in the optical path)	Rotate the revolving nosepiece into the fixed position, i.e. position the objective into the optical path
	The condenser is incorrectly positioned – lowered too far or skewed	Adjust the condenser – set up Köhler illumination
	The diaphragm is not properly centered or closed too much for this objective	Center the diaphragm. Open the diaphragm to illuminate the entire field of view
	There is dirt or oil on the objective, eyepiece, or condenser surfaces	Remove dust using a special puffer or brush. Clean the lens surfaces with a tissue moistened with O-xylene
Dust is visible in the field of view	There is dust on the eyepiece lens	Remove dust using a special puffer or brush
Fluorescence is not observed	The wrong fluorescence filter has been selected	Select the filter to match the selected fluorescent dye
The focal plane of the image is tilted (brighter on one side and darker on the other)	The specimen does not lie flat on the stage	Place the specimen flat on the stage, securing it with the specimen holder
Poor image quality (low resolution, poor contrast)	The objective is damaged	Have the objective repaired by a qualified technician or replaced
	Inappropriate coverslip thickness	Use the specimen with the coverslip of standard thickness (0.17mm)
	The specimen is mounted upside down	Place the specimen with the coverslip facing up
	There is immersion oil on the front lens of the dry objective (most often 40x). Immersion oil has dried on the front lens of the 100x objective	Remove immersion oil from the front lens surfaces with a tissue moistened with O-xylene
	Immersion oil is not applied with the 100x objective	Apply immersion oil
	Immersion oil contains bubbles	Remove immersion oil from the objective, condenser, specimen, slide and re-apply
	Inappropriate immersion oil is used	Replace the oil
	The aperture diaphragm is opened too wide	Adjust the opening to match the numerical aperture of the objective used
	The objective is not correctly engaged in the optical path	Rotate the revolving nosepiece until it clicks into place correctly

MECHANICAL COMPONENTS		
The image does not remain sharp during observation	The coarse focusing tension adjusting knob is loosened, causing the stage to lower spontaneously	Adjust the coarse focusing tension adjusting knob
The coarse focusing knob is too tight to rotate	The coarse tension adjusting knob is overtightened	Loosen the tension of the coarse focusing knob
When switching from the low magnification objective to the high magnification objective, the objective touches the slide	The specimen slide is mounted upside down	Mount the slide with the specimen (coverslip) facing up
	The coverslip is too thick	Use the coverslip of the standard thickness
The specimen image when viewed with two eyes in two eyepieces does not coincide	The eyepiece tubes of the binocular head are not adjusted to the observer's interpupillary distance	Adjust the microscope head

8 SCOPE OF DELIVERY

The scope of delivery (Table 5):

Component	Pcs	Note
MICROSCOPE		
MAIN COMPONENTS		
Stand (with the transmitted light illuminator, power source and focusing mechanism built into the base)	1	
Reflected light illuminator	1	
Lamphouse with LEDs	1	
ICO Infinitive trinocular microscope head	1	
Revolving nosepiece	1	Mounted on the stand
Stage	1	Mounted on the stand
REPLACEABLE PARTS		
Centerable Abbe condenser	1	
A 0.9 darkfield condenser	1	Optional
A 1.36–1.25 oil darkfield condenser	1	Optional
Darkfield slider	1	Optional
Phase-contrast device	1	Optional
Polarizer/analyzer set	1	Optional
4X/0.10 plan achromatic objective ∞/–	1	
10x/0.25 plan achromatic objective ∞/–	1	
10x/0.35 plan achromatic objective ∞/–	1	Optional
20x/0.40 plan achromatic objective ∞/0,17	1	Optional
40x/0.85 plan achromatic objective ∞/0.17 (spring loaded)	1	
60X/0.80 plan achromatic objective ∞/0.17 (spring loaded)	1	Optional
100x/1.25 plan achromatic objective (oil) ∞/0.17 (spring loaded)	1	
10x/22mm eyepiece	2	
10x/22mm eyepiece with a scale	1	Optional
12.5x/14mm eyepiece	2	Optional
15x/15mm eyepiece	2	Optional
20x/12mm eyepiece	2	Optional
25x/9mm eyepiece	2	Optional
Eyecup	2	

