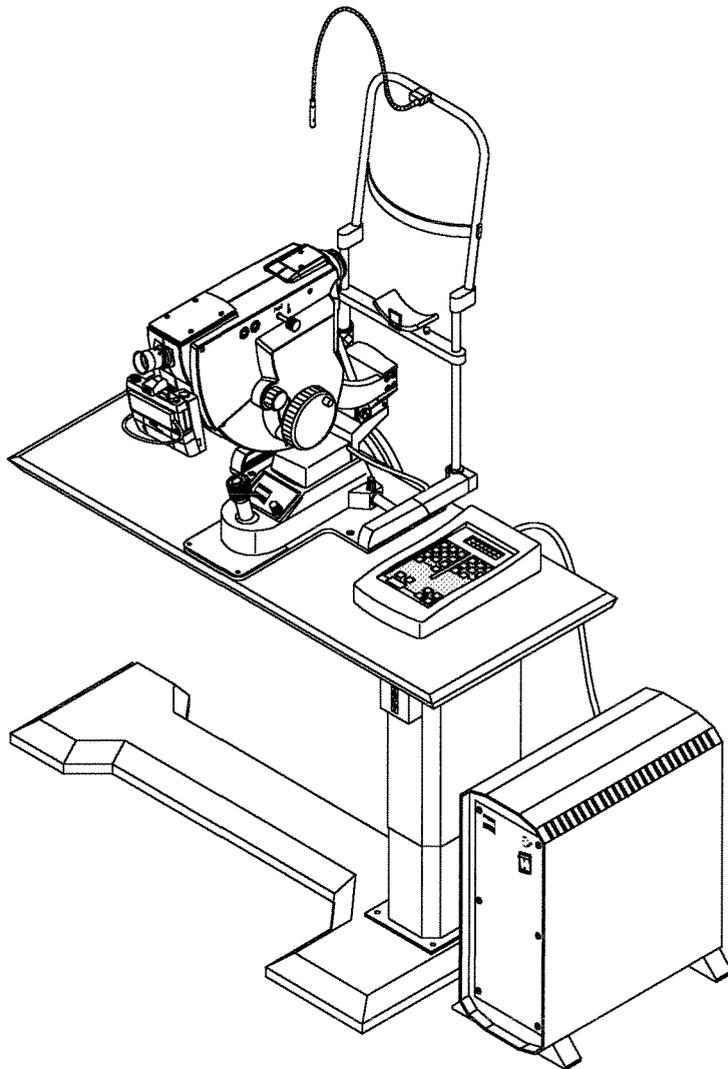


FF 450/FF 450 IR

Fundus Camera



User's Manual





	Page
Notes on safety	3
Labelling	3
Instrument safety	3
Notes on installation and usage	4
Intended use	4
Instrument description	5
Construction of basic unit	5
Controls of fundus camera	6
IT 350 Instrument Table	10
Notes on the use of the IT 350	11
Standard photographic equipment	11
BL 450 Flash Unit	12
Control console	13
Display unit	14
Key groups	14
Installation	16
Removing transport locks	16
Setting up the fundus camera	17
Mounting the fixation light	18
Making electric connections	19
Mounting the 35 mm camera	21
Options	22
Photographic equipment for top camera port	22
Mounting the 35 mm camera to Port 2	22
FF 450 video adapter	23
Mounting a video camera to Port 2	23
Internal fixation device	24
Astigmatism compensator	24
Demonstration eye with holder	25
1.75x converter lens	25
Supplementary lamp	25

	Page
Operation	26
Checking the voltage setting	26
General notes on handling	27
Preparing the eyepiece	27
Preparing the BL 450 Flash Unit	27
Preparing the fundus camera	28
Adjustment to the patient	28
Operating modes	30
Fluorescein angiography (FLUO)	30
Red-free photographs	30
Colour photographs (COLOR)	31
Fluorescein angiography	31
Contraindications	31
Injection	31
Procedure for a series of fluorescein angiograms	32
Incidents after fluorescein injections	33
Documentation	34
Flow diagram of photographic documentation	34
Program flow in FLUO mode with 35 mm camera	35
Program flow for red-free photographs	36
Program flow in COLOR mode	37
Program flow in ICG mode	38
Care and maintenance	39
Replacing lamps	39
Replacing the halogen lamp	39
Replacing the flashbulb	40
Replacing the filament lamp of the fixation light	40
Replacing fuses	41
Trouble shooting table	42
Notes on instrument care	44
 Specifications	 45
 Declaration of EC Conformity	 46
 Important for safety:	
Notes on safety	3
Care and maintenance	39
Trouble shooting table	42

Warning: Risk of injuries!
Strictly observe warning labels!



- Do not look into the light source, for instance into the objective!
- When replacing the halogen lamp, ensure the power cable is disconnected. Only replace halogen lamps only with original types with holder. Lamps are to be replaced by trained staff only.
- The flashbulb may only be replaced by service staff.

Instrument safety



- Proper operation of the instrument is imperative for its safe function. Therefore, read this manual thoroughly before using the instrument. If you need supplementary information, please contact our service or authorised agents.
- Make sure the set operating voltage corresponds with local mains.
- Do not cover ventilation slots.
- Never leave the instrument switched on and unattended.
- Disconnect the power cord by grasping its plug. Never pull at the cord.
- Operate the power switch to turn off the instrument.
- Make sure the instrument is turned off when it is not in use.
- The power cord must be connected to a socket with an earthing contact. Avoid the use of an extension cable. Do not interrupt the earthing contact either inside or outside the instrument, as this may endanger operator, patient and instrument. If the protection is reduced or any cables are damaged, discontinue using the instrument. Take care that it cannot be used by others, and contact service department.
- The instrument may only be opened by service staff employed with or authorised by Zeiss.
(Exception: Replacement of halogen lamp)
- Clean optical components only externally following the instructions given in this manual.

Notes on safety

Notes on installation and usage

- Do not use the instrument in hazardous environments. Do not operate it in the presence of flammable anaesthetics and volatile solvents such as alcohol, benzene or similar agents.
- Do not set up the instrument in humid rooms. Avoid dripping or splashing water near the instrument.
- Only use accessories described in this manual. If you intend to use other accessories, consult Zeiss service or sales department prior to use.



Caution:

This instrument is a high-quality technical product. To ensure perfect and reliable operation, have it checked at least every 12 months by authorised service technicians.

Intended use

The FF 450 Fundus Camera is a monocular retina camera designed for routine use. It is suitable for clinical diagnosis. The fundus camera also provides documentation of findings by using the appropriate options (photographic equipment, electronic image sensors with digital basic station).

- The instrument may not be modified and repaired except by Zeiss service staff or other authorised persons. The user is responsible for any consequences resulting from using the instrument for applications other than those described in this manual.
- Read and observe the highlighted safety instructions and notes with particular attention and care.
- The instrument may only be operated by trained or instructed staff.
- The FF 450 Fundus Camera was designed in compliance with the Standard DIN VDE 0750 Part 1 and IEC 601-1. Manufacture, testing, installation, maintenance and repair are subject to relevant German and international regulations.
- According to the German Ordinance on Medical Instruments the FF 450 Fundus Camera is a Group 3 instrument.
- When using the instrument, observe the respective national regulations on the prevention of accidents.

Construction of basic unit

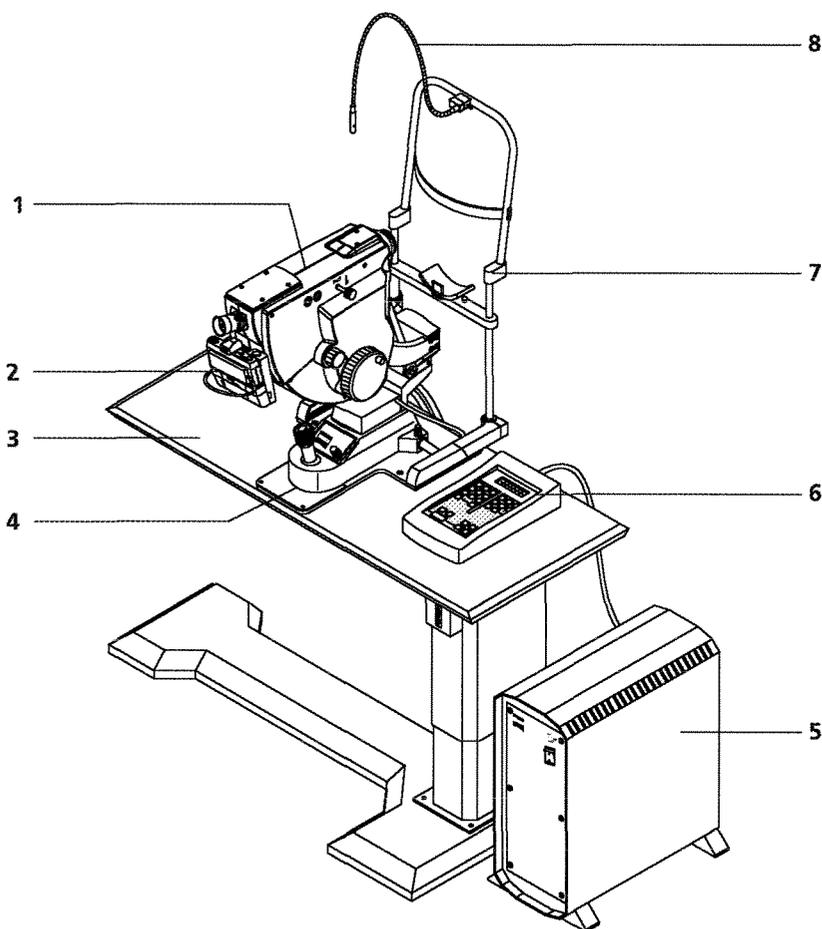


Fig. 1 Construction of basic unit

The main subassemblies of the FF 450 with photographic equipment include:

- 1 **Fundus camera** including illuminating and viewing system with filters as well as ports for documentation systems.
- 2 **Photographic equipment** including NIKON F3-HP camera and data back.
- 3 **IT 350 Instrument Table** with motorised table height adjustment.
- 4 **Instrument base** with 3D joystick for positioning the fundus camera, brightness control for halogen lamp, and head rest.
- 5 **BL 450 Flash Unit** comprising connectors for powering fundus camera, fixation light, supplementary lamp, control console, and instrument table.
- 6 **Control console** comprising display and keyboard.
- 7 **Head rest** comprising vertically adjustable chin rest, forehead rest strap, and mounting holes for fixation light.
- 8 **Fixation light**, swan's neck design, freely movable.

