# MAGUS POL 850
# POLARIZING 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

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 touch the lens surfaces with your fingers. Use a brush and special lens-cleaning solution to keep the lenses clean.

11. Bulb installation:

— Do not touch the glass surface of the bulb with your bare hands. When installing the bulb, wear gloves or wrap the bulb with a cotton cloth.

— Use a clean cotton cloth moistened with alcohol-based disinfectant to wipe dirt off the surface of the bulb. Dirt may etch the surface of a bulb, thereby reducing its brightness and shortening its life.

— Check the bulb contact condition. If contact damage occurs, the bulb may stop working or cause a short circuit.

— When replacing the bulb, its base should be inserted as deeply as possible into the socket. If the bulb is not correctly inserted, it may pop out of the socket or cause a short circuit.

# CONTENTS

MAGUS Pol 850 Polarizing 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

## PURPOSE

The microscope is designed to study objects in transmitted and reflected light using the brightfield and polarization techniques.

Orthoscopic and conoscopic observations are available.

In the transmitted light, you can study geological specimens as well as anisotropic biological and polymeric specimens in thin sections.

In the reflected light, you can study polished sections with one polished side. The thickness of the polished sections is arbitrary, typically 5–10mm. The microscope allows for the examination of opaque objects up to 15mm thick.

The polarizing microscope uses the birefringence of an anisotropic specimen to deliver an image. Plane-polarized light, when passing through an anisotropic specimen, splits into two beams and changes the plane of polarization. The analyzer brings the vibrations of the beams into the same plane, thereby causing interference. The bright, high-contrast image changes color when the stage rotates.

Plan achromatic objectives are strain-free. The intermediate attachment houses an analyzer, a Bertrand lens, and a slot for compensators.

The microscope is used in crystallography, petrography, mineralogy, forensics, medicine, and other fields of science.

## SPECIFICATIONS (TABLE 1)

| | |
|---|---|
| Magnification, x | 50–600 (25–1000/1600/2000)** |
| Tube length | Infinity (∞) |
| Microscope head | Trinocular (Siedentopf type)<br>Eyepiece diameter: 23.2mm<br>30° inclined<br>Interpupillary distance: 48–75mm<br>Diopter adjustment (left barrel): ±5dp |
| Eyepieces, magnification, x/field, mm | 10x/20; 10x/20 with a reticle<br>10x/20 with a scale*; 16x/11*; 20x/11* |
| Revolving nosepiece | 5 objectives with four centerable slots |
| Optical design | Infinity plan achromatic objectives (∞), strain-free; parfocal distance: 45mm; may be used with specimens with no coverslip |
| Objectives magnification, x/aperture/ working distance, mm | PL L 5x/0.12/26.1<br>PL L 10x/0.25/5.0<br>PL L 40x/0.6/3.9<br>PL L 60x/0.7/2.0<br>PL L 2.5x/0.07/11.0*<br>PL L 50x/0.7/3.7*<br>PL L 80x/0.8/1.2*<br>PL L 100x/0.85/0.4* |
| Stage | Round stage, Ø150mm, 360° rotatable, centerable<br>1° graduation of the rotation angle<br>With the vernier scale, measurements are made with an accuracy of 0.1° |

| | |
|---|---|
| Focusing mechanism | Coaxial coarse & fine focusing knobs on both sides<br>Fine focusing scale value: 2μm<br>Coarse focusing tension adjusting knob<br>Coarse focusing lock knob |
| Illumination method | Transmitted and reflected light |
| Transmitted light illumination | Built-in field diaphragm, centerable, height-adjustable Abbe condenser with NA 1.25, with an adjustable aperture diaphragm and a flip-down lens |
| Transmitted light polarizer | 0°, 90°, 180°, 270° marks on the scale, 360° rotatable |
| Transmitted light source | 12V/30W halogen bulb, brightness-adjustable |
| Reflected light illumination | Built-in field and aperture diaphragms. Removable polarizer<br>Color filters: yellow, blue, light blue, and frosted glass |
| Reflected light source | 12V/30W halogen bulb, brightness-adjustable |
| Compensator | λ compensator, λ/4 compensator, quartz wedge |
| Power supply, V/Hz | AC power supply 220±22/50 |
| Operating temperature range | +5... +35 °C |
| Operating humidity range | 20... 80% |
| Dimensions without package (WxHxD), mm | 201×545×457 |
| Package dimensions (WxHxD), mm | 271×630×431 |
| Weight | 14.0 |
| Weight with package | 16.5 |

*** 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 source, transmitted light source, focusing mechanism, stage, and revolving nosepiece
— reflected light illuminator with a lamphouse
— trinocular head
— intermediate tube with a Bertrand lens
— compensators
— condenser with a transmitted light polarizer
— set of objectives and eyepieces
— set of spare parts and accessories
— packaging
— user manual.

See Section 7 of the User manual for a full kit contents.
The general view of the microscope is given in Fig. 1 and 2.

