# Axioplan 2 imaging and Axiophot 2 Universal Microscopes

Operating Manual

Knowledge of this manual is required for the operation of the instrument. Please therefore familiarize yourself with its contents and pay special regard to the sections dealing with the safe handling of the instrument.



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# Notes on the safe operation of the instrument

The Axioplan 2 imaging Universal Microscope has been designed and tested in compliance with EN 61010 part 1 (DIN VDE 0411) and IEC 1010-1 and left the factory in a perfect state with regard to its safety facilities. To ensure that this remains the case and to guarantee the safe operation of the equipment, the instructions and warnings given in this manual must be observed.
The instrument meets the requirements of the EC directive 89/336/EEC and the EMC legislation of November 9th 1992. It has been allocated the protection degree IP 20 and is categorized as Class 1 Equipment. The power plug must be inserted in a socket featuring a grounding (earth) contact. The grounding effect must not be nullified by an extension cable which does not have a protective ground wire.

### For your own safety and for the protection of the instrument against damage

Axioplan 2 imaging features special protective devices such as attenuation filters to protect the eyes against intense radiation, and stops to protect specimens and objectives against knocks and mechanical damage. These protective devices must be used and must not be removed. You must familiarize yourself with the protective devices provided by Axioplan 2 imaging under all circumstances.

WARNING!

**Danger of crushing!**
In stands with a motorized focusing drive, there is a danger of crushing your hand between the stage carrier and stand base when the stage is lowered. For this reason, do not place you hand under stage carrier when the stage is being lowered.

CAUTION!

**Gas discharge lamps!**
In unfavorable circumstances and with improper use, gas discharge lamps can explode, flinging splinters of glass through the air and causing possible injury. Therefore, it is imperative that the safety and operating instructions of the manufacturer of the gas discharge lamp be followed (chapter —> *Care, Maintenance*).
Gas discharge lamps emit ultraviolet radiation which can cause burns on the eyes and skin. Never look directly into the light of these lamps and avoid direct, unprotected incidence of their light on your skin. When using the microscope, always use the protective devices belonging to the instrument, e.g. special attenuation filters.
Gas discharge lamps are contained, for example, in our microscope illuminators HBO 50, HBO 100 and XBO 75.

WARNING!

**Specimens hazardous to health!**
The Axioplan 2 imaging is not equipped with any special devices for protection against corrosive, toxic, radioactive or other substances hazardous to health. All legal requirements, especially national accident regulations, must be observed when handling such specimens.

WARNING!

**Hot surfaces!**
Do not touch the hot lamp housing. Always disconnect the power plug before changing a lamp and allow the unit to cool down for approx. 15 minutes.

WARNING!

**Thermally sensitive fluorescence filters!**
Fluorescence filters are sensitive to the thermal radiation of the microscope lamp and their performance can be permanently impaired by it. Therefore never remove the heat-reflecting filter on the microscope illuminators when you are working with fluorescence filters.

WARNING!

**Heat build-up!**
Placing objects against or covering ventilation slots on the microscope or its components can lead to a build-up of heat which will damage the instrument and, in extreme cases, cause a fire. Therefore, always keep the ventilation slots clear (minimum distance 15 cm). Always check whether the microscope is switched off before placing the dust cover over it.

WARNING!

**Dust and dirt!**
Dust and dirt can impair the performance of the Axioplan 2 imaging.
Therefore, protect the microscope as far as possible against these influences. Always use the dust cover if you do not intend to use the Axioplan 2 imaging for longer periods of time.

WARNING!

**Operation!**
The instrument must be operated by trained staff only. They must be instructed in the hazards involved in microscopy and the respective field of application.
This includes an awareness of the risk of eye injury due to intensive irradiation by light.

# General

### Notes on exchangeable components:

The perfect functioning of the instrument requires that you use spare parts and components which are marketed and approved by us. In the event of doubt, please contact our service staff. The use of parts from other manufacturers may impair the performance of the Axioplan 2 imaging or indeed damage the instrument. The use of such parts is the sole responsibility of the user.

No other care, maintenance or repair work must be carried out apart from the activities specified in —> *Care, Maintenance*.

**Note:** We would like to expressly emphasize here that any adjustments not described in the *Microscope Components* chapter must only be performed by persons expressly authorized by us to do so.
The Axioplan 2 imaging is a precise optical instrument which may be impaired in its function or even damaged by inexpert handling.

### Note on power unit integrated in stand:

The integrated power unit is used to supply voltage to the microscope illumination, the Axiophot 2 photo module and the coded motorized components. The power unit must not be used to supply voltage to other external power consuming devices. This can lead to overloading and destruction of the power unit.

# General

The Axioplan 2 imaging is a universal microscope which is suitable for all applications relevant to light microscopy. Its modular design, numerous components and wide range of accessories allow the Axioplan 2 imaging to be adapted and extended to perform a large number of special applications. There is practically no field of application in light microscopy for which the Axioplan 2 imaging cannot be used. However, users wishing to utilize the motorized and automatic functions of Axioplan 2 imaging must take this into account when choosing the basic stand configuration. You will already have made this decision before starting to read this manual. But we would nevertheless like to point out that the configuration for which you have opted must not necessarily be the definitive one. If you wish to change your basic configuration at a later date, the option most certainly exists. Our specialist staff will be pleased to provide you with any advice you may need.
The aim of this manual is to describe the many possible functions of Axioplan 2 imaging.
However, the sheer number of functions offered may sometimes lead to a certain amount of confusion. Therefore, if you have any doubts concerning the capabilities of your Axioplan 2 imaging, please contact our subsidiary or us direct. Our address and telephone number are given on the inside cover of this manual.

In the chapter entitled *Stand* you will find the various basic versions of the Axioplan 2 imaging stands. Starting with the manual version, this chapter deals with all stand functions available, up to and including the stand featuring all motorizable functions and the LightManager.

The chapter *Microscope components* describes the operating functions with which you yourself can equip or extend the Axioplan 2 imaging. Not all parts described there must be present on the Axioplan 2 imaging. However, if you are considering adding some of the components to your configuration, the corresponding catalog numbers are listed.

The chapter *Microscopy Techniques* provides you with information on the basic settings of the microscope, e.g. KÖHLER illumination adjustment, and contains instructions concerning the operation of the microscope for specific applications.

**Abbreviations**

| | |
|---|---|
| achr. | achromatic |
| AL | incident light |
| apl. | aplanatic |
| Br | suitable for eyeglass wearers (eyeglasses can be placed directly against eyepieces) |
| C | camera |
| C-Mount | camera mount |
| D | diameter or coverglass thickness |
| DF | darkfield |
| DIC | differential interference contrast |
| DL | transmitted light |
| E-Pl | flat-field eyepieces with aspheric correction |
| FAA | clear working distance |
| Fl | fluorescence |
| foc. | focusable diopter compensation on eyepiece |
| fot. | photographic |
| FT | chromatic beam splitter |
| HAL | halogen illuminator or lamp |
| HBO | mercury pressure short arc lamp |
| HD | bright/darkfield |
| HF | brightfield |
| ICS | infinity color-corrected system |
| Korr | correction mount |
| LD | long working distance |
| LFB | luminous field diaphragm |
| MC | microscope camera |
| MPM | microscope photometer |
| N.A. | numerical aperture |
| P | photometry |
| Ph 1,2,3 | phase contrast; the numbers refer to the diameter of the ring stop used; with an objective with the designation Ph 2, use the ring stop with the corresponding designation Ph 2. |
| Pol | polarization |
| SFZ | field of view number |
| SI | system integration |
| SLR | single lens reflex |
| Stemi | stereomicroscope |
| SW | wrench size |
| UD | universal rotary stage |
| Var | VAREL contrast |
| vis. | visual |
| W-Pl | wide angle flatfield |
| XBO | xenon short arc lamp |
| ZBE | intermediate image plane |

# Purpose

The Axioplan 2 imaging has been designed as a universal microscope and can be used for all areas of light microscopy. Depending on its equipment, it is used in the following fields:

- ❑ transmitted-light microscopy
- ❑ incident-light microscopy
- ❑ fluorescence microscopy
- ❑ photomicrography
- ❑ videomicroscopy

The Axioplan 2 imaging also performs the contrasting methods in transmitted light and incident light:

- ❑ darkfield
- ❑ phase contrast
- ❑ polarization contrast
- ❑ differential interference contrast

Motorizable functions and the recognition of coded microscope components used permits the performance of applications in such fields as process automation and telepathology.
Here, the microscope is controlled by a built-in microprocessor and a control software which activates the standard interfaces CAN-BUS and RS 232 C in personal computers.

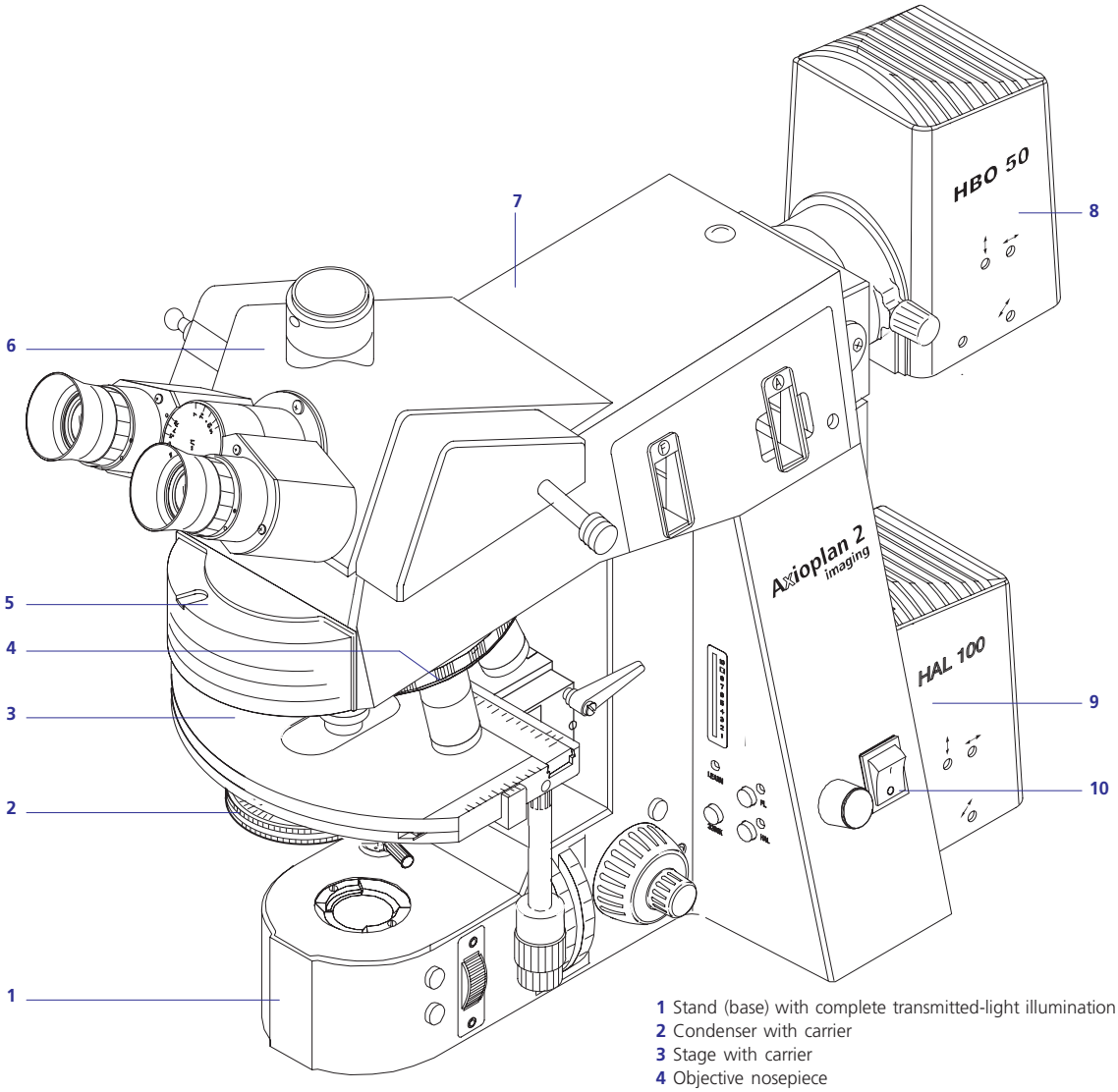
### Installation conditions

- ❑ Dust-free environment
- ❑ Maximum relative air humidity 85 %
- ❑ Vibration-free worktop

Specifications concerning power supply, storage, temperature and other technical details are contained in the chapter entitled *Technical Data*.

# Overview and Connections

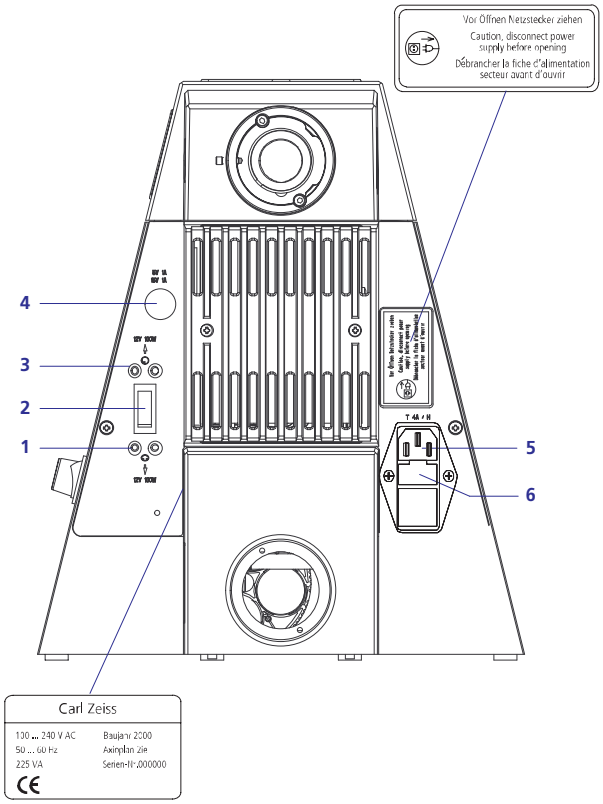
The stand shown in the illustration is equipped with a wide variety of functional units. It may therefore differ from the stand you have purchased. Should you therefore see any components in the drawing, which are not present on your own microscope, this does not mean that you have an incorrect Axioplan 2 imaging configuration.
Setting and adjustment of certain components and modules of the Axioplan 2 imaging sometimes require special tools which are included in the delivery package of the microscope. This particularly concerns the SW 3 ball-headed screwdriver and the SW 1.5 screwdriver for Allen head screws.




**1** Stand (base) with complete transmitted-light illumination
**2** Condenser with carrier
**3** Stage with carrier
**4** Objective nosepiece
**5** Reflector turret
**6** Tube
**7** Stand (upper part) with complete incident-light illumination
**8** Lamp for incident light
**9** Lamp for transmitted light
**10** ON/OFF switch

**Fig. 1 Axioplan 2 imaging (motorized)**

# Putting into Operation




1 Sockets of the integrated power unit for the transmitted-light illumination
2 Toggle switch to change between transmitted and incident light
3 Sockets of the integrated power unit for the incident-light illumination
4 Socket for Axiophot 2 photo module (5 V / 15 V)
5 Socket for instrument plug (line voltage)
6 Compartment for instrument fuses

**Fig. 2 Axioplan 2 imaging (instrument back)**

**Note:** To determine whether your microscope is the Axioplan 2i or the Axioplan 2ie type, check the type plate at the rear of the microscope (also compare the versions on page 22).

## Unpacking and setting up the microscope

The microscope is usually delivered fully assembled in a specially designed transportation container. The Axiophot 2 photo module along with the notebook necessary for controls and any necessary intermediate tubes if applicable are packed separately. The transportation container contains instructions on unpacking of the instrument.
Please comply with the instructions included.
Due to the complexity of the Axioplan 2 imaging and to ensure satisfactory operation, the setting up and initial operating of the microscope is generally carried out on site by our customer service staff.
The Axioplan 2 imaging will be prepared before hand-over, enabling the user to fit all components listed in chapter *Microscope Components* unaided. The necessary procedures are described there.

## Putting microscope into operation

The Axioplan 2 imaging microscope features an integrated wide-range power unit and can be connected to line voltages ranging from 100 ... 240 V AC, 50 ... 60 Hz. The wide-range power unit sets itself **automatically** to the appropriate line voltage.

- Check that all connected components have been mounted correctly and are sitting properly.
- Set ON/OFF switch (Fig. 1/**10**) to position **O**.
- Connect power unit first to the instrument and then to the line.
- Make the other electrical connections, such as microscope illuminators, connecting cable to TV camera, Axiophot 2, notebook etc.

**Note:** All the electrical and electronic connections must be made before switching on the instrument so that they can be recognized by the initialization routines.

- Set ON/OFF switch to position **I**.

This last setting switches on the microscope and makes it ready to use after approx. 10 s. If the instrument is equipped with the light manager, this last position is set.

- Switch on notebook or PC (if connected).

## Switching off the instrument

- Set ON/OFF switch to position **O**.

# Stand

All the stand configurations described in the following are usually tailored to the customers special requirements.
For example, it is possible that the stand configuration delivered to you includes only incident-light or fluorescence equipment and that transmitted-light components are therefore not available. The same applies to the objective nosepiece, of which seven models are available.

The following stand types exist for the Axioplan 2 imaging:

- ❑ Manual type
  this stand can only be operated manually. Motorized and codable functions cannot be easily retrofitted.
- ❑ Type E
  Unlike the manual type, this stand is equipped with an electronic system permitting all the appropriately prepared microscope components (except the z-focusing drive) to be motorized. These functions can also be easily retrofitted.
- ❑ Motorfocus type (MOT)
  Like type E, plus motorized z-focusing equipment.

Aside from these basic types we also use the following abbreviations in this manual:

- ❑ LM/E type
  Like type E, plus additional LightManager (LM).
- ❑ LM/MOT type
  Like Motorfocus type, plus additional LightManager.

Upgrading to include motorized functions is possible, but requires the stand type E or higher.
Should you intend to upgrade your microscope to include motorized functions, please get in touch with the Zeiss service department.

The components of the upper stand part are available in the following versions:

- ❑ reflector turret: manual or motorized
- ❑ nosepiece: manual, coded or motorized
- ❑ reflected-light shutter: motorized

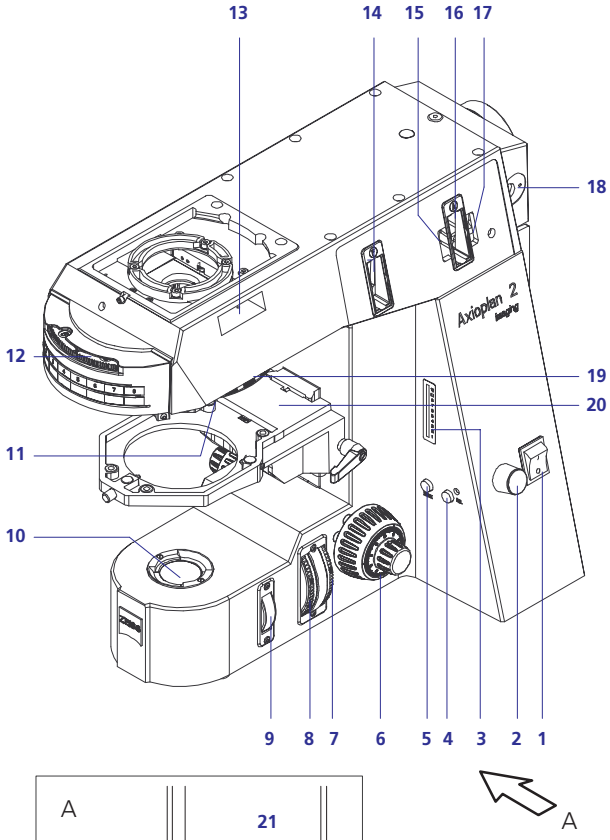
The components of the lower stand part are available in the following versions:

- ❑ condenser turret: manual or motorized
- ❑ luminous-field diaphragm: manual or motorized
- ❑ filter wheels: manual, coded or motorized
- ❑ z-focusing drive: manual or motorized

Features and components common to reflected- and transmitted-light stand types:

- ❑ lamp connection
- ❑ light exit
- ❑ power units for HAL 100 microscope illuminator and electronic control system
- ❑ switches, adjusting and display components
- ❑ mechanical parts for stage focusing

The following description of stands starts with the manual model. On this basis, only the differences and additional functions are described for the other stand models.




**1** ON/OFF switch
**2** Light intensity control
**3** LED line lamp voltage
**4** HAL on/off key with LED
**5** 3200K key (color temperature key)
**6** Focusing drive
**7** Filter wheel 2
**8** Filter wheel 1
**9** Luminous-field diaphragm (transmitted light)
**10** Light exit of transmitted-light equipment
**11** Compartment for compensators
**12** Reflector turret
**13** Analyzer compartment
**14** Compartment for pushrod for aperture diaphragm (incident light)
**15** Compartment for filter slider
**16** Compartment for pushrod for luminous-field diaphragm (incident light)
**17** Compartment for filter slider
**18** Adjustment aid for lamp setting (incident light-option)
**19** Objective nosepiece
**20** Lowerable stage carrier
**21** Swinging in/out of diffusion disk (transmitted light)

**Fig. 3** **Manual stand**

## Manual stand

The stand shown here may differ from your stand model. Most differences will be present in the upper part of the stand, i.e. they concern incident-light and polarizing microscopy. If the configuration illustrated is different from your own Axioplan 2 imaging, this does not necessarily mean that an error has been made, but is probably due to the stand equipment you have chosen for your respective application.

### Controls

(the numbers refer to Fig. 3.)

**1 ON/OFF switch**

Position **O** = instrument switched off
Position **I** = instrument switched on
For optical status checking, the switch lights up in green in position **I** (for defects see chapter —> *Care, Maintenance*).
When the Axioplan 2 imaging is switched on, not only the HAL 100 microscope lamp is supplied, but also the Axiophot 2 photo module, if mounted, and the motorized internal components.

**2 Light intensity control**

Knob for adjusting light intensity of connected HAL 100 microscope illuminators.
The power unit integrated in the stand is highly stabilized against voltage fluctuations and supplies adjustable DC voltage in the range from 0 ... 12 V. A yellow LED line displays the set voltage range and the light intensity.

**Note:** If the light intensity cannot be adjusted, please check whether the color temperature key (**4**) is switched off.

**3 LED line lamp voltage**

Display of set line lamp voltage.

**4 HAL on/off key**

Switches halogen lamp alternately on or off. LED lights when switched on.

**5 3200K key(color temperature key)**

Knob to set the 3200 K color temperature for photomicrography using color film (artificial light). A constant color temperature of 3200 K is required for color photography. This is achieved if a fixed DC voltage of 10.5 V is supplied to the HAL 100 microscope illuminator.

Correct functioning can not be guaranteed if other lamps than the HAL 12 V/100 W lamps supplied by Carl Zeiss are used.

**7, 8 Filter wheels for transmitted light**

Two rotatable filter wheels (filter magazine) with 4 positions each are equipped with different filters; two different models are available.

The wheels, which feature click stops, are rotated into position. The set filters are marked on the wheels.

❑ **Filter magazine D 452155-0000-000**

Filter magazine for general use

The positions of the two wheels can be combined as required.

| | | |
|---|---|---|
| Filter wheel 2 (**7**) | 100 | open position |
| | 25 | neutral-density filter 0.25 |
| | 6 | neutral-density filter 0.06 |
| | 1,5 | neutral-density filter 0.015 |
| Filter wheel 1 (**8**) | 100 | open position |
| | 6 | neutral-density filter 0.06 |
| | G | wide-band interference filter green |
| | CB | conversions filter 3200 K ... 5500 K |

Conversion or green filters are additionally inserted into the colored glass carrier or laid onto the light exit of the transmitted-light illumination.

❑ **Filter magazine D FOTO 000000-1088-124**

Filter magazine for the brightness control at a constant color temperature of 3200 K. The 3200 K color temperature must be selected. The 9th LED of LED line lights constantly. The positions of the two wheels can be combined as required.

Because the color temperature of 3200 K is achieved at a high lamp voltage, this brightness can be reduced using the filter wheels to a "normal degree" more acceptable to the eye / camera.

The following brightness steps can be set:

Filter wheel 2 (**7**) coarse steps
- 100 — maximum brightness at 3200 K 100%
- 6 — normal brightness at 3200 K 6%
- 0.4 — low brightness at 3200 K 0.4%
- 0 — transmitted light blocked

Filter wheel 1 (**8**) fine steps
- 100 — brightness 100% of coarse step
- 50 — brightness 50% of coarse step
- 25 — brightness 25% of coarse step
- 12 — brightness 12% of coarse step

**9 Luminous-field diaphragm**

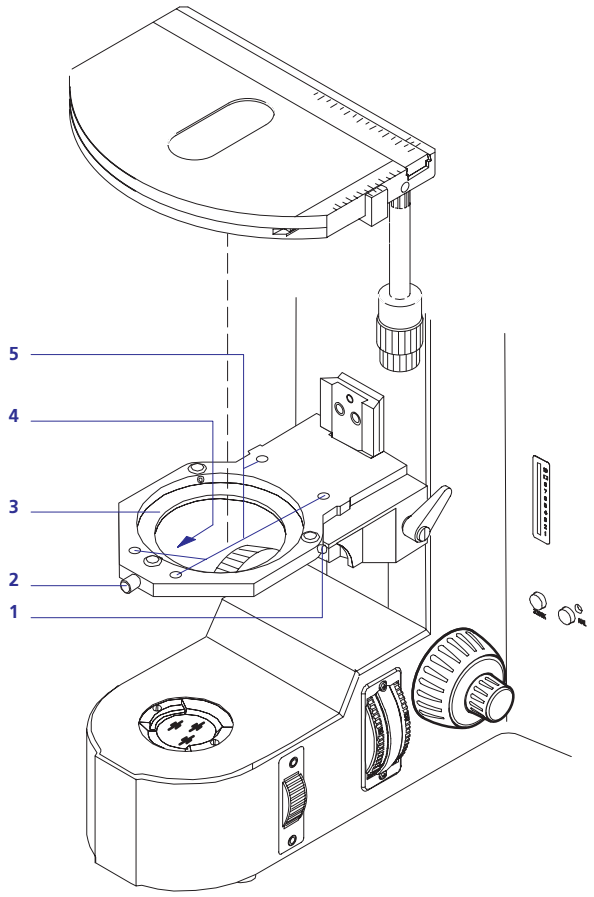
Wheel for the continuous setting of the aperture of the luminous-field diaphragm (transmitted light).

**10 Light exit of transmitted-light equipment**

Light filters with dia. 32 mm can be placed on the plane surface of the centering ring supplied.

**Note:** Additional filters can be inserted in the colored glass carrier of the condenser mount.

# Stand




**1** Stage centering screw for stage centering (on both sides)
**2** Screw-on cap for spring pin of stage clamp
**3** Angular guidance for attachment of dovetail for specimen stages
**4** Spring pin of stage clamp
**5** Drilled holes to screw on fixed stages and scanning stages

**Fig. 4 Stage mounting**

### 6 Manual focusing drive

The universal microscope Axioplan 2 imaging is focused via coaxial drives on both sides of the stand.
**Coarse drive** (large knob on the inside):
1 revolution approx. 2 mm.
**Fine drive** (small knob at the outside):
Gear ratio 1:10 (1 revolution approx. 0.2 mm,
1 graduation mark approx. 2 µm).

### 21 Diffusion disk (transmitted light)

Setting via right/left rotation using SW 3 ball-headed screwdriver

Diffusion disk OFF

Diffusion disk ON

The diffusion disk improves the homogeneous illumination of the object plane. Normally, it is swung into position. It can be swung out using the SW 3 ball-headed screwdriver to increase the visibility of the lamp filaments during adjustment of the microscope illuminator.

### 20 Stage carrier

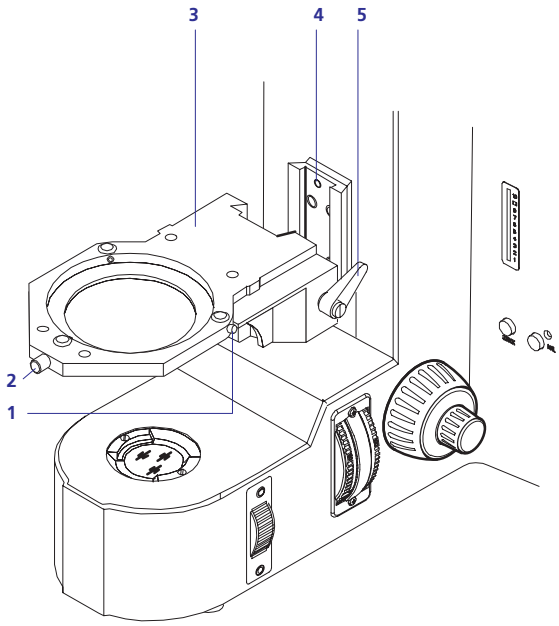
The stage carrier is used to mount the stage and the condenser carrier to which the condenser is attached.
The stage carrier is either fixed to the stand or removable.
The non-rotating mechanical stage and the scanning stage are screwed to the carrier with screws.

### Attaching/removing rotary mechanical stages

(Fig. 4)

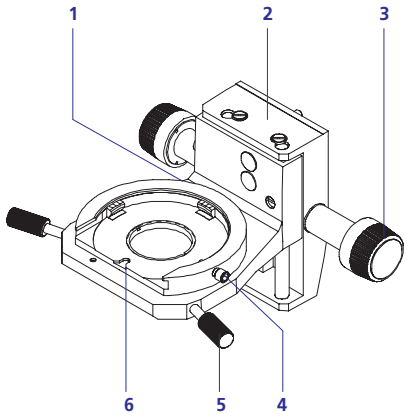
- Loosen screw-on cap (**2**) (3 ... 4 mm).
- Attach notch of stage dovetail to the spring pin (**4**) at the front.
- Push stage against spring pin and lower into the stage carrier in the back, then let go.
- Tighten screw-on cap (**2**).

The stage can now be rotated to the right and left.




**1** Stage centering screw for stage centering (on both sides)
**2** Screw-on cap for spring pin of stage clamp
**3** Stage carrier
**4** Dove tail guiding device
**5** Clamping lever

**Fig. 5 Height adjustment of the stage carrier**




**1** Clamping screw for height stop, prevents the specimen from being pressed out inadvertently from below by the condenser
**2** Carrier guidance
**3** Height adjustment controls on both sides
**4** Clamping screw to fix the condenser
**5** Centering screws on both sides
**6** Orientation groove for the condenser

**Fig. 6 Condenser carrier**

### Stage centering

All stages are factory-precentered, i.e. when the stage is rotated, a set specimen feature will remain in the image center. Should a set feature move away from the image center when the stage is rotated, the stage must be centered again.

- Loosen stage clamping screw (Fig. 4/**6**).
- Correct the drift of the image part by simultaneously rotating the two stage centering screws (**1**).
- When the stage is centered, tighten the screw-on cap.

**Note:** When highly magnifying objectives are used the centering is only exact for one chosen objective.

### Height adjustment of the removable stage carrier

(Fig. 5)
The height of the removable stage carrier is adjustable, which is very useful, for example, in the case of very high specimens (max. specimen height = 49 mm).

- Hold stage carrier (**3**) with your left hand. Loosen clamping lever (**5**).
- Change height of stage carrier, tighten clamping lever (**5**). Do not press too hard.

**Note:** To remove the stage carrier. Loosen the clamping lever and take the carrier out of the dovetail guiding device (**4**) by moving it to the left. Orientation of the clamping lever can be selected as required by pressing against the spring and rotation into the required position.

### Condenser carrier (Fig. 6)

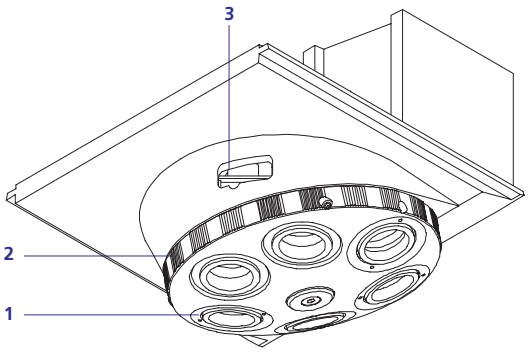
The condenser carrier is screwed to the stage carrier. All the condensers available for the Axioplan 2 imaging are attached to the condenser carrier. The height of the carrier can be adjusted on both sides and permits the centering of the inserted condensers.

**Note:** For the setting of KÖHLER illumination, the image of the luminous-field diaphragm must be centered in the field of view.

**Setting the height stop** (Required KÖHLER illumination setting must have been performed):

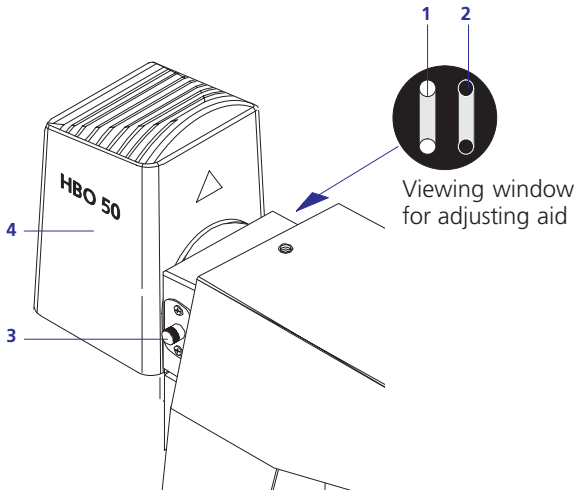
- Loosen clamping screw (**1**) for height stop using SW 3.
- Set the specimen.
- Image the luminous-field diaphragm sharply (by adjusting the height of the condenser).
- Move up the condenser by approx. half a rotation of the control.
- Tighten clamping screw for height stop (**1**).

