



Instruction Manual  
**ELTROTEC Rigid Endoscopes**

SKF-D  
MKF-D  
PKF

Rigid endoscopes for machines, equipment and cavity walls

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Certified according to DIN EN ISO 9001: 2008

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## 1. Safety

The operation of the system requires knowledge of the instruction manual.

### 1.1 Symbols Used

The following symbols are used in this instruction manual:



Indicates a hazardous situation which can result in serious or fatal injuries if not avoided.



Indicates a hazardous situation which results in minor or moderate injuries if not avoided.



Indicates a situation which may result in property damage if not avoided.



Indicates a user action.



Indicates a user tip.

### 1.2 Warnings



The probe is electrically conductive. Avoid contact with live parts.

> Death by electric shock

> Danger of injury



Never look directly into the aperture of the endoscope or into the optical fiber if these are connected to a switched-on light source.

> Danger of injury, blinding, damage to the eyes

**NOTICE**

Never bend or crush the endoscope.

> Damage to or destruction of the endoscope

Always place the endoscope down carefully; do not let it fall.

> Damage to or destruction of the endoscope

Avoid hard knocks to the rigid probe.

> Damage to or destruction of the endoscope

Keep the endoscope away from acids, bases, oil and gasoline. Do not use it in the vicinity of flammable/volatile vapors.

> Damage to or destruction of the endoscope

Do not place items on top of the endoscope, posing a mechanical load.

> Damage to or destruction of the endoscope

### **1.3 Proper Use**

ELTROTEC rigid endoscopes are used to monitor and inspect the inside of machines, equipment and cavity walls.

- The ELTROTEC rigid endoscopes are not suitable for medical purposes.
- The system may only be operated within the limits specified in the technical data, see Chap. 2.2.1, see Chap. 2.2.2, see Chap. 2.2.3.
- ELTROTEC rigid endoscopes must be used in such a way that no persons are endangered or machines are damaged in the case of malfunctions or total failure of the measurement system.
- Take additional precautions for safety and damage prevention for safety-related applications.

#### 1.4 Proper Environment

- Operating temperature:
  - Endoscope probe: -20 °C to +100 °C (-4 °F to +212 °F)
  - Entire endoscope: -20 °C to +50 °C (-4 °F to +122 °F)
- Storage temperature: -20 °C to +50 °C (-4 °F to +122 °F)
- Humidity: up to 95% at 40 °C (non-condensing)
- Ambient pressure: up to 3 bar
- Liquid-tight part: Distal end of the endoscope
- Resistance to liquids: The endoscope probe may be immersed in the following liquids for short periods: water, saline solution (5 %), kerosene, gasoline, diesel, 70 % alcohol

<b>NOTICE</b>
---------------

The maximum continuous service temperature of the endoscope probe must not exceed +100 °C (+212 °F) as the adhesives used in the interior of the endoscope would evaporate.

> Destruction of the endoscope

## 2. Functional Principle, Technical Data, Dimensional Drawings

Use the knurled ring on the eyepiece to focus the image.

The cladding tube of the endoscope consists of corrosion-resistant stainless steel which protects the optics against the strain of everyday use. The cladding tube of the endoscope consists of corrosion-resistant stainless steel which protects the optics against the strain of everyday use.

Objects are illuminated by an external light source from our accessory range, see Chap. [A 1.1](#). The light source is connected to the endoscope either directly or through optical fiber. Depending on the required light intensity, halogen, LED or xenon light sources can be employed, which thanks to optimized optical fibers provide optimum illumination of the field of view.

The ELTROTEC rigid endoscopes may also be connected to a camera system, see Chap. [A 1.5](#).

A complex lens system guides the lens-generated image through the endoscope cladding tube to the eyepiece.

### 2.1 Model SKF-D

#### 2.1.1 Short Description



*Fig. 1 Rigid endoscope, model ELTROTEC SKF-D*



The ELTROTEC SKF-D endoscope, see Fig. 1, is a high-quality optical instrument. Its many versions, see Fig. 2, make it ideal for a wide range of applications in industrial or craftsmanship sectors. If using a mirror tube for an endoscope with a 0° angle (direction of view), the angle can be deflected by 65°, 90° or 110°.