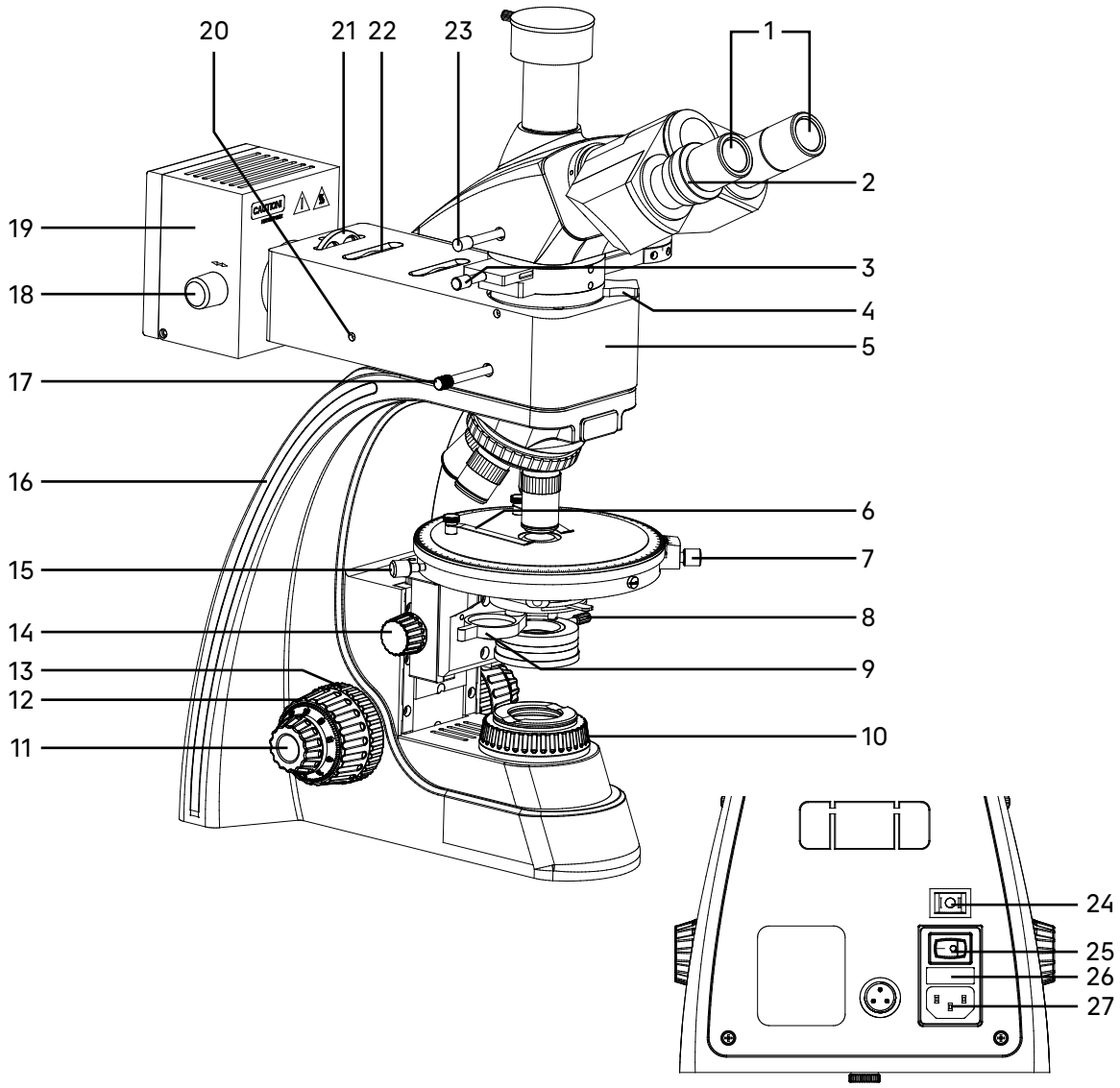



Fig. 1. MAGUS Pol 850 Microscope. View from the left

1. Eyepieces
2. Diopter adjustment
3. Bertrand lens
4. Compensator
5. Reflected light illuminator
6. Spring clips
7. Stage angle locking screw
8. Condenser with aperture diaphragm
9. Flip-down top condenser lens
10. Collector
11. Fine focusing knob
12. Coarse focusing knob
13. Coarse focusing lock knob
14. Condenser focus knob
15. Stage centering screw
16. Stand
17. Transmitted/reflected light illuminator lever
18. Lamp focusing knob
19. Lamphouse
20. Field diaphragm centering screw
21. Color filter
22. Aperture diaphragm
23. Beam splitter lever
24. Transmitted/reflected light illuminator switch
25. ON/OFF switch
26. Fuse holder
27. Power connector

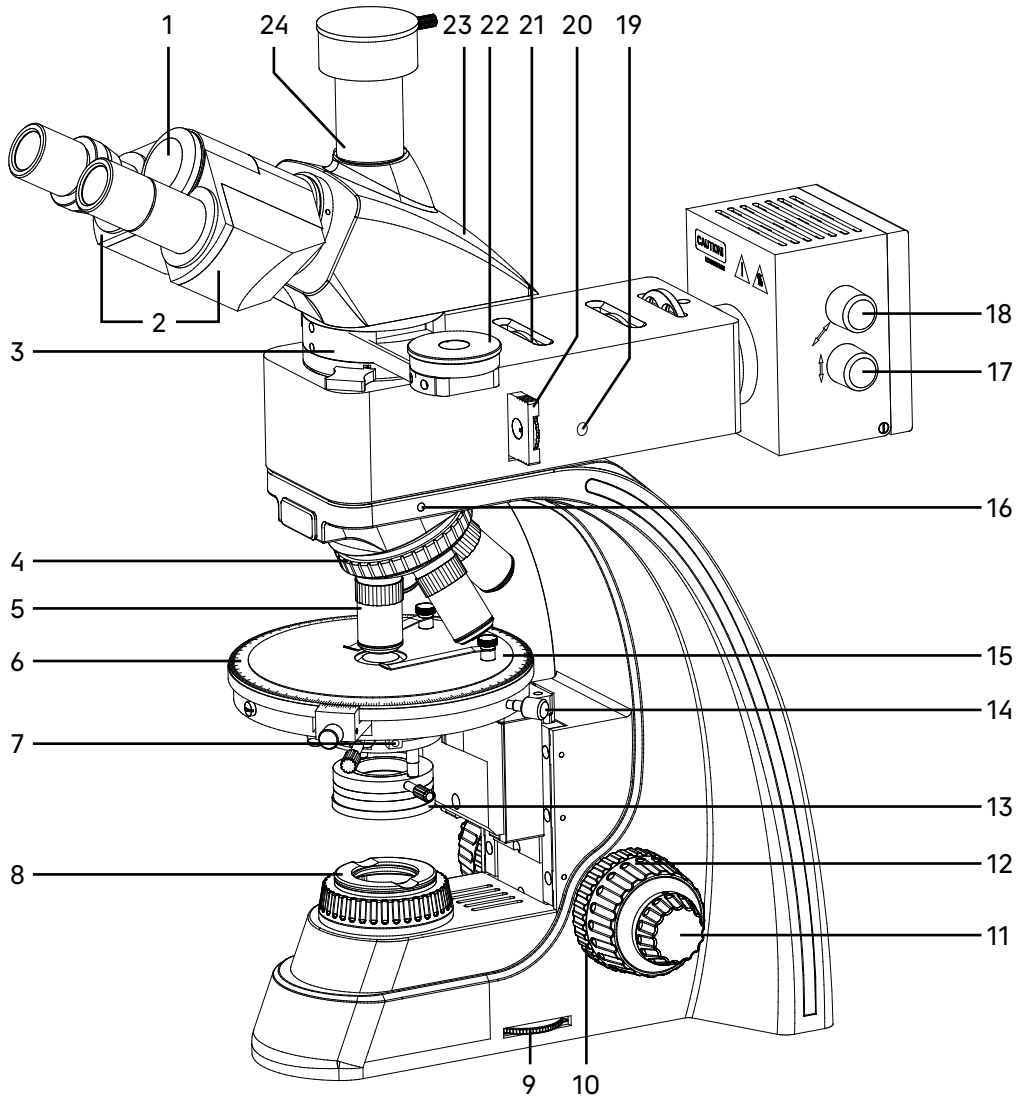



Fig. 2. MAGUS Pol 850 Microscope. View from the right

1. Interpupillary distance adjustment scale
2. Eyepiece tubes
3. Intermediate attachment
4. Revolving nosepiece
5. Objectives
6. Stage rotation scale
7. Condenser centering screw
8. Color filter holder
9. Brightness adjustment ring
10. Coarse focusing tension adjusting knob
11. Fine focusing knob
12. Coarse focusing knob
13. Transmitted light polarizer
14. Stage centering screw
15. Stage
16. Locking screw of the reflected light illuminator
17. Up/down lamp adjustment knob
18. Left/right lamp adjustment knob
19. Field diaphragm centering screw
20. Reflected light polarizer
21. Field diaphragm
22. Analyzer
23. Microscope head
24. Trinocular tube

# 2 COMPONENTS

## STAND

The stand 16 (Fig. 1) has stable ergonomic design.

Parts attached to the stand:

— revolving nosepiece 4 (Fig. 2) with objectives 5 (Fig. 2)
— stage 15 (Fig. 2)
— condenser mount (not shown in Fig. 1 and 2)
— collector 10 (Fig. 1).

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 required voltage to power the halogen bulb.

The back panel of the microscope stand contains an ON/OFF switch 25 (Fig. 1), transmitted/reflected light illuminator switch 24 (Fig. 1), fuse holder 26 (Fig. 1), and a connector for the AC power cord 27 (Fig. 1), which connects the microscope to an AC outlet.

There is a brightness adjustment ring 9 (Fig. 2) on the right of the stand.

## 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. Coarse focusing is performed by rotating the coaxial knobs 12 (Fig. 1, 2) on both sides of the microscope stand.

Fine focusing is performed by rotating the knobs 11 (Fig. 1, 2) on both sides of the microscope stand. Fine focusing allows for more precise focusing on the specimen and re-focusing the microscope to get an accurate image resolution when changing objectives and specimens. Fine focusing scale value: 2µm.

