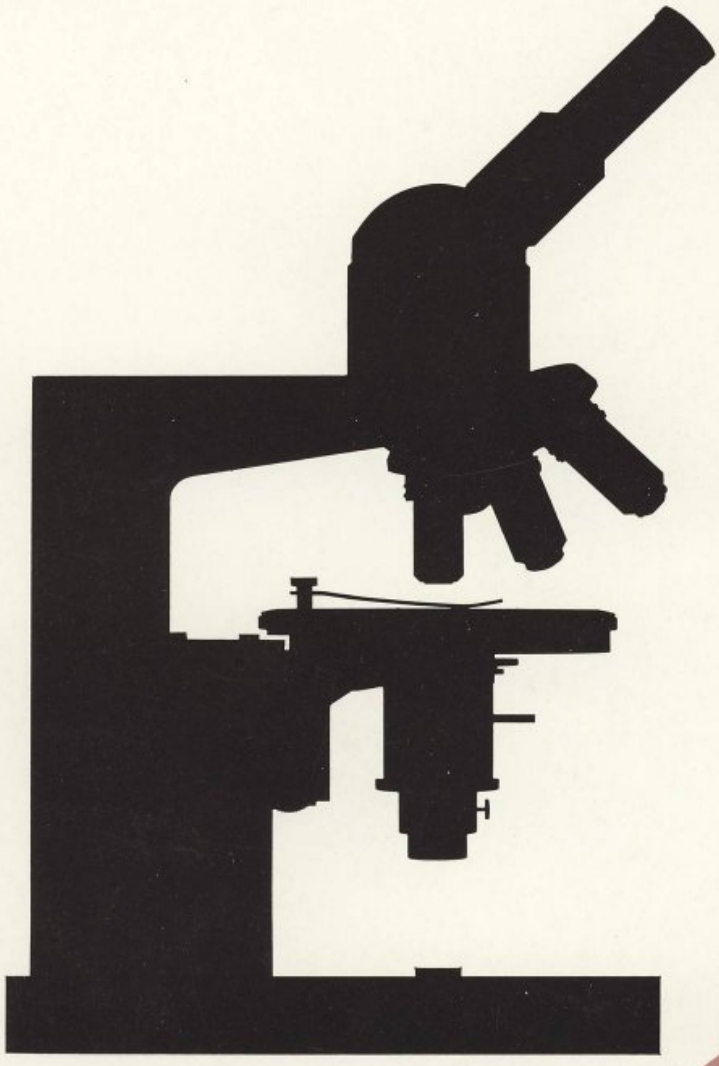
HM-POL
polarizing microscope

Leitz
WETZLAR

Instructions



550 - 33 / Engl.

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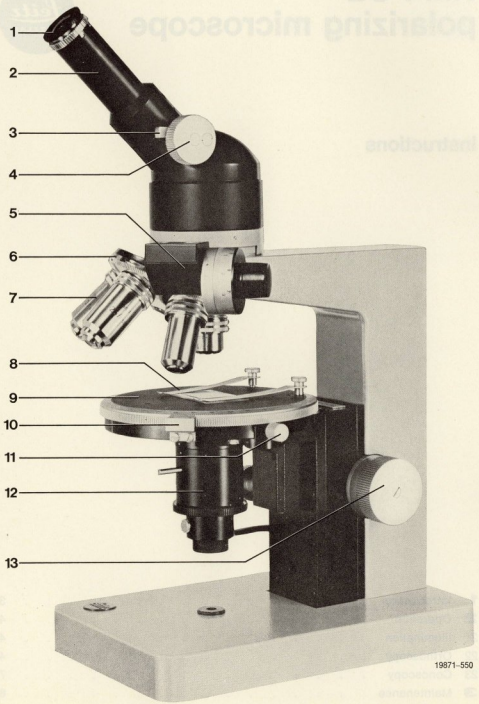

1 Introduction

The LEITZ HM-POL polarizing microscope is a students and teaching microscope with which the most important investigations in polarized light can be carried out in parallel and convergent light. The combination of light source, condenser, and polarizer permits considerably simplified operation. The following structural features are characteristic of the microscope:

Built in 5W ellipsoid illuminator, with polarizor rotatable through 90°.

Single knob coarse and fine focusing, actuating the object stage, which runs on ball bearings.

Quintuple objective centring revolving nosepiece.