**Note:** Depending on which stage carrier is mounted (fixed or removable), the appropriate special condenser carrier is screwed on. Its difference mainly lies in its height adjustment, and is of interest only for incident-light microscopy and where high specimens in the range of up to 49 mm are used. If you intend to change the condenser carrier, please get in touch with our service department.




**1** Thread (normally W 0.8", M 27 for incident light darkfield) to screw in the objectives
**2** Knurled ring for nosepiece rotation
**3** Compartment for compensators

**Fig. 7 Objective nosepiece**




**1** Image of the light arc
**2** Mirror image of the light arc of the lamp reflector
**3** Slide-in knob for adjusting aid activation
**4** HBO 50 lamp housing

**Fig. 8 Adjusting aid**

### 19 Objective nosepiece

The objective nosepiece is used for mounting the objectives and changing them quickly. Depending on the application, the customer can choose from nine different nosepieces.

**Note:** Nosepiece positions which are not being used must be covered with dust caps.

The nosepieces for polarization are equipped with centering screws (SW 1.5) for the centering of the objectives.

Nosepieces for DIC feature one compartment for insertion of a DIC slider in each objective mount.

**Note:** Please do not try to remove the nosepiece from the stand, since this will result in the loss of the centering; this can only be reset by our service staff.

### 11 Compartment for the insertion of compensators

(Fig. 7/**3** and Fig. 3/**11**)
(—> *Microscope Components*)

### 12 Reflector turret

The reflector turret (Fig. 3/**12**), consists of a filter wheel with 5 click stops to which the required reflector modules are attached. Attachment and change of modules can be performed by the user (—> *Microscope Components*).

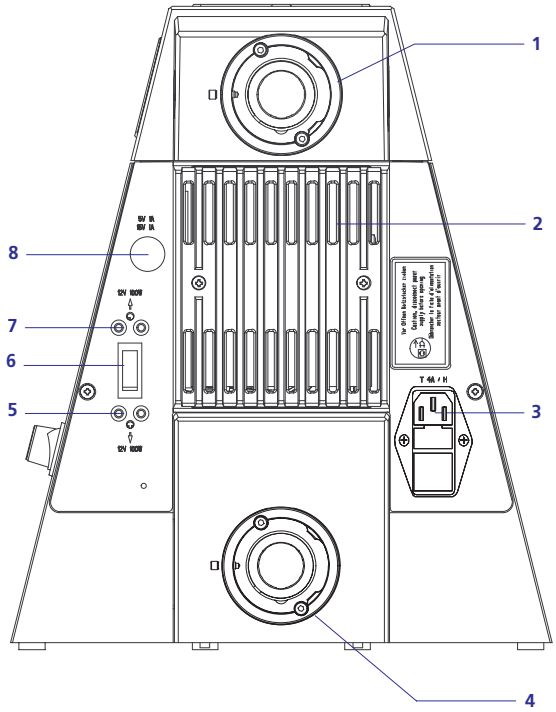
### 13 Analyzer compartment

(Fig. 3/**13**)
(—> *Microscope Components*)

### 18 Adjusting aid for HBO/XBO incident microscope illuminators

(Fig. 8)
The adjusting aid simplifies optimum setting of the HBO 50/100 and XBO 75 in fluorescence microscopy.
A mirror directs the image of the light arc to a round window visible from the outside (matt black filter). Here, the position change of the focal point and its mirror image, performed by adjusting the screws on the microscope illuminator, can be viewed.
The lamp is set optimally if the image and the reflected image of the light arc are shown in the window centrally and in focus.

# Stand




**1** Connecting tube for microscope lamps - incident light
**2** Ventilation slots
**3** Socket for instrument plug
**4** Connecting tube for microscope lamps - transmitted light
**5** Sockets for microscope lamps - transmitted light
**6** Toggle switch transmitted light/incident light
**7** Sockets for microscope lamps - incident light
**8** Socket for Axiophot 2 photo module

**Fig. 9 Back of manual stand, also see Fig. 2**

## Back of manual stand

Key to Fig. 9 (back of manual stand)

**1** Connecting tube for microscope lamps – incident light with locking screw for dovetails to position the lamps

**2** Ventilation slots (always keep clear; minimum distance: 15 cm)

**3** Sockets for instrument plug with integrated compartment for instrument fuses (change of fuses chapter —> *Care, Maintenance*)

**4** Connecting tube for microscope lamps – transmitted light with locking screw for dovetails to position the lamps

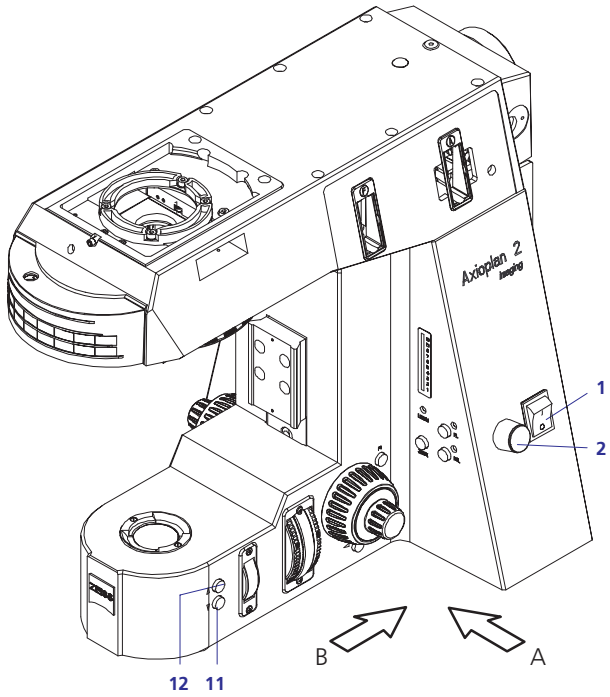
**5** Sockets of the integrated power unit for HAL 100/transmitted light microscope lamps

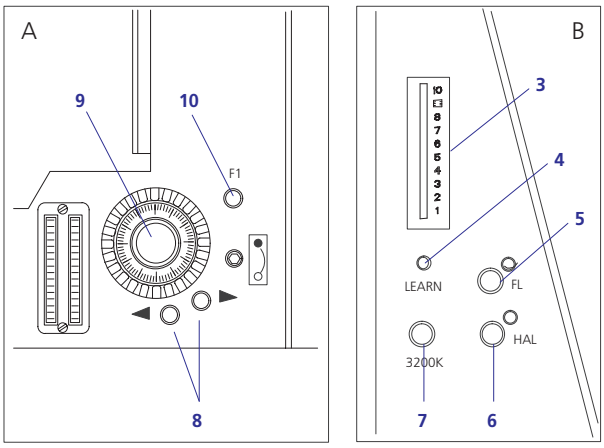
**6** Toggle switch to change between incident and transmitted light.
the short delay after you push the switch helps prevent you from hurting your eyes in the unexpected bright light.

**7** Sockets of the integrated power unit for HAL 100/incident light microscope lamps

**8** Socket for Axiophot 2 photo module

## Stand E / Stand MOT




**1** ON/OFF switch
**2** Light intensity control
**3** LED line lamp voltage
**4** LED LEARN
**5** FL on/off key with LED
**6** HAL on/off key with LED
**7** 3200K key (color temperature key)
**8** Turret key pair
**9** Coarse/fine drive for focusing
**10** F1 key
**11** Rapid stage lowering CHANGE (on both sides: only on MOT stand)
**12** Rapid stage lowering VIEW (on both sides: only on MOT stand)

**Fig. 10 Motorized stand**

### Specialties

- ❑ Integrated electronic system in the stand base
- ❑ Motor focusing (only MOT stand)

Manual operation of these stands differs only slightly from the operation of the manual stand. The following therefore describes only those stand functions, which the instructions for the operation of the manual stand do not cover.
The stand described here is equipped with all the available motorized and coded functions and may therefore differ from your stand configuration.

**Note: Microscope Software**
Some of the motorized functions of the stands can only (or also) be operated from the PC via the software. For a description of this function, please see the chapter *Microscope Software*.

The following item numbers refer to Fig. 10 (motorized stand).

**1 ON/OFF switch**

**O** Instrument switched off
**I** Instrument switched on

For optical status checking, the switch lights up in green in position **I** (for defects see chapter —> *Care, Maintenance*).
When the Axioplan 2 imaging is switched on, not only the HAL 100 microscope lamp is supplied, but also the Axiophot 2 photo module (if attached), and the motorized and coded components.

**Note:** Motorized focusing and all the other motorized or codable functions are only available when the instrument is switched on.

**2 Light intensity control**
Knob for adjusting light intensity of connected HAL 100 microscope illuminators.
As the control knob has no stops, turning knob right increases lamp voltage up to maximum, turning knob left decreases lamp voltage down to minimum.

**3 LED line lamp voltage**
Display of set lamp voltage and for programming of focusing speeds.

**4 LED LEARN**
Check display in learn mode

**5 FL on/off key (fluorescence shutter)**
Switches the fluorescence shutter alternately on or off.
The fluorescence shutter shuts out the beam path of incident light, without switching off the lamp. This increases the durability of the fluorescence lamps.
By pressing the FL key the fluorescence shutter is opened, the incident/fluorescence light beam is released and the lamp for transmitted light is switched off. The LED next to the FL key lights up when shutter is open.
By pressing the FL key, the incident light is blocked and the lamp for transmitted light is switched on. The halogen illuminator (transmitted light) can be switched on or off separately at any time.

**6 HAL on/off key**
Switches halogen lamp alternately on or off. LED lights up green when switched on.
After switching on, the current valid LightManager value for the light intensity of the halogen illuminator is loaded (default value for lamp voltage 3 V). The fluorescence/incident lamp can be switched on or off at any time.

**7 3200K key (color temperature key)**
Knob to set the 3200 K color temperature for photomicrography using color film (artificial light). On the LED line of the lamp voltage the LED 9 illuminates as a point (corresponds to 10.9 V).

**8 Turret key pair – on both sides**
These two keys, fitted on left and right of the stand, each control a motorized microscope component.
The function allocation of the key pairs is automatic when switching on or can be changed with the system configuration program AxioSet.

The automatic function allocation is carried out allowing for the following priorities.

Key pair on right side of stand:
1. Optovar turret / Optovar zoom
2. Objective nosepiece

Key pair on left side of stand:
1. External filter wheel
2. Reflector turret

If, for example the instrument has no Optovar and also no external filter wheel, then the key pair on the right side of stand operates the objective nosepiece and the key pair on the left side operates the reflector turret.

With the aid of the instrument configuration program AxioSet, the following functions can be allocated to the turret key pairs:

- ❏ Objective nosepiece
- ❏ Reflector turret
- ❏ Condenser turret
- ❏ Optovar
- ❏ External filter wheel
- ❏ Front filter wheel (filter wheel 1)
- ❏ Rear filter wheel (filter wheel 2)
- ❏ Virtual filter wheel (both filter wheels are switched to respectively double the filter effect)
- ❏ Photo module (VIS, photo-, video switch-over)
- ❏ 2-TV tube

**9 Motorized focusing drive**
Operation takes place manually by means of the coarse or fine drive knob (on both sides of stand), that act on an electronic encoder.

**10 F1 key**
Key that can be programmed and used via the user software (AxioVision).

**11, 12 Rapid stage lowering CHANGE (LOAD)/ VIEW (WORK) – only MOT stand**

Knob on right side of stand for rapid lowering of stage and subsequent raising back to previous position.
The right key pair can be allocated with the work/load function or with one of the functions that can also be assigned to the turret key pairs.
Key assignment is carried out with the aid of the system configuration program AxioSet.

**Stage lowering (LOAD)**

- Press CHANGE knob (**11**).
  Stage will be lowered. The current focus setting is stored.

**Moving stage up (WORK)**

- Press VIEW knob (**12**).
  Stage moves up and the stored focus position is precisely reset.

The user-friendly design of this function enables you to operate the CHANGE/VIEW keys with either your right or your left hand.

CAUTION!

**Risk of injury and instrument damage**
Please do not insert your hand or any objects between the stage and the objective when the stage is moved upwards. The same applies to the downward motion: in that case, the space between condenser and stand base is reduced.

**Note:** By actuating the focusing drive on the stand, the WORK position is moved into the current position.

**Lowering of stage to mechanical stop**

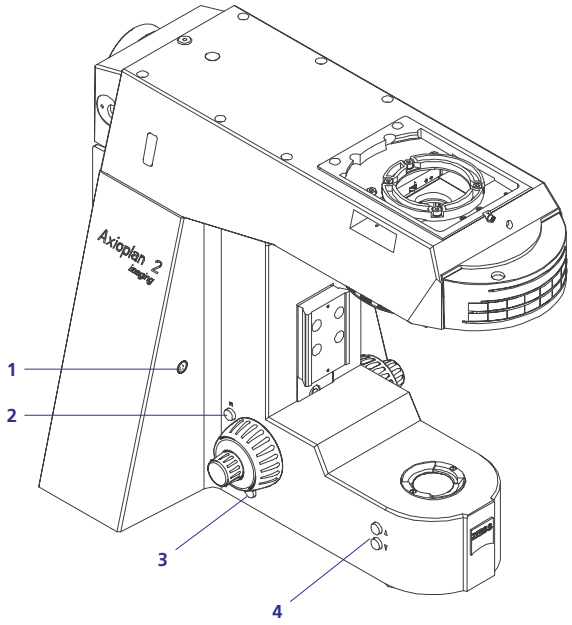
- The stage can be moved from the LOAD position to the lower mechanical stop by pressing and holding the LOAD key. The WORK position is retained.
- If the stage has been lowered past the LOAD position, the stage can be moved back up to the LOAD position by pressing and holding the WORK key.

**Emergency stop for stage movement when approaching LOAD/WORK position**

- If movement to the WORK or LOAD position is started by briefly pressing the LOAD/WORK key, in the case of an emergency the stage movement can be immediately stopped by pressing one of two keys again. The WORK position is retained.
- From this emergency stop position, the WORK position can be returned to by pressing and holding the WORK key.

**Note:** The WORK position is retained when changing the objective; only the parfocality balance for the current objective is carried out.
After the change of objective the stage does not move automatically from the LOAD position back into the WORK position. Only after actuation of the WORK key will the stage move back into the WORK position.

Actuation of the focusing drive in the LOAD position cancels the WORK position and sets this to the current position. In this case the stage must be moved back manually into the original WORK position. To do this swing the objective out of its lock-in position. When in this position the focusing speed is switched to the highest level to aid the re-focusing.




**1** Socket for motorized condensers
**2** F2 key
**3** Turret key pair
**4** Rapid stage lowering CHANGE (LOAD) / VIEW (WORK)

**Fig. 11 Motorized stand**

**1 Socket for motorized condensers** (Fig. 11)
Both the voltage supply and the control of the motorized condensers is controlled via this connector.

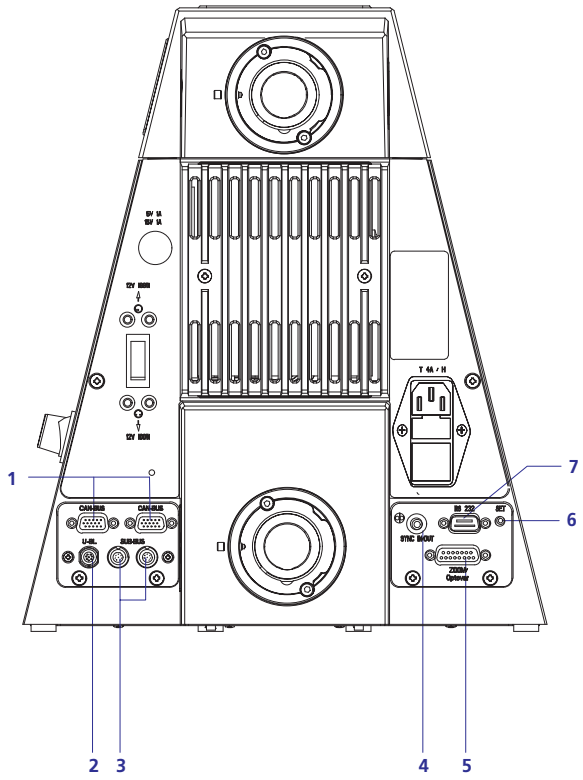
- Switch off Axioplan 2 imaging
- Secure condenser to condenser carrier.
- Connect plug of condenser cable to SUB BUS connection (**1**) on stand.

**Note:** When the Axioplan 2 imaging is switched on, instrument initialization is performed to allow recognition of the connected modules. This means that the system cannot recognize any modules which are connected **after** the Axioplan 2 imaging has been switched on.

**2 F2 key** (Fig. 11)
Key that can be programmed and used via the user software (AxioVision).

**3 Turret key pair – left side** (Fig. 11)
(refer also to page 17)

**4 Rapid stage lowering CHANGE (LOAD)/ VIEW (WORK) – left side** (Fig. 11)
Can be assigned and deactivated with the WORK/LOAD function via the system configuration program AxioSet.




**1** CAN bus connector
**2** U-BL connector
**3** SUB bus connector
**4** SYNC IN/OUT connector
**5** Connector for zoom/Optovar intermediate tube
**6** RS 232 C interface
**7** SET programming key

**Fig. 12 Back of motorized stand**

### 1 CAN bus connector

For connection of the photo module Axiophot 2 / 2 TV tube.

The Axioplan 2 imaging can be actuated through one of the interfaces via a CAN bus. Normally the signals are transmitted from a PC , which must be fitted with an appropriate driver card (CAN bus interface), to the Axioplan 2 imaging and read out from there. The second connection also allows cascading. This enables several series-connected instruments to be activated by a PC.
The control commands for programming languages under WINDOWS™ are provided by DLLs (Dynamic Link Libraries). For details please see —> *Interface description* or get in touch with our service department.

## Back of stand E / MOT

### 2 U-BL connector

A controller manufactured by Uni-Blitz (e.g. order no. 000000-1105-733) can be connected here, through which the complete function of the Uni-Blitz shutter (incident light) integrated in the stand can be controlled. This enables response times of 10 ms to be achieved, which cannot be attained with the internal stand actuation. If the cable (order no. 000000-0425-188) is connected, the internal shutter control is deactivated and the shutter can only be controlled via the controller. That means the shutter no longer responds to the FL key or an AxioVision command.

### 3 SUB bus connector

Further external motorized components (such as the exciter filter wheel mot 8-way ) can be connected to the microscope via this connector.

### 4 SYNC IN/OUT socket

The incident light shutter can be opened via this input with a TTL signal (IN), or the shutter outputs a TTL signal, which enables synchronization with e.g. a camera (OUT). Programming / selection IN/OUT takes place via the system configuration program AxioSet.

### 5 Socket for intermediate tube Optovar / zoom

The currently installed intermediate tube (coded) is connected with the microscope (control-side) at this connector via the supplied connection cable.

### 6 RS 232 C interface

The Axioplan 2 imaging is connected directly to a PC via this connection and can then be operated using the microscope software. The RS 232 C cable is used to connect the stand to a PC serial connection. The PC serial connections are usually designated COM 1 and COM 2 (—> *Chapter Microscope control software*).

### 7 SET programming key

This key has two functions:

- ❑ Storage of LightManager functions (—> *LightManager, Operating / Programming Stand E / MOT*)
- ❑ Activation of learn mode

# Stand

## Coded microscope parts

Various modules of the Axioplan 2 imaging and some additional microscope components can be coded.
Coding is beneficial when the microscope software is used. The software can recognize coded parts of the microscope and display their position or status, even if the parts involved are not motorized. For example, filter wheels or intermediate tubes can be coded without being motorized. In this case, the software would record and display a manual change of the filter or Optovar/zoom position.
However, the microscope software must be appropriately configured if it is to recognize the coded positions.
The configuration is performed with the aid of a setup program delivered with the instrument. Normally, the setup program has already been implemented in the factory prior to delivery of Axioplan 2 imaging.

**Note: Equipping the nosepiece**
The microscope software must be started via the PC before the nosepiece is fitted with objectives (normally, the nosepiece is fitted with objectives in the factory as ordered). Fit the nosepiece mounts with the objectives displayed for these mounts by the program. If the objective to be used is not displayed by the program, the **Setup** program must be called and this objective input for a mount on the nosepiece.
Always check whether the objective position and the appropriate display correspond in the program.
The same applies for the positions of the reflector turret.

## General

The main task of the LightManager is to regulate the brightness of the microscope image so that the user always has a pleasant brightness level, regardless of the chosen objective.

Settings that have been considered once as correct are stored and are automatically reproduced depending on the chosen LightManager when changing the objective nosepiece / reflector turret. It is not necessary to connect the microscope to a computer to perform this function.
**Requirements** for the LightManager, however, are the **motorized or coded nosepiece** and the **option of motorized adjustment for the** following components:

- ❑ 3200K setting (color temperature)
- ❑ luminous-field diaphragm for transmitted light
- ❑ aperture diaphragm for transmitted light
- ❑ condenser turret positions (7x)
- ❑ condenser front optics
- ❑ filter wheels 1 and 2
- ❑ fluorescence shutter

The KÖHLER illumination setting process should already have been performed prior to the initial use of your Axioplan 2 imaging (—> *Page 82*). You should also make an occasional check to ensure that this setting has not changed.
The factory-programmed setting of the LightManager guarantees a practical starting situation, from which you can make your own settings and then store them with the SET key (Fig. 12/**7**).

The following description of LightManager is for the Axioplan 2ie stand, coded (000000-1078-234) and motorized (000000-1078-233), with the motorized upper stand part (000000-1079-078), in conjunction with motorized achromatic aplanatic universal condenser (445437-0000-000, 445438-0000-000 or 445440-0000-000). This stand version has been supplied since 10/2000, check the type plate of your microscope.

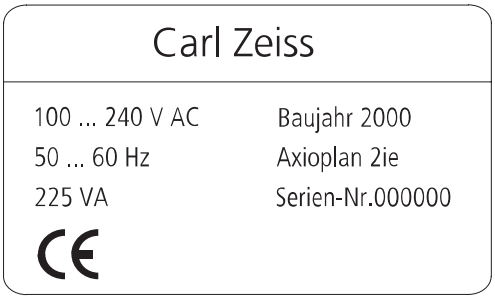



**Fig. 13 Type plate, Axioplan 2ie**

Unlike earlier stand models, the Axioplan 2ie offers the following LightManager versions:
Mode 1: LightManager permanently deactivated.
Mode 2: LightManager
Mode 3: LightManager with SmartContrast
Mode 4: LightManager material

If a LightManager mode (2, 3, or 4) is selected, this will be automatically activated on switching on the instrument.

### Selection of LightManager modes (permanent)

To select a LightManager mode, proceed as follows:

- Press the SET key until a double beep is heard.

This activates the learn mode and the LED LEARN flashes.

- Press the F2 key.

The set LightManager mode is displayed via the four lowest LEDs of the LED line (lamp voltage):
- ❑ First (lowest) LED lights up: LightManager mode 1
- ❑ Second LED lights up: LightManager mode 2
- ❑ Third LED lights up: LightManager mode 3
- ❑ Forth LED lights up: LightManager mode 4

- After 3 s the display switches back to lamp voltage display.
- Every time the F2 key is pressed again during these 3 s the next LightManager mode can alternately be set. The corresponding LED on the LED line lights up for status chekking.
- Press SET key briefly to confirm the setting. The LED LEARN turns off.

**Note: Intermediate tubes Optovar / zoom**
If an intermediate tube Optovar is inserted in your Axioplan 2 imaging, no LightManager values are stored for it.

### Deactivating LightManager (temporarily)

The LightManager can be deactivated if necessary regardless of the mode selected. The microscope then behaves like a manual instrument. However, the motorized functions of the Z drive are not influenced.

- To temporarily deactivate the LightManager, keep the FL key pressed while switching on microscope, until a beep sound is heard.

The LightManager is automatically activated when next switched on.

## LightManager (mode 2)

On activation of LightManager mode 2, a brightness value and a contrast process can be stored for each objective. This mode is essentially the LightManager as used in the earlier versions of Axioplan 2.

Default components:
– objective nosepiece

Components stored with this:
– lamp voltage for brightness value
– 3200K setting (color temperature)
– filter wheels 1 and 2 (transmitted light)
– luminous-field diaphragm
– condenser turret
– aperture diaphragm
– condenser front lens

### Allocation of brightness values and a contrast process for the current objective:

- Switch off incident light illumination using the FL key.
- Swing selected objective into beam path.
- Adjust front lens and luminous-field diaphragm of condenser.
- Select contrast process on condenser turret.
- Set aperture diaphragm (only on H and DIC).
- Set brightness via lamp voltage control or 3200K key and select filter combination on filter wheels.

**Note:** On microscope equipment with manual condenser, the condenser settings are not taken into account by the light manager.

- Press SET key briefly to store setting.
- The procedure described can be carried out immediately or later as required for objectives used or for all objectives.
- The settings are always stored by pressing the SET key for the current objective.

**Note:** Two lamp voltages ("variable" through the lamp voltage control and 3200K via 3200K key) can be permanently stored. The voltage value activated after a change of objective depends on whether the 3200K setting has been activated or not during the previous storing of LightManager via the SET key. If a voltage value has been stored for both conditions and the 3200K setting was stored last, then the latter will then be active. Switching to "variable" voltage value is carried out by pressing the 3200K key.
The filter wheel setting is not affected by this.

### Programming of transmitted light brightness for "FL + HAL"

- Switch on FL and HAL.
- Select objective.
- Set brightness value for **FL + HAL** (lamp voltage / 3200K setting and filter wheels).
- Press SET key briefly to store setting.
- Carry out setting of all other selected objectives likewise.

**FL + HAL** can only be stored once for each objective and is valid for all stored contrast processes.
If no brightness value **FL + HAL** has been stored for an objective, then the "normal" brightness values are valid for FL and HAL.
A previously stored "variable" voltage is not overwritten when storing 3200K.

### Erasing LightManager values for an objective

- Swing objective into place.
- Switch off HAL and FL.
- Keep 3200K key pressed and briefly press SET key.

The LightManager values for the current objective are erased.

## Light manger with SmartContrast (Mode 3)

This light manger mode offers (alongside LightManager function mode 2) together with SmartContrast the ability to set the illumination versions (HAL or/and FL) and the contrast process simply by changing the reflector position.

For this the LightManager allows up to four transmitted light contrast processes (H, D, Ph, DIC) together with the corresponding brightness value to be saved for each objective. However, this requires a motorized universal condenser.

At each reflector turret position, the illumination version (**HAL**, **FL** or **HAL + FL**) and a contrast process (only with HAL), **can be stored regardless** of the objective position.

First default component (LightManager):
– objective nosepiece

Components stored with this:
– lamp voltage for brightness value
– 3200K setting (color temperature)
– filter wheels 1 and 2 (transmitted light)
– luminous-field diaphragm
– condenser turret
– aperture diaphragm
– condenser front lens

Second default component (SmartContrast):
– reflector turret

Components stored with this:
– illumination version: HAL on/off; FL on/off
– condenser turret (only set contrast process)

The contrast process can be selected by simply changing the reflector turret position. The matching, optimum brightness as well as the matching phase ring or DIC prism is automatically set for the current objective. If no brightness has been selected for this contrast process, the so called preferred contrast is set and no reaction occurs.

If the reflector turret is switched to a position with FL filter, the SmartContrast function switches automatically from HAL (transmitted light) to FL (incident light). It is also possible to combine a contrast process in transmitted light (e.g. phase contrast) with incident light.

For FL combined with HAL a further so called **FL+HAL** transmitted light brightness can be stored once for each objective. This brightness is set regardless of the set contrast process, if FL and HAL are switched on simultaneously.

In the case of 7-way universal condensers (with DIC), differentiation between brightfield and DIC I is not possible. DIC-brightnesses can only be stored for objectives with DIC II or DIC III.

Reflector turret positions and objective are programmed independently of each other.

Assigning an illumination process to the reflector turret is also possible without a motorized condenser.

### Allocation of brightness values and multiple contrast processes to the current objective

- Switch off incident light illumination using the FL key.
- Swing selected objective into beam path.
- Adjust front lens and luminous-field diaphragm of condenser.
- Select contrast process on condenser turret.
- Set brightness via lamp voltage control or 3200K key and select filter combination on filter wheels.
- Set aperture diaphragm (only on H and DIC).

**Note:** On microscope equipment with manual condenser, the condenser settings are not taken into account by the light manager.

- Press SET key briefly to store setting.

If further (maximum three more) contrast processes are to be stored for this objective, proceed as follows:

- Select contrast process on condenser turret.
- Set brightness via lamp voltage control or 3200K key and select filter combination on filter wheels.
- Set aperture diaphragm (only on H and DIC).
- Press SET key briefly to store setting.

- The procedure described can be carried out immediately or later as required for objectives used or for all objectives.
- The settings are always stored by pressing the SET key for the current objective.

If necessary the programming of the reflector turret (SmartContrast) can then be carried out.

**Note:** The contrast process stored last is stored as the "preferred contrast".

### Allocation of illumination version and contrast process for the current reflector turret position

- Swing the reflector turret position into beam path.
- Set contrast process and illumination version (**HAL**, **FL**, or **HAL + FL**).
- Keep F1 key pressed and briefly press SET key.
- Then set the required reflector positions, contrast processes and illumination version likewise and store the setting for each reflector turret position by keeping F1 key pressed and briefly pressing the SET key.

**Note:** With regard to the contrast process, only H, D, Ph or DIC are stored for the reflector turret position. The phase ring matching to the objective or the DIC prism are taken from the objective memory.
On **HAL** and **FL + HAL**, the contrast process set on the condenser is stored regardless of the current objective and its actual stored assignment.
If only **FL** is set, then no transmitted light contrast process is stored.

### Programming of transmitted light brightness for "FL and HAL"

- Switch on FL and HAL.
- Select objective
- Set brightness value for **FL + HAL** (lamp voltage / 3200K setting and filter wheels).
- Press SET key briefly to store setting.
- Carry out setting of all other selected objectives likewise.

**FL + HAL** can only be stored once for each objective and is valid for all stored contrast processes.
If no brightness value **FL + HAL** has been stored for an objective, then the "normal" brightness values are valid for FL and HAL.
A previously stored "variable" voltage is not overwritten when storing 3200K.

### Erasing LightManager values for an objective

- Swing objective into place.
- Switch off HAL and FL.
- Keep 3200K key pressed and briefly press SET key.

The LightManager values for the current objective are erased.

### Erasing LightManager values of reflector turret

- Switch off HAL and FL.
- Keep 3200K key and F1 key pressed and briefly press SET key.

All LightManager values for the reflector turret are erased.

## LightManager material (mode 4)

This LightManager mode is for halogen illumination in the incident light.

A lamp voltage for the brightness value can be stored for every combination of objective nosepiece and reflector turret (max. 56 values).

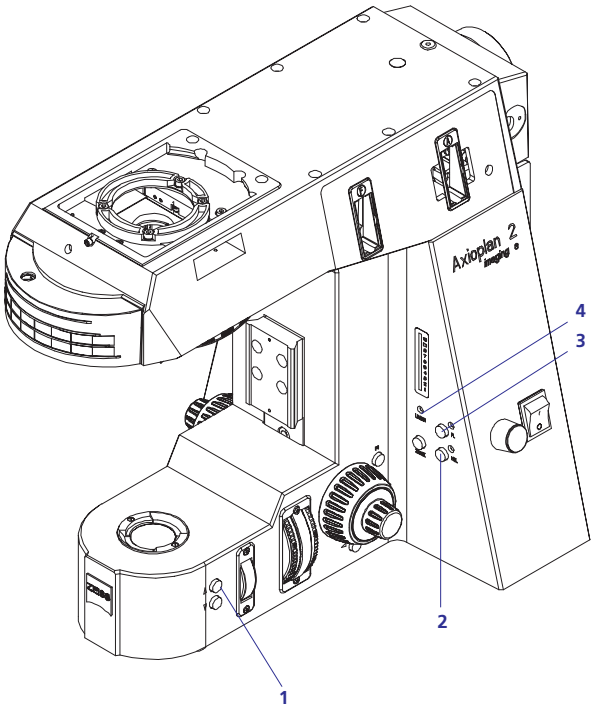
Default components:
– objective nosepiece
– reflector turret

Components stored with this:
– lamp voltage for brightness value
– 3200K setting (color temperature)

### Storing of a HAL voltage for the objective nosepiece/ reflector turret combination

- Swing the reflector turret position into beam path.
- Swing objective nosepiece in.
- Set HAL voltage.
- Press SET key briefly to store setting.
- Then set the HAL voltage value for every desired combination of reflector turret/objective nosepiece position and store with SET key.