The coarse focusing tension adjustment is performed by the ring 10 (Fig. 2) 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 revolving nosepiece with objectives does not lower spontaneously during operation.

The coarse focusing lock knob 13 (Fig. 1) 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.

**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 trinocular head 23 (Fig. 2) provides the visual observation of the specimen image. The microscope head is installed in the slot of the intermediate attachment.

The interpupillary distance is adjusted by rotating the eyepiece tubes in the range of 48–75mm. The distance between the eyepieces matching the observer's interpupillary distance is marked on the adjustment scale 1 on the microscope head (Fig. 2).

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

Eyepiece diameter: 23.2mm.

There is a diopter adjustment on one of the tubes to compensate for the observer's ametropia.

An imaging system with a monitor is installed in the trinocular tube 24 (Fig. 2) using a C-mount adapter. You can switch the light path to the trinocular tube using the lever 23 (Fig. 1). The lever has two positions: 100/0 and 0/100.

## EYEPIECES

The microscope kit includes eyepieces 1 (Fig. 1) and an eyepiece with crosshairs. The eyepieces have long eye relief and are designed to work with or without glasses.

Eyepiece diameter: 23.2mm.

Eyepiece magnification: 10x. Field of view: 20mm.

The 10x eyepiece with a scale, 16x/11 and 20x/11 eyepieces are not included in the kit and are optional.

## REVOLVING NOSEPIECE

The revolving nosepiece 4 (Fig. 2) allows for the installation of five objectives. The free slot is used to adjust the bulb position in the reflected light illuminator and install an additional objective. 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. Otherwise, the centering of the slots will be affected. 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. The objectives are turned "away from the observer".

Four out of five slots of the revolving nosepiece are centered to align the optical axis of the objective and microscope. Thus, as the revolving nosepiece rotates, the section of the object that was in the center of the field of view on one objective remains in the center of the field of view on the other objectives. The 10x objective is screwed into the non-centerable slot of the revolving nosepiece, so that the other slots are aligned with that slot.

## OBJECTIVES

The objectives are designed specifically for polarized light observations: the strain-free optics ensure that the birefringence comes from the specimen and not from the optical components. Parfocal distance: 45mm, linear field of view: 20mm. The objectives have long focal length and are designed for the infinity-corrected tube length.

Each objective has the following inscriptions: "PL L" 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 specifications of the objectives (Table 2):

| Objective identification | Microscopy technique | Magnification | Numerical aperture | Working distance, mm | Color marking |
|---|---|---|---|---|---|
| PL L 2.5x/0.07 | Brightfield / Polarized light | 2.5 | 0.07 | 11.0 | Red |
| PL L 5x/0.12 | Brightfield / Polarized light | 5x | 0.12 | 26.1 | Red |
| PL L 10x/0.25 | Brightfield / Polarized light | 10x | 0.25 | 5.0 | Yellow |
| PL L 40x/0.6 | Brightfield / Polarized light | 40x | 0.60 | 3.9 | Light blue |
| PL L 50x/0.7 | Brightfield / Polarized light | 50x | 0.70 | 3.7 | Light blue |
| PL L 60x/0.7 | Brightfield / Polarized light | 60x | 0.70 | 2.0 | Blue |
| PL L 80x/0.8 | Brightfield / Polarized light | 80x | 0.80 | 1.2 | Blue |
| PL L 100x/0.85 | Brightfield / Polarized light | 100x | 0.85 | 0.4 | White |

**If objectives are damaged, we recommend repairing them in the service center.**

**The objectives are intended to image the specimens through air. Do not use immersion oil.**

## REFLECTED LIGHT ILLUMINATION

The reflected light illuminator is shown in Fig. 3.

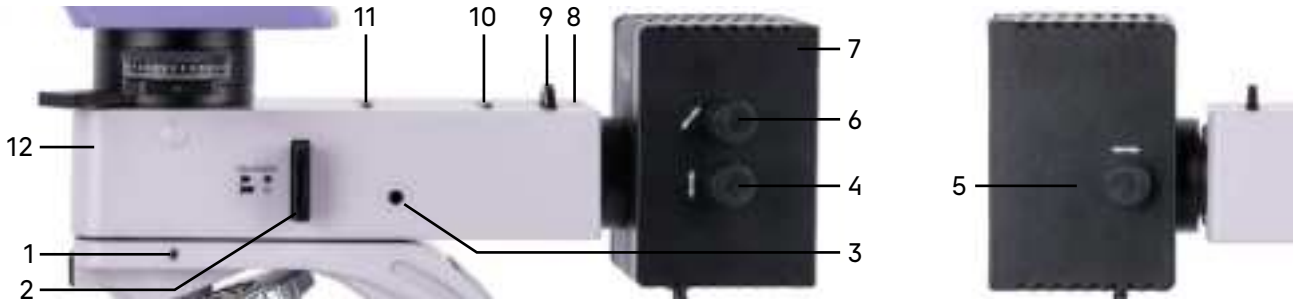



Fig. 3. Reflected light illumination system

1. Illuminator locking screw
2. Polarizer
3. Field diaphragm centering slot
4. Up/down lamp adjustment knob
5. Lamp focusing knob
6. Left/right lamp adjustment knob
7. Reflected light lamphouse
8. Lamphouse locking screw
9. Color filters
10. Aperture diaphragm ring
11. Field diaphragm ring
12. Reflected light illuminator body

**Illuminator**

The reflected light illuminator 12 (Fig. 3) is installed in the slot of the microscope stand and secured with the screw 1 (Fig. 3) using an Allen wrench. The lamphouse 7 (Fig. 3) with the lamp is fixed on the illuminator body with the screw 8 (Fig. 3).

There is a transmitted/reflected light switch lever 17 (Fig. 1) on the illuminator body. The "R" position corresponds to the reflected light observations, and the "T" position is for the transmitted light observations.

There is a polarizer, a field and an aperture iris diaphragms installed inside the illuminator.

The polarizer 2 (Fig. 3) in the illuminator is introduced into the optical path. The plane of polarization is changed by rotating the ring on the polarizer.

By rotating the rings 10 (Fig. 3) and 11 (Fig. 3), you adjust the opening of the aperture and field diaphragms based on the field of view and exit pupil of the objective being used.

The field diaphragm limits the image field in the optical system. If the diaphragm is opened too wide, details of the specimen that are not needed for illumination are illuminated. Diffraction of irregular light reflection degrades the image contrast. Too small an opening of the diaphragm causes reduction of the field of view.

When operating the microscope, you should adjust the field aperture images to the center of the field of view. The field diaphragm centering is performed by using Allen wrenches installed in the slots 3 (Fig. 3) located on both sides of the illuminator. Then the aperture size is adjusted by rotating the ring 11 (Fig. 3). We recommend opening the aperture slightly larger than the field of view.

The aperture diaphragm defines the numerical aperture of the illumination system. When the numerical aperture of the illumination system matches the aperture of the objective, the best image resolution and optimal contrast are achieved. If the aperture diaphragm is opened too wide, it may result in poor image resolution and low contrast. Improper use of the aperture diaphragm is the main cause of color distortion.

To adjust the aperture diaphragm, remove one of the eyepiece tubes, cover the tube opening with a piece of paper, and use a needle to make a small hole in the center. When looking through the hole, you can see the image of the aperture diaphragm (polygon) and the image of the objective exit pupil (circle). Closing the diaphragm to 1/3 (1/4) of the exit pupil will be the best to achieve the highest image quality. This does not reduce the resolving power of the objective and increases contrast. If an aperture diaphragm has a larger opening, the image contrast is significantly reduced. Conversely, if the aperture opening is too small, the contrast of the image will increase, but the lines will become too thick, the resolution will drop, and color distortion (achromatic aberrations) will appear.