UV protective glass (shield)	1	
Filter slider	1	In the reflected light illuminator
Black protective plate for under-stage installation	1	
C-mount camera adapter	1	
Monitor	1	Optional
Calibration slide	1	Optional
ACCESSORIES AND SPARE PARTS		
Allen head screw for the reflected light illuminator	1	Installed in the stand socket
Head locking screw	1	Installed in the illuminator socket
Lamphouse locking screw	1	Installed in the illuminator adapter socket
UV shield locking thumbscrew	2	Installed in the illuminator socket
Allen wrench or screwdriver	2	
Dust cover (of various designs)	6	Supplied
Transmitted light source – LED	1	In the microscope stand
Fluorescence light source – B LED	1	In the reflected light illuminator
Fluorescence light source – G LED	1	In the reflected light illuminator
Fluorescence light source – V LED	1	In the reflected light illuminator
Fluorescence light source – UV LED	1	In the reflected light illuminator
Color filter set for transmitted illumination	1	
3A/250V Fuse	1	Installed in the illumination system
Bottle of immersion oil	1	
Power cord of the microscope	1	
Reflected light illuminator power cord	1	Mounted on the LED lamphouse
Dust cover	1	
User manual	1	
DIGITAL CAMERA		
Digital camera	1	
USB cable	1	
Flash drive with drivers and software	1	
User manual	1	

9 CARE AND MAINTENANCE

REPLACING THE FUSE

Before replacing the fuse, turn the ON/OFF switch to "0" position (OFF). Unplug the power cord from the AC outlet and remove it from the connector on the back panel of the stand. The fuse holder is located on the back panel of the stand above the AC power input. Using a flathead screwdriver, hook and remove the fuse block from the fuse holder. Replace the blown fuse with a new one. Return the fuse block to the holder. Plug the power cord into the connector and an AC outlet, turn on the ON/OFF switch to check the fuse for proper operation.

For convenience, there is a slot for a spare fuse at the base of the fuse block. Once you have used the spare fuse from the block, we recommend placing a new fuse in the slot. This will save time for searching a new fuse when the fuse is blown during operation.

REPLACING THE BULB

This microscope employs LED bulbs as a light source.

The bulbs should be replaced by the equipment vendor or in a qualified service center. If you replace the LED yourself, the illumination function may be impaired.

MAINTENANCE

1. Once you have finished using the microscope, switch off the power supply. When not using the microscope for a long time, switch off the power supply.
2. The microscope should be kept clean. Do not install the dust cover unless the microscope is completely cooled down and dry.
3. Cleaning lenses:
   Remove dust from the lenses with a soft brush. Significant contamination can be removed using a soft cloth moistened with a small amount of a mixture of alcohol and ethyl ether (mixture proportion: 20–30% alcohol and 70–80% ethyl ether) or special O-xylene solution. Wipe the lenses from the center outward.

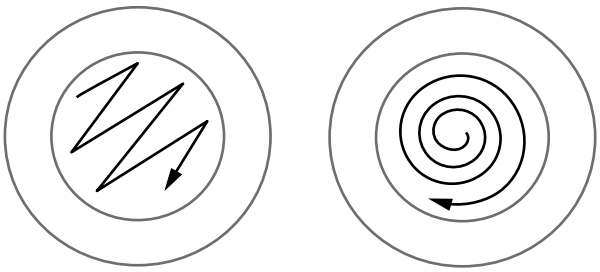


Fig. 19. Cleaning lenses

4. Cleaning the surfaces: wipe with a clean soft cloth; significant contamination can be wiped off with a neutral detergent.

   Do not wipe the microscope stand with any organic solvent (e.g., alcohol, ethyl ether or its diluted solution). This may cause damage to the coating of the microscope stand surface.
5. Cleaning the camera: blow off dust and small particles or brush them off with a soft brush, then clean the surface with a soft, clean cloth moistened with alcohol or ether.
6. Storage: when not using the microscope for a long time, switch off the power, wait for the lamp to cool down, cover the microscope with a dust cover. Store the microscope in a dry, ventilated and clean place, with no exposure to acids, alkalis, or steam, otherwise mold may form on the lenses.

   It is recommended to apply a layer of rust-preventive coating to the moving parts of the microscope.
7. Periodic inspection: the microscope should be regularly inspected and serviced to maintain its performance.

10 MAGUS WARRANTY

MAGUS provides a **5-year international warranty** from date of purchase (valid for the entire life of the instrument). The Levenhuk company warrants the product to be free from defects in materials and workmanship. The Seller warrants that the MAGUS product you have purchased meets specification requirements, provided that the Buyer complies with terms and conditions of transport, storage, and operation of the product. The warranty period for accessories is **6 (six) months** from the date of purchase.

For more information on warranty terms and conditions, see www.magusmicro.com

For warranty service, please contact your nearest Levenhuk representative office.

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