**Note:** The voltage values can only be overwritten, but not erased.




**1** Fast stage lowering VIEW
**2** HAL on/off key
**3** FL on/off key
**4** LED LEARN

**Fig. 14 Motorized stand**

## Automatic balancing of focusing speed and focus position (parfocality) of different objectives

The lower part of the MOT stand is equipped with a Harmonic Drive™, which converts the hand movement in the focusing process into different sensitive vertical stage movements (proportionally to the objective's magnification). Motor focusing also compensates minor focus differences which always occur between the objective. First, however, the following learning process needs to be activated:

- Focus dry objective exactly with the highest magnification/aperture.
- Activate learn mode by pressing and holding SET key (Fig. 12/**7**) for more than 3 seconds. The setting of learn mode is indicated by the constant flashing of the LED LEARN in orange (Fig. 14/**4**).
- Set the focusing speed using the two keys for fast stage lowering, top = coarse (Fig. 14/**1**), bottom = fine.

The focusing speed display takes place via the lamp voltage LED line in 10 stages.

- Focus once more exactly on the specimen.
- Now switch to the objective with the next lower magnification/aperture. The settings for focus position and focusing speed of the previous objective position are stored.
- Now set the focusing speed and focus position for the current objective as for the reference objective and swing to the next objective position to store the setting.
- Proceed with the other objectives accordingly. Oil immersion objectives should be adjusted last.
- Exit the learn mode by briefly pressing the SET key. On releasing the SET key the acceptance of the adjustment values is confirmed by a brief beep sound.

**Note:** Transfer of the adjustment values into the permanent memory only takes place on exiting the learn mode. If the microscope is switched off while in learn mode, the original adjustment values remain.

## Focus limit (software limit)

Additional to the hardware end position recognition, the focus limit (i.e. an upper limit for the working range of the focusing drive) can be set through the stand electronics.

This limit represents an absolute focus position, equally valid for all objective nosepiece positions, and is only corrected by the value of the parfocality balance of the respective objective.

The factory setting of the focus limit is above the upper limit switch, to prevent it becoming active.

- Activate the focus limit by prolonged pressing of the VIEW (WORK) key.

The current focusing drive position is set as a software limit (top Z position) and storing is indicated by a brief beep sound.

- To move the focus limit press and hold the VIEW (WORK) key and move the focus drive up **or** down.

The current Z position is stored as a focus limit on releasing the VIEW (WORK) key.

# System configuration AxioSet

The motorized Axioplan 2 ie can be additionally configured to the programming options of the stand electronics, using the system configuration program AxioSet.
This stand version has been supplied since 10/2000, check the type plate of your microscope (see Fig. 13).

The system configuration program AxioSet is installed on a PC, which is connected to the stand via the RS 232-interface. AxioSet automatically recognizes the configurable microscope components and offers the corresponding configuration options. The following functions can be set:

- ❑ key assignment
- ❑ parfocality
- ❑ focusing speed of the objectives
- ❑ activation/deactivation of automatic functions
- ❑ LightManager settings:
  - – LightManager mode
  - – determination of included components
  - – securing / recovery of settings (data)
  - – defining positions of external filter wheel
  - – antiglare device
- ❑ diagnostic function fax report for service use
- ❑ administration (storing and loading) of individual LightManager settings in multi-user mode.

# Microscope control software AxioVision Control

## What does AxioVision Control offer?

AxioVision permits the remote control of the following Carl Zeiss microscopes from you PC:

- ❑ Axioplan 2
- ❑ Axioplan 2 imaging
- ❑ Axioplan 2 ie
- ❑ Axiophot 2
- ❑ Axiovert 100 M
- ❑ Axioskop 2 MOT
- ❑ Axiovert 200 M

**Note:** To determine whether your microscope is the Axioplan 2i or the Axioplan 2ie type, check the type plate at the rear of the microscope (also compare the versions on pages 8 and 22).

Remote control with AxioVision Control provides the following benefits:

- ❑ convenient remote control function with visual navigation aid
- ❑ flexible storage of microscope settings and activation via function keys
- ❑ AxioMouse permits microscope operation via PC-mouse
- ❑ convenient photomicrography with Axiophot 2 and MC 200
- ❑ management of different user profiles

## System requirements

### Recommended hardware

The following hardware is recommended for KS and AxioVision:

- ❑ Pentium III processor 600 MHz or faster
- ❑ 256 MB RAM
- ❑ 9 GB hard disk
- ❑ video adapter 1280 x 1024 bits, true color
- ❑ CD-ROM drive
- ❑ two parallel (LPT) and three serial ports (com)
- ❑ 21" multisync monitor
- ❑ WINDOWS 98 / WINDOWS NT 4.0 Service SP5 or WINDOWS 2000 Professional

Please note that the hardware requirements for KS software options, Framegrabber or cameras may be higher.

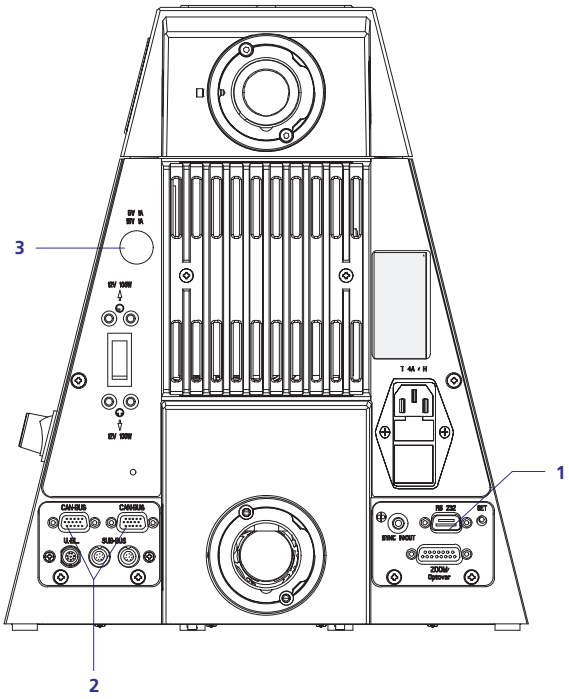
### Minimum system requirements

The following lists the minimum system requirements for hardware for AxioVision rel. 3.0 and KS 300/400 SP6:

- ❑ Pentium II 300 MHz processor or faster
- ❑ 128 MB RAM
- ❑ minimum 2 GB hard disk
- ❑ video adapter 1024 x 768 bits, true color
- ❑ CD-ROM drive
- ❑ minimum 17" multisync monitor
- ❑ WINDOWS 98 or WINDOWS NT 4.0 SP5

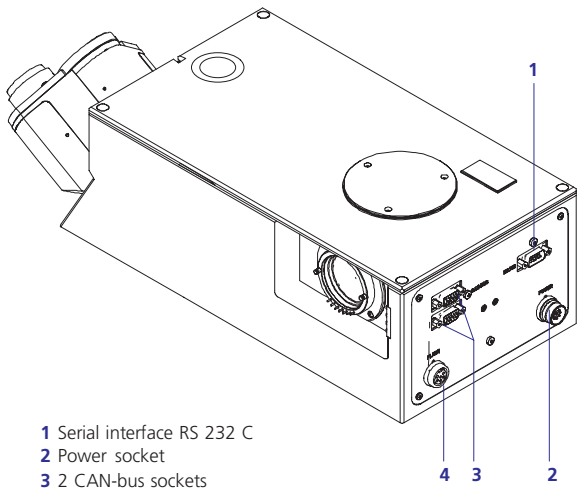
Please note that the hardware requirements for KS software options, Framegrabber or cameras may be higher.

**Note:** Detailed information on the microscope control software is contained in the AxioVision Control manual, B 40-623 d (Cat. No. 000000-1068-563).




**1** RS 232 C connection
**2** CAN-bus connection
**3** Socket for Axiophot (voltage)

**Fig. 15 Back of motorized stand**




**1** Serial interface RS 232 C
**2** Power socket
**3** 2 CAN-bus sockets
**4** Spare socket

**Fig. 16 Electrical connections Axiophot 2**

## Electrical connections

### Microscope

The coupling of the Axioplan 2 imaging with the PC or the notebook is performed via the RS 232 C serial interface (Fig. 15/**1**) using a connecting cable.

### Axiophot 2 photo module

The electrical connections are on the back of the Axiophot 2 photo module:

- ❑ CAN-bus socket for cable connection to the stand and other microscope components (Fig. 16/**3**)
- ❑ RS 232 C serial interface – for the connection of a PC or notebook (Fig. 16/**1**)
- ❑ Spare socket (Fig. 16/**4**)
- ❑ Power socket (Fig. 16/**2**)

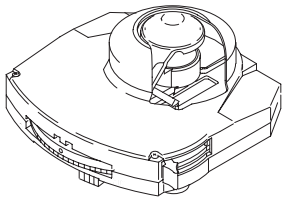
**Connection to the manual stand**

- Connect the supplied RS 232 C connection cable to the serial interface of the photo module (Fig. 16/**1**) and to the serial interface of your notebook/PC.
- Connect the internal voltage supply cable supplied to the power socket (Fig. 16/**2**) of the photo module and to the socket (Fig. 15/**3**) at the back of the stand.
- Tighten all safety screws on the plugs.

**Connection to the stand E/MOT**

- Use the RS 232 C cable supplied to connect the serial interface of the photo module (Fig. 16/**1**) or the stand (Fig. 15/**1**) to the serial interface of your notebooks/PC.
- Connect the internal voltage supply cable supplied to the power socket (Fig. 16/**2**) of the photo module and to the socket (Fig. 15/**3**) at the back of the stand.
- Connect the photo module and stand by connecting the CAN-bus cable to the appropriate CAN-bus sockets (Fig. 16/**3**) or (Fig. 15/**2**).
- Tighten all safety screws on the plugs.

# System overview
## Condensers

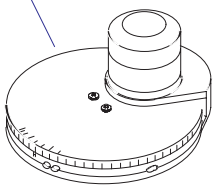


**Achromatic-aplanatic universal condenser 0.9 H**
(000000-1035-632)
**Achromatic-aplanatic universal condenser 0.9 H D Ph**
(445436-0000-000)
**Achromatic-aplanatic universal condenser 0.9 H D Ph DIC**
(445439-0000-000)
**Polarizer for condensers**
(000000-1028-973)

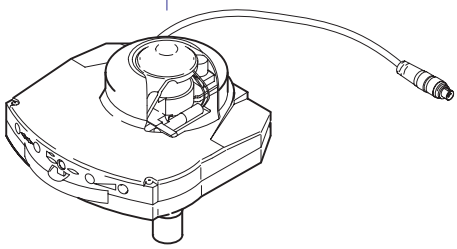
**DIC prism I / 0.9 (with polarizer)**
(000000-1005-002)
**DIC prism II / 0.9 (with polarizer)**
(000000-1005-003)
**DIC prism III / 0.9 (with polarizer)**
(000000-1005-004)

**DIC prism I / 0.9**
(000000-1004-901)
**DIC prism II / 0.9**
(000000-1004-902)
**DIC prism III / 0.9**
(000000-1004-903)

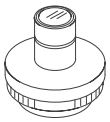
**DIC prism II / 1.4**
(445375-0000-000)
**DIC prism III / 1.4**
(445376-0000-000)



**Achromatic-aplanatic condenser 1.4 H Ph DIC**
(445453-0000-000)

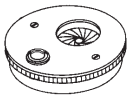


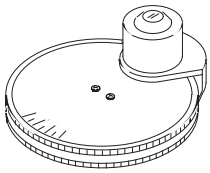
**Achromatic-aplanatic universal condenser 0.9 H MOT**
445437-0000-000
**Achromatic-aplanatic universal condenser 0.9 H D Ph MOT**
(445438-0000-000)
**Achromatic-aplanatic universal condenser 0.9 H D Ph DIC MOT**
(445440-0000-000)
**Polarizer for condensers**
(000000-1028-973)



**Achromatic condenser 0.8 H**
(000000-1087-444)
**DIC prism III / 0.8**
(000000-1087-445)

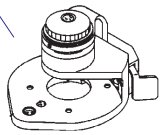
**Brightfield insert**
(445467-0000-000)



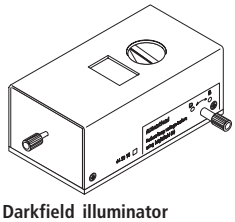


**Achromatic condenser 0.8 H D Ph DIC**
(445445-9901-000)
**DIC prism III / 0.8**
(445485-0000-000)

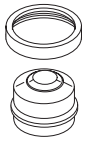
**Front lens 0.9 / d=2.9 Pol**
(445331-0000-000)



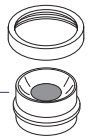
**Achromatic-aplanatic swing-in condenser system 0.24/d=10.7**
(445325-9901-000)



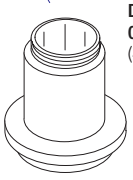
**Darkfield illuminator**
(445314-9901-000)



**Ultra condenser 1.2/1.4 (0.75-1.0)**
(465500-0000-000)



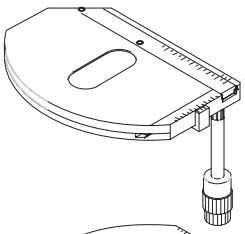
**Dry darkfield condenser 0.8/0.95 (0.6-0.75)**
(465505-0000-000)



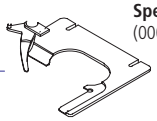
**Condenser holder Z**
(445323-0000-000)

# System overview
## Stage carriers, Stages, Condenser carriers

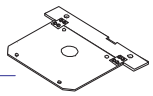
**Rotary, centerable mechanical stage 75x50 / 240° R**
(000000-1067-325)



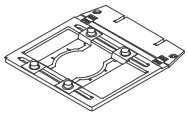
**Specimen holder for MS 75 x 50**
(000000-1067-330)



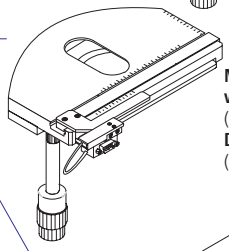
**Specimen holder A**
(000000-1070-588)



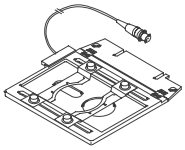
**Universal holder frame for culture dishes and specimen carriers**
(000000-1100-843)



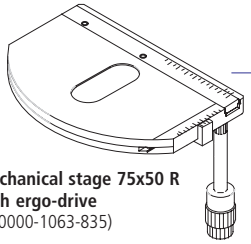
**Mechanical stage 75x50 R with electr. vernier scale**
(000000-1046-520)
**Display unit SCD**
(413507-9001-000)



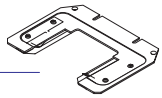
**Heatable universal holder frame A-H**
(000000-1116-055)
**Tempcontrol 37 analog (1-channel)**
(000000-1116-057)



**Mechanical stage 75x50 R with ergo-drive**
(000000-1063-835)



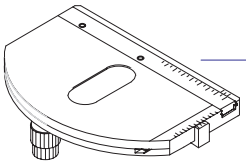
**Specimen holder with special fixation**
(000000-1070-589)



**Specimen holder D Pol**
(453563-0000-000)

**Holder frame for heating and cooling inserts**
(000000-1107-544)

**Specimen holder A Pol**
(453564-0000-000)

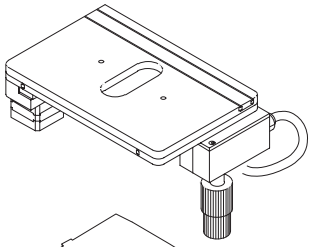


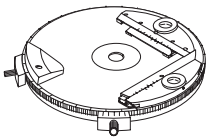
**Mechanical stage 75x50 L with ergo-drive**
(000000-1063-836)

**Mechanical stage 75x50 mot with control unit**
(000000-1025-145)

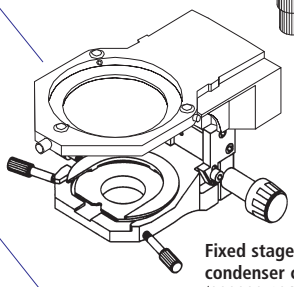
**Specimen holder**
(according to price list)

optional
**Joystick for 2 axes**
(000000-1033-996)
or
**Coaxial electronic drive**
(000000-1034-960)

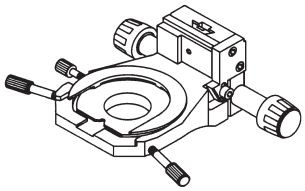




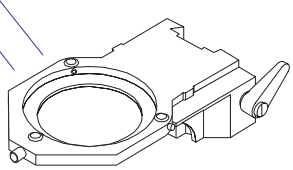
**Rotary stage Pol**
(453550-0000-000)
**with object guide Pol**
(453560-0000-000)



**Fixed stage carrier with condenser carrier**
(000000-1062-273)

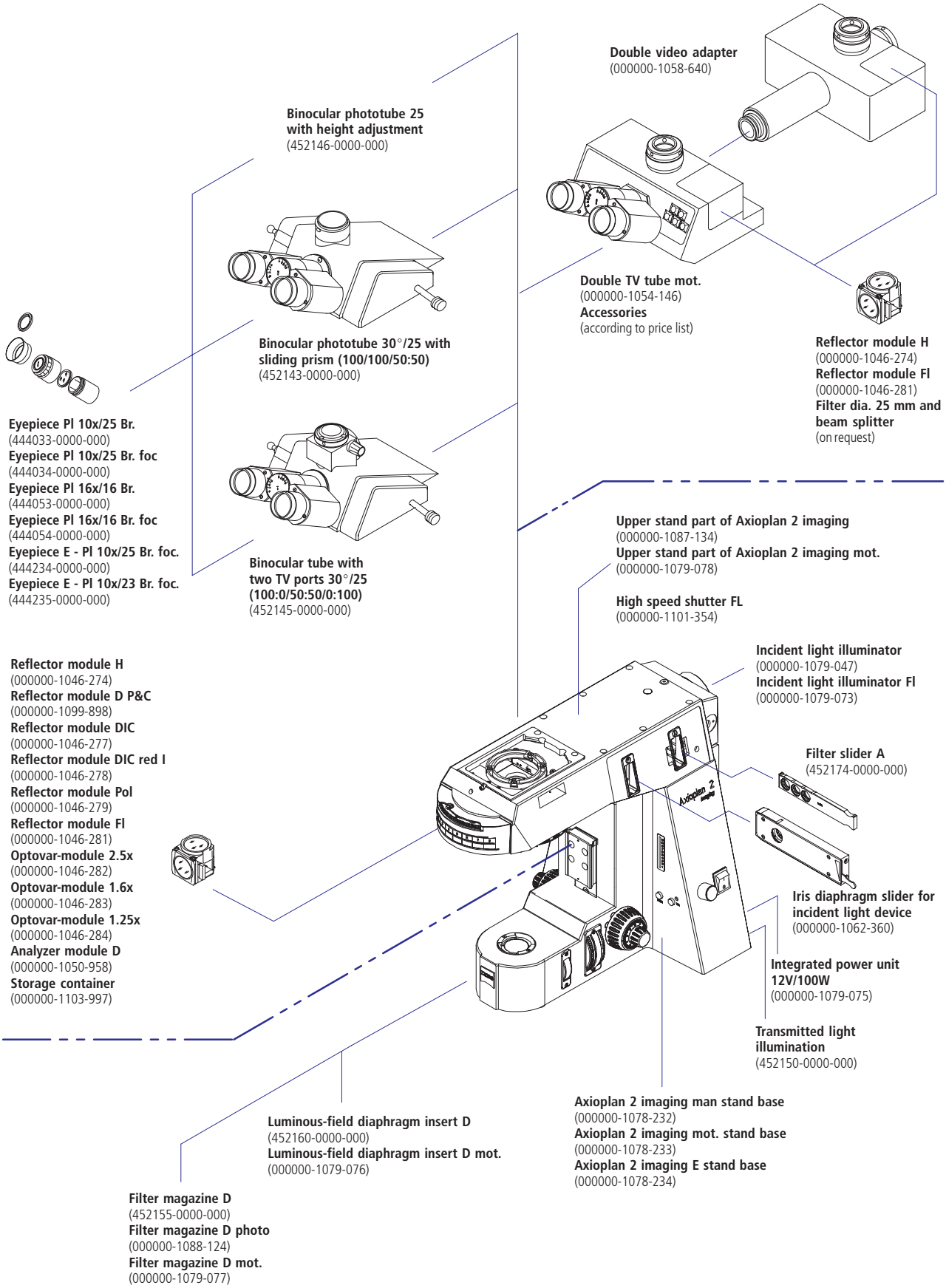


**Centerable condenser carrier with height adjustment on both sides for removable stage carrier**
(000000-1101-554)

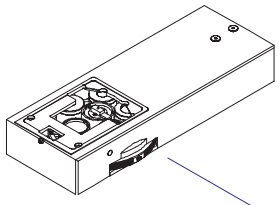


**Lowerable and removable stage carrier**
(000000-1062-274)

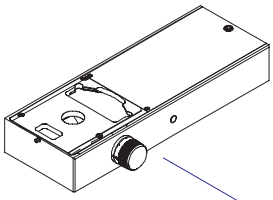
# System overview
## Stand, Tubes, Eyepieces, Filters, Reflectors



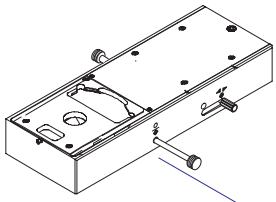
# System overview
## Intermediate tubes, Nosepieces, Compensators



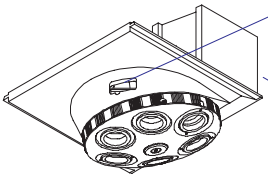
**Optovar intermediate tube 1.0x/1.25x/1.6x/2.0x/2.5x cod.**
(452175-0000-000)

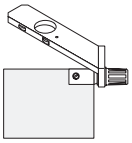


**Intermediate zoom tube 1.0x ... 2.5x cod.**
(452180-0000-000)



**Intermediate tube Pol (with quartz depolarizer)**
(452184-0000-000)

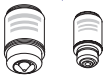




**Fluorescence protection screen**
(452163-0000-000)

**7x nosepiece H W 0.8**
(452130-0000-000)
**6x nosepiece H DIC W 0.8**
(452131-0000-000)
**6x nosepiece H D DIC M27 cod.**
(452136-0000-000)
**7x nosepiece H W 0.8 mot.**
(452137-0000-000)
**6x nosepiece H D DIC M27 mot.**
(452138-0000-000)
**6x nosepiece H DIC W 0.8 mot.**
(000000-1067-351)
**6x nosepiece Pol W 0.8 cod.**
(412139-0000-000)

**DIC sliders**
entire line
according to
price list

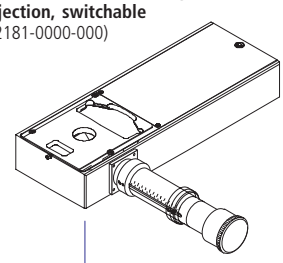


**Objectives**
entire line of ICS
objectives according
to price list

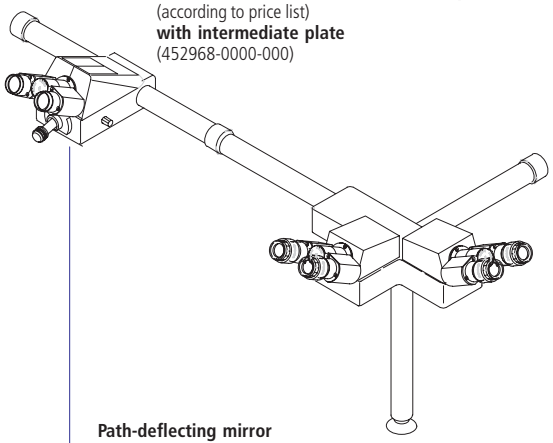
**Antiflex cap for Epiplan-Neofluar 1.25x**
(444921-0000-000)
**Antiflex cap for Epiplan-Neofluar 2.5x**
(444922-0000-000)

**Intermediate ring M 27 on W 0.8 H=0.94**
(444911-0000-000)
**Intermediate ring H "O" M 27 on W 0.8**
(000000-1095-168)

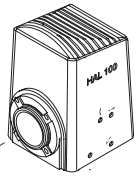
# System overview
## Intermediate tubes, Illumination, Analyzers



**Intermediate tube for image projection, switchable**
(452181-0000-000)



**Multi-observation device for "Axioskop 2"**
(according to price list)
**with intermediate plate**
(452968-0000-000)

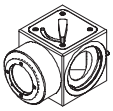


**HAL 100 lamp housing**
**with collector, lamp mount and heat-reflecting filter**
(447219-0000-000)

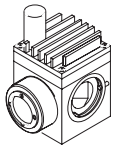
**HBO 50 lamp housing**
**with lamp mount**
(447220-0000-000)
**Collector HBO 50/SF 25**
(447270-0000-000)

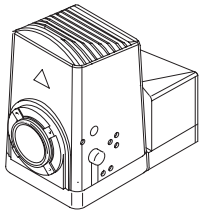
**Power supply unit for HBO 50**
(392642-0000-000)

**Path-deflecting mirror for two illuminators**
(447230-9901-000)

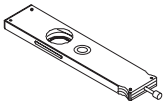


**Path-deflecting mirror for two illuminators (mot)**
(000000-1095-490)

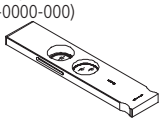




**Bertrand lens slider PH**
(453671-0000-000)

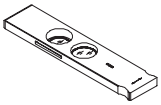


**Fixed analyzer slider**
(453657-0000-000)



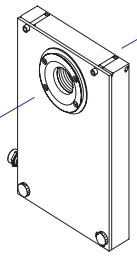
**Slider with analyzer with λ-rotary lambda plate**
(453663-0000-000)

**Slider for quartz depolarizer**
(453659-0000-000)

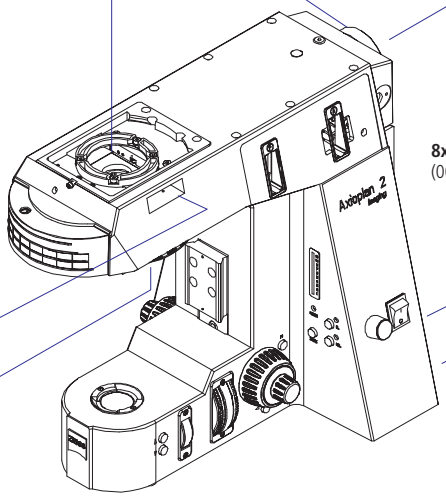


**Quartz depolarizer d=32 mm**
(453653-0000-000)

**HBO/XBO adjusting aid**
(452169-0000-000)



**8x exciter filter wheel**
(000000-1008-106)

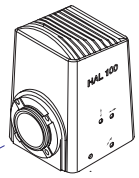


**N HBO 103 lamp housing**
(000000-1007-980)
**N XBO 75 lamp housing**
(000000-1007-981)
**Collector N HBO 103/XBO 75**
(000000-1007-976)
**Quartz collector N HBO 103/XBO 75**
(000000-1007-977)
**Achromatic collector**
(000000-1007-978)
**HBO 103 W/2 mercury short arc lamp**
(380301-9350-000)
**XBO 75 W/2**
**xenon short arc lamp**
(380079-9190-000)

**HBO 100 W ebq 100 dc power unit**
(000000-1003-928)
**ebx 75 isolated power unit**
(000000-1003-924)
**Adjustable power unit AttoArc 2 N HBO**
(000000-1007-975)

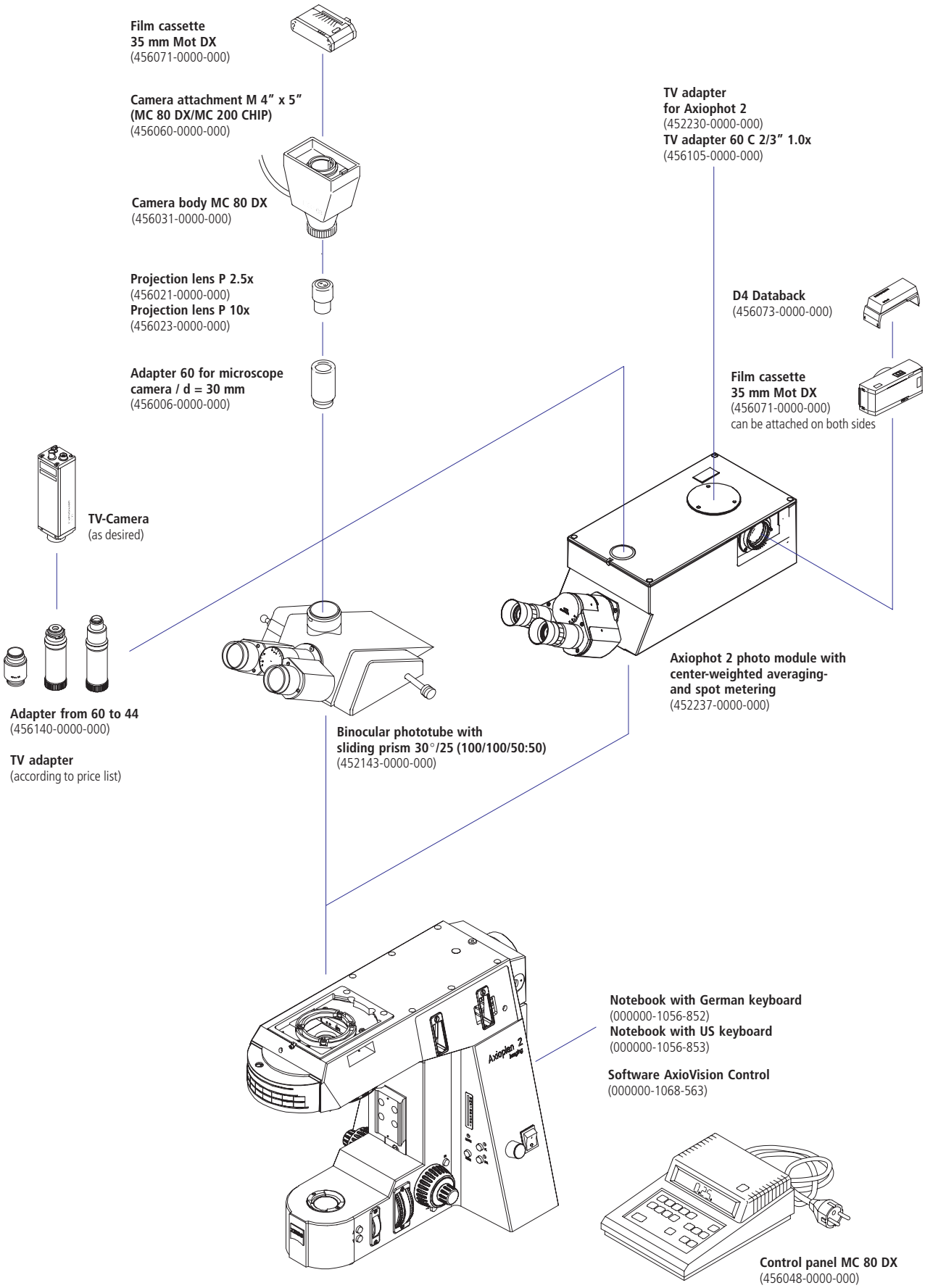
**Notebook with German keyboard**
(000000-1056-852)
**Notebook with US keyboard**
(000000-1056-853)

**Software AxioVision Control**
(000000-1068-563)



**HAL 100 lamp housing**
**with collector, lamp mount and heat-reflecting filter**
(447219-0000-000)

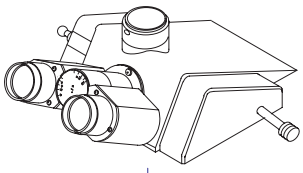
# System overview
## Equipment for Documentation



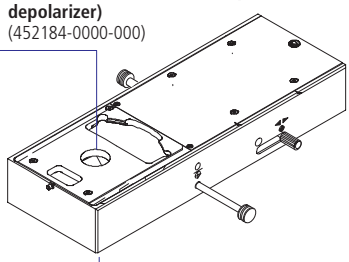
# System overview
## Equipment for polarization

**Eyepiece E - Pl 10x/23 Br. foc.**
(444235-0000-000)

**Binocular phototube with sliding prism 30°/25 (100/100/50:50)**
(452143-0000-000)

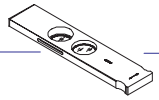


**Intermediate tube Pol (with quartz depolarizer)**
(452184-0000-000)

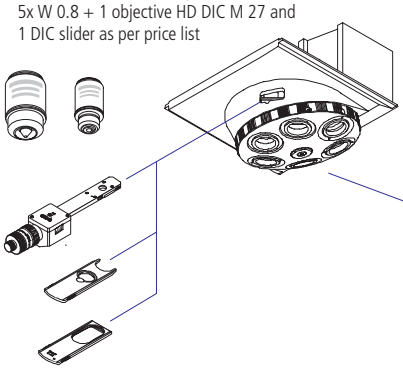


**Quartz depolarizer d=32 mm**
(453653-0000-000)

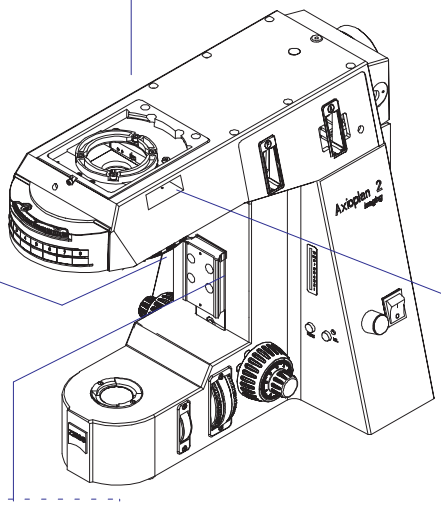
**Fixed analyzer slider**
(453657-0000-000)

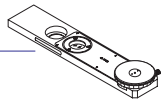


**6x nosepiece Pol W 0.8 cod.**
(452139-0000-000) up to 6 objectives Pol. W 0.8
(1x with intermediate ring 000000-1095-168) or
5x W 0.8 + 1 objective HD DIC M 27 and
1 DIC slider as per price list



**Slider for quartz depolarizer**
(453659-0000-000)

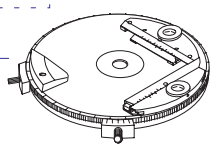


**Rotary analyzer**
(453662-0000-000)
**Slider with analyzer with rotary λ- plate**
(453663-0000-000)

**Brace-Köhler rotary compensator /10**
(000000-1115-703)
**Tilting compensator K 0-30**
(000000-1115-698)
**Tilting compensator B 0-5**
(000000-1115-700)
**Senarmont compensator 546/4 nm**
(000000-1115-695)
**Rotary compensator +/-8, 6x20**
(453710-0000-000)
**Compensator , 6x20**
(453704-0000-000)
**Compensator /4, 6x20**
(453714-0000-000)

**Stage carrier/ Condenser carrier**



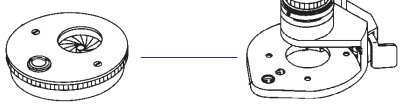
**Rotary stage Pol**
(453550-0000-000)
**with object guide Pol**
(453560-0000-000)

**Specimen holder A Pol**
(453564-0000-000)

**Specimen holder D Pol**
(453563-0000-000)

**Fixed polarizer D**
(453615-0000-000)
**Rotatable polarizer D**
(453620-0000-000)
**Rotatable polarizer with colored glass carrier**
(000000-1118-000)
**Fixed polarizer D with rotary λ-plate**
(445226-0000-000)

**Front lens 0.9 / d=2.9 Pol**
(445331-0000-000)



**Brightfield insert**
(445467-0000-000)

**Achromatic-aplanatic swing-in condenser system 0.24/d=10.7**
(445325-9901-000)

# Microscope Components – Overview, Description, Instructions for Use

The Axioplan 2 imaging incorporates the System Integration principle. This SI design allows the Axioplan 2 imaging to be configured or converted to meet various requirements.

