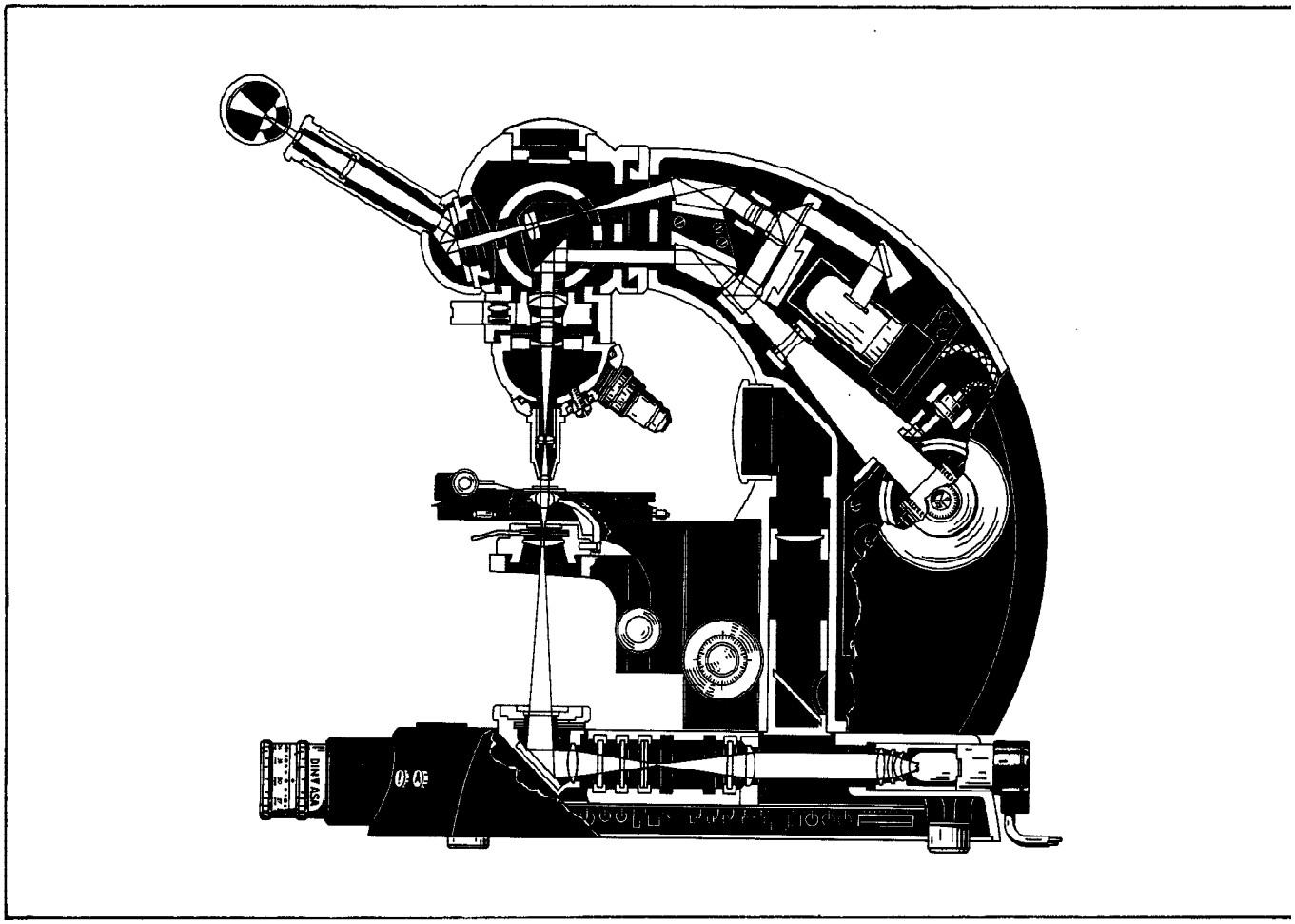
Transmitted - light Photomicroscope III

Operating Instructions

G 41 170 / I - e

Sectional view of transmitted-light Photomicroscope III

1



Notes

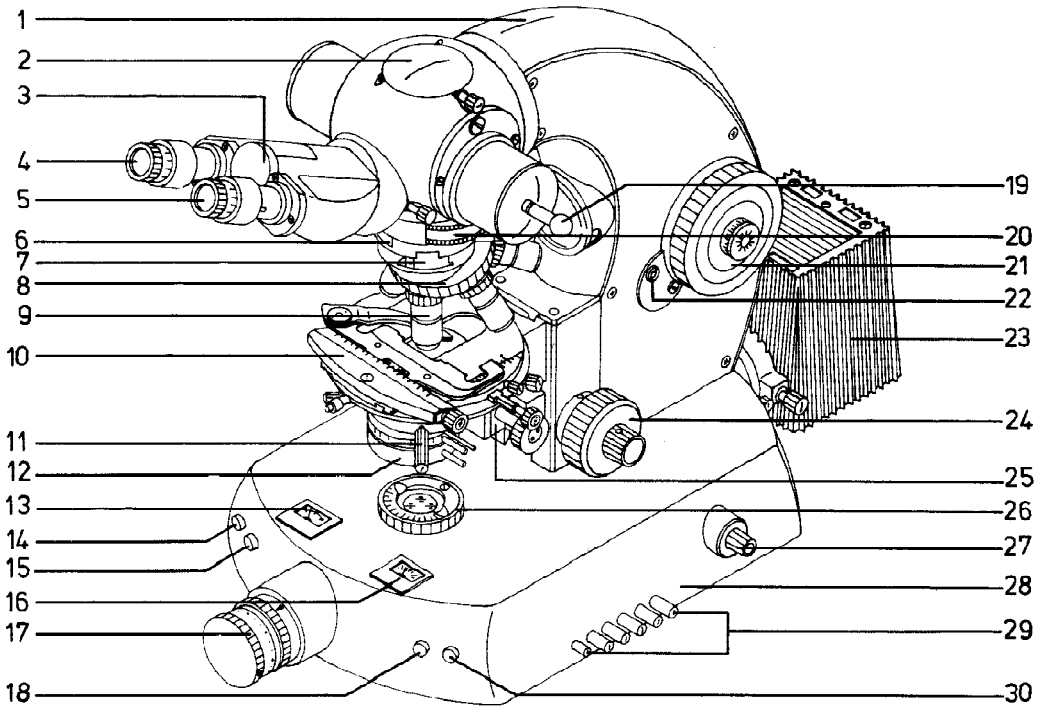
This manual deals exclusively with the use of Photomicroscope III in transmitted light. Its use in incident light, for fluorescence, photometry, polarizing microscopy, etc. is described in separate manuals which are listed at the end of this manual.

- The 6- to 10-digit numbers which you will find in these instructions, e.g. 47 30 12-9902, are ordering numbers of instruments or instrument components.
- Specifications subject to change.

Contents **Page**

Description of instrument

2



Photomicroscope III, stand equipment 49 21 10

Operating controls

1 Stand
2 Port for attachment camera, e.g. TV camera, or photometer attachment (close with lid when not in use)
3 Inclined binocular tube G (47 30 12-9902)
4 Wide-angle focusing eyepiece
5 Wide-angle focusing eyepiece
6 Fill plug in opening for analyzer slider
7 Slot for compensators and auxiliary objects
8 Quintuple nosepiece with Telan system (47 31 59)
9 Objective
10 Circular, rotary, centering mechanical stage 50 x 75 mm with centering piece and graduation (47 34 57-9901)
11 Condenser centering screws
12 Color filter holder with auxiliary lens carrier (47 08 61-9901)
13 Voltmeter for illuminators connected to power supply (47 20 83) with scales 0-12 V and 0-6 V
14 Pushbutton B opens the shutter electrically; when released it closes the shutter
15 Pushbutton T opens the shutter; when pushed again and thus unlocked it closes the shutter
16 Brightness indicator for photography (see also p. 20 ff)

17 Film speed selector

18 Pushbutton !: several functions (see also p. 20 ff)

19 Pushrod with the following click stops:

white ring:	100 % light to the binocular tube
red ring:	20 % light to the binocular tube, 80 % upwards
black ring:	photography position; normally almost 50 % light for observation and almost 50 % for photography; less than 5 % for multiplier
colorless ring:	100 % light upwards, e.g. to a camera

20 Optovar magnification changer with Bertrand lens; with the upper knurled ring you focus the objective exit pupil where an image is formed, for example, of light source or aperture diaphragm, with the lower knurled ring you set the magnification factor 1.26 – 1.6 or Ph (to observe the objective exit pupil)

21 Cassette with frame counter (47 20 26-9901)

22 Pin permitting multiple exposures when pushed in with a screwdriver

23 Microscope illuminator 100

24 Coarse/fine focusing control

Note: Before operating the focusing control remove the transport lock (plastic plate beneath the pinion box) by lifting the pinion box with the coarse focusing control

25 Attachable condenser carrier (47 15 58-9901) with condenser adjustment control and fitted transmitted-light condenser; should the condenser carrier move down, tighten the disk of the control with the supplied wrench

26 Setting ring for luminous field diaphragm

27 ON-OFF switch for automatic photography and power switch with voltage control for illuminators connected to power supply (47 20 83)

28 Microscope base

29 Filter selector

Filters (pushbuttons from front to back):

Neutral density filter 0.03 (46 78 42)
Neutral density filter 0.12 (46 78 41)
Neutral density filter 0.5 (46 78 40)
Neutral density filter 0.5
Green filter VG 9 (46 78 05)
Blue conversion filter (46 78 50)
for photography on daylight film

If you want to use several filters at a time, push the corresponding buttons in simultaneously. The black pushbutton is the OFF-switch.

With the neutral density filters the transmittance can be graded at a ratio of 2:1. The transmittance of a filter combination is determined by multiplication; two neutral density filters, for example, have a transmittance of 0.5 x 0.5 = 0.25.

30 Pushbutton A: camera shutter ready for photography

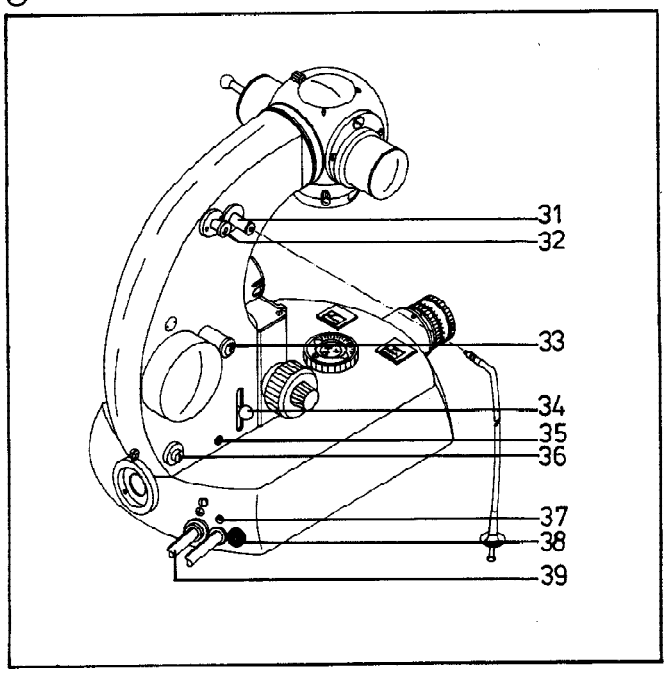
31 Receptacle for cable release. When working with cable release all the light is relayed to the film which is important for images of low light intensity.

32 Selector for integrated or spot measurement

pushed in: the exposure time is determined automatically according to the mean brightness of 2/3 of the central image field

pulled out: the exposure time is determined automatically according to the illuminance within the circle in the center of the reticle visible in photography position

3



33 Control to adjust the flash duration to the film material and the type of its development

34 Reflecting mirror knob

up: the light is relayed to the luminous field diaphragm for transillumination

down: the light leaves the opening of the aperture diaphragm insert for incident illumination

35 Terminal for flash lead of flash generator

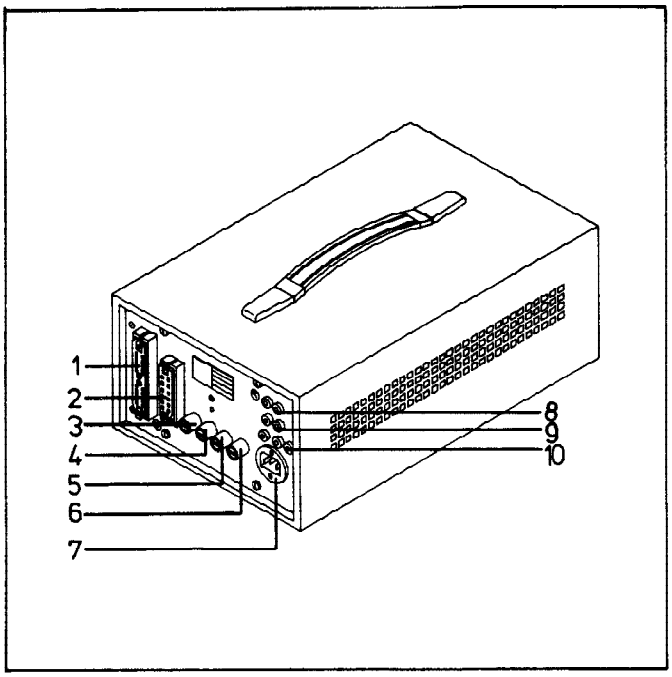
36 Flash ready signal (see also p. 26)

37 Terminal for connection of light sensor to flash generator

38 Socket for pedal switch or pulse generator for remote control

39 Electrical connections to power supply (47 20 83)

4



Power supply (2/3 rack 19") 47 20 83

1 22-pole socket for the supply voltages of the automatic exposure control
2 12-pole socket for the mains-voltage lines to the microscope
3 Fuse 1: secondary
4 Fuse 2: secondary
5 Fuse 3: primary
6 Fuse 4: primary
7 Mains socket
8 Socket for external measuring instrument, 6 V rated voltage, or 6 V max. 50 W filament lamp
9 Socket for 6 V max. 50 W filament lamp
10 Socket for 12 V max. 100 W filament lamp for plugs with 13 mm or 16 mm pin spacing

The following lamps can be connected:

One 12 V 100 W, or
One 12 V 60 W plus one 6 V 15 W, or
One 12 V 30 W plus two 6 V 15 W, or
Two 6 V 15 W

When connected to the mains, the power supply is switched on with the power switch on the right side of the microscope base, which is also voltage control. The adjusted lamp voltage is indicated by the voltmeter to the left of the microscope base.

