levenhuk MAGUS POL 800 Polarizing Microscope User Manual

Contents

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INTRODUCTION

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 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.

MAGUS Pol 800 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.

DESCRIPTION

PURPOSE

- The microscope is designed for studying anisotropic geological, biological, and polymeric objects in polarized and regular transmitted light.
- Orthoscopic and conoscopic observations are available.
- 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	40–600 (1000/1250/1500/2000, 2500)**
Tube length	Infinity (∞)
Microscope head	Trinocular (Siedentopf type) Eyepiece diameter: 30mm 30° inclined Interpupillary distance: 48–75mm Diopter adjustment (left barrel): ±5dp
Eyepieces, magnification, x/field, mm	10x/22; 10x/22 with crosshairs 10x/22 with a scale*; 12.5x/14mm*; 15x/15mm*;20x/12mm*; 25x/9mm*
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 0.17mm thick coverslips
Objectives, magnification, x/aperture/working distance, mm	PL 4x/0.10 WD 21.00mm PL 10x/0.25 WD 5.00mm PL 40x/0.65 (spring loaded) WD 0.66mm PL 60x/0.80 (spring loaded) WD 0.46mm PL 5x/0.12 WD 26.10mm* PL 20x/0.4 WD 8.80mm* PL 100x/1.25 (spring loaded) WD 0.36mm* PL 100x/0.80 (spring loaded, dry) WD 2.02mm*
Stage	Round stage, Ø150mm, 360° rotatable, centerable 1° graduation of the rotation angle With the vernier scale, measurements are made with an accuracy of 0.1°
Focusing mechanism	Coaxial coarse & fine focusing knobs on both sides Fine focusing scale value: 2µm Coarse focusing tension adjusting knob Coarse focusing lock knob
Illumination method	Transmitted 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
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	201×458×377
Package dimensions (WxHxD), mm	271×630×431
Weight without package, kg	12.0
Weight with package, kg	14.5

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

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

MICROSCOPE KIT

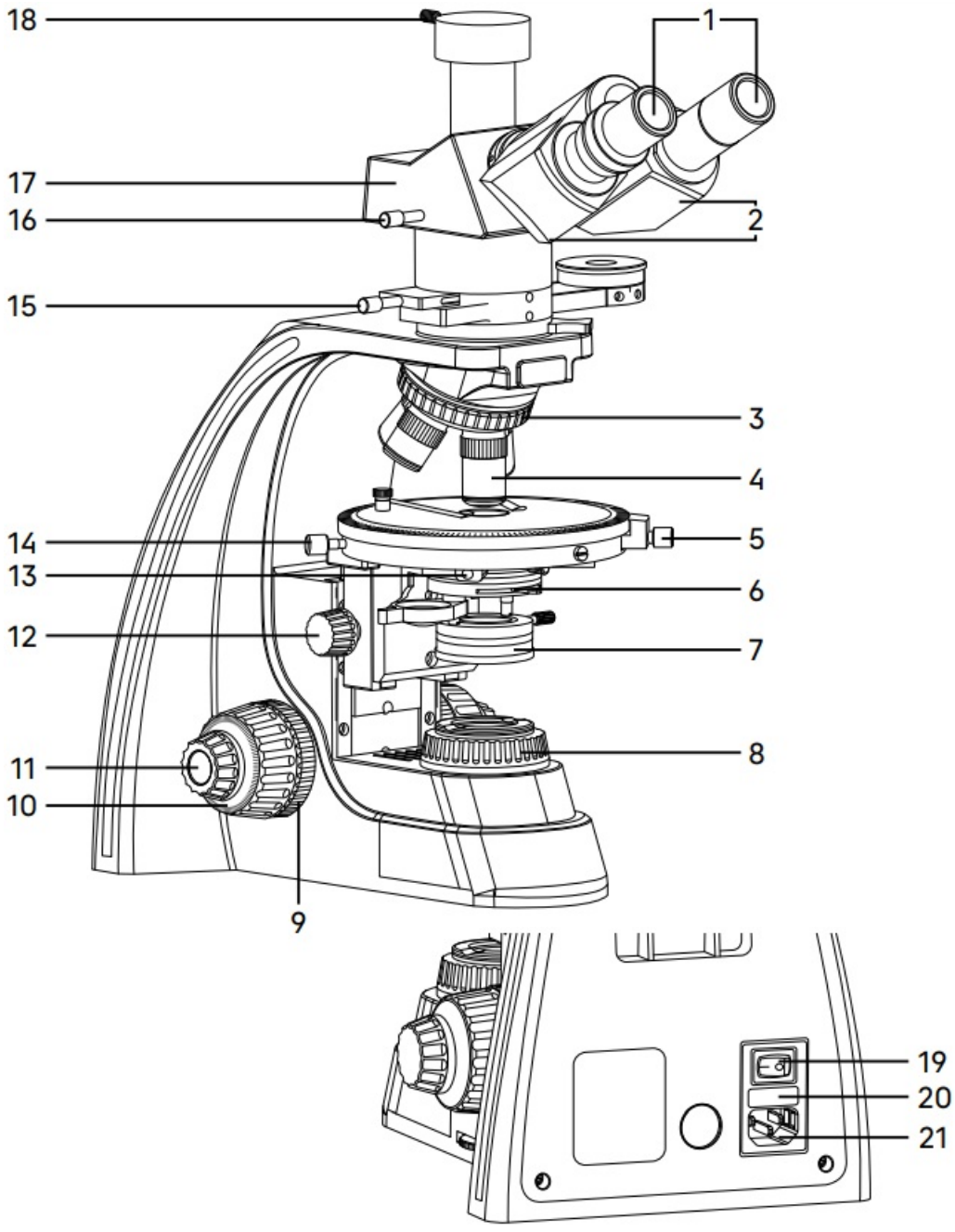
The microscope kit includes the following main components:

- stand with a built-in power source, transmitted light source, focusing mechanism, stage, and revolving

nosepiece

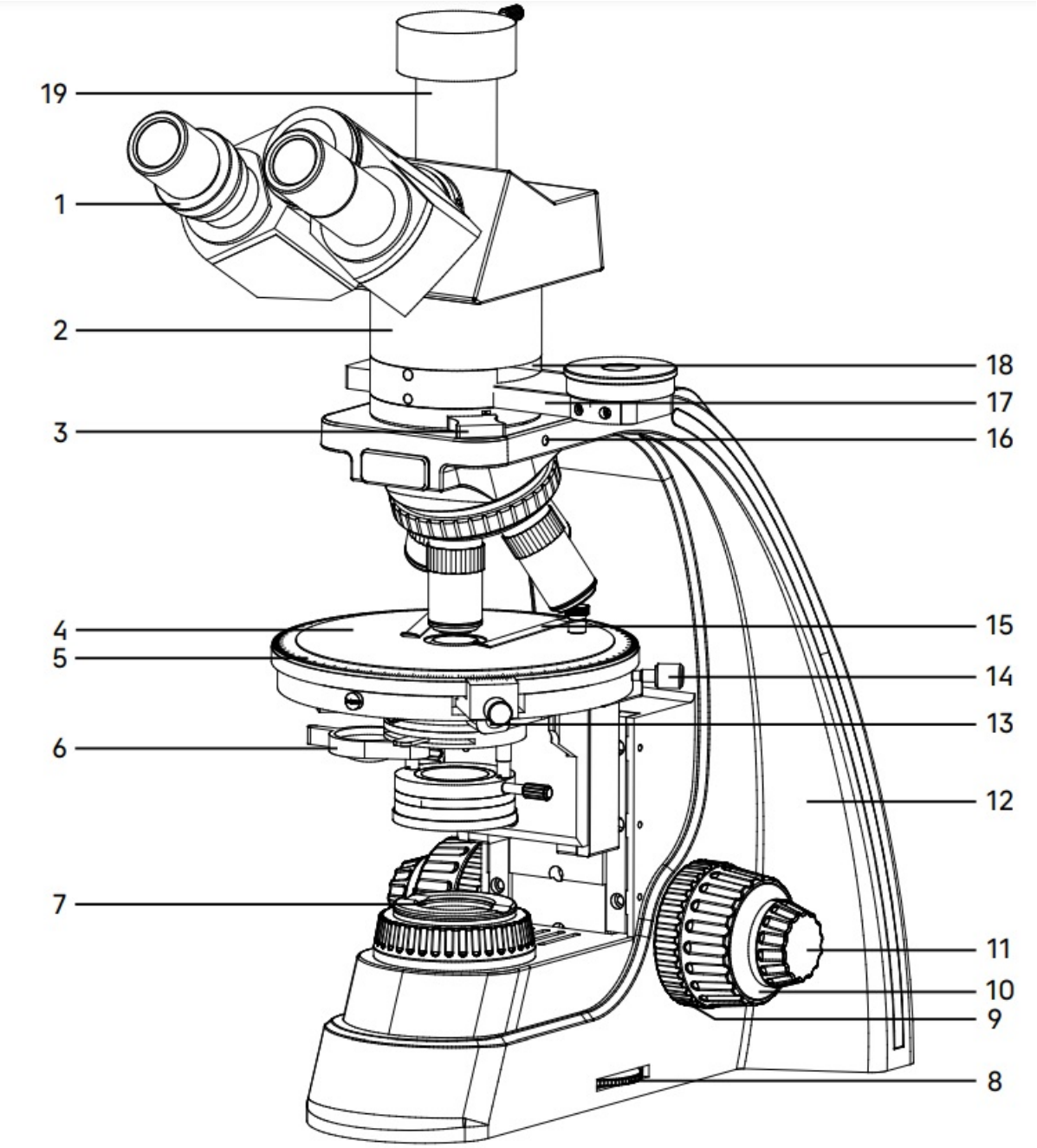
- trinocular head
- intermediate attachment with a Bertrand lens
- compensators
- condenser with a polarizer
- set of objectives and eyepieces
- set of spare parts and accessories
- packaging
- user manual.