Permanently built in monocular tube with Bertrand lens and pin hole stop.

Fig. 1
LEITZ HM-POL polarizing microscope
1 eyepiece
2 monocular tube
3 pinhole stop
4 Bertrand lens
5 tilting compensator
6 objective centring nosepiece
7 objective
8 stage clip
9 object stage
10 verniers
11 arresting screw
12 ellipsoid illuminator
13 single-knob adjustment

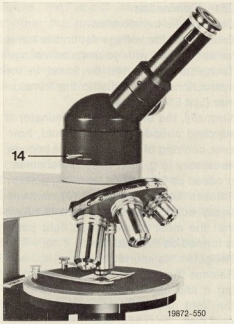

Fig. 2
Monocular tube on the HM-POL
14 analyser

the knurled screw (10.2) for the vertical adjustment. Swing the front lens of the condenser (10.1) into the beam only with objective apertures larger than 0.25.

2.4 HM-POL with incident-light outfit:

The incident-light outfit is used for observation in natural and polarized light. The incident-light objectives with adapter rings required for this are listed in the table below. The handpress (Fig. 11) serves for the precision alignment of the surface of the sample.

2.4.1 Mounting:

After releasing the locking device remove the tube (Fig. 12). Pull out the compensator from the tube slot. Release the clamping screw, remove the intermediate optical system (Fig. 13), and keep it protected from dust. Place the incident-light device in position (engage the locating pin on the underside in the slot on the stand [Fig. 14]). Retighten the clamping screw. Place the tube in position and lock it. Screw incident-light objectives (designated with engraved ∞) with their adapter rings into the objective centring revolving nosepiece in place of the transmitted-light objectives. The adapters for the NPI 5/0.09, NPI Oel 5/0.09 NPI Meth. Jod. 5/0.09 measure 6mm, those of all other objectives 15mm.

2.4.2 Adjustment:

1: Attach the incident-light stage micrometer or a surface-silvered glass plate to an object slide with plasticine, align it with the handpress (Fig. 11) and secure it to the object stage with the stage clips. If necessary, an incident-light specimen which is as homogeneous as possible is also satisfactory.

2. Adjust the eyelens of the eyepiece until the crosslines appear sharp with the relaxed eye (accommodated to distant vision).

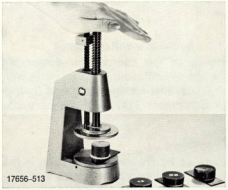

Fig. 11 Handpress

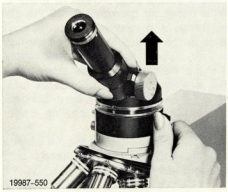

Fig. 12 Removal of the monocular pol tube

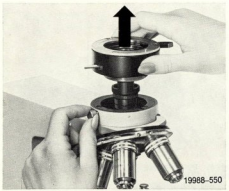

Fig. 13 Removal of the intermediate optical system

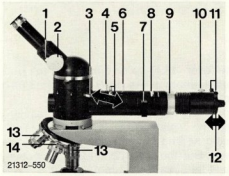

Fig. 14 Incident-light device on the HM-POL

1. Pinhole stop
2. Bertrand lens
3. Rotating analyser, disengageable
4. Field diaphragm
5. Centring screws for the field diaphragm
6. Aperture diaphragm
7. Polarizer, disengageable
8. Filter slot
9. Knurled clamping ring for the illuminator
10. Clamping screw for the lamp mount
11. Centring screws for lamp centration
12. Adjustable lamp mount
13. 15mm adapter
14. 6mm adapter
    Alternatively 10mm adapters can be used for thick samples. No adapter ring will then be required for the NPI 5x/0.09 P objective.

3. Remove the Bertrand lens (14.2) and pinhole stop (14.1) from the beam (turn the knurled knob to the left, move the lever down).

4. Disengage the analyser (14.3) (pull out the lever).

5. Open the aperture and field diaphragms (14.6, 14.4) (both levers to the right).

6. Centre the objectives: see para "Objective Centring" under 2.2 in Instructions 550-33 for the HM-POL.

7. Adjust the light source with centring knobs (14.11) and by moving the lamp socket (14.12) until the object field is evenly illuminated. The objective aperture must then also be evenly illuminated. Check by swinging in the Bertrand lens (14.2); with the binocular tube after temporary removal of an eyepiece.