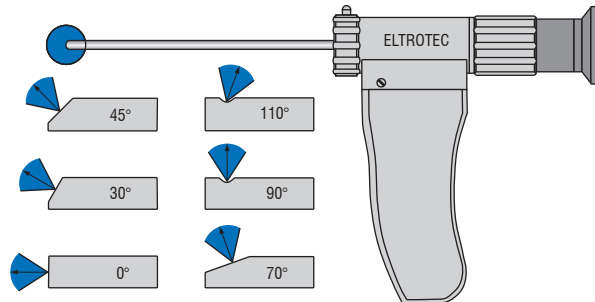


Fig. 2 Direction of view

Even deflected angles provide large fields of view, see Fig. 3.

A complex lens system guides the lens-generated image through the endoscope cladding tube to the eyepiece.

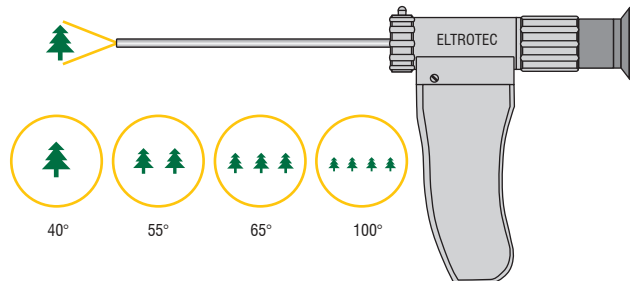


Fig. 3 Field of view

### 2.1.2 Technical Specifications for Model SKF-D

<b>Model</b>	<b>ELTROTEC SKF-D endoscope</b>
Outer-Ø	2.8; 4.0; 5.8; 8.0; 10.0 mm
Length	See catalog
Field of view	See catalog
Direction of view	See catalog
Depth of field	Approx. 4 mm to infinite
Diopter adjustment	Yes – external focus ring
Design	Corrosion-resistant stainless steel, chrome-plated metal eyepiece, metal eye cup
Lens system	A special computer-calculated rod lens system for up to 4 mm; an achromatic or combined system for 5.8 mm and up.
Endoscope probe can be rotated	See catalog
Mirror tube	See catalog
Fiber optic connector	Lemo 1
Lens mount/eyepiece mount	M14x1
Eye cup Ø	32 mm screw-in type
Handle	Made from plastic; removable