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.



1. Eyepieces
2. Eyepiece tubes

3. Revolving nosepiece
4. Objectives
5. Stage rotation locking screw
6. Condenser with aperture diaphragm
7. Polarizer
8. Collector
9. Coarse focusing lock knob
10. Coarse focusing knob
11. Fine focusing knob
12. Condenser focus knob
13. Condenser centering screw
14. Stage centering screw
15. Bertrand lens lever
16. Beam splitter lever
17. Microscope head
18. Video device (dust cap) locking screw
19. ON/OFF switch
20. Fuse holder
21. Power connector



1. Diopter adjustment ring
2. Intermediate attachment
3. Compensator
4. Stage
5. Stage rotation scale
6. Flip-down lens of the condenser
7. Color filter holder
8. Brightness adjustment ring
9. Coarse focusing tension adjusting knob
10. Coarse focusing knob
11. Fine focusing knob
12. Stand
13. Condenser centering screw
14. Stage centering screw
15. Spring clips

16. Intermediate attachment locking screw
17. Analyzer
18. Bertrand lens
19. Trinocular tube

COMPONENTS

STAND

The stand 12 (Fig. 2) has stable ergonomic design. Parts attached to the stand:

- revolving nosepiece 3 (Fig. 1) with objectives 4 (Fig. 1)
- stage 4 (Fig. 2)
- condenser mount (not shown in Fig. 1 and 2)
- collector 8 (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 19 (Fig. 1), fuse holder 20 (Fig. 1), and a connector for the AC power cord 21 (Fig. 1), which connects the microscope to an AC outlet.There is a brightness adjustment ring 8 (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 10 (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 9 (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 convenient for the user, but the revolving nosepiece with objectives does not lower spontaneously during operation.
- The coarse focusing lock knob 9 (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.
- The coarse and fine focusing range is at least 21mm. The coarse focusing travel is 39.8mm/circle.
- 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 trinocular head 17 (Fig. 1) 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.For convenience, the microscope head is inclined at 30°.
- **Eyepiece diameter:** 30mm.
- 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 19 (Fig. 2) using a C-mount adapter. You can switch the light path to the trinocular tube using the lever 16 (Fig. 1). The lever has two positions: 100/0 and 0/100.

INTERMEDIATE ATTACHMENT

The intermediate attachment is installed in the slot on top of the stand 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. 3.

Fig. 3. Intermediate attachment

1. Bertrand lens lever
2. Bertrand lens insert
3. Slot for compensators
4. Compensator
5. Intermediate attachment locking screw
6. Vernier scale on the analyzer
7. Analyzer rotation disk with a scale
8. System with an analyzer

- The analyzer 8 (Fig. 3) 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 7 (Fig. 3).
- Rotation angles in the range of 0–360° are measured on the scale on the disk 7 (Fig. 3) with a graduation value of 1° and Vernier scale 6 (Fig. 3) with a graduation value of 0.1°.
- The slot 3 (Fig. 3) located at the angle of 45° to the direction of polarized light vibrations is used for mounting the compensators 4 (Fig. 3) 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. 3) introduces and removes the Bertrand lens 2 (Fig. 3) 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 3 (Fig. 3) of the intermediate attachment.