Controls of fundus camera

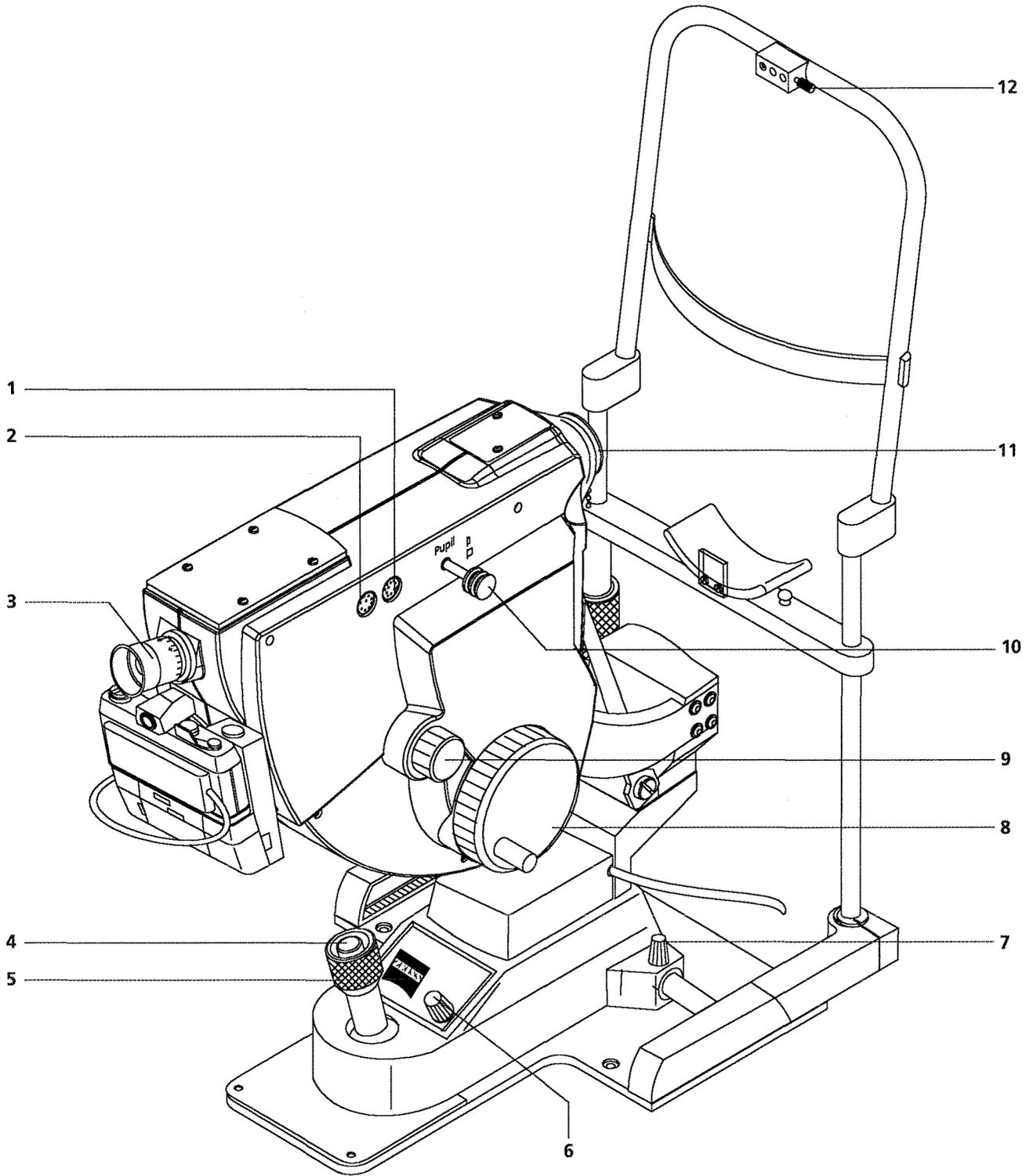


Fig. 2 Controls of fundus camera

In the view from the right (Fig. 2) , the following controls of the FF 450 are illustrated:

- 1 **Connector** for data back of a camera mounted to Port 2.
- 2 **Connector** for camera control of a camera mounted to Port 2.
- 3 **Eyepiece**
- 4 **Release button**
- 5 **Joystick** for horizontal (X–Y) and vertical (Z, by rotation) adjustment of the instrument base.
For coarse horizontal adjustment, hold on to the joystick and push the instrument base into the desired direction.
- 6 **Control** for adjusting halogen lamp brightness.
- 7 **Knurled knob** for locking the instrument base.
- 8 **Hand wheel** for tilting the fundus camera.
- 9 **Knurled knob** for internal focusing covering a diopter range of ± 30 dpt.
- 10 **Slide** for pupil reduction. The pupil of the optical system can be reduced when focusing the fundus. The thus extended depth of field at the same time provides improved reflex-free adjustment.
- 11 **Protective cap** for protecting the objective from dirt and damage when the instrument is not in use. The protective cap is firmly connected to the fundus camera through a bead chain. It should be replaced after use.
- 12 **Clamp screw** to lock the fixation light in its mount.

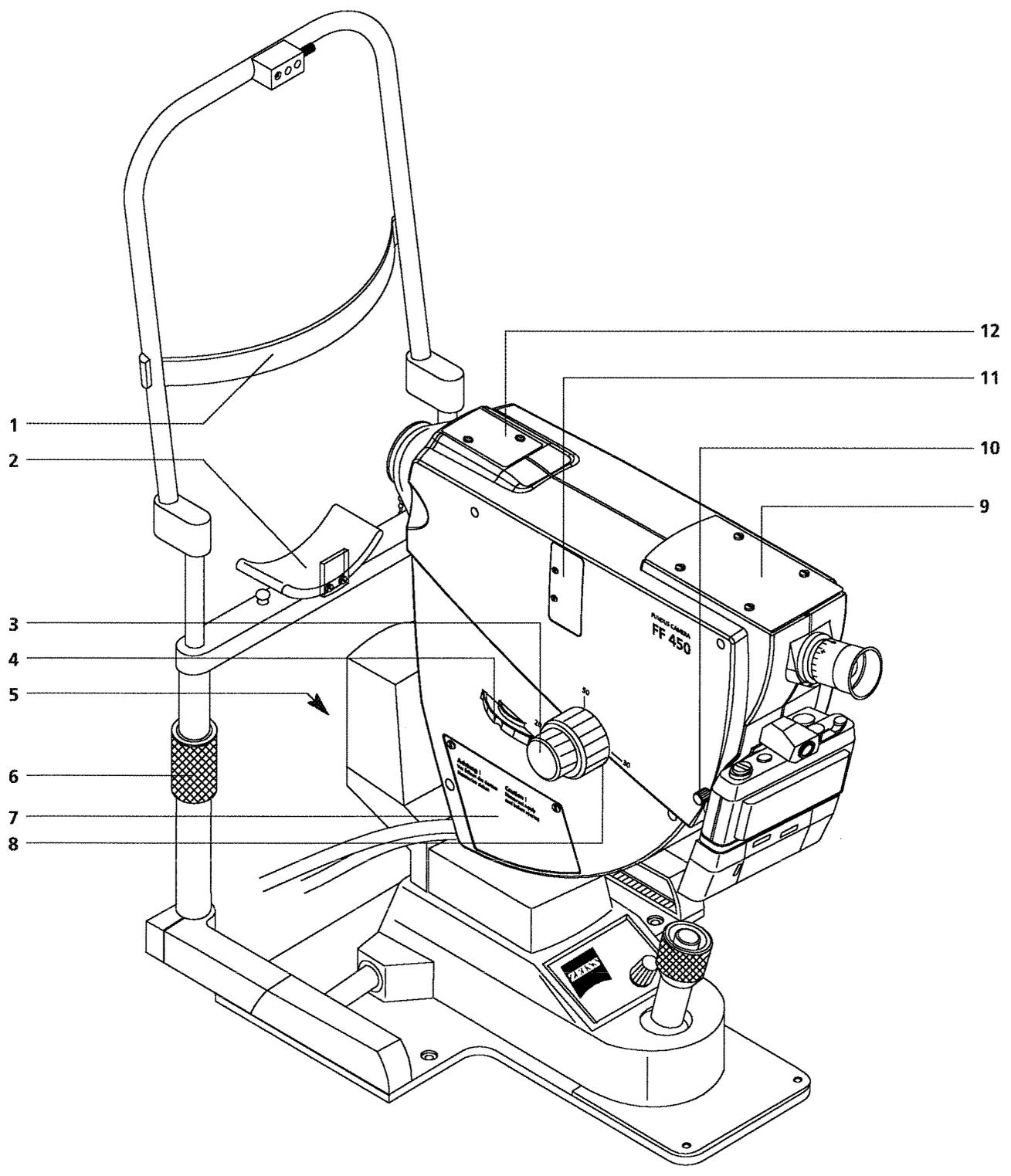


Fig. 3 Controls of fundus camera

In the view from the left (Fig. 3), the following controls of the FF 450 are illustrated:

- 1 **Forehead rest strap**
- 2 **Chin rest**, vertically adjustable for reliable fixation of the patient's head.
- 3 **Internal focusing control.**
- 4 **Filter wheel** with three positions:
 - C for colour photographs
 - RF for red-free photographs
 - A for fluorescein and ICG angiograms (ICG only with FF 450 IR)
- 5 **Clamp screw** for swivelling the fundus camera about its vertical axis.
- 6 **Knurled sleeve** for vertical adjustment of chin rest
- 7 **Cover** of lamp unit
- 8 **Field angle selector** with three settings: 50° 30° and 20° corresponding to viewing magnifications of 11x, 19x, and 29x.
- 9 **Cover** for camera port 2.
- 10 **Lock screw** to clamp 35 mm camera to the dovetail mount of the fundus camera.
- 11 **Cover** for astigmatism compensator mount
- 12 **Cover** for internal fixation device mount

IT 350 Instrument Table

The IT 350 is a motorised instrument table specially designed for ophthalmic instruments.

An electric motor drive allows optimum adjustment to the height necessary for patient comfort.

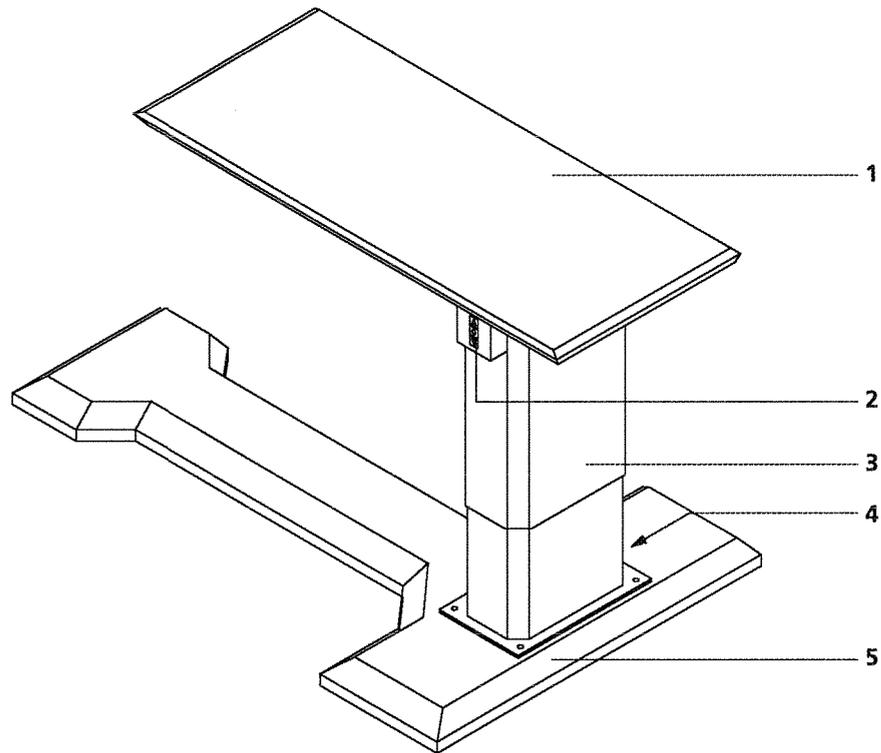


Fig. 4 IT 350 Instrument Table

Fig. 4 illustrates the following main components of the IT 350:

- 1 **Tabletop** supporting instrument base and control console.
- 2 **Rocker switch** for vertical adjustment of table.
- 3 **Lifting column**, containing electric motor drive for vertical adjustment of table.
- 4 **Power connection** with female connector and fuse compartment.
- 5 **Table base** with 4 adjusting screws for tabletop levelling.

