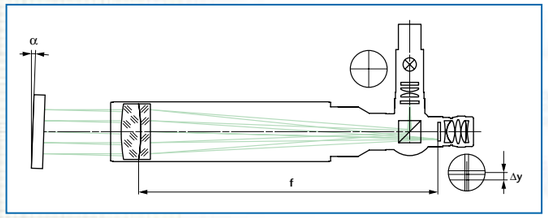
AUTOCOLLIMATORS
INTRODUCTION

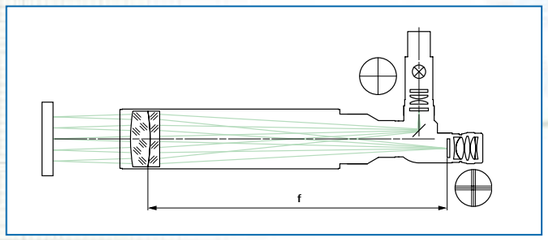
Layout and principle of operation

An autocollimation telescope (autocollimator) combines the function of a collimator and a telescope in one unit. The collimator and telescope share the same optical path, which is accomplished using either a physical or geometrical beam splitter.

The illustration below shows the schematic set-up of an autocollimator with straight viewing, a physical beam splitter and infinity adjustment. The autocollimation telescope projects the image of the collimator reticle to infinity. A target mirror, located in the beam path of the autocollimator objective, returns the projected image into the autocollimator and creates an image of the collimator reticle via the beam splitter in the eyepiece reticle plane (autocollimation image).
The mechanical (objective tube) axis is adjusted to the optical axis with angle accuracy of ±30 µm/*f* for autocollimators with *f*≤300 mm. The reticle adjustment amount ±10 µm.



An autocollimator with geometrical beam splitter is arranged similarly (see illustration below). The collimator reticle is reflected into the beam path by the path-folding mirror which has a small angle in relation to the optical axis. The beam reflected off the target mirror passes below the path-folding mirror and produces an image of the collimator reticle in the eyepiece reticle plane.



Calculation of the angles

An autocollimator can be used to measure the angle of a mirror in two axes with respect to the optical axis of the autocollimator. If the mirror is exactly perpendicular to the optical axis, the beam is reflected upon itself. If the mirror is tilted by the angles α_x and α_y, the reflected beam enters the objective obliquely. Depending on the amount of tilt, the autocollimation image in the eyepiece reticle plane is displaced to a greater or lesser amount. The displacement Δx and Δy of the autocollimation image in X and Y direction provides a measure of the angular displacement of the mirror:

$$\alpha_x = \arctan\left(\frac{\Delta x}{2f}\right) \approx \frac{\Delta x}{2f}$$

$$\alpha_y = \arctan\left(\frac{\Delta y}{2f}\right) \approx \frac{\Delta y}{2f}$$

f: focal length of the autocollimation objective.

Numerical example:
A displacement of the reticle image of 3 mm measured with an autocollimator with 300 mm focal length corresponds to a tilting angle of:

$\alpha \approx 3/2/300 \text{ rad} = 5 \cdot 10^{-3} \text{ rad} = 0{,}2865° = 17'11''$.

The image displacement of 10 µm in the reticle plane corresponds to an angular tilt of:

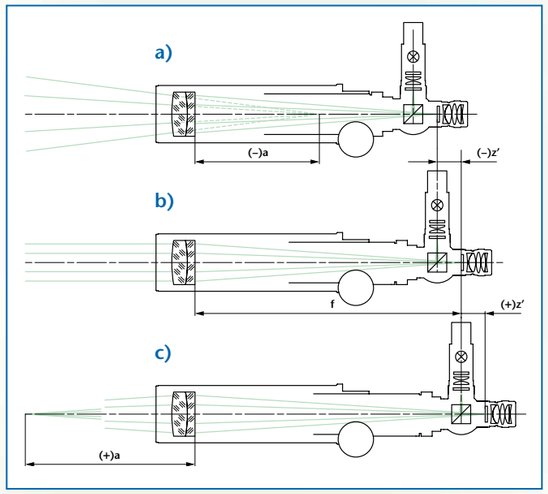
Focal length	Angular tilt
50 mm	21″
90 mm	11″
140 mm	7,4″
200 mm	5,2″
300 mm	3,4″
500 mm	2,1″
600 mm	1,7″
1100 mm	0,9″

Adjustable Focus

Autocollimators with adjustable distance between reticle and objective are also available. This adjustment by the user allows objective focus at distances other than infinity. If the reticle is displaced out of the focal plane by a distance z', then the autocollimator is focused at a distance a according to:

$$a = \frac{f'^2 + z'f}{z'}$$

$z'<0$ corresponds to a decrease of the distance between objective and reticle. The resulting image distance is negative (virtual object position) (a).
$z'>0$ corresponds to a real image with positive object distance (c).
$z'=0$ produces an image at infinite distance (b).



Selection criteria

Long or short focal length?
Depending on the magnification of the instrument a longer focal length leads to a greater measuring sensitivity and measurement accuracy. As the focal length increases, the measuring range decreases proportionally. A longer focal length affects the mechanical extension of the tube, as well.

Small or large objective aperture?
Light conditions are more favourable when large apertures are used, and the evaluation of the results is easier and more accurate. A long distance between mirror and autocollimator or a partially reflective surface demands a relatively large free aperture (or aperture ratio). For these measurements a relatively large aperture diameter should be used.

Geometrical or physical beam splitter?
The geometrical beam splitter results in smaller image angles, but greater image brightness and less stray light. These autocollimators are used mainly with small targets. Due to their internal layout, these autocollimators cannot be used for measurement of triple mirrors or corner cubes. In most cases an autocollimator with physical beam splitter is recommended, due to the larger measuring range of this configuration.

Fixed or variable distance setting?
The measurement of the angles of plane mirrors in autocollimation is made with a parallel, or infinity focus, beam. Fixed, infinite focus is generally the best choice. For measurement tasks requiring an adjustable focal distance, use an objective tube with focus adjustment. Fixed focus tubes set at other than infinity can be ordered.

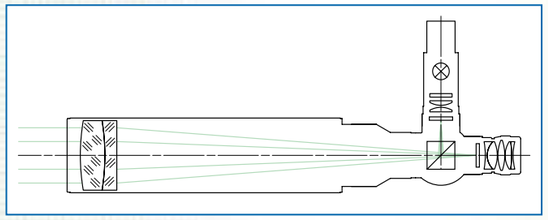
Eyepiece focal length?
In contrast to eyepiece with f=14,7 mm eyepiece with f=10 mm gives a larger magnification but lesser FOV and eyepiece with f=25 mm gives a smaller magnification but larger FOV. In case a C-Mount–Camera adapter should be used, the eyepieces f=14,7 or f=25 mm must be selected.

AUTOCOLLIMATORS

STRAIGHT VIEWING

Description:
For a general description of the principle of functioning see page 42.

An autocollimator with straight viewing has the user's line of sight co-linear with the objective axis. These autocollimators are preferably used in horizontal direction, where the eyepiece is at eye level. In a down-looking arrangement or on optical table 90°- or 60°-viewing is often more suitable.



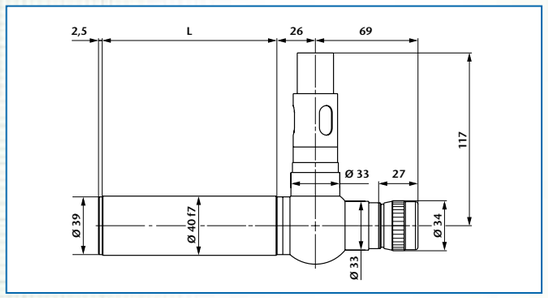
Application areas:
- Measurement of angular tilt
- Measurement of parallelism of plane plates
- Adjustment of optical elements
- Qualitative testing of the imaging properties of optical elements and systems

Notes on ordering:
- Optionally, the autocollimators can be equipped with an eyepiece having 10 mm or 25 mm focal length.
- Two reticles, 6V/5W illumination w/cord, and eyepiece are included.
- If not specified otherwise, the autocollimator is adjusted to infinity at 546 nm wavelength. Adjustment to other distances or wavelengths is also possible on demand.
- The nomenclature of the autocollimators with straight viewing is as follows:

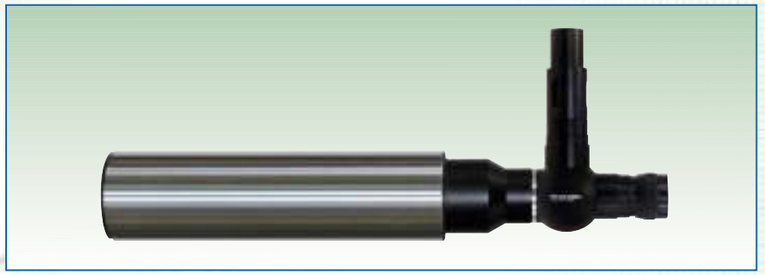
Example: AK G 50/ 40/ 14,7

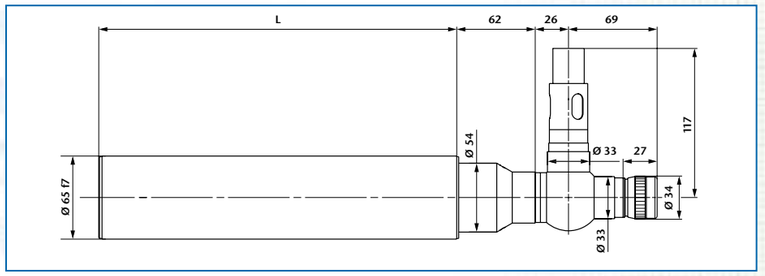
- AK: Autocollimator
- G: Straight viewing
- 50/: Focal length
- 40/: Tube diameter
- 14,7: Eyepiece focal length

Important:
Please specify collimator reticle and eyepiece reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.