Fig. 4. Compensators

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.

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. 5.

Fig. 5. Transmitted light illumination

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

- The screw 1 (Fig. 5) is used to secure the condenser in the mount 8 (Fig. 5).
- The adjustable field diaphragm, centerable and height-adjustable Abbe condenser with an adjustable aperture diaphragm 7 (Fig. 5) and a flip-down lens of the condenser 2 (Fig. 5) 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. 5) 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 polarizer in a frame 4 (Fig. 5). 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.

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: 30mm.
- Eyepiece magnification: 10x. Field of view: 22mm.
- Eyepieces with a different magnification and a 10x eyepiece with 0.1mm scale are not included 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 fixed slot of the revolving nosepiece, so that the other slots are aligned with that slot. The microscope stage is also aligned with the fixed slot of the revolving nosepiece.

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: 22mm. The objectives are designed for the infinity-corrected tube length.

Each objective has the following inscriptions: “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.

Objective identification	Microscopy technique	Magnification	Numerical aperture	Working distance, mm	Color marking
PL 4x/0.10	Brightfield Polarized light	4x	0.10	21.00	Red
PL 5x/0.12	Brightfield Polarized light	5x	0.12	26.10	Red
PL 10x/0.25	Brightfield Polarized light	10x	0.25	5.00	Yellow
PL 20x/0.40	Brightfield Polarized light	20x	0.40	8.80	Green
PL 40x/0.65	Brightfield Polarized light	40x	0.65	0.66	Light blue
PL 60x/0.80	Brightfield Polarized light	60x	0.80	0.46	Blue
PL 100x/1.25 oil	Brightfield Polarized light	100x	1.25	0.36	White
PL 100x/0.80	Brightfield Polarized light	100x	0.85	2.02	White

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

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

STAGE
The stage is shown in Fig. 6.

Fig. 6. Round stage

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

The stage 3 (Fig. 6) is equipped with a rotatable disk 1 (Fig. 6). Rotation angles in the range of 0–360° are measured on the scale on the disk 2 (Fig. 6) with a graduation value of 1° and vernier scale 5 (Fig. 6) Fig. 6. Round stage with a graduation value of 0.1°.
The position of the rotatable disk is fixed with the screw 4 (Fig. 6). 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. 6).

UNPACKING AND ASSEMBLING

The assembly procedure is given in Fig. 7.

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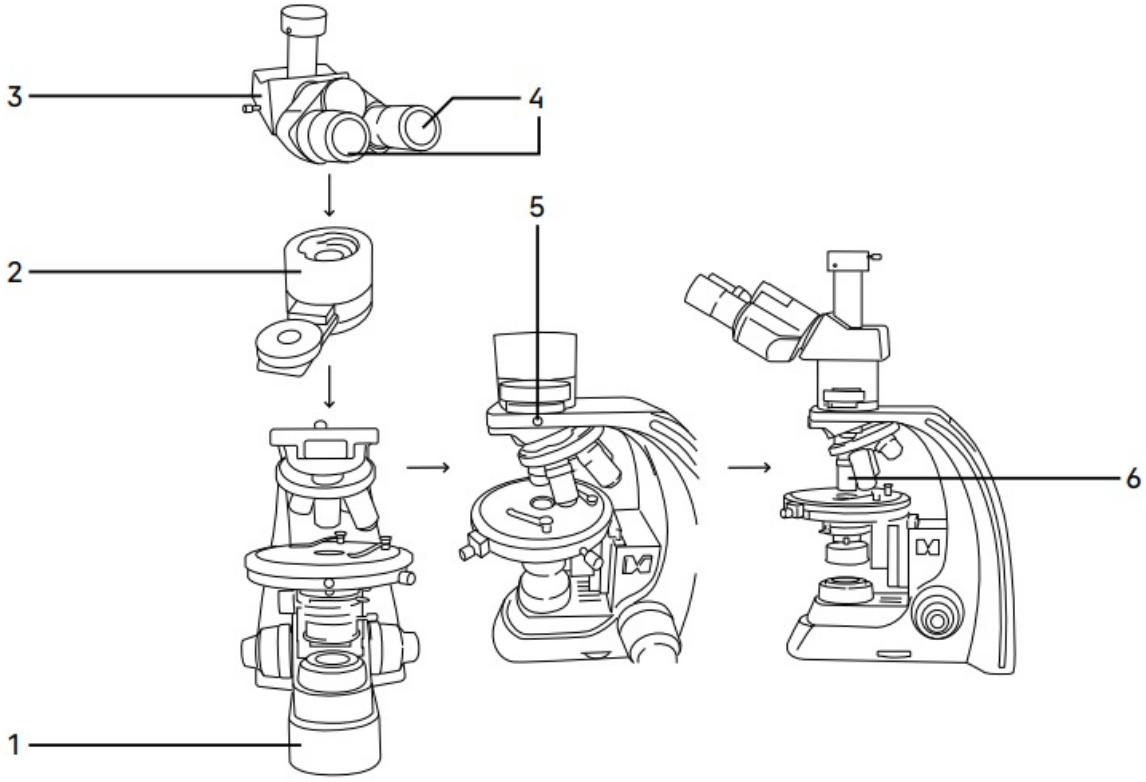