### 2.1.3 Dimensional Drawing for Model SKF-D

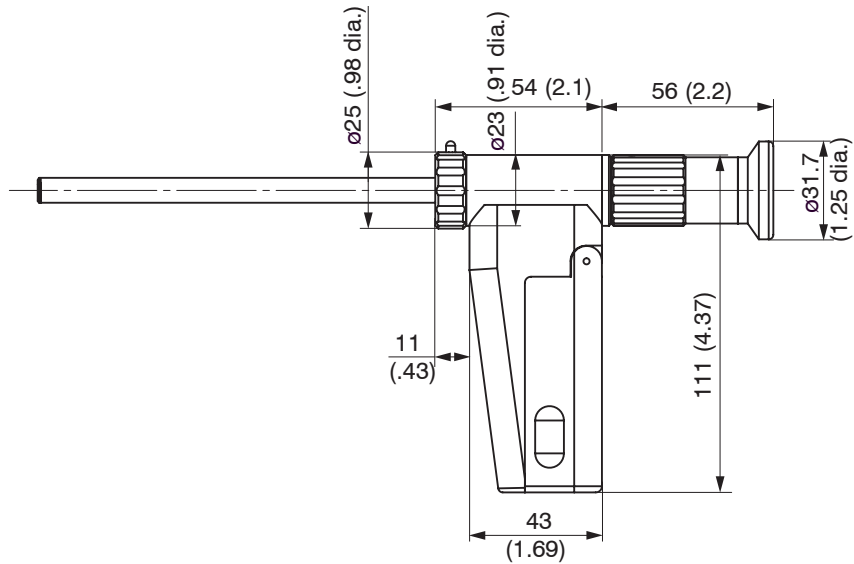


Fig. 4 Dimensional drawing for ELTROTEC SKF-D endoscope in mm, not to scale

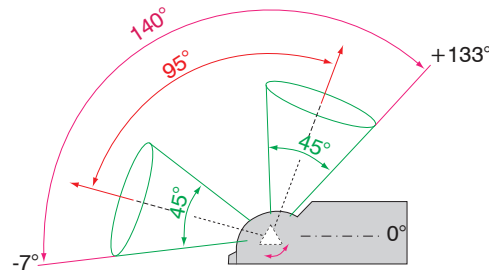
## 2.2 Model MKF-D

### 2.2.1 Short Description



*Fig. 5 Rigid endoscope, model ELTROTEC MKF-D*

The Eltrotec MKF-D endoscope, see [Fig. 5](#), is unique thanks to its built-in swing-prism, see [Fig. 6](#), which can be used to adjust the direction of view to any angle between  $-7^\circ$  and  $133^\circ$ , see [Fig. 2](#). The direction of view can be controlled with a separate knurled ring on the eyepiece using just one finger.



*Fig. 6 Swing-prism for model ELTROTEC MKF-D*

The 45° angular field of view provides a sufficiently large viewing area. The entire region in front of the endoscope can be inspected by moving the prism as the lens can also be rotated through 370°.

### 2.2.2 Technical Specifications for Model MKF-D

<b>Model</b>	<b>ELTROTEC MKF-D endoscope</b>	
Outer-Ø	4.3; 6.0; 8.0; 9.0; 12.0; 14.0 mm	
Length	See catalog	
Field of view	Approx. 45°	
Direction of view	Ø 4.3 mm	10° to +130°
	Other Ø	-7° to +133°
Depth of field	Approximately 4 mm to infinite	
Dioptr adjustment	Yes – external focus ring	
Design	Corrosion-resistant stainless steel, chrome-plated metal eyepiece, metal eye cup	
Lens system	Special computer-calculated achromatic or combined system	
Endoscope probe can be rotated		Yes
	Ø 4.3 mm	290°
	Other Ø	370°
Mirror tube	No	
Fiber optic connector	Lemo 1	
Lens mount/eyepiece mount	M14x1	
Eye cup Ø	32 mm screw-in type	
Handle	Made from plastic; removable	

### 2.2.3 Dimensional Drawing for Model MKF-D

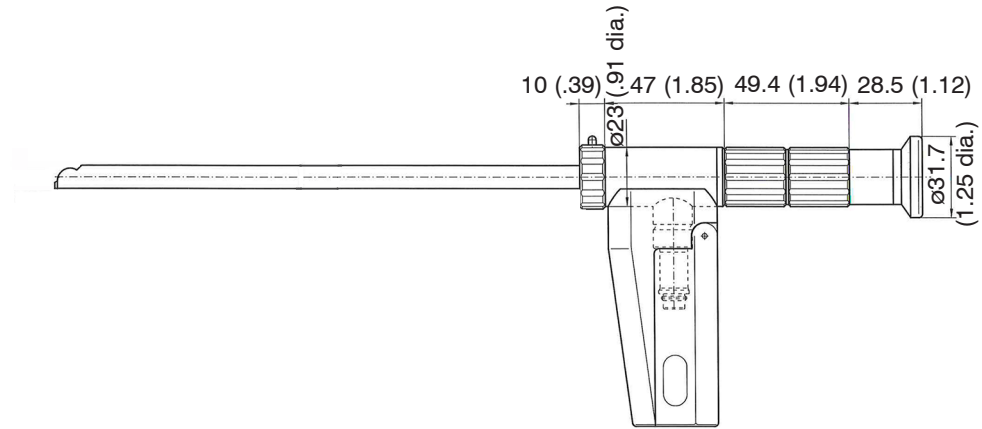


Fig. 7 Dimensional drawing for ELTROTEC MKF-D endoscope in mm, not to scale

## **2.3 Model PKF**

### **2.3.1 Short Description**



*Fig. 8 Rigid endoscope, model ELTROTEC PKF*

The miniature Eltrotec PKF endoscope is ideally suited for the inspection of miniature components and channels in the field of microelectronics and precision engineering. With a diameter of only 0.7 mm, it is one of the smallest rigid endoscopes. The low light transmission due to its small diameter is compensated for through the use of high-quality glass-rod lenses (GRIN lenses).