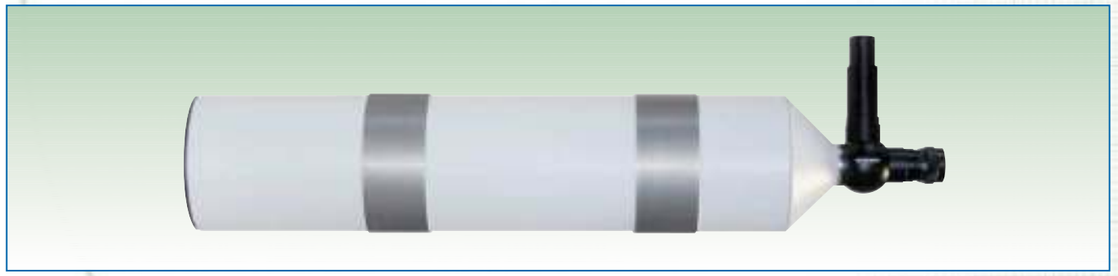


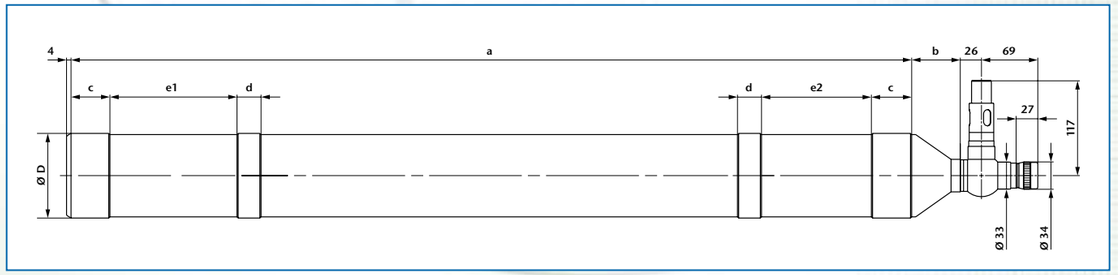
Ord.-No.	Description	Focal length	Free aperture	Meas. range	L
229 001	AKG 50/40/14,7	50	10	5,0°	65
229 002	AKG 90/40/14,7	90	16	3,0°	65
229 003	AKG 140/40/14,7	140	28	2,0°	118
229 004	AKG 200/40/14,7	200	28	1,5°	173
229 005	AKG 300/40/14,7	300	28	1,0°	274
229 006	AKG 500/40/14,7	500	28	0,5°	474





Ord.-No.	Description	Focal length	Free aperture	Meas. range	L
229 007	AKG 300/65/14,7	300	50	1,0°	233
229 008	AKG 500/65/14,7	500	50	0,5°	415
229 010	AKG 500T/65/14,7	500	50	0,5°	233





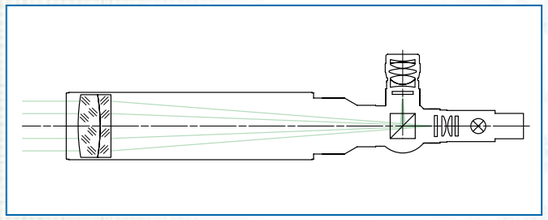
Ord.-No.	Description	Focal length	Free aperture	Meas. range	D	a	b	c	d	e1	e2
229 012	AKG 600/128/14,7	600	100	0,40°	Ø 128 f7	530	46	–	58	154	78
229 013	AKG 1100/105/14,7	1100	78	0,25°	Ø 105 f7	1045	66	50	30	165	100

AUTOCOLLIMATORS

90°-VIEWING

Description:
For a general description of the principle of functioning see page 42.

An autocollimator with right angle viewing has the user's line of sight at 90° to the objective axis. These autocollimators are preferably used down-looking on optical tables where a straight viewing is not feasible.



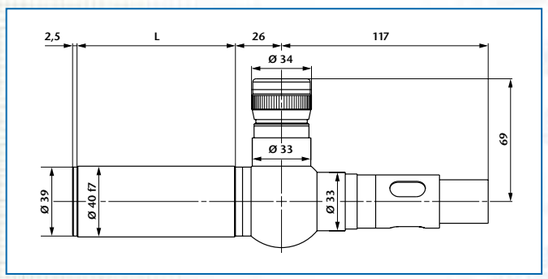
Application areas:
- Measurement of angular tilt
- Measurement of parallelism of plane plates
- Adjustment of optical elements
- Qualitative testing of the imaging properties of optical elements and systems

Notes on ordering:
- Optionally, the autocollimators can be equipped with an eyepiece having 10 mm or 25 mm focal length.
- Two reticles, 6V/5W illumination w/cord, and eyepiece are included.
- If not specified otherwise, the autocollimator is adjusted to infinity at 546 nm wavelength. Adjustment to other distances or wavelengths is also possible on demand.
- The nomenclature of the autocollimators with 90°-viewing is as follows:

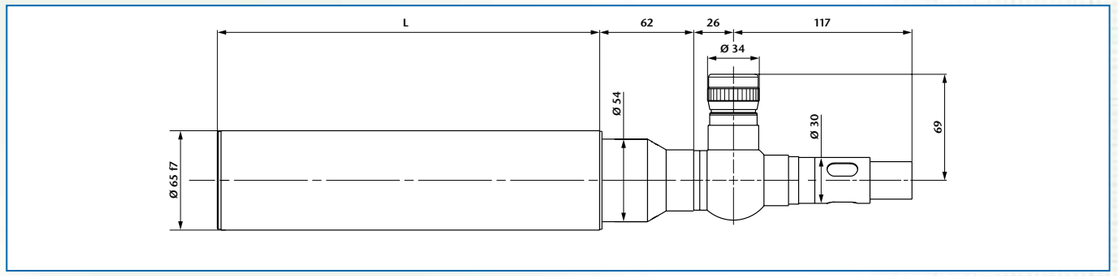
Example: AK R 50/ 40/ 14,7

- AK: Autocollimator
- R: 90° viewing
- 50/: Focal length
- 40/: Tube diameter
- 14,7: Eyepiece focal length

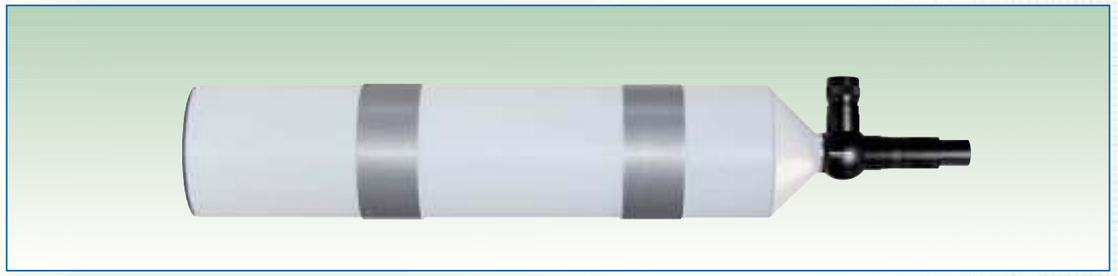
Important:
Please specify collimator reticle and eyepiece reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.
Please specify direction of use if reticles with lettering (e.g. coordinate division etc.) are used so that the lettering will be right-side-up.

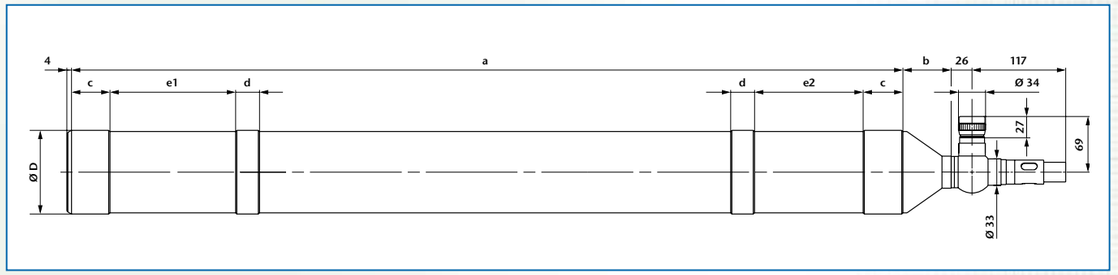


Ord.-No.	Description	Focal length	Free aperture	Meas. range	L
229 201	AKR 50/40/14,7	50	10	5,0°	65
229 202	AKR 90/40/14,7	90	16	3,0°	65
229 203	AKR 140/40/14,7	140	28	2,0°	118
229 204	AKR 200/40/14,7	200	28	1,5°	173
229 205	AKR 300/40/14,7	300	28	1,0°	274
229 206	AKR 500/40/14,7	500	28	0,5°	474



Ord.-No.	Description	Focal length	Free aperture	Meas. range	L
229 207	AKR 300/65/14,7	300	50	1,0°	233
229 208	AKR 500/65/14,7	500	50	0,5°	415
229 210	AKR 500T/65/14,7	500	50	0,5°	233





Ord.-No.	Description	Focal length	Free aperture	Meas. range	D	a	b	c	d	e1	e2
229 212	AKR 600/128/14,7	600	100	0,40°	Ø 128 f7	530	46	–	58	154	78
229 213	AKR 1100/105/14,7	1100	78	0,25°	Ø 105 f7	1045	66	50	30	165	100

AUTOCOLLIMATORS

60°-VIEWING/60°-VIEWING WITH DOUBLE MICROMETER

Description:
The function and layout resemble an autocollimator with 90°-viewing (see page 46).

The 60°-viewing is used in a horizontal position where the angled eyepiece is more ergonomic. In addition to the standard autocollimator with collimator and eyepiece reticle (see fig. A) versions with mechanical (see fig. B) or digital micrometer (see fig. C) are available as well.

For a general description of the principle of functioning of autocollimators with double micrometer see page 42 or 54, too.

The scale division (SD) of the mechnical double micrometer is 5 µm.

Fig. A

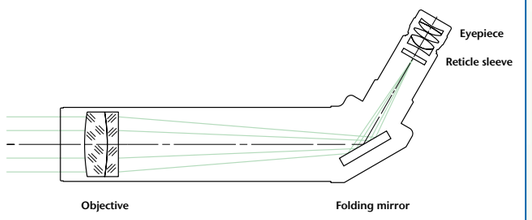


Fig. B

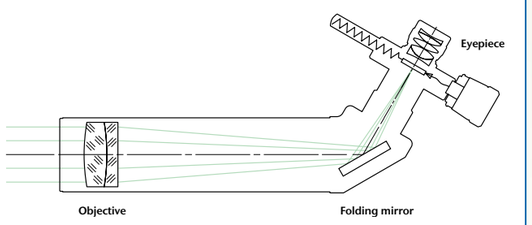
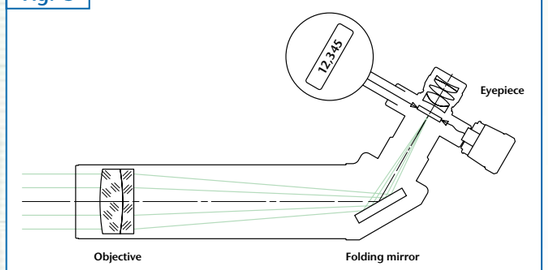


Fig. C



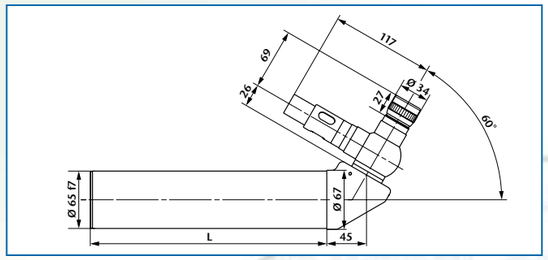
Application areas:
- Measurement of angular tilt
- Measurement of parallelism of plane plates
- Adjustment of optical elements
- Qualitative testing of the imaging properties of optical elements and systems

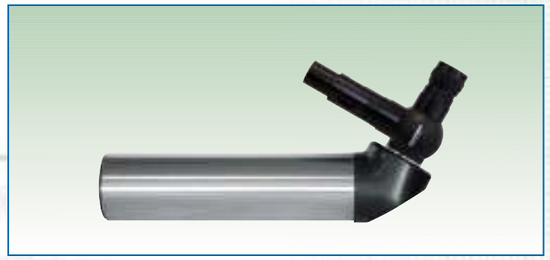
Notes on ordering:
- Optionally, the autocollimators can be equipped with an eyepiece having 10 mm or 25 mm focal length.
- Two reticles, 6V/5W illumination w/cord, and eyepiece are included.
- If not specified otherwise, the autocollimator is adjusted to infinity at 546 nm wavelength. Adjustment to other distances or wavelengths is also possible on demand.
- Specify the unit of display of the digital gauges (mm, arcsec oder mrad).
- The nomenclature of the autocollimators with 60°-viewing and 60° viewing with double micrometer respectively is as follows:

Example:	AK	W	300/	65/	14,7	MD / MDD
	Autocollimator					
		60° viewing				
			Focal length			
				Tube diameter		
					Eyepiece focal length	
						Double micrometer
						Digital double micrometer

Important:
Please specify collimator reticle and eyepiece reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.