8. Cross the polarizers: slide the polarizer (14.7) and the analyser (14.3) into the beam. Rotate the analyser until maximum extinction in the object field is obtained. For precision crossing: insert the Bertrand lens in the beam and rotate the analyser until a dark, blurred cross becomes visible.

9. Align the sample to be examined with the handpress and place it on the object stage –, turn the desired objective in, close the field diaphragm at least to the edge of the field of view, set the aperture diaphragm for the desired image contrast.

2.5 HM-POL with Pol interference contrast device R

The Pol interference contrast device R consists of:
Incident-light device,
pol objectives, and
adapters with Wollaston prisms,
polarizer and analyser,
6v 15W low-voltage lamp.
Mounting and adjustment as for the incident-light device (see para 4.1 and 4.2).

21 Illumination

Connect the transformer.
Ensure that the voltage set on the transformer agrees with your mains voltage. Technical details will be found in the instructions enclosed with the transformer (List 514-91, p. 4).
Normally, the 5W ellipsoid illuminator is supplied already centred. Should, however, centring of the light source become necessary (e. g. after lamp replacement) proceed as follows:
Release knurled screw (3.18) and vertically adjust the lamp mount (3.19) so that the most concentrated light patch is formed on the opal disc.
Retighten the knurled screw.
Release the knurled ring (3.17) by rotating it and adjust the lamp mount until the light patch is in the centre of the opal disc.
Retighten knurled ring.
Again vertically adjust the lamp mount until the opal disc is uniformly illuminated. 6v 5W replacement lamp Code No. 500073.
With this setting all objectives can be used. If the condenser aperture is to be reduced to increase image contrast or to measure phase differences, the illuminator must be lowered with knob (3.15). The lever (3.16) serves for the rotation of the polarizer so that it is possible to work both with crossed and with parallel polarizers.

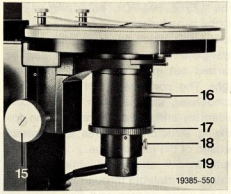

Fig. 3
Ellipsoid illuminator
15 drive knob
16 polarizer
17 knurled ring
18 knurled screw
19 lamp mount

22 Orthoscopy

Orthoscopy is the normal observation of the object.
Turn the objective of desired magnification into the optical path. Place the specimen on the object stage and immobilize it with the stage clips (1.8). For higher magnifications the use of an attachable mechanical stage is recommended.
Focus the specimen by means of the coarse and fine adjustment (1.13).

Centring the objective

a) Move a prominent part of the specimen into the centre of the crosslines M.
b) Rotate the object stage until the area of the object is furthest away from the centre M of crosslines. Position A. (In extreme cases the point A (maximum deviation of the object area) can be situated even outside the field of view).

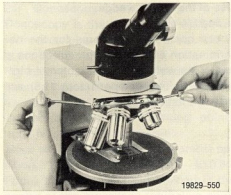

Fig. 4
Centring of the individual objectives with the aid of the centring keys

c) Insert both centring keys (Fig. 4) in the apertures above the objective used. Move the microscopic image by turning the centring keys so that the object area is precisely in the middle (position B) of the line connecting the crosslines M and the maximum deviation position A.
d) Move the specimen manually or with the aid of the attachable mechanical stage until the prominent area is in the centre of the crosslines (M).

Rotate the object stage and check whether the rotating axis of the stage coincides with the centre of the crosslines in the eyepiece. If exact coincidence has not yet been achieved, repeat the centring procedure.

Crossing polarizer and analyser

Set an empty area in the specimen or remove the specimen from the optical path.
Set the lamp at maximum brightness.
Move the illuminator to its topmost position (3.15).
Turn lever (3.16) to the front.
Swing in the analyser (2.14).
Turn in the Bertrand lens (1.4).
Adjust lever (3.16) so that maximum darkness is obtained in the eyepiece. (If higher power objectives are used a symmetrical, dark, blurred cross will be recognised with correct focusing.)
Turn out the Bertrand lens.
The microscope is now ready for orthoscopic illumination.

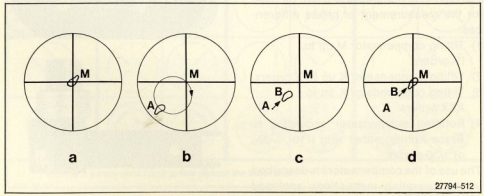

Fig. 5 Centring an objective

Orientation of the specimen

For most investigations in polarized light anisotropic objects must be rotated through 45° from their extinction position. For this purpose the angle value of the stage is read off the verniers (1.10) and the new position of the stage (diagonal position) found by addition or subtraction of 45°.