The aperture and field diaphragms of the microscope illuminator combined in an optical system are intended to enhance the quality of the object image. Diaphragm settings should be based on the optical properties of the objective and desired contrast.

The aperture and field diaphragms should not be considered as a tool to adjust the image brightness. The brightness should be adjusted by changing the light intensity using the knob 9 (Fig. 2) for adjusting the halogen bulb brightness.

**Lamphouse**

The lamphouse 7 (Fig. 3) is secured to the illuminator with the screw 8 (Fig. 3).

Inside the light-protective housing of the lamphouse there is a lamp holder 1 (Fig. 4). The lamphouse cover 2 (Fig. 4) is secured to the lamphouse body using a screw 3 (Fig. 4).

Knobs 4 (Fig. 3) and 6 (Fig. 3) are used for centering the lamp in horizontal and vertical directions.

The filament image is focused into the plane of the aperture diaphragm by moving the collector with the knob 5 (Fig. 3).

The lamphouse has a power cable 4 (Fig. 4) that is not removable. The bulb is powered from the AC power supply through a power source built into the microscope base.

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

**The lamphouse warms up during operation. To avoid fire, it is forbidden to cover the lamphouse, to place laboratory glassware, examined samples and other objects on its surface.**


Fig. 4. Lamphouse

**Color filters**

Color filters may be applied as necessary. The ring with color filters 9 (Fig. 3) is installed on the top of the reflected light illuminator.

## INTERMEDIATE ATTACHMENT

The intermediate attachment is installed in the mounting hole on top of the reflected light illuminator and secured with a screw using an Allen wrench.

There is an analyzer, a slot for compensators and a Bertrand lens in the intermediate attachment.

The general view of the intermediate attachment is given in Fig. 5.


Fig. 5. Intermediate attachment

1. Bertrand lens lever
2. Slot for compensators
3. Compensator
4. System with an analyzer
5. Analyzer vernier scale
6. Analyzer rotation disk with a scale
7. Bertrand lens

The analyzer 4 (Fig. 5) is introduced into the optical path until it is fixed and removed by moving it to the rightmost position.

The analyzer is rotated by the ring 6 (Fig. 5).

Rotation angles in the range of 0–360° are measured on the scale on the disk 6 (Fig. 5) with a graduation value of 1° and vernier scale 5 (Fig. 5) with a graduation value of 0.1°.

The slot 2 (Fig. 5) located at the angle of 45° to the direction of polarized light vibrations is used for mounting the compensators 3 (Fig. 5) in frames.

Compensators are used to achieve greater contrast when objectives with weaker birefringence are used. λ and λ/4 slides are inserted into the slot as far as they will go.

The lever 1 (Fig. 5) introduces and removes the Bertrand lens from the optical path. The Bertrand lens is used for conoscopic studies of minerals, i.e. the study of the optical effect that occurs when a beam of convergent light passes through a crystal.

The conoscopic figure does not produce an image of the mineral itself, but reproduces the resulting interference effects. The interference pattern has various shapes and properties based on the optical properties of the mineral and indicatrix section. Under convergent light, the number of axes, optical sign, and the relative value of the angle between the optical axes for biaxial minerals may be determined.

**Compensators**

Compensators are designed for various crystallographic studies.

Compensators are installed in the slot 2 (Fig. 5) of the intermediate attachment. λ and λ/4 slides are inserted as far as they will go. The compensator frame has the following inscriptions: "Y", which is the direction of one of the main crystallographic axes, and λ/4, λ, which is the value of the path difference. The thickness of the 1-4λ compensation wedge increases towards the handle.

Fig. 6. Compensators

**A quarter-wave plate (λ/4)** introduces a relative phase shift of 90° between the orthogonal wavefronts (ordinary and exceptional) when linearly polarized light passes through. It converts linearly polarized light into elliptical or circularly polarized light. The λ/4 plate is used to enhance the contrast of objects with weak birefringence, to determine the birefringence sign in conoscopy, to allow for the quality analysis of conoscopic and orthoscopic images, and to evaluate optical path differences in birefringent samples.

**A first order full-wave plate (λ)** introduces a phase shift of 90° into the green wavelength of light, which is then blocked by the analyzer, leaving the linear polarization of the other light wavelengths unchanged. It is used for quantitative analysis in conoscopic and orthoscopic polarization microscopy, for determining the optical sign of a positive or negative birefringent sample, for determining the thickness of the object and the birefringence of crystalline and polymeric materials, for enhancement of contrast of the objects with weak birefringence, e.g. biological objects, such as cell membranes, starch, microtubes, etc.

**A quartz wedge (1-4λ)** introduces a phase shift, which changes smoothly depending on the thickness of the quartz plate at the particular location of the wedge. It is used for semi-quantitative simple analysis, for qualitative analysis of minerals, for determining the optical sign of a birefringent sample when higher order interference colors are present, for determining the direction of anisotropy in birefringent samples, and for examining fibers.

## TRANSMITTED LIGHT ILLUMINATION

The transmitted light illumination system is given in Fig. 7.

1. Condenser locking screw
2. Flip-down lens of the condenser
3. Collector
4. Transmitted light polarizer
5. Locking screw of the transmitted light polarizer
6. Aperture diaphragm lever
7. Condenser with aperture diaphragm
8. Condenser mount
9. Condenser centering screws


Fig. 7. Transmitted light illumination

The screw 1 (Fig. 7) is used to secure the condenser in the mount.

The adjustable field diaphragm, centerable and height-adjustable Abbe condenser with an adjustable aperture diaphragm 6 (Fig. 7) and a flip-down lens of the condenser 2 (Fig. 7) allow for setting up Köhler illumination. The aperture diaphragm of the condenser is controlled by the lever 6 (Fig. 7). The centering screws 9 (Fig. 7) are used for condenser centering. The flip-down lens of the condenser is introduced into the optical path when low-magnification objectives are used (less than 10x) to illuminate the entire field of view.

Below the aperture diaphragm of the condenser in the holder there is a transmitted light polarizer in a frame 4 (Fig. 7). The polarizer is secured with the screw 5 (Fig. 5). The polarizer can be rotated 360° by the knurled ring of the frame. Four rotation angles relative to the analyzer are inscribed on the polarizer scale: 0°, 90°, 180°, 270°.

The transmitted light source is a 30W halogen bulb.

## STAGE

The stage is shown in Fig. 8.

1. Stage rotatable disk
2. Stage rotation scale
3. Stage
4. Stage angle locking screw
5. Vernier scale
6. Stage centering screws
7. Spring clips


Fig. 8. Round stage

The stage 3 (Fig. 8) is equipped with a rotatable disk 1 (Fig. 8). Rotation angles in the range of 0–360° are measured on the scale on the disk 2 (Fig. 8) with a graduation value of 1° and vernier scale 5 (Fig. 8) with a graduation value of 0.1°.

The position of the rotatable disk is fixed with the screw 4 (Fig. 8). The stage diameter is 150mm.

Analysis of an anisotropic object requires precise alignment of the stage rotation axis with the optical axis of the microscope. The stage design provides for centering by two screws 6 (Fig. 8).