Technical data

Mains voltage	100-110-115-127-220-240 V		
Frequency	50 ... 60 Hz		
Power consumption	190 VA		
Filament lamp supply	variable with potentiometer		
	12 V rated: ca. 4 ... 14 V 6 V rated: ca. 2 ... 7 V		
Fusing	S 1 T 0.4 A S 2 T 0.8 A		38 01 27 0160 38 01 27 0190
220 ... 240 V	S 3 T 1 A S 4 T 1 A		38 01 27 0200 38 01 27 0200
100 ... 127 V	S 3 T 2 A S 4 T 2 A		38 01 27 0240 38 01 27 0240
Weight	ca. 9 kg		
Dimensions	length: 380 mm	width: 240 mm	height: 150 mm

Assembly

General information

Because of the many possible configurations of the modular system, only the assembly of some important components is described here. Other components (see also p. 30 ff) are assembled in the same manner.

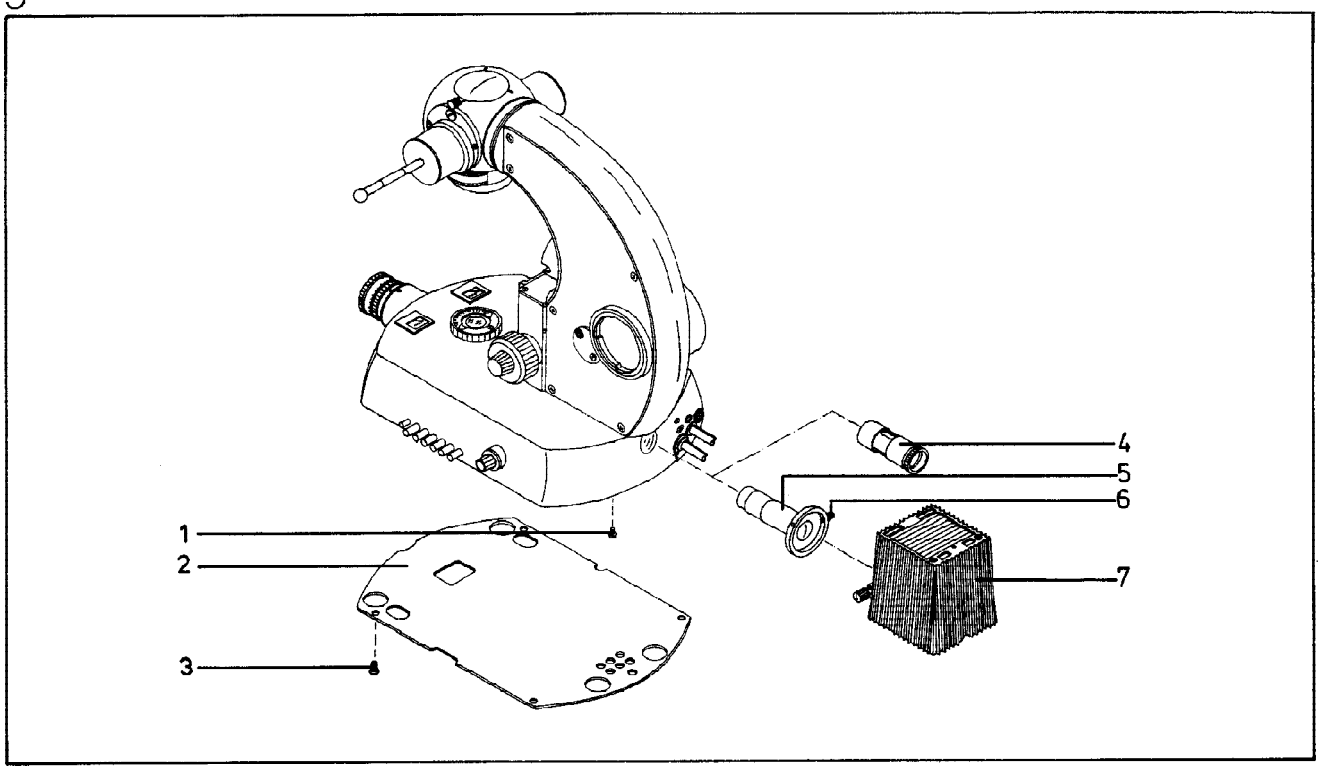
Mounting illuminator 100

- Loosen screw (6) of mounted tube (5) (46 70 40-9903), with the dovetails of the slightly tilted illuminator (7) press down the spring bolt and fit the dovetails.
- Tighten screw (6)
- The power switch on the right side of the microscope base must be OFF; connect illuminator 100 with power supply

To mount illuminator 100 on a microcope with 6 V 15 W low-voltage illuminator, proceed as follows:

- Loosen four screws (3) and remove cover sheet (2)
- Loosen screw (1) and take out tube (4)
- Slide in tube (5) and secure with screw (1)
- Secure cover sheet (2) with screws (3)

5



Mounting the stage assembly

Fitting the condenser carrier

- Flick up lever (7) and place right guide rail against change slide (8); let the left side snap in Lower condenser carrier (5) as far as it will go, flick down lever (7) and tighten it slightly

Mounting the specimen stage

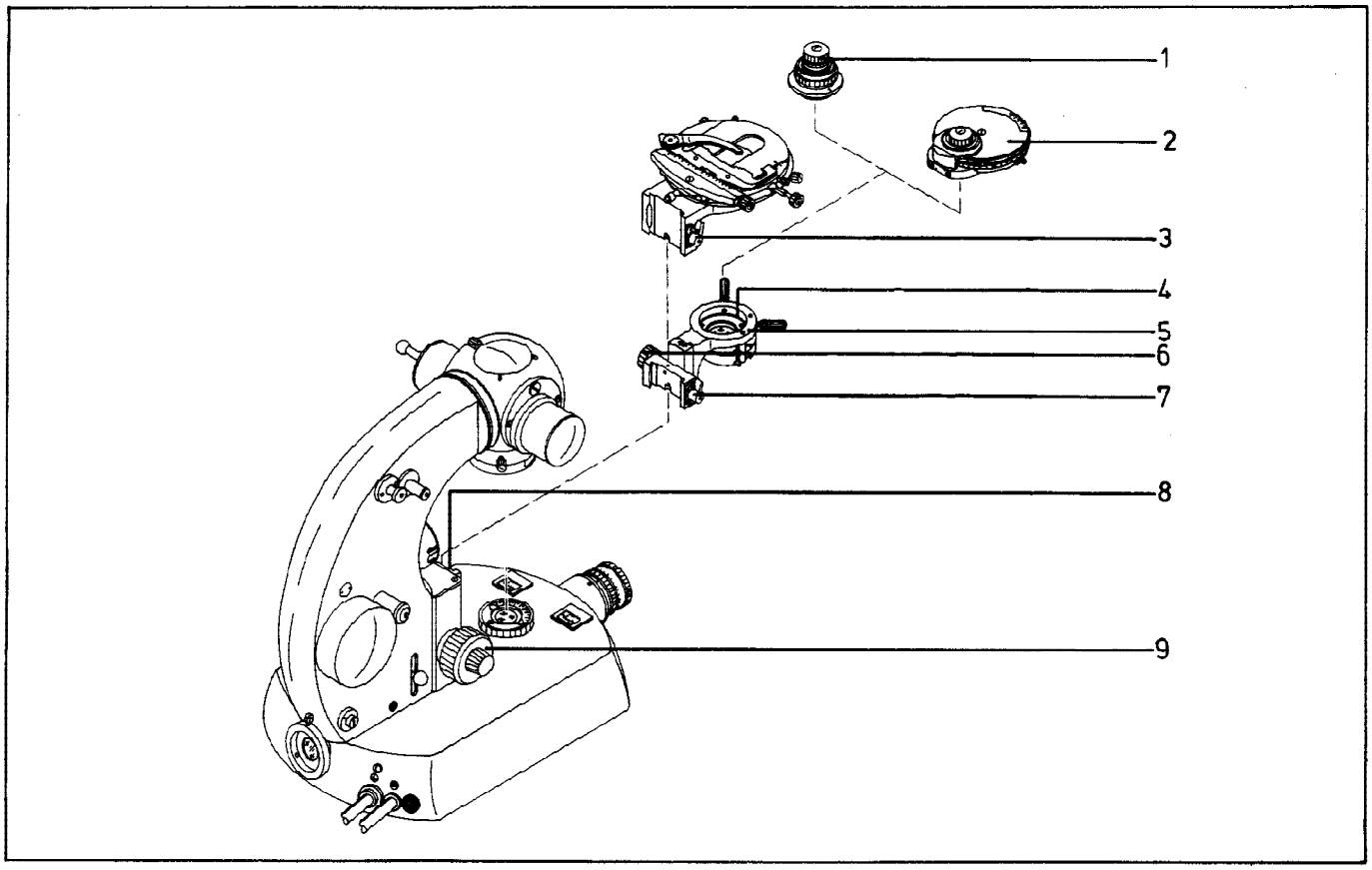
- Rack down change slide with coarse focusing control (9)
- Flick up lever (3) and place right guide rail against change slide; let the left side snap in, slide it down as far as it will go and flick down lever.

  Separately supplied stage and stage carrier must be assembled. The stage is screwed to the stage carrier with four screws.

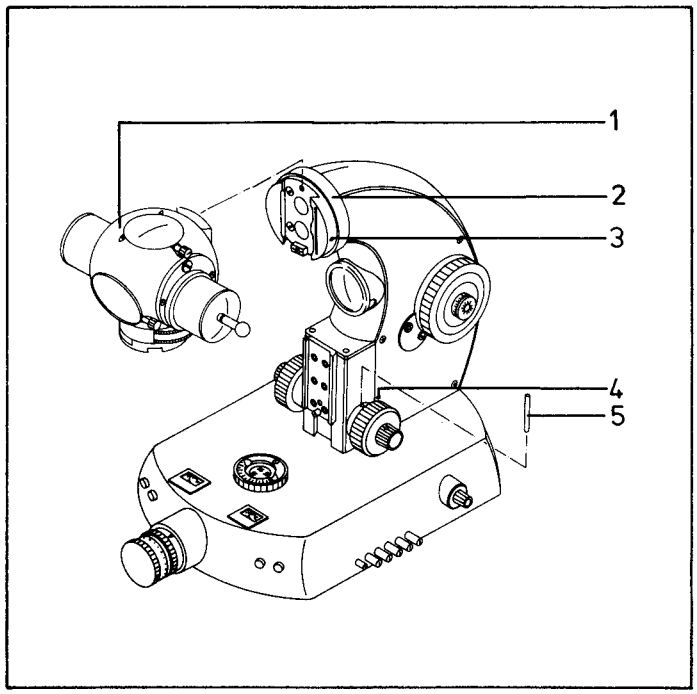
Fitting the condenser

- Rack up microscope stage completely with coarse focusing control (9) and rack down condenser carrier completely with knob (6).
- Press dovetails of single condenser (1) or multiple condenser (2) (e. g. for phase contrast or DIC) against spring bolt and fit into receptacle (4). The spring bolt must engage the notch of the condenser.
- With knob (6) rack condenser up completely

6



7



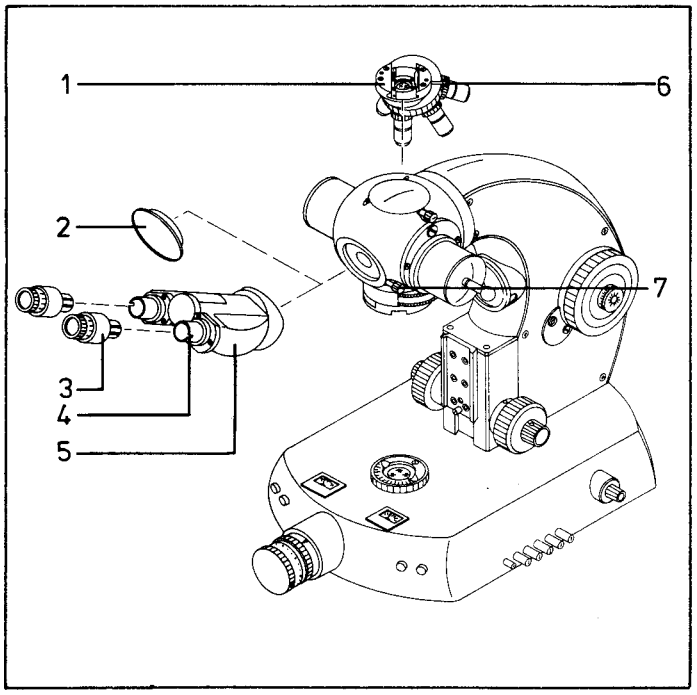
Correct adjustment of coarse/fine focusing control

The coarse/fine focusing control acts on the specimen stage. The motion of the coarse focusing control can be adjusted by plugging the supplied metal pin (5) into the borehole and moving it in the direction of the arrow to stiffen the motion. Set the fine focusing to a medium working range by turning the control until dot (4) is bracketed by the two lines. Then focus on the specimen by operating the control; the fine focusing will have enough play in either direction.
One interval of the graduation corresponds to a vertical movement of the stage of 2µm = 0.002 mm.

Mounting the tube head

- Loosen clamping screw of flat ring (2) and slide ring back
- Place slide of tube head (1) on top of guides of stand, slide it down as far is it will go and secure it with clamping screw (3). Pull ring (2) back and secure with screw to the left.

8



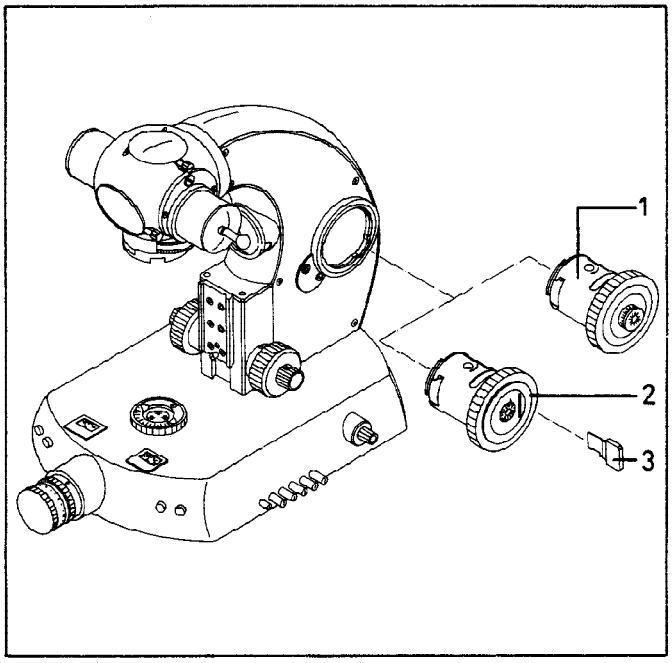
Fitting the nosepiece mount to the dovetail glide mount of the stand

- Screw a uniformly graded series of objectives (e.g. 2.5-10-25-40-100) into the nosepiece.
- Insert nosepiece (1) with objectives from behind left into the dovetail glide mount as far as it will go and secure with screw (6).