Fig. 7. Assembling the microscope

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

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 1 to “–” position. Adjust the brightness using the ring 2 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.

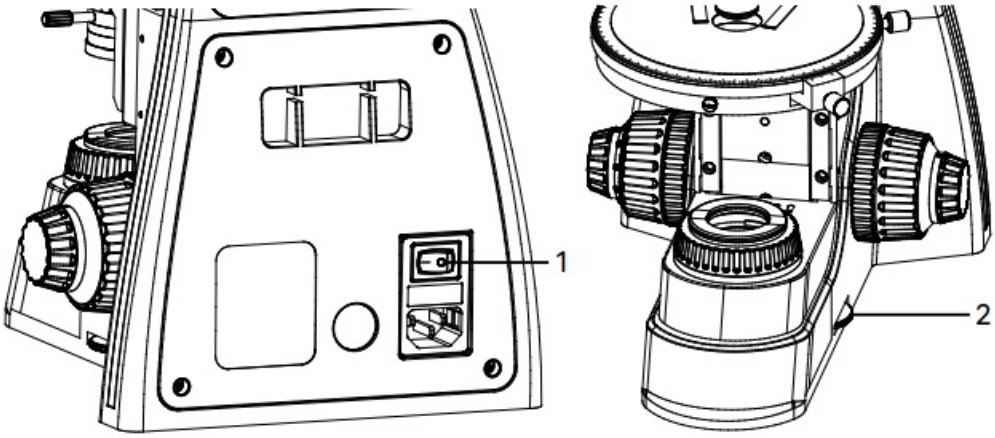


Fig. 8. Switching on the illumination and adjusting the brightness

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.

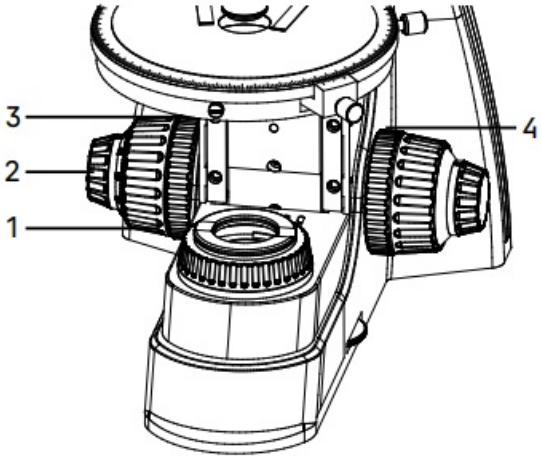


Fig. 9. Focusing on the specimen

- 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 Fig. 9. Focusing on the specimen focusing knob.
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.