The rotation through 45° can be carried out without any calculations as follows, unless above-average accuracy of the 45° angle is required:

If, for instance, a rotation through 45° to the left is required, the left thumb nail is inserted in the knurl above the white index line on the front of the stage and the stage rotated until the nail faces the indicator mark of the vernier on the left. Proceed analogously for rotation to the right.

Measurement of phase differences

The following compensators can be used for the measurement of phase differences:

1) Tilting compensator M up to IV orders.
2) Tilting compensator K up to X orders.
3) Tilting compensator K up to XXX orders.
4) Rotating compensator according to Brace-Köhler, either with λ/10-, λ/20-, or λ/30-plates.

The use of the compensators is described in the operating instructions enclosed with them.

Use of the quartz wedge, λ- and λ/4-slide

These compensators serve for the determination of the vibration directions γ′ and α′ as well as the character of birefringence. The compensators (1.5) are inserted in the tube slot.

Fig. 6 Tilting compensator M on the HM-POL

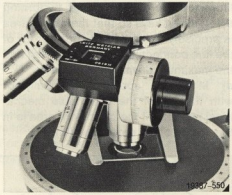

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Fig. 7 Rotary compensator according to Brace-Köhler

2.3 **Conoscopy**

Conoscopy is the observation of the interference phenomena in the rear focal plane of the objective.

For setting a conoscopic image (interference figure) the same manipulations as described under para 2.2 must be carried out. But the following points must be specially considered:

Move the illuminator into its topmost position. Turn in the objective 40/0.65. Focus the object to be examined in the centre of the crosslines (objective centration). Swing in the Bertrand lens (1.4). Focus the interference figure by rotating the eyelens of the eyepiece.

For the conoscopic observation of very small objects the pinhole stop (1.3) must additionally be swung into the light path.

For the determination of the optical character of crystals (positively or negatively birefringent) fixed compensators (λ- and λ/4-plates), the quartz wedge or the tilting compensators can be used according to the table below.

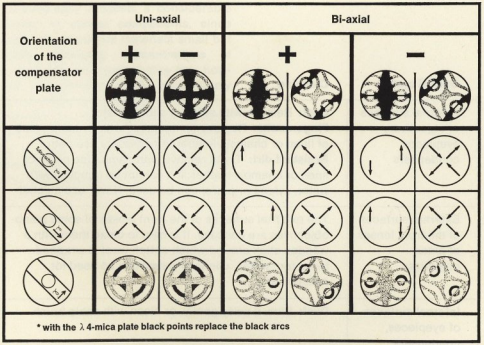

Fig. 8 Table for the determination of the optical character of a specimen

3 Maintenance

When the microscope is not being used it should always be protected against dust. The dust cover supplied with it is very useful, but for prolonged periods of non-use it is better to store it in a dust-proof cabinet.
For work in tropical, humid climate it is recommended to install a weak source of heat in the storage cabinet. For this purpose ordinary filament lamps (10–25W) can be used and permanently left on. The microscope and its accessories should be returned to this cabinet immediately after use. A few holes should be drilled in the top and bottom of the cabinet to ensure adequate vertilation.

Care of the optical components
The optical components of the microscope must be kept scrupulously clean. It should, however, be borne in mind that very soft anti-reflecting layers are sometimes used for coating internal surfaces of objectives, eyepieces, and condensers. The layers on the external surfaces of micro-optical systems are about as hard as glass. Since all these layers are extremely thin, cleaning must be carried out with appropriate care.
Objectives must not be dismantled for cleaning.
Any damage evident in the interior of optical systems should be dealt with by our factory.

Optical system	Cleaning
External surfaces of objectives, eyepieces, condensers	**Dust:** Remove with soft, dry sable brush. **Fingermarks:** Remove immediately with a damp piece of linen or chamois leather; if necessary use petrol. **Resistant dirt:** Try to remove with damp, fine piece of linen or chamois leather; if it cannot be removed with water, xylene or petrol can be used. Never use alcohol.
External surfaces of the front lenses of plano-objectives	The external surfaces of the front lenses of some plano-objectives are concave. It is best to clean them with a wooden stick around which cotton wool is wrapped. Here, too, water, xylene or petrol can be used for resistant dirt.
Internal surfaces of eyepieces, condensers	**Dust:** Blow it away gently, or clean with sable brush.