### 2.3.2 Technical Specifications for Model PKF

Model	ELTROTEC PKF endoscope
Outer-Ø	0.7; 1.0; 1.7; 2.0 mm
Length	See catalog
Field of view	Approx. 50°
Direction of view	0°
Ø 1.7 and 2.0 mm	Also available in 15°
Depth of field	Approx. 4 mm to infinite
Dioptr adjustment	Yes – external focus ring
Design	Corrosion-resistant stainless steel, chrome-plated metal eyepiece, metal eye cup
Lens system	Special computer-calculated glass-rod lenses (GRIN lens)
Endoscope probe can be rotated	No
Fiber optic connector	Lemo 1
Lens mount/eyepiece mount	M12x1
Eye cup Ø	32 mm
Handle	No



### 2.3.3 Dimensional Drawing for Model PKF

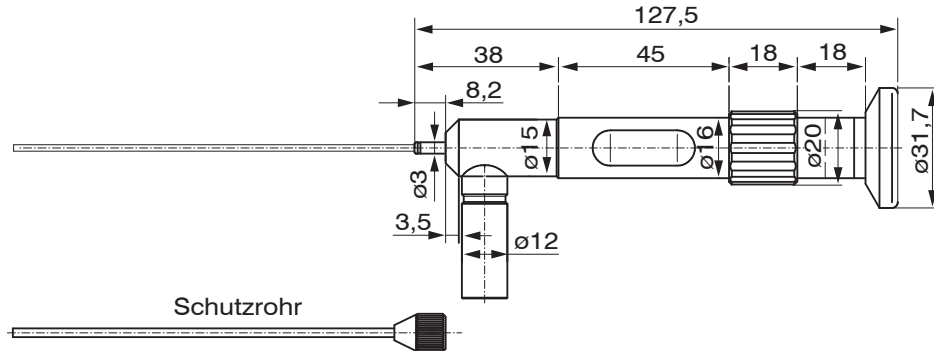


Fig. 9 Dimensional drawing for ELTROTEC PKF endoscope in mm, not to scale

## 3. Delivery

### 3.1 Unpacking / Included in Delivery

- 1 ELTROTEC SKF-D / PKF or MKF-D endoscope
- 1 Lemo 1 adapter
- 1 Cleaning set

Suitable light sources, optical fibers and cameras are listed in Optional Accessories, see Chap. A 1.

- ➡ Check the delivery for completeness and shipping damage immediately after unpacking.
- ➡ In case of damage or missing parts, please contact the manufacturer or supplier immediately.

### 3.2 Storage

- Storage temperature: -20 °C to +50 °C (-4 °F to +122 °F)
- Humidity: up to 95 % at 40 ° (no condensation)

## 4. Mounting

### 4.1 Installing Lens and Camera

➡ Remove any protective caps from the lens and from the camera, see [Fig. 11](#), see [Fig. 13](#).

**NOTICE**

You must avoid contact with the protective camera glass and the lens glass.

> Fingerprints are difficult to remove

> Image quality can be affected

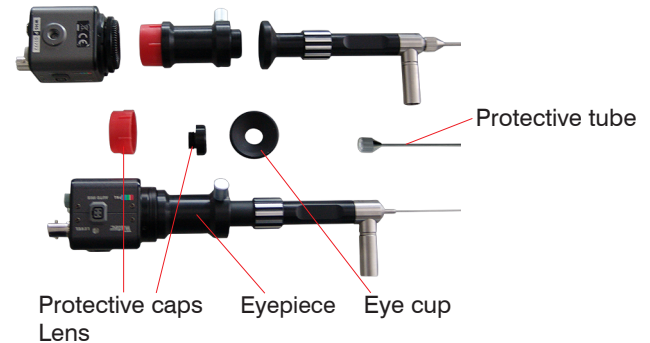
### 4.2 Assembling the Screw-threaded Lens

➡ Unscrew the eye cup from the rigid endoscope.

➡ Connect the lens to the screw fastener of the rigid endoscope, see [Fig. 10](#), see [Fig. 11](#).