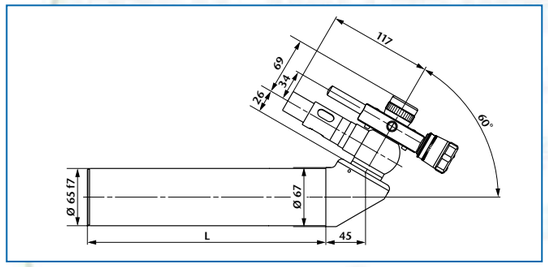
60°-VIEWING



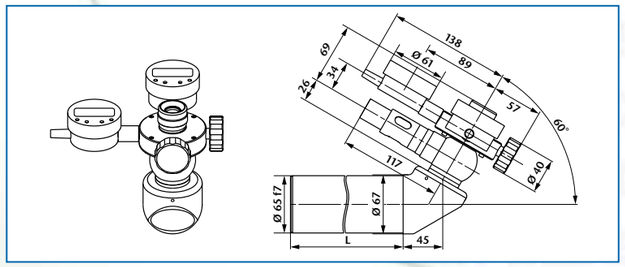


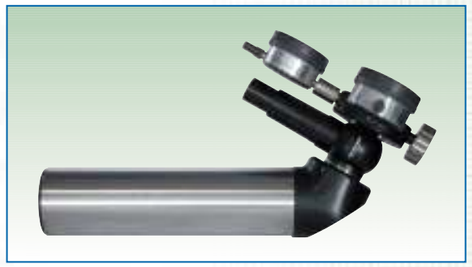
Ord.-No.	Description	Focal length	Free aperture	Meas. range	L
229 027	AKW 300/65/14,7	300	50	1,0°	233
229 028	AKW 500/65/14,7	500	50	0,5°	415
229 030	AKW 500T/65/14,7	500	50	0,5°	233

60°-VIEWING WITH DOUBLE MICROMETER



Ord.-No.	Description	Focal length	Free aperture	Meas. range	SD	L
229 169	AKW 300/65/14,7 MD	300	50	0,3°	2,0″	233
229 170	AKW 500/65/14,7 MD	500	50	0,2°	1,0″	415
229 171	AKW 500T/65/14,7 MD	500	50	0,2°	1,0″	233





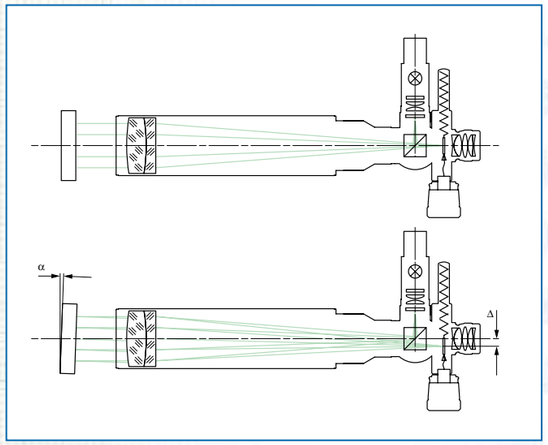
Ord.-No.	Description	Focal length	Free aperture	Meas. range	Resolution	L
229 107	AKW 300/65/14,7 MDD	300	50	0,50°	0,5 arcsec	233
229 108	AKW 500/65/14,7 MDD	500	50	0,25°	0,2 arcsec	415
229 110	AKW 500T/65/14,7 MDD	500	50	0,25°	0,2 arcsec	233

AUTOCOLLIMATORS

STRAIGHT VIEWING – WITH DOUBLE MICROMETER

Description:
For a general description of the principle of functioning see page 42.

An autocollimator with a micrometer driven eyepiece reticle can directly read reticle displacement for higher accuracy compared to a fixed reticle. By using the formula given on page 42 this displacement can be converted into angular tilt of the reflector. The scale division (SD) of the micrometer drums is 5 µm.



Notes on ordering:

- Optionally, the autocollimators can be equipped with an eyepiece having 10 mm or 25 mm focal length.
- Two reticles, 6V/5W illumination w/cord, and eyepiece are included.
- If not specified otherwise, the autocollimator is adjusted to infinity at 546 nm wavelength. Adjustment to other distances or wavelengths is also possible on demand.
- The nomenclature of the autocollimators with straight viewing and double micrometer is as follows:

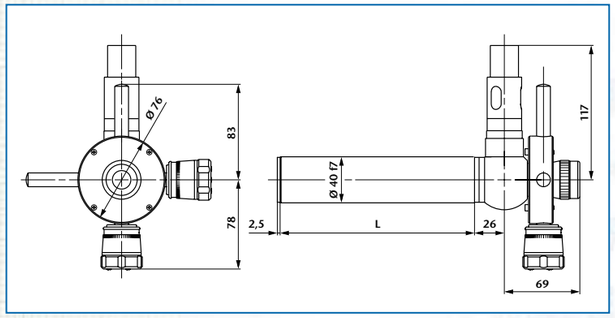
Example: AK G 50/ 40/ 14,7 MD

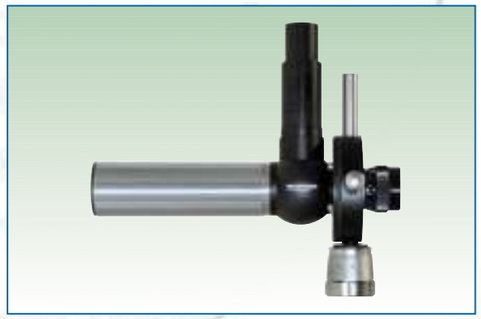
- AK – Autocollimator
- G – Straight viewing
- 50/ – Focal length
- 40/ – Tube diameter
- 14,7 – Eyepiece focal length
- MD – Double micrometer

Important:
Please specify collimator reticle and eyepiece reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.

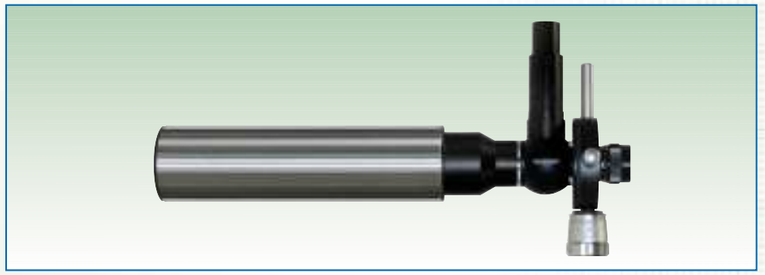
Application areas:

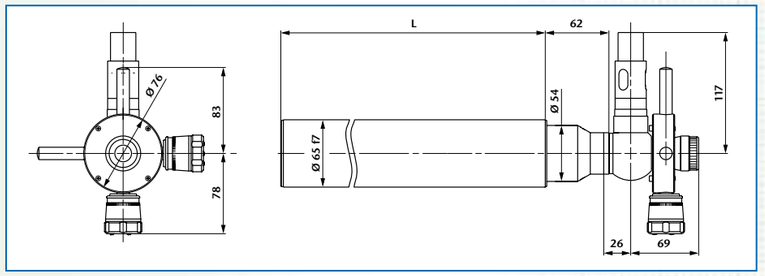
- Measurement of angular tilt
- Measurement of parallelism of plane plates
- Straightness measurement of guide ways (manually)



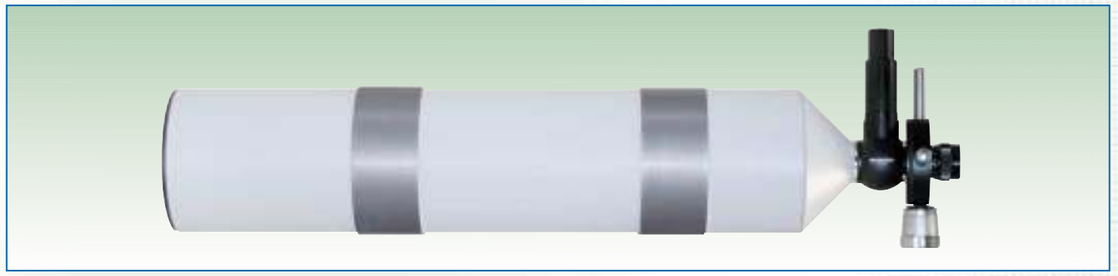


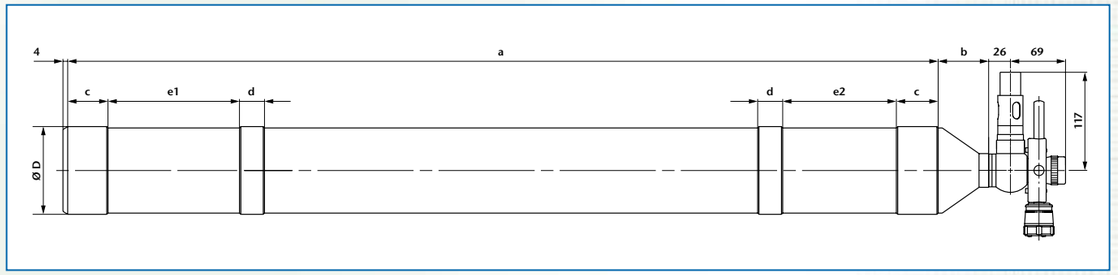
Ord.-No.	Description	Focal length	Free aperture	Meas. range	SD	L
229 155	AKG 50/40/14,7 MD	50	10	1,6°	20,0″	65
229 156	AKG 90/40/14,7 MD	90	16	1,0°	11,5″	65
229 157	AKG 140/40/14,7 MD	140	28	0,6°	7,5″	118
229 158	AKG 200/40/14,7 MD	200	28	0,4°	5,0″	173
229 159	AKG 300/40/14,7 MD	300	28	0,3°	3,5″	274
229 160	AKG 500/40/14,7 MD	500	28	0,2°	2,0″	474





Ord.-No.	Description	Focal length	Free aperture	Meas. range	SD	L
229 161	AKG 300/65/14,7 MD	300	50	0,3°	2,0″	233
229 162	AKG 500/65/14,7 MD	500	50	0,2°	1,0″	415
229 163	AKG 500T/65/14,7 MD	500	50	0,2°	1,0″	233





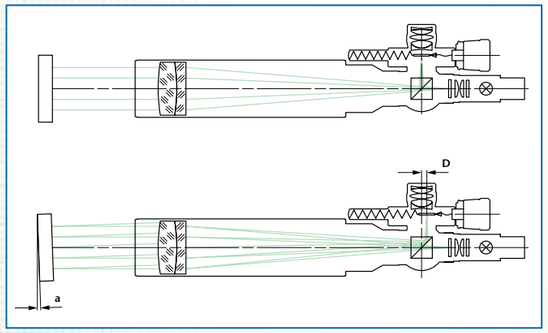
Ord.-No.	Description	Focal length	Free aperture	Meas. range	SD	D	a	b	c	d	e1	e2
229 165	AKG 600/128/14,7 MD	600	100	0,15°	0,85″	Ø 128 f7	530	46	–	58	154	100
229 164	AKG 1100/105/14,7 MD	1100	78	0,08°	0,50″	Ø 105 f7	1045	66	50	30	165	78

AUTOCOLLIMATORS

90°-VIEWING – WITH DOUBLE MICROMETER

Description:
For a general description of the principle of functioning see page 42.