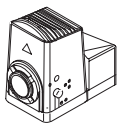
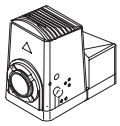
The following part of the manual describes all of the components with which the stands of the Axioplan 2 imaging can be combined. Please note that some components require a specific stand model. For example, the use of parts controllable by motor is not possible with the purely manual version of the stand, but requires at least a type E stand.

If the retrofitting of a motorized function is not possible with the equipment which you have purchased, please contact Zeiss customer service. It is possible that the retrofitting procedure can be performed without difficulty.
If components can only be used with the Axioplan 2 imaging or only under certain conditions, this is indicated in the overview given for the components in question.

# Microscope Components

## Microscope illuminators

### Overview

| Designation | Application/ Combination | Component parts | Cat. No. |
|---|---|---|---|
| **HAL 100**<br>halogen illuminator  | Incident light and transmitted light<br>All stands | Lamp housing<br>(with collector, lamp mount and heat-reflecting filter;<br>power unit integrated in Axioplan 2 imaging)<br>12 V/100 W halogen lamp | 447219-0000-000<br><br><br><br>380079-9540-000 |
| **N HBO 103**<br>gas discharge illuminator Mercury<br>External power unit required.  | Epi-fluorescence<br>All stands | N HBO 103 lamp housing<br>N HBO 103/XBO 75 collector<br>N HBO 103/XBO 75 quartz collector<br>HBO 103 W/2 mercury short arc lamp<br>Power unit HBO 103 W ebq 100 dc | 000000-1007-980<br>000000-1007-976<br>000000-1007-977<br><br>380301-9350-000<br>000000-1003-928 |
| **HBO 50**<br>gas discharge illuminator Mercury<br>External power unit required.  | Epi-fluorescence<br>All stands | HBO 50 lamp housing<br>(with lamp mount)<br>HBO 50/SF 25 collector<br>Power supply unit for HBO 50 | 447220-0000-000<br><br>447270-0000-000<br>392642-0000-000 |
| **XBO 75**<br>gas discharge illuminator Xenon<br>External power unit required.  | Epi-fluorescence and for high light intensities in incident light<br>All stands | N XBO 75 lamp housing<br>N HBO 103/XBO 75 collector<br>N HBO 103/XBO 75 quartz collector<br>XBO 75 W/2 xenon short arc lamp<br>ebx 75 isolated power unit | 000000-1007-981<br>000000-1007-976<br>000000-1007-977<br>380079-9190-000<br>000000-1003-924 |

**Note:** For the procedure for the assembly and adjustment of the HBO 50 and HBO 103/XBO 75 illuminators, please see the separate operating manuals "Microscope illuminator with HBO 50" (G 42-160) and "Microscope illuminator with HBO 100/XBO 75" (G 42-165).

# Microscope Components

## General notes


WARNING!

**Thermally sensitive fluorescence filters!**
Fluorescence filters are sensitive to the thermal radiation of the microscope lamp.
Therefore, never remove the heat-reflecting filter from the illuminator tube.

## Notes on the handling of lamps


CAUTION!

**Risk of injury!**

- Operate the lamps in the closed housing only.
- Gas discharge lamps emit intensive UV light. With longer periods of direct exposure, this can lead to skin burns and, in the long term, to skin cancer.
  Blindness or injury to the conjunctiva may result from looking directly into the lamp.
- Change lamps in cold state only: there is a risk of explosion due to the high internal pressure of warm lamps. Xenon lamps are also under pressure when cold.
  Maximum safety: protective visor and leather gloves with long cuffs.
- Always switch off the power unit and microscope prior to lamp change.
- Never touch the glass bulbs of the lamps to be changed, but use the protective caps delivered with the new lamps.
  Do not forget to remove the protective caps after the new lamps have been inserted.


WARNING!

**Risk of damage to instrument Risk of damage to instrument!**
Before you drape the dust cover over the microscope, switch off the microscope and the external power supply of the microscope illuminator.


WARNING!

**Heat build-up!**
Placing objects against or covering ventilation slots will lead to a build-up of heat which can destroy the instrument or cause a fire.
Therefore, always keep the ventilation slots clear.


CAUTION!

**Risk of burning!**
Do not touch the lamp housing when using the microscope for long periods.
The area of the upper ventilation slots in particular is subject to pronounced heating,
resulting in a risk of burning.

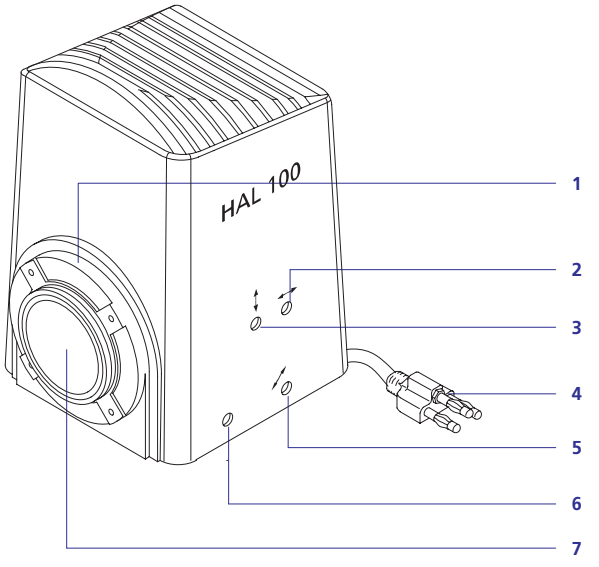
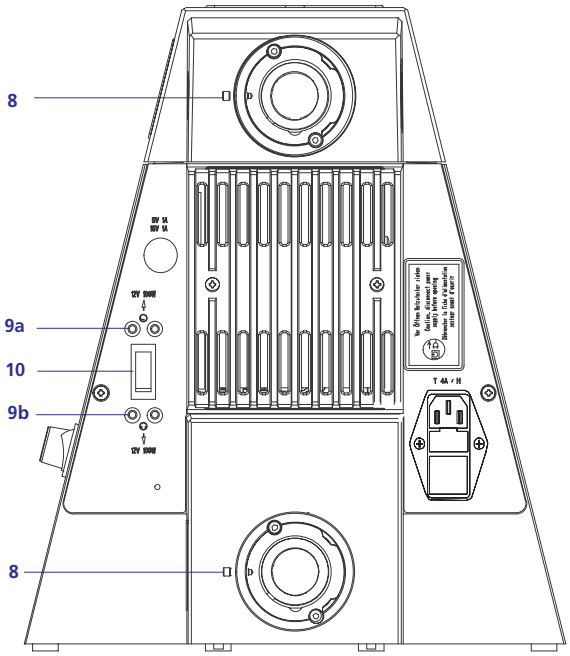



**Fig. 17 HAL halogen illuminator**




**1** Dovetail ring
**2** Focus adjustment of lamp filament
**3** Vertical adjustment of lamp filament
**4** Plug for 12 V DC voltage supply
**5** Lateral adjustment of lamp filament
**6** Securing screw for lamp housing
**7** Light exit
**8** Clamping screw for securing illuminator
**9a** Socket, illuminator voltage for transmitted light
**9b** Socket, illuminator voltage for transmitted light
**10** Toggle switch for switching between incident light/transmitted light

**Fig. 18 Connecting microscope illuminators**

### HAL - halogen illuminator

(Fig. 17; Fig. 18)

The HAL microscope illuminator is suitable for transmitted light and incident light microscopy and is part of the standard equipment of the Axioplan 2 imaging.
It consists of a reflector, collector, heat-reflecting filter, lamp mount and a 12 V/100 W halogen lamp.
The illuminator is attached via a clamp system with dovetail-ring (**1**) and clamping screw (**8**).

**Note:** A second heat-reflecting filter (467828-0000-000) is required for Pol applications. The filter is installed in the illumination tube using a retaining ring.

### Electrical supply

The Axioplan 2 imaging microscope features an integrated wide-range power unit and can be connected to line voltages ranging from 100 ... 240 V AC, 50 ... 60 Hz. The wide-range power unit sets itself **automatically** to the appropriate line voltage.

- Connect illuminator to 3-pin plug (**4**) at socket (**9a**, incident light) or (**9b**, transmitted light).

**Note:** If the stand is not equipped with 3-pin sockets, the third pin of the lamp connector must be unscrewed first.

- Connect the instrument to the line and switch it on via the ON/OFF switch (Fig. 20/**13**).
- Set toggle switch (**10**) in the appropriate position (transmitted light/incident light).
- Set light intensity via the voltage control (Fig. 20/**14**).

After switching on and setting (**10**) the lamp may take a few seconds to light.

**Note:** An adjustable DC voltage of 3... 12 volts stabilized against power fluctuations is present at sockets (**9a**) and (**9b**). Only one HAL illuminator may be connected. Other illuminators are supplied by external power units which are adapted to the powers of the respective lamps.

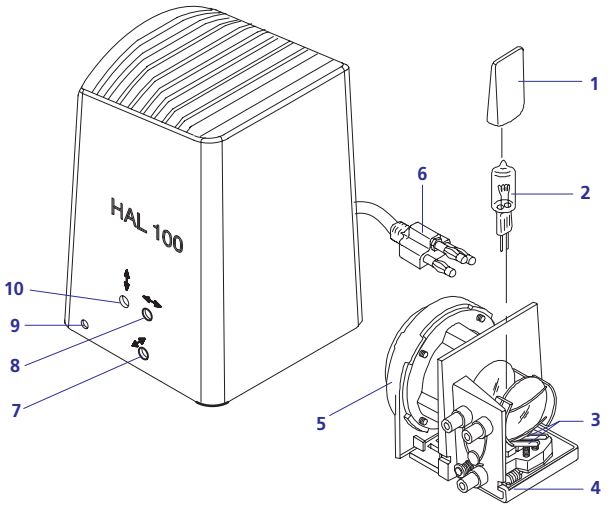
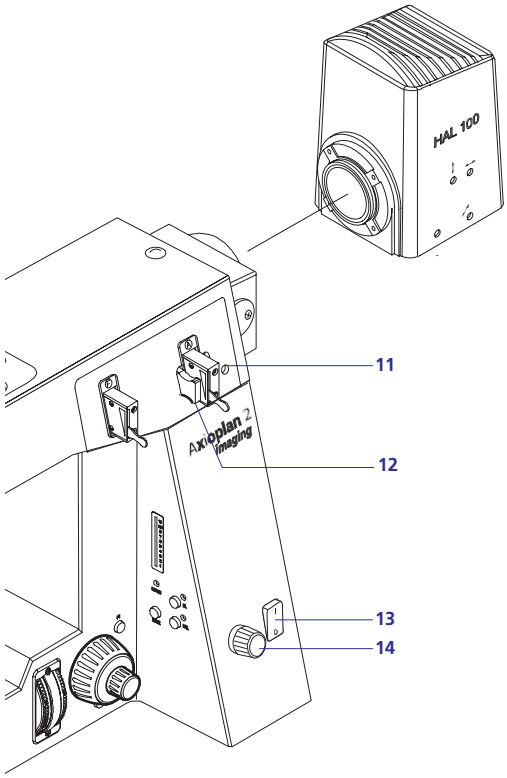



**Fig. 19 Lamp housing and lamp mount**




**1** Protective cap
**2** Halogen lamp
**3** Spring
**4** Lamp mount
**5** Internal tube
**6** Plug for 12 V DC voltage supply
**7** Lateral adjustment of lamp filament
**8** Focus adjustment of lamp filament
**9** Securing screw for lamp housing
**10** Vertical adjustment of lamp filament
**11** ON/OFF switch for diffusion disk, incident light
**12** Filter, incident light
**13** ON/OFF switch (I = ON, 0 = OFF)
**14** Voltage control for setting the light intensity

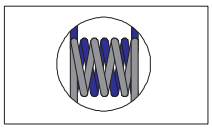
**Fig. 20 Connection for incident light**

### Adjusting the halogen lamp (Fig. 19; Fig. 20)

The SW 3 mm screwdriver enclosed is required to set screws (**7**), (**8**) and (**10**).

Coarse adjustment

- Loosen clamping screw and detach operational microscope illuminator from stand.
- Switch on Axioplan 2 imaging. Ensure not to look in light exit opening.
- Direct light ray towards a projection surface (wall, paper) at least 3 m away.
- Adjust screw (**8**), until the lamp filament is imaged sharply on the projection surface.
- Adjust screws (**7**) and (**10**) until the image of the lamp filament fills the gaps in the reflector image (—> *below*).



Fine adjustment

- If HAL 100 is connected to incident light tube, remove filters if fitted at **11** and **12** ; use Allen key if connected to transmitted light diffusion disk and switch off filter via filter wheels.
- Attach microscope illuminator to stand.
- Focus on specimen with ≤ 40× objective and look for a free object area.
- Insert Bertrand or remove eyepieces so that you can observe pupil image with lamp filament and its mirror image.
- Adjust screws (**7**) and (**10**) until both images are centered.
- Reactivate diffusion disk (transmitted light) and filters use.
- Optimize homogeneous illumination of pupil image with screw (**8**).

### Changing the halogen lamp

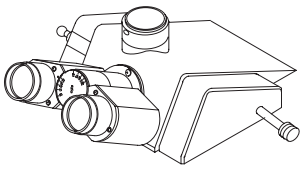
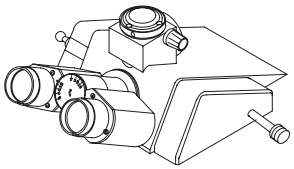
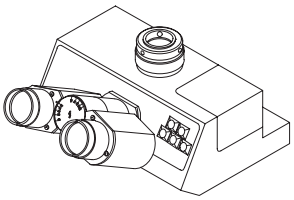
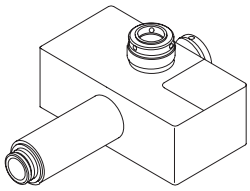
- Remove plug (**6**) from socket (Fig. 18/**9a** or **9b**).
- Remove microscope illuminator and allow to cool if necessary.
- Loosen screw (**9**) and pull out lamp housing in upward direction. The lamp mount is now accessible.
- Turn lamp housing upside down and remove old lamp by pressing spring (**3**).
- Insert now lamp in socket with the springs presse. Remove protection cap (**1**).
- Give spring short press downward to center the lamp.
- Re-attach lamp housing.

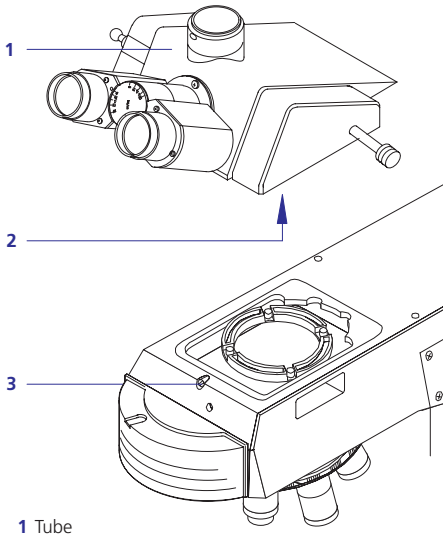
**Note:** Hold new halogen lamps by protective caps (**1**) only. Even the tiniest traces of grease on the glass bulb of the lamp can impair the performance and service life of the lamp.

# Microscope Components

## Tubes

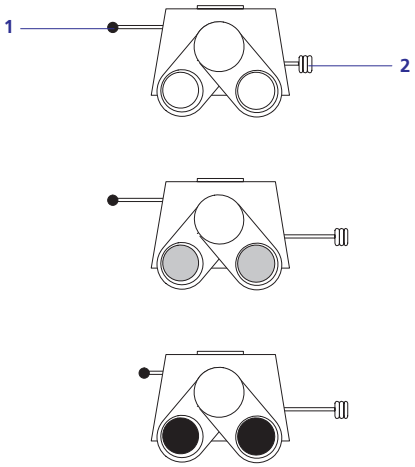
### Overview

| Designation | SFZ | Splitting | Application/ Combination | Cat. No. |
|---|---|---|---|---|
| **Binocular phototube** with sliding prism 30°/25  | 25 | 100 : 0<br>50 : 50<br>0 : 100 | 3 switch positions<br>1 eyepiece shutter as light shutter with 50 : 50 ratio | 452143-0000-000 |
| **Binocular phototube** with two porst 30°/25  | 25 | 100 : 0<br>50 : 50<br>0 : 100 | 3 switch positions and switching mirror in the phototube for two ports as and alternative for photo/TV<br>1 eyepiece shutter as light shutter with 50 : 50 ratio | 452145-0000-000 |
| **Binocular phototube 25** with height adjustment (5° ... 30°) | 25 | 100 : 0<br>20 : 80 | | 452146-0000-000 |
| **2-TV tube mot.**  | 25 | 100 : 0<br>50 : 50<br>0 : 100 | Motorized light path switching;;<br>2 switching levels with:<br>– 3 switching positions for beam splitting<br>– 2 switching positions for the two photo/TV ports (100 % to the top / 100 % to the back, or splitting freely assignable with reflector module H or FL and Ø 25 mm filter) | 000000-1054-146 not for use in conjunction with Optovar-intermediate tubes |
| **Double video adapter**  | | | Upgrading of one photo/TV port to 2 switchable camera/ TV ports (100 % to the top / 100 % to the back, or splitting freely assignable with reflector module H or FL and Ø 25 mm filter) | 000000-1058-640 |




**1** Tube
**2** Tube lens
**3** Securing screw

**Fig. 21 Tube mounting**




**1** Upper pushrod (eyepiece shutter)
**2** Lower pushrod (deviating prism)

**Fig. 22 Light splitting**

## General

All binocular tubes have a viewing angle of 30°. The inter-pupillary distance can be set between 55 and 75 mm by pressing the two halves of the tube together or pulling them apart.

**Note:** If intermediate tubes are used, the tube lens (Fig. 21/**2**) of the binocular tubes must be removed. It can be stored in the container supplied.
The cover of the container, which includes two pins, can be used as a tool for the removal.

## Attaching tubes

(Fig. 21)

To attach tubes, you need the SW 3 Allen key.

- Loosen securing screw (**3**) on the stand.
- Place tube (**1**) onto the upper part of the stand and align it.
- Tighten securing screw (**3**).

## Light splitting

(Fig. 22)

The binocular tubes are equipped with pushrods fitted to the sides of the tubes. These pushrods move a sliding prism which directs part or all of the light to the photo/TV ports.

In principle, the position of the pushrods is the same for all tubes.

Upper pushrod pulled out and lower pushrod inserted: 100 % light to eyepieces.

Upper and lower pushrods (**1**) and (**2**) pulled out:
50 % light to the photo/TV ports, 50 % to the eyepieces.
In tubes with 3 switching positions (452143-0000-000, 452145-0000-000) the center position of the pushrod (**2**) splits the beam in 50 % for Photo/TV and 50 % for the eyepieces (on 452146-0000-000 (0 % for photo/TV and 20 % to eyepieces).

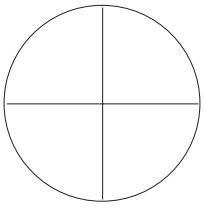
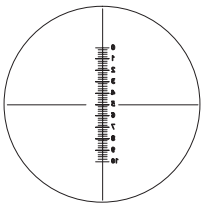
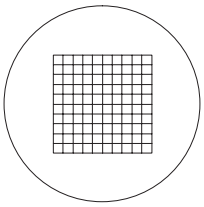
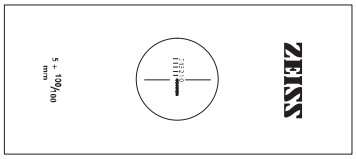
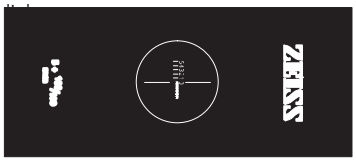
Upper pushrod (**1**) pushed in: eyepiece blocked.

In tubes with more than one photo/TV port, an additional knob is included on the respective port for blocking or deflecting the light.

# Microscope Components

## Eyepieces

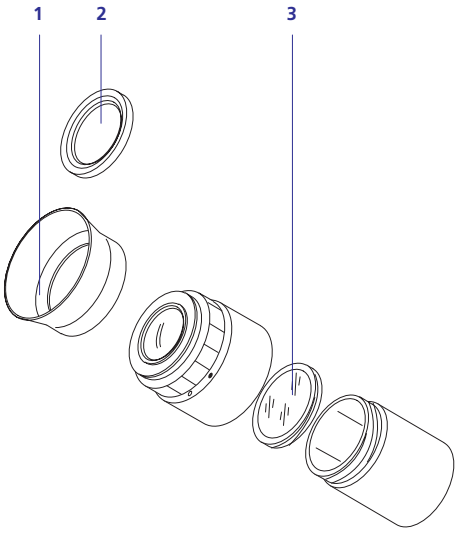
### Overview

| Designation | Application/Combination | Cat. No. |
|---|---|---|
| **Eyepieces** | | |
| Eyepiece E - Pl 10x/25 Br. foc. | Standard eyepiece of research category for large field of view 25 mm. | 444234-0000-000 |
| Eyepiece E - Pl 10x/23 Br. foc. | High-performance aspheric eyepiece for Epiplan objectives or for use of intermediate tube Pol in field of view 23. | 444235-0000-000 |
| Eyepiece PL 16x/16 Br. foc. | These highly magnifying special eyepieces are of help when you are working constantly with high additional magnifications. | 444054-0000-000 |
| Photo eyepiece S-Pl 8x/16 | For the attachment of the MC 200 CHIP microscopic camera. | 444029-0000-000 |
| Photo eyepiece S-Pl 10x/20 | For the attachment of microscope cameras. | 444049-9902-000 |
| Photo eyepiece S-Pl 12.5x/16 | For the attachment of microscope cameras. | |
| **Reticles for 10x eyepieces** (Measuring and counting) | | |
| Eyepiece crossline disk  | d = 26 mm | |
| Eyepiece crossline-micrometer  | 14 : 140 / d = 26 mm | |
| Eyepiece grid micrometer  | 12.5x 12.5/5; 10 / d = 26 mm | |
| **Micrometer objective** (for calibrations) | | |
| Micrometer objective   | positive 5+ 100 / 100 µm, d = 0.17 mm | |
| Micrometer objective for incident   | negative 5+ 100 / 100 µm, d = 0 | |
| Other aids on request | | |

## General

(Fig. 23)

The Zeiss microscopes are generally supplied with two focusing eyepieces.
Eyeglass protective rings (**2**) are attached to the eyepieces to prevent lens scratching.
Folding eyecups (**1**) can be used alternatively.




**1** Folding eyecup
**2** Rubber ring for spectacle wearers (instead of **1**)
**3** Reticle

**Fig. 23 Eyepiece**

## Designations/Markings

### Br.

The designation **Br.** on the eyepieces means that eyeglass-wearers can use their eyeglasses for microscopy and place them directly against the eyepieces. Users who do not wear glasses should keep a distance to the eyepieces allowing them to view the entire field The folding eyecup can be of help here.

### foc.

The designation **foc.** on the eyepieces means that they are focusable. This allows you to compensate for differences in the visual performance of your two eyes .

- For focusing, turn the eyepiece for the eye with better vision to the zero position and focus on the specimen using the fine drive. Then turn the focusing ring of the other eyepiece until you see the specimen in focus.

If you choose to wear your correctly fitted glasses when using the microscope, this adjustment is not necessary, since the compensation is performed by the glasses. Both eyepieces are set to zero. Visual defects, such as astigmatism, are not correctd. Eyeglasses or contact lenses should be worn.
If one of the eyepieces contains a reticle (**3**), you first have to focus the eyepiece on the reticle.

- To do this, remove the eyepiece from the tube and turn the upper part of the eyepiece until stop. Hold the eyepiece against a bright surface and turn the upper part in again until the reticle is visible in focus.
- Insert the eyepiece into the tube again and focus both eyepieces on the specimen (as described above).

### White dot

This is the zero position of the eyepiece of no reticles are used.

### Red dot

This is the zero position of a reticle is used in the eyepiece.

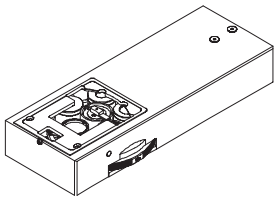
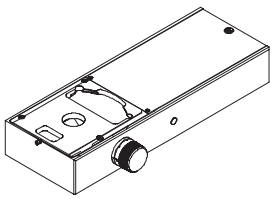
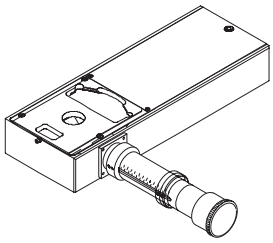
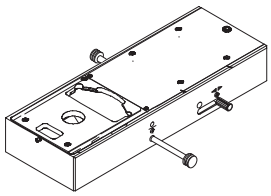
**Note:** Before looking through the microscope, check whether the eyepiece is in a zero position and set it to diopter power, if required.

## Use of reticles

Eyepieces featuring a red dot allow the use of reticles. Make sure that the reticle always faces the field stop. Reticles should be inserted by the Zeiss servicing staff in dust-free conditions.

## Intermediate tubes

### Overview

| Designation | Application/Combination | Cat. No. |
|---|---|---|
| **Optovar**<br>1.0x/1.25x/1.6x/2.0x/2.5x<br>coded  | Additional magnification, in steps;<br>for correctly dimensioned scale projection (Databack) with Axiophot 2 photo module (can also be used for microscopes without Axiophot 2 and without data transfer). | 452175-0000-000 |
| **Zoom intermediate tube**<br>coded  | Additional magnification, stepless, coded. | 452180-0000-000 |
| **Intermediate tube for data projection**<br>switchable  | Projection of data into intermediate image. | 452181-0000-000 |
| **Intermediate tube Pol**  | Crossline or iris stop can be inserted in field of view, focusing of Bertrand optics for axial image observation (conoscopy), removal of individual object details form field of view using iris diaphragm, for Axioplan 2 imaging Pol / Axiophot 2 Pol. | 452184-0000-000 |

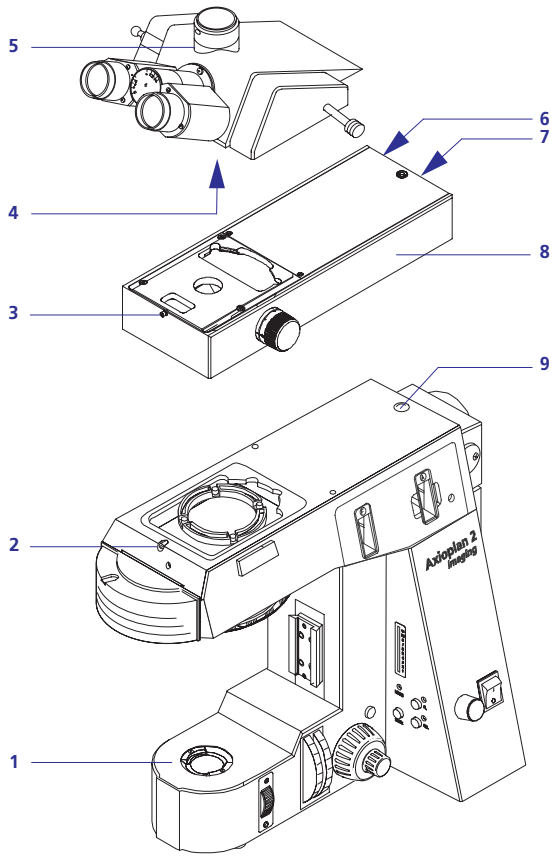



**Fig. 24 Mounting of intermediate tube**

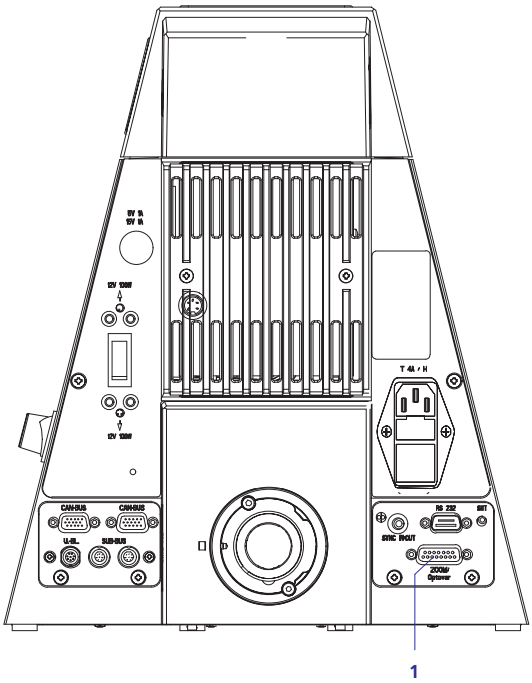



**Fig. 25 Back of stand**

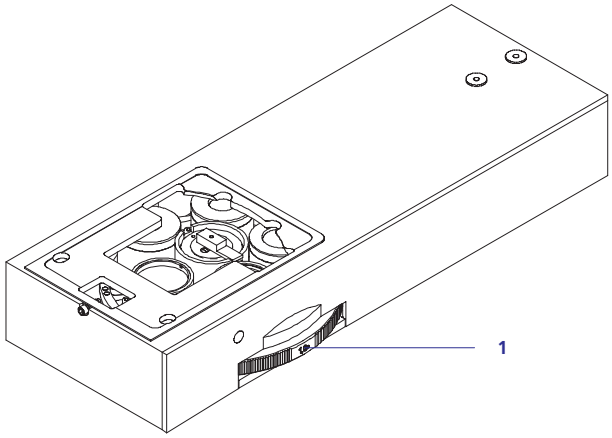
## General

Intermediate tubes are always attached to the upper part of the stand. To do this, the binocular tube must first be removed and its tube lens removed.

**Note:** Use the cover of the tube lens container to remove the tube lens (**4**).

## Mounting of an intermediate tube

- Switch off your instrument.
- Loosen clamping screw (**2**) on stand (**1**) and remove the tube (**5**) upwards.
- Attach the intermediate tube (**8**) to the stand. Centering is carried out using the dovetail.
- Tighten clamping screw (**2**) on stand only slightly at first.
- Insert the supplied clamping screw with washer (**7**) into the drilled hole provided and screw into the threaded hole (**9**) of the stand.
- Align the intermediate tube with the edges of the intermediate tube and screw tight clamping screws (**2**) and (**7**).
- Remove the tube lens (**4**) from the tube because a tube lens is integrated in the intermediate tube.
- Attach the tube (**5**) to the intermediate tube (**8**) and center via the dovetail.
- Align the tube with the edges of the intermediate tube and tighten the clamping screw (**3**).
- For coded and motorized intermediate tubes, connect the serial interface of the intermediate tube (Fig. 24/**6**) with that of the stand (Fig. 25/**1**) via the cable supplied.