*Fig. 10 Assembling the SKF-D endoscope*

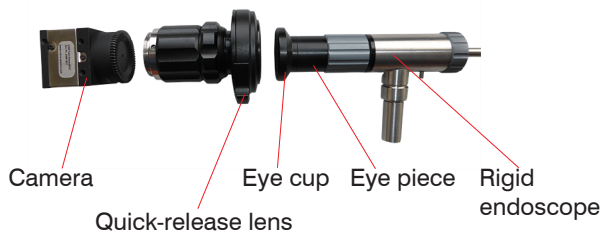


*Fig. 11 Assembling the PKF endoscope*

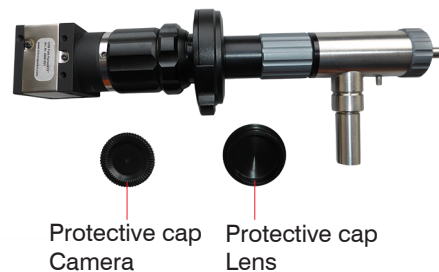
### 4.3 Assembling the Quick-release Lens

The eye cup remains connected to the endoscope.

➡ Push the quick-release fastener back from the lens and slide it over the eye cup, see Fig. 12, see Fig. 13.



*Fig. 12 Individual components for assembling the camera / lens / endoscope*



*Fig. 13 Final assembly of the camera / quick-release lens and endoscope*

**i** The quick-release fastener does not work without the eye cup.

#### 4.4 Connecting the USB Camera with the USB Cable

- ▶ Connect the USB camera, see Chap. A 1.5, and the screw-threaded lens.
- ▶ Connect the USB cable to the USB camera, see Fig. 14.



Fig. 14 Connecting the USB camera with the USB cable

- **i** Tighten the screws to ensure that the cable doesn't become loose and the connection won't be interrupted.

- ▶ Plug the USB connector into your laptop.
- ▶ Load the software and instruction manual from the supplied CD and start the program.

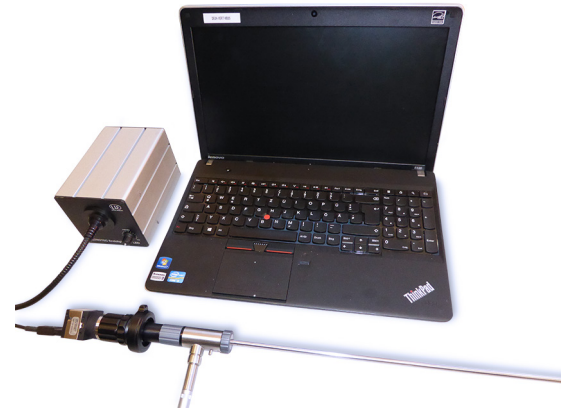


Fig. 15 Final assembly of the endoscope, inclusive USB camera, laptop and light source

#### 4.5 Connecting the Analog Camera

- ▶ Connect the analog camera, see Fig. 14, and the screw-threaded lens.
- ▶ Connect the BNC cable to the analog camera, see Fig. 16, and to the monitor.
- ▶ Connect the power supply to the analog camera and to the power source, see Fig. 16.
- ▶ Connect the remote control unit to the OSD socket, see Fig. 16, in order to fine-tune the camera settings, such as white balance, gamma correction and shutter times.
- ▶ Remove the cable when your adjustments are complete.

The settings will be retained.

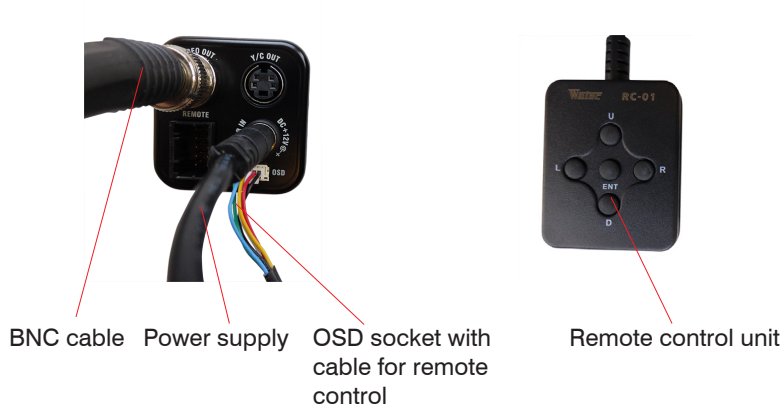


Fig. 16 Connecting the analog camera

Fig. 17 Final assembly of the endoscope, inclusive analog camera, laptop and light source

#### 4.6 Handle for SKF-D and MKF-D Endoscopes

A handle is supplied for use with ELTROTEC SKF-D and MKF-D endoscopes. You are not required to use the handle, it is simply an additional tool for endoscopy.