An autocollimator with a micrometer driven eyepiece reticle can directly read reticle displacement for higher accuracy compared to a fixed reticle. By using the formula given on page 42 this displacement can be converted into angular tilt of the reflector. The scale division (SD) of the micrometer drums is 5 µm.



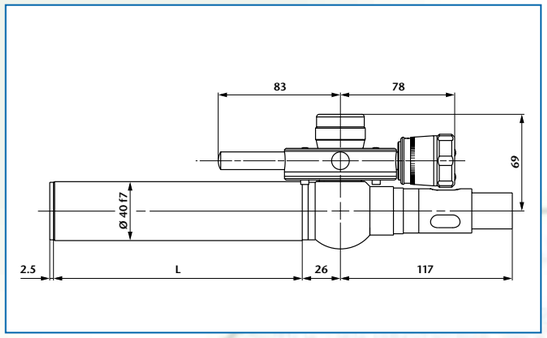
Application areas:
- Measurement of angular tilt
- Measurement of parallelism of plane plates
- Straightness measurement of guide ways (manually)

Notes on ordering:
- Optionally, the autocollimators can be equipped with an eyepiece having 10 mm or 25 mm focal length.
- Two reticles, 6V/5W illumination w/cord, and eyepiece are included.
- If not specified otherwise, the autocollimator is adjusted to infinity at 546 nm wavelength. Adjustment to other distances or wavelengths is also possible on demand.
- The nomenclature of the autocollimators with 90°-viewing and double micrometer is as follows:

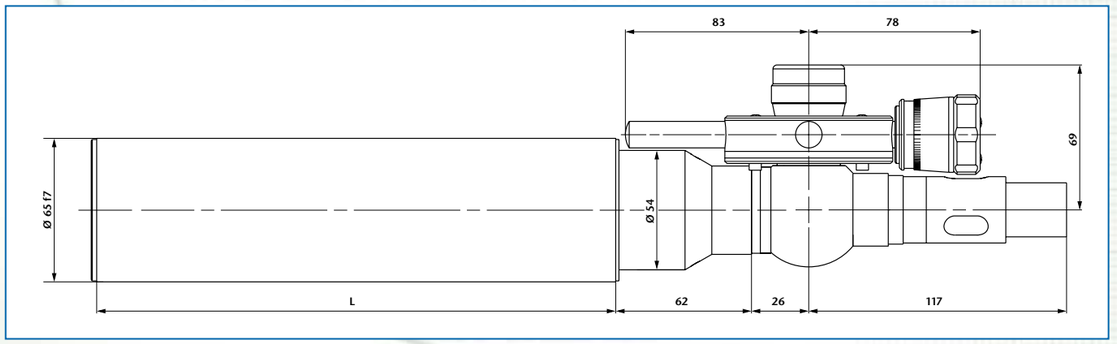
Example: AK R 50/ 40/ 14,7 MD

- AK – Autocollimator
- R – 90° viewing
- 50/ – Focal length
- 40/ – Tube diameter
- 14,7 – Eyepiece focal length
- MD – Double micrometer

Important:
Please specify collimator reticle and eyepiece reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.
Please specify direction of use if reticles with lettering (e.g. coordinate division etc.) are used so that the lettering will be right-side-up.



Ord.-No.	Description	Focal length	Free aperture	Meas. range	SD	L
229 271	AKR 50/40/14,7 MD	50	10	1,6°	10,0″	65
229 272	AKR 90/40/14,7 MD	90	16	1,0°	5,5″	65
229 273	AKR 140/40/14,7 MD	140	28	0,6°	3,5″	118
229 274	AKR 200/40/14,7 MD	200	28	0,4°	2,5″	173
229 275	AKR 300/40/14,7 MD	300	28	0,3°	2,0″	274
229 276	AKR 500/40/14,7 MD	500	28	0,2°	1,0″	474



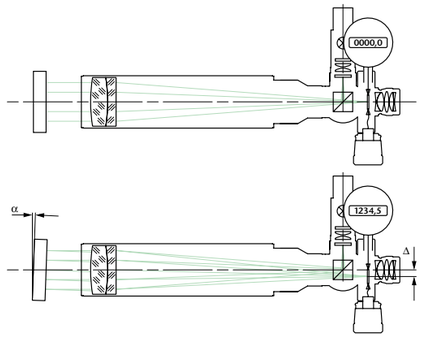
Ord.-No.	Description	Focal length	Free aperture	Meas. range	SD	L
229 277	AKR 300/65/14,7 MD	300	50	0,3°	2,0″	233
229 278	AKR 500/65/14,7 MD	500	50	0,2°	1,0″	415
229 280	AKR 500T/65/14,7 MD	500	50	0,2°	1,0″	233

AUTOCOLLIMATORS

STRAIGHT VIEWING – WITH DIGITAL DOUBLE MICROMETER

Description:
For a general description of the principle of functioning see page 42.

An autocollimator with a micrometer driven eyepiece reticle can directly read reticle displacement for higher accuracy compared to a fixed reticle.
In place of the micrometer drums above, optionaly, programmable digital gauges allow direct reading of the tilting angle in arcsec or milliradians (see page 42 for converting the displacement into angular tilt of the reflector).



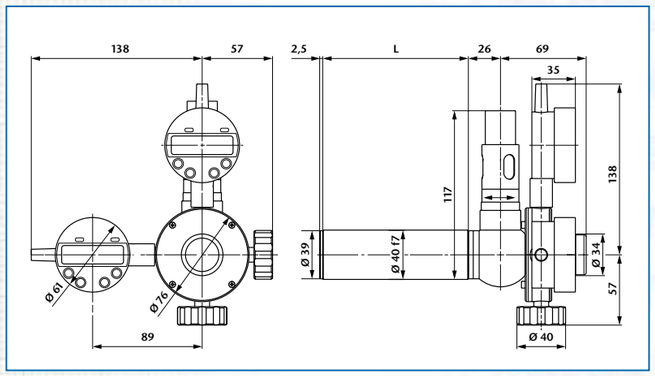
Application areas:
- Measurement of angular tilt
- Measurement of parallelism of plane plates

Notes on ordering:
- Optionally, the autocollimators can be equipped with an eyepiece having 10 mm or 25 mm focal length.
- Two reticles, 6V/5W illumination w/cord, and eyepiece are included.
- If not specified otherwise, the autocollimator is adjusted to infinity at 546 nm wavelength. Adjustment to other distances or wavelengths is also possible on demand.
- Specify the unit of display of the digital gauges (mm, arcsec, milliradians).
- The nomenclature of the autocollimators with straight viewing and digital double micrometer is as follows:

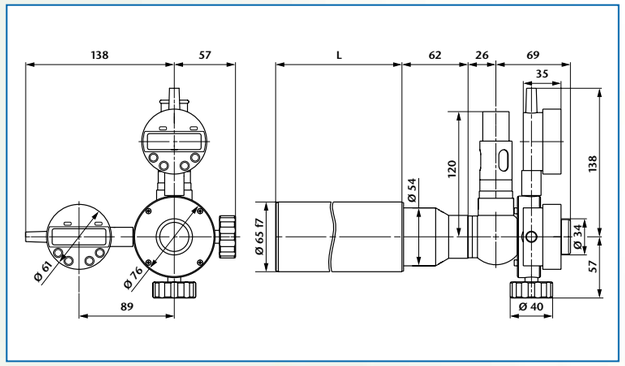
Example: AK G 50/ 40/ 14,7 MDD

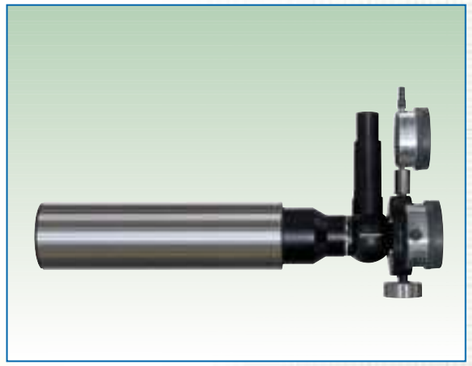
- AK – Autocollimator
- G – Straight viewing
- 50 – Focal length
- 40 – Tube diameter
- 14,7 – Eyepiece focal length
- MDD – Digital double micrometer

Important:
Please specify collimator reticle and eyepiece reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.

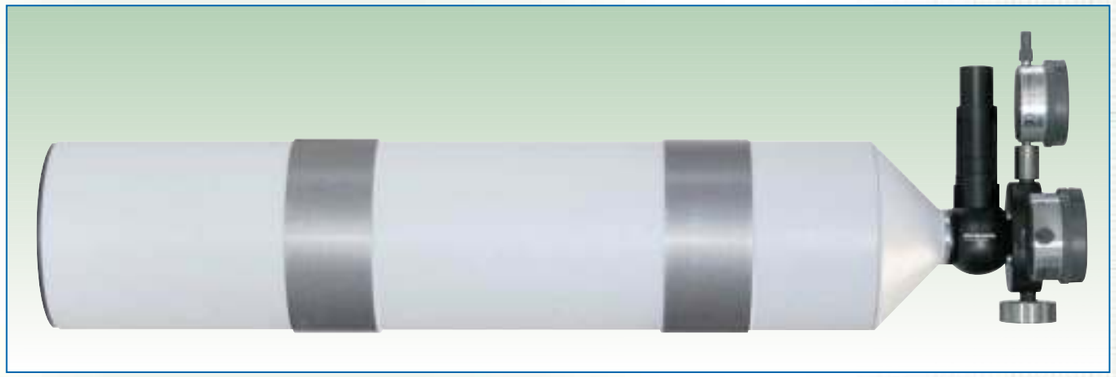


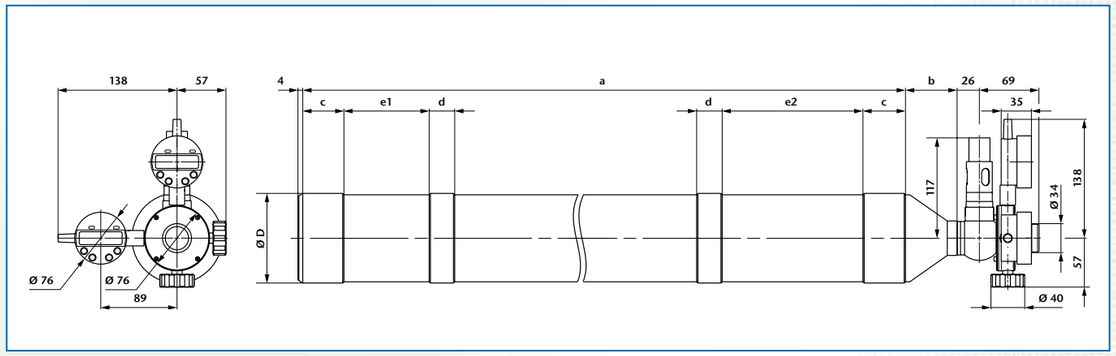
Ord.-No.	Description	Focal length	Free aperture	Meas. range	Resolution	L
229 081	AKG 50/40/14,7 MDD	50	10	2,80°	2,0″	65
229 082	AKG 90/40/14,7 MDD	90	16	1,50°	1,0″	65
229 083	AKG 140/40/14,7 MDD	140	28	1,00°	1,0″	118
229 084	AKG 200/40/14,7 MDD	200	28	0,70°	0,5″	173
229 085	AKG 300/40/14,7 MDD	300	28	0,50°	0,5″	274
229 086	AKG 500/40/14,7 MDD	500	28	0,25°	0,2″	474