Mounting the inclined tube, fitting the eyepieces

- Unscrew clamping screw (7) and remove lid (2)
- Press down spring bolt of clamping screw (7) with dovetails of inclined tube (5).
- Mount inclined tube on tube head and hold it until it is secured with clamping screw (7).
- Plug eyepieces (3) into tubes; they must engage notch (4).

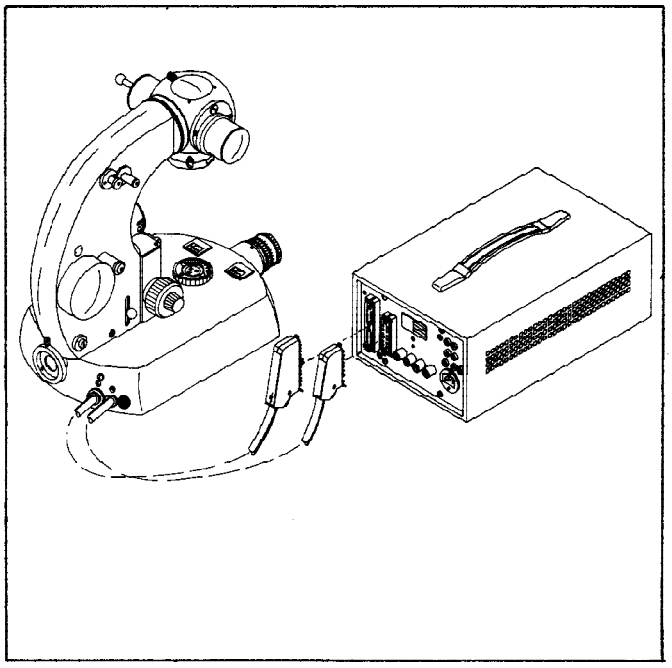
9



Mounting the film cassette

Load the cassette with film (see also p. 20 ff), and attach cassette with frame counter (1) (47 20 26-9901) so that the red line is opposite the red dot. Push in the cassette and lock it by a clockwise turn.
When using the cassette for negative idenfication (2) (47 20 27-9901) slider (3) with or without identification data must always be inserted in the slot.

10



Connecting the microscope with the power supply

On the power supply hook the plugs in on top and push them in at the bottom.

Operation of instrument

Preparatory work

Remember for the use of the lamps

The power switch on the right side of the microscope base must be OFF before connecting the power supply (47 20 83) to the mains. The mains voltage indicated on the dial must comply with the local mains voltage. If this is not the case, call the maintenance service.

The lamps can generally be operated at undervoltage, which increases their life. Short-term operation at overvoltage is allowed, but remember that halogen lamps are immediately destroyed when run at overvoltage.

The voltage is indicated by the voltmeter to the left of the microscope base.

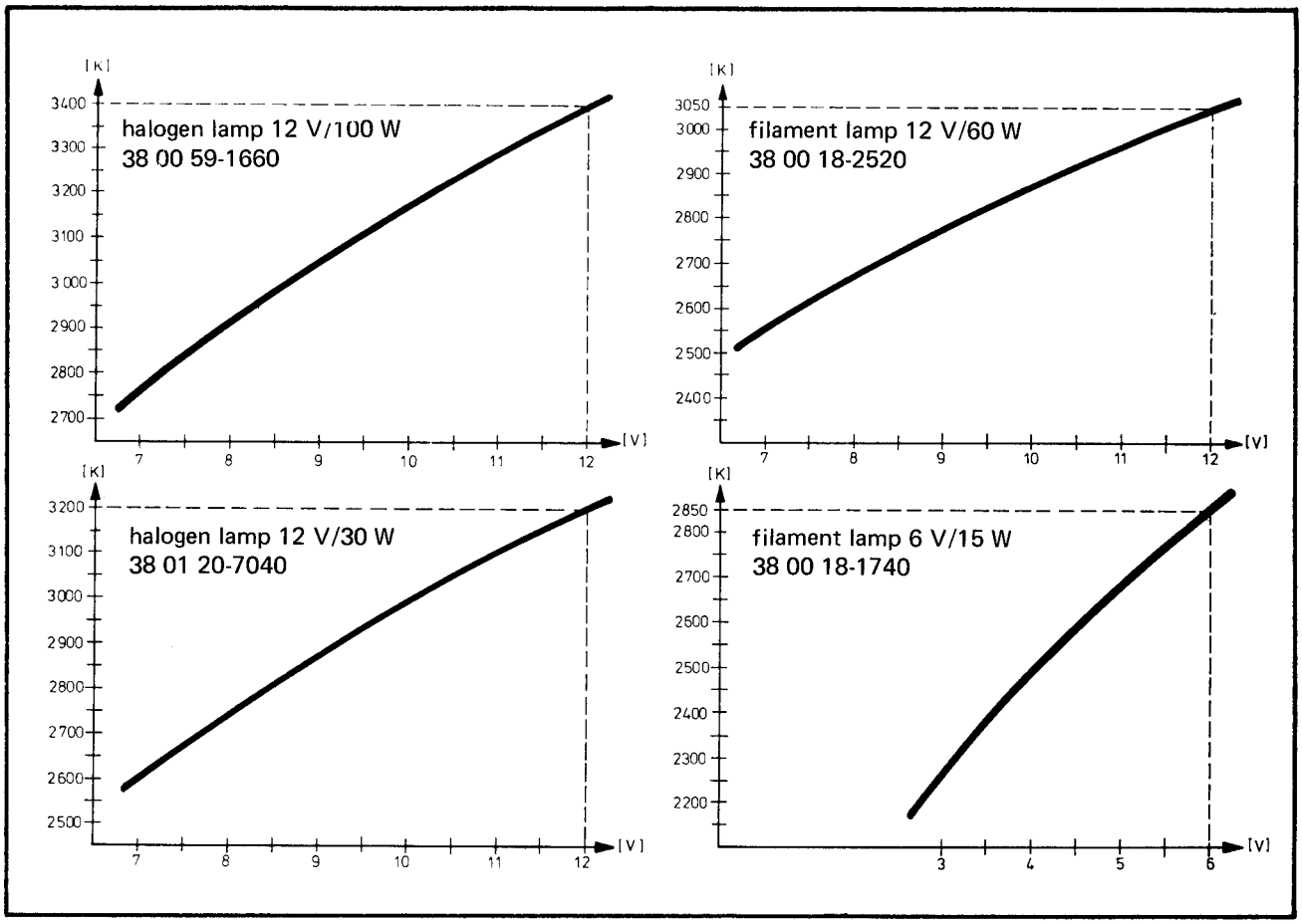
The correct light filter and the correct lamp voltage adjustment are important for **photography** with the microscope.
Green filter VG 9 (46 78 05) is generally used for **black-and-white** film. Like conversion filter CB 12 it is brought into the light path with the filter selector in the microscope base.*

It is recommended to run the lamp at 6 V 12 V rated voltage for **color photography.** Do not use conversion filters for artificial-light film, but blue conversion filter CB 12 (46 78 05) for daylight film.

Excellent results can be achieved in color photography if a certain color temperature is set by varying the lamp voltage, and this color temperature then ajusted to the color temperature of the folm with the aid of a conversion filter. Slight variations of the color temperature due to the optical system of the microscope cannot be considered. The four diagrams on the opposite page show the color temperatures of 6 V 15 W and 12 V 60 W filament and 12 V 30 W and 12 V 100 W halogen lamps as a function of the lamp voltage. The next table lists the color temperatures which must be set to arrive at the color temperature of the film with the indicated filters.

*The luminous field diaphragm holder accepts further conversion filters.

The four diagrams below show the color temperature T as a function of the lamp voltage U



Adjustment of light source to a color temperature of	Filter	Change of color temperature to
3100 K 2825 K 2400 K	CB 3 (46 78 52) CB 6 (46 78 51) CB 12 (46 78 50)	3400 K (artificial-light film)
2925 K 2700 K 2300 K	CB 3 CB 6 CB 12	3200 K (artificial-light film)
3300 K 3000 K 2750 K	CB 12 CB 15 CB 18	5500 K (daylight film)

CB 15 is a combination of a CB 12 and a CB 3 filter, CB 18 that of a CB 12 and a CB 6 filter.

Centering the light source

see the operating instructions of the illuminator.

Brightfield

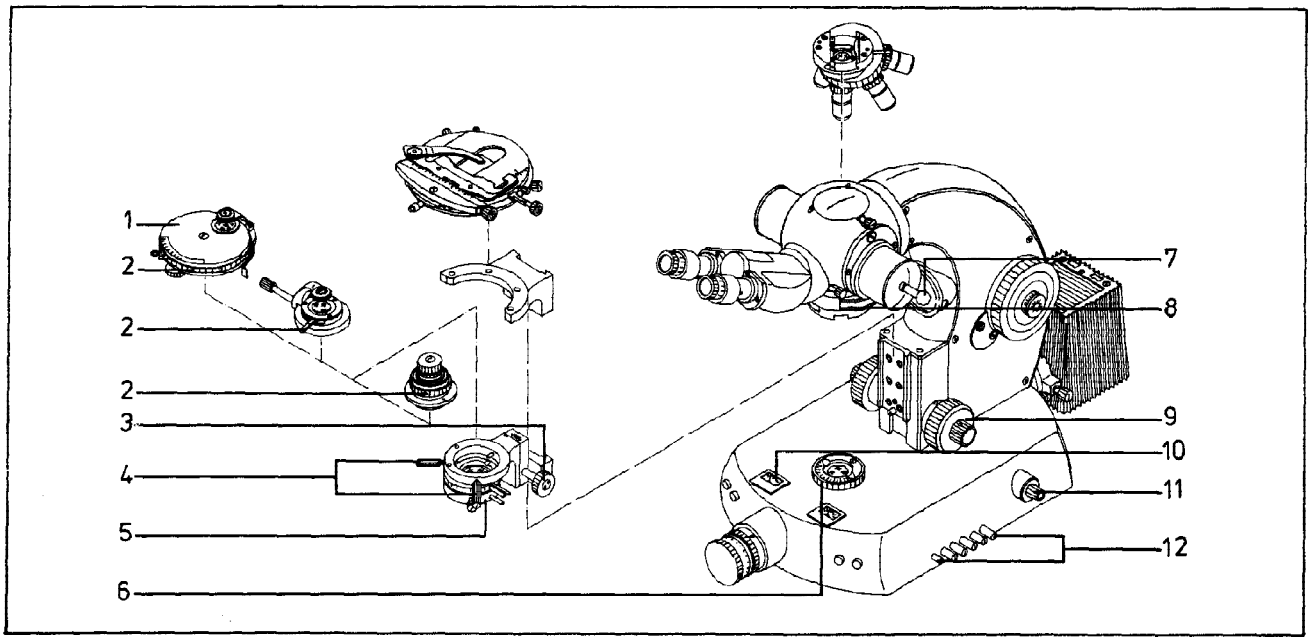
General information

Specimens which show sufficient contrast for differentation or which have been specially prepared by staining so that their structures become visible are examined in transmitted-light brightfield.

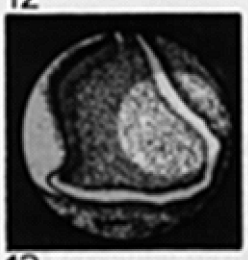
Adjusting the microscope

- Mount specimen in specimen holder
- Turn in a 10x or 16x objective
- Power switch (11) OFF; connect microscope illuminator to power supply and power supply to the mains
- Power switch (11) ON; adjust to rated voltage (indicated by voltmeter (10)). (For color photography see pp. 12/13 for lamp voltage and conversion filter)
- Set Optovar (8) to the factor 1.25
- Hinge up reflecting mirror, the light must leave the exit opening in the microscope base (luminous field diaphragm)
- Set pushrod (7) to photography position (black ring)
- Turn in the focusing eyelenses of both eyepieces until the diagonal double crosslines of the reticle are in focus
- Push pushrod (7) in
- Adjust both tubes until you see a circular sharply defined image
- Focus on the specimen with coarse/fine focusing control (9)
- Adjust illumination with neutral density filters (12)

11

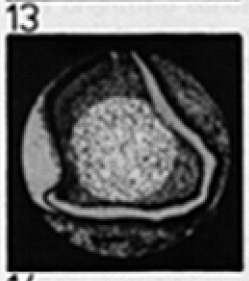


12



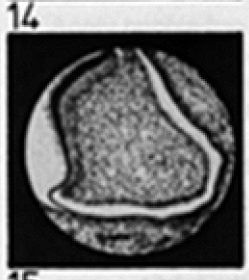
Close luminous field diaphragm (6) while observing through the tube. Lower condenser with knob (3) until a sharp image of the diaphragm is produced in the specimen plane (a multiple condenser (1) must be engaged in position J).

13



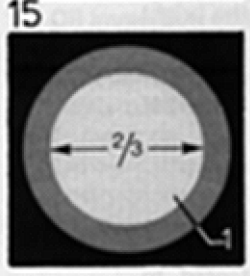
With the two screws (4) center the image of the luminous field diaphragm in the field of view.

14



Open luminous field diaphragm almost as far as the edge of the field of view, center it precisely and open it further until it just disappears beyond the edge of the field of view.

15



Adjust image contrast with condenser diaphragm (2). The diaphragm diameter should cover about 2/3 of the objective aperture when the objective exit pupil is observed with the Optovar in position Ph.

Center the lamp coil in the pupil as described in the operating instructions of the microscope illuminators.
Set Optovar again to 1.25 and correct the adjustment of the illuminating aperture to suit the specimen (resolution, contrast). Adjust the image brightness with neutral density filters, never use the aperture diaphragm for the purpose. After objective change only the aperture diaphragm size must be re-adjusted.

Oil immersion objectives

The condenser should be immersed if its aperture is higher than 0.9 and a high illuminating aperture is needed. Apply a drop of immersion oil (supplied with every immersion objective) to the bottom of the specimen slide and to the condenser front lens.
Every oil immersion objective is connected with the coverglass as follows: turn objective out of the light path, apply a drop of oil to the coverglass, push up the resilient mount of the objective front lens and turn it clockwise which locks it.
Turn in the objective, immerse the front lens and focus with the fine focusing control.

Low-power objectives

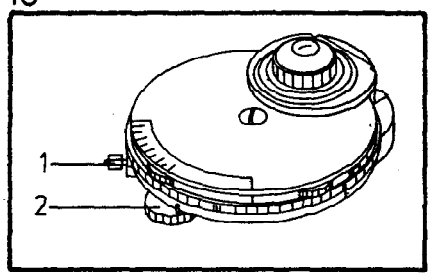
Objectives of 6.3 and lower powers image large fields. For adequate illumination of such fields swing out the condenser front lens or unscrew it and swing out the auxiliary lens (5). Lowering the condenser may improve the illumination. Open the luminous field diaphragm which acts as contrast aperture diaphragm.
The Planachromat 1.0/0.04 objective (46 20 10) to image large object fields has a built-in field lens and is used without condenser. The auxiliary lens remains swung in. This objective is not parfocalized with other objectives.