# 3 UNPACKING AND ASSEMBLING

1. Unpack the microscope and check the scope of delivery using Section 7 of the User Manual.
2. Take out the stand and place it on a stable work table, remove packaging and dust cover.
3. Take out the reflected light illuminator. Install the illuminator on the microscope stand and secure it with an Allen wrench.
4. Remove the trinocular microscope head and intermediate attachment with a Bertrand lens, analyzer, and a compensator. Insert the intermediate attachment into the mounting slot of the illuminator and secure it with a screw using an Allen wrench. Mount the trinocular head on the intermediate attachment and fix it.
5. Take out the eyepieces and insert them into the eyepiece tubes. Rotate the eyepieces, making sure they are tightly seated in the tubes.
6. Attach the lamphouse to the connection adapter on the reflected light illuminator and secure it with the screw. Connect the power cable to the microscope.
7. Insert the objectives into the sockets of the revolving nosepiece in increasing order of magnification. The 10x objective is screwed into the slot with no centering.
8. Install the condenser with an aperture diaphragm and a transmitted light polarizer into the condenser mount and secure it with a screw.
9. Install the reflected light polarizer in the illuminator.
10. Make sure that all the components are securely and safely mounted.
11. Check and sort the supplied accessories and tools in the correct order. Keep them in proper order to avoid confusion.
12. Keep the packaging should you need to transport the microscope.

# 4 BRIGHTFIELD OBSERVATION PROCEDURE

## 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.

Turn the ON/OFF switch **2** to "–" position. Set the switch **1** to "I" position which corresponds to the transmitted light observations. Adjust the brightness using the ring **3** so that the light brightness is 70% of full power.

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.

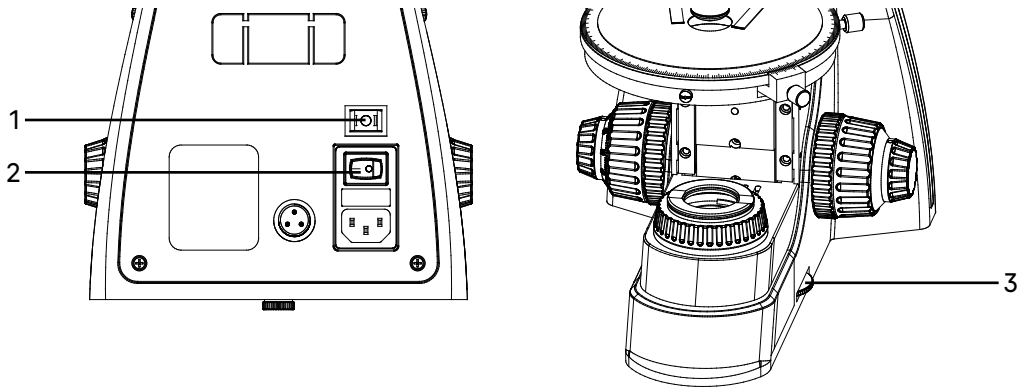



Fig. 9. Switching on the illumination and adjusting the brightness

## PLACING THE SPECIMEN

Place the specimen on the stage and secure it with the spring clips.

The stage is 360° rotatable. Its diameter is 150mm.

Before polarized light observations, you should align the optical path of the objectives with the center of the rotary stage.

## FOCUSING ON THE SPECIMEN

Focusing on the specimen is achieved by coarse and fine focusing knobs.

Perform the focusing using the 10x objective.

Rotate the revolving nosepiece to place the 10x objective in the optical path. The revolving nosepiece is rotated until locked.

Rotate the coarse focusing knob **1** to raise the stage all the way up. Looking into the eyepiece and slowly rotating the focusing knob, lower the stage. When you see the specimen image in the field of view, stop rotating the coarse focusing knob.

Rotate the fine focusing knob **2** to focus on the specimen and get a crisp image.

Fix the coarse focusing lock knob **3** by rotating it clockwise as far as it will go.

When using high-magnification objectives, raise the stage all the way up by rotating the coarse focusing knob and enable the coarse focusing lock knob. After that, focus on the specimen using the fine focusing knob.

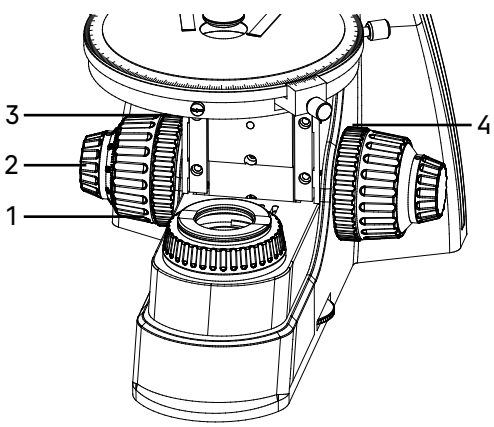



Fig. 10. Focusing on the specimen

Adjust the coarse focusing tension.

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, rotate the coarse focusing tension adjusting knob **4**. By rotating it clockwise, you tighten the tension, and by rotating it counter-clockwise, you loosen it.

## ADJUSTING THE EYEPIECE TUBES

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.

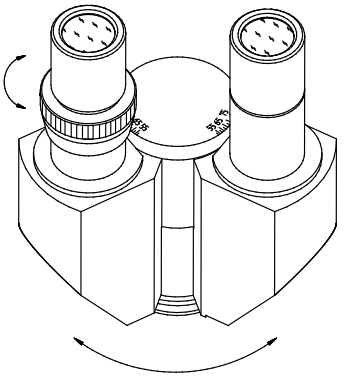
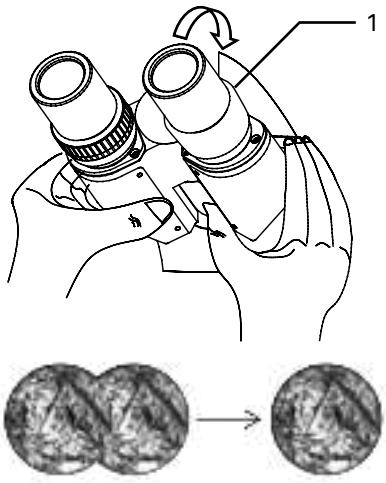


Fig. 11. Adjusting the diopter adjustment mechanism




Adjust the interpupillary distance. Adjust the distance between the eyepieces to your interpupillary distance by rotating the eyepiece tubes **1** around the central axis until you see a single circular image when looking through the eyepieces with both eyes (Fig. 12 a, b).

Fig. 12. Adjusting the interpupillary distance

## SETTING UP KÖHLER ILLUMINATION IN TRANSMITTED LIGHT

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:**

— Make sure that the microscope power supply is on, reflected/transmitted light illuminator switch is in the "I" position, and the reflected/transmitted light lever is in the "T" position.

— Remove the analyzer 22 (Fig. 2) and Bertrand lens 3 (Fig. 1) from the optical path by moving them to the rightmost position.

— Install the eyepiece with crosshairs into the eyepiece tube 2 (Fig. 2).

— Place the 10x objective into the optical path.

— Open the field diaphragm **1** and aperture diaphragm **4** by the knob **5**. Raise the condenser all the way up by the knob **2**.

— While looking through the eyepieces, reduce the opening of the field **1** and aperture diaphragms so that only the center of the field of view is illuminated.

— The condenser has been pre-centered by the manufacturer. If re-centering is required, bring the image of the light spot to the center of the eyepiece field of view using the centering screws **3**. Use a universal Allen wrench to do this.

— Rotate the knob **2** to carefully move the condenser up and down and place the condenser to the operating position. In the operating position of the condenser, 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.

— Increase the opening of the field diaphragm **1** until it just disappears outside of the field of view.

— Remove the eyepiece from the tube and, while observing the objective exit pupil, increase the opening of 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.

— The objective exit pupil can be also observed with a Bertrand lens introduced into the optical path.