Ord.-No.	Description	Focal length	Free aperture	Meas. range	Resolution	L
229 087	AKG 300/65/14,7 MDD	300	50	0,50°	0,5″	233
229 088	AKG 500/65/14,7 MDD	500	50	0,25°	0,2″	415
229 090	AKG 500T/65/14,7 MDD	500	50	0,25°	0,2″	233





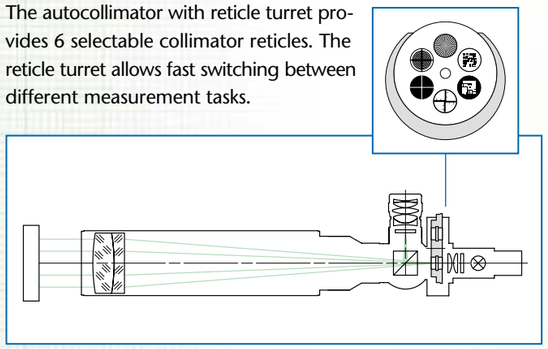
Ord.-No.	Description	Focal length	Free aperture	Meas. range	Resolution	D	a	b	c	d	e1	e2
229 092	AKG 600/128/14,7 MDD	600	100	0,20°	0,2″	Ø 128 f7	530	46	–	58	154	78
229 093	AKG 1100/105/14,7 MDD	1100	78	0,08°	0,1″	Ø 105 f7	1045	66	50	30	165	100

AUTOCOLLIMATORS

90°-VIEWING – WITH RETICLE TURRET

Description:
For a general description of the principle of functioning see page 42.

The autocollimator with reticle turret provides 6 selectable collimator reticles. The reticle turret allows fast switching between different measurement tasks.



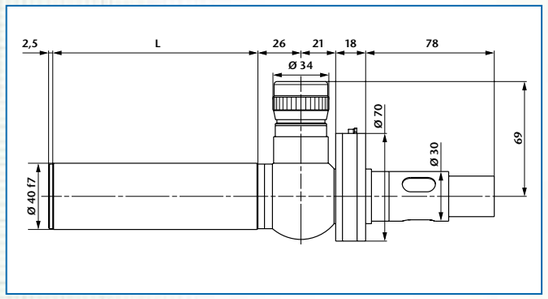
Application areas:
- Measurement of angular tilt
- Testing of the infinity setting of camera objectives
- Qualitative testing of the imaging properties of optical elements and systems
- Fast testing of wedges and plane parallel plates with pinhole diaphragm turret

Notes on ordering:
- Optionally, the autocollimators can be equipped with an eyepiece having 10 mm or 25 mm focal length.
- Reticles, 6V/5W illumination w/cord, and eyepiece are included.
- In contrast to autocollimators with only one collimator and one eyepiece reticle the optical axis can not be adjusted to its mechanical (tube) axis.
- If not specified otherwise, the autocollimator is adjusted to infinity at 546 nm wavelength. Adjustment to other distances or wavelengths is also possible on demand.
- The nomenclature of the autocollimators with 90°-viewing and with reticle turret is as follows:

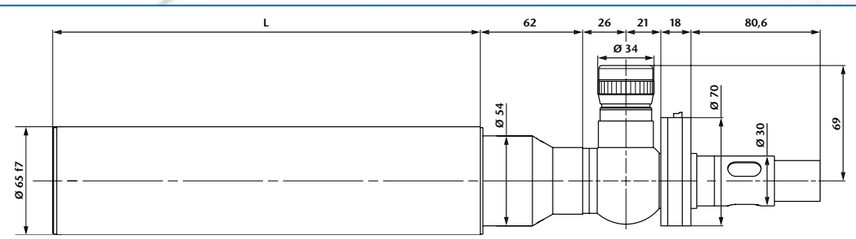
Example: AK R 50/ 40/ 14,7 SW

- AK – Autocollimator
- R – 90° viewing
- 50/ – Focal length
- 40/ – Tube diameter
- 14,7 – Eyepiece focal length
- SW – Reticle turret

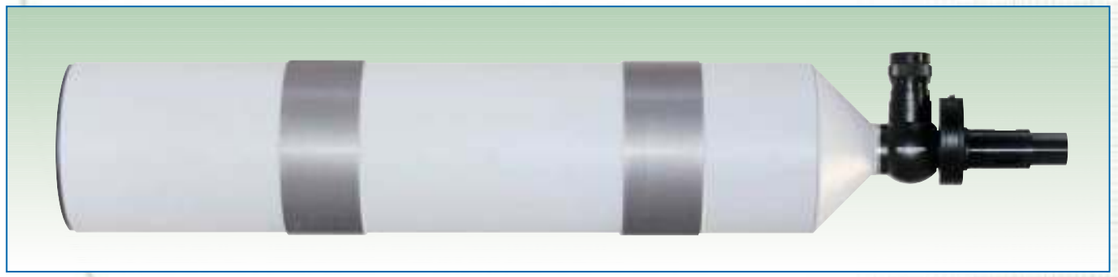
Important:
Please specify six collimator reticles and one eyepiece reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.
Please specify direction of use if reticles with lettering (e.g. coordinate division etc.) are used so that the lettering will be right-side-up.

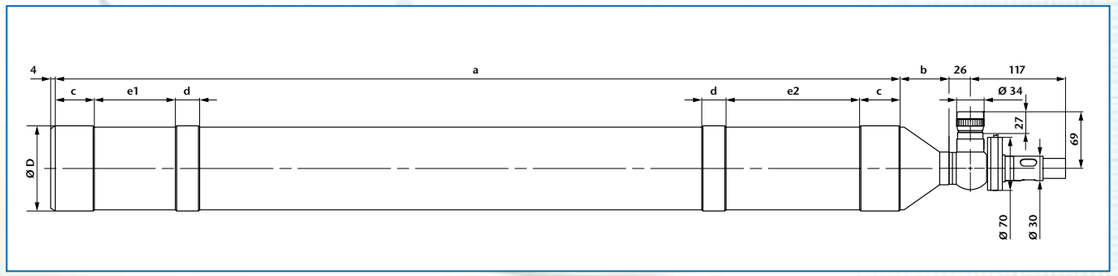


Ord.-No.	Description	Focal length	Free aperture	Meas. range	L
229 281	AKR 50/40/14,7 SW	50	10	5,0°	65
229 282	AKR 90/40/14,7 SW	90	16	3,0°	65
229 283	AKR 140/40/14,7 SW	140	28	2,0°	118
229 284	AKR 200/40/14,7 SW	200	28	1,5°	173
229 285	AKR 300/40/14,7 SW	300	28	1,0°	274
229 286	AKR 500/40/14,7 SW	500	28	0,5°	474



Ord.-No.	Description	Focal length	Free aperture	Meas. range	L
229 287	AKR 300/65/14,7 SW	300	50	1,0°	65
229 288	AKR 500/65/14,7 SW	500	50	0,5°	65
229 290	AKR 500T/65/14,7 SW	500	50	0,5°	118



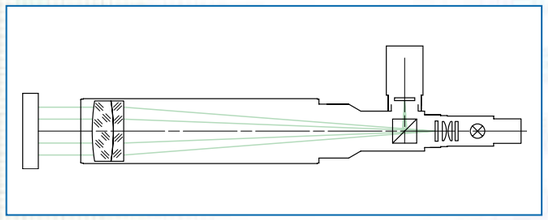


Ord.-No.	Description	Focal length	Free aperture	Meas. range	D	a	b	c	d	e1	e2
229 292	AKR 600/128/14,7 SW	600	100	0,40°	Ø 128 f7	530	46	–	58	154	78
229 293	AKR 1100/105/14,7 SW	1100	78	0,25°	Ø 105 f7	1045	66	50	30	165	100

AUTOCOLLIMATORS
WITH CCD-CAMERA MOUNT

Description:
For a general description of the principle of functioning see page 42.

The principle, function and layout resemble the autocollimator with 90°-viewing (see page 46). The eyepiece and the eyepiece reticle are replaced by a mount for a CCD-camera and the auto-collimation image is directly imaged on the camera chip when the camera is mounted. With no eyepiece reticle the displacement of the return image is measured on a video monitor or using a computer, frame grabber and software (see page 106).



Application areas:
- Measurement of angular tilt
- Measurement of parallelism of plane plates
- Adjustment of optical elements
- Qualitative testing of the imaging properties of optical elements and systems

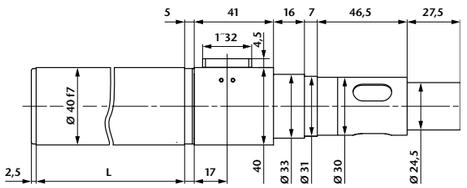
Notes on ordering:
- One Reticle and 6V/5W illumination w/cord are included.

More notes on ordering:
- **CCD-camera and computer hardware/software are NOT included.**
- As this type of autocollimator does not have an eyepiece reticle a direct measurement of the reticle displacement is impossible. Additional computer with software and frame grabber is needed.
- For angular measurement the autocollimator should be equipped with a negative crosshair reticle (see page 83). For testing of imaging quality use resolution target or Siemens Star (see page 87).
- If not specified otherwise, the autocollimator is adjusted to infinity at 546 nm wavelength. Adjustment to other distances or wavelengths is also possible on demand.
- The nomenclature of the autocollimators with CCD-camera mount is as follows:

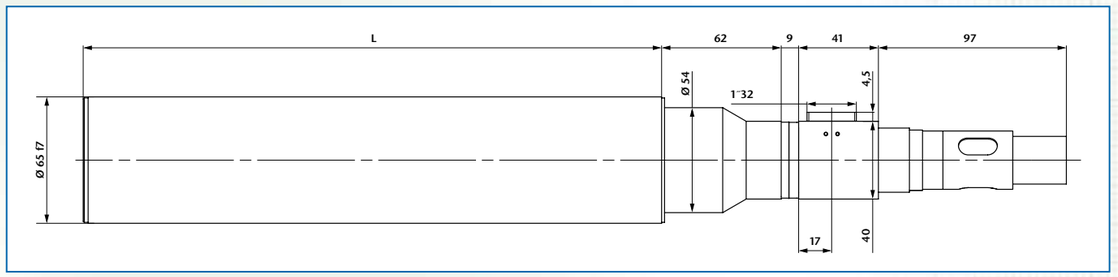
Example: AK R 50/ 40/ CCD

- AK – Autocollimator
- R – 90° viewing
- 50/ – Focal length
- 40/ – Tube diameter
- CCD – CCD-Camera mount

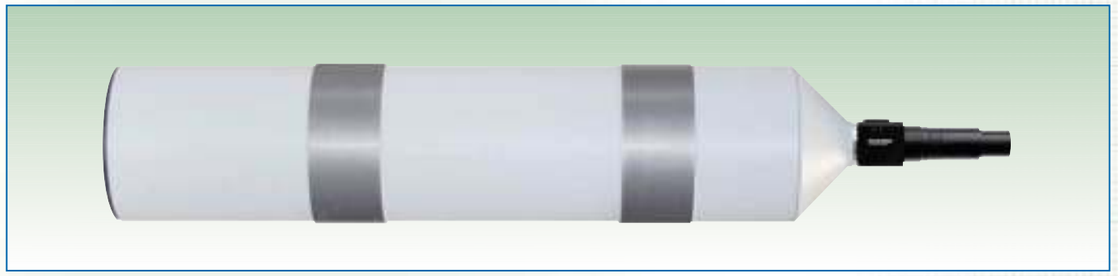
Important:
Please specify collimator reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.