Phase contrast

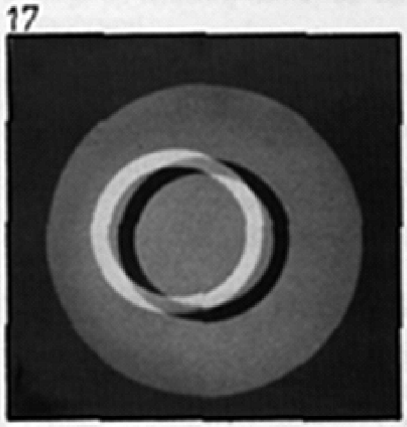
General information

Phase contrast reveals the shape and structure of unfixed, unstained specimens such as liver cells, bacteria, tissue cultures, smears and thin sections.
For the application of this method the microscope is equipped with phase-contrast condenser and phase-contrast (Ph) objectives.

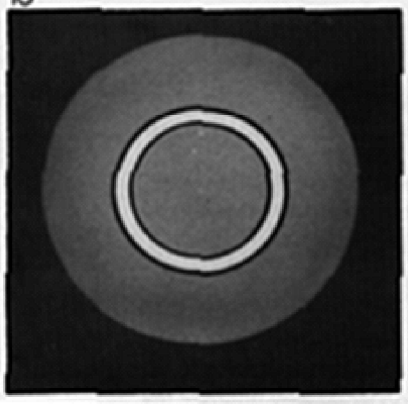
16



17



18



Operation

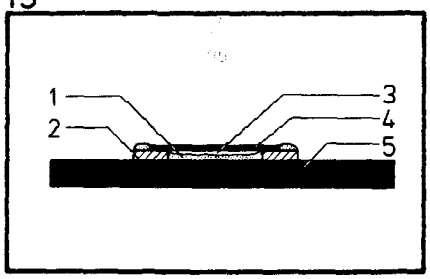
Screw Ph objectives into nosepiece.

- Mount Ph condenser in condenser carrier; the spring bolt must engage the notch. Set dial to J.
- Adjust the specimen in brightfield using a low-power objective (Ph 2).
- Bring a green filter (in the microscope base) into the light path.
- Turn dial of Ph condenser to the position for the Ph objective (marked on the objective), e. g. to 2 for a Neofluar 16/0.40 Ph objective.
- Set Optovar magnification changer to Ph and by turning its upper knurled ring focus on phase ring and annular stop (Fig. 17).
- With lever (1) and knob (2) of the Ph condenser move the bright ring until it lies exactly within the dark one (Fig. 18).
- Set Optovar again to 1.25 for example.
  The phase-contrast image can be seen through the binocular tube.

Specimen preparation for phase-contrast examination

To achieve satisfactory results, the specimen must be adapted to the optical conditions of the phase-contrast method. Because of the high sensitivity of the method, the preparation must be made particularly careful. Use only schlieren- and bubble-free specimen slides and coverglasses and remove before use any detergent residues. The specimen must be limited by plane surfaces, i. e. it is impossible to investigate suspensions or specimens on hollow-edged slides. We recommend an oil chamber for the examination of such specimens. The necessary plastic rings are supplied with the mounting medium (46 29 29). Such chambers are particularly useful to observe live specimens.

19



Oil chamber

1 Paraffin oil
2 0.5 -1 mm thick plastic ring
3 Culture medium
4 Coverglass
5 Specimen slide

Darkfield

General information

Darkfield is particularly suited to examine linear structures such as edges and fissures of unstained thin specimens, and reveals, for instance, flagella, spirochetae and bacteria with high contrast and in their natural colors.

The microscope equipment for darkfield is the same as for brightfield except for a darkfield condenser instead of the brightfield condenser. The darkfield condenser illuminates the specimen with a hollow cone of rays with an internal aperture larger than the objective aperture. Only the light refracted by the specimen reaches the objective; the image background remains dark.

Operation

Adjustment with immersion condenser

- Mount H-Ph-D condenser IV/Z (46 52 77) or ultra condenser (46 55 00) on holder Z (46 55 42) in condenser carrier.
- Apply bubble-free immersion oil to condenser front lens
- Place specimen under the microscope
- Rack up condenser until the immersion oil has reached the specimen slide
- Focus on the specimen with 10x or 25x objective
- Close luminous field diaphragm
- Adjust the condenser vertically until the light spot in the field of view is small, bright and sharply defined, and center this image of the luminous field diaphragm in the field of view with the centering screws.
- Open luminous field diaphragm until its image just disappears beyond the edge of the field of view.

Oil immersion objectives with NA higher than 1.0 must feature built-in iris diaphragms

- Push up resilient mount of objective front lens and lock it by a clockwise turn.
- Apply bubble-free immersion oil to the coverglass
- Immerse objective front lens
- Close iris diaphragm of the objective
- Focus on the specimen
- Re-adjust luminous field diaphragm
- Open objective iris so far that the dark background is not brightened

Adjustment with dry darkfield condenser

- Mount dry darkfield condenser in condenser carrier
- Turn dry objective into the light path; its aperture must be lower than that of the adjusted condenser
- Do not use immersion oil
- Make all other adjustments as described above

Differential interference contrast (DIC)

General information

With Normarski DIC differences in the optical phase length of a specimen are made visible as a relief. The contrast also depends on the orientation of the observed structure (azimuth effect). To achieve optimum contrast the specimen should be turned about its optical axis, which is best done with a rotary microscope stage.

Operation

Only the DIC adjustment proper is described here. For details about the coordination of DIC condenser, DIC auxiliary prisms of the condenser, objective and DIC slider als well as exchange of the condenser head and the DIC auxiliary prism of the single DIC condenser, etc. see operating instructions G 41-215/I.

Orienting polarizer and analyzer

- Remove DIC condenser turret (8) (46 52 73) or (46 52 85) or condenser (7) (46 52 67), auxiliary lens (10), objectives (3), DIC slider (4) and eyepiece from the light path.

- Swing in polarizer and set to oscillation direction East-West. A polarizer (9) (47 08 69) is swung into the light path, a rotary polarizer set to 0°, or a 32 mm dia. polarizing filter (11) (47 36 00) put into filter holder (9) or placed on filter holder (12) so that the two white lines of the filter mount are in East-West (right-left) direction.

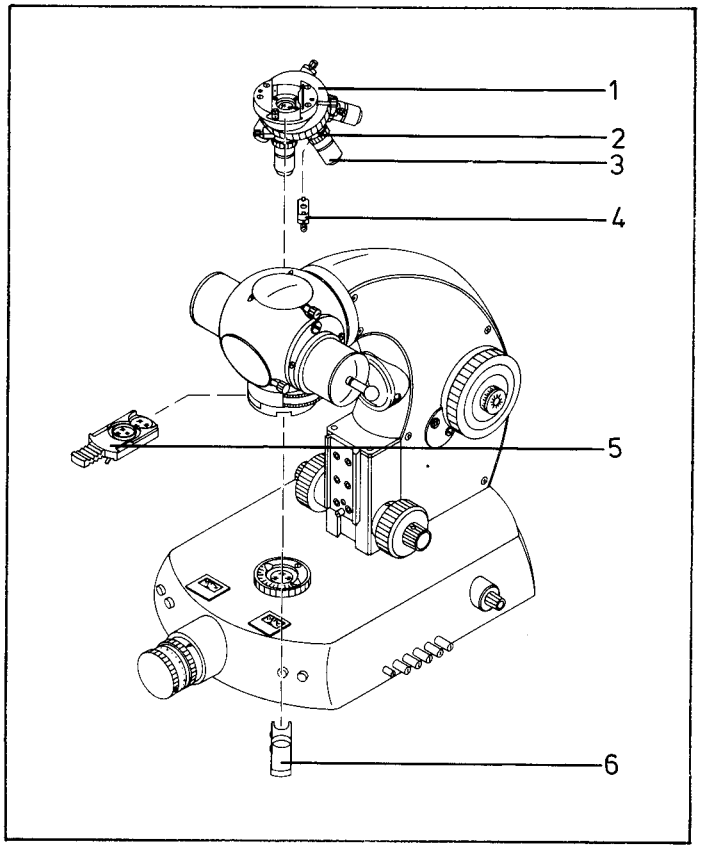
- Switch on the lamp, open the luminous field diaphragm and look through the empty tube. Slide in analyzer (6) (47 36 63-9901) as far as it will go. Set scale of rotary analyzer (47 36 62) to 0°; maximum extinction must be achieved in this position. In case of deviations correct with polarizer or analyzer. Retain maximum extinction position for DIC observation. Swing in auxiliary lens (10) and plug eyepiece into tube.

Mounting the DIC system

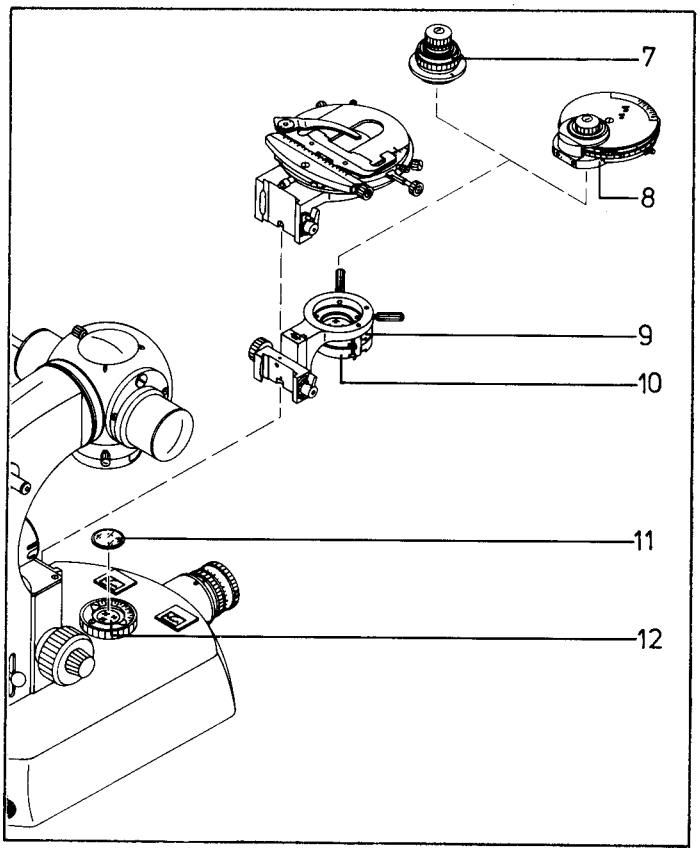
- Fit DIC condenser (7, 8) into condenser carrier; the spring bolt must engage the notch. The engraved T of single condensers must face the observer.

- Screw objectives (3) into quintuple nosepiece (1) (47 31 56) with five rigidly mounted, oriented DIC adapter rings (2) (47 44 65). Exchange the normal nosepiece for the DIC nosepiece. From left to right slide DIC slider for each objective (engraving on top) into the slot of the DIC adapter ring.
  Other (e. g. phase-contrast) objectives are screwed into the empty DIC adapter rings which guarantees exact parfocalization.
  Put proper auxiliary prism into condenser (46 52 67) and screw in the corresponding condenser head (see also operating instructions G 41-215/I).

20



21



Adjusting the specimen in DIC

- First adjust the specimen in brightfield with condenser turret (8) set to J. Remove auxiliary object (6), DIC slider (4), polarizer or analyzer (5) from the light path. Close aperture stop; otherwise unstained specimens will remain invisible.

- Turn in the DIC prism of the condenser which corresponds to the objective (condenser turret (8) in position I or II, single condenser equipped with corresponding prism and its iris diaphragm open); polarizer (9) or analyzer (11) must be in the light path.

- Slide DIC slider (4) into light path and adjust the contrast by turning its screw

  Color contrast is produced by a lambda plate (6) in the light path. The DIC system can also be used to observe stained specimens in amplitude contrast. It may be necessary for the purpose to slightly turn polarizer (9) or analyzer (11) out of crossed position.

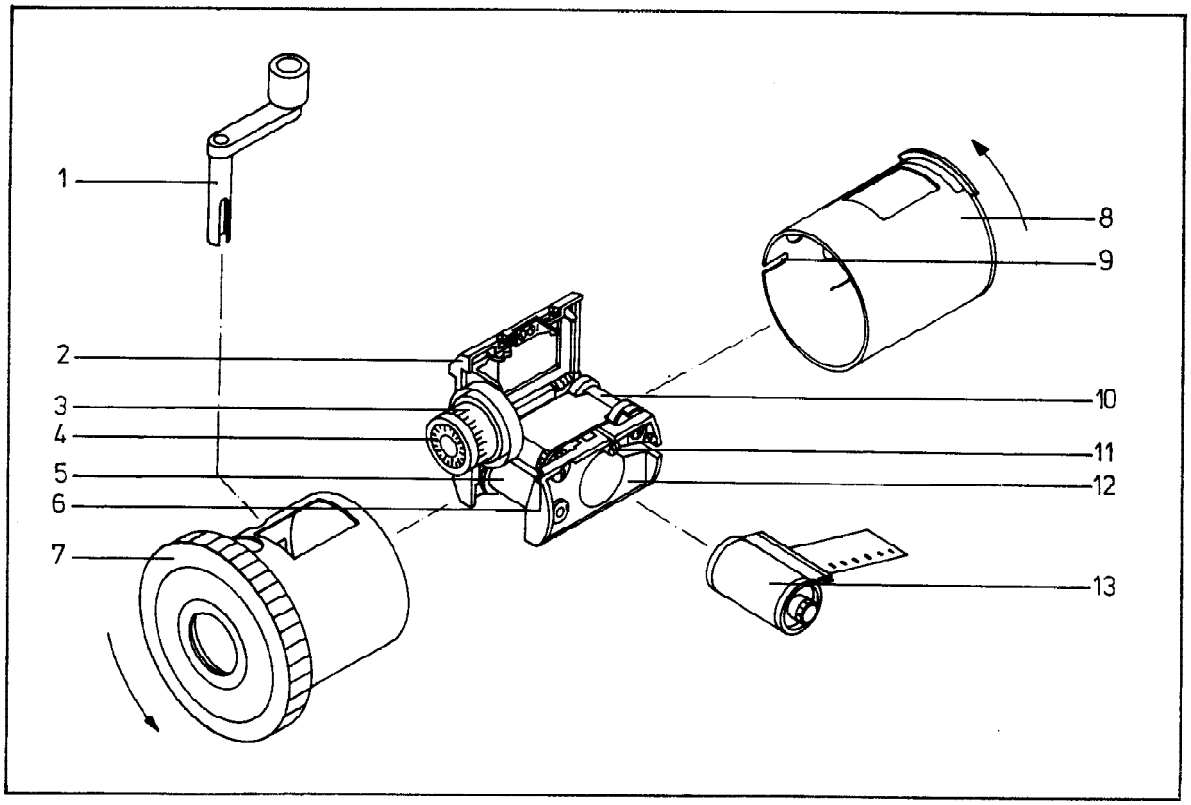
Camera

Automatic photography

Loading the cassette with a film cartridge

- Turn the cassette fully counterclockwise (it is provided with a red mark for re-fitting) and remove it from the housing.
- Press on the cassette bottom, turn upper part (7) clockwise and pull out inner housing (8).
- Remove spool holder (12) from inner housing (8).
- Lid (2) opens when pushing slotted knob (11)
- Load cartridge (13), pull film (emulsion up) over spool (10) so that the sprockets of transport spool (6) engage the film perforation.
- Thread film behind spool (5) and fix it in the usual manner. Tighten film by turning spool (5). Close lid and let it snap in.
- Put spool holder into inner housing (8); the pin of the spool holder must engage notch (9).
- Assemble cassette, close it by a counterclockwise turn, fit it in the microscope (red mark) and lock it by a clockwise turn.
- Set dial (4) to the film type used. Make two blind shots (e. g. with pushbutton B) and set frame counter (3) of cassette to 35.
- Set speed selector to the film speed
- The exposed film is rewound with crank (1).