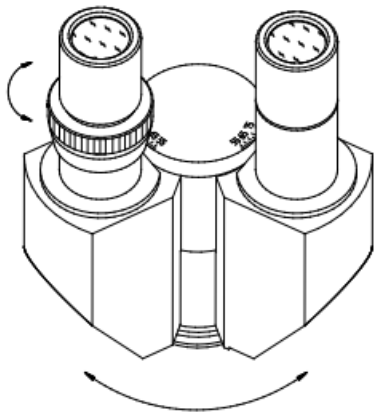
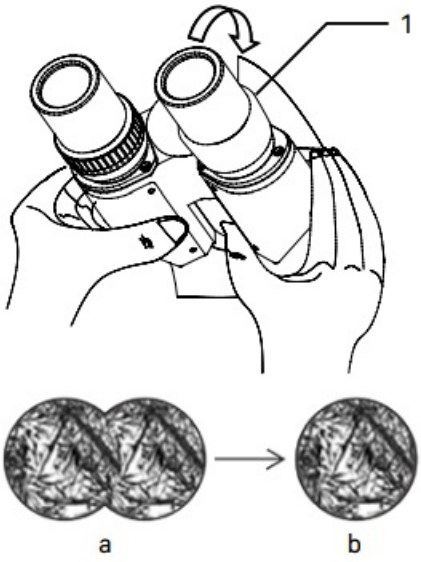


Fig. 10. Adjusting the diopter adjustment mechanism

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. 11 a, b).
Fig. 11. Adjusting the interpupillary distance



SETTING UP 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.

Thellumination 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.
- Remove the analyzer 17 (Fig. 2) and Bertrand lens 18 (Fig. 2) from the optical path by moving them to the rightmost position.
- Install the eyepiece with a reticle into the eyepiece tube 2 (Fig. 1).
- 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 turning the centering screws 3 with a universal wrench.
- 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.

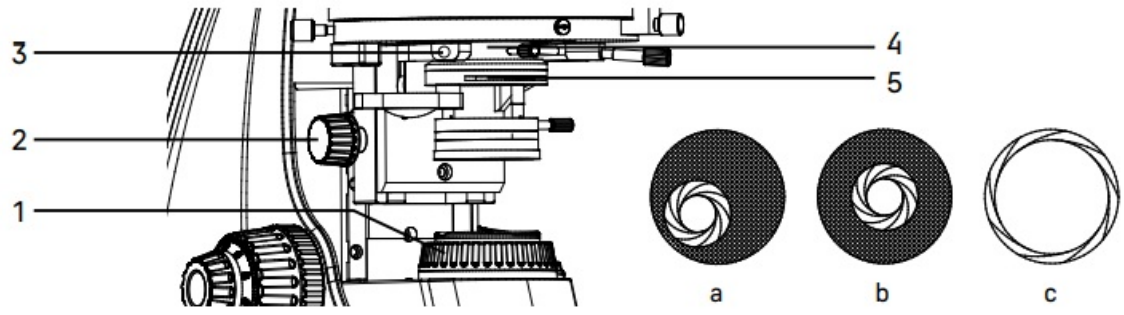


Fig. 12. Centering the condenser

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.

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 reticle 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.

Use the two centering screws 1 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.

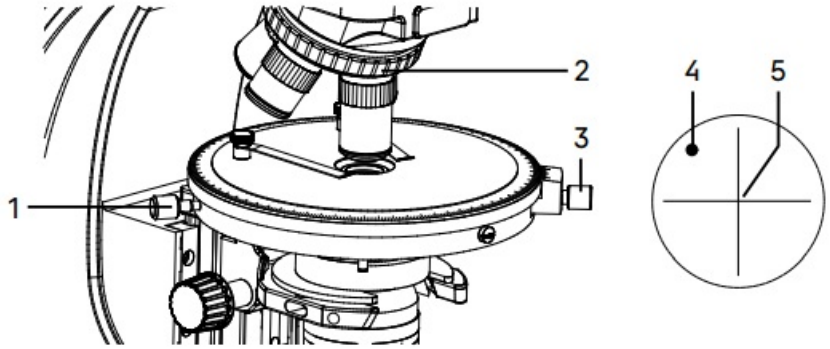


Fig. 13. Centering the stage and objectives

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.

OBSERVATIONS WITH ONE POLARIZER

Turn the ON/OFF switch to the ON position. Remove the analyzer 17 (Fig. 2) from the optical path. Mount the specimen on the stage 4 (Fig. 2) and secure it with spring clips. Make sure that there is an eyepiece with a reticle 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.

OBSERVATIONS WITH AN ANALYZER AND A POLARIZER

You can observe an object with a polarizer and an analyzer both crossed and parallel positions of the polarization devices.
Introduce the analyzer 17 (Fig. 2) into the optical path. Use the scale of the analyzer and polarizer to set the desired crossed or parallel position of the polarization 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 attachment.