**1** Disk

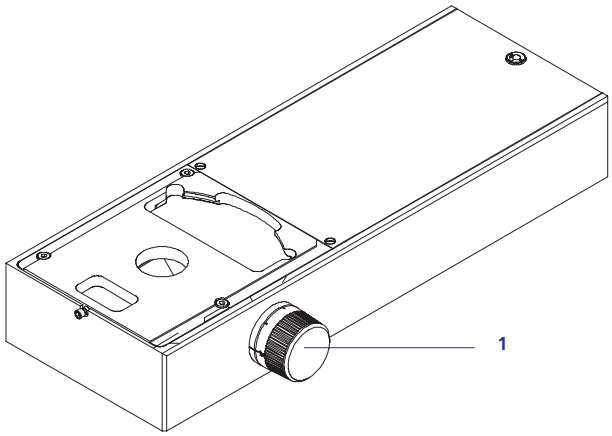
**Fig. 26 Optovar intermediate tube**

### Optovar intermediate tube
(Fig. 26)

The Optovar intermediate tube additionally allows a convenient magnification change in the steps 1.0x ; 1.25x; 1.6x; 2.0x; 2.5x. You can read the magnification factors at the projecting disk (**1**) on the right-hand side. To set a different magnification factor, turn the disk to the appropriate click-stop position.

**Note:** E-Pl eyepieces should be used instead of the Pl models because of their better imaging quality. Optovar in position 1x should only be used with eyepieces E-Pl 10x/25 Br.

If, when determining the microscope magnification, you do not want to work with these factors, then combine the magnification of Optovar and the 10x eyepiece and you practically have the eyepiece powers 10x; 12,5x; 16x; 20x and 25x.

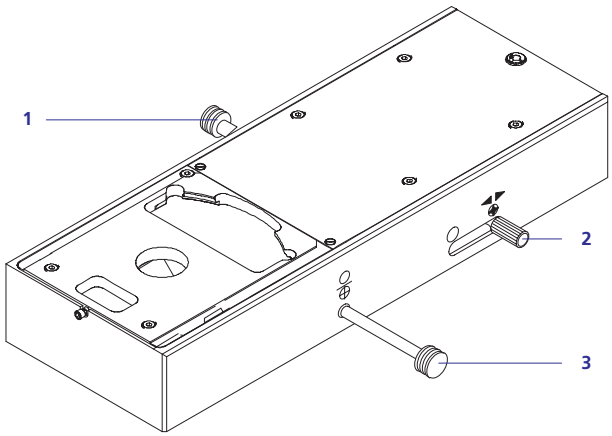



**1** Knob for magnification setting

**Fig. 27 Zoom intermediate tube**

### Zoom intermediate tube 1.0x ... 2.5x
(Fig. 27)

The intermediate tube with zoom extends the magnification range of the microscope continuously from 1x ... 2.5x. The required magnification can be set with knob (**1**) and the zoom factors can be read off at the scale.




**1** Pushrod for field diaphragm
**2** Rotary and slider knob for Bertrand lens
**3** Pushrod for reticle

**Fig. 28 Intermediate tube Pol**

### Intermediate tube Pol
(Fig. 28)

The intermediate tube Pol is equipped with a Bertrand lens, a quartz depolarizer, a reticle which can be switched on/off and a field diaphragm (iris).

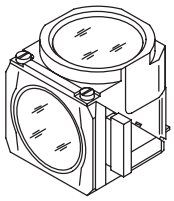
The combined rotary and slider knob (**2**) is used to swing in/out and to focus the Bertrand lens. In its rear position (symbol ⊕ ), the Bertrand lens is in the beam path (conoscopy).

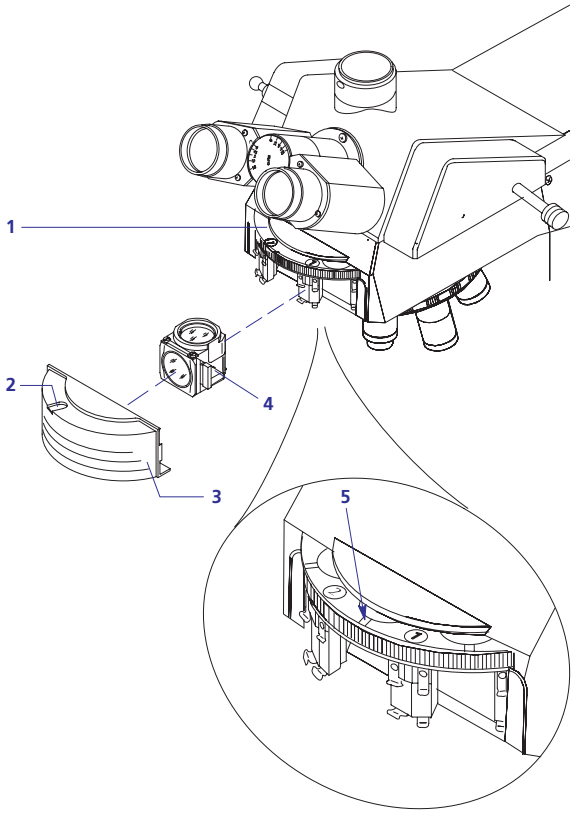
Pushrod (**1**) is used to adjust the field diaphragm:
- pushrod in – diaphragm open
- pushrod out – diaphragm closed

Pushrod (**3**) is used to project a reticle into the beam path:
- pushrod in – reticle out of beam path
- pushrod out – reticle in beam path

## Reflector modules

### Overview

| Designation | Application/Combination | Cat. No. |
|---|---|---|
| **Reflector module H** | Brightfield, incident light | 000000-1046-274 |
| **Reflector module D** | Darkfield, incident light | 000000-1099-898 |
| **Reflector module DIC** | Differential interference contrast, incident light | 000000-1046-277 |
| **Reflector module DIC red I** | Differential interference contrast, incident light.<br>The integrated λ-plate converts optical path differences into colors. | 000000-1046-278 |
| **Reflector module Pol** | Brightfield, incident light, polarization | 000000-1046-279 |
| **Reflector module FL**  | Fluorescence, usable filter sets | 000000-1046-281 |
| **Optovar-module 2.5x** | Focusing aid for photography for additional magnification at a weak magnification, can be used only in transmitted light | 000000-1046-282 |
| **Optovar-module 1.6x** | For additional magnification in transmitted light | 000000-1046-283 |
| **Optovar-module 1.25x** | For additional magnification in transmitted light | 000000-1046-284 |
| **Analyzer module D** | Differential Interference Contrast, polarization | 000000-1046-958 |




**1** Reflector turret
**2** Window showing position number of swung-in reflector module
**3** Protective cap
**4** Reflector module
**5** Position number of the relevant reflector module

**Fig. 29 Attachment of reflector modules**

### Attachment of reflector modules

Usually, the reflector turret is correctly equipped in the factory. The reflector turret features eight reflector positions and can be equipped as required.
To retrofit or change the equipment, proceed as follows (see —> Fig. 29):

- Swing the required opening of the reflector turret (**1**) into the beam path - see —> window (**2**). Then turn the reflector turret clockwise by four click-stops (manually or via microscope control software). The required opening is now accessible on the front of the reflector turret.
  For checking purposes, the position number (**2**) is engraved in the reflector turret - see —> smaller digit at (**5**).
- Grasp protection cap (**3**) at the top and bottom and remove it in forward direction.
- Remove the non-required reflector module (if fitted) from the reflector turret opening by first pulling whilst slightly tilting it out of the lower spring elements and then from the upper spring elements.
- Insert the new module (**4**) into the upper spring clamps on the reflector turret from below via the holding elements on the right and left. Then press on the module at the bottom until it engages also in the lower spring elements of the reflector turret.

The reflector module requires no further adjusting procedures.

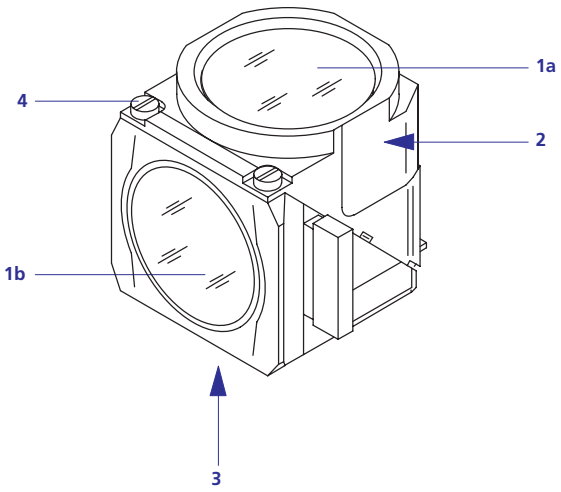
### Reflector module Fl

You can configure the reflector module Fl (000000-1046-281) for fluorescence microscopy with filters and beam splitters to meet your own personal requirements. You can order the filer and beam splitter combination separately from us. However, you can also purchase completely assembled reflector modules from us.

#### Mounting of filter inserts

- First, remove the reflector module from the reflector turret in accordance with the above instruction.
- Use the mounting tool plate (contained in tool set) to loosen the ring screw for the filter to be changed and screw it out completely.
- Remove the filter by turning it out onto the surface of hour hand.
- Insert the new filter into the opening, place the ring screw in position and re-tighten.

**Note:** The reflecting surfaces of the filters must always be oriented in the direction of the illumination.




**1a** Barrier filter
**1b** Exciter filter
**2** Surface for sticker attachment
**3** Reflecting surface of beam splitter
**4** Attachment screw for module halves

**Fig. 30** **Mounting of beam splitter**

### Mounting of beam splitter

To enable the mounting of the beam splitter, the reflector module is divided diagonally into two halves which are connected via two slotted screws.

- Loosen the two slotted screws (**4**) using a screwdriver of a suitable size.
- Fold apart the two reflector halves and carefully remove the beam splitter lying between the two halves.
- Place the new beam splitter on the spring frame intended for it in one of the reflector halves (reflecting surface showing downwards, **3**).

**Note:** You can recognize the reflecting surface of the beam splitter by carefully viewing the edge: the reflection coating does not reach up to the edge.

- Fold over the other half and screw both halves together using the two slotted screws.
- After completion of the mounting procedure, please attach the supplied sticker indicating the filter combination to the side of the reflector module intended for it (**2**).

**Note:** Please be extremely careful when performing the above steps and make sure to avid dirt on the filter inserts and the beam splitter or damage to these units.
Ideally, the filters and the beam splitter should be assembled by Carl Zeiss service staff.

# Microscope Components

## Objectives

### General

All the objectives of the Axioplan 2 imaging incorporate the principle of ICS optics, i.e. they project the image to infinity. Only the tube lens produces the intermediate image which can be viewed via the eyepieces.

### Abbreviations

| | |
|---|---|
| ICS | Infinity Color-corrected System |
| H | brightfield |
| D | darkfield |
| HD | bright/darkfield |
| Ph 1, 2, 3 | phase contrast; the numbers refer to the diameter of the annular diaphragm to be used: for an objective described PH2, use the annular diaphragm Ph 2. |
| DIC | Differential interference contrast |
| AA | working distance: distance between objective and sample surface or cover slip surface |
| Pol | polarization |
| Fl | fluorescence |
| N.A. | numerical aperture |
| Imm | immersion medium |
| W | water |
| Oil | oil |
| Glyc | glycerin |
| Korr. | adjustable correction of cover slip thickness |
| LD | long working distance |
| ∞ | infinity |
| S | segment (magnification value including the UD segment) |

### Attachment of objectives

- Remove dust caps from the openings of the objective nosepiece.
- Screw in objectives (in the order of increasing magnifications).

**Note:** When using a coded nosepiece, please make sure to insert the objectives in accordance with the positions displayed in the Microscope Software.
Check the positions by comparing the objectives displayed in the program to the objectives actually inserted.

Nosepiece positions which are not being used must always be covered with dust caps.

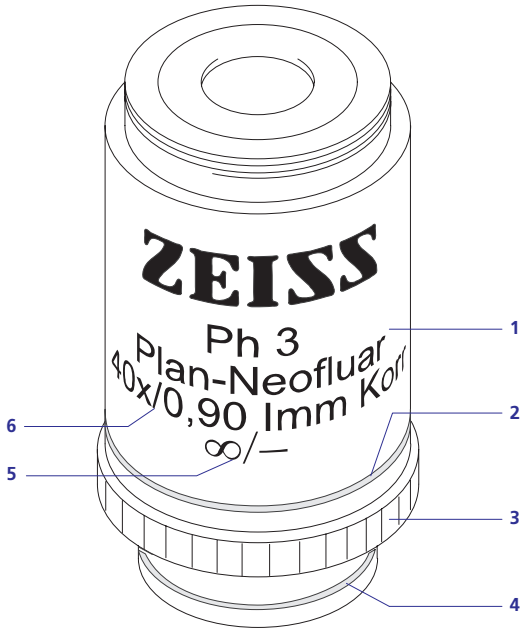



**Fig. 31** **Labeling of objectives**

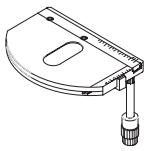
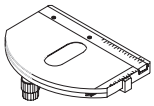
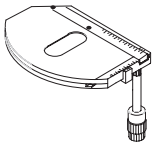
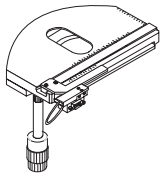
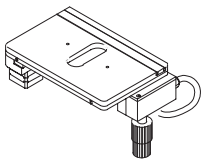
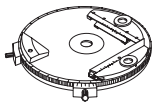
## Labeling of objectives

| Number | Explanation | Color | Meaning |
|---|---|---|---|
| 1 | The color of the labeling marks the contrasting technique intended for this objective. | black | Standard |
| | | red | Pol / DIC |
| | | green | Ph 1, 2, 3 |
| 2 | Color coding of the magnification | black | 1.25x |
| | | brown | 2.5x |
| | | red | 4x; 5x |
| | | orange | 6.3x |
| | | yellow | 10x |
| | | green | 16x; 20x; 25x; 32x |
| | | light blue | 40x; 50x |
| | | dark blue | 63x |
| | | white | 100x; 150x |
| 3 | Mechanical setting ring (only for special objectives) For optical correction when using different immersion media or in the case of different thickness of cover slips/chamber bottoms. Also available with objectives with adjustable aperture iris. | | |
| 4 | Color coding for immersion liquid to be used. | black | oil |
| | | white | water |
| | | orange | glycerin |
| | | red | variable |
| 5 | Tube length/cover slip thickness; tube length ∞ marks ICS optics | like 1 | |
| 6 | Magnification/numerical aperture | like 1 | |

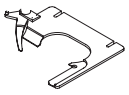
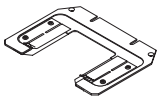
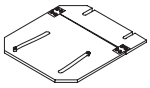
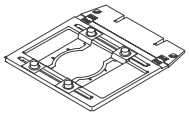
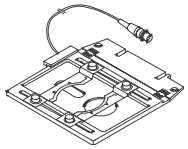
# Microscope Components

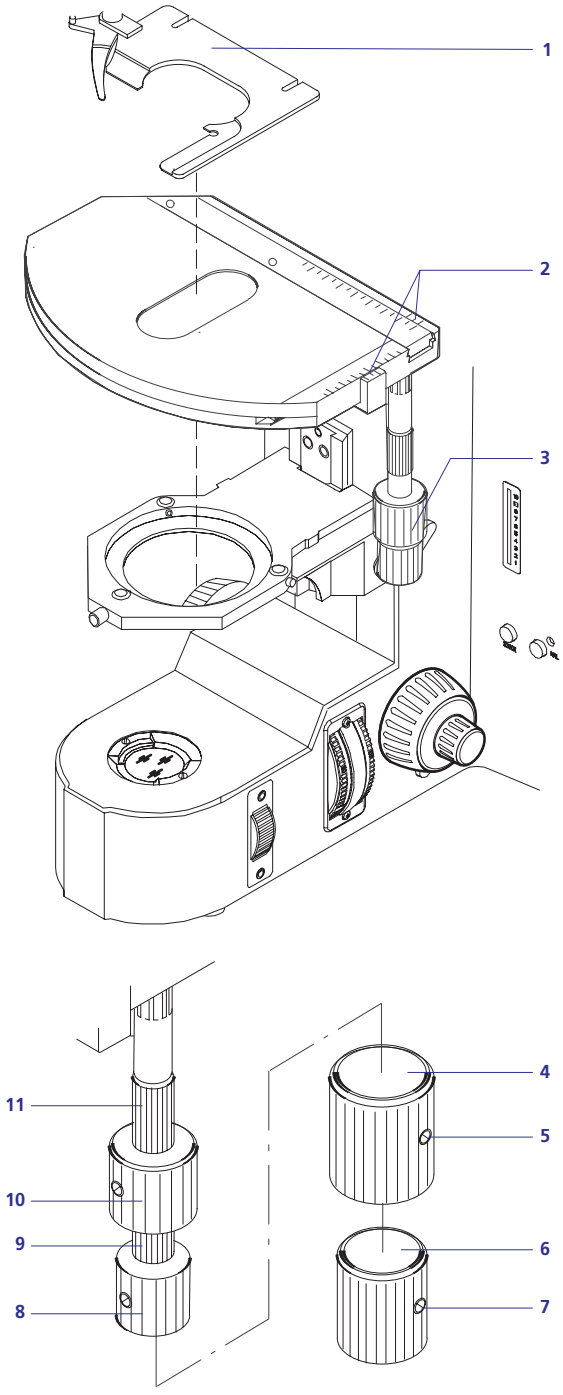
## Stages

### Overview

| Designation | | Comments | Cat. No. |
|---|---|---|---|
| **Stages** | | | |
| **Mechanical stage 75 x 50 R with ergo drive** |  | stage focusing on right; abrasion-proof coating, height adjustment and adjustment of smoothness of drive controls | 000000-1063-835 |
| **Mechanical stage 75 x 50 L with ergo drive** |  | stage focusing on left; abrasion-proof coating, height adjustment and adjustment of smoothness of drive controls | 000000-1063-836 |
| **Rotary, centerable mechanical stage 75 x 50, 240° R** |  | rotatable about 240°; abrasion-proof coating, | 000000-1067-325 |
| **Mechanical stage 75 x 50 R** electronic |  | with electronic vernier; abrasion-proof coating incorporates: display unit SCD | 000000-1046-520<br><br>413507-9001-000 |
| **Mechanical stage 75 x 50 mot. with control unit** |  | options: with joystick for 2 axes (000000-1033-996) or with coaxial electronic drive (000000-1034-960) | 000000-1025-145 |
| **Pol rotary stage with object guide** |  | for polarizing microscopy | 453550-0000-000 with 453560-0000-000 |

# Microscope Components

| Designation | Comments | Cat. No. |
|---|---|---|
| **Specimen holders** | | |
| **Specimen holder for MS 75x50**  | | 000000-1067-330 |
| **Special specimen holder**  | with special positioning | 453538-0000-000 |
| **Specimen holder, incident light**  | | 000000-1070-588 |
| **D Pol specimen holder**  | combination with 453560-0000-000 | 453563-0000-000 |
| **A Pol specimen holder**  | combination with 453560-0000-000 | 453564-0000-000 |
| **universal holder frame for culture dishes and specimen carriers**  | | 000000-1100-843 |
| **Heatable universal holder frame, A-H**  | in conjunction with Tempcontrol 37 analog (1 channel) (000000-1116-057) | 000000-1116-055 |
| **Holder frame for heat and cool stage inserts** | | 000000-1107-544 |
| **Specimen holder** for mechanical stage 75x50 mot with control unit (000000-1025-145) | | according to price list |




**1** Specimen holders
**2** Graduation and vernier
**3** Coaxial drive for stage movement in x/y
**4** Sleeve
**5** Clamping screw
**6** Sleeve
**7** Clamping screw
**8** X drive control
**9** Knurled ring for adjustment of X drive
**10** Y drive control
**11** Knurled sleeve for adjustment of Y drive

**Fig. 32** **Mechanical stage**

## General

(Fig. 32)

According to model, mechanical stages can be fixed or rotated and centered. The travel range is 75 mm in direction x and 50 mm in direction y. On a fixed stage the stage drive is located to the right or the left. On the rotary mechanical stage the stage drive is on the right.

## Attachment/removal and centering of stages

(see —> Stage carriers in the chapter *Manual stand)*

## Adjustment of drive controls

The drive controls (**8**, **10**) have removable sleeves (**4**, **6**). The sleeves provide a larger diameter, which allows a finer adjustment of the stage position.
The sleeves can be removed by removing clamping screws (**5**, **7**, two each).
The drive length can be adjusted by 15 mm. To do so, move the knobs individually down or up.
The ease of movement of the stage drives can be adjusted.

Adjustment of direction x:

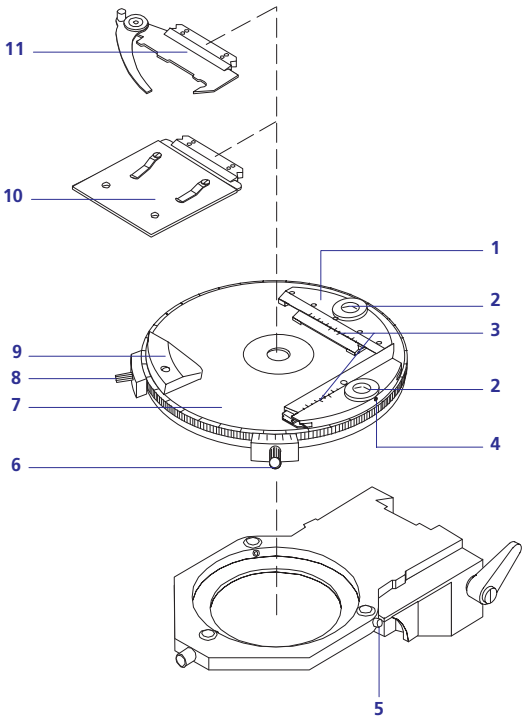
- If necessary remove sleeves. To do so, remove clamping screws.
- Move x drive control (**8**) down, move y drive control (**10**) up.
- Hold x drive control (**8**) and turn light colored knurled ring positioned above (**9**) to right (easier) or left (stiffer) until required ease of movement is reached.

Adjustment of direction y:

- Hold y drive control (**10**) and turn light colored knurled sleeve positioned above (**11**) to right (stiffer) or left (easier) until required ease of movement is reached.
- Refit sleeves as necessary and tighten clamping screws.

## Rotation range of rotary mechanical stage

The stage travel range can be rotated in y ≤ 27 mm by 240°. Rotation beyond this travel range is not possible.




**1** Object guide
**2** Drives of the object guide
**3** Vernier
**4** Point stop
**5** Centering screw
**6** Stop device of stage rotation
**7** Rotary stage Pol
**8** Click-stop of stage rotation
**9** Counterweight
**10** Specimen holder A Pol
**11** Specimen holder D Pol

**Fig. 33** **Pol rotary stage**

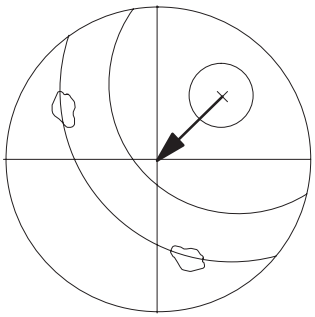


**Fig. 34** **Centering of Pol rotary stage**

## Rotary stage Pol

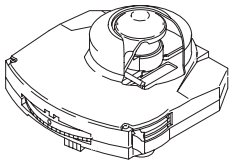
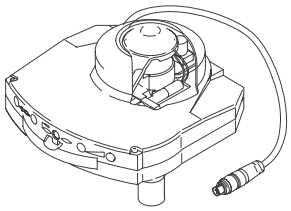
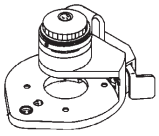
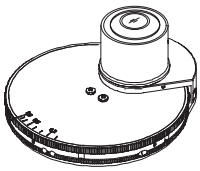
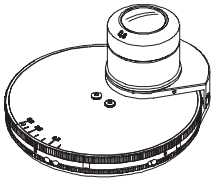
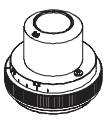
The rotary stage Pol (**7**), used with polarizing microscopes, is a rotatable and centerable stage with an object guide (**1**) for a travel range of 45 mm in x and 25 mm in y. Object coordinates can be determined with an accuracy of 0.1 mm.
Either the specimen holder D Pol (**11**) or A Pol (**10**) for incident-light specimens can be attached to the object guide.
Together with a reticle in the intermediate tube, a 360°graduation (**3**) and one vernier each to read off 1/10° are used for angle measurement.
The stage rotation can be locked by screw (**6**). Tightening screw (**8**), provides a click-stop every 45°.
**Stage centering** is required to make sure that an object feature in the center of the field of view does not migrate when the stage is turned. Checking the centering before each examination is a matter of routine for the user of a polarizing microscope and is performed as follows:

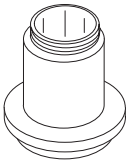
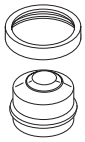
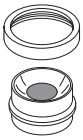
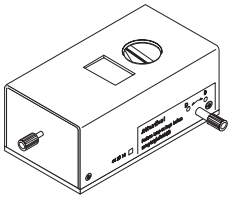
- The nosepiece Pol of your microscope features 5 centerable threaded mounts and one fixed threaded mount containing an objective. Swing in the objective and focus on a high-contrast specimen.
- Turn the stage. Almost all object features move on circles; the center of all these circles is the center of rotation of the stage (—> *Fig. 34*).
- With the small Allen wrench inserted at (**5**), bring this object spot to the point of intersection of the eyepiece crosslines, i.e. the optical axis of the objective. This centering procedure may have to be repeated.

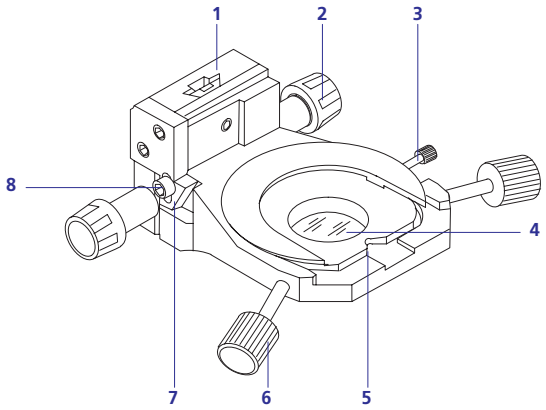
The point counter on the controls of the object guide (**1**) provides a click after every 0.5 mm of specimen movement (the point counter with 0.2 mm steps (453570-0000-000) is optional). The point counter simplifies systematic screening of a specimen, and it can also be used for volume and quantitative analysis. The click-stops are set with the supplied Allen wrench on screw (**4**) (unscrew (**4**) to activate the click-stop, screw in to deactivate).
To prevent defocusing, clip plastic rings on the drive controls (**2**) and operate the controls from the side.
The attachable mechanical stage is always supplied with a counterweight (**9**), which can be screwed on to the stage using the SW 3 Allen wrench. It is used for symmetrical weight distribution and prevents defocusing when the stage is rotated. It should be used at high magnifications in particular. If it is not factory-mounted, please refer to the leaflet supplied with the device.

## Condensers for Transmitted Light

### Overview

| Specification | Comments | Cat. No. |
|---|---|---|
| **Achromatic-aplanatic universal condenser 0.9 H**<br>**Achromatic-aplanatic universal condenser 0.9 H D Ph**<br>**Achromatic-aplanatic universal condenser 0.9 H D Ph DIC**  | highest flexibility and resolution;<br>front lens swung in:<br>for objectives 10x ... 100x<br>front lens swung out:<br>for objectives 1.25x ... 10x<br>brightfield insert or turret disk for contrasting elements with 5 or 7 positions | 000000-1035-632<br><br>445436-000-000<br><br><br>445439-000-000 |
| **Achromatic-aplanatic universal condenser 0.9 H MOT**<br>**Achromatic-aplanatic universal condenser 0.9 H D Ph MOT**<br>**Achromatic-aplanatic universal condenser 0.9 H D Ph DIC MOT**  | highest flexibility and resolution;<br>front lens swung in:<br>for objectives 10x ... 100x<br>front lens swung out:<br>for objectives 1.25x ... 10x<br>brightfield insert or turret disk for contrasting elements with 5 or 7 positions | 445437-000-000<br><br>445438-000-000<br><br><br>445440-000-000 |
| **Achromatic-aplanatic system condenser 0.24/d=10.7 swing-in Pol**  | highest flexibility and resolution;<br>front lens 0.9 swung in:<br>for objectives 10x ... 100x<br>front lens swung out:<br>for objectives 2.5x ... 10x<br>front lens 0.6 swung in:<br>for objectives 10x ... 40x | 445325-9901-000 |
| **Achromatic-aplanatic condenser 1.4 H DIC**  | oil immersion on the illumination side for optimum resolution in transmitted light, fixed front lens;<br>for brightfield and Differential Interference Contrast, for objectives 20x ... 100x. | 445453-0000-000<br>also for phase contrast and darkfield |
| **Achromatic condenser 0.8 H D Ph DIC**  | for brightfield, darkfield and phase contrast with<br>objectives Ph 1, Ph 2 and Ph 3; DIC III<br>fixed front lens; for objectives 5x ... 100x<br>with iris diaphragm for aperture adjustment. | 445445-9901-000 |
| **Achromatic condenser 0.8 H**  | brightfield condenser, fixed front lens;<br>for objectives 5x ... 100x;<br>with iris diaphragm for aperture adjustment. | 000000-1087-444 |

| Designation | Comments | Cat. No. |
|---|---|---|
| **Condenser holder Z**  | to allow mounting of: ultracondenser 1.2/1.4 or dry darkfield condenser 0.8/0.95. | 445323-0000-000 |
| **Ultracondenser 1.2/1.4**  | special condenser for darkfield, high magnification and aperture, suitable for objectives with aperture 0.75 ... 1.0. | 465500-0000-000 |
| **Dry darkfield condenser 0.8/ 0.95**  | special condenser for darkfield, high magnification and aperture, suitable for objectives with aperture 0.6 ... 0.75. | 465505-0000-000 |
| **Darkfield illuminator**  | for unilateral darkfield illumination at low magnifications between 1.25x ... 10x; switching to brightfield is possible. | 445314-0000-000 |




**1** Condenser carrier
**2** Height adjustment
**3** Clamping screw for the condenser
**4** Tension-free illumination optics
**5** Orientation notch
**6** Centering screw
**7** Stop for height adjustment
**8** Stop screw for height adjustment

**Fig. 35 Condenser carrier**

## Condenser carrier

(Fig. 35)

The condenser you selected is contained in the condenser carrier. These are its control elements:

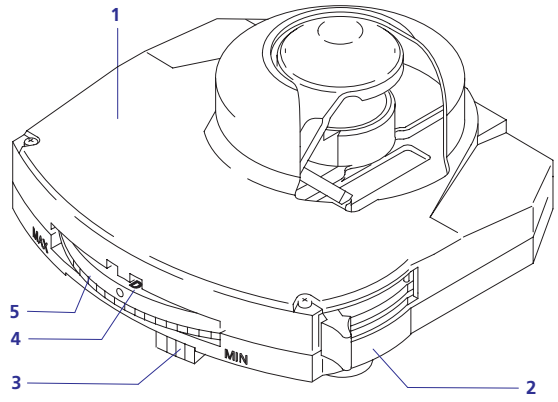
- ❑ Height adjustment on both sides (max. 34 mm) (**2**). The ease of motion is factory-adjusted (to be changed only by the service staff).
- ❑ Clamping screw (**3**) for the condenser (used only for condenser exchange using SW 3 key).
- ❑ Two centering screws (**6**) for the condenser. These are used to center the luminous-field diaphragm image for the setting of the KÖHLER illumination.

  To prevent the specimen from being pressed upward out of the object holder, the height movement of the condenser is limited by a stop screw.

The stop (**7**) is adjusted as follows:

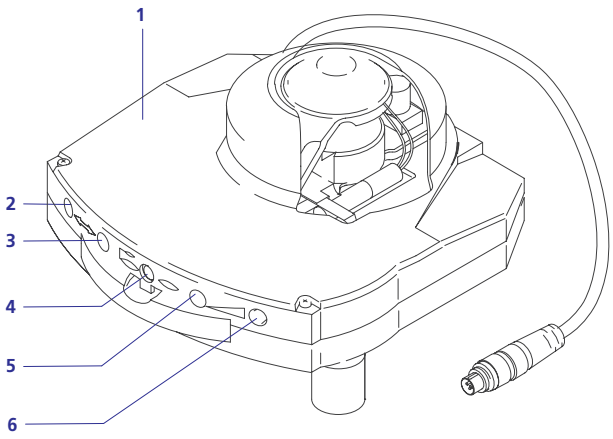
- Loosen stop screw (**8**), pin will fall downwards.
- Adjust the specimen (use a thick specimen mount).
- Image the luminous-field diaphragm (close it until it becomes visible).
- Move the condenser slightly upwards (diaphragm image goes slightly back out of focus).
- Press stop screw (**8**) upwards and tighten again.

Your specimen can now no longer be touched by the condenser.




**1** Universal condenser
**2** Lever to swing in/out the front lens
**3** Sliding knob for aperture diaphragm
**4** Window for turret position
**5** Turret wheel to swing in the brightfield insert or the contrast stops

**Fig. 36** **Universal condenser**




**1** Motorized universal condenser
**2** Key to turn turret disk further to right
**3** Key to turn turret disk further to left
**4** Front lens on/off key
**5** Key to close aperture diaphragm
**6** Key to open aperture diaphragm

**Fig. 37** **Motorized universal condenser**

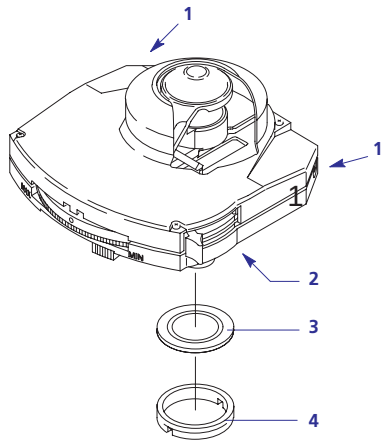
### Achromatic-aplanatic universal condenser

(Fig. 36)
Depending on the version, the achromatic-aplanatic universal condenser (**1**) is equipped with:
– fold-out front lens
– turret disk for:
brightfield – without or with DIC I, II, III
darkfield – D
phase contrast – Ph 1, Ph 2, Ph 3
interference contrast – DIC I, II, III.
– aperture diaphragm (iris diaphragm).
The front lens is folded in / out using lever (**2**). Turning the turret wheel (**4**) swings the brightfield insert and the contrast stops in the beam path. The abbreviation of the set turret position (e.g. D) is displayed in one of the windows (**5**). Slider (**3**) opens and closes the aperture diaphragm.