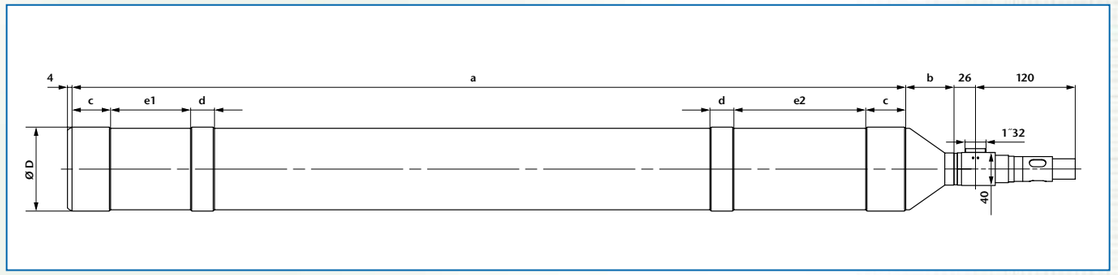


Ord.-No.	Description	Focal length	Free aperture	Meas. range*	L
229 421	AKR 50/40/CCD	50	10	x:4,50° y:3,20°	65
229 422	AKR 90/40/CCD	90	16	x:2,50° y:1,80°	65
229 423	AKR 140/40/CCD	140	28	x:1,60° y:1,20°	118
229 424	AKR 200/40/CCD	200	28	x:1,10° y:0,80°	173
229 425	AKR 300/40/CCD	300	28	x:0,75° y:0,60°	274
229 426	AKR 500/40/CCD	500	28	x:0,45° y:0,30°	474



Ord.-No.	Description	Focal length	Free aperture	Meas. range*	L
229 427	AKR 300/65/CCD	300	50	x:0,75° y:0,60°	233
229 428	AKR 500/65/CCD	500	50	x:0,45° y:0,30°	415
229 429	AKR 500T/65/CCD	500	50	x:0,45° y:0,30°	233





Ord.-No.	Description	Focal length	Free aperture	Meas. range*	D	a	b	c	d	e1	e2
229 432	AKR 600/128/CCD	600	100	x:0,35° y:0,25°	Ø 128 f7	530	46	–	58	154	78
229 433	AKR 1100/105/CCD	1100	78	x:0,20° y:0,15°	Ø 105 f7	1045	66	50	30	165	100

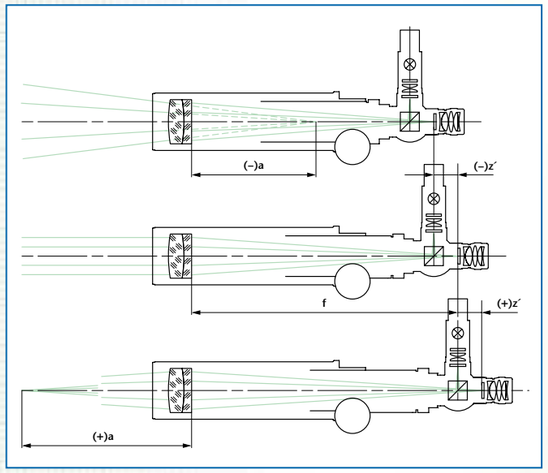
* with 2/3" CCD-Kamera

AUTOCOLLIMATORS

FOCUSABLE – STRAIGHT VIEWING

Description:

For a general description of the principle of functioning of focusable autocollimators see page 43.



Application areas:

- Measurement of angular tilt
- Qualitative testing of the imaging properties of optical elements and systems
- Measurement of large radii of curvature
- Infinity adjustment to other wavelengths

Notes on ordering:

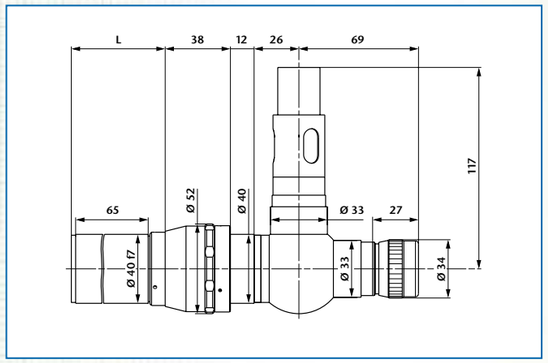
- Optionally, the autocollimators can be equipped with an eyepiece having 10 mm or 25 mm focal length.
- Two reticles, 6V/5W illumination w/cord, and eyepiece are included.
- The nomenclature of the adjustable autocollimators with straight viewing is as follows:

Example: AK G V 90/ 40/ 14,7 ±6

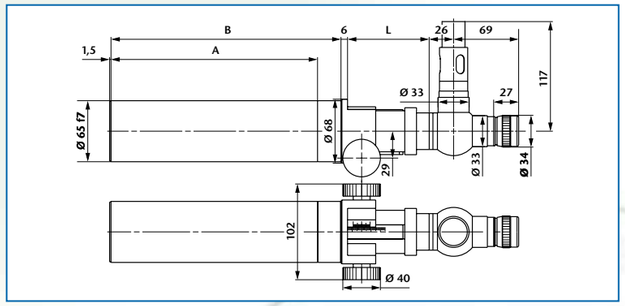
- AK – Autocollimator
- G – Straight viewing
- V – Variable
- 90/ – Focal length
- 40/ – Tube diameter
- 14,7 – Eyepiece focal length
- ±6 – Tube extension in mm

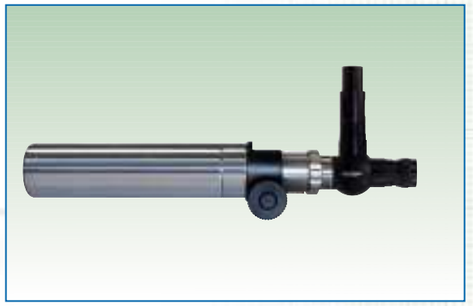
Impotant:

Please specify collimator reticle and eyepiece reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.

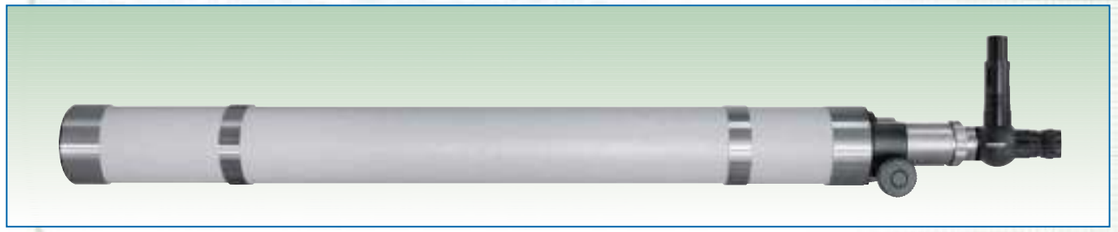


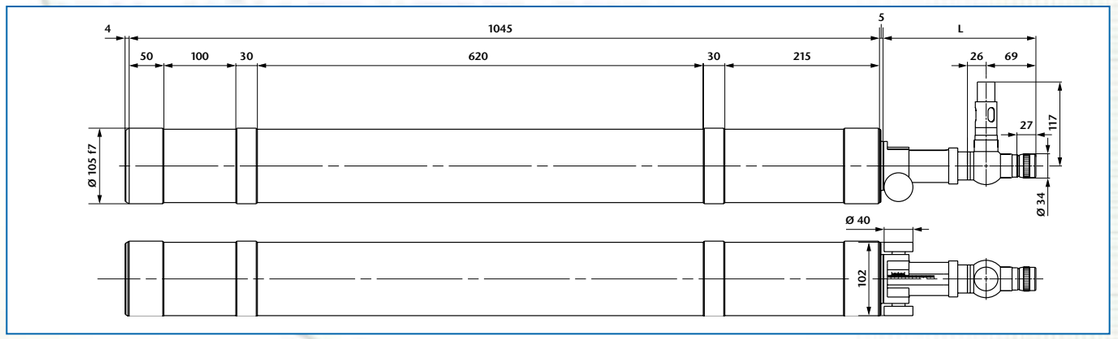
Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	Distance range	L
229 501	AKGV 90/40/14,7/±6	90	16	±6	3,0°	–∞...–1,25 m 1,40 m...+∞	77±6
229 502	AKGV 90/40/14,7/+12	90	16	+12	3,0°	0,80 m...+∞	71^{+12}
229 503	AKGV 90/40/14,7/–12	90	16	–12	3,0°	–∞...–0,60 m	83_{-12}
229 504	AKGV 140/40/14,7/±6	140	28	±6	2,0°	–∞...–3,10 m 3,30 m...+∞	77±6
229 505	AKGV 140/40/14,7/+12	140	28	+12	2,0°	1,70 m...+∞	71^{+12}
229 506	AKGV 140/40/14,7/–12	140	28	–12	2,0°	–∞...–1,40 m	83_{-12}





Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	Distance range	A	B	L
229 507	AKGV 300/65/14,7/±25	300	50	±25	1,0°	–∞...–3,4 m 3,8 m...+∞	220	245	87±25
229 508	AKGV 300/65/14,7/+50	300	50	+50	1,0°	2,1 m...+∞	220	270	62^{+50}
229 509	AKGV 300/65/14,7/–50	300	50	–50	1,0°	–∞...–1,5 m	220	220	112_{-50}
229 510	AKGV 500/65/14,7/±50	500	50	±50	0,5°	–∞...–4,5 m 5,4 m...+∞	310	360	112±50
229 511	AKGV 500/65/14,7/+100	500	50	+100	0,5°	3,0 m...+∞	310	410	62^{+100}
229 512	AKGV 500/65/14,7/–100	500	50	–100	0,5°	–∞...–1,5 m	310	310	162_{-100}





Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	Distance range	L
229 516	AKGV 1100/105/14,7/±50	1100	78	±50	0,25°	–∞...–23,7 m 25,8 m...+∞	202±50
229 517	AKGV 1100/105/14,7/+100	1100	78	+100	0,25°	13,2 m...+∞	202^{+100}
229 518	AKGV 1100/105/14,7/–100	1100	78	–100	0,25°	–∞...–12,0 m	202_{-100}

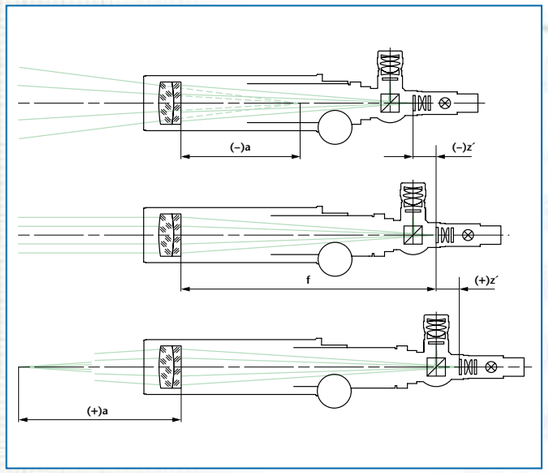
AUTOCOLLIMATORS

FOCUSABLE – 90°-VIEWING

Description:

For a general description of the principle of functioning of focusable autocollimators see page 43.