Notes on the use of the IT 350 Instrument Table

For detailed notes on the operation of the IT 350, see the separate manual of the IT 350. The features below should be observed for safe operation.

Caution: Thermal overload!

The motor of the lifting column is not designed for continuous duty. Only move the table up or down when it is necessary.

A continuous duty time of > 2.5 min may result in overheating of the motor. In this case, a thermal circuit breaker will automatically switch off the motor. Only after an appropriate cooling time, the motor and thus the lifting column will operate again.



Standard photographic equipment

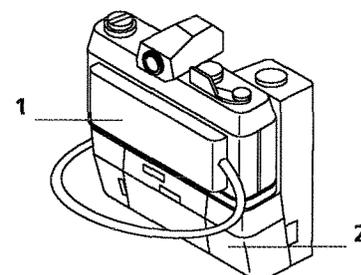
The photographic equipment of the FF 450 comprises the NIKON F3-HP 35 mm camera (incl. winder, **2**) and data back (**1**).

The camera is mounted to the bottom camera port (Port 1) as shown in Fig. 18. The operations required for mounting the photographic equipment are described in section **Mounting the 35 mm camera**.

The data back serves for exposing data (Patient ID, frame no., and date, onto the film).

Optionally it is possible to mount a second camera of the same type to the top camera port (Port 2), for instance for taking colour photographs.

For details of the use of the NIKON F3-HP camera, such as inserting film, see the provided separate operating instructions of the camera.



- 1 Data back
- 2 Winder

Fig. 5 35 mm camera

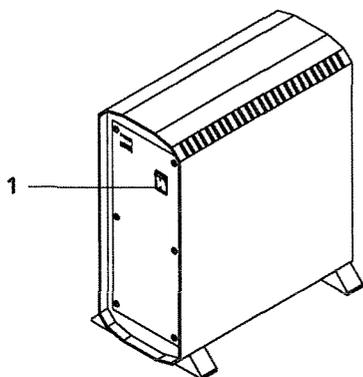
BL 450 Flash Unit

The BL 450 Flash Unit contains all electric supplies for the FF 450 Fundus Camera, IT 350 Instrument Table, control console, fixation lamp and the optional supplementary lamp.

The connectors are located on the rear panel of the unit.

Power switch (1) is the main switch of the fundus camera. Operation of this switch connects all supply units or disconnects them from the mains supply.

The power switch is the only control on the flash unit required for operation of the fundus camera.



1 Power switch

Fig. 6 BL 450, front view

Control console

Photographic recording cycles are controlled and menu-guided through the keyboard of the control console. The keyboard is subdivided into 5 groups of keys. They serve for program menu execution according to the selected operating mode. The current program item and the corresponding parameters are displayed on the alphanumeric display.

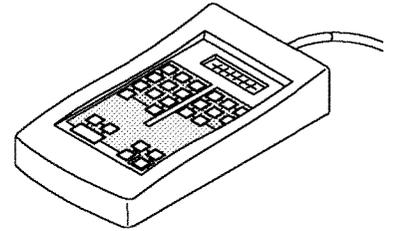
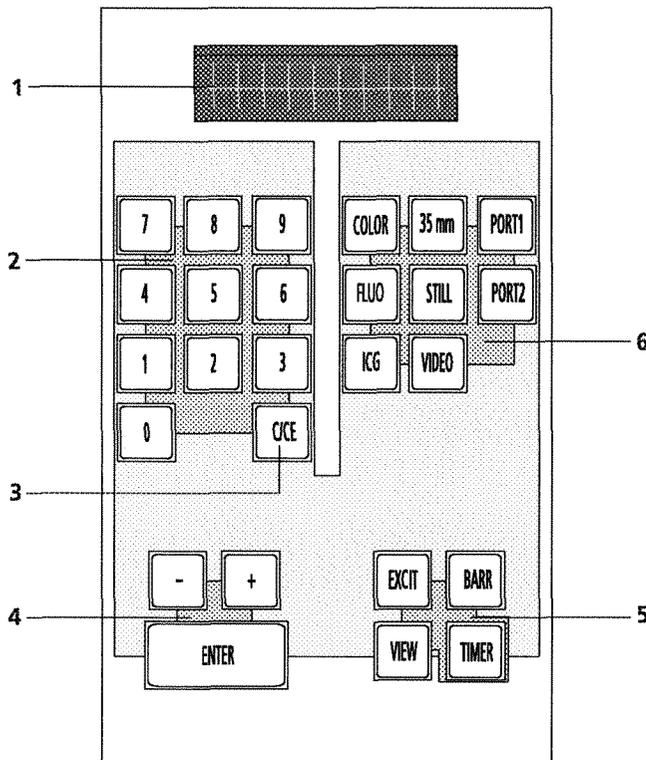


Fig. 7 Control console



- 1 Display
- 2 Numerical keys
- 3 Reset key
- 4 Keys for continuous variation of parameters, ENTER key
- 5 Group of keys for auxiliary functions before image recording
- 6 Keys for recording mode selection

Fig. 8 Operating panel of control console

The keys light differently depending on recording mode and operating state:

- Key does not light:
The function assigned to this key is not available.
- Key lights green/yellow:
The function/key can be activated for the selected program.
- Key lights red:
In the selected program, this function is active.

Display unit

The display unit consists of a two-line, luminous vacuum fluorescence display. It allows convenient and reliable reading in almost all conditions. The following information is displayed:

- Next program step to be executed
- Operating mode
- Photographic port (PORT 1, PORT 2)
- Flash energy
- Patient ID no.
- Frame no.
- Current time after timer release

Key groups

Numerical keys

These keys serve for entering numerical data (e.g. Patient ID) in the respective menus.

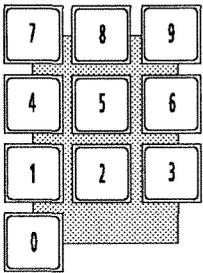


Fig. 9 Numerical keys



Fig. 10 Reset key

Reset key

The Reset key provides the following functions:

- Cancelling a previous numerical entry.
- Aborting the menu at any point of program execution and returning in steps to the initial state.
- By pressing the Reset key once in the Ready state (—>Program flows), the program will return to the menu "Entry of Patient ID" (—> *Section Program flow*).
By pressing the key twice, the program returns to the initial state.

Key group with -, + and ENTER key

Use the - and + keys to change the parameters at predefined intervals and continuously increment or decrement the Patient ID.

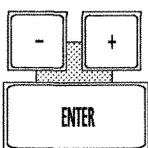


Fig. 11 Key group with -, + and ENTER key

Use the ENTER key to confirm the entered parameters, call the next menu item or, in the Ready state, release single photographs.

Key group for auxiliary functions

In the FLUO mode, these keys are accessible to activate specific auxiliary functions for setting operations or viewing before recording is started.

You can press the **EXCITE** and/or **BARR** keys to swing the exciter filter or the barrier filter into the optical path thus obtaining photo-realistic imaging in visual observation.

Independent of the current state of these keys, the corresponding filters will **always** be swung into the light path when recording images in the FLUO mode (fluorescein angiography) except for red-free records.

The **TIMER** key starts the timer before the actual recording process. If it is not pressed, the timer starts with the first exposure.

With the **VIEW** key you can switch between viewing port (eyepiece) and documentation port 2.

This function is useful, when between single records you want to check the setting of the fundus camera or follow the course of an angiography by video camera.

Recording mode selector keys

Use these keys to select the recording mode and activate the software-controlled program steps.

The recording modes are characterised by three groups of functions that activate corresponding control functions of the fundus camera or standby:

- Use **COLOR**, **FLUO** keys to select the desired operating mode.



Note:

The **ICG** mode is applicable only for FF 450 versions with an image archiving system.

- Use the **35 MM**, **STILL** or **VIDEO** keys to select the recording medium.
 - 35 MM:** 35 mm film acc. to DIN 4335 or ISO 1007-1977
 - STILL:** Still image on CCD camera, fitted at Port 2
 - VIDEO:** Image switched by mirror to PORT 2, illumination by halogen lamp, online observation on video camera.
- Use **PORT 1** (bottom) or **PORT 2** (top) keys to select the port the 35 mm camera(s) or equivalent image sensor(s) are connected to.



Note:

You can switch between Port 1 and Port 2 at every program step and operating mode.

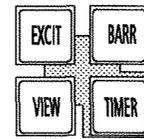


Fig. 12 Key group for auxiliary functions

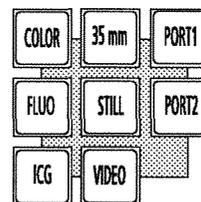


Fig. 13 Recording mode selector keys

**Caution:**

Before installation carefully read and observe the instructions given in the chapter "Instrument safety".

The FF 450 Fundus Camera comes in three shipping containers. They contain the following subassemblies:

- FF 450 Fundus Camera, instrument base and head rest with fixation light in foamed plastic case
- BL 450 Flash Unit in foamed plastic case
- Accessories (e.g. photographic equipment)

Before installation, make sure all components are present. The instrument is to be installed by the user.

Removing transport locks

For transport, the movable parts of the fundus camera are secured by transport locks which should be retained for reuse whenever you want to change the instrument site.

Remove the following items:

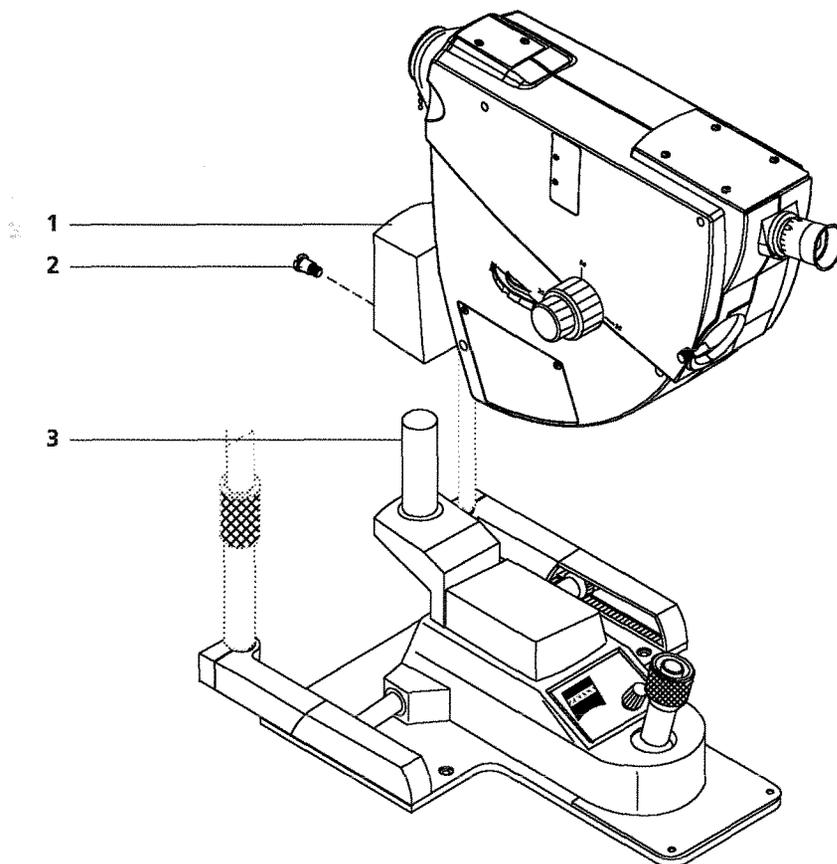
- 2 foamed plastic pads in the guide rails of the instrument base,
- 1 small wooden board arranged underneath the locks for horizontal motion,
- 1 foamed plastic pad under the joystick.