### Motorized universal condenser

(Fig. 37)
Depending on the version, the achromatic-aplanatic universal condenser (**1**) is equipped with:
– A motorized fold in/fold-out front lens
– A motorized turret disk for:
brightfield – without or with DIC I, II, III
darkfield – D
Phase contrast – Ph 1, Ph 2, Ph 3
interference contrast – DIC I, II, III.
– motorized actuated aperture diaphragm (iris diaphragm).
In automatic operating mode the front lens, turret wheel and aperture diaphragm of the universal condenser are moved automatically into the pre-set positions, or positions stored with the SET key. In manual operating mode the functions are carried out manually via the five keys located at the front.

- Key to turn turret disk further right (**2**): The turret disk is moved on by one position, i.e. the position to the left of the current turret position is set. To set the next position, the key must be briefly released.
- Key to turn turret disk further left (**3**): The turret disk is moved on by one position, i.e. the position to the right of the current turret position is set. To set the next position, the key must be briefly released.
- Front lens on/off key (**4**): The front lens is folded in or out.
- Key to close aperture diaphragm (**5**) or key to open aperture diaphragm (**6**): Aperture diaphragm is closed or opened (up to stop), as long as the key remains pressed.




**1** Centering screws
**2** Cover on underside
**3** Stop
**4** Retainer ring

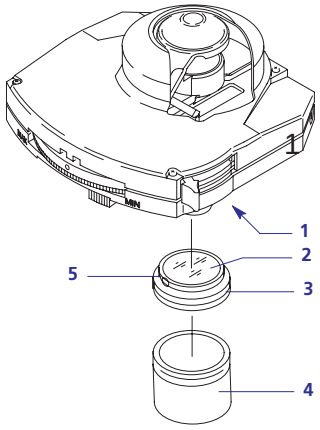
**Fig. 38** **Changing the phase stop**

### Changing the phase stops in the universal condenser (if required)

(Fig. 38)

- Tighten both centering screws (**1**) until stop using SW 1.5 ball-headed screwdriver.
- To loosen the cover on the condenser underside (**2**), loosen both grub screws using SW 2 screwdriver and remove the cover. Position turret disk with stop to be changed in the exchange opening and hold it on the knurled ring, since no click-stop is effective in this position.
- Use mounting device contained in tool set to unscrew retainer ring (**4**) from the condenser underside (**2**) and allow phase stop (**3**) to slide out.
- To insert the new stop, turn condenser round, insert the new stop, and tighten retainer ring. The shiny glass underside of the stop must point downwards when the condenser is inserted.
- Loosen both centering screws and re-center stop using the centering telescope. Ensure that the correct label is visible on the knurled ring of the turret when the unit is swung into the beam path.

**Note:** Phase or darkfield stops may only be inserted in centerable openings, DIC prisms only in openings with an iris stop.




**1** Cover on underside
**2** DIC prism
**3** Prism mount
**4** Double-function tool
**5** Groove

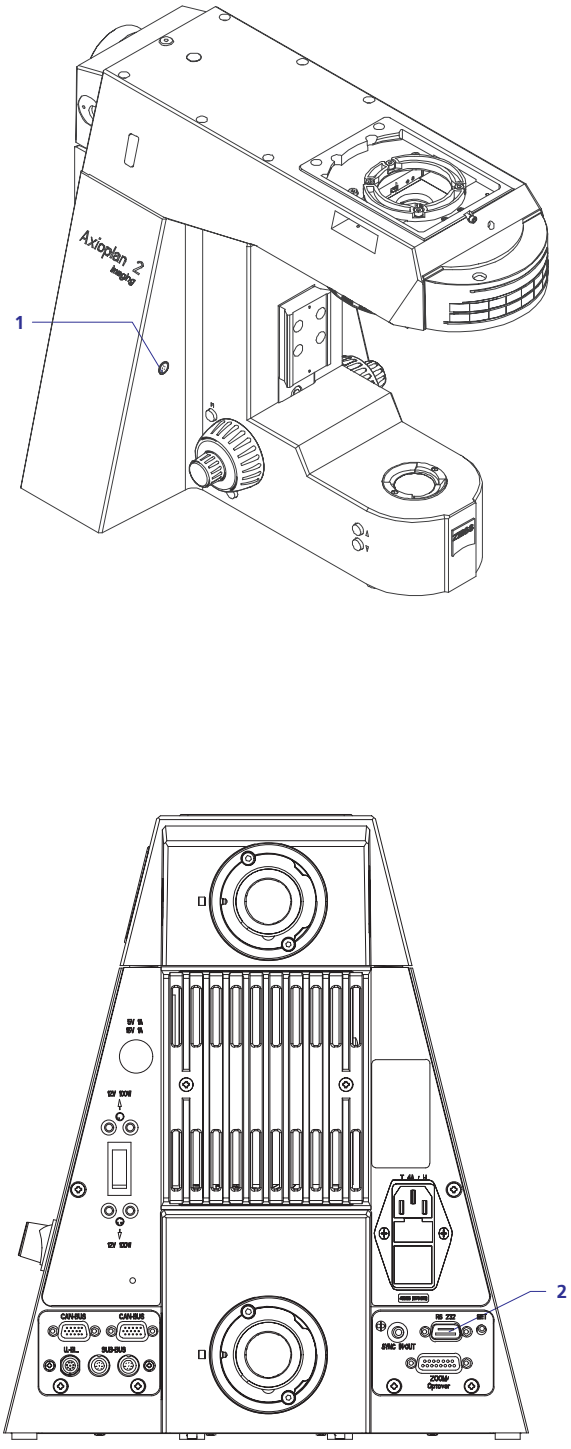
**Fig. 39** **Changing the DIC prism**

### Changing the DIC -prisms in the universal condenser

(Fig. 39)

The positions of the DIC prisms are marked with I, II, III.

- To loosen the cover on the condenser underside (**1**), loosen both grub screws using SW 2 screwdriver and remove the cover. Position turret disk with DIC prism to be changed in the exchange opening and hold it on the knurled ring, since no click-stop is effective in this position.
- Unscrew retainer ring using the so-called double function tool (**4**).
- Screw threaded side (**4**) of the tool into the prism mount (**3**) and then pull out the DIC prism.
- Remove DIC prism (**2**) from the tool and screw on the new, required prism.
- Installation of the DIC prism is made in reverse order. Make sure that the DIC prism its oriented correctly (groove (**5**) must engage in the pinion of the mount). Make sure that the knurled ring of the turret disk is labeled correctly.




**1** Socket for the plug of the motorized condenser
**2** SET programming key

**Fig. 40** **Condenser socket and SET key**

### Achromatic-aplanatic condenser 1.4

The achromatic-aplanatic condenser 1.4 is equipped with fixed front lens and turret disk.
The turret disk contains 6 positions and accepts max. 2 DIC prisms, 2 phase stops and 1 darkfield diaphragm. A position for brightfield with iris has been provided.
The DIC prisms are inserted in the condenser 1.4 with the same orientation as in the achromatic-aplanatic system condenser. A retaining ring is used to secure them in position on the condenser 1.4.

### Attachment of motorized condensers to the stand

The stand E or the motorized stand with LightManager is required to enable the integration of motorized condensers.
The motorized luminous-field diaphragm, motorized filter wheels and at least a coded nosepiece are available.

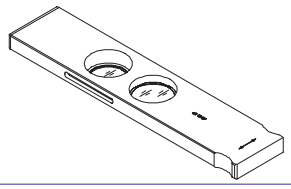
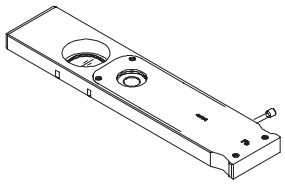
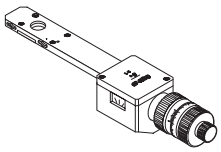
- Switch off instrument.
- Insert plug of the condenser into the socket on the left side of the stand base and secure it using the knurled ring.
- Insert dovetail ring of condenser into the condenser carrier and clamp it (SW 3).
- Switch on instrument. The instrument automatically recognizes the condenser type used.

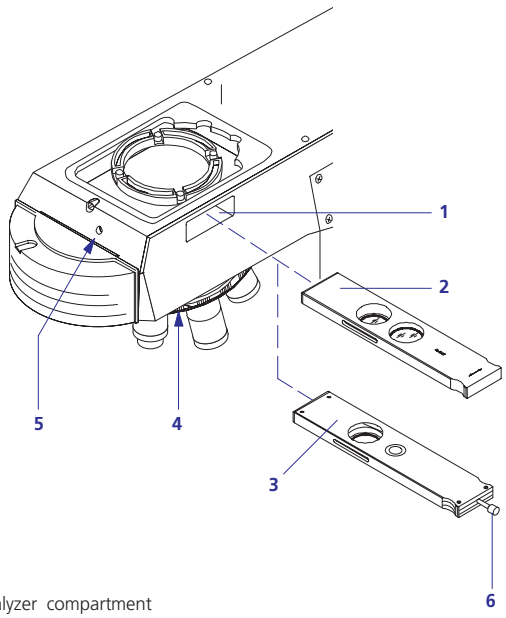
Normally, the microscope is equipped with objectives and condenser in the factory and the basic settings of the LightManager (object field adjustment, aperture adjustment and, if required, brightness adjustment) are performed afterwards. The parameter settings of the LightManager are made with reference to the objective in the beam path and stored accordingly.
If certain parameters need to be changed, this can be performed manually on the condenser. The SET key (**2**, on the instrument back) permits the new parameters to be stored. The LightManager will then use these parameters. Regardless of this, it is always possible to operate motorized condensers via PC, which is even recommended, for reasons of higher operating convenience.
The achromatic condenser 0.8 H D Ph mot. (445446-0000-000) also offers the possibility of motorized switching of the turret disk by pressing a key on the condenser.
The aperture iris diaphragm is manually set using the knurled wheel.

**Note:** When an objective or the entire nosepiece equipment is change, resetting of the LightManager in accordance with the new instrument configuration is absolutely necessary.

## Analyzers, Compensators and DIC sliders

### Overview

| Designation | | Cat. No. |
|---|---|---|
| **Analyzers** | | |
| Fixed analyzer slider |  | 453657-0000-000 |
| Slider with analyzer and rotary λ- plate | | 453663-0000-000 |
| Rotary analyzer | | 453662-0000-000 |
| Slider for quartz depolarizer | | 453659-0000-000 |
| Quartz depolarizer d = 32 mm<br>(can also be used in 453657-0000-000) | | 453653-0000-000 |
| **Bertrand lens slider** | | |
| Bertrand lens slider Ph |  | 453671-0000-000 |
| **Compensators** | | |
| Compensator λ, 6 x 20 mm | | 473704-0000-000 |
| Compensator λ/4, 6 x 20 mm | | 473714-0000-000 |
| Compensator λ, rotatable ±8°, 6 x 20 mm | | 453710-0000-000 |
| Sénarmont compensator 546:4, 6 x 20 mm | | 000000-1115-695 |
| Tilting compensator K 0 – 30 λ | | 000000-1115-698 |
| Tilting compensator E 0 – 5 λ | | 000000-1115-700 |
| Rotary Brace - Köhler compensator λ/10 |  | 000000-1115-703 |
| **DIC sliders for ICS optics**<br>(only usable with DIC nosepiece or nosepiece Pol 1x) |  | according to price list |
| **Polarizers** | | |
| Fixed polarizer D | | 453615-0000-000 |
| Rotatable polarizer D | | 453620-0000-000 |
| Fixed polarizer D with rotary λ-plate | | 445226-0000-000 |




**1** Analyzer compartment
**2** Analyzer slider
**3** Bertrand lens slider
**4** Compartment for auxiliary objects and compensators
**5** Fixations for **2** and **3**
**6** Lever for Bertrand lens setting

**Fig. 41** **Mounts for sliders, analyzers and compensators**

## General

(Fig. 41, shown without tube)

The components listed in the overview on page 65 are used to regulate the optical contrast in the microscope and to adjust the auxiliary devices necessary to regulate the contrast. Compensators are required for contrast enhancement and measurements.

In brightfield/phase contrast, the Bertrand lens slider (**3**) is inserted at (**1**) and the fixed or rotary analyzer slider (**2**) or the quartz depolarizer is included in the DIC equipment.

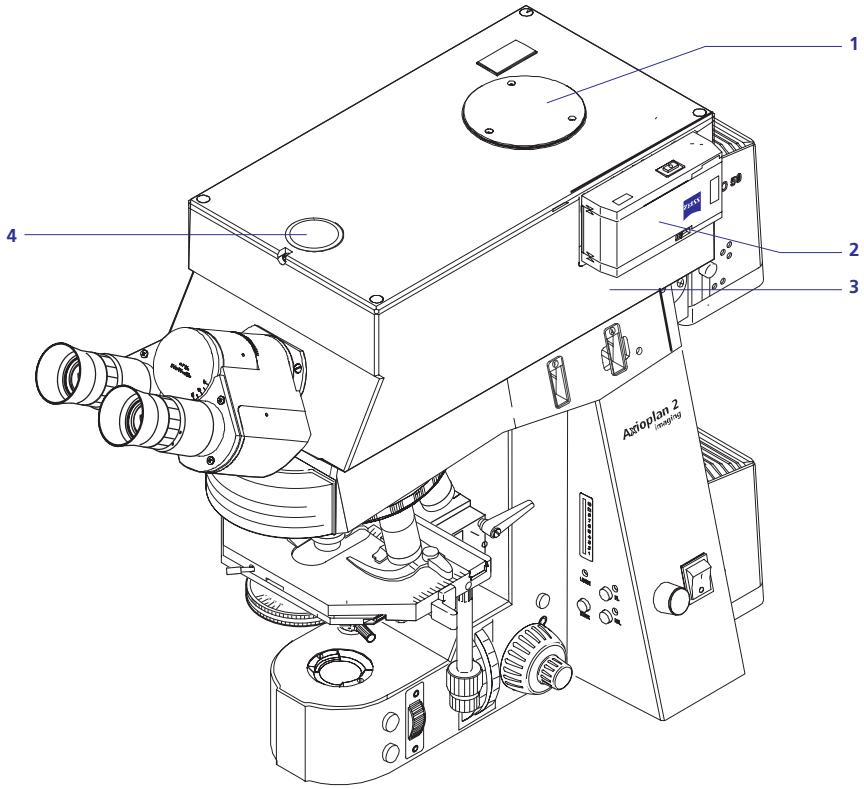
Compensators are inserted in compartment (**4**).

**Note:** To allow the use of DIC sliders, your microscope must be quipped with an objective nosepiece for DIC.

Please refer to page 75 for information on how to adjust the microscope with polarizers, analyzers and DIC prisms for differential interference contrast.

## Axiophot 2 Photo module

### Overview




**1** TV-camera port with 2.5x magnification
**2** 35 mm Mot DX film cassette (right)
**3** Axiophot 2 photo module
**4** TV camera port

**Fig. 42** **Axiophot 2 photo module**

# Microscope Components

## General

The Axiophot 2 photo module turns your microscope into a universal and completely new photo-microscope. Motorized control elements and operation via notebook (or PC) only makes work with the Axiophot 2 methodically richer and at the same time considerably easier.
If you opt for a microscope equipped with the Axiophot 2 photo module, we will supply you with the completely assembled stand, including an intermediate tube, if required.
Installation and setup of the entire instrument and retrofitting of the photo module to existing instruments (hardware and software) will be performed by our service department or customer service staff.

## Key features and technical data

- ❑ Two 35 mm cameras (35 mm Mot DX cassette) and one large format camera with automatic exposure control.
- ❑ With 35 mm film cassette: automatic film advance, automatic advance to 1st picture when a new film is loaded, and motorized rewinding.
- ❑ Decimal display of exposure time, countdown during exposure.
- ❑ Automatic exposure time extension for exposures requiring long exposure times (reciprocity failure compensation) in 9 steps.
- ❑ Optional spot metering or center-weighted averaging.
- ❑ Possibility of fixing the automatic exposure time for comparison photos.
- ❑ Multiple exposures.
- ❑ Exposure corrections: 3 exposure values; maximum correction amount: 1/3 exposure value
- ❑ Automatic auto-bracketing with pre-selected correction (calibration series, etc.).
- ❑ Illuminated frame visible with both eyes, adjustable brightness.
- ❑ Projection of data and reference scale.
- ❑ Motorization of following settings:
  - – switch-over observation/documentation
  - – switch-over photo/video port
  - – switch-over light metering/film
  - – switch-over center-weighted averaging/spot metering
  - – switch-over of cameras

Standard 35 mm film cartridges 135 (visible in the window) are used for the 35 mm Mot DX film cassette.
The magnification on film for 35 mm film:
**objective magnification x 2.5**.

## 35 mm Mot DX film cassette

### Removing the cassette

- Use both hands to grasp the film cassette on the right and left, press unlocking button (**2**) until stop using your thumb, and only then pull cassette off in upward direction.

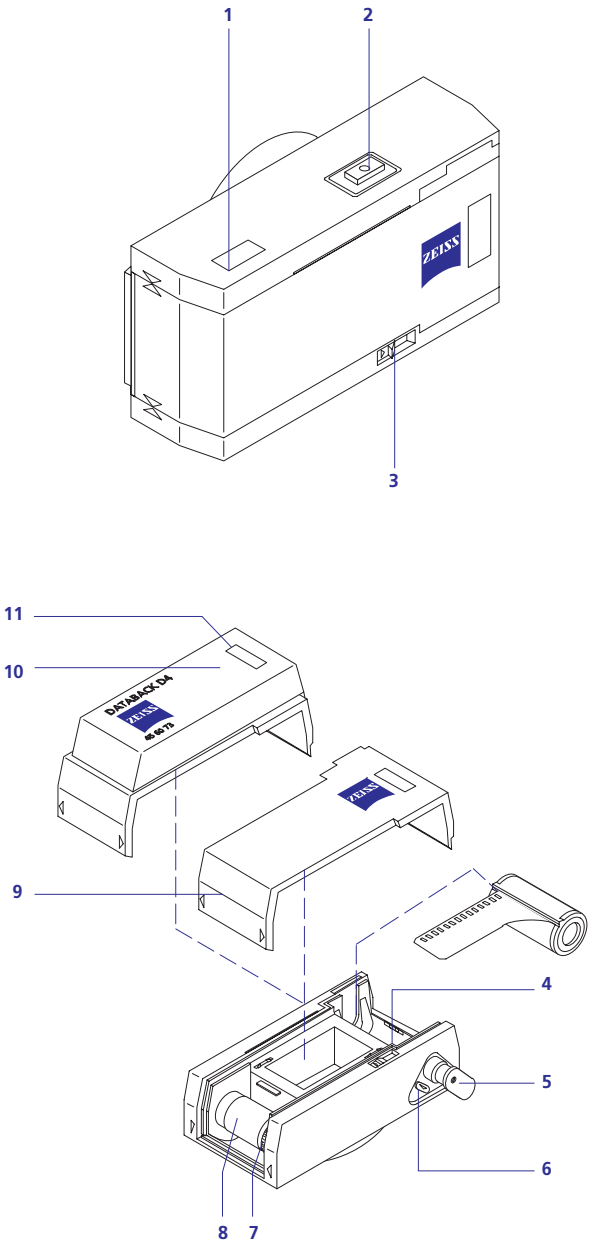
### Inserting a film

- Push locking slider (**6**) (underside) in direction of arrow. This will cause the cartridge holding pivot (**5**) to pop out. The plain back (**9**) or data back can be removed. If necessary remove film particles in cassette using a soft brush.
- Insert cartridge into cartridge compartment (**4**).
- When pulling the film out of the cartridge, make sure that it is flat; place the film leader on the rubber cladding of the take-up reel (**8**) in such a way that your fingers do not touch the rubber cladding. Press in the cartridge holding pivot (**5**). Do not pull end of film too far out of cartridge.
- Insert plain back (**9**) or databack (**10**) on left side (see arrows on the back and on the cassette) and press right side of the back to snap it shut. Make sure again that the rubber cladding of the take-up reel is not touched. Mechanical frame counter (**1**) shows **S** (Start).

**Note:** For No. 135 (35 mm) film you may use film cartridges with or without DX coding.
We advise you not to use bulk film, see page 87.

Carefully clean (remove lubrication residue) the rubber cladding of the take-up reel (**8**) after exposure of 60 ... 80 films or when problems arise with the film advance (motor is not switched off, mechanical counter (**1**) is not set to **S** = Start).
Cleaning agents: Q-tips and water with a little washing-up liquid.

- Set rewind button (**3**) to **R**.
- Soak Q-tips in the water with washing-up liquid.
- Use Q-tips to clean rubber cladding of the take-up reel, move reel by turning its knurled ring (**7**). If necessary, repeat cleaning procedure until the cotton remains clean.
- Dry moist rubber cladding using a dry Q-tip.




**1** Mechanical counter
**2** Eject key
**3** Slider for film rewinding
**4** Compartment for film cartridge
**5** Cartridge holder
**6** Lock for back of cassette
**7** Knurled ring
**8** Take-up reel
**9** Back of cassette
**10** Data back for film cassette
**11** Control window

**Fig. 43 35 mm Mot film cassette**

### Attaching the cassette

Eject key (**2**) is pointing upwards and must not be pressed when attaching cassette.

- Use both hands to hold the film on right and left of the camera body, and insert parallel to the upper edge of the photo module (right or left) until it engages, i.e. the unlocking button (**2**) springs out. The film leader is wound automatically; mechanical counter reads **0**.

After exposure of the first frame (and if a databack is used, exposure of the data), the film is automatically advanced to the next frame. The mechanical counter (**1**) of the film cassette displays the current frame number.

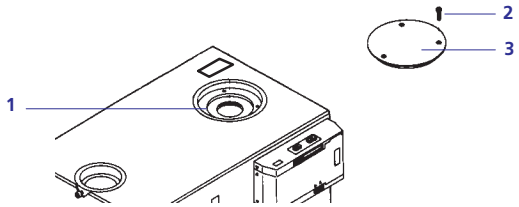
When end of film is reached, the film advance motor is shut down; the software display window shows the message **FILM END**.

### Rewinding the film

Takes place automatically after actuation of slider "R" at (**3**). After unloading the film the slider "R" is automatically set to the normal film advance position when the camera back is attached.

### Data back for 35 mm Mot DX film cassette

The data back (**10**) is attached to the Mot film cassette instead of the standard back (**9**). The film cassette with data back is then attached as usual.




**1** Mount
**2** Screws
**3** Cover

**Fig. 44** **Mounting a second TV camera**

### Second TV camera

A second TV camera can be mounted as follows (**1**):

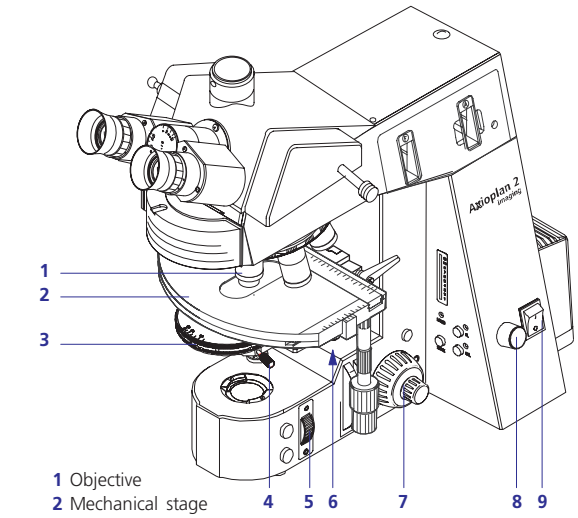
- Remove cover (**3**) by removing 3 screws (**2**).
- Secure intermediate piece TV (452230-0000-000) using the 3 screws.
- Connect TV camera C 2/3" only using TV adapter 1.0x (456105-0000-000); Connect TV camera C 1/2" only using TV adapter 0.63x (456107-000-000); Connect TV camera C 1/3" only using TV adapter 0.50x (456106-0000-000).
- 3C-CTV cameras cannot be used at this point.
- The camera factor of the TV camera is calculated from:
  TV camera factor x 2.5.

**Note:** —> *Getting started with microscopy* G 40-100-d

## Transmitted light brightfield

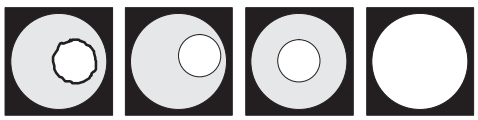
To set the transmitted-light illumination in accordance with the KÖHLER principle, proceed as follows:

- On the rear of the instrument, switch on the transmitted-light illumination using the toggle switch and then switch on the microscope at the ON/OFF switch (**9**).
- At the voltage regulator (**8**) set approx. 3 ... 4 volts as the supply voltage for the illumination.
- First, place a high-contrast specimen on the stage (small, thin coverglass face up.).
- Swing in 10x objective (yellow ring) (**1**) on nosepiece into beam path.
- Check the 0 positions on the eyepiece scale (—> *Microscope Components, Eyepieces, page 47*).
- Raise the condenser to the specimen carrier using the height adjustment; do not swing front optics to the side.
- Set H (brightfield) on index of condenser turret and use knurled ring (**3**) of turret disk to close aperture diaphragm to approx. half its size.




**1** Objective
**2** Mechanical stage
**3** Knurled ring for aperture diaphragm
**4** Centering screws of the condenser
**5** Knurled ring for luminous field diaphragm
**6** Condenser height adjustment
**7** Focusing drive
**8** Voltage regulator for light intensity
**9** ON/OFF switch


E



A B C D

**Fig. 45** **Microscope setting for transmitted light brightfield**

You should now see spots of light (the exit pupils) behind the eyepieces. If you are working with a binocular phototube, all of the light will be directed to the binocular tube if the push-rod is slid in all the way.
When looking into the tube you will see a bright circle (the eyepiece stop) with each eye.

- Merge the two circles into one by adjusting both eyepiece tubes to your PD.
- Focus the specimen using the focusing drive (**7**). The eyepiece setting for spectacle wearers should be"0" (if you are working without glasses —> page 47).
- Close luminous field diaphragm with knurled ring (**5**) moderately. It will then appear unfocused in the image (**A**).
- Focus the diaphragm image (**B**) by lowering the condenser slightly with (**6**).
- Use centering screws (**4**) of the condenser to move the diaphragm image to the center of the field of view (**C**).
- Open luminous field diaphragm on knurled ring (**5**) until it just disappears from the field of view (**D**).
- Now adjust the contrast with the aid of the aperture diaphragm (**3**) to suit the needs of the specimen being examined. The value of the aperture diaphragm can be read off on the scale of the condenser.

**Note:** If you are not certain of the level contrasting, proceed as follows: for objects displaying moderate contrast, approx. 2/3 of the exit pupil of the objective should be illuminated (**E**) (eyepiece removed) using the aperture diaphragm (**3**).

Every objective change also changes the field of view and the objective aperture, i.e. the above procedure must be repeated.

- When a low-power objective images more than the condenser can illuminate, swing the condenser front optics out of position via the lever and lower it, if required.
- If your microscope features a LightManager, the illumination is set automatically. You can store the microscope setting via the SET key (—> *Stand, LightManager*).

If your instrument is motorized and you are using the microscope software via a notebook/PC, you can store a total of 16 reproducible microscope settings (—> *Microscope Software*).

## Transmitted light darkfield

### Use

- ❑ To examine small and extremely small specimens and specimen features such as treponemas, spirochaetae, flagella, bacteria, etc. or emulsions if the contrast supplied by phase contrast is insufficient.
- ❑ If the inherent colors of natural, i.e. unstained, specimens such as living organisms in water (algae, protozoa, lower order animals) are clearly visible.

### Additional equipment

- ❑ Always required: a condenser with a central stop whose numerical aperture is higher than that of the objective used.
- ❑ Objectives with aperture ≥ 1.0 must feature an integrated iris aperture diaphragm.

### Adjustments required

- ❑ Set the illumination as for brightfield; the luminous field diaphragm must be imaged and centered. If the height of the condenser has been correctly set, an almost sharp image of the luminous field diaphragm will be obtained.
- ❑ Check the objective pupil to ensure that it really is dark.

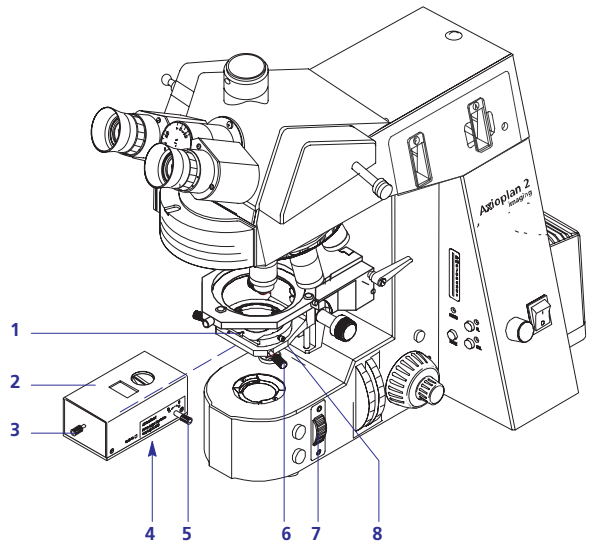
**Note:** With darkfield illumination, there may be a ring of light in the pupil which you should eliminate by focusing the condenser and (if an iris objective is available) by closing the iris diaphragm. The decisive criterion of a high-quality darkfield is, of course, a totally black background in the field of view,

### Additional notes

Darkfield requires even cleaner specimens than other methods; films of grease (fingerprints) in particular will cause lightening of the background.
The somewhat difficult adjustment of the darkfield is simplified by initially pre-centering with a low-power objective. As the luminous field can only be seen in areas where particles light up and since large areas of the specimen ultimately examined may contain no such particles, a specimen displaying uniform detail distribution should be chosen, e.g. a blood smear.

| Plan-Neofluar | Plan-Apochromat | Illumination |
|---|---|---|
| 10x/0.30 | 10x/0.32 | Ph stop 3 ≥ 0.44 |
| 20x/0.50<br>40x/0.75 D | 20x/0.75 | darkfield stop<br>0.76 - 0.90 |
| 100x/1.3 oil iris | 40x/1.0 oil iris<br>100x/1.3 oil iris | Dry darkfield condenser<br>0.8/ 0.95<br>ultra darkfield condenser 1.2 - 1.4 oil |

the table shows recommended combinations for some selected objective




**1** Orientation notch on condenser carrier
**2** Darkfield illuminator
**3** Adjusting screw
**4** Screw
**5** Screw
**6** Centering screws
**7** Knob for luminous field diaphragm
**8** Clamping screw

**Fig. 46** **Microscope configuration for darkfield**

## Darkfield illumination in low magnifications

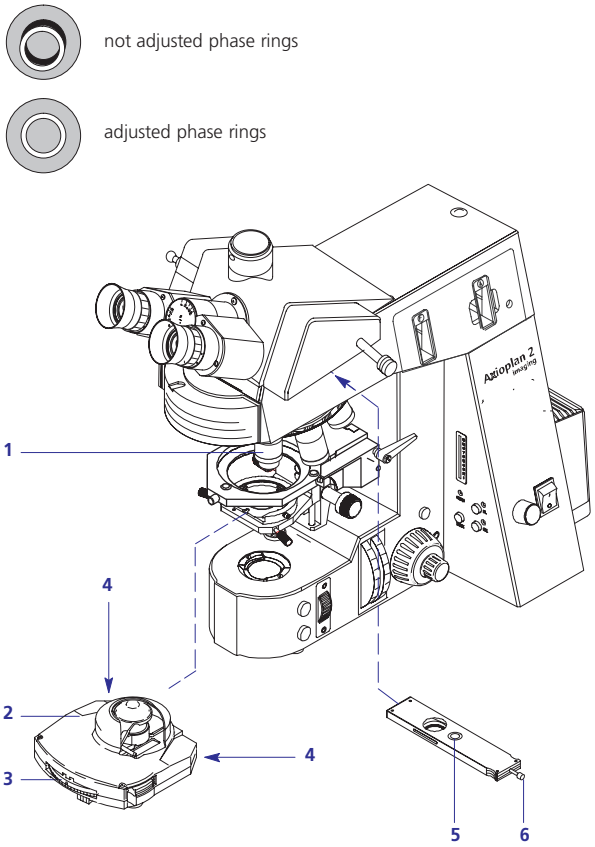
**Darkfield illuminator (2) 445314-9901-000**
(for low magnifications from 1.25x ... 20x)

**CAUTION!**

**Glare hazard!**
When switching from darkfield to brightfield, the lamp brightness must be reduced under all circumstances.