Special cases
a) Corrosive substances such as acetic acid etc.
If possible, corrosive substances should not be used on the object stage of the microscope. Even if the objects are protected by a coverglass, the objective is in a constant atmosphere of corrosive fumes. During prolonged exposure the front lens may be attacked and the optical quality considerably impaired. The use of other fixatives etc. is therefore preferable. If this is not feasible, only achromats should be used for examination, since the highly developed types of glass used in apochromats are more sensitive to corrosive substances.

b) Hydrofluoric acid
This etching medium frequently used in metallography presents a considerable danger to optical components, since especially in porous materials small but highly damaging concentrations of hydrofluoric acid collect; they can, however, be removed rapidly and reliably with the following method:
Immerse the etched specimen in a saturated ammonium pentaborate solution for an hour. Rinse well and dry. The specimen is now ready for metallographic examination.
Ammonium pentaborate has been found compatible with numerous metallic, ceramic, metalloid, and semi-conductor specimens which require etching with hydrofluoric acid.
The solution is prepared by dissolution of 9.8g ammonium pentaborate in 100ml distilled water. This solution is 0.36-molar and saturated.

Insert for Instructions 550-33 Engl. for the HM-POL Polarizing Microscope

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2.1.1 **6v/5W low-voltage lamp:**

Instead of the microscope equipment with the 5W ellipsoid lamp an outfit with the 6v 5W low-voltage lamp and Swing-out Condenser 711 f (9.7) can be supplied.

Mounting:

Insert the 6v 5W low-voltage lamp in the bore in the foot of the stand and moderately tighten the knurled nut on the underside of stand.

Adjusting the lamp:

Place a groundglass screen or piece of white paper on the aperture of the object stage and remove the condenser. Release the clamping screw on the left and adjust and rotate the lamp mount until the illumination in the stage aperture is bright and even. Focus by turning the mount (9.5) of the lamp condenser until the illumination can no longer be improved.

The lamp can also be adjusted if a piece of white paper is placed directly onto the lamp condenser mount.

2.1.2 **15W Micro-Dia Lamp Attachment:**

This lamp can replace the 6v 5W low-voltage lamp; it, too, should be used with the Swing-out Condenser 711 f. In the non-adjustable mount 15W lamps for the existing mains voltage can be inserted. They are connected to the mains or other current sources (such as accumulators) without transformers.

Type of mount, position and dimensions of the bulb must match the dimensions of the lamp attachment.

The lamp is switched on with a rotating switch on the illuminator (knurled ring 10.3).

2.1.3 **Adjusting the Swing-out Condenser 711 f:**

Fully raise the condenser by means of

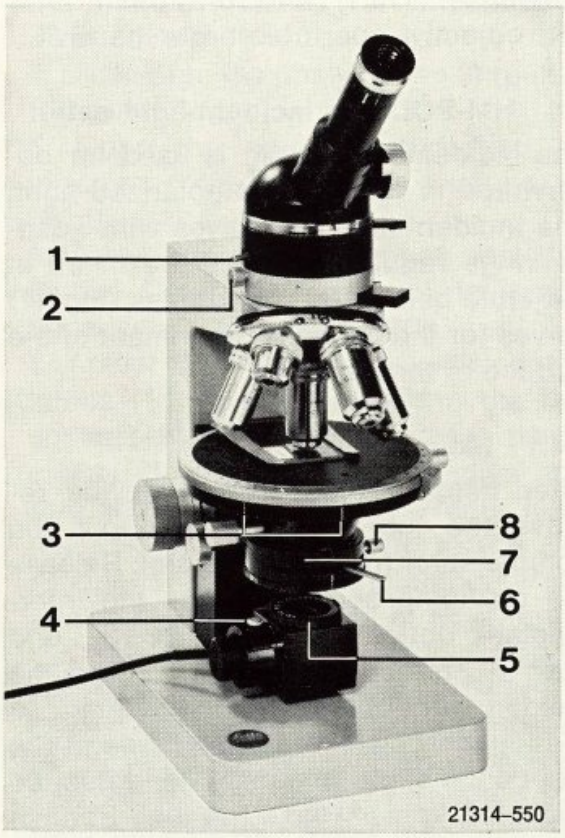

Fig. 9 HM-POL with Condenser 711 f and 6v 5W low-voltage lamp
1. Disengageable analyser
2. Clamping screw for the intermediate optical system
3. Indicator for 45° and 90° rotation of the object stage
4. Clamping screw for the lamp mount
5. Lamp condenser mount
6. Lever for the aperture diaphragm
7. Swing-out Condenser 711 f
8. Clamping screw for the polarizer