Setting up the fundus camera

- Mount the instrument base onto the instrument table and fasten it to the tabletop.
- Turn clamp screw (7, Fig.2) to lock instrument base.
- Loosen clamp screw (2) on housing (1) of guide sleeve.
- Carefully lower the FF 450 onto the instrument base. Take care that the guide sleeve of the carrier arm smoothly slides onto the mounting pivot (3) and clamp screw (2) fits into the recess of the mounting pivot. This screw limits the swivel range.

Caution:

Hold the fundus camera vertically when mounting to avoid its canting on the pivot.



- 1 Housing of guide sleeve
- 2 Clamp screw
- 3 Mounting pivot

Fig. 14 Mounting the fundus camera to the instrument base

Mounting the fixation light

- Take fixation light (1) out of packing.
- Remove knurled screw (2).
This screw is required for mounting the fixation light to older versions of the head rest.
- Plug fixation lamp onto holder (4) on the head rest bracket.
- Turn knurled screw (5) to lock the fixation light.

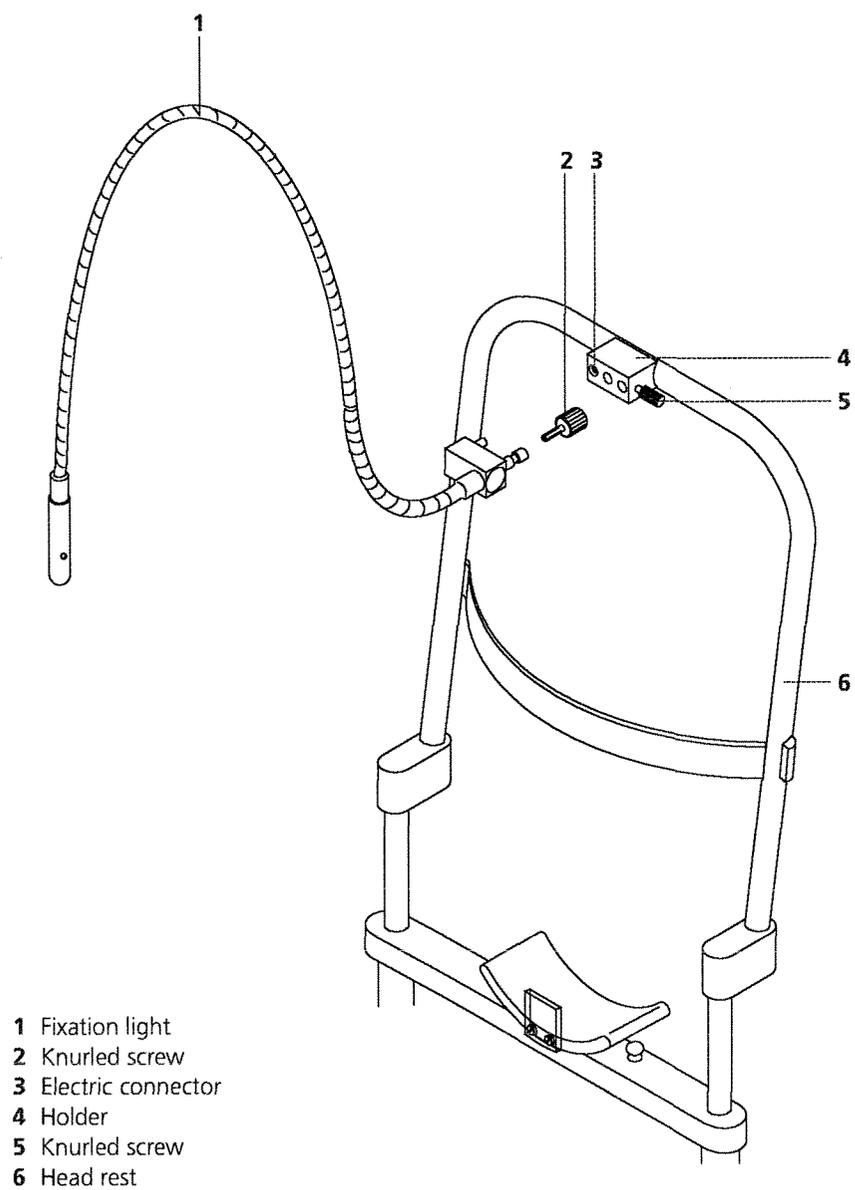


Fig. 15 Mounting the fixation light

Making electric connections

The power switch of the flash unit serves as main switch of the instrument system. All subassemblies of the fundus camera are powered through the flash unit.

Caution:

Before making the electric connections between flash unit, fundus camera and control console, make sure to disconnect the power cord of the flash unit from mains.



- On patient side, lay the cables of fundus camera (flash cable, control cable), as well as those of instrument base (halogen lamp supply) and head rest (fixation light) between the guide rods of the head rest. For the cable of the control console, select the shortest possible way to the flash unit (depending on which side of fundus camera it is set up).
- Connect the cables to the corresponding connectors to establish the connections between instrument and flash unit. The connectors on the flash unit are labelled accordingly (Fig. 16).



Note:

Each connector is different to avoid wrong connections.

Make the following connections to the BL 450 (Fig. 16):

- 1 Cable of fixation light
- 4 Cable of instrument base
- 5 Cable of control console
- 7 FF 450 control cable
- 8 FF 450 flash cable



Note:

Make sure the safety clip is closed properly.

For power supply of the instrument table, a special power cable must be connected between IT 350 and flash unit (15, Fig. 16, Fig. 17).

Fig. 16 illustrates other connectors for accessories.

- Do not to the mains supply until all instrument connections have been made. Connect the power cable (9, Fig. 16) to an earthed mains socket.

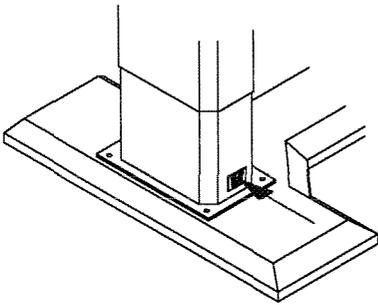
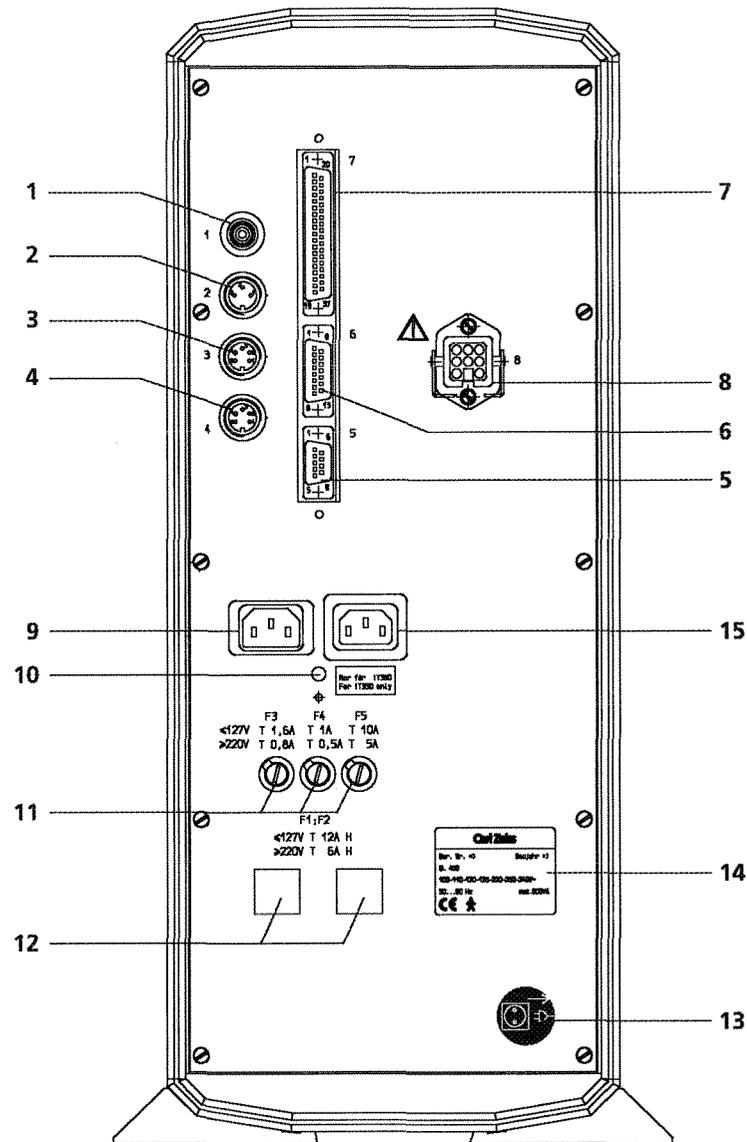


Fig. 17 Mains connector on IT 350



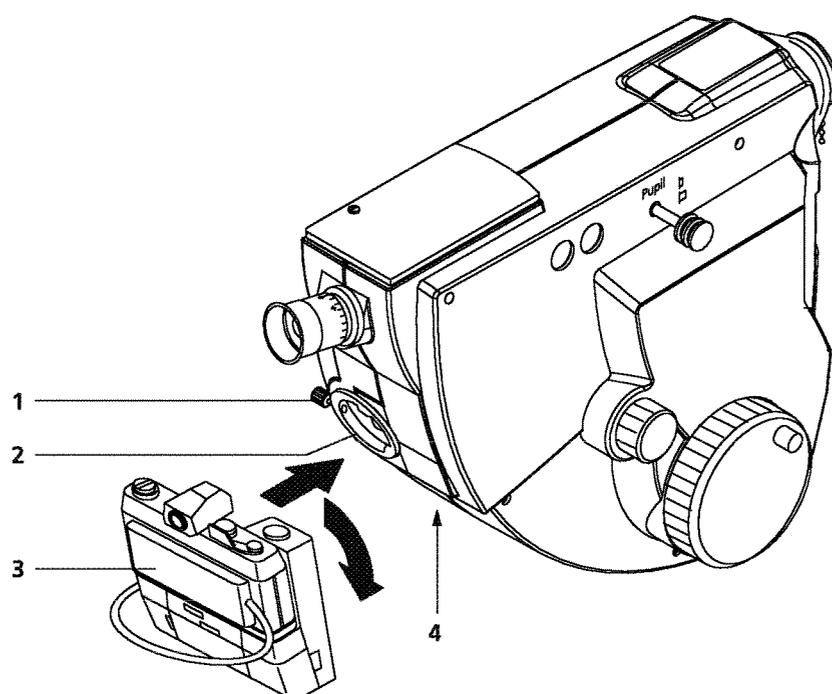
- 1 RCA connector (cinch) for fixation light
- 2 Flange socket, 3-pin, for supplementary lamp
- 3 Flange socket, 5-pin, for foot switch
- 4 Flange socket, 5-pin, for instrument base
- 5 Serial port
- 6 Connector for control console
- 7 Connector for FF 450 control cable
- 8 Connector for FF 450 flash cable
- 9 Instrument connector with line filter for mains connection
- 10 Display window for set line voltage
- 11 Fuse holders
- 12 Thermal circuit breakers
- 13 Warning label "Disconnect power cable before opening"
- 14 Nameplate
- 15 Instrument connector for connection of IT 350 Instrument Table

Fig. 16 Connectors of flash unit

Mounting the 35 mm camera

The NIKON F3-HP camera is supplied unmounted. The dovetail mount for connection to the FF 450 and the data back for exposing defined data are already mounted to the camera.