### Setting the optimum darkfield illumination

- Insert illuminator (**2**) in lowered condenser carrier, ensuring that screw (**4**) on dovetail ring engages with orientation notch (**1**).
  Clamp with screw (**8**).
- Use screw (**5**) to select darkfield setting (see symbol).
- Move illuminator under the stage carrier with aid of condenser drive.
- Select objective 1.25x.
- Place auxiliary, strongly scattering specimen (strip of paper) on the stage and focus.
- Close luminous field diaphragm (**7**). Use screw (**3**) to produce uniform vignetting on the upper and lower edges of the field of view. Produce right/left symmetry with the two centering screws (**6**) of the condenser carrier. For technical reasons, the vignetting remaining in the upper and lower areas of the field of view is inevitable with the 1.25x objective. However, the photo frame is uniformly illuminated.
- Place specimen in position; use large slides and large coverglasses, as the light-scattering edges then lie well outside of the object field.
- If the image brightness is insufficient, the diffusion screen can be removed from the illumination ray path without causing any drawbacks. Opening of luminous field diaphragm (**7**) also directs more light to the specimen, but also more reflections outside the photo frame.
- When switching to next highest objective magnification (2.5x) turn screw (**3**) until the field of view is fully illuminated without reflections. Adjust the luminous field diaphragm until the image background is optimally dark. With higher objective magnifications up to 20x, adjust the luminous field only without changing the illuminator setting.
- This illuminator can also be used for brightfield by swinging out the deflection mirror via screw (**5**).




**1** Objective
**2** Condenser
**3** Diaphragm ring
**4** Centering screws
**5** Bertrand lens
**6** Lever for Bertrand lens setting

**Fig. 47** **Microscope configuration for phase contrast**

## Phase contrast

### Use

These techniques are used for unstained specimens in particular in order to enhance their contrast.

### Additional equipment

❑ Objectives (**1**) designated "Ph", these can also be used for brightfield.
❑ A condenser (**2**) featuring "Ph" positions.

### Additional adjustment

The phase rings in the various objectives are of different sizes and marked "Ph 1", "Ph 2" and "Ph 3" on the objective (**1**). The turret bears the same designations, e.g. "Ph 1".

- Combine the designation on the turret disk with the corresponding objectives.

Perfect phase contrast is only obtained if the (dark) ring in the objective and the (bright) ring in the condenser exactly coincide.
The Bertrand lens slider (**5**) provides more convenient viewing of the objective pupil, especially with phase stop centering.

- Loosen screw (Fig. 41/**5**) visible on the front of the stand using Allen key SW 3 until the slider can be inserted and tighten it again until the stops become effective.
- When moved to the left, the Bertrand lens, focused via a lever (**6**) is effective.

(checking without this attachment is also possible with the eyepiece removed, in the same way as for the condenser diaphragm).
If the centering is not perfect [the two rings must coincide (Fig. 47 top)] this can be corrected by using centering screws (**4**), and SW 1.5 key. This type of centering is suitable for all condensers designed for phase contrast.
The centering remains unchanged when the condenser disk is turned or changed, and even if the entire condenser is removed.
To enhance the contrast, a green filter can be moved into the ray path either via the filter wheel or placed on the light exit (transmitted light) or the color glass carrier.

**Note:** Meticulously clean glass-to air specimen surfaces (fingerprints?) are of greater importance in phase contrast than in brightfield. Diaphragm ring (**3**) of the condenser has no function, since the Ph openings do not contain iris diaphragms.
The diaphragms in the Ph positions of the condenser are part of the front optics with which the condenser was supplied; if the front optics are changed, other diaphragms are required.

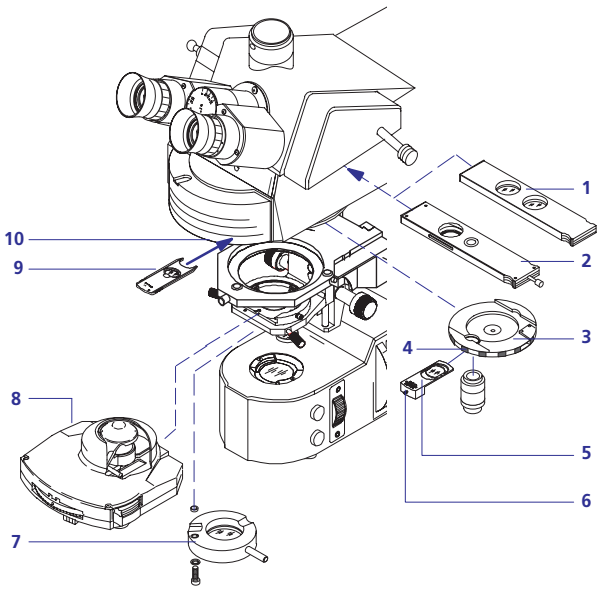
## DIC - Differential interference contrast in transmitted light

**Use**

- ❑ For unstained specimens which are too thick for phase contrast examination, with the result that layers of the specimen outside the focal plane impair the clarity of the image.
- ❑ If the halo typical of phase contrast impairs the observation of small details in the specimen.

**Additional equipment**

- ❑ normally Plan-Neofluar objectives,
- ❑ a special nosepiece (**3**) with slots (**4**) for mounting the DIC sliders,
- ❑ DIC slider (**5**), showing on its surface the magnification and aperture of the objective for which it is intended. Insert DIC in slot (**4**) until the click-stop is reached.
- ❑ a condenser turret (**9**) with DIC prisms,
- ❑ a polarizer (**8**), which is swung into position beneath the condenser,
- ❑ an analyzer slider (**1**), which is inserted on the right side of the upper stand part.




**1** Analyzer slider
**2** Bertrand lens slider
**3** Objective nosepiece
**4** Slots for DIC slider
**5** DIC slider
**6** Knurled screw
**7** Polarizer
**8** Condenser turret
**9** Compensator
**10** Compartment for compensators

**Fig. 48** **Microscope configuration for differential interference contrast**

**Adjustment**

Like the 3 (or 2) Ph positions of the condenser, there are 3 (or 2) DIC positions, marked I, II, III, suitable for combination with the appropriately marked DIC sliders.
This permits the following combinations:

| Objective | DIC position |
|---|---|
| 10x/0.30 | DIC I condenser setting |
| 20x/0.50 | DIC II condenser setting |
| 40x/0.75 | |
| usually > 40x | DIC III condenser setting |

Unlike the Ph positions, the DIC positions are provided with an iris diaphragm. Open this completely at first. To enhance contrast, it can then be closed slightly, this generally being the last stage in the adjustment (see also —> KÖHLER illumination, page 71).
Optimum contrast is set by using the knurled screw (**6**) of the DIC sliders (**5**) in the nosepiece.

- Swing in the DIC-suitable objective via the nosepiece. Insert the appropriate DIC slider into the nosepiece compartment until click-stop.
- Swing in the DIC analyzer module on the reflector.
- Swing in the suitable DIC prism I, II or III (number visible on the condenser turret disk). No further steps are required if a condenser with integrated polarization filter (e.g. 445439-0000-000) is used. Otherwise, a polarization filter must be inserted below the condenser.

**DIC setting using the SÉNARMONT polarizer**

The following must be taken into consideration when a SÉNAMONT polarizer, consisting of a carrier with λ/4 plate (above) and a rotary polarizer (below), is used:

- Insert SÉNAMONT polarizer below the condenser until click-stop.
- Set luminous-field diaphragm and aperture diaphragm in accordance with the rules of KÖHLER illumination.
- Set optimum contrast using the knurled screw on the DIC slider. When the DIC slider is moved symmetrically around its center position, specimen details can be displayed in 3D in such a way that they appear in different planes.
- In SÉNARMONT DIC, the optimum contrast is set by turning the polarizer using the rod in the lower part of the SÉNARMONT polarizer. The λ/4 plate above it must always be swung in to allow contrasting according to SÉNARMONT to function. If the DIC slider has been moved to the center position before, there will be darkness in the click-stop position of the SÉNAMONT polarizer, i.e. the path difference is 0 mm in this position.

**Additional notes**

In DIC, contrast is created by (pseudo) relief and, in the case of linear structures, is therefore dependent on their orientation: with orientation in the same direction as the "light shadow", contrast is low, while in the direction perpendicular to the shadow optimum contrast is obtained. The possibility of specimen rotation is therefore (almost) imperative for adjustment. Please bear in mind that the mechanical stage can be used as a rotary stage.

To ensure reflection-free illumination, the luminous field and aperture diaphragms should not be opened any wider than allowed for the KÖHLER principle.

DIC uses polarized light and is therefore impaired if "optically active" elements are located between the polarizer (**7**) and the analyzer (**1**) e.g. foils which are sometimes used for histological sections, or plexiglass culture dishes with plastic bases (dishes with glass bases are also available). Color DIC is obtained if you use compensator λ (473704-0000-000) (**9**). This slider may be used only in transmitted light.

Use the reflector module DIC Red I (000000-1046-278) for color DIC in incident light.

The DIC prisms in the DIC positions of the condenser are part of the front optics supplied with the condenser on delivery.

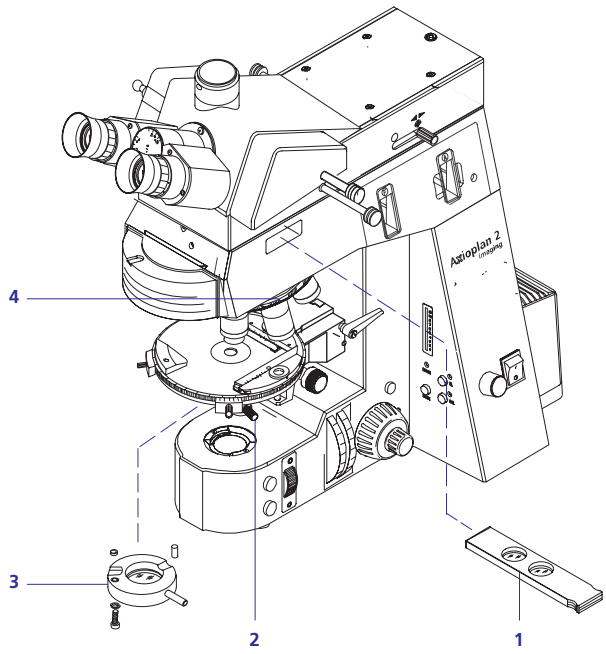
## Transmitted-light polarization – Detection of birefringence

**Use**

this technique is used for the examination of transparent, birefringent objects. It is a characteristic feature of birefringent objects that, with polarizer and analyzer in a crossed position, the otherwise dark field of view turn bright 4 times when you rotate the object stage through 360°. In the process, interference colors from only just visible gray (e.g. biological specimens), white, red, yellow, blue, etc. up to higher-order white can occur, regardless of birefringence, the thickness and the orientation of the object.

**Adjustments**

- Adjust your polarizing microscope for standard brightfield examination (see —> page 71).
- Center the rotary stage Pol (see —> page 59) to ensure that the optical axis of the objective in the non-centerable turret opening has been centered on the rotary axis of the stage. If this alignment has been performed correctly, an object feature in the center of the reticle will remain in position when the stage is turned.
- Tighten screw (**2**) locking the stage in position and swing the first objective in a centerable threaded mount into the beam path. If the threaded mount is not centered, the previously focused object feature will no longer be in the center of the reticle.
- Bring the displaced feature into the center of the reticle by adjusting the two centering screws of the objective using two small Allen wrenches. The centering screws are located on the left and the right of the objective position on the knurled ring of the nosepiece (**4**). Proceed in the same manner for the next centerable threaded mount of the nosepiece. After you have centered all objectives, loosen the screw locking the stage rotation.
- Re-check the position of each objective by turning the stage. An object feature located in the center of the reticle should now remain in the center.
  To maintain this centering, we recommend using the knurled ring of the nosepiece to change the objectives instead of the objectives themselves.
- Swing the polarizer (**3**) into the beam path and adjust it to 0°, if your microscope is equipped with a rotary polarizer.
- Insert the analyzer (**1**) until it snaps in and the field of view is dark.
  If you work with a measuring analyzer, adjust the measuring scale to 90° and secure it in position.
  If you use a ±10° rotary analyzer with a rotary λ plate, adjust the analyzer to the central click-stop.
  the λ plate will be ineffective if it is positioned above the analyzer, and effective if it is below the analyzer.
- Bring the object to be examined into the field of view and turn the stage including the object.
  As described above, colorless or colored changes of the object indicate the presence of birefringence. Optically anisotropic materials can also remain dark, however, if an isotropic direction, e.g. of optically uniaxial or biaxial crystals, is in parallel to the viewing direction.
  In this case, you can establish whether the object is optically isotropic or anisotropic by using the conoscopic viewing method (see —> page 80).




**1** Analyzer slider
**2** Stop device of stage rotation
**3** Polarizer
**4** Objective nosepiece

**Fig. 49** **Transmitted-light polarization**

## Transmitted-light polarization – Determining the $n_{\gamma'}$ direction of oscillation

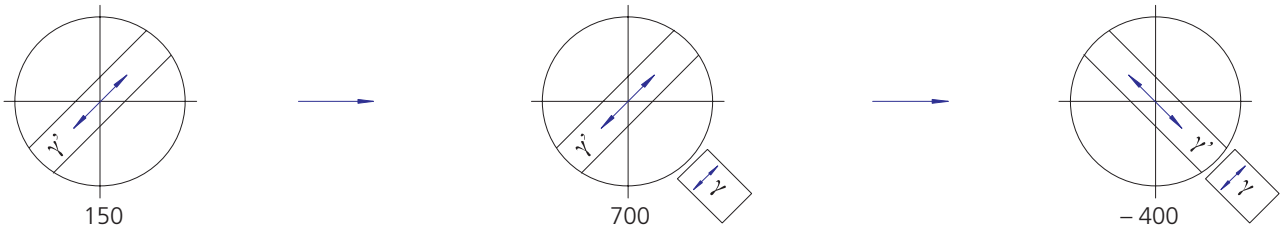



**Fig. 50** Determining the $n_{\gamma'}$ direction of oscillation using a synthetic fiber as an example

### Use

The position of the two directions with the greatest ($n_{\gamma'}$) and the smallest ($n_{\alpha'}$) refractive index (both in relative terms) or with the greatest ($n_{\gamma}$) or with the smallest ($n_{\alpha}$) refractive index (both in absolute terms) relative to the morphological directions of crystal surfaces, crystal needles or fibers is an important feature used, for example, in the diagnosis of biocrystals (gout, preudogout).

### Adjustments

- Perform the adjustments described under —> *Adjustments* on page 77. The fiber lights up in the field of view.
- Turn the stage to the first click-stop, deactivate the click-stop and turn the stage in such a way that the object displays maximum darkness.
- Activate the click-stop and turn the stage by 45° to the next click-stop so that the longitudinal axis of the fiber is oriented in the NE-EW direction (Fig. 50). Here, the object displays maximum brightness (diagonal position), e.g. gray-white.
- This color corresponds to a path difference of 150 nm in the Michel-Lévy color chart (Fig. 50 and Fig. 51).
- After inserting the compensator λ, the color turns to yellow-orange (path difference approx. 400 nm).
- By turning the stage by 90°, the fiber appears green-blue (path difference approx. 700 nm).

### Conclusions

The $n_{\gamma}$ - direction of the compensator λ is oriented in the NE-SW direction. The color of the surroundings of the fiber is a deep red of the 1st order (path difference is one λ; ; approx. 550 nm). the fiber itself appears green-blue (path difference approx. 700 nm). The higher interference color (700 nm) can only be the result of the addition of the path differences of approx. 150 nm and compensator λ (approx. 550 nm), the lower one (approx. 400 nm) only by subtraction.

The colors will be added if the $n_{\gamma}$ of the compensator and the $n_{\gamma'}$ of the object are parallel. Hence, the $n_{\gamma'}$ of the object also lies in NE-SW direction at a higher interference color and is oriented in parallel to the longitudinal axis of the fiber.

### Summary

Compare interference colors (path differences) in the two diagonal positions. The larger path difference will occur if both $n_{\gamma}$- directions are parallel. Thus, the $n_{\gamma'}$ - direction of the object has been determined.

**Note:** Michel-Lévy color charts are available under Cat No. 42-312.

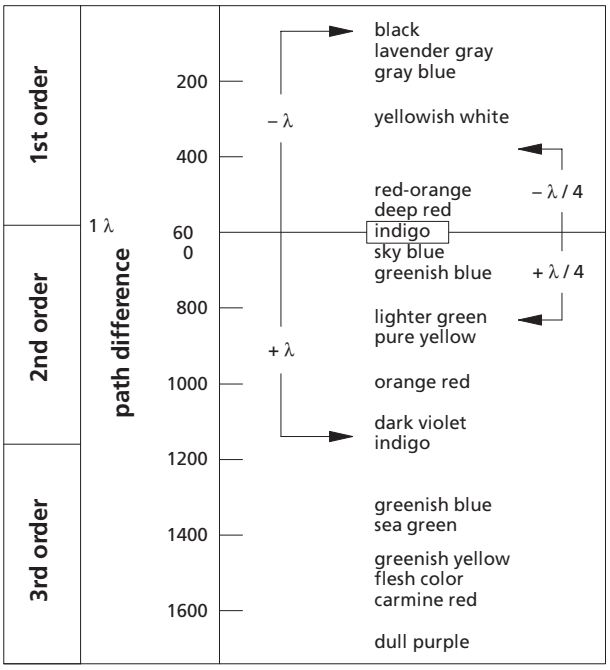



**Fig. 51** Schematic illustration of the Michel-Lévy color chart

## Transmitted-light polarization – Determining and measuring path differences

**Use**

The color chart only allows the rough estimation of path differences of transparent, anisotropic substances, such as minerals, synthetic crystals, plastic, strained glass, biocrystals or erythrocytes. for exact measurement, a compensator is needed. This compensator reduces the path difference caused by the object to zero (1st order black), i.e. it compensates for the path difference.

Unlike determining the $n_{\gamma'}$ - direction, where the position of addition is of importance, the object must be in the position of subtraction relative to the compensator, i.e. the $n_{\gamma'}$ of the object must be turned against the $n_{\gamma}$ - direction of the compensator by 90°.

**Selecting the correct compensator**

We can provide the suitable compensator for every path difference measurement: rotary Brace – Köhler compensator λ/8 with a minimum measuring range from 0 to 72 nm and tilting 0 Ehringhaus compesator E 0 – 6 λ with a maximum range from 0 to 3.276 nm. Path differences can only be measured if the path difference of the object lies within the measuring range of the compensator used. To obtain as high measuring accuracy as possible, the measuring range of the compensator used and the path difference should approximately be of the same magnitude. To find the correct compensator, insert your object in the dark field between the crossed polarizer and analyzer. Turn the stage and note the interference colors obtained. (see table below).

**Measurement**

- Focus on the specimen (objective 10x).
- Bring polarizer and analyzer into crossed position.
- Turn specimen
  – to extinction or standard position,
  – activate the stage click-stops
  – set a diagonal position displaying maximum brightness at 45°

Insert the compensator selected, move it out of its zero position and watch whether:

- the interference colors become deeper, i.e. the path difference decreases. The $n_{\gamma}$ - direction of the compensator and the $n_{\gamma'}$ - direction of the object are perpendicular to each other (position of subtraction). The specimen is correctly positioned for compensation.
- the interference colors become paler (position of addition), i.e. the path difference increases. The black of the 1st order never appears. In this case turn the specimen by another 90°.
- All you have to do now is to adjust the compensator in such a way that the point of measurement is completely dark. Using the recorded angles, you can read off the path difference in nm from the relevant table or calculate the path difference when you work with the rotary Brace – Köhler compensator.

H. de Sénarmont compensator

The Sénarmont technique allows the measurement of path differences up to 1 λ. This technique differs in the following points from the above description:

- A Sénarmont compensator 546/4 is used which is a λ/4 plate with $n_{\gamma}$ in the east-west orientation.
- a rotary analyzer is used for measurement.
- the path difference is calculated using the angle measured.

**Note:** It is advisable to use monochromatic light for measurement. To achieve this, use the green interference bandpass filter 546, d=32x3 (467807-0000-000).

| Interference color | Using compensator λ you will obtain: | Path difference | Compensator / Technique |
|---|---|---|---|
| Dark gray | colors (blue, yellow), 1st order gray present | λ/10 (approx. 50 nm) | Rotary Brace – Köhler compensator λ/8 |
| White | colors, 1st order white present | λ/2 (approx. 270 nm) | H. de Sénarmont technique or Ehringhaus tilting compensator 0 – 6 λ |
| More or less deep interference colors | colors or white; colors of 1st to 4th order are present | λ/2 to 5 λ (approx. 270 to 2700 nm) | Ehringhaus tilting compensator 0 – 6 λ |

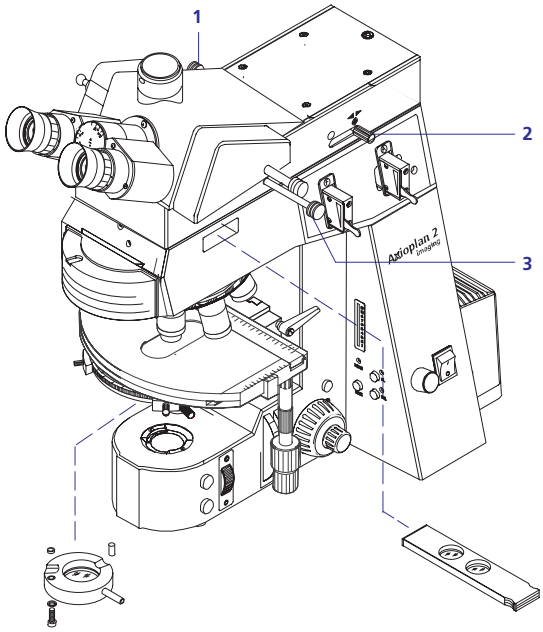
## Transmitted-light polarization – Determining the optical characteristics of crystal

### Use

Determining the optical characteristics of transparent and weakly absorbing crystals is part of the diagnosis of crystals. This technique is also termed concoscopic observation. Its main field of application is the classic microscopy of rocks. It is also possible, however, to identify and characterize synthetic crystals, industrial minerals and plastics (e.g. films).

### Adjustments

- Adjust your polarizing microscope for standard brightfield examination (see —> page 71) and polarization in transmitted light (see —> page 77).




**1** Pushrod for field diaphragm
**2** Rotary and slider knob for Bertrand lens
**3** Pushrod for reticle

**Fig. 52** **Transmitted-light polarization**

- Bring the low-power objective (2.5x/0.075) into the beam path. The best orientation for conoscopic observation have those crystals (e.g. thin rock section) whose brightness level is changed as little as possible in orthoscopic observation when you turn the stage. In this case, the optical axis of uniaxial crystals or one of the optical axes of a biaxial crystal is nearly parallel to the viewing direction.
- After selecting a crystal in this manner, position it in the center of reticle (**3**). Bring the dry objective providing the largest aperture (40x/0.85) into the beam path, swing in the condenser front lens and re-check that the condenser diaphragm is fully open. Lift the condenser until the image of the luminous field diaphragm is sharp (see —> page 71).
- Close the filed diaphragm (**1**) until the grain boundaries of the crystal selected are no longer visible. This ensures that the interference figures of neighboring crystals are not superimposed on the interference figures of the crystal to be examined. Thus, object features with as small a diameter as 10 µm can be eliminated from the field of view.
  When turning the stage, the object must remain in the center of the reticle, i.e. it must also remain in the visible area (re-center, if necessary).
- Swing in the Bertrand lens (symbol ⊕ ) with knob (**2**) on the intermediate tube Pol. Use the Bertrand lens to focus the pupil image (interference figure).
  The conoscopic image obtained now shows you whether the crystal has one or two axes. Use the compensator λ to determine the optical characteristics of the crystal (optically positive or optically negative); the compensator λ/4 can also be used for this purpose.
  Use the wedge compensator 0 – 4 λ (quartz wedge) to determine the optical characteristics of absorbent crystals (e.g. augite, hornblende) or crystals with anomalous birefringence.

### Uniaxial crystals

If the optical axis of a uniaxial crystal is oriented in parallel to the viewing direction, a dark cross becomes visible in conoscopic viewing which can be surrounded by concentric interference fringes (dependent on the birefringence and the thickness of the specimen). These interference fringes are also termed isochromats (Greek isos = equal, chroma = color).
The cross remains visible while the stage is turned. Focus your attention on the NE quadrant of the cross (1st quadrant; counting is counterclockwise).

When working with the compensator λ:

- After inserting the compensator λ, the following appears in the 1st and 3rd quadrant near the center of the dark cross:
  – yellow = optically negative
  – blue = optically positive

When working with the compensator λ/4:

- After inserting the compensator λ/4, a dark spot appears near the center of the dark cross:
  – in 1st and 3rd quadrants = optically negative
  – in 2nd and 4th quadrants = optically positive

When working with the wedge compensator 0 – 4 λ:

- After insertion of the wedge compensator 0 – 4 λ, the isochromats in the 1st and 2nd quadrant are moving:
  – outward = optically negative
  – inward = optically positive

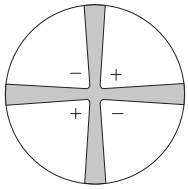
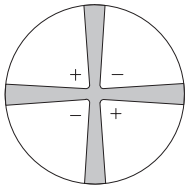
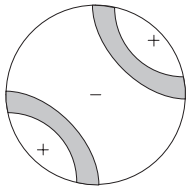
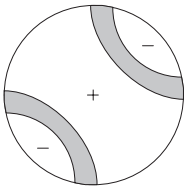
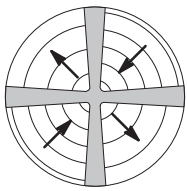
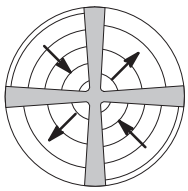
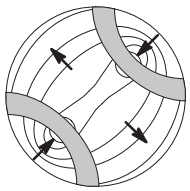
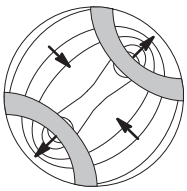
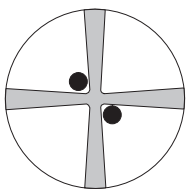
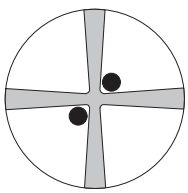
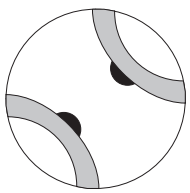
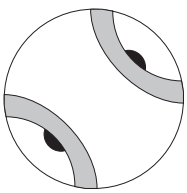
**Biaxial crystals**
If biaxial crystals display a cross in conoscopic observation which resolves into the two branches of a hyperbola, the acute bisectrix (1st center line) is oriented in parallel to the viewing direction. Turn stage until the dark branches of the hyperbola (isogyres) are in the 1st and 3rd quadrants

When working with the compensator λ:
- After inserting compensator λ , the following appears:
  – yellow on the outside (concave side of hyperbola) and blue on the inside (convex side of hyperbola) = optically negative
  – blue on the outside and yellow on the inside = optically positive

When working with the compensator λ/4:
- After inserting the compensator λ/4, a dark spot appears:
  – on the outside of the dark isogryre = optically negative
  – on the inside of the dark isogryre = optically positive

When working with the wedge compensator 0 – 4 λ:
- After insertion of the wedge compensator 0 – 4 λ, the isochromats in the 1st and 3rd quadrant are moving:
  – outward = optically negative
  – inward = optically positive

**Note:** If an optical axis of a biaxial crystal is parallel to the viewing direction, only one branch of the hyperbola will be visible in conoscopic viewing, with the vertex of this branch lying in the center of the filed of view. If the stage is turned, the branch of the hyperbola will move about its vertex. Proceed in the same manner as described above to determine the optical characteristics of the crystal.

| | Optically uniaxial | | Optically biaxial | | |
|---|---|---|---|---|---|
| | positive | negative | positive | negative | |
| λ plate (white —> blue —> yellow) |  |  |  |  | + = blue<br>– = yellow |
| Quartz wedge (direction of movement during insertion) |  |  |  |  | direction of movement |
| λ/4 plate (position of black spots) |  |  |  |  | |

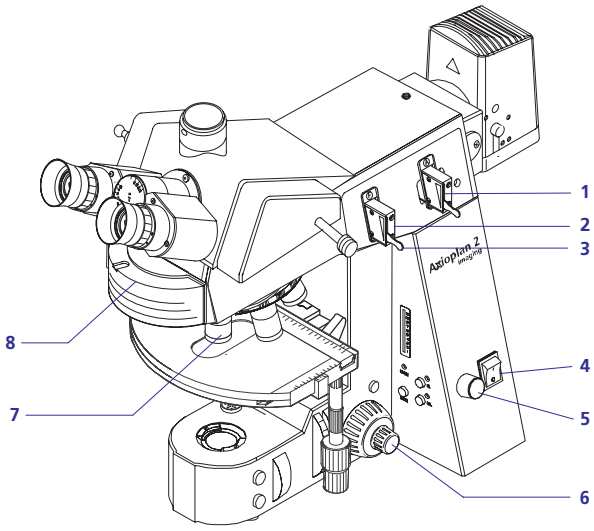
## Incident light brightfield

(Fig. 53)

**Note:** In all incident-light techniques, the compensators 6 x 20 (see also —> overview on page 65) must be removed from the beam path to prevent image quality from being impaired.

To set the incident light-illumination in accordance with the KÖHLER principle, proceed as follows:

- On the rear of the instrument, switch on the incident-light illumination sing the toggle switch and then switch on the microscope at the ON/OFF switch (**6**).
- At the voltage regulator (**7**) set approx. 3 ... 4 volts as the supply voltage for the illumination.
- Place a polished specimen on the stage (align top surface parallel to support, e.g. with leveling press).




**1** Slider with iris diaphragm as aperture diaphragm
**2** Slider with iris diaphragm as luminous-field diaphragm
**3** Lever for iris diaphragm
**4** ON/OFF switch
**5** Voltage control for light intensity
**6** Focusing drive
**7** Objective
**8** Reflector turret

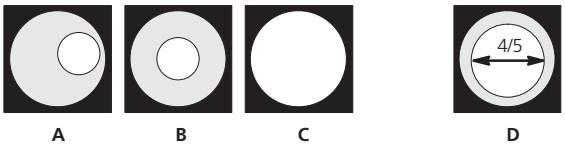



**Fig. 53 Microscope setting for incident light brightfield**

- Swing in 10x objective (yellow ring) (**9**) on nosepiece, and the reflector module for brightfield on reflector turret (**10**) into beam path.
- Check the 0 positions on the eyepiece scale (—> *page 47*).

You should now see spots of light (the exit pupils) behind the eyepieces. If you are working with a binocular phototube, all of the light will be directed to the binocular tube if the pushrod is slid in all the way.
When looking into the tube you will see a bright circle (the eyepiece stop) with each eye.

- Merge the two circles into one by adjusting both eyepiece tubes to your PD.

For the incident-light technique a slider with iris diaphragm is used as aperture and luminous-field diaphragm. As the aperture diaphragm is not visible in the incident-light technique, the slider for the aperture diaphragm must first be centered in the luminous-field diaphragm compartment and then be inserted into the aperture diaphragm compartment.

- Insert slider with iris diaphragm into luminous-field diaphragm compartment as far as click-stop (**2**).
- Close the diaphragm via the lever (**3**), until it is visible in the field of view.
- Focus the specimen with focusing drive (**8**). The image of the luminous field diaphragm (**A**), which lies exactly in the specimen plane may be helpful here.
- Move the diaphragm image into the center of your field of view (**B**) with the aid of the two centering screws on slider (using ball-headed screwdriver). Use lever (**3**) to open this diaphragm until the field of view is just free and no more (**C**).
- Remove the centered slider from the compartment (luminous-field diaphragm) and insert in aperture diaphragm compartment as far as click-stop (**3**).
- Then insert a second slider with iris diaphragm in luminous-field diaphragm compartment (**3**) and center likewise.

Every objective change also changes the objective aperture, i.e. the aperture diaphragm must be readjusted.
If your microscope features a LightManager (motorized aperture diaphragm, at least coded nosepiece), the microscope setting can be stored via the SET key (—> *Stand, LightManager*).

- Now adjust the contrast with the adjusting lever of the aperture diaphragm to suit the needs of the specimen being examined.

**Note:** In the case of uncertainty how far to stop down, a good rule of thumb is that approx. 4/5 of the exit pupil of the objective should be illuminated (**D**). [The exit pupil is visible at the bottom of the tube when the eyepieces are removed or when the Bertrand lens is swung in and focused (Bertrand lens slider)]. If necessary, the aperture diaphragm can be brought into the center of the pupil using centering screws (**2**) and then stopped down to 4/5 its size using pushrod (**4**).

## Incident light darkfield

### Use

Object features which heavily scatter light, such as scratches, cracks, pores or the surfaces of metal fractures light up bright in darkfield illumination. Ideal brightfield objects such as specular surfaces including features with different degrees of reflection remain completely dark, however.

### Additional equipment

- ❑ Nosepiece with connecting thread M 27
- ❑ HD objectives
- ❑ Reflector module D

### Adjustments required

- Set illumination as for brightfield.
- Then switch to darkfield by swinging in reflector D on the reflector turret.
- Open luminous-field diaphragm and aperture diaphragm fully, as this work in darkfield using the incident light technique requires maximum illumination intensity.

**Note:** When switching back to brightfield, do not forget to close the luminous-field diaphragm and the aperture diaphragm to the normal values. There will otherwise be a risk of glare.