22



Fitting the cassette and negative identification

Attach cassette to housing – red line opposite red dot – push it in and secure it by a clockwise turn.

Every film advance is recorded by the cassette (1) (47 20 26-9901) with frame counter. It stops the automatic system if no film is loaded, the film is torn or the end of the film reached.

Cassette (2) (47 20 27-9901) for negative identification has no frame counter. Film advance is stopped only when the end of the film is reached.

The supplied foils are coated on one side, and two small holes limit the 4 mm wide margin for identification data. Entries made with pencil can be erased any number of times.

The lettered foil is slid under the spring clip of slider (3); the latter is slid into the slot of the cassette as far as it will go.

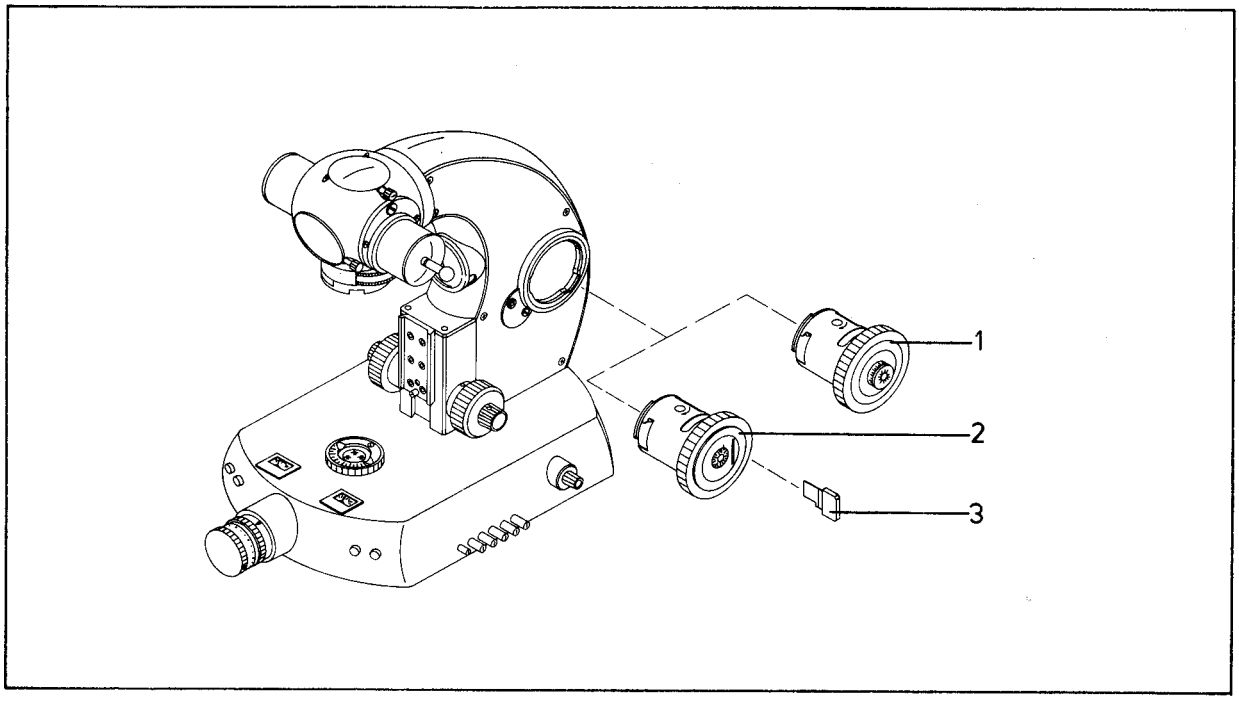
Foils with image scales (47 20 92) feature L-sphaped recesses where objective magnification (e. g. 40) and Optovar position (e. g. 1.25) are indicated. A scale bar (e. g. 50 μm = 0.05 mm) can be superimposed onto the image.

Using, for example, the quintuple nosepiece for wide field with the factor 0.63,

the Optovar is operative in position	1.25	1.6	2
with the factor	0.8	1	1.6

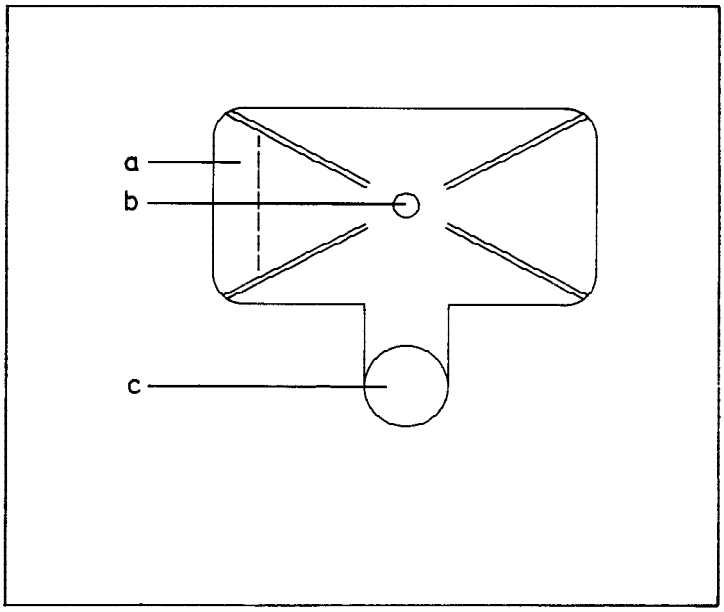
When cassette (47 20 27-9901) with negative identification is loaded with a film, slider (3) with or without foil must be inserted in the slot of the cassette.

23



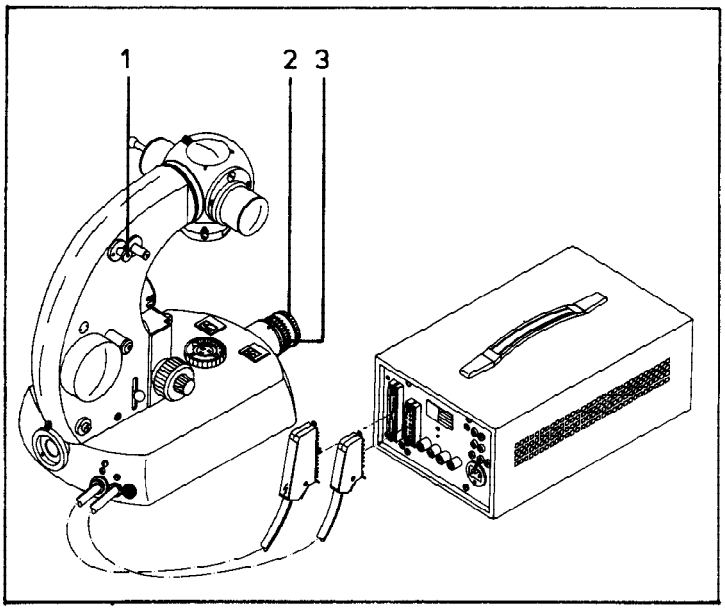
Settings and exposure

24



a negative identification area
b spot measurement of automatic system
c the light sensor of the computer flash determines the flash duration according to the brightness of this area

25



Adjust the specimen image in the tube as described on p. 14 ff for brightfield.
Pull the pushrod of the reflecting system as far as the black ring. The image section that will be photographed is visible through the tube. The picture will be sharp only if both the double lines and the image in their direct vicinity will be in focus. Focusing is particularly important at low magnifications. Like in the camera viewfinder, the image section that can be seen when the reflecting system is in position for photography is smaller than on the film. To avoid vignetting the luminous field diaphragm should be opened further.

Leave knob (1) pushed for integrated measurement. The automatic system then determines the exposure time according to the mean brightness of 2/3 of the image field center. (For spot measurement see opposite page). The light sensor of the automatic exposure control is an HTV 931 A photomultiplier which is insensitive to red light.
Film material with speeds from 5 DIN (2.5 ASA) to 40 DIN (8000 ASA) can be used.

With selector (2) and correction switch (3) set automatic exposure control to film speed and developer so that the shutter is closed after the correct exposure time.
For black-and-white photography set the film speed indicated by the manufacturer of the film.

For automatic photography on color reversal film the film manufacturer usually recommends test exposures before starting a film series. 3 DIN intervals and/or changes of ASA values by a factor of 2 can be set with the film speed selector. Each step towards higher values shortens the exposure time by one half. With the film speed correction switch intervals of ± 1 DIN or changes of ASA values by a factor of 1.26 are possible.
For filters and lamp voltages see pp. 12/13.

The measuring instrument to the right on the microscope base is the brightness indicator for photography. It deflects in the case of short exposure times. No deflection indicates exposure times of 1 sec or longer. Full deflection which corresponds to an exposure time of less than 1/100 sec, stops the automatic exposure control. The intensity of the illumination must then be reduced by varying the lamp voltage (for black-and-white film only) or by the use of light filters, or a lower-speed film must be used, or flash exposures made.

Test exposures with the automatic exposure control

Starting from the given film speed (e. g. 18 DIN/50 ASA) make three test exposures at two times longer exposure times and two at two times shorter ones.

Example

DIN	9	12	15	18	21	24
ASA	6.3	12.5	25	50	100	200

For photography use that position of the film speed selector which brought about the best picture.

Pushbutton A which is pushed when the reflecting system is in photography position, opens the camera shutter and releases automatic operation. It closes the shutter again after the correct exposure time. The film is advanced and the camera ready for the next exposure.
Pushbutton A lights as long as the shutter is open.
When the automatic exposure control is released, e.g. by pushing button A, the measuring instrument to the right on the microscope base indicates the exposure time. The time the pointer needs to reach its starting position is a measure of the exposure time.

Pushbutton ! lights when the camera is ready for exposure, it **flashes** if no film is loaded, the film is torn, or the end of the film reached.
Push this button to advance the film by one frame without exposure, or to release the locked automatic exposure control or film advance.

Brief instructions for photography with automatic exposure control

- The microscope is ON
- The image is adjusted in the tube
- The reflecting system is in photography position (black ring) and the eyepieces are focused on the double-line cross
- The cassette with loaded film is inserted
- The upper left knob on the Photomicroscope is pushed in (integrated measurement)
- Focus the image with the fine focusing control
- Check correct film speed setting
- Push button A. The noise of the film advance indicates that the camera is ready for the next exposure.

- Presser la touche A sur le pied du statif. Le transport du film que l'on entend nettement indique que la chambre est de nouveau prête pour la prise de vue suivante.

Microscope magnification and image scale

Microscope magnification

The microscope magnification when viewing the image through the tube is determined by multiplication:

$$M = M_{obj} \times T \times M_{eyep}$$

M = microscope magnification
M_{obj} = objective magnification
T_{Gr} = factor of nosepiece (normally = 1, wide field = 0.63)
T_{Opt} = Optovar factor (1.25 – 1.6 – 2)
M_{eyep} = eyepiece magnification (e. g. 10)

With an eyepiece of the same field-of-view number a widefield system (revolving nosepiece with a factor of 0.63) offers 2-1/2 times (240 %) more area for surveying. If you want the same magnification with a wide-field system as with a normal system, use an eyepiece with a 1/0.63 higher factor (e. g. a 12.5x eyepiece instead of 8x or a 16x eyepiece instead of 10x). The wide-field system can be used only in combination with flatfield objectives and wide-angle eyepieces.

Image scale

This is the ratio of a distance on the film to its true length. The image scale of the integral camera of the Photomicroscope is the product of: $M_{obj} \times T_{Opt}$ x factor of projection lens 3.2

Image scale on film with normal nosepiece

Objective	Optovar set to		
	1.25	1.6	2
1	4	5	6.3
2.5	10	12.5	16
4	16	20	25
6.3	25	32	40
8	32	40	50
10	40	50	63
16	63	80	100
25	100	125	160
40	160	200	250
63	250	320	400
80	320	400	500
100	400	500	630

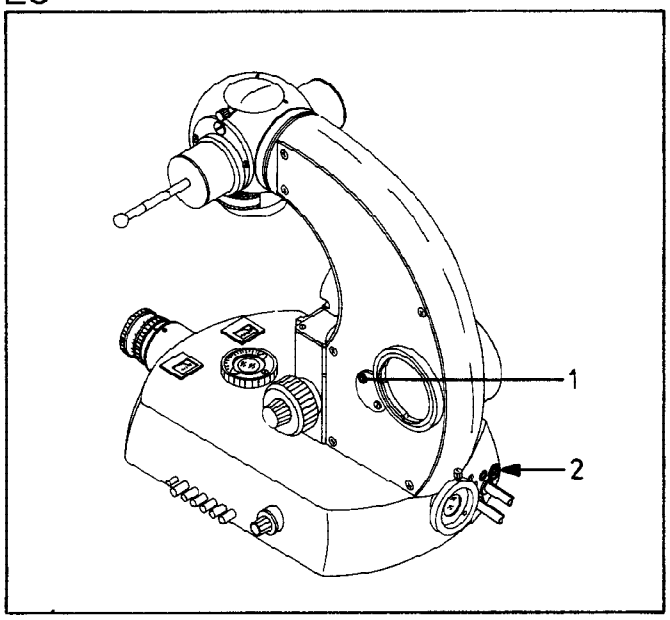
Image scale on film with nosepiece with wide-field system (factor 0,63)

Objective	Optovar set to		
	1.25	1.6	2
1	2.5	3.2	4
2.5	6.3	8	10
4	10	12.5	16
6.3	16	20	25
8	20	25	32
10	25	32	40
16	40	50	63
25	63	80	100
40	100	125	160
63	160	200	250
80	200	250	320
100	250	320	400

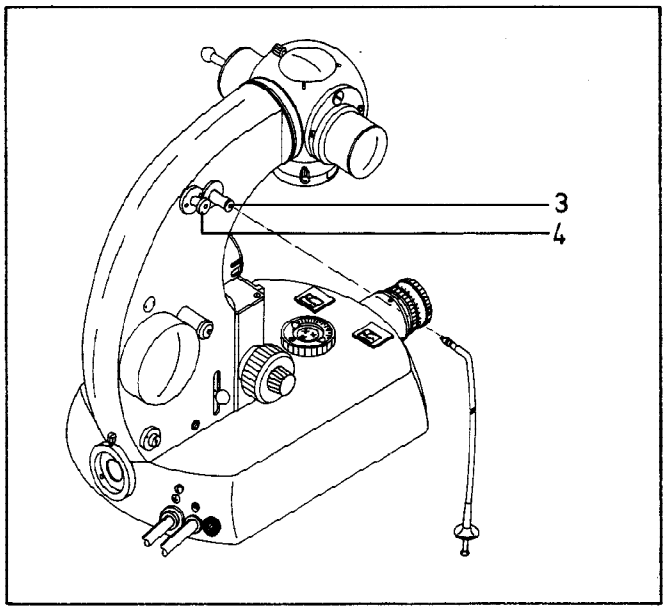
With MC 63 attachment camera the image scale on film of a large-format camera is:
$M_{obj} \times T_{Gr} \times T_{Opt} \times M_{eyep} \times 0.8$
where M_{eyep} is the magnification of the photographic eyepiece.
(See also operating instructions G 41-415).
To ensure exactness of your work, calibrate once every optical combination with a stage micrometer.