When handling the 35 mm camera, observe the operating instructions provided with the NIKON F3-HP.



- 1 Clamp screw
- 2 Dovetail mount
- 3 Nikon F3-HP camera
- 4 Connectors for 35 mm camera

Fig. 18 Mounting the 35 mm camera to the bottom port (Port 1)

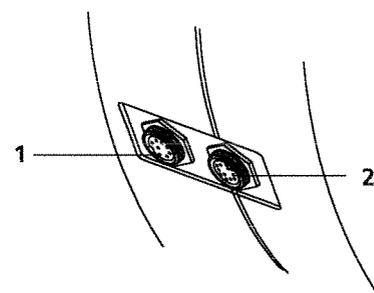
- Adjust the 35 mm camera (3) to 1/15 sec and attach it to dovetail mount (2) of fundus camera and fasten it by clamp screw (1).



Note:

When attaching the camera, turn the camera by about 45°. Otherwise, the slightly projecting winder would hinder connection to the dovetail mount. When the camera mount has engaged in the dovetail mount, turn the camera back to normal use position.

- Make the electric connections between 35 mm camera, data back and fundus camera. Fig. 19 illustrates the corresponding connectors on the fundus camera.



- 1 Connector for camera control
- 2 Connector for data back

Fig. 19 Connectors for 35 mm camera

Photographic equipment for top camera port

On the top, the fundus camera has a second port for image recording (Port 2). Via a FF 450 adapter on this port, various recording systems can be connected.

For the FF 450 Fundus Camera with photographic equipment, a NIKON F3-HP 35 mm camera (without data back) is offered as an option.

Mounting the 35 mm camera to Port 2

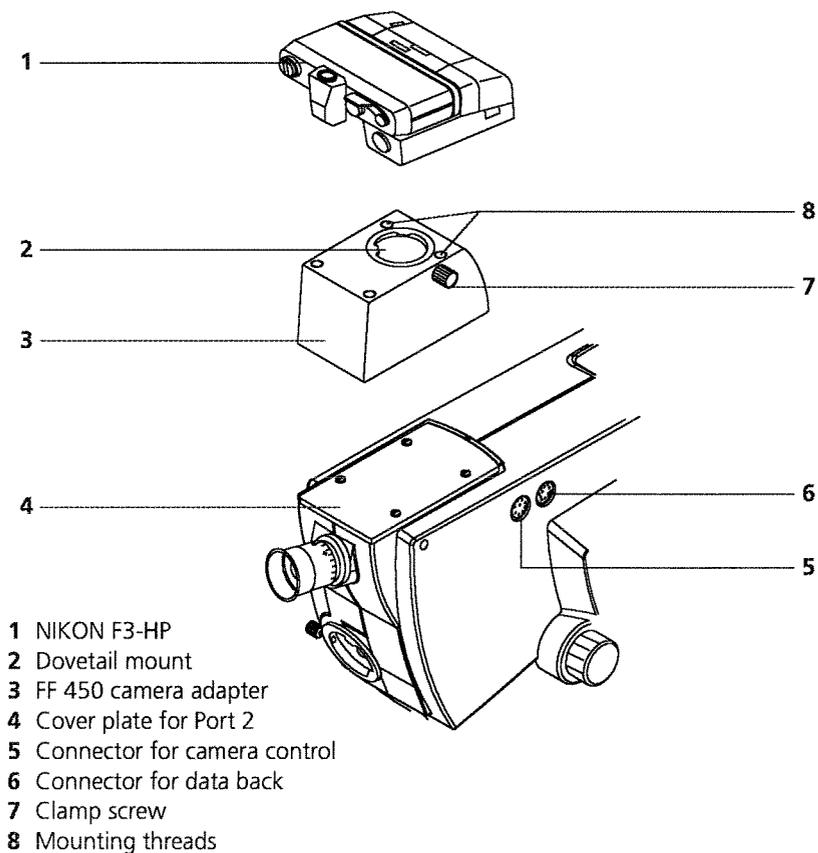


Fig. 20 Mounting a 35 mm camera to Port 2

- Loosen the screws of cover plate (4) and remove the plate.
- In place of the cover plate, mount the FF 450 camera adapter (3).
- Attach the NIKON F3-HP camera to dovetail mount (2) and fasten the camera by means of clamp screw (7).
- Establish electric connection between fundus camera and 35 mm camera by connecting the cable for camera control to connector (5) and the data back cable to connector (6).



Note:

When handling the NIKON F3-HP, observe the operating instructions provided with this camera.

FF 450 video adapter

Port 2 also allows connection of the FF 450 video adapter. This adapter accommodates two additional cameras.

Preferably, the Ports A and B of the adapter are provided for video cameras. However, after connection of an appropriate relay lens, you may also mount a second 35 mm camera to the video adapter.

Control (3) serves for selecting Port A or B.

Mounting a video camera to Port 2

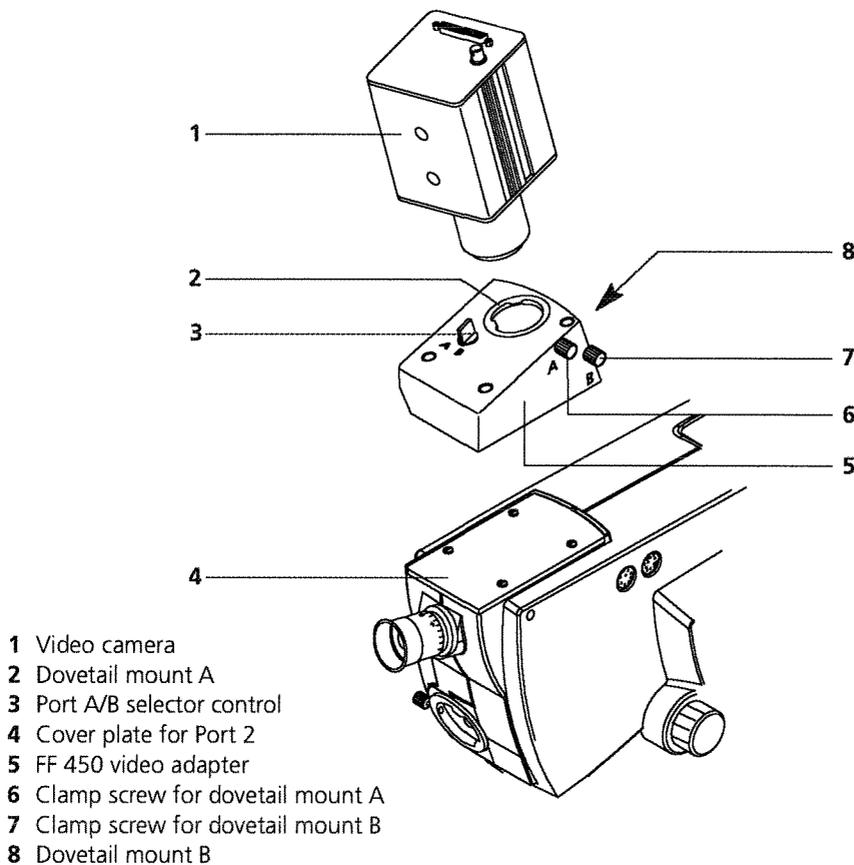


Fig. 21 Mounting a video camera to Port 2

- Loosen the screws of cover plate (4) and remove the plate.
- In place of the cover plate, mount the FF 450 video adapter (3).
- Attach the video camera to dovetail mount (2, Port A or 8, Port B) and fasten the camera by means of clamp screw (6 or 7).
- Establish electric connections between video camera and the corresponding camera supply and image analysis unit.



Note:

When handling the video camera, observe the operating instructions provided with the camera.

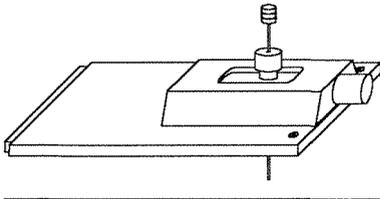


Fig. 22 Internal fixation device

Internal fixation device

The internal fixation device is arranged in the plane of the first intermediate image of the retina. This plane lies immediately behind the ophthalmoscopy lens. The manipulator allows free movement of the fixation mark in this plane. By moving the mark axially along the optical axis an ametropia of ± 10 D of the patient can be compensated. Every point of the field of view is accessible by moving the control handle.

- To mount the internal fixation device, remove cover plate (**12**, Fig. 3) from the fundus camera by loosening the two fastening screws. Replace it with the plate containing the fixation device.

Astigmatism compensator

The astigmatism compensator provides continuous compensation of a patient's astigmatism. This is applicable particularly to astigmatism of oblique bundles when examining peripheral fundus areas. The compensating range is from 0 D cyl to about 20 D cyl at optional angle.

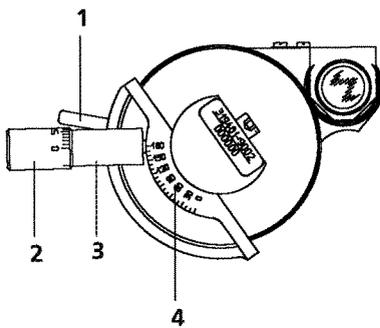


Fig. 23 Astigmatism compensator

- To mount the astigmatism compensator, remove cover plate (**8**, Fig. 3) after loosening the two fastening screws.
- Put the astigmatism compensator into the opening and screw it down.
- Use detent lever (**1**, Fig. 23) to swing the astigmatism compensating optics into the optical path. By pushing the lever in and swing it upward until it clicks in.
- Swivel adjusting screw (**3**) to set the axis of astigmatism. The axis is continuously adjustable in the range $0^\circ \dots 180^\circ$. Read the set axis value from scale (**4**).
- For setting the cylindrical power, turn knurled knob (**2**) of adjusting screw. The scale of the knurled knob is provided with a diopter scale.

Demonstration eye with holderr

For training purposes, a demonstration eye is available.

In use, mount the holder with the demonstration eye to the rod of the head rest.

Ametropia is adjustable (± 5 D) by sliding the unit longitudinally.