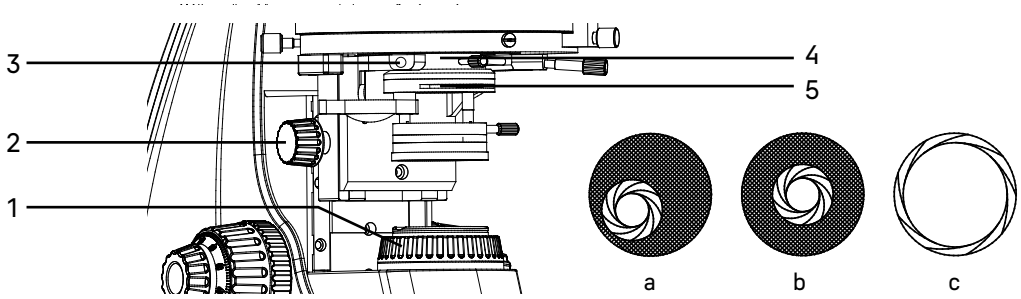



Fig. 13. Centering the condenser

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

## CENTERING THE STAGE AND OBJECTIVES

The revolving nosepiece has centerable slots. The objectives mounted in the revolver should be aligned with the axis of stage rotation. The slots of the revolving nosepiece have been pre-centered by the manufacturer, so you should not adjust them unless necessary.

To center the stage, place the specimen on the stage, bring the image into focus as described above using a 10x objective and an eyepiece with crosshairs. The 10x objective should be mounted in the fixed slot of the revolving nosepiece.

Find a point in the field of view and move the specimen on the stage to bring the point to the center of the crosshairs **5**.

Loosen the screw **3** and rotate the stage disk. If the selected detail of the specimen does not move from the center, the stage is centered.

If the selected detail of the specimen moves when the stage disk is rotated, set it as far as possible **4** from the center **5**.

Halve the distance from the center of the crosshairs to the selected object detail (center point between **4** and **5**) and move the target point to that location.

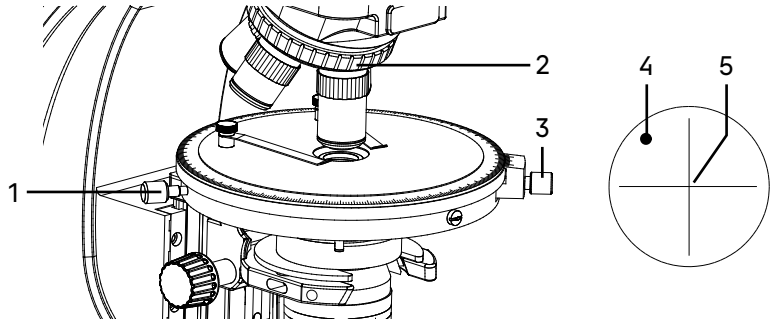



Fig. 14. Centering the stage and objectives

Use the two centering screws **3** of the stage, located on both sides, to move the target point to the center and align it with the center of the crosshairs.

Make sure that the target point remains in the center of the crosshairs when you rotate the disk. If necessary, repeat all the operations described above until the target point set in the crosshairs remains centered when the stage is rotated.

Once the stage is centered, you should center the objectives. To do this, introduce the objective mounted in the centerable slot into the optical path.

Find a target point in the observed image and bring it to the center **5**.

Rotate the stage disk. If the selected point of the specimen does not move from the center of the crosshairs, the objective is centered.

If the selected point of the specimen moves when the stage disk is rotated, set it as far as possible **4** from the center **5**.

Halve the distance from the center of the crosshairs to the selected object detail (center point between **4** and **5**) and move the target point to that location.

Rotate the screws installed in the centering slots of the revolving nosepiece **2** to move the target point to the center and align it with the center of the crosshairs. In doing so, do not touch the stage centering screws **1**.

Make sure that the target point remains in the center of the crosshairs when the disk is rotated. If necessary, repeat all the operations described above until the target point set in the crosshairs remains centered when the stage is rotated.

## TRANSMITTED LIGHT OBSERVATIONS WITH A POLARIZER

Switch on the lamp for transmitted light observations. Make sure that the transmitted/reflected light lever 17 (Fig. 1) has been moved to the "T" position. Remove the analyzer 22 (Fig. 2) from the optical path. Place the specimen on the stage and secure it with the spring clips 6 (Fig. 1). Make sure that there is an eyepiece with crosshairs in one of the tubes.

Rotate the revolving nosepiece to introduce the desired objective into the optical path. Bring the specimen into focus and check the objective centering by rotating the stage disk. If necessary, center the objective slot as described above.

Adjust the illumination as described above. When you observe shape, size and coloration of the object, there are no special requirements to the aperture of the illuminating beam.

However, the coloration of strongly absorbing objects is effectively observed with medium- and high-magnification objectives with the condenser aperture diaphragm fully closed and the light source at maximum brightness.

You should also reduce the opening of the aperture diaphragm of the condenser to minimum and set the illuminator to the maximum allowable brightness to observe the phenomena of relief, shagreen surface, Becke line, etc.

## TRANSMITTED LIGHT OBSERVATIONS WITH A POLARIZER AND AN ANALYZER

You can observe an object with the polarizer and analyzer both crossed and parallel positions of the polarizing devices.

Introduce the analyzer 22 (Fig. 2) into the optical path. Use the scale of the analyzer and polarizer to set the desired crossed or parallel position of the polarizing devices.

It is recommended to study the sample birefringence based on the observation of interference colors and determine its syngony based on the observation of the extinction character with the closed aperture diaphragm of the condenser and the maximum possible brightness of illumination.

Compensators are used to determine the optical properties of minerals with weak birefringence. Compensators are installed in the slot of the intermediate tube.

## OBSERVATION OF INTERFERENCE PATTERNS (CONOSCOPY)

The image observed by conoscopy reproduces the interference effects that occur and does not provide an image of the mineral itself. The interference pattern has various shapes and properties based on the optical properties of the mineral and the indicatrix section. Thus, under convergent light, the number of axes, optical sign, and the relative value of the angle between the optical axes (for biaxial minerals) are determined.

Interference patterns are observed using a Bertrand lens. Interference (conoscopic) patterns of the observed objects are produced in the rear focal plane of the microscope objective. The Bertrand lens projects the patterns with a single magnification onto the eyepiece focal plane. Objects in the conoscopic optical path should be observed using 40x/0.60 and 60x/0.70 high aperture objectives. To observe a conoscopic image, the microscope optics are adjusted as follows:

— place the specimen on the stage

— place the 60x objective into the optical path

— raise the condenser all the way up

— remove the analyzer from the optical path if it is in place

— remove the flip-down lens of the condenser from the optical path

— install the eyepiece with crosshairs in one of the tubes

— bring the specimen into focus to make sure that the objective slot has been centered

— place the Bertrand lens into the optical path

— reduce the opening of the aperture diaphragm to match the size of the objective exit pupil

— remove the Bertrand lens from the optical path

— while observing through the eyepiece, place the section of the object you want to observe in the center of the field of view: place the selected grain on the center of the crosshairs

— introduce the analyzer into the optical path and use the scale of the analyzer and polarizer to set the crossed position of nicols

— introduce the Bertrand lens into the optical path and observe a conoscopic image

— rotate the analyzer slightly relative to the zero position to achieve the best possible contrast in the conoscopic image.

## REFLECTED LIGHT OBSERVATIONS

The reflected light illumination system allows for Köhler illumination with adjustable field and aperture iris diaphragms.

**Set up Köhler illumination as follows:**

— Switch on the reflected light illuminator as follows: turn the switch 24 (Fig. 1) to the "II" position and the lever 17 (Fig. 1) – to the "R" position.