Special applications

26



27



Multiple exposure (1)

As long as pin (1) is pushed down, e.g. with a screwdriver, multiple exposures are possible. The film advance is blocked. The film advance motor works as usual but its connection to the cassette is interrupted.

If the exposure time is known (e.g. previously determined as switching time of the automatic system):

Pushbutton B opens the shutter electrically; when released it closes the shutter.

Pushbutton T opens the shutter and closes it when pushed again and at the same time unlocked.

Remote control (2)

Like with pushbutton A the automatic exposure control can be released by a remote control, a pedal switch or a pulse generator which is plugged in at the back of the microscope base (arrow) between sockets 1 and 2.

Dull images (3)

To expose images of low light intensity connect a cable release at (3). When pushed the automatic system opens the shutter as if pushbutton A were operated. As long as the cable release is pushed all light is directed on the film but during this time the specimen cannot be observed. Observation is possible when releasing the cable release; for exposure push it again. Like the supplied one the cable release should protrude at least 17 mm.

Spot measurement (4)

Pull this knob for spot measurement with the automatic system. The exposure time is then measured according to the intensity of the illumination within the circle in the center of the reticle. Use this kind of measurement if the contrast is extreme and small areas of the specimen are important for image content and exposure.

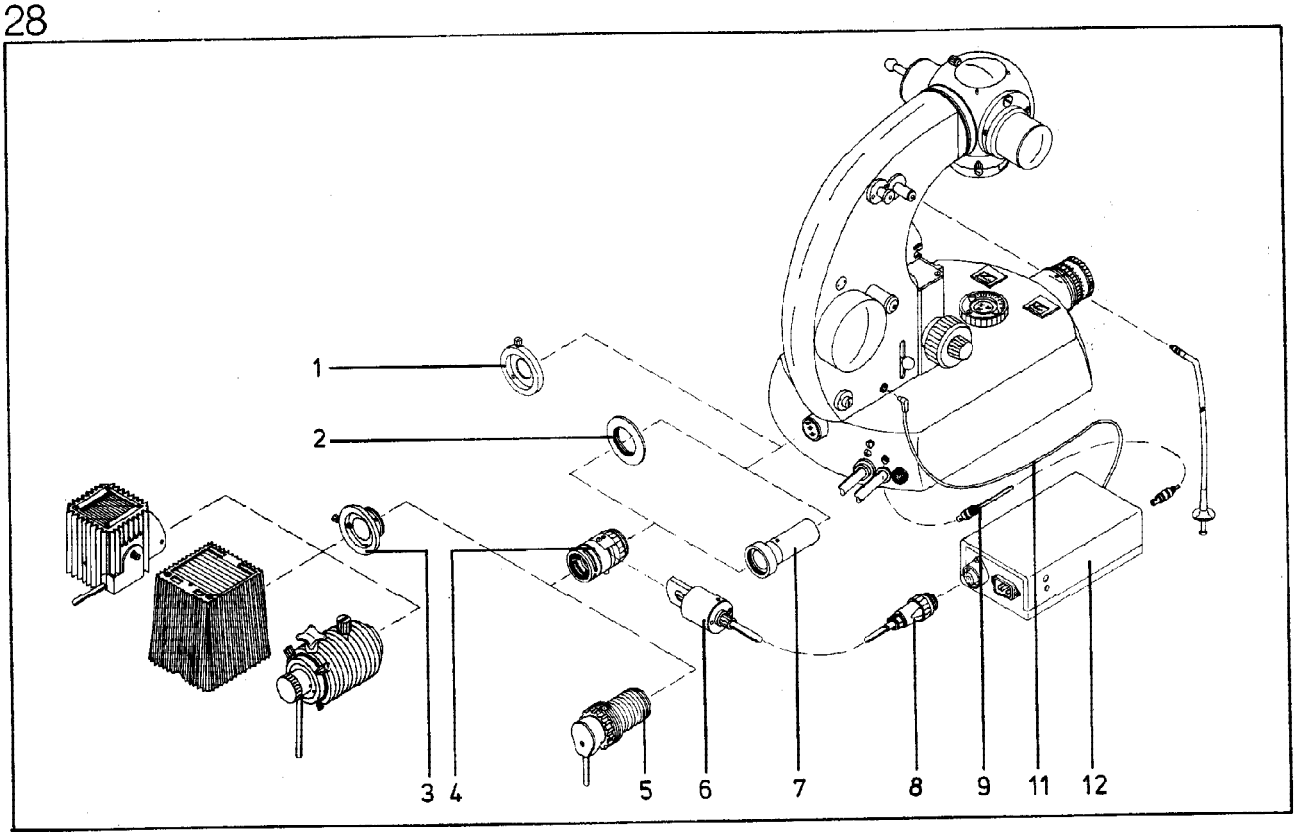
Computer flash

The built-in light sensor measures the image brightness in the film plane and automatically determines the flash duration between 1/50 000 and 1/500 sec. Xenon flash is excellent for true color reproduction on daylight color film. Films with speeds between ca. 6 and 27 DIN can be used.

Assembly

- If the microscope is equipped with tube (46 70 40-9903) for illuminator 100, exchange dovetail receptacle (1) for ring (2) (42 70 09).
- If the microscope is equipped with tube (46 70 50), exchange this tube for tube (7) (46 70 45) (see also p. 8).
- Insert flash slider with cable (6, 8) (46 80 46) in double flash lamp condenser (4) (46 70 20) and secure with screw.
- Plug cable to microflash II (11). Screw double flash lamp condenser (4) to lamp housing with lamp condenser (5) (46 72 50). (Via adapter (3) (46 70 42) illuminators 30, 60 and 100 can be attached instead of the aforementioned lamp housing).
- Equip lamp housing with illuminators and make electrical connections (see also p. 30).
- Secure flash unit by tightening clamping ring towards the microscope, which determines the lateral tilting position of the illuminator.
- Plug flash cable (0.5 m) (10) (38 00 74-4840) to sockets of flash generator and Photomicroscope. Plug sensor cable (9) (39 79 02-8003) to sockets of flash generator and Photomicroscope.
- Connect flash generator to the mains; the power switches of microscope and flash generator must be OFF.

28



Flash generator (39 29 03-9901)

1 Power switch: postion 0 = OFF
position 1 = ON

2 Pushbutton for flash release, e.g. for test release

3 Step switch to change the speed in 4 steps

4 Signal lamp lights if there is sufficient light after flash discharge

5 Socket for flash cable

6 Signal lamp lights when the flash generator is ready

7 Socket for light sensor of Photomicroscope

8 Socket for flash slider cable

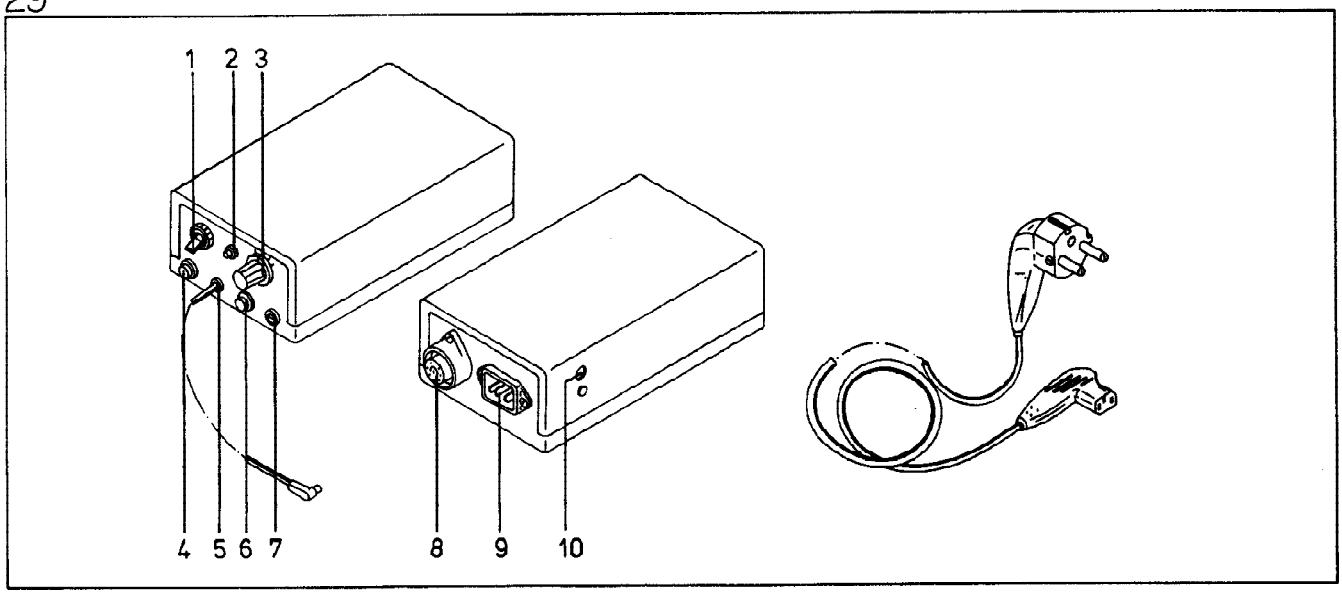
9 Mains socket

10 Voltage indicator

Technical data

Mains voltage	100-110-115-127-220-240 V
Frequency	50 ... 60 Hz
Power consumption	12 VA
Output	45 Ws
Max. flash frequency	12 ... 15 sec
Fusing	fuse switching off the mains voltage in case of high temperatures and on again at normal temperature
Note	to avoid overheating the instrument, interrupt for ca. 3 min after ca. 50 flash releases

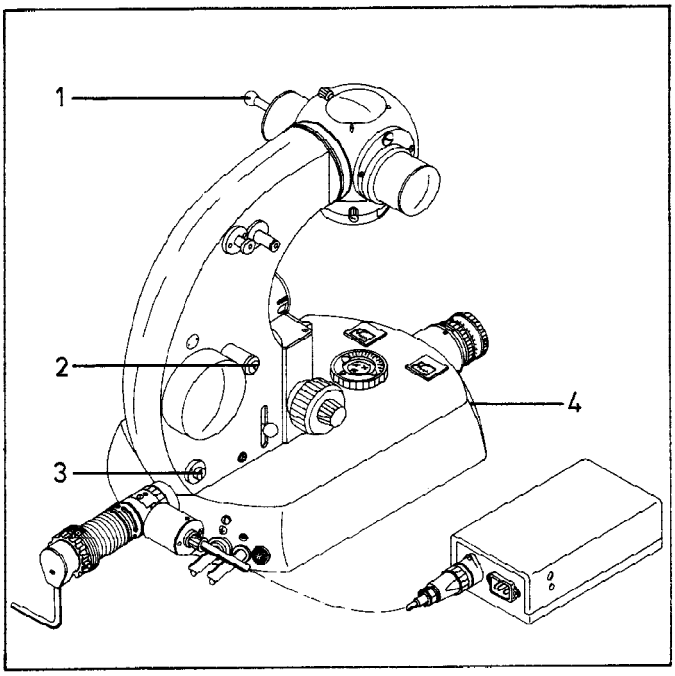
29



Exposure

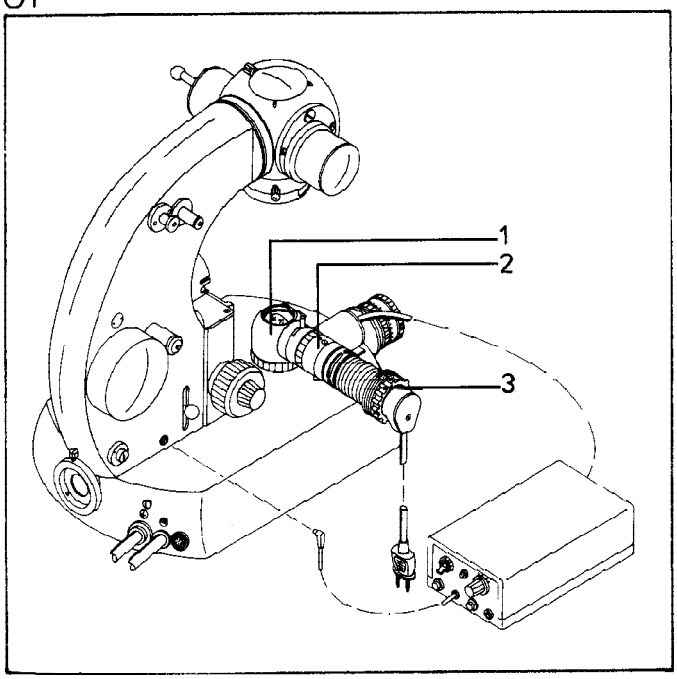
Special note: for a better control by the computer flash bring an in-base neutral density filter 0.12 into the light path under normal conditions (brightfield illumination) and with objectives of 10x and lower magnifications. Use no filter when working with objectives of higher than 10x magnification. When applying light-attenuating methods such as DIC work without neutral density filter also with objectives of less than 10x magnification.