Fig. 18 Assembling the handle

①	Handle with locking mechanism	④	<ul style="list-style-type: none"> <li>➡ Slide the handle onto the endoscope. It should engage easily.</li> <li>➡ Now flip the handle open.</li> </ul>
②	Optical fiber	⑤	➡ Slide the optical fiber into the handle from below, see Chap. A 1.3.
③	Lemo 1 adapter	⑥	➡ Close the handle.

## 4.7 Light Source

➡ Insert the optical fiber into the fiber optic connection at the light source, see Fig. 19.

Certain optical fibers (such as gooseneck fiber optics with multiple arms) and adapters are equipped with a cam (spin lock) which is kept in place in the ring lock recess to prevent the connected plug from rotating.



Optical fiber    Fiber optic connection

*Fig. 19 Connecting the optical fiber with the light source <sup>1</sup>*



*Fig. 20 Connected optical fiber*

1) Example: ELTROTEC Endolight FOT LED

## 5. Operation

### 5.1 Commissioning

The endoscope is connected to an optical fiber, see Chap. 4.6, and a light source, see Chap. 4.7, or with a hand light source, see Fig. 21, see Chap. A 1.1 .



Fig. 21 Attaching the LED lamp (e.g. ELTROTEC SuperNova LED) to an endoscope

➡ Switch on the light source and insert the endoscope into the part for inspection.

Never look directly at the light source or into the optical fiber.

> Risk of blinding, damage to the eyes

➡ Adjust the light intensity depending on the degree of reflection.

Turn the knurled ring on the eyepiece to adjust the sharpness of the image (focus) for the endoscope. The depth of field (focus) ranges from 3 mm to infinite.

➡ If required, attach the mirror tube.

If using a mirror tube (models PKF-D and SKF-D), you can turn the knurled upper part of the mirror tube to provide a 360° field of view without rotating the central body. The notch in the knurled part of the mirror tube indicates the direction of the mirror.

**⚠ CAUTION**



 Place the endoscope down carefully after use.

Depending on the version (see catalog), the endoscope probe can be rotated.

## 6. Troubleshooting

The following troubleshooting tips are designed to help you solve certain issues on site. If you are unable to fix a problem using these troubleshooting steps, please contact the customer service and return the ELTRO-TEC SKF-D / PKF or MKF-D endoscope to the manufacturer, see Chap. 9.

**NOTICE**

Do not attempt to dismantle the endoscope.

> Damage to or destruction of the endoscope

### 6.1.1 Poor Image Quality

Possible cause	Troubleshooting
The lens of the eyepiece or the lens might be dirty.	 Clean the lens glass or the lens gently to remove stains and dirt.

### 6.1.2 Strong Reflections

Possible cause	Troubleshooting
The light source is set too bright.	 Adjust the intensity of the light source.

### 6.1.3 Image Won't Focus

Possible cause	Troubleshooting
The endoscope probe is positioned too close to the inspected object.	 Keep a larger distance to the inspected object.

### 6.1.4 Image is Hazy and no Longer Circular

Possible cause	Troubleshooting
One or more lenses are broken.	 The endoscope must be sent in for repair.

## 7. Instructions for Operation

### 7.1 Cleaning

- ➡ Clean the ELTROTEC SKF-D / MKF-D or PKF endoscope with a soft, clean cloth, low-pressure compressed air or a cloth moistened with alcohol. Or use the supplied cleaning set.



- ➡ Use low-pressure compressed air to clean the endoscope.

or

- ➡ Use a cotton swab moistened with isopropyl alcohol (cleaning set) to clean the endoscope.

*Fig. 22 Using compressed air or the cleaning set*

- i** We recommend using a cotton swab moistened with alcohol to clean the eyepiece, fiber optic connector and lens. Please use isopropyl alcohol (rubbing alcohol).

If the endoscope comes in contact with foreign materials or substances, it is strongly recommended to clean the endoscope immediately after use, as trying to remove hardened dirt or stains may damage the lens or impact image quality.

#### **NOTICE**

Never use chemical solvents, commercial glass cleaners or other cleaning agents.