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 40×0.65, 60×0.80, 100×0.80, or 100×1.25 high aperture objectives. To observe a conoscopic image, the microscope optics are adjusted as follows:

- place the specimen on the stage

- introduce an objective with an aperture and magnification specified above
- 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 a reticle 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 reticle center
- 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.

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.

USING OPTIONAL EQUIPMENT

STAGE ATTACHM

Fig. 14. Mechanical 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.

EYEPIECE WITH A SCALE

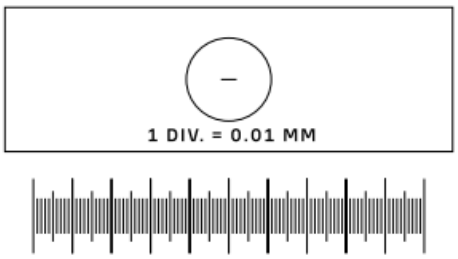


Fig. 15. Calibration slide

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 Fig. 15. Calibration slide 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	
5	
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 CAMERA

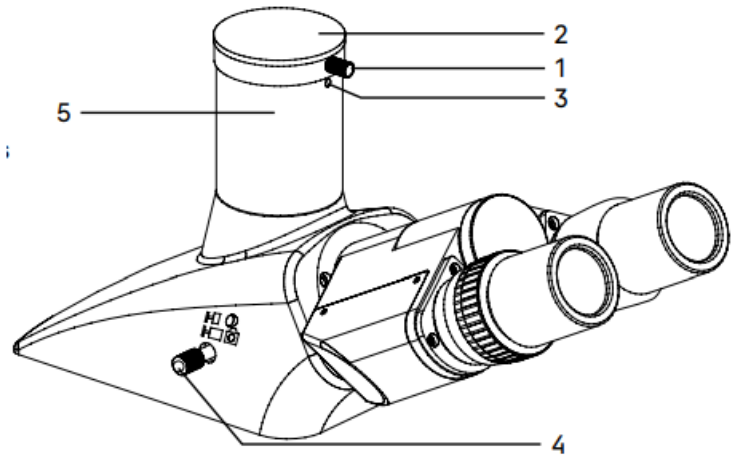


Fig. 16. Using the trinocular tube

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 4.
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 5 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 4. If the image is blurry, adjust the focus using the fine focusing knob.

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:Adjust it as follows:

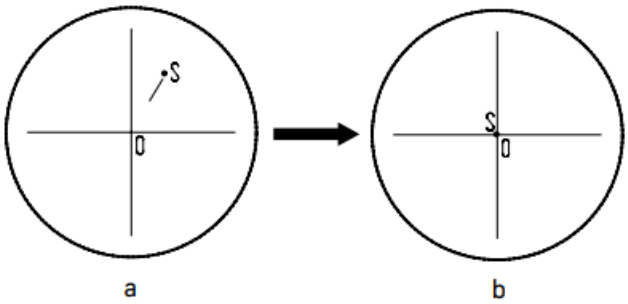


Fig. 17. Adjusting the camera image

- 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. 17a), move the specimen on the stage so that the point is in the center of the field
of view, as shown in Fig. 17b. 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.

- 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.

TROUBLESHOOTING

Potential problems and remedies (Table 3):

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
	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

SCOPE OF DELIVERY

The scope of delivery (Table 4)

Component	Pcs	Note
MAIN COMPONENTS		
Stand with built-in power source, transmitted light source, focusing mechanism, stage, and revolving nosepiece	1	
Condenser with a polarizer	1	
Trinocular microscope head	1	
Intermediate attachment with a Bertrand lens, an analyzer and a slot for compensators	1	
REPLACEABLE PARTS		
Infinity plan achromatic objective: PL 4x/0.10 WD 21.00mm	1	
Infinity plan achromatic objective: PL 10x/0.25 WD 5.00mm	1	
Infinity plan achromatic objective: PL 40x/0.65 (spring loaded) WD 0.66mm	1	
Infinity plan achromatic objective: PL 60x/0.80 (spring loaded) WD 0.46mm	1	
Infinity plan achromatic objective: PL 5x/0.12 WD 26.10mm	1	Optional
Infinity plan achromatic objective: PL 20x/0.4 WD 8.80mm	1	Optional
Infinity plan achromatic objective: PL 100x/1.25 oil (spring loaded) WD 0.36mm	1	Optional
Infinity plan achromatic objective: PL 100x/0.8 (spring loaded, dry) WD 2.02mm	1	Optional
10x/22mm eyepiece	2	
10x/22mm eyepiece with crosshairs	1	
10x/22mm eyepiece with a scale. The scale value is 0.1mm	1	Optional
12.5x/14mm eyepiece	2	Optional
15x/15mm eyepiece	2	Optional
20x/12mm eyepiece	2	Optional
25x/9mm 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	
Screwdriver	1	
12V/30W halogen bulb	1	
Fuse	1	
Microscope power cord	1	
Dust cover	1	
User manual	1	