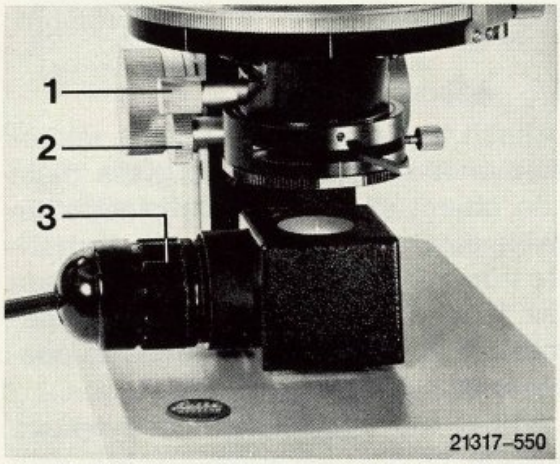

Fig. 10 15W micro-dia lamp attachment on the HM-POL
1. Rotating knob for the swinging in and out of the front lens of the condenser
2. Knob for the vertical condenser adjustment
3. Knurled-ring rotating switch

2.5.1 **Adjusting the objectives:**

See the sections "Objective Centring" under 2.2 in Instructions 550-33 for the HM-POL and "Adjusting the Objectives" in the Instructions 550-40 R for the Incident-light Interference Contrast Device R.

Attention: The adapters with the built-in Wollaston prisms must on no account be removed.

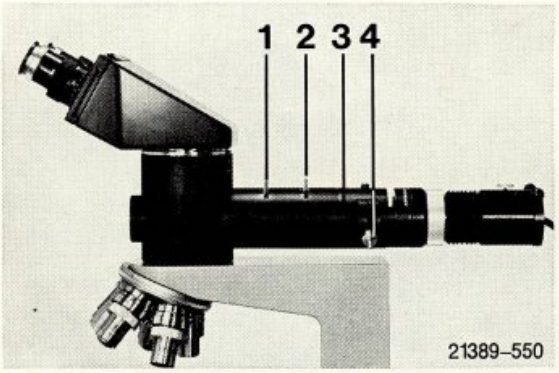

Fig. 15 Pol interference contrast device R on the HM-POL
1. Field diaphragm
2. Aperture diaphragm
3. Slide with λ-plate
4. Clamping lever for polarizer rotation

*) Contrary to the illustration above, the field diaphragm can be centred as shown in Fig. 14.

2.5.2 **Preparing for operation:**

Place a sample aligned with the hand-press on the object stage and clamp it. Turn the objective in (e.g. NPI 10/0.20 P), close the field diaphragm (15.1), open the aperture diaphragm (15.2), critically focus the image of the object (a sharp image of the field diaphragm is formed at the same time), open the field diaphragm (15.1) no further than to the edge of the field of view. Close the aperture diaphragm (15.2) so that only about 2/3 of the full objective aperture remains. With the Bertrand lens (14.2) in the beam or after the temporary removal of an eyepiece the aperture diaphragm can be viewed. Rotate the polarizer: move the lever (15.4) up or down until the object appears at the desired contrast (relief-like image).

For observations in colour contrast insert the λ-plate (15.3) in the beam. This basic setting is identical for all objectives. But the Oel 1.25 x/1.30 P objective must be used with immersion oil.

Strain-free incident-light objectives. Other objectives on request.

Type of objective	Engraving Reproduction ratio / aperture	Free Working distance mm	Coverglass correction [1]
Plan-achromats	NPI P 5 x 0.09	12	DO
NPI P	NPI P 10 x 0.20	14	DO
Incident light	NPI P 20 x 0.40	0.90	DO
	NPI P 50 x 0.85	0.38	O
Immersions	Oel P 20 x 0.40	0.46	DO
systems	Oel P 32 x 0.65	0.30	DO
Incident light	Oel P 50 x 0.85	0.35	DO

[1]) D: with 0.17mm coverglass DO: can be used with or without coverglass

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