> Damage to or destruction of the endoscope

### 7.2 Maintenance

The endoscope does not require regular maintenance activities or calibration.

## 8. Warranty

All components of the device have been checked and tested for perfect function in the factory. In the unlikely event that errors should occur despite our thorough quality control, this should be reported immediately to MICRO-EPSILON Eltrotec.

The warranty period lasts 12 months following the day of shipment. Defective parts, except wear parts, will be repaired or replaced free of charge within this period if you return the device free of cost to MICRO-EPSILON Eltrotec. This warranty does not apply to damage resulting from improper handling or violent action or repairs or modifications by third parties. MICRO-EPSILON is exclusively responsible for repairs.

No other claims, except as warranted, are accepted. MICRO-EPSILON Eltrotec will specifically not be responsible for eventual consequential damages. We reserve the right to make design changes in the interest of further development.

## 9. Service, Repair

If a fault or defect occurs on the ELTROTEC rigid endoscope, please send the affected parts in for repair or replacement.

If the cause of a fault cannot be clearly determined, please always send the complete measurement system to:

MICRO-EPSILON Eltrotec GmbH  
Manfred-Wörner-Straße 101  
73037 Göppingen / Germany

Phone +49 (0) 7161 / 98872-300  
Fax +49 (0) 7161 / 98872-303  
eltrotec@micro-epsilon.de  
www.micro-epsilon.com

## 10. Decommissioning, Disposal

➡ Remove the optical fiber from the endoscope.




Incorrect disposal may cause harm to the environment.

➡ Dispose of the device, its components and accessories, as well as the packaging materials in compliance with the applicable country-specific waste treatment and disposal regulations of the region of use.

## Appendix



### A 1 Accessories

#### A 1.1 Light Sources




Name	Photo	Description	Article number
FOT 20 Halogen	 <p>A small, rectangular blue halogen light source with a black power cord on the left side and a circular lens on the right side. The model number 'FOT 20' is printed on the right side.</p>	High-performance halogen light source, 20 W	20910382
FOT 100 Halogen	 <p>A blue halogen light source with a black top surface. It features a circular lens and a control knob on the top surface. The model number 'FOT 100' is printed on the top surface.</p>	High-performance halogen light source, 100 W	20910403
FOT 150 Halogen	 <p>A blue halogen light source with a black top surface and a black handle on top. It features a circular lens and a control knob on the top surface. The model number 'FOT 150' is printed on the top surface.</p>	High-performance halogen light source, 150 W	20910384

Name	Photo	Description	Item number
ELTROTEC Endolight FOT LED		High performance LED light source	20912110
ELTROTEC Endolight FOT Xenon		Xenon light source, 24 W	20911638
ELTROTEC SuperNova LED		LED light source	20752293
LED hand-held light source		LED light source	20752105

**A 1.2 Mirror Tube**

<b>Name</b>	<b>Photo</b>	<b>Description</b>	<b>Item number</b>
Mirror tube for standard endoscopes		90° deflection; rotatable stainless steel tube 360°; prism-shaped mirror	Different models
Mirror tube for Eltrotec PKF		Rotatable stainless steel tube 360°; prism-shaped mirror 65° / 90° and 110° deflection	Different models

**A 1.3 Fiber-optic Cables**

Name	Photo	Description	Item number
EL 1/4 1800 MEP with Lemo 1 adapter		Glass fibers with high packing density; total length of fiber bundle 4 mm/1800 mm; protective metal tubing with PVC coating	20710831
EL 1/4 1800 MEP/S with Lemo 1 adapter		Additional versions available on request!	20711767
Liquid light conductor FL 1/4 1800 MEP with Lemo 1 adapter		Approximately 30% improved transmission; lighting bundle Ø 4 mm; protective tube with PVC coating	20710446
Liquid light conductor FL 1/4 1800 MEP/S incl. universal adapter		Additional versions available on request!	20711803
Adapter Lemo 1 to optical fiber			21061030

## A 1.4 Cameras

Name	Photo	Description	Item number
Analog color CCD camera CA1/3		One-cable connection; white balancing	20962182
Analog color CCD camera Endo CA1/3		Camera parameters can be set via cable remote control; external power supply	20961577
Analog color CCD camera Endo CA1/2			20962287
USB 2.0 color camera Endo CU1/3		Includes software for image display and storage. Power supplied via USB interface; different resolutions available	20961601