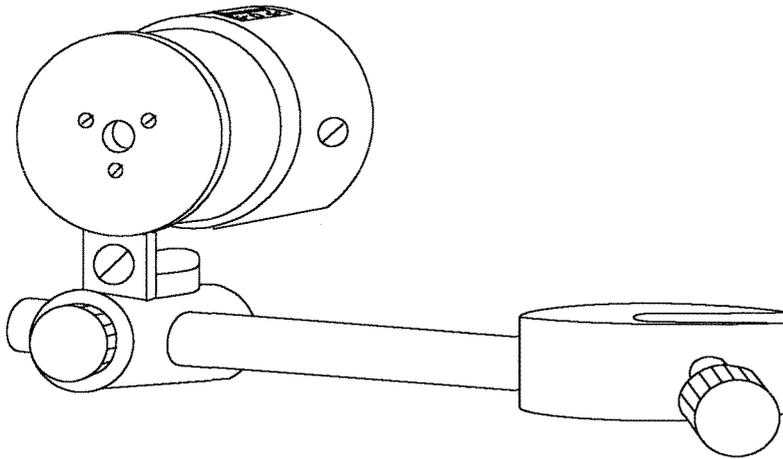


Fig. 24 Demonstration eye with holder

1.75x converter lens

The 1.75x converter lens is available for increasing the lateral magnification. The converter lens is mounted between the camera port of the fundus camera and the 35 mm camera.

- First, remove 35 mm camera from fundus camera.
- Unscrew the dovetail mount from the T2–adapter of the camera. Store it in an appropriate box.
- Screw the converter lens into the T2–adapter.
- You can mount the camera to the desired port of the fundus camera using the dovetail mount of the converter lens.

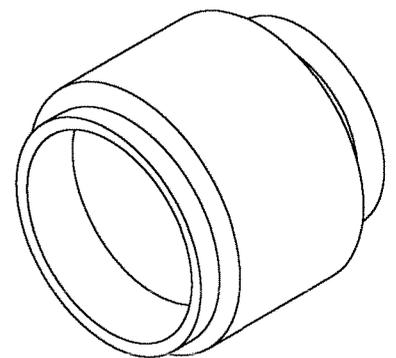


Fig. 25 1.75x converter lens

Supplementary lamp

This lamp serves for illuminating the patient's arm during the injection for fluorescein angiography. The supplementary lamp mounts to the head rest.

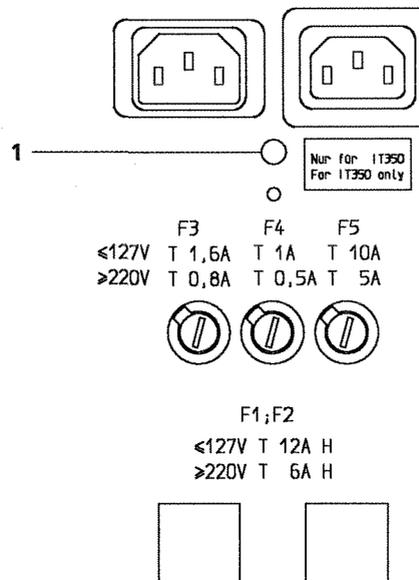

Caution:

Before operating the instrument, read and observe the instructions given in the chapter *Instrument safety*.

Checking the voltage setting

The instrument is factory-set to the standard mains voltage of the user's country. On the BL 450 flash unit, you can read the setting in the window below the power connector on the rear panel.

Make sure this value corresponds with the local line voltage. If not, have the instrument set to the available line voltage by service staff. In this case the fuses must also be changed (—> *Chapter Care and maintenance, Replacing fuses*).



1 Display window indicating the set line voltage

Fig. 26 Location of line voltage display window


Caution:

The user is responsible for maintaining the above mentioned requirements for operation.

General notes on handling

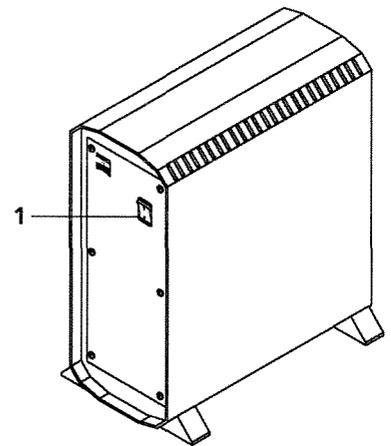
After you have installed and used the fundus camera and its accessories, you should, if possible, maintain a regular procedure including the following operations:

Preparing the eyepiece

- If you are emmetropic, pull out the eyecup of the super high-eyepoint eyepiece. If you wear glasses push it in.
- Set the diopter setting ring of the eyepiece to 0 D.
- To compensate for your ametropia (up to ± 4 D), turn the diopter setting ring accordingly. By looking through the eyepiece and turning the setting ring until the double cross-hair is sharply defined.

Preparing the BL 450 Flash Unit

- Operate power switch to switch on the unit.
- If the fundus camera has not been used for more than two months, switch on the power supply two hours before starting examinations to allow the electrolytic capacitors to charge.



1 Power switch

Fig. 27 BL 450 Flash Unit

Preparing the fundus camera

- Insert film into 35mm camera (—> *Operating instructions of NIKON F3-HP*).
- Mount 35mm camera to camera port (—> *chapter Installation, Photographic equipment*) and establish electric connections.
- Pull fundus camera with instrument base away from patient.
- Turn control (6, Fig. 29) to set the desired field angle. This will speed up positioning to the patient's eye.

Adjustment to the patient

Preparing the patient:

- Dilate patient's pupil.
- Sit the patient down. Adjust the height of the instrument table. Have patient rest their chin on chin rest and forehead against forehead rest. Turn knurled sleeve (—> pp. 8 and 9) until the patient's eye is level with the marks on the head rest.
- Have patient lean slightly forward so that their forehead and chin are firmly positioned.
- If necessary, adjust your seat.

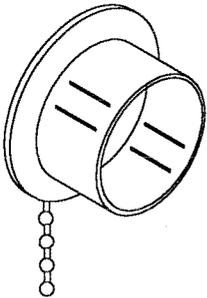


Fig. 28 Objektivschutzkappe

Setting the fundus camera:

- Move the instrument base laterally for alignment to either left or right eye.
- Remove objective cap now. Not before.

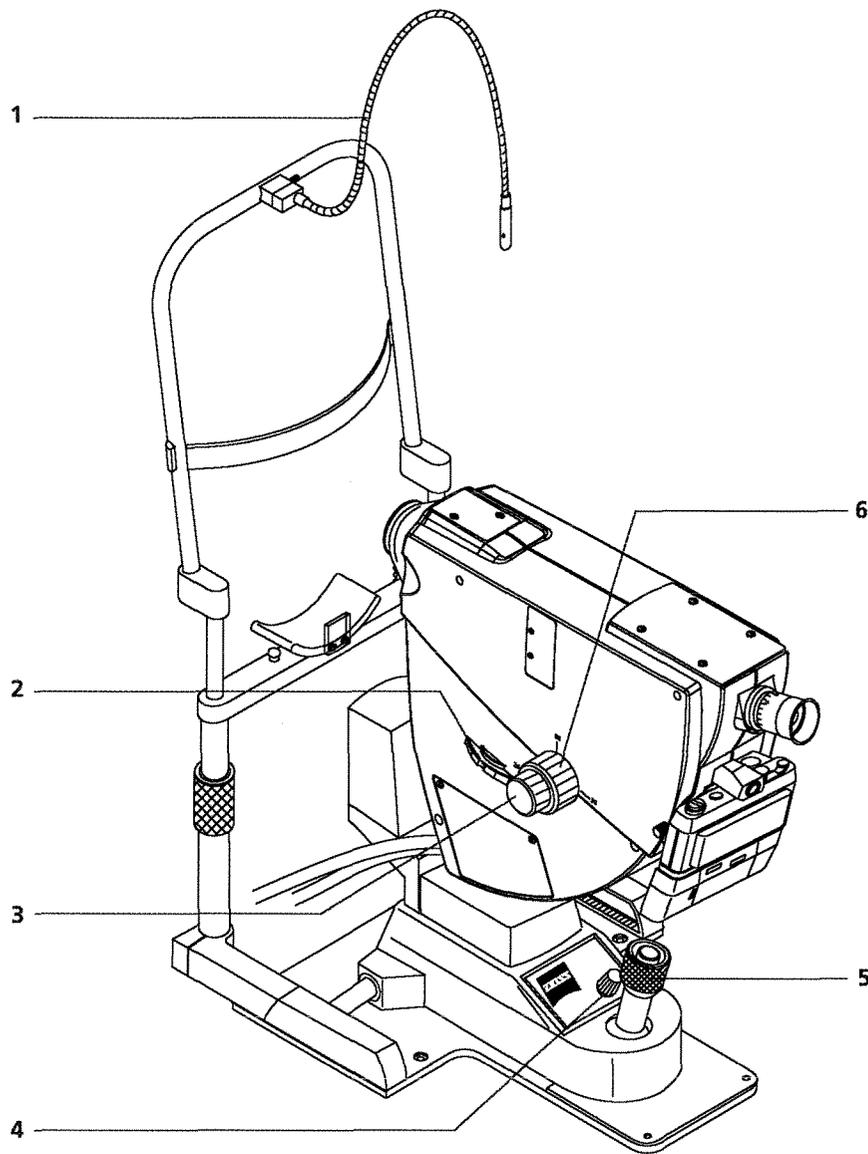


Note:

The objective cap is connected to the fundus camera with a bead chain.

- Have patient look to either the external fixation light (non-examined eye) or fixation target of the internal fixation device (examined eye).
- Turn the brightness control (4, Fig. 29) on the instrument base to adjust observation brightness.
- Move instrument base back and forth to focus the light ring of the fundus camera onto the patient's pupil.

- If necessary, select appropriate filter of the filter wheel (2) (—> *Section Operating modes*).
- Turn focusing control (3) to focus onto the fundus oculi.
- Eliminate any residual reflections or vignetting by fine adjustment of the instrument base. For this, move the joystick (5) or turn its control knob for vertical adjustment.



- 1 Fixation light
- 2 Filter wheel
- 3 Focusing control
- 4 Brightness control of halogen lamp
- 5 Joystick with release button
- 6 Field angle control

Fig. 29 Fine adjustment of fundus camera

Operating modes

The fundus camera version with photographic equipment allows the following operating modes to be employed:

- Fluorescein angiography (**FLUO**) with red-free option
- True color photography (**COLOR**)

The **ICG** mode is not available in the photographic version as the technical requirements for the use of infrared film are extremely high. Therefore, the **ICG** mode is provided only for the FF 450 Fundus Camera version with image archiving system.

The recording cycles are controlled and menu-guided via the control console. The basic program flow is illustrated by a flow chart in the section Documentation. The operations for taking photographic records in the **COLOR** and **FLUO** modes are described in the section Program flow.

Fluorescein angiography (FLUO)

In the **FLUO** mode, b/w photographs are taken of the patient's eye dilated for fluorescein angiography.

For this, the patient's eye is illuminated by blue light exciting the injected solution to emit fluorescence light. The emitted green light is filtered out in the documentation path of light.

The keyboard contains control keys to move the exciter filter (blue) and barrier filter (yellow) in and out before taking the photographs. In this way, the operator can view the patient's eye the way it will be recorded subsequently on film or image sensor.

For every image record in **FLUO** mode, the exciter and barrier filters are moved in and out automatically.

Fluorescein angiography is a diagnostic method extending over a longer period. Therefore, documentation of the process is by serial photographs (> Section *FLUO, Preparing the patient*).

In the **FLUO** mode, software allows for both single and serial photographs. Images are taken by pushing the button on the joystick.

Red-free photographs

Usually **red-free** photographs are taken before angiography. These photographs provide high contrast b/w photographs of the vascular system of the fundus before injection.