— Place the specimen on the stage. The specimen with no coverslip (polished section) for reflected light observations shall be a plane-parallel polished plate no more than 15mm thick. Unevenness of the examined surface with respect to the base surface is allowed within 5'.

— Introduce the objective of the required magnification into the optical path and make sure that its slot has been centered.

— Remove the analyzer 22 (Fig. 2) from the optical path if it has been introduced.

— Insert the eyepiece with crosshairs in one of the tubes of the microscope head in place of an ordinary eyepiece.

— Bring the specimen surface into sharp focus. Moving the object, bring the cleanest section into the field of view.

— Reduce the opening of the field diaphragm **2**.

— Verify the centering of the field aperture image relative to the center of the crosshairs. If necessary, center the image with two centering wrenches, having previously installed them in the sockets **7**.

— Open the field diaphragm **2** until its image fills the field of view.

— Place the Bertrand lens into the optical path.

— Open the aperture diaphragm **3** to match the size of the objective exit pupil.

— If the filament image is offset from the center, reduce the opening of the aperture diaphragm and manipulate the lateral **5** and longitudinal **6** adjustment knobs to adjust the lamp position. If the filament image is blurry, adjust the position of the collector using the knob **4**.

— Remove the Bertrand lens **1** from the optical path.

— For best image quality, the aperture diaphragm of the illuminator should be closed to approximately 1/3 of the objective exit pupil diameter, and the field diaphragm should be closed to the field of view so that that the images of the diaphragm edges are close to the edge of the microscope's field of view, not outside of the field.

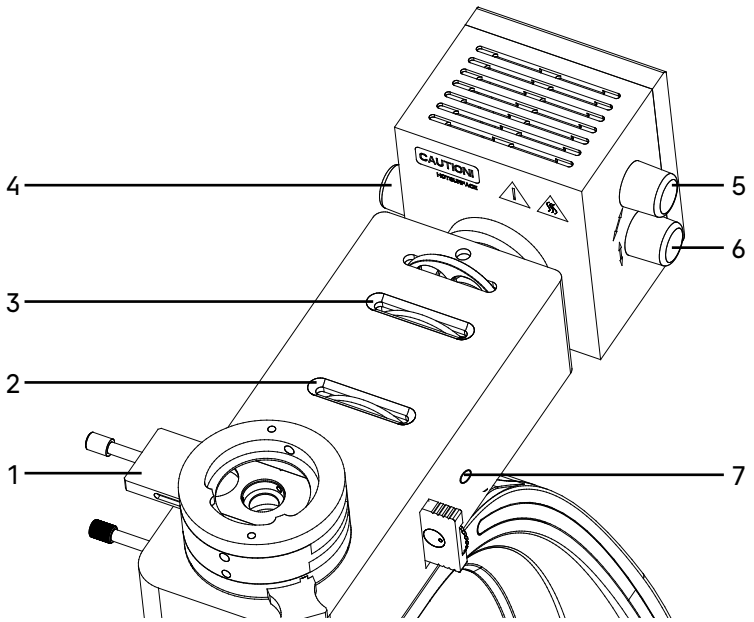



Fig. 15. Reflected light illuminator

## REFLECTED POLARIZED LIGHT OBSERVATIONS

Introduce the polarizer 13 (Fig. 1) and analyzer 22 (Fig. 2) into the optical path.

The polarization device is aligned in such a way that the setting of the analyzer on the numerical scale to position "90" corresponds to the crossed position of the polarization devices.

Setting the polarization devices in the crossed position is observed in the field of view of an eyepiece with a low- or medium-magnification objective at the maximum brightness.

The crossed position should correspond to maximum darkening of the field of view.

If necessary, this can be achieved by slightly turning the analyzer away from the preset position.

**Complete extinction of light in the crossed position of the polarizer and analyzer with all objectives may not be observed.**

If the observation technique requires parallel position of the polarizer and analyzer, set the analyzer scale to "0".

### 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/0.70, the total magnification of the microscope is 10x40 = 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/0.70, 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.

# 5 USING OPTIONAL EQUIPMENT

### STAGE ATTACHMENT

A mechanical stage attachment is used for convenient movement of specimens in two mutually perpendicular directions: X-axis (right-left) and Y-axis (forward/backward).

The stage attachment is mounted on pins into the stage holes and secured with a screw.

Fig. 16. Mechanical attachment

### EYEPIECE WITH A SCALE

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.

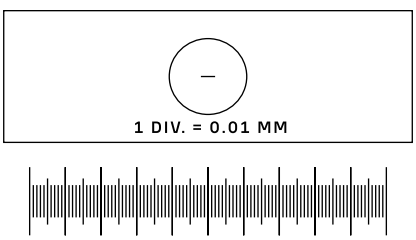



Fig. 17. Calibration slide

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 |
|---|---|
| 2,5 | |
| 5 | |
| 10 | |
| 40 | |
| 50 | |
| 60 | |
| 80 | |
| 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.

## DIGITAL CAMERA

The microscope is designed to observe a specimen through the eyepieces and to photograph the specimen. The microscope has a trinocular tube. The light splitting ratio is 100/0 and 0/100. The beam splitting is performed by the lever **5**.

It is important that you choose the proper camera to solve specific tasks with a microscope: using low or high magnification objectives, in the bright field or using other contrast techniques. You should pay attention to the camera's light sensitivity, pixel and sensor size, resolution, and data rate. The wrong camera will not allow taking good quality pictures, which will distort the results of the observation.

To enable the camera:

— Loosen the attachment screw **1** and remove the dust cap **2**.

— Connect the camera to the C-mount adapter from the microscope kit.

— Fit the camera into the trinocular tube **4** and secure it with the screw **1**.

— Place the 10x objective into the optical path. Looking through the eyepieces, bring the specimen into sharp focus.

— Switch on the camera as described in the camera's user manual.

— Pull out the knob **5**. If the image is blurry, adjust the focus using the fine focusing knob.

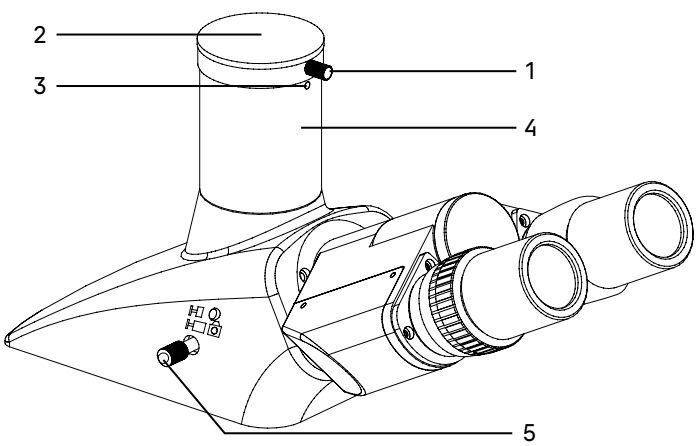
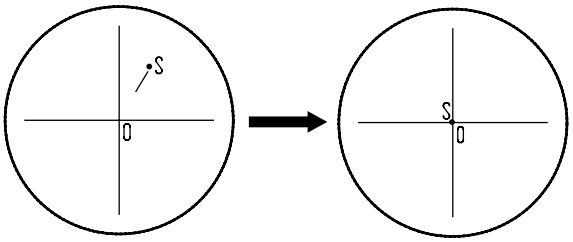



Fig. 18. Using the trinocular tube

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. There are three centering screws on the trinocular tube.