This autocollimator is equipped with right angle viewing (see page 46).



Application areas:

- Adjustment of optical and mechanical systems
- Qualitative testing of the imaging properties of optical elements and systems
- Measurement of large radii of curvature
- Infinity adjustment to other wavelengths

Notes on ordering:

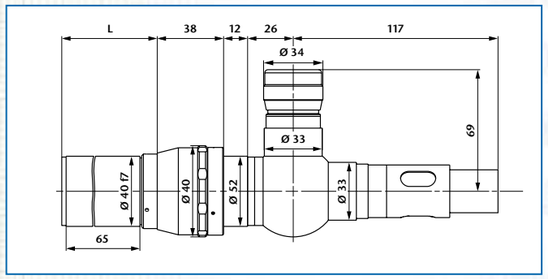
- Optionally, the autocollimators can be equipped with an eyepiece having 10 mm or 25 mm focal length.
- Two reticles, 6V/5W illumination w/cord, and eyepiece are included.
- The nomenclature of the adjustable autocollimators with 90°-viewing is as follows:

Example: AK R V 90/ 40/ 14,7 ±6

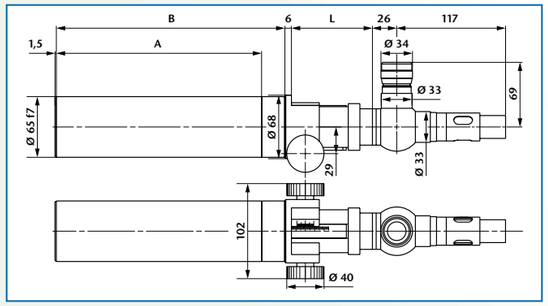
- AK – Autocollimator
- R – 90° viewing
- V – Variable
- 90/ – Focal length
- 40/ – Tube diameter
- 14,7 – Eyepiece focal length
- ±6 – Tube extension in mm

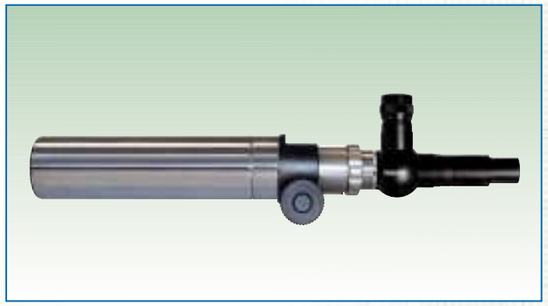
Important:

Please specify collimator reticle and eyepiece reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.
Please specify direction of use if reticles with lettering (e.g. coordinate division etc.) are used so that the lettering will be right-side-up.

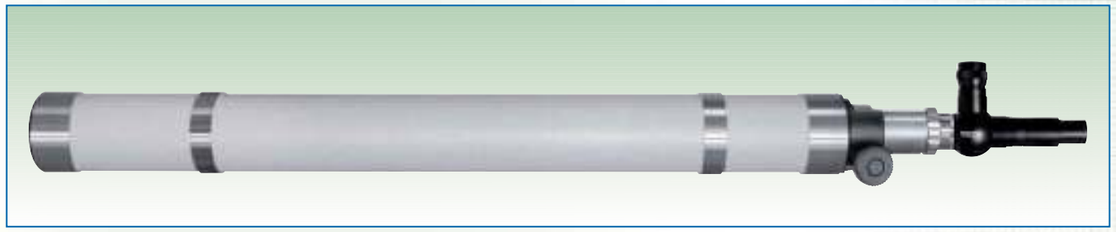


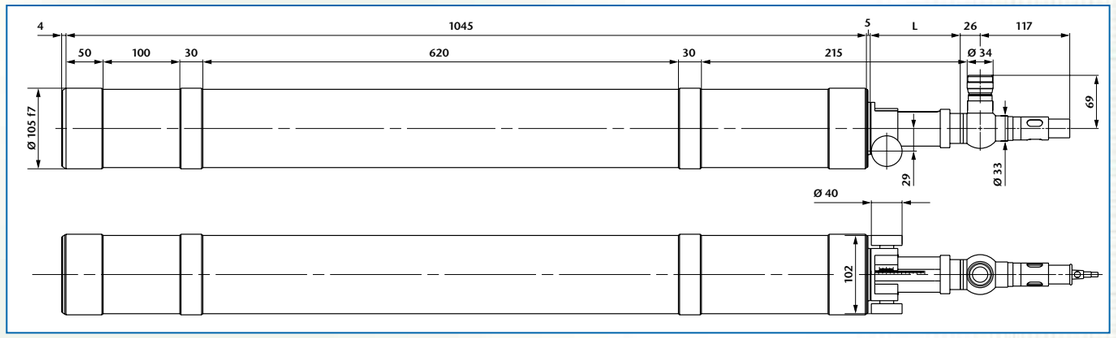
Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	Distance range	L
229 701	AKRV 90/40/14,7/±6	90	16	±6	3,0°	–∞...–1,25 m 1,40 m...+∞	77±6
229 702	AKRV 90/40/14,7/+12	90	16	+12	3,0°	0,80 m...+∞	71^{+12}
229 703	AKRV 90/40/14,7/–12	90	16	–12	3,0°	–∞...–0,60 m	83_{-12}
229 704	AKRV 140/40/14,7/±6	140	28	±6	2,0°	–∞...–3,10 m 3,30 m...+∞	77±6
229 705	AKRV 140/40/14,7/+12	140	28	+12	2,0°	1,70 m...+∞	71^{+12}
229 706	AKRV 140/40/14,7/–12	140	28	–12	2,0°	–∞...–1,40 m	83_{-12}





Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	Distance range	A	B	L
229 707	AKRV 300/65/14,7/±25	300	50	±25	1,0°	–∞...–3,4 m 3,8 m...+∞	220	245	87±25
229 708	AKRV 300/65/14,7/+50	300	50	+50	1,0°	2,1 m...+∞	220	270	62^{+50}
229 709	AKRV 300/65/14,7/–50	300	50	–50	1,0°	–∞...–1,5 m	220	220	112_{-50}
229 710	AKRV 500/65/14,7/±50	500	50	±50	0,5°	–∞...–4,5 m 5,4 m...+∞	310	360	112±50
229 711	AKRV 500/65/14,7/+100	500	50	+100	0,5°	3,0 m...+∞	310	410	62^{+100}
229 712	AKRV 500/65/14,7/–100	500	50	–100	0,5°	–∞...–1,5 m	310	310	162_{-100}





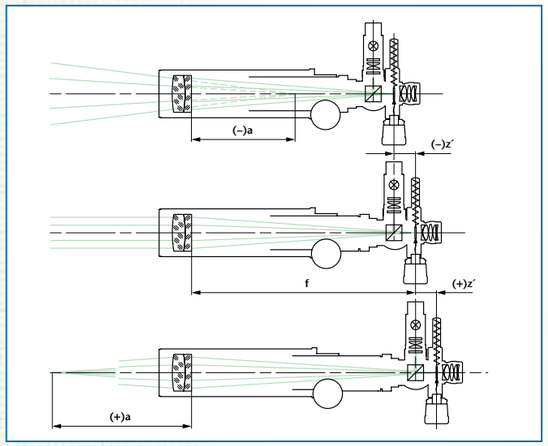
Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	Distance range	L
229 716	AKRV 1100/105/14,7/±50	1100	78	±50	0,25°	–∞...–23,7 m 25,8 m...+∞	177±50
229 717	AKRV 1100/105/14,7/+100	1100	78	+100	0,25°	13,2 m...+∞	177^{+100}
229 718	AKRV 1100/105/14,7/–100	1100	78	–100	0,25°	–∞...–12,0 m	177_{-100}

AUTOCOLLIMATORS

FOCUSABLE – STRAIGHT VIEWING WITH DOUBLE MICROMETER

Description:
For a general description of the principle of functioning of focusable autocollimators see page 43.

Additionally, micrometers allow the direct measurement of eyepiece reticle movement. The scale division (SD) of the micrometer drums is 5 µm.



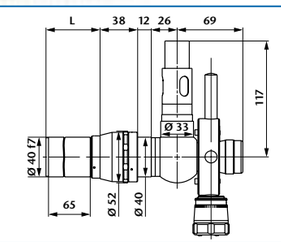
Application areas:
- Measurement of angular tilt
- Qualitative testing of the imaging properties of optical elements and systems
- Measurement of large radii of curvature
- Infinity adjustment to other wavelengths
- Adjustment of optical and mechanical systems

Notes on ordering:
- Optionally, the autocollimators can be equipped with an eyepiece having 10 mm or 25 mm focal length.
- Two reticles, 6V/5W illumination w/cord, and eyepiece are included.
- The nomenclature of the adjustable autocollimators with straight viewing and with double micrometer is as follows:

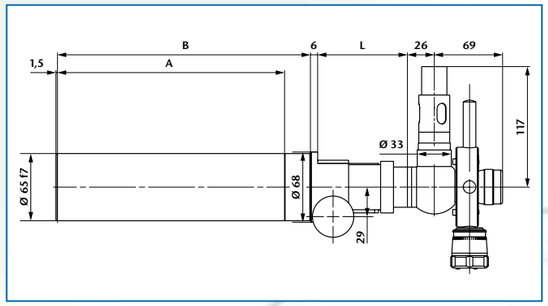
Example: AK G V 90/ 40/ 14,7 ±6 MD

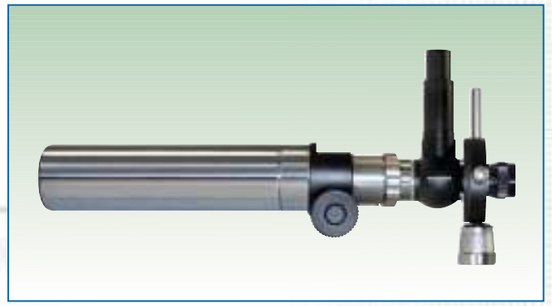
- AK – Autocollimator
- G – Straight viewing
- V – Variable
- 90/ – Focal length
- 40/ – Tube diameter
- 14,7 – Eyepiece focal length
- ±6 – Tube extension in mm
- MD – Double micrometer

Important:
Please specify collimator reticle and eyepiece reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.