For this, turn filter wheel (**2**, Fig. 29) to position "RF". A sensor detects the filter and prevents exciter and barrier filters from being moved into the optical path when you release a flash.

Colour photographs (COLOR)

In the **COLOR** mode, the patient's eye is recorded on a 35 mm colour film in true colours.

Usually only a few (1 ... 3) photographs are taken in this mode. Therefore, software permits only single photographs to be taken released by pressing the button on the joystick.

When using the **COLOR** mode, turn the filter wheel to position "C".

Of course, you can take red-free photographs also in this mode (—> *Red-free photographs*).

Fluorescein angiography (general notes)



Caution: Observe contraindications!

To avoid any incidents, carefully watch the patient and observe the existing contraindications for fluorescein injections.

Contraindications include among others:

- Renal insufficiency
- Serious cardiovascular diseases
- Poor general state of health
- Pregnancy

Injection

The manner of fluorescein injection is crucial for obtaining high contrast fluorescence images.

Maximum fluorescein concentration in the vessels of the fundus must be achieved within the shortest possible time.

- For the injection process, you can mount the optional 12V 5W lamp to the head rest.
- To obtain a clearly visible fluorescence, carry out the injection within 2 to 3 seconds.
- The injected dose should be between 8 and 10 ml of a 10% solution (for adults) [Prof. Dr. A. Wessing: "Fluoreszenzangiografie der Retina", Textbook and atlas].
- Do not remove the injection needle until the angiogram is finished (→ *Incidents after fluorescein injections*).

Procedure for a series of fluorescein angiograms

- First, focus onto the patient's eye without any filters.
- Carefully check the focus setting, as it is difficult to correct it during the angiogram series.
It is recommended that the patient is informed of the intended angiogram series and ask her/him to keep the eye steady and open wide.
- Set up the menu in the FLUO mode to menu item Ready (> *Program flow in FLUO mode*).
- Swiftly inject the fluorescein solution.
- When the contrast medium reaches the eye's vessels (after an "arm-to-retina" time of about 10 s), start the angiogram series and continue for about 20 seconds. Then, take single exposures at increasing intervals.

Incidents after fluorescein injections

(Notes were taken from specialist literature.)

Though incidents after injection of fluorescein sodium are rare, they occur occasionally. In the literature some serious incidents have been described.

- Paravenous injection of smaller volumes of fluorescein sodium is not uncommon.
- Vertigo and vomiting occurring shortly after the injection may occur. Both will subside within a few minutes without any lasting impairment of the patient's general well-being.

Caution:

Considerably more severe are sensitisation effects extending from a quickly subsiding urticaria to a severe anaphylactic shock. Other incidents include circulatory syncope, respiratory disorders and generalised convulsive fits.

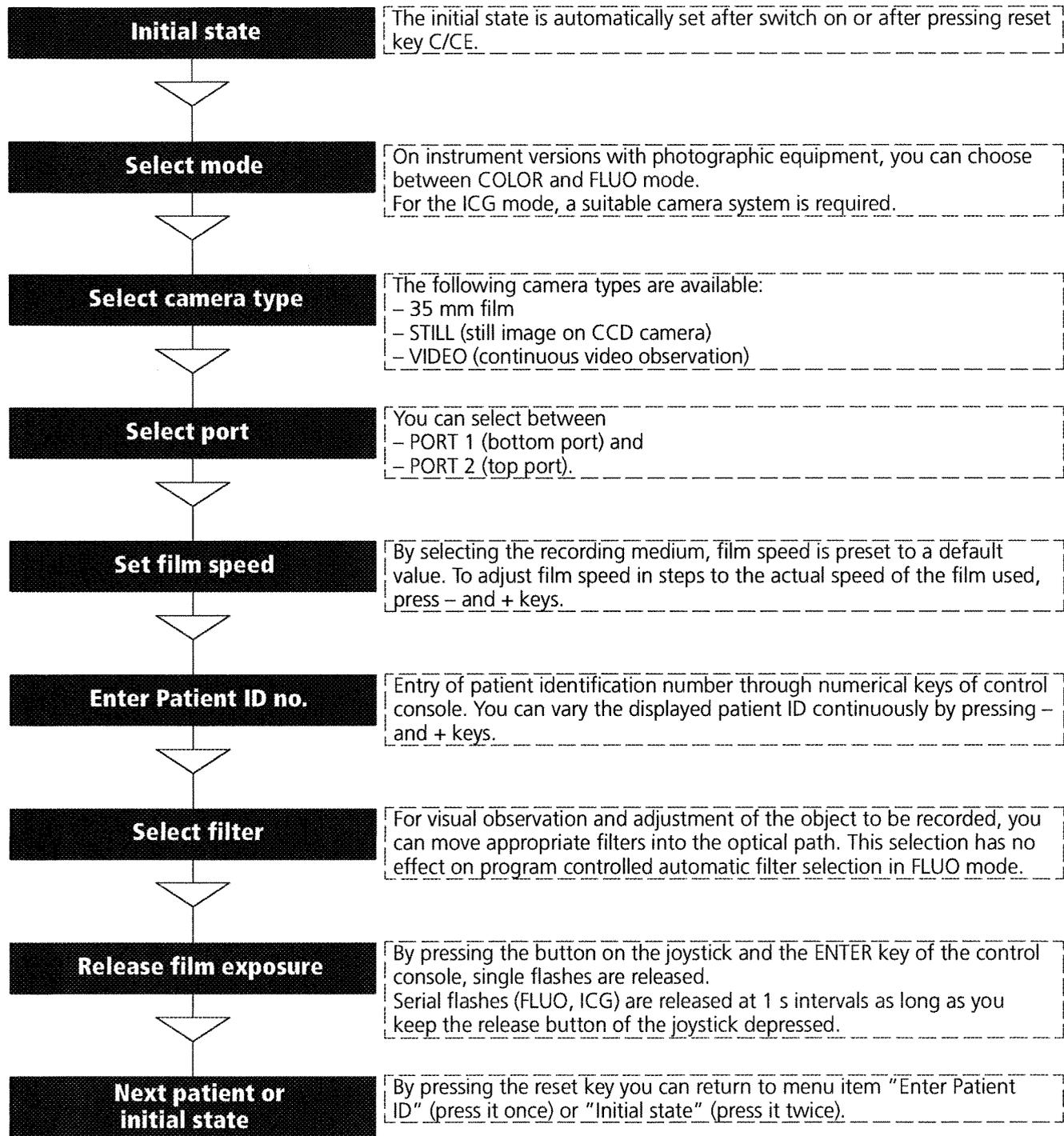


Before carrying out fluorescein injections, take appropriate precautions for possible incidents.

- Nearby, keep everything at hand required for resuscitation and shock treatment (oxygen apparatus, cardiovascular drugs, cortisone drugs).
- To enable rapid injection of required drugs, do not remove the injection needle used for fluorescein injection, until the angiogram has been finished.**
- In case of serious incidents, it is recommended to keep the patient under observation for at least 24 hours. If necessary, consult an internal specialist.

Documentation

Flow diagram of photographic documentation



Program flow in FLUO mode with 35 mm camera

The description of operations below is based on the following prerequisites:

- Fundus camera has been adjusted to the fundus to be recorded.
 - Initial state of program has been set by pressing reset key C/CE twice.
- The displays appearing at the individual program steps are shown in the adjacent column.

- Turn filter wheel to position "A".
- Press **FLUO** key.
The display requests you to select one of the available camera types through key group (6, Fig. 8, green lighting keys).
- Press **35 MM** key for b/w photographs..

If you use only one 35 mm camera for recording, it is better to mount it to the bottom camera port (Port 1). The top camera port (Port 2) should be reserved for an additional 35 mm camera (—> *Section Program flow in COLOR mode*).

- Select **PORT 1**.

Film speed is preset by default to 400 ASA.
If the speed of the used film is different, press - or + keys to set this value.

- To confirm the film speed setting, press **ENTER**.
In the next program step, enter the Patient's identification no. for exposure on the film.
- Use numerical keys to enter Patient ID.
To increment or decrement Patient ID continuously, use - and + keys.
- To confirm the entered Patient ID, press **ENTER**.

The instrument is ready now for photographic records.
The display shows the applied flash energy (E: 13) and the current frame number (F: 000).

Color accept ?	35 mm 64	Port 2
-------------------	-------------	--------

Fluo Select Camera		
-----------------------	--	--

Fluo Select Port	35 mm	Port
---------------------	-------	------

Fluo Speed	35 mm 400	Port 1
---------------	--------------	--------

Fluo Pat-Id:	35 mm 000000	Port 1
-----------------	-----------------	--------

Ready	E: 13	F: 000
-------	-------	--------

Ready	E: 13	F: 000
-------	-------	--------

The preset flash energy has been based on experience.

You can increase or decrease the energy by steps to adapt it to the currently existing object-related conditions. For this, use - and + keys.



Note:

In the Ready state, you can reselect the port (Port1 <—> Port2).

- To release the flash and activate the camera, press the release button of the joystick or the **ENTER** key.

T: 001	E: 13	F: 001
Okay	?0	

On flash release, timer is starting and the number of frames taken so far appears on the display.

If you wish the timer to start before the first flash, start it manually by pressing the **TIMER** key (—> *Fluorescein angiography*).



Note:

Single photographs are released by short presses of the button of the joystick.

You may also release single photographs by pressing the **ENTER** key.

To take serial photographs at 1 s intervals, keep the release button depressed.

- After you have taken the photographs, you can return to the program item "Entry of Patient ID" by pressing the reset key **CICE** once.
- To return to the initial state of the program, press the **CICE** key twice.
- To start another photographic cycle with the same recording conditions and instrument parameters, press the **ENTER** key. – The program will then maintain the previous settings and activate the Ready state.

Fluo	35 mm	Port 1
accept ?	400	

Program flow for red-free photographs

Red-free photographs are possible in both FLUO and COLOR modes, the program flow is analogous to that of these modes (—>pp. 35 ... 38).

- After you have selected FLUO or COLOR mode, turn filter wheel (**4**, Fig. 3) to position RF to move the red-free filter into the optical path.
- To take the photographs, proceed as described under Program flow in FLUO and COLOR mode.

Program flow in COLOR mode

The description of operations below is based on the following prerequisites:

- Fundus camera has been adjusted to the fundus to be recorded.
- The program has been reset by pressing reset key C/CE twice.

- Turn filter wheel to position "C".
- Press **COLOR** key.
The display requests you to select one of the available camera types through key group (6, Fig. 8, green lighting keys).
- Press **35 MM** key for 35 mm photographs..

If you have mounted a 35 mm camera for b/w photographs to the bottom port (Port 1), take the colour photographs with a second 35 mm camera mounted to the top port (Port 2).

- In this case, select **PORT 2**.

Film speed is preset by default to 64 ASA.

If the speed of the used film is different, press - or + keys to set this value.

- To confirm the film speed setting, press **ENTER**.
- In the next program step, enter the Patient's identification no. for exposure on the film.
- Use numerical keys to enter Patient ID.
To increment or decrement Patient ID continuously, use - and + keys.
- To confirm the entered Patient ID, press **ENTER**.

The instrument is ready now for photographic records.

The display shows the applied flash energy (E: 4) and the current frame number (F: 000).

The preset flash energy is based on experience.

You can increase or decrease the energy by steps to adapt it to the currently existing object-related conditions. For this, use - and + keys.