30



- A film is loaded in the cassette
- Pushrod (1) is set to black ring for photography. Make sure that no extremely bright or dark feature lies at the site of measurement of the light sensor (2) of the computer flash. The light sensor measures within the circular area below the outlines of the photographic format.
- Power switch of flash generator ON
- Push stand-by button (3)
- Pushing button B (4) shortly opens the shutter and at the same time fires the flash via flash terminal. Push stand-by button (3) again if you want to use the normal automatic exposure control of the Photomicroscope.

31



The computer flash can also be attached to the luminous field diaphragm insert by way of mirror housing with iris (1) (46 70 12). Double lamp condenser (2) will then be mounted next to mirror housing (1). This combination can be used with low-voltage illuminator (3) only. Neutral density filters are put on the mirror housing.

Calibration

Light sensor (2) is adjustable with a coin to different speeds, synchronous with the speed switch of the flasch generator. For an exact adjustment make a series of test exposures.

Switch positions for exact calibration

Film speed	DIN	6	9	12	15	18	21	24	27
	ASA	3	6	12	25	50	100	200	400
Position of light sensor of Photo-microscope III	1					1	2	3	4
	2				1	2	3	4	
	3			1	2	3	4		
	4		1	2	3	4			
	5	1	2	3	4				
		Switch position of flash generator							

As a rule, set the Photomicroscope's light sensor to 1 or 2 for a speed range between 18 and 27 DIN and/or 15 and 24 DIN.

Important note
Because the maximum flash duration is limited, do not use low-speed films at high magnifications and/or in DIC. Because of their high resolving power it is useless to apply low-speed films in photomicrography, where not the film material but the optical system of the microscope limits the resolving power.

Please note that if the green lamp Control of the flash generator lights after flash discharge, there was enough light for correct exposure. If this lamp does not light, the limit of capacity of the flash is reached or has been exceeded. Lower magnification, no light-attenuating filters or higher-speed film will then ensure correct exposure.
The capacity of the flash can be expanded by the use of a cable release (top left of the microscope). You then cannot observe the specimen during exposure, but double the amount of light will reach the film.

Components and accessories

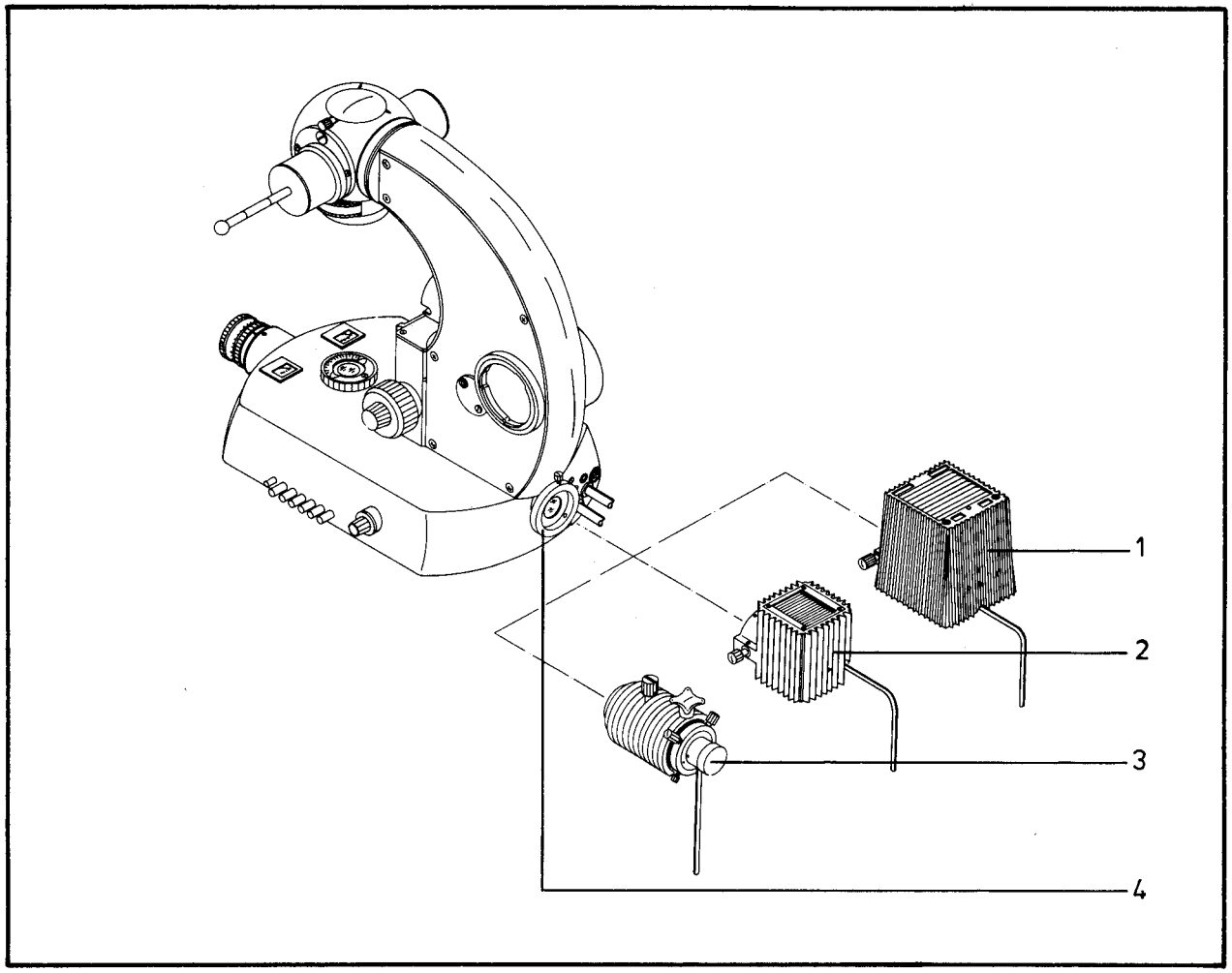
Microscope illuminators

One illuminator 100
Two illuminators 30
Three illuminators 60

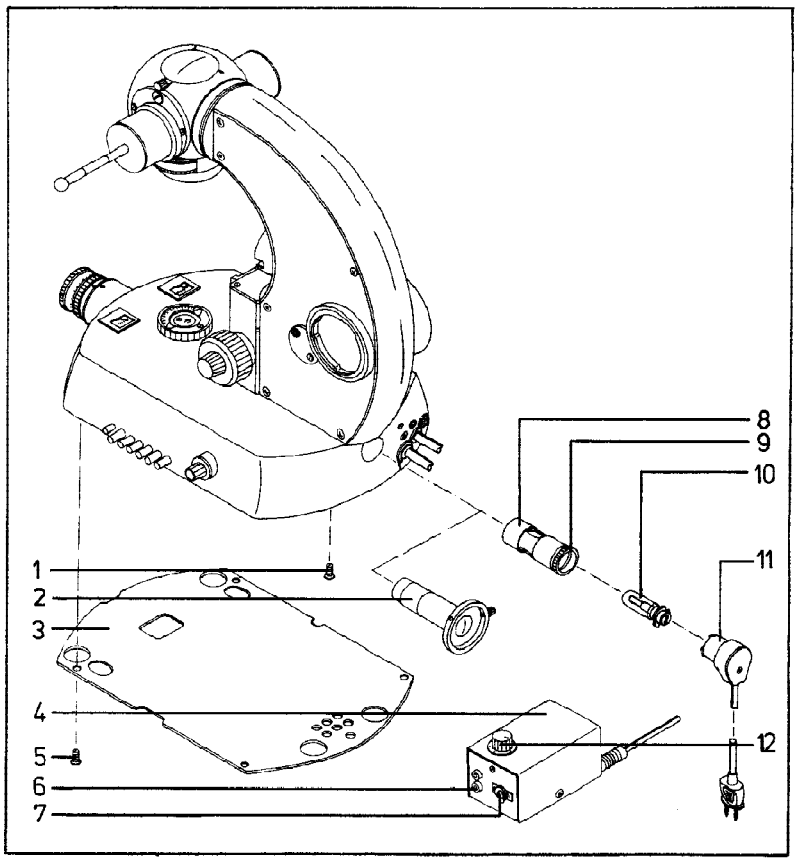
} are mounted on tube (4) (46 70 40-9903)

Because assembly, lamp exchange and adjustment of illuminators 30, 60 and 100 are described in the corresponding operating instructions, only the 6 V 15 W low-voltage illuminator is dealt with in this manual.

32



33



6 V 15 W illuminator

Tube with lamp condenser (8)
46 70 50

6 V 15 W low-voltage filament lamp (10)
38 00 18-1740

Socket (11) of 6 V 15 W lamp
46 80 10-9903

6 V 15 W step-up transformer (4)
39 25 64-9903

Two lamp cable sockets (6); connect only a 6 V 15 W lamp.

ON-OFF switch (7).

Step switch (12) to vary the lamp voltage in steps of 1 V.

Assembly

Exchange tube (2) for connection of illuminator 100 for tube (8): loosen for screws (5), remove plate (3), loosen screw (1), pull out (2), insert (8) and secure it.
Hold filament lamp (10) with a soft cloth, plug it into socket (11) (red dot opposite red pin). Push lamp in, turn it clockwise to the stop and let it snap in. Remove fingerprints on the bulb. Turn ring (9) until its red dot is opposite the red dot of tube (8). Slide filament lamp in socket into tube (8) and secure with ring (9).
Connect lamp cable to the mains via transformer.

Technical data of step-up transformer 39 25 64-9903

Primary voltage 110-127-220-240 V
Frequency 50 ... 60 Hz
Power consumption 25 VA
Secondary voltage 3-4-5-6-7-8 V

Fusing acc. to DIN 41662

F 1	100 ... 127 V	T 0.315 A	250 V	38 01 27 0150 000
	220 ... 240 V	T 0.16 A	250 V	38 01 27 0120 000
F 2		T 3.15 A	250 V	38 01 27 0260 000

Transmitted-light condensers

Multiple condensers	Bright-field	Dark-field	Phase contrast	DIC	Cat. No.
Achr.-apl.* NA 1.4	●	●	●		46 52 77
Achr.-apl. NA 1.4	●		●	●	46 52 85
Achr.-apl. NA 0.63 long back focal lengths: 7 mm in air, 11 mm in glass	●		●		46 52 72
Achr.-apl. NA 0.63 long back focal lengths: 7 mm in air, 11 mm in glass	●	●	●	●	46 52 73
II Z with swing-out lens NA 0.9	●		●		46 52 70-9906
II Z with swing-out lens Pol NA 0.9	●		●		46 52 82-9906
Single condensers					
Achr.-apl. NA 0.32	●				46 52 67
Z with swing-out lens NA 0.9	●				46 52 52
Z with swing-out lens NA 1.3	●				46 52 53
Z with swing-out lens Pol, NA 0.9	●				46 52 62
Z with swing-out lens Pol, NA 1.3	●				46 52 63
Darkfield ultra condenser NA 1.2/1.4 for objective apertures 0.75-1.0		●			46 55 00
Darkfield dry condenser NA 0.8/0.95 for objective apertures 0.6-0.75		●			46 55 05
Darkfield dry condenser NA 0.6/0.85 for objective apertures 0.4-0.6		●			46 55 06

*condenser sets with exchangeable front lens:

Front lens NA 0.63	●				46 52 55
Front lens NA 0.9	●				46 52 56
Front lens NA 1.4	●				46 52 58
Front lens NA 0.63 Pol	●				46 52 65
Front lens NA 1.4 Pol	●				46 52 68

Achromatic-aplanatic (achr.-apl.) condensers form an image of the luminous field diaphragm without disturbing color fringes, which ensures homogeneous illumination. Therefore they are preferable for color photomicrography, color TV microscopy and similar tasks. Optimum image contrast can be adjusted with the aperture diaphragm.

Objectives

Magnification/NA	Working distance (mm)	Covergl. thickn. (mm)	Cat. No. brightfield	Cat. No. phase contrast
Planapochromat objectives				
4/0.14	9.2	-	46 02 40	
10/0.32	0.35	-	46 04 40	
25/0.65	0.14	0.17	46 06 40	46 06 41
40/0.95 corr	0.09	0.11-0.23	46 07 42	46 07 43
40/1.0 oil with iris	0.38	-	46 17 46	46 17 47
63/1.4 oil	0.09	-	46 18 40	46 18 41
100/1.3 oil	0.09	-	46 19 40	46 19 41
100/1.3 oil with iris	0.09	-	46 19 46	
Neofluar, Plan-Neofluar objectives				
6.3/0.20	10.9	-	46 03 20	
10/0.30	4.8	-	46 04 20	
16/0.40	0.9	0.17	46 05 20	46 05 21
16/0.5 w, oil, glycerin (flatfield objective)	0.15	-	46 15 25	46 15 26
25/0.60	0.54	0.17	46 06 20	46 06 21
25/0.8 w, oil, glycerin corr (flatfield objective)	0.3	-	46 16 25	46 16 26
40/0.75	0.33	0.17	46 07 20	46 07 21
40/0.75	0.38	-	46 07 52	
40/0.9 w, oil, glycerin corr (flatfield objective)	0.15	0.17	46 17 25	46 17 26
63/0.90 corr (flatfield objective)	0.09	0.11-0.23	46 08 12	46 08 13
63/1.25 oil	0.5	-	46 18 20	46 18 21
63/1.20 w corr (flatfield objective)	0.12	0.12-0.21	46 18 32	
63/1.20 w, w/out coverglass (flatfield objective)	0.12	-	46 18 25	46 18 26
63/1.25 oil (flatfield objective)	0.11	0.17	46 18 36	46 18 37
63/1.25 oil with iris (flatfield objective)	0.11	0.17	46 18 38	
100/1.30 oil	0.24	0.17	46 19 20	46 19 21
Planachromat objectives				
1.0/0.04	4.4	-	46 20 10	
1.25/0.04	4.0	-	46 20 14	
2.5/0.08	9.0	-	46 01 10	
6.3/0.16*	4.9	-	46 03 10	46 03 11
10/0.22	4.8	-	46 04 10	
16/0.35	2.8	0.17	46 05 10	46 05 11
25/0.45	1.4	0.17	46 06 10	46 06 11
40/0.65	0.7	0.17	46 07 10	46 07 11
40/0.60 corr LD	1.5	1.1-1.5	46 07 15	46 07 16
100/1.25 oil	0.09	0.17	46 19 10	46 19 11
100/1.25 oil with iris	0.09	0.17	46 19 16	

*cannot be used for phase contrast with condensers 47 52 77 and 47 52 85

1. Planachromat objectives

Classical, well corrected flatfield objectives for any kind of routine microscopy, suitable for B/W and color photomicrography.

2. Neofluar objectives

Fluorite objectives with a much better chromatic correction and much higher apertures than Achromat objectives with the same number of lens elements. Particularly suitable for fluorescence and phase-contrast microscopy because of their excellent image contrast.