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.

Replacing the reflected light bulb:

- unplug the power cord from the connector
- loosen the attachment screw 1 and open the cover, as shown in Fig.18

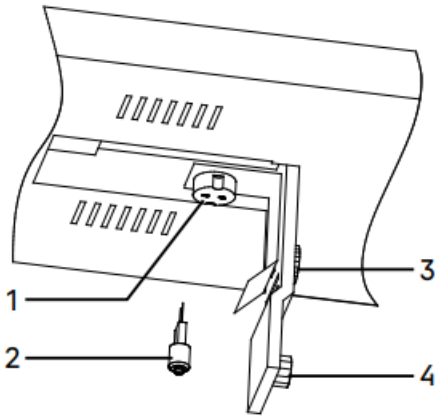


Fig. 18. Replacing the bulb

- remove the faulty lamp 2 and install a new one.

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

- attach the cover and secure it with the screw
- connect the power cord, turn the ON/OFF switch to “–” position
- center the lamp as described above.

Replacing the fuse:

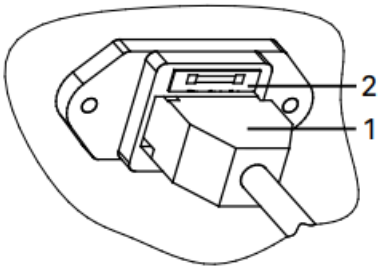


Fig. 19. Replacing the fuse

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.

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 out.

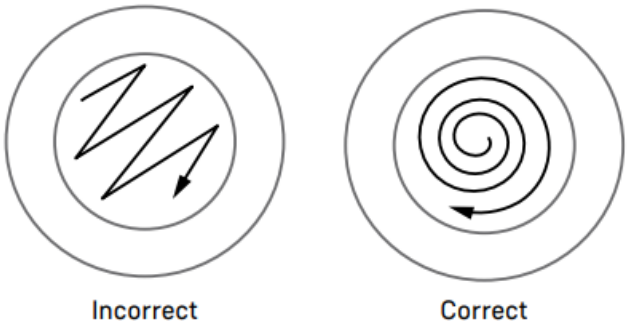


Fig. 20. Cleaning lenses

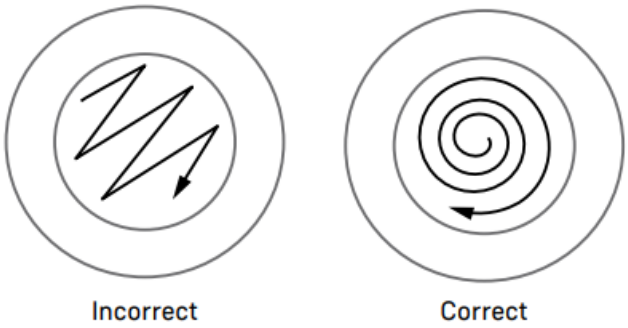


Fig. 20. Cleaning lenses

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.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.
7. 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.
8. Periodic inspection: the microscope should be regularly inspected and serviced to maintain its performance.

MAGUS WARRANTY

1. 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 oeration of

the product. The warranty period for accessories is 6 (six) months from the date of purchase.

2. For more information on warranty terms and conditions, see **www.magusmicro.com**
3. For warranty service, please contact your nearest Levenhuk representative office

CONTACT

www.magusmicro.com

Documents / Resources

 MAGUS	**levenhuk MAGUS POL 800 Polarizing Microscope** [pdf] User Manual POL 800, MAGUS POL 800 Polarizing Microscope, MAGUS POL 800, Polarizing Microscope, Microscope

References

- **Levenhuk's official website in USA**
- **User Manual**