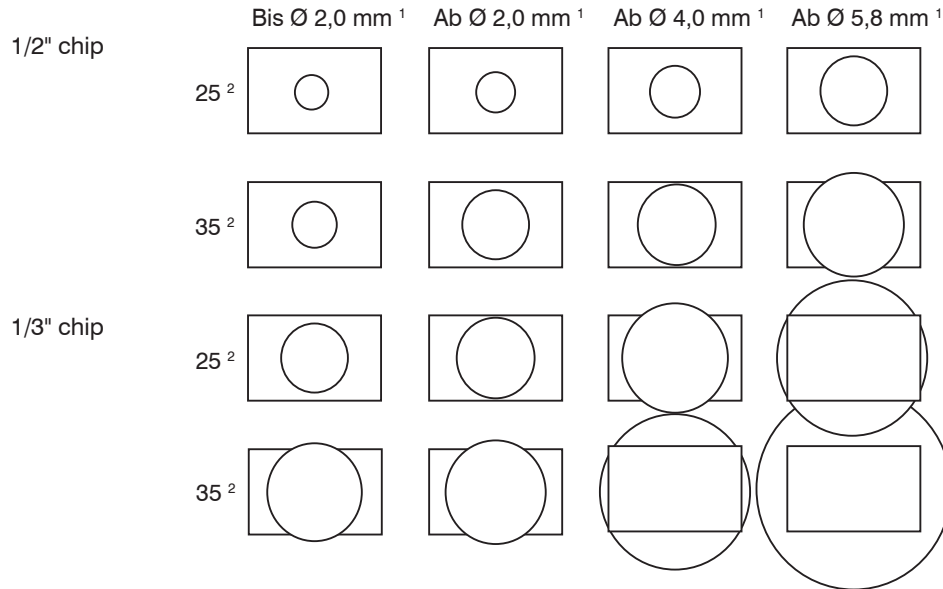


### A 1.5 Lenses

To achieve the optimum image display size on the monitor, the lens must be selected to suit the camera chip and the diameter of the endoscope.

You will find different lenses on the following pages.

**Example:** An endoscope with a 2.8 mm diameter is used in conjunction with a USB camera containing a 1/3 camera chip. We recommend using a 25 mm lens to get a full-size image.



*Fig. 23 Lens selection criteria*

Small CCD chip - small focal length/larger endoscope diameter - shorter focal length

1) Endoscope diameter 2) Lens focal length

Name	Photo	Description	Item number
C-mount TV lens with quick release. Adjustable focus and focal length		Focal length f: 32 - 47 mm; suitable for all endoscope types with a $\varnothing$ 32 mm eye cup	20961001
		Focal length f: 18 - 35 mm; suitable for all endoscope types with a $\varnothing$ 32 mm eye cup	20962209
C-mount TV lens (fixed focal length)		32 mm focal length, M14x1 for rigid endoscopes SKF-D and MKF-D with a $\varnothing$ of 5.8 mm or higher	20961426
		Focal length f: 47 mm, M14x1 for rigid endoscopes SKF-D up to a $\varnothing$ of 4.0 mm	20961055
		Focal length f: 32 mm, M12x1 for endoscopes MTFS and ME	20960088
		Focal length f: 47 mm, M12x1 for PKF endoscopes	20960099

Name	Photo	Description	Item number
C-mount TV lens with quick release		Focal length f: 20; suitable for all endoscope types with a $\varnothing$ 32 mm eye cup	20751998
		Focal length f: 25; suitable for all endoscope types with a $\varnothing$ 32 mm eye cup	20751488
		Focal length f: 35; suitable for all endoscope types with a $\varnothing$ 32 mm eye cup	20751225
Camera adapter with quick release		Type DCC 37 mm; for $\varnothing$ 32 mm eye cups	20751552
		Type DCC 58 mm; for $\varnothing$ 32 mm eye cups	20751716
Lens spacer rings (all standard sizes available)		M37/M27 to M58/M72	Different models

Name	Photo	Description	Item number
Angled eyepiece / 90° AE9003		Attachable to all endoscope eye- pieces of the Top-Line series with a $\varnothing$ 32 mm eye cup	20751227







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