Adjust it as follows:

— Set the beam splitter lever **5** 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. 19a), move the specimen on the stage so that the point is in the center of the field of view, as shown in Fig. 19b. 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.




a b

Fig. 19. Adjusting the camera image

— Look at the specimen on a monitor or display screen and make sure that the image of the point 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 point 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.

## 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.

# 6 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 halogen bulb is damaged | Replace the halogen bulb |
| | The fuse has blown | Replace the fuse |
| | The circuit board connector has poor contact | Have the connector repaired by a qualified electronics technician |
| | The installed bulb does not comply with the specifications | Use the appropriate bulb |
| | The transmitted/reflected light switch is set in the wrong position or switched off | Select the correct switch position depending on the observed object |
| | **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 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 |
| Poor image quality (low resolution, poor contrast) | The objective is damaged | Have the objective repaired by a qualified technician or replaced |
| | 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 |
| | The flip-down lens of the condenser is in the wrong position: introduced in the optical path or not fully removed | Install the lens properly |
| 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 |

| MECHANICAL COMPONENTS | | |
|---|---|---|
| The image does not remain sharp during observation | The coarse focusing tension adjusting knob is loosened, causing the revolving nosepiece 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 |
| 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 |

# 7 SCOPE OF DELIVERY

The scope of delivery (Table 5)

| Component | Pcs | Note |
|---|---|---|
| **MAIN COMPONENTS** | | |
| Stand with built-in power source, transmitted light source, focusing mechanism, stage, and revolving nosepiece | 1 | |
| Condenser with a transmitted light polarizer | 1 | |
| Reflected light illuminator | 1 | |
| Lamphouse | 1 | |
| Trinocular microscope head | 1 | |
| Ring with color filters | 1 | In the reflected light illuminator |
| Intermediate attachment with a Bertrand lens, an analyzer, and a slot for compensators | 1 | |
| **REPLACEABLE PARTS** | | |
| Infinity plan achromatic objective: PL L 5x/0.12 WD 26.1mm | 1 | |
| Infinity plan achromatic objective: PL L 10x/0.25 WD 5.0mm | 1 | |
| Infinity plan achromatic objective: PL L 40x/0.6 (spring loaded) WD 3.9mm | 1 | |
| Infinity plan achromatic objective: PL L 60x/0.7 (spring loaded) WD 2.0mm | 1 | |
| Infinity plan achromatic objective: PL L 2.5x/0.1 WD 11mm | 1 | Optional |
| Infinity plan achromatic objective: PL L 50x/0.7 (spring loaded) WD 3.7mm | 1 | Optional |
| Infinity plan achromatic objective: PL L 80x/0.8 (spring loaded) WD 1.2mm | 1 | Optional |
| Infinity plan achromatic objective: PL100x/0.85 (spring loaded) WD 0.4mm | 1 | Optional |
| 10x/20mm eyepiece | 2 | |
| 10x/20mm eyepiece with crosshairs | 1 | |
| 10x/20mm eyepiece with a scale, value is 0.1mm | 1 | Optional |
| 16x/11mm eyepiece | 2 | Optional |
| 20x/11mm eyepiece | 2 | Optional |
| λ compensator | 1 | |
| λ/4 compensator | 1 | |
| Quartz wedge | 1 | |
| C-mount camera adapter | 1 | |
| Digital camera | 1 | Optional |
| Monitor | 1 | Optional |

| | | |
|---|---|---|
| Calibration slide | 1 | Optional |
| Mechanical attachment | 1 | Optional |
| **ACCESSORIES AND SPARE PARTS** | | |
| Set of Allen wrenches | 1 | |
| Allen wrench | 1 | |
| 12V/30W halogen bulb | 2 | |
| Fuse | 1 | |
| Microscope power cord | 1 | |
| Reflected light illuminator power cord | 1 | |
| Dust cover | 1 | |
| User manual | 1 | |

# 8 CARE AND MAINTENANCE

## REPLACING THE BULB AND THE FUSE

Before replacing the bulb or fuse, turn the ON/OFF switch to "0" position (off). Unplug the power cord from the power outlet. Wait about 30 minutes for the bulb to cool down.

1. **Replacing the reflected light bulb:**

— unplug the power cord from the connector

— loosen the lock screw using a wrench and remove the back cover of the lamphouse, as shown in Fig. 20

— remove the faulty lamp **2** and install a new one.

**When installing the bulb, use a cloth or silk gloves from the microscope kit. Fingerprints on the surface may shorten its life.**

— install the cover on the lamphouse and secure it with a screw

— connect the power cord, turn the ON/OFF switch 1 to "–" position

— center the lamp as described above.

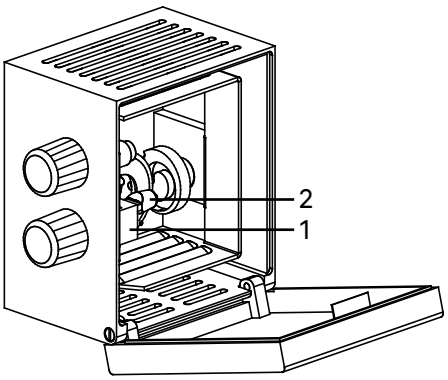



Fig. 20. Replacing the reflected light bulb

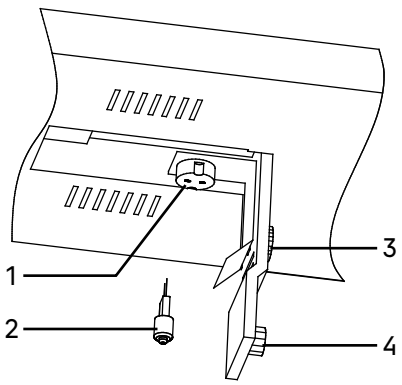



Fig. 21. Replacing the transmitted light bulb

2. **Replacing the transmitted light bulb.**
Access to the transmitted light bulb is at the base of the microscope.

— unplug the power cord from the connector

— loosen the screw **4** and open the cover **3**, as shown in Fig. 21

— remove the faulty lamp **2** and install a new one into the socket 1

**Use a cloth when installing the bulb. Fingerprints on the bulb surface shorten its life.**

— attach the cover and secure it with the screw

— connect the power cord, turn the ON/OFF switch 1 to "–" position

— center the lamp as described above.

3. **Replacing the fuse.**
   The fuse is built into the inlet power connector. It is replaced as follows:

— Unplug the power cord **1**.

— Using a flathead screwdriver, remove the fuse holder **2**. Replace the blown fuse with a new one.

— Install the fuse holder back into the inlet power connector.

— Plug the power cord into the AC outlet and turn on the ON/OFF switch to "–" position to check the fuse for proper operation.

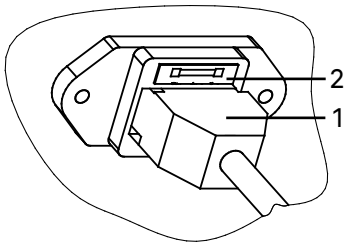


Fig. 22. Replacing the fuse

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.

### 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.

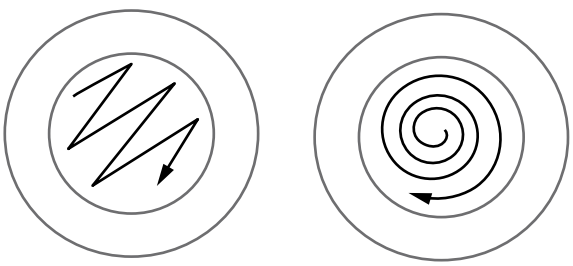


Fig. 23. Cleaning lenses

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. 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.**
6. Periodic inspection: the microscope should be regularly inspected and serviced to maintain its performance.

# 9 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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