3. Plan-Neofluar objectives

Special immersion objectives for different immersion media (see table above where w = water; oil and glycerin), particularly suitable for fluorescence microscopy because of their high image-side apertures.

4. Planapochromat objectives

Top-of-the-line objectives for sophisticated color photomicrography with apertures higher than those of Neofluar objectives.

Eyepieces

Compensating flatfield (Kpl) and wide-angle (W) eyepieces

Magnification	Field-of-view number	Angular field	Cat. No.
Kpl 10x W Br	20	45°	46 40 44-9901
Kpl 12.5x W Br	20	53°	46 41 44
Kpl eyepieces with focusing eyelens for reticles			
Kpl 10x W Br	20	45°	46 40 48
Kpl 12.5x W Br	20	53°	46 41 48

Eyepieces designated "Br" are high-eyepoint eyepieces for eyeglass wearers.

Nosepieces

	Standard type	Pol type
Septuple nosepiece with Telan system	47 31 69	
Quintuple nosepiece with Telan system	47 31 59	47 31 57
Holder with Telan system for single objectives		47 31 17

The quintuple and septuple nosepieces which run in ball bearings and are of high setting accuracy accept complete series of objectives. The individual objectives are quickly turned in.

The holder for single objectives is recommended for the heating stage. All objectives are parfocalized and come in resilient mounts which guarantees optimum specimen protection.

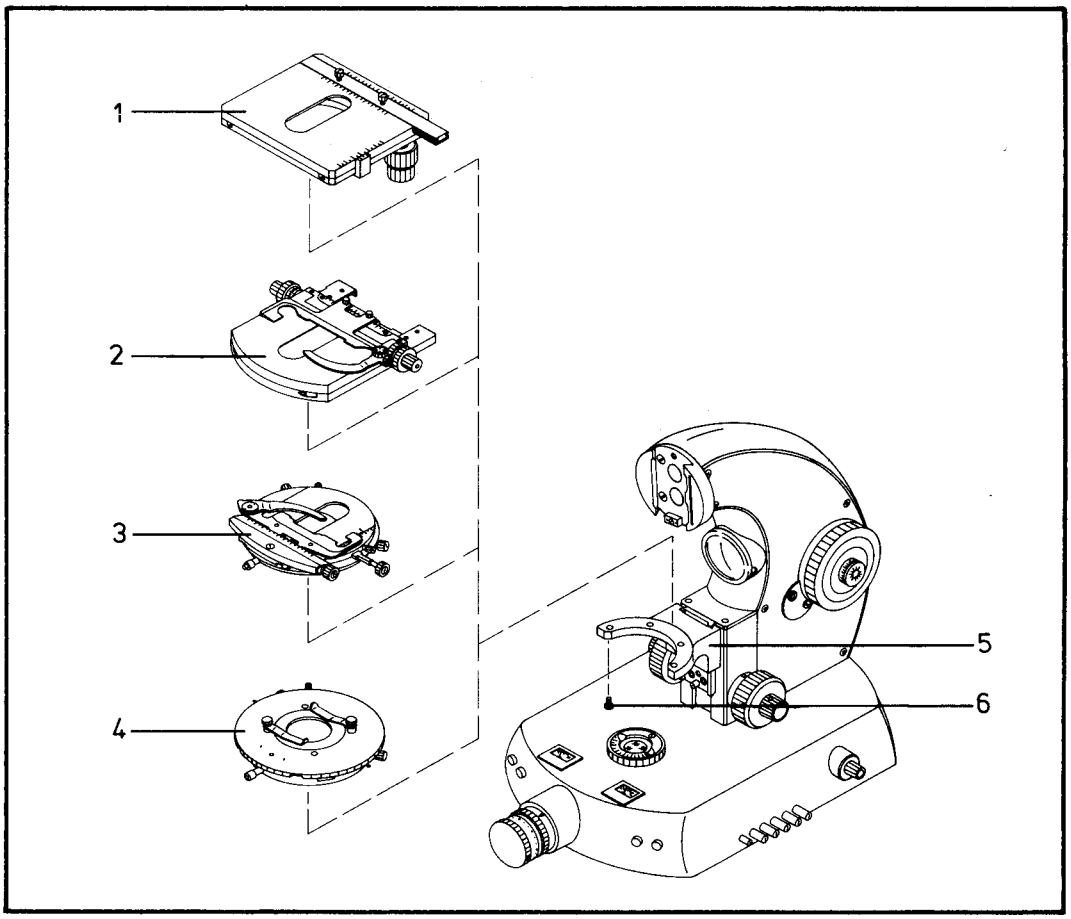
Specimen stages

General information

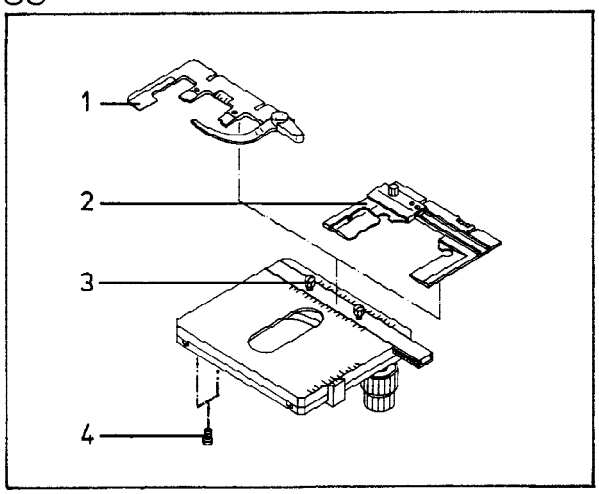
Fig. 34 shows all specimen stages which can be used on Photomicroscope; the stages are described in detail further below.
The stages are mounted on the microscope by way of the attachable stage carrier (5) to which the stage is screwed with 4 screws (6). For assembly see p. 8.

	Stages and accessories	Cat. No.
1	Mechanical stage 50 x 75 mm, left-hand control	47 34 15
	Mechanical stage 50 x 75 mm, right-hand control	47 34 16
2	Mechanical stage 50 x 75 mm with graduated coaxial control on both sides	47 34 28-9901
3	Circular, rotary, centering mechanical stage 50 x 75 mm with centering piece, without graduation	47 34 56-9901
	Circular, rotary, centering mechanical stage 50 x 75 mm with centering piece, with graduation	47 34 57-9901
4	Circular, rotary, centering gliding stage with centering piece	47 34 54
5	Stage carrier	47 15 40

34



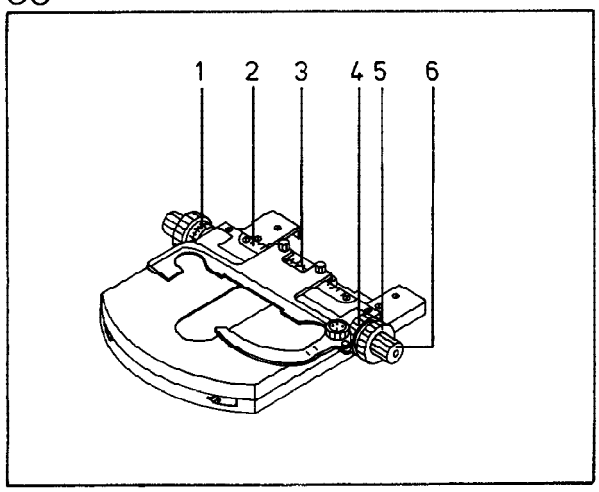
35



Mechanical stage 50 x 75 mm

Either specimen holder 50 (1) (47 34 48) or adjustable specimen holder (2) (47 34 45) can be fixed with screws (3).
The travelling range is basically 30 x 75 mm, expandable to 50 x 75 mm by mounting the stage rotated through 180° on the stage carrier and changing the position of screw (4).

36



Mechanical stage 50 x 75 mm with graduated coaxial control on both sides

1 Graduation with black and red numbers corresponding to black/red graduation in reading window (2), for Y-motion.

2 Reading window for the travelling range of the Y-motion marked black and red.

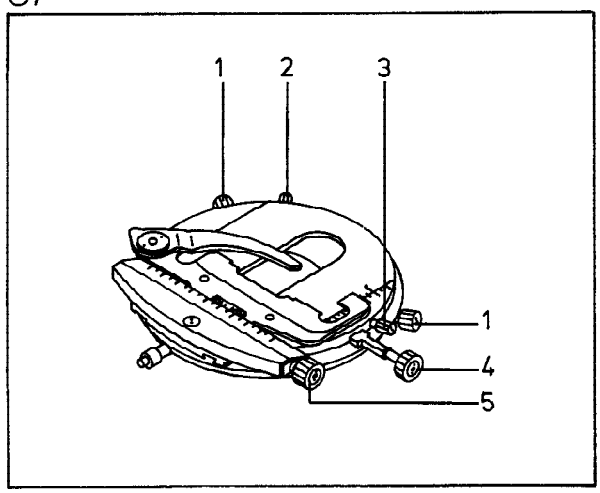
3 Graduation of X-motion

4 Knurled ring to adjust stiffness of Y-motion control

5 Y-motion (to-fro) control

6 X-motion (left-right) control

37



Circular, rotary, centering mechanical stage 50 x 75 mm with centering piece, without graduation

1 Centering screws with plugged-on knobs

2 Screw to lock stage rotation

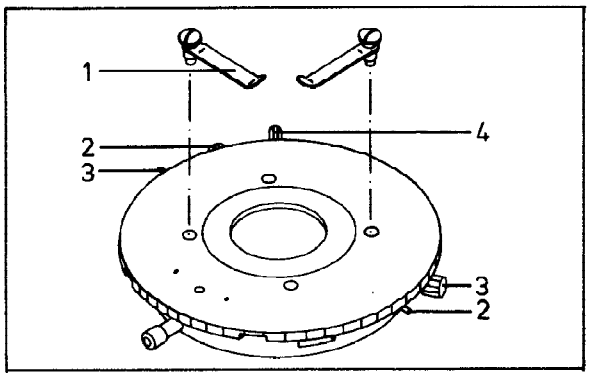
3 Screw to adjust stiffness of motion of control 4

4 Control to move the specimen in Y

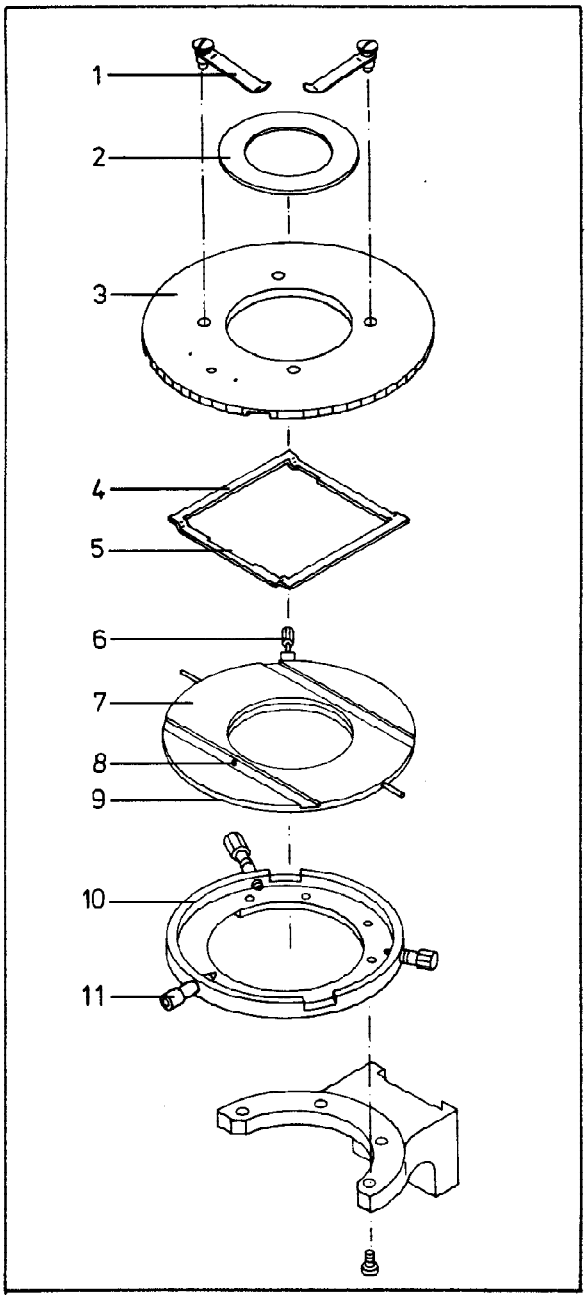
5 Control to adjust the specimen in X

Stage centering
Turn in 10x or 16x objective and focus on a fine-grain feature. Turn specimen stage uniformly.
Turn knobs (1) on centering screws so that the center of rotation of the stage coincides with the center of the field of view. The center of rotation of the stage is that point around which all other object points rotate.
Move the specimen with centering screws (1) until it no longer moves on a circle but turns about its own axis. For exact stage centering we recommend the use of a crossline reticle in the eyepiece.

38



39



Circular, rotary, centering gliding stage with centering piece

1 Stage clips (47 33 73)

2 Controls to move the stage plate; when the stage is turned the specimen remains within the field of view if the axis of rotation is centered relative to the center of the field of view.

3 Knobs on stage centering screws

4 Control to lock stage rotation

Gliding stage centering

Turn in 10x or 16x objective. Turn and shift gliding stage until a marked feature coincides with the axis of rotation. Mark the center of the field of view by closing the centered luminous field diaphragm.
With knobs (3) on centering screws bring axis of rotation and center of the field of view to coincidence.

Lubricating the gliding stage

When the stage has not been in use for some time the motion of its parts may be stiff, and all gliding surfaces of the stage must be lubricated with the supplied oil (10 cm^3) (46 29 78):

Remove stage clips (1), ring (2) and plate (3).

Take frame (4) out of its notches (remember for the assembly that pin 8 of the base plate must engage notch 5 of frame 4).

Unscrew centering screws (6).

Press base plate (7) against spring bolt (11) of centering piece (10) and take it out (remember for the assembly that spring bolt (11) must engage notch 9).

Clean all gliding surfaces with xylol and apply a thin film of oil. Assemble the stage by proceeding in the reverse sequence.

Move assembled gliding stage repeatedly in all directions to distribute the oil. If the motion is too smooth, you have used too much oil.

Further equipment of Photomicroscope is described in these operating instructions:

G 41-303	Microscope illuminator 30
G 41-310/III	Microscope illuminator 100
G 41-351	Epi-fluorescence condenser III RS
G 41-415	MC 63 attachment camera system
G 41-507	Universal R Pol, Photomicroscope III Pol polarizing microscopes
G 41-656	Incident-light Photomicroscope III
G 41-710/I	MHP microhardness tester
G 41-820/I	Microscope photometer 01 K
G 41-825	Microscope photometer 03