Note:

In the Ready state, you can select the port again (Port1 <—> Port2).

Color	35 mm	Port 2
accept ?	64	

Color		
Select Camera		

Color	35 mm	Port
Select Port		

Color	35 mm	Port 2
Speed	64	

Color	35 mm	Port 2
Pat-Id:	000000	

Ready	E: 4	F: 000
-------	------	--------

- To release the flash and activate the camera, press the release button of the joystick or the Enter **ENTER** key.



Note:

In the COLOR mode, you can only take single photographs by single presses of the release button on the joystick.

- After you have taken the photographs, you can return to the program item "Entry of Patient ID" by pressing the reset key **CICE** once.
- To return to the initial state of the program, press the **CICE** key twice.
- To start another photographic cycle with the same recording conditions and instrument parameters, press the **ENTER** key. – The program will then maintain the previous settings and directly activate the Ready state.

Color	35 mm	Port 2
accept ?	64	

Program flow in ICG mode

Records in ICG mode require the use of a suitable camera system for the wavelengths to be evaluated.

The program flow in this mode is analogous to that of FLUO and COLOR modes. Therefore, description of the individual program steps will not be repeated.

Proceed as described under Program flow in FLUO mode or Program flow in COLOR mode.

Caution:

The instrument may be modified and repaired only by service technicians employed with or authorised by the manufacturer. The manufacturer is not liable for damages caused by unauthorised tampering with the instrument. Such tampering will also forfeit any rights to claim under warranty.

The maintenance work you may carry out yourself is described below:



Replacing lamps

Warning: Risk of injuries!

Before changing the lamp, switch off the instrument and disconnect its power cord.

To avoid burns, let the defective lamp cool down, before replacing it.

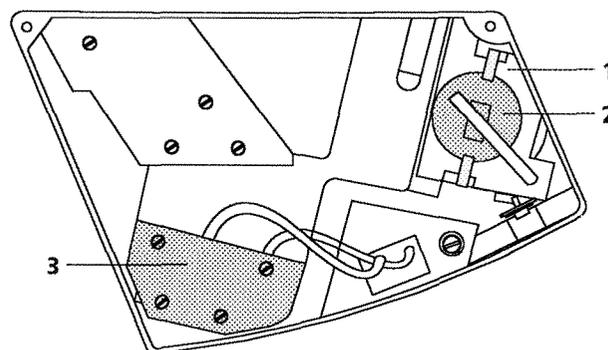


Caution:

Avoid touching the lamp bulb with bare fingers.



Replacing the halogen lamp



- 1 Carrier with holder for halogen lamp
- 2 Halogen lamp
- 3 Flashbulb

Fig. 30 Location of halogen bulb and flash bulb

- To make the lamps accessible, remove cover (7, Fig. 3). The location of the lamps is shown in Fig. 30.
- The defective halogen lamp is easily pulled out of its holder.
- Replace defective lamps only with original types. Plug new lamp with its pins into the holder. Lamp adjustment is not necessary.
- Re-attach the cover, before connecting the instrument to mains again.

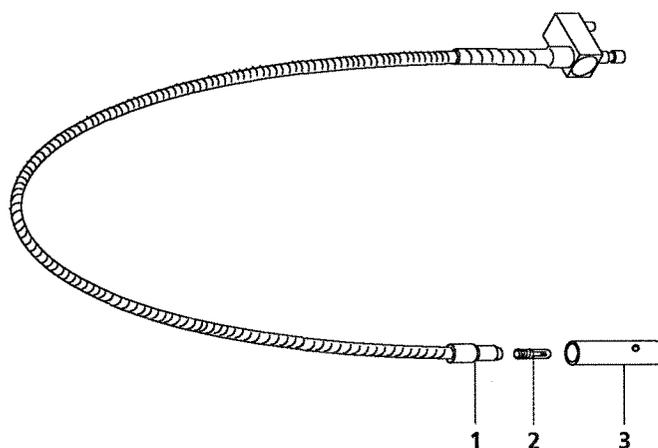
Replacing the flashbulb

**Caution:**

The flashbulb may be replaced by trained service technicians only.

The flashbulb has a long life. It is very unlikely that the flashbulb needs replacing between regular maintenance checks.

Replacing the filament lamp of the fixation light



- 1 Holder of filament lamp or red blinking LED
- 2 Filament lamp or LED
- 3 Cover sleeve

Fig. 31 Replacing the filament lamp or the LED of the fixation light

- Disconnect mains supply.
- Pull off cover sleeve (3) from holder (1) of fixation light.
- Unscrew defective filament lamp or the LED (2) from its holder and replace it with a new one.
Only use original lamp types.
- Slip cover sleeve onto lamp holder.
- Finally, connect instrument to mains again.

Replacing fuses

Caution:

Before changing fuses, switch off the instrument and disconnect its power cord.



The fuses you can replace yourself are arranged on the rear panel of the BL 450 flash unit and on the base of the lifting column of the IT 350 Instrument Table directly above the mains socket.

- Use a screwdriver to unscrew the fuse link.
- Replace defective fuse, screw in fuse link again.

Use the following fuses:

BL 450 Flash Unit		
Symbol/ Location	Protected circuit	Designation acc. to IEC 127F1
Fuse cartridge in table base	2 fuses; mains input circuit; lifting system	T 6.3A, 220-240V T 10A, 100-127V
F3		T 0.8A, 220-240V T 1.6A, 100-127V
F4		T 0.5A, 220-240V T 1A, 100-127V
F5		T 5A, 220V-240V T 10A, 100V-127V

T = slow-blow.
All other fuses are multifuses mounted to printed circuit boards and thus not replaceable by the user

Table 1 User-replaceable fuses of BL 450 Flash Unit and IT 350 Instrument Table

F1 and F2 are thermal circuit breakers that need not be replaced.

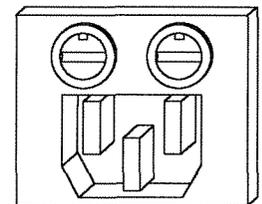
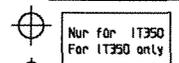
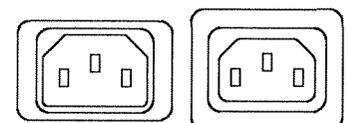


Fig. 32 Fuses on lifting column of IT 350



	F3	F4	F5
<127V	T 1,6A	T 1A	T 10A
≥220V	T 0,8A	T 0,5A	T 5A



F1, F2
 <127V T 12A H
 ≥220V T 6A H

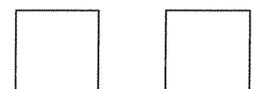


Fig. 33 Fuses on BL 450

Troubleshooting table for FF 450 and BL 450

Trouble	Possible cause	Remedy
No electrical function (power indicator LED of key does not light)	Power key set to OFF	Press power key, LED must be on.
	Power cord not connected	Connect power cord to mains socket
	Local mains voltage is different from factory-set operating voltage	Call service technician
No response of fundus camera (power indicator LED does not light)	No electric connection between fundus camera and flash unit	Connect control cable of fundus camera with flash unit
	Fuse F3 on flash unit blown	Replace fuse F3 on flash unit
	Fuse F1 or F2 on instrument table blown	Push in key of F1 or F2 again
Halogen lamp and flashbulb not working	Connector disconnected	Connect control cable of fundus camera with flash unit
All functions OK, except for halogen lamp	Lamp voltage control set to "Min."	Turn control clockwise
	Halogen lamp defective	Replace lamp acc. to chapter "Replacing lamps"
	Fuse of halogen lamp control circuit blown	Replace fuse F4 on flash unit
Brightness of halogen lamp cannot be adjusted	Connector of instrument base not connected to flash unit	Establish connection
No continuous adjustment possible over setting range of brightness control	Lamp control circuit defective	Call service technician
No response when releasing photographs on instrument base (joystick)	Connector of instrument base not connected to flash unit	Establish connection
No release of photographs, error message appears	Camera or BAS not properly connected	Check and make connections.

Troubleshooting table for FF 450 and BL 450

Trouble	Possible cause	Remedy
No flashes when releasing photographs	No electric connections between fundus camera and flash unit	Connect flash cable to flash unit
	Flashbulb defective	Have it replaced by service technician
	Fuse of flash circuit blown	Replace fuse F5 on flash unit
Fixation light does not light	Bulb of fixation light defective	Replace bulb acc. to chapter "Replacing lamps"
	Connector of head rest cable not connected to flash unit	Establish connection
Supplementary lamp does not light	Connecting cable not connected to flash unit	Establish connection
In the case of malfunctions of mechanical and optical subassemblies, call service technician.		

Table 2 Troubleshooting table

Notes on instrument care

Because of its simple, enclosed design, the fundus camera is almost maintenance-free.

It is, however, necessary to clean optical components occasionally (ophthalmoscopy lens, eyepieces). To remove dust from accessible surfaces, use a soft brush.

Clean very dirty painted surfaces with a cloth moistened with weak detergent.

If necessary, clean the front surface of the lens with an ether/spirit mixture (1:1) applied to a cotton swab. For cleaning, switch on the illumination so that you can check the cleaning effect. Clean the surface by moving the cotton swab or another appropriate tool of the optics cleaning kit circularly from the lens centre to the edge.

When not in use, cover the instrument to protect it from dust using the dust cover provided. Store 35mm camera body and all other accessories in their storage boxes. Cover camera port and ophthalmoscopy lens with the plastic caps provided.

Store the original packing material for future transportation or repair. If you wish it can be returned to the supplier.

Field angle	50°	30°	20°
Viewing magnification	11x	19x	29x
Visual observation	through special 10x eyepiece with reticle, monocular		
Distance front lens – patient's eye operator – patient's eye	42 mm 470 mm		
Compensation of ametropia	± 30 D, continuous		
Flash rate	1x per second		
Filters	red-free and filter for fluorescein angiography, ICG filter (only with FF 450 IR)		
Image size on 35 mm film	26 mm diameter, vertically limited to 24 mm		
Swivel range	± 45° horizontally + 15°/–10° vertically by hand wheel		
Instrument table	motorised, asymmetrical design, suitable for wheelchair patients, 2.5 min short-term operation		

Ambient conditions	
Permissible ambient temperature	10 ... 35 °C (50 ... 95 °F)
Permissible humidity	0 ... 80% (no condensation)

Electric system	
Compliance with standards	DIN EN 60601–1 (IEC 601–1)
Line voltage	IT 350: 115 V/60 Hz, 4,8 A 230 V/50 Hz, 2,4 A BL 450: 100–110–120–125–220–230–240 V
Line frequency	50 ... 60 Hz
Performance	600 VA
Fuses	according to page 41
Earthing conductor	Instrument to be connected only to sockets with perfect earthing conductor.

Dimensions	
FF 450 Fundus Camera	430x310x800 mm ³
BL 450 Flash Unit	480x190x470 mm ³
IT 350 Instrument Table	880x650xmax.1030 mm ³
Control console	150x150x30 mm ³

Table 3 Specifications

The FF 450 / FF 450 IR Fundus Camera

complies with the

- EC Directive 89/336/EEC of the Council of 03.05.1989 for the harmonisation of the regulations of the member states on electromagnetic compatibility

and the

- German Law on the electromagnetic compatibility of instruments of 09.11.92.

The instrument satisfies the requirements of the following standards:

Radio noise suppression

EN 55011 (07/92) /

Class B

Noise immunity

EN 60601-1-2



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