## DIC – Differential interference contrast in incident light

### Use

This technique is used for the high-contrast display of reflecting surfaces featuring height differences of several wavelengths up to the λ/20 range.

### Additional equipment

- ❑ Epiplan-Neofluar Pol, DIC or HD DIC objectives.
- ❑ Special HD DIC W 0.8 or HD DIC M 27. nosepiece
- ❑ DIC sliders matched to the objectives used.
  The magnification and aperture of the suitable objective are given on the top surface of the sliders. Insert DIC slider in slot until the click-stop is reached.
- ❑ DIC slider +, for maximum contrast at reduced resolution provided by objective.
- ❑ DIC or DIC red I reflector module.

### DIC enhancement

If contrast is unsatisfactory using the standard DIC equipment, use the sliders marked + which are available for the objectives listed below (overview). The increased contrast may result in decreased resolution.

| Objective | DIC slider |
|---|---|
| 5x / 0.15 | 5x / 0.15 Epi + |
| 10x / 0.30 | 10x / 0.30 Epi + |
| 20x / 0.50 | 20x / 0.50 Epi + |
| LD 20x / 0.40 | LD 20x / 0.40 Epi + |

**Note:** If you want to work with the reflector module Pol, sliders with or without a compensator λ must be used for the analyzer compartment (see —> Fig. 48/**2**, page 75).

### Additional notes

In DIC, contrast is caused by surface relief. With linear structures, therefore, contrast is dependent on whether the orientation of these structures is in the "light shadow" direction (very low contrast) or at right angles to it (maximum contrast). For this reason, it is advantages to have the possibility of object rotation to obtain an image displaying the highest contrast. This can be achieved using either a rotary mechanical stage or a rotary polarization stage.

Colored DIC is obtained if the DIC red I reflector module is used or the Pol reflector module is inserted together with an analyzer slider and a λ-plate, rotatable by ±10° (453662-0000-000).

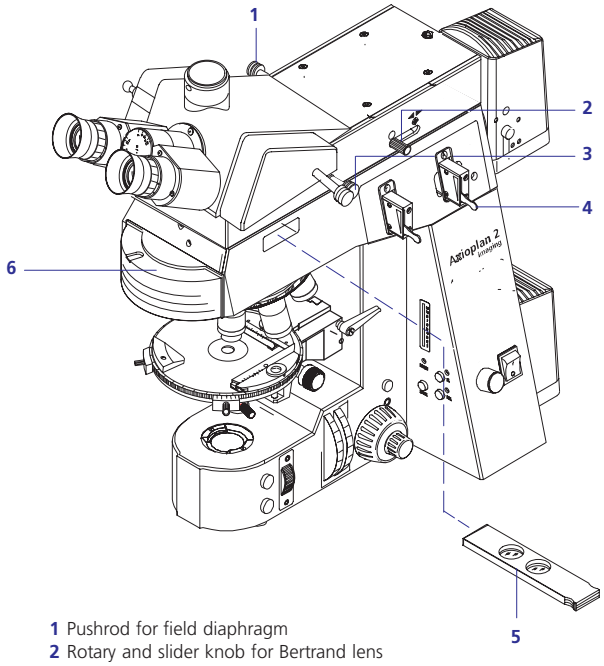
## Incident-light polarization – Detection of bireflection and reflection pleochroism

### Use

Polished sections of ore minerals, coals, ceramic products, specific metals and metal alloys display a different reflection behavior depending on the orientation of their crystals or object features. Thus, this technique is also another contrasting technique.

### Adjustments

- Adjust your polarizing microscope for standard examinations in incident light (see —> page 82).
- Bring the reflector module Pol into the beam path by turning the reflector turret (**6**). The incident-light polarizer is oriented in the E-W direction.
- Insert analyzer (**5**) into the analyzer compartment. The analyzer is oriented in the N-S direction.




**1** Pushrod for field diaphragm
**2** Rotary and slider knob for Bertrand lens
**3** Pushrod for reticle
**4** Lever for aperture diaphragm
**5** Analyzer slider
**6** Reflector turret

**Fig. 54** **Incident-light polarization**

- Close the aperture diaphragm by 2/3 of its diameter using the lever (**4**).
- Your object will display bireflection if object features possess differences in brightness or color which change when the stage is turned.
- Pleochroism is present when color changes occur in the object during the turning of the stage (incident-light polarizer in beam path, analyzer swung out).

If the polarizing microscope you use for the examination of incident-light objects is equipped with an intermediate tube Pol, you must remove the Bertrand lens from the beam path using rotary and slider knob (**2**) and push in the pushrods for field diaphragm (**1**) and for reticle (**3**).

**Note:** When rotary and slider knob (**2**) is in front position, the Bertrand lens is swung out of the beam path, in its rear position, the lens is in the beam path.

## Epi-Flouresc ence

### Additional equipment

- ❑ Recommended: Plan-Neofluar or Fluar objectives (UV excitation).
- ❑ Fl reflector module (with the relevant filter combination) and shutter module in the reflector turret
- ❑ HBO 103 or HBO 50 mercury vapor short-arc lamp for reflected-light illumination
- ❑ HAL 100 halogen illuminator for transmitted-light illumination

**Note:** It is absolutely necessary that the mercury vapor short-arc lamp has been aligned before the reflected-light fluorescence technique is used. Realignment might also become necessary depending on the hours of use.


**Explosion hazard!**
The HBO 50 W lamp must be exchanged after expiry of the average service life of 100 hrs. The average service life of the HBO 103 is 300 hrs. Their illuminance decreases I the course of many hours of use so that homogeneous illumination of the object field can no longer be guaranteed. Furthermore, there is a risk of explosion. The remaining service hours can be read off on the power supply unit.
Please refer to manual *N HBO 103 and N XBO 75 Microscope Illuminators* (B 40-065 d) for further details on how to change and align the lamps.

### Setting of the illumination

The initial epi-fluorescence setting is made considerably easier if a Plan-Neofluar 20x/0,50 objective and a strongly fluorescent specimen is used. It is also possible to use demonstration specimens first.

**Note:** If the λ compensator has still remained in the compartment above the nosepiece after use of the DIC technique, it must be removed before epi-fluorescence can be set.

- Switch on the HAL100 halogen illuminator
- Swing in the Plan-Neofluar objective 20x/0.50.
- Move condenser turret to position H, transmitted-light brightfield (or phase contrast), and search the specimen spot to be examined.
- Keep the light path in the reflected-light illuminator blokked with the shutter module A on the reflector turret or with the barrier position of the reflected-light filter slider (A).
- Switch on the HBO 103 or HBO 50 mercury vapor short-arc lamp and allow it to heat up to its operating temperature for approx. 15 minutes.
- Select and switch on the required fluorescence filter combination (depending on the type of excitation) on the reflector turret of the Fl reflector module.
- When using the reflected-light slider, unblock the light path in the reflected-light illuminator.
- Remove one eyepiece from the tube and use your eye to set the aperture diaphragm. Open the aperture diaphragm until the entire objective exit pupil is free.
- Insert the eyepiece in the tube again and close luminous-field diaphragm until it becomes visible in the field of view.
- Use the two centering screws on the condenser carrier to center the luminous-field diaphragm in the edge of the field of view.
- Either open the luminous field diaphragm until it just disappears behind the edge of the field of view, or close it into the field of view if there is a risk of bleaching of the specimen.
- Finally, refocus on the specimen and optimize the collector position of the HBO 103, if required. Set the collector in such a way that the illumination of the field of view is as homogeneous as possible if the reflector module of short wavelength excitation is used. Modules with an excitation of a longer wavelength do not require the correction of the collector position.

**Note:** To avoid eye injury, please use the fluorescence protection screen (452163-0000-000 —> *System Overview*).

## Photomicrography with the Axiophot 2

**Note:** If your polarizing microscope (Axioplan 2 imaging Pol, Axiophot 2 Pol) is equipped with an intermediate tube Pol, you must remove the wire reticle (see —> Fig. 28/**3**) from the beam path if you do not want it recorded in the photo.

### How to proceed for photography

- Carefully set your Axiophot 2 photo module for observation.
  Set the beam splitter to allow simultaneous observation and photography (—> *Microscope Software*).
- Select illumination technique, objective magnification and condenser setting as usual.
- Set the brightness required for observation (3200 K color temperature) on the stand (Fig. 3/**4**).
- Load the correct film into the film cassette and attach the photo module.
- Select the film type used under **Film data** in **Photo** program module. Set the required exposure metering technique (normally center-weighted averaging) and the illumination technique (FL/D; H/Ph/DIC; H) under **Mode**.

The display field of the **Photo** menu now shows the exposure time, the correct data of the loaded film and the frame counter.

- Switch on the luminous frame.
- Set the image frame and focus.
  Proceed carefully. If the focusing cross and the specimen are visible in focus simultaneously, imaging on the film will also be in focus.
  In the case of a low objective magnification, the use of the Optovar 2.5x or the **Focus Finder** function are absolutely required as a focusing aid.
- Click **START** to take the photo.

The following is then performed automatically:
– luminous frame disappears
– new, current exposure metering
– exposure
– data projection
– film advance
– luminous frame appears again

The next exposure can be released.

### Film selection

Reversal films (films for slides) are used for color photomicrography. In general, we would recommend reversal films for artificial light (3200 K).
If daylight film is used, the conversion filter 3200/5500 is required.
Films marked "professional" feature closer tolerances in sensitivity and color balance, i.e. homogeneous results are obtained. Always use DX-coded films in their original cartridges.

### Use of yarded films

We do not recommend the use of yarded films, since light entry, scratches on the film, dirt, etc. might impair the quality of the film. The use of damaged cartridges can result in defective film advance.
If you wish to work with a yarded film, please be sure to follow these instructions:

Only use DIN 4535 or ISO 1007-1977 cartridges. Ensure not to exceed the given maximum measurements.

Film cartridges are not suitable for continuous operation. Discard the cartridges after 10 loads maximum.

The front part of the film needs to be cut in accordance with DIN 4536 or ISO 1977 (—> *Fig. 55)*.
– Do not cut through a perforation hole when cutting the front part of the film.
– The cut needs to be as long as 7 ... 9 perforation holes and must run parallel to the edge of the film.
– The corners must be rounded in order to prevent the film from jamming the cartridge opening or parts of the cassette.
– The end part of the film must be cut off at a right angle and secured tightly with adhesive tape (rewinding).
– Avoid using very long films (some cartridges cannot be used for 36 exposures with every type of film). This could result in defective film advance.

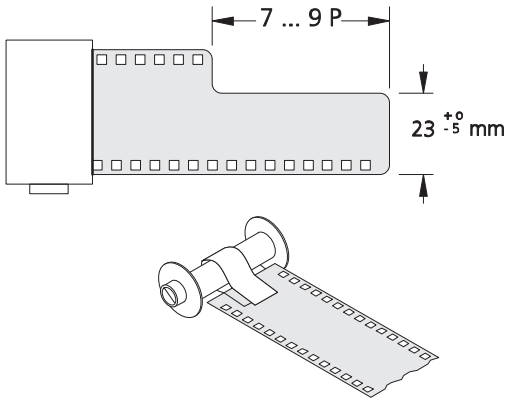



**Fig. 55** **Use of yarded film**

## Correction of the color balance of color reversal films

The color balance of a type of color reversal film can differ from batch to batch.
Both these deviations and influence from the optical system on the color can be compensated using commercially available color compensating (CC) filters.
The filter density is indicated by a 2-digit number and the color by its initial letter.
Examples: 05 – B (blue), 10 – G (green), 20 – R (red)

### Assessing the color balance

- View slides on a standard light box, the light source of which has the correct illuminance and the spectral energy distribution of 5000 K.
- Take test exposures of an object area with as much empty background as possible in transmitted-light brightfield.
- The empty background of an exposure series should range from dark gray, medium gray and light gray to white.

### Correction of the color balance

- Place CC filters in the complementary color of the color tinge on the slide to be corrected.

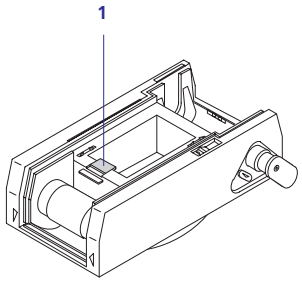
| Color tinge | Color of CC filter |
|---|---|
| blue | yellow Y |
| green | purple (magenta) M |
| red | bluish green (cyan) C |
| yellow | blue B |
| purple | green G |
| bluish green | red R |

If the required color balance is obtained during observation using a filter with density 10, for example, a CC filter of half this density, i.e. density 0.5, should be used for the exposure to follow. Normally, filters of density CC – 05 to CC – 10 are sufficient for correction.

**Note:** Perfectly corrected color exposures make it necessary that the microscope setting, the developing procedure and the film batches remain unchanged.

## Data projection for 35 mm photography

The data projected into the image may be poorly legible against bright object structures. We would therefore recommend you to slide the data shield (—> Fig. 56/**1**) on the film support into the frame window until stop. This shield masks out a field of 2.5 mm x14 mm at the edge of the format, and the data are then clearly legible on the black background. The data shield can be moved only **before** insertion of the film; it is not possible to move it while a 35 mm cassette is attached.




**1** Data shield

**Fig. 56** **35 mm Mot film cassette**

## Compensation of reciprocity failure

The automatic compensation of the reciprocity failure (RECI value) may become effective in the case of exposure times of more than 1 second. When the film type is entered, the relevant data are automatically called from the database of the software and the exposure time is corrected.

When using films not included in the database, determine the correct value as follows:
No test exposures are required if the film manufacturer indicates the extension of the exposure time, e.g. +2 values for an exposure time of 10s. "+2 values"
means that the exposure time must be quadrupled, i.e. 40 s.

- First, set your microscope so that the automatic system indicates 10 s with RECI set to 0 (in this exceptional case, you may use the aperture diaphragm to reduce the brightness).
- Now change the RECI value and you will quickly find the one which most closely approximates 40 s. This will then be the value for your film (8 in the above example).

If no data have been indicated by the manufacturer, test exposures in the range of the required exposure time must be made using the RECI values 0 ... 9.

### Fluorescence photography

The following specialties apply compared to photomicrography:

- The often low brightness requires long exposure times. Before taking the exposure, therefore select the option **100% of light to film** under **Set Exposure Function**. Reduce the brightness of the luminous frame in a useful way.
  At lowest brightness, set the beam splitting to 100% of light for observation and again select the function **100% of light to film** before taking the exposure.
- Fluorescence light is neither daylight nor artificial light, but is generated in the specimen itself. Normally, better results are obtained in fluorescence microscopy when daylight films are used.
- Don't be afraid of using high-speed films. The graininess of such films rarely impairs the quality of fluorescence images.
- The dark or black background will often cover a large part of the measuring field of the automatic exposure metering system (also with spot metering). Especially in the spot area, the brightness/darkness ratio can be easily estimated and corrected via exposure correction.
  If a typical measuring area of a specimen shall not remain in the image center during the exposure, you can store the appropriate exposure time, move the required specimen section into the center and then release the exposure.
- The exposure margin is considerably large due to the high "contrast" because luminous structures in front of a dark background always stand out clearly even in different illumination.
  However, if an exact color rendition of the fluorescence dyes is important to you, an exposure series with different exposure times is recommended.
- Some fluorescence dyes bleach out quickly, especially under pronounced, high-energy excitation radiation. To protect the specimen, you can reduce – at least temporarily – the excitation intensity via the aperture diaphragm.

**Note:** Always remember that weak fluorescence is more visible in a dark workroom.

### Exposure times and filters

The Axiophot 2 photo module covers the following longest exposure times for 35 mm film with exposure correction 0:

| Sensitivity of the film | Longest exposure time |
|---|---|
| 100 ISO | 960 s |
| 400 ISO | 240 s |
| 1600 ISO | 60 s |
| 6400 ISO | 15 s |

| Filters for photomicrography | Ø 32 mm | Ø 18 mm |
|---|---|---|
| gray filter 0.50 (50 % transmission) | 467840-0000-000 | |
| gray filter 0.12 (12 % transmission) | 467841-0000-000 | |
| gray filter 0.03 (3 % transmission) | 467842-0000-000 | |
| neutral-density filter 0.25 (25 % transmission) | | 467856-0000-000 |
| neutral-density filter 0.06 (6 % transmission) | | 467855-0000-000 |
| conversion filter 3200-5500 K | 467847-0000-000 | 467854-0000-000 |
| blue filter CB 6 | 467851-0000-000 | |
| blue filter CB 3 | 467852-0000-000 | |
| interference-green filter | 467803-0000-000 | |

# Care, Maintenance

## General

The instrument back may be removed only by service personnel.

Please ensure that your instrument is not exposed to inadmissible climatic influences (humidity and temperature) for longer periods of time.

Always protect the instrument against dust and humidity. Therefore, always drape the dust cover over the instrument after use. Do not forget to switch off the lamps first.

Remove dust on optical surfaces using a natural hair brush and a squeeze-blower device.

To remove stubborn dirt or fingerprints, use commercially available cloths for cleaning optics and eyeglass lenses.

For moving your Axioplan 2 imaging to another location on your premises, ensure that all mobile parts are secured in position or transport them separately. Also protect your instrument against toppling, cover it and ensure under all circumstances that it is not subjected to knocks or mechanical shock. If you are in doubt, please contact our customer service staff.

## Lamp change

Prior to every lamp change, ensure that you read the special instructions and safety regulations of the lamp manufacturer.

Allow the lamp to cool down appropriately before you change it.

Even at room temperature, lamps filled with xenon gas are subjected to considerable internal pressure. Therefore, always wear gloves and face protection for you personal safety.

Never touch the glass of the lamps with your bare hand. Even the slightest trace of grease may impair the intensity and service life of the lamp.

Ensure that the used lamps are disposed of in a proper way.

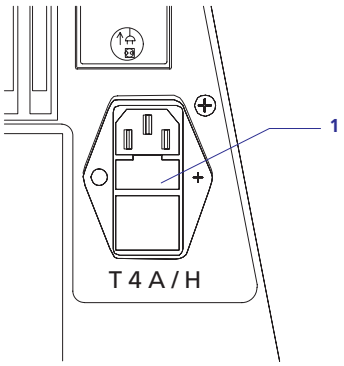
For further information, please see the information leaflet enclosed with the mercury short-arc lamp, e.g. the HBO 103.

## Line supply

Your Axioplan has been designed for use with a line voltage ranging from 100 ... 240 V / 50 ... 60 Hz.

## Changing the fuses

The compartment (**2**) for mounting the instrument fuses is also located on the rear of your microscope.
It contains two T4 AH fuses for 250 V.




**1** Fuse compartment

**Fig. 57** **Rear of stand - Fuse compartment**

- Pull out the fuse compartment in a forward direction (using a small screwdriver, if required), remove the defective fuse and insert a new one.
- Press the fuse compartment back into the rear panel of the instrument.

# Technical Data

| Range | Description |
|---|---|
| **Ambient conditions** | |
| Room temperature | + 10 ... + 35 °C |
| Humidity | max. 75 % at + 35 °C |
| Storage temperaure | – 40 ... + 70 °C, humidity 10 ... 30 % |
| Weight | depending on configuration used |
| **Safety** | |
| Equipment class | I |
| Degree of protection | IP 20 |
| Radio disturbance characteristics | conforming to EN 55011 (Class B) |
| Electromagnetic immunity | conforming to EN 50082-2<br>The instrument meets the requirements of the EC directive 89/336/EEC and EMC legislation of 09. Nov. 1992 |
| Degree of contamination | 2 (altitude 2000 m) |
| Overvoltage category | II |
| **Electrical supply** | |
| Power connection | 100 ... 240 V ± 10 %; 50 ... 60 Hz<br>no conversion required. |
| Power consumption | approx. 225 VA |
| Data for connection of Axiophot 2 | |
| Line supply | + 5 V, + 15 V |
| **Data for connection of 12V/100W microscope lamp** | |
| DC voltage, stabilized | 3 ... 12 V; suitable for photometry (continuous light) |
| **12 V/100 W halogen lamp** | |
| Lamp voltage | 12 V |
| Power | 100 W |
| Color temperature at 10.5 V | 3200 K |
| Luminous flux | 3100 lm |
| Mean service life | 50 h |
| Luminous surface | 3.1 x 3.1 $mm^2$ |
| **Fuses** | |
| Power inlet | F1/F2: 115 V / 230 V: T 4 AH / 250 V according to IEC 127 |

# Interface Description

**WARNING!**

**Destruction of the electronic system**
Wrong interface configurations can destroy the electronic system. This interface description is therefore meant for personnel trained in the used of hardware and software only.

## General

Every microscope unit, described as a CAN-node in the following, has its own address which may occur only once within the network.
(range A ... Z, switch position 1 ... x).
This address enable individual activation of every CAN-node via the
RS 232 C interface.
During communication, the target address must be sent first, then the source address and then the actual command.
A uniform BIOS (Basic Input Output System) containing the communication via RS 232 C and CAN is used for all CAN-nodes on the basis of 80C517A uP.
Furthermore, the BIOS also contains a Download Routine, which allows the firmware of a CAN-node, if EEPROM is present, to be changed during operation.
Further commands are available for test purposes, e.g. to test memory and ports.

## CAN-BUS

The CAN-bus (Controller Area Network Serial Communication Bus) has been developed in the automotive industry especially for high data security and fast reaction times. It allows the use of approx. 26 instrument units (CAN-nodes) in a network.

### Technical Data

– transfer rate max. 1000 k Baud (100x faster than RS 232 C with 9600 Baud)
– single-wire transfer (can also be used for light guide transfer)
– automatic error recognition and transfer repetition
– multimaster
– real time
– approx. 40 m cable possible with 1000 k Baud and approx. 600 m cable with 100 k Baud

## Communication via RS 232 C

### Protocol

The communication between the CAN network and the PC (host computer) is performed via RS 232 C. The PC can be connected to any required CAN-node.
(for test purposes, it is also permitted to connect several PCs to the CAN network).

Prior to transmission of each individual character, each communication partner must check whether the other partner is ready for reception. The RTS and CTS handshake lines are used for this.
Normally, the interrupt-controlled reception routine of a CAN-node is always active. If functions are performed where time is a critical factor, or if the input buffer is full, the handshake is switched to "not ready for reception".
At 9600 Baud, overfilling of the input buffer is not possible in practice, since the interpreter normally deals with the data faster than it can be supplied by the RS 232 C interface.

### Data of the RS 232 C interface

9600 Baud, 8 data bits, 1 stop bit, no parity.

The pin assignment of the RS 232 C interface is identical to that of the PC (see —> Fig. 58).
The lines in the cable connecting the PC and the Axioplan 2 imaging have been crossed.

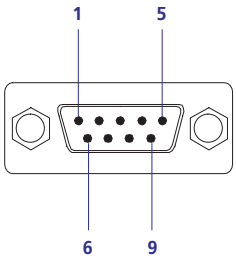



**Fig. 58** **Pin assignment of RS 232 C interface (view on connector front)**

**Note:** Do not use a commercial RS 232 cable to connect to the RS 232 C interface.

## Communication via CAN

### Protocol

Communication between the connected CAN-nodes is performed via Can-bus. In every CAN-node, incoming data is stored in the reception buffer via an interrupt routine. Transmission is made without interrupt in the base loop with the lowest priority. If transmission cannot be made via the CAN-bus, the trial is interrupted after a time-out of approx. 1 sec and the error byte is set.
The interrupt-controlled reception routine of a CAN-node is always active and cannot be switched off on the CAN-bus.
Data of the CAN interface: 100 000 Baud. (CAN controller parameters: 4, 1C, AB)

### Statuses

In the basic status, a CAN-node waits for commands from the host/control panel and simultaneously performs incremental part functions of so-called continuous functions.
Continuous functions are functions which require the CPU CAN-nodes to be permanently active or which need some time and are therefore processed incrementally so that control can be forwarded to the command interpreter in the meantime (example: flashing of green LED).
If a complete command has been received (via CR), it will be passed on to the command interpreter and the system adopts the status Function Performance.
The functions activated by the command interpreter can take data from the input buffer, (substatuses data reception, data transmission). The stand control returns to the basic condition from all statuses by activation of Time Out – if need be.

### Command structure (input format)

A command consists of a sequence of ASCII-characters, which is finished with Hex 0D (CARRIAGE RETURN). Only printable ASCII-characters, and no binary-coded data (except the carriage return as an end character), are permitted.

A command consists of a name and parameters. A name always consists of two letters.
The first letter (always a capital letter), normally designates the function group,
the second letter (capital = WRITE, small = READ), the actual function.

All parameters are numeric (Integer, 8 bit) and strings are permitted. String parameters are always last and are delimited by quotation marks (”). Numbers are transmitted in different fixed formats.

When a command line is executed, the syntax is checked. If a syntax error occurs, all characters up to the next CARRIAGE RETURN are bypassed.

### Output format

Each numeric or non-numeric output is made in the ASCII-format. Strings are transmitted without any special delimiters (quotation marks).

The target address and source address is given before every number or every string, and the CARRIAGE RETURN character (Hex 0D) is then entered as the end character. It is therefore possible at all times to see which CAN-node the message is coming from.

| Formats | | |
|---|---|---|
| 0 ... 255 | 0 ... 255 | preceding zeros can be deleted |
| 0 ... 255 | 00 ... FF | 2 characters must always be transmitted (TB) |
| 0 ... 65535 | 0000 ... FFFF | 4 characters must always be transmitted (TD2) |
| 0... ± 8388607 | 000000 ... FFFFFF | 6 characters must always be transmitted |
| ”Str1” | | string format, max. 4 characters between 2 quotation marks |

**Important:**
A message may contain max. 8 byte of information, plus 2 byte of addresses and 1 byte with the end character (CR). This means that a message is 11 byte long.

### SYNC IN/OUT socket

Input and output can be assigned with TTL signals.

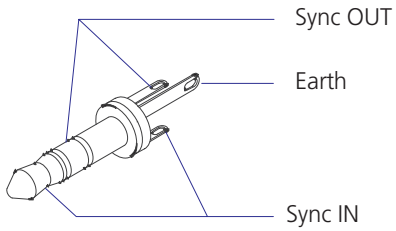



**Fig. 59** **Pin assignment of 3.5 mm stereo jack plug for connecting to SYNC IN/OUT socket**

## General functions

Error statuses in a CAN-node can have different causes:
Communication errors occur if transmission on the RS 232 C lines is disturbed or if data is continued to be sent in spite of the CAN-node not being ready for reception (displayed by handshake).
Time-out errors occur if a CAN-node function wants to transmit data which is not accepted by the recipient or if a function waits for receiver data which have not been transmitted.
Syntax errors occur if, for example, an incorrect command name is transmitted (fail character, name too long or too short, command not existing), or if a command is transmitted with the wrong number of parameters or wrong parameter types.
Errors in function execution occur if transferred function parameters or combinations of parameter values result in fail values.
Hardware errors occur if there is a defect in the hardware (blocked motors, defective components, etc.).
Where errors can cause damage to the instrument, measures are taken immediately by the CAN-node (if possible) to avoid this. (For example, the motor current is switched off in the case of blocked motors.)
Otherwise, it is the job of the activating program to inquire the error status and to provide suitable remedy.
Errors are displayed as follows:

- ❑ an error byte which can be read using the Eb command;
- ❑ a red LED which is normally off, but permanently switched on in the event of an error until reset of the error status by reading the error byte.

The following error bits occur in the error byte:

- ❑ 0. – Overrun Error (Input-Buffer Overflow)
- ❑ 1. – Transmit Error (Output-Buffer Overflow)
- ❑ 2. – Timeout on send (function waits in vain for host to be ready to receive data)
- ❑ 3. – Timeout on read (function waits in vain for data from host)
- ❑ 4. – Reserved
- ❑ 5. – Syntax error (detected by the command interpreter. Can also be caused by a transmittance error.)
- ❑ 6. – Reserved (not yet assigned)
- ❑ 7. – Error during execution of function (cause: wrong parameter value or hardware error)

## Test functions

To test hardware, functions are available which permit data to be written byte-by-byte on any position in the memory address range (TB) or to be read from any position (Tb).
Furthermore, (Trn) and (Tpn) permit the A/D converter and ports of the uP 517A micro controller (517 or 509) to be read, and (TPn) enables the ports to be written.
The use of commands permitting a change of the memory range require detailed knowledge of the hardware because wrong application may result in a system crash.
A green LED, flashing in 0.5 s (2 Hz) intervals indicates that the processor does not yet run properly, even when the red error LED is switched on.

## Start sequence

Every CAN-node runs through the following sequences during startup:

- ❑ Initialization of the processor and the hardware and checking the EEPROM application, approx. 1 s.
- ❑ Waiting time of 1 s, until all CAN-nodes are initialized.
- ❑ Checking whether further CAN-nodes are connected to the network (the CAN-bus status is set accordingly).
- ❑ Waiting time of 1 s, until all CAN-nodes have sent queries to each other.
- ❑ Starting of application program.

During this start sequence, the red LED is on continuously, the green LED blinks in 0.5 s intervals.

**Note:** For further information, please order the detailed programming instructions from our service department.

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# Appendix

## Brief operating manual for LightManager

### Selection of LightManager modes

Mode 1 : LightManager permanently deactivated

Mode 2 : LightManager
(1 contrast process for each objective)

Mode 3 : LightManager with SmartContrast
(up to 4 contrast processes for each objective + 1 contrast process for each reflector turret position.)

Mode 4 : LightManager "Material"
(incident-light illumination for each objective)

- Press SET key until a double beep is heard.
- Press F2 key 1x:
  Current mode is displayed in LED line (illumination).
- Press F2 key 2x: Change mode.
- Store by pressing SET key (short beep).

### Programming LightManager (mode 2, 3, 4)

1. Store the contrast settings for an objective:

- FL off, HAL on (only mode 2 and 3).
- Lamp voltage / 3200K.
- Transmitted-light filter wheels, luminous-field diaphragm (only mode 2 and 3).
- Condenser turret, aperture diaphragm, front lens (only mode 2 and 3).
- **Press SET key.**

2. Resetting an objective

- HAL off.
- **Keep 3200K key pressed and briefly press SET key.**

### Programming SmartContrast (mode 3)

1. Programming LightManager mode 3 (see above)

- FL off, HAL on.

2. Saving illumination version and contrast process of a certain reflector position

- **Keep F1 key pressed and briefly press SET key.**

3. Resetting an objective

- HAL off.
- **Keep 3200K and FL key pressed and briefly press SET key.**

# Appendix

## Setting of parfocality and focusing speed

### Procedure for setting all objectives

1. Set strongest dry objective (reference objective).
2. Focusing.
3. Press SET key until a double beep is heard, this activates the SET mode (recognizable by continual flashing of LEARN LED (orange)).
4. Setting of focusing speed using the two left keys of rapid stage lowering (top course, bottom fine).
5. Set focus exactly.
6. Save current valid values (focus / focusing speed) by changing objective.
7. All dry objectives: proceed as under points 4. – 6. Program immersion objectives last.
8. Note: To store the setting of the last objective, a further change of objective must take place.
9. After programming all required objectives:
   Exit Set mode by briefly pressing SET key ; Confirmation: short beep sound.

Returning to normal mode (green).

### Procedure with a new objective

1. Swing in strongest dry objective (reference objective) and focus.
2. Keep SET key pressed until double beep sound to enter Set mode.
3. Move in new objective (without changing focus).
4. Set focus and focusing speed (see above).
5. Perform change of objective.
6. Exit the Set mode.

**Note:** Storing of values in permanent memory is only performed during point 9. If instrument is switched off in Set mode, the originally stored values remain valid.
If microscope is connected to a PC, the individual values for each user can be stored in a file and be re-loaded as required with the aid of the configuration program AxioSet.

# Appendix

## Acoustic signals of Axioplan 2 imaging MOT

An acoustic signal occurs with the following functions:

| Action | Function | Signal |
|---|---|---|
| Switch on stand | | Short beep on completion of internal initialization |
| Briefly pressing SET key (< 3 s) (normal mode) | Storing of current LightManager settings | Short beep on releasing the SET key |
| Keeping 3200K pressed and briefly pressing SET key (< 3 s) (normal mode) | Erasing LightManager values of an objective | Short beep on releasing the SET key |
| Keeping 3200K and F1 pressed and briefly pressing SET key (< 3 s) (normal mode) | Erasing LightManager values of complete reflector turret | Short beep on releasing the SET key |
| Keeping SET pressed (> 3 s) (normal mode) | Activation of learn mode | Double, long beep sound |
| Briefly pressing SET key (< 3 s) (learn mode) | Exiting learn mode | Short beep on releasing the SET key |
| Briefly pressing Work key in work position (normal mode) | Actualizing work position | Short beep |
| Prolonged pressing Work key in work position (normal mode) | Setting the focus software limits. | Short beep on releasing the Work key |
| Keeping Work key pressed and focusing (normal mode) | Moving focus software limits | Short beep on releasing the Work key |
| Manual moving into work position using the Work key (normal mode) | | Short beep on reaching work position |
| Focusing over the focus limits (normal mode) | Focus limits (top and bottom, software or limit switch) | Alternating beep sound |
| Focusing in the load position (normal mode) | Current position becomes work position | Long beep when actuating focus buttons |
| Actuation of focus buttons while in "Work/Load" travel (normal mode) | Interrupting "Work/Load" travel | Long beep sound when actuating focus buttons |
| Obstacle during "Work/Load" travel (normal mode) | Safety shutdown | Warning sound 3x short, 1x long |