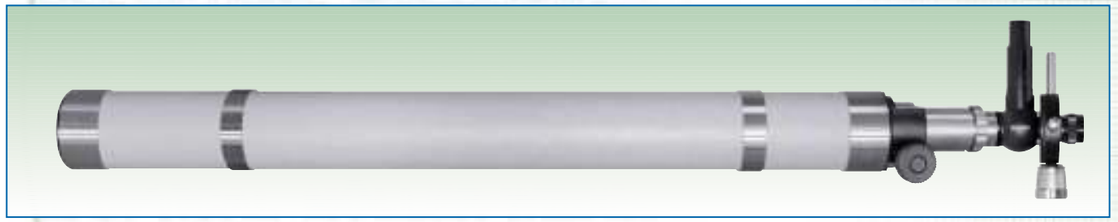


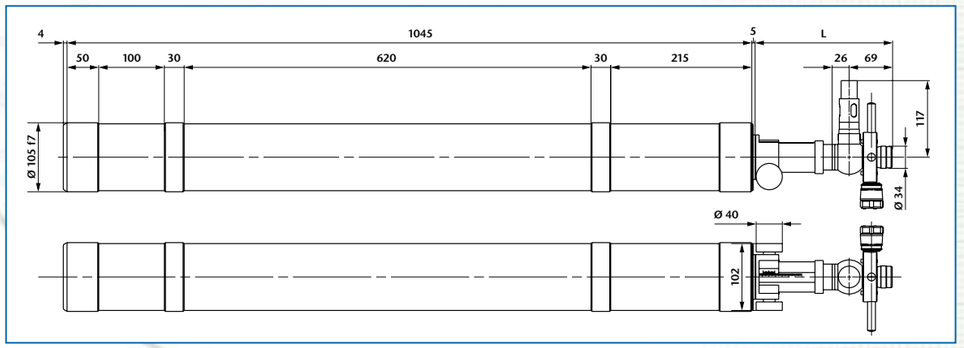
Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	SD	Distance range	L
229 631	AKGV 90/40/14,7/±6 MD	90	16	±6	3,0°	5,5″	–∞...–1,25 m 1,40 m...+∞	77±6
229 632	AKGV 90/40/14,7/+12 MD	90	16	+12	3,0°	5,5″	0,80 m...+∞	71^{+12}
229 633	AKGV 90/40/14,7/–12 MD	90	16	–12	3,0°	5,5″	–∞...–0,60 m	83_{-12}
229 634	AKGV 140/40/14,7/±6 MD	140	28	±6	2,0°	3,5″	–∞...–3,10 m 3,30 m...+∞	77±6
229 635	AKGV 140/40/14,7/+12 MD	140	28	+12	2,0°	3,5″	1,70 m...+∞	71^{+12}
229 636	AKGV 140/40/14,7/–12 MD	140	28	–12	2,0°	3,5″	–∞...–1,40 m	83_{-12}





Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	SD	Distance range	A	B	L
229 640	AKGV 300/65/14,7/±25 MD	300	50	±25	1,0°	2,0″	–∞...–3,4 m 3,8 m...+∞	220	245	220±25
229 638	AKGV 300/65/14,7/+50 MD	300	50	+50	1,0°	2,0″	2,1 m...+∞	220	270	195^{+50}
229 639	AKGV 300/65/14,7/–50 MD	300	50	–50	1,0°	2,0″	–∞...–1,5 m	220	220	245_{-50}
229 641	AKGV 500/65/14,7/±50 MD	500	50	±50	0,5°	1,0″	–∞...–4,5 m 5,4 m...+∞	310	360	245±50
229 644	AKGV 500/65/14,7/+100 MD	500	50	+100	0,5°	1,0″	3,0 m...+∞	310	410	195^{+100}
229 645	AKGV 500/65/14,7/–100 MD	500	50	–100	0,5°	1,0″	–∞...–1,5 m	310	310	295_{-100}





Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	SD	Distance range	L
229 642	AKGV 1100/105/14,7/±50 MD	1100	78	±50	0,25°	0,5″	–∞...–23,70 m 25,80 m...+∞	202±50
229 646	AKGV 1100/105/14,7/+100 MD	1100	78	+100	0,25°	0,5″	13,20 m...+∞	202^{+100}
229 643	AKGV 1100/105/14,7/–100 MD	1100	78	–100	0,25°	0,5″	–∞...–12,00 m	202_{-100}

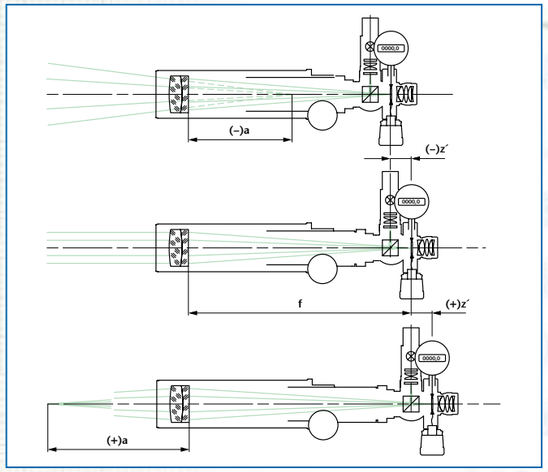
AUTOCOLLIMATORS

FOCUSABLE – STRAIGHT VIEWING WITH DIGITAL DOUBLE MICROMETER

Description:

For a general description of the principle of functioning of focusable autocollimators see page 43.

In place of the micrometer drums above, optionaly, programmable digital gauges allow direct reading of the tilting angle in arcsec or mrad.



Application areas:

- Measurement of angular tilt
- Adjustment of optical and mechanical systems
- Qualitative testing of the imaging properties of optical elements and systems
- Measurement of large radii of curvature
- Infinity adjustment to other wavelengths

Notes on ordering:

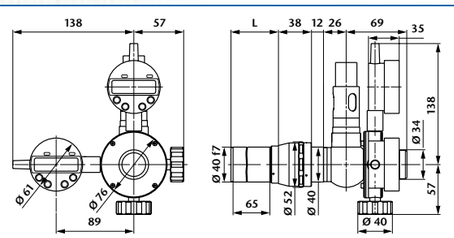
- Optionally, the autocollimators can be equipped with an eyepiece having 10 mm or 25 mm focal length.
- Two reticles, 6V/5W illumination w/cord, and eyepiece are included.
- Specify the unit of display of the digital gauges (mm, arcsec, milliradians).
- The nomenclature of the adjustable autocollimators with digital double micrometer is as follows:

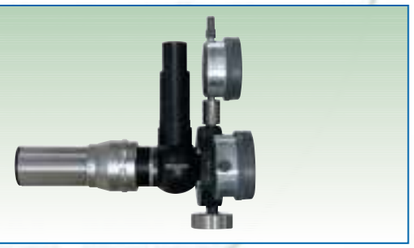
Example: AK G V 90/ 40/ 14,7 ±6 MDD

- AK – Autocollimator
- G – Straight viewing
- V – Variable
- 90/ – Focal length
- 40/ – Tube diameter
- 14,7 – Eyepiece focal length
- ±6 – Tube extension in mm
- MDD – Digital double micrometer

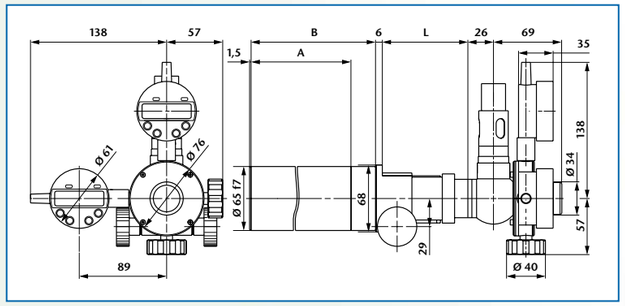
Important:

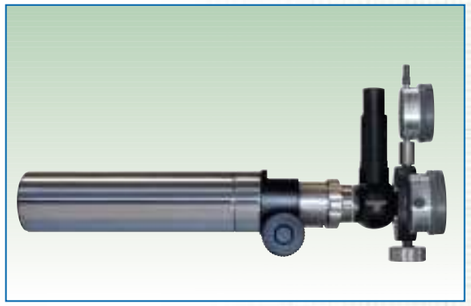
Please specify collimator reticle and eyepiece reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.



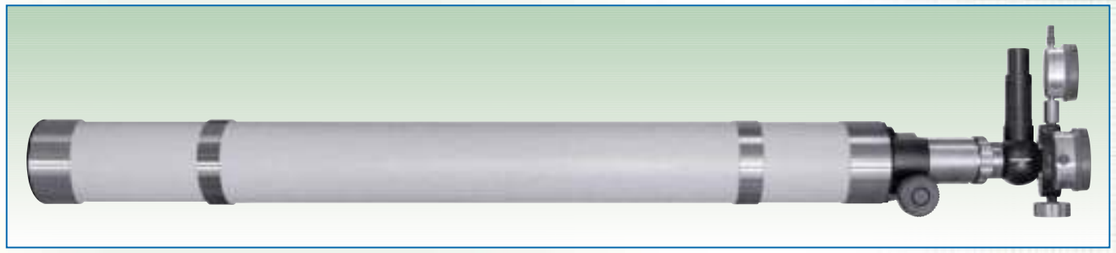


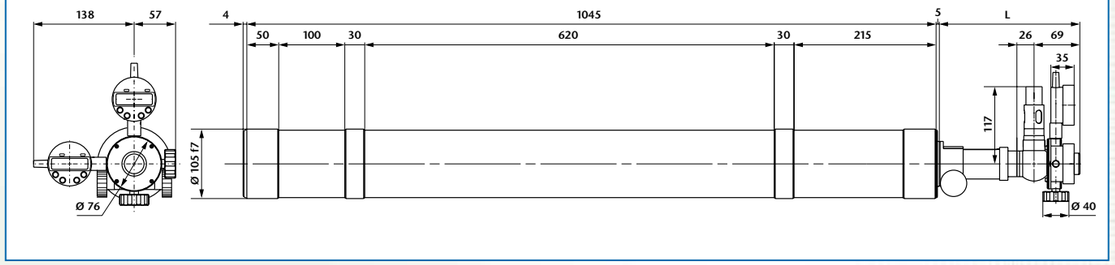
Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	Resolution	Distance range	L
229 581	AKGV 90/40/14,7/±6 MDD	90	16	±6	3,0°	1,0″	–∞...–1,25 m 1,40 m...+∞	77±6
229 582	AKGV 90/40/14,7/+12 MDD	90	16	+12	3,0°	1,0″	0,80 m...+∞	71^{+12}
229 583	AKGV 90/40/14,7/–12 MDD	90	16	–12	3,0°	1,0″	–∞...–0,60 m	83_{-12}
229 584	AKGV 140/40/14,7/±6 MDD	140	28	±6	2,0°	1,0″	–∞...–3,10 m 3,30 m...+∞	77±6
229 585	AKGV 140/40/14,7/+12 MDD	140	28	–12	2,0°	1,0″	1,70 m...+∞	71_{-12}
229 586	AKGV 140/40/14,7/–12 MDD	140	28	–12	2,0°	1,0″	–∞...–1,40 m	83_{-12}





Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	Resolution	Distance range	A	B	L
229 587	AKGV 300/65/14,7/±25 MDD	300	50	±25	1,0°	0,5 arcsec	–∞...–3,4 m 3,8 m...+∞	220	245	87±25
229 588	AKGV 300/65/14,7/+50 MDD	300	50	+50	1,0°	0,5 arcsec	2,1 m...+∞	220	270	62^{+50}
229 589	AKGV 300/65/14,7/–50 MDD	300	50	–50	1,0°	0,5 arcsec	–∞...–1,5 m	220	220	112_{-50}
229 590	AKGV 500/65/14,7/±50 MDD	500	50	±50	0,5°	0,2 arcsec	–∞...–4,5 m 5,4 m...+∞	310	360	112±50
229 591	AKGV 500/65/14,7/+100 MDD	500	50	+100	0,5°	0,2 arcsec	3,0 m...+∞	310	410	62^{+100}
229 592	AKGV 500/65/14,7/–100 MDD	500	50	–100	0,5°	0,2 arcsec	–∞...–1,5 m	310	310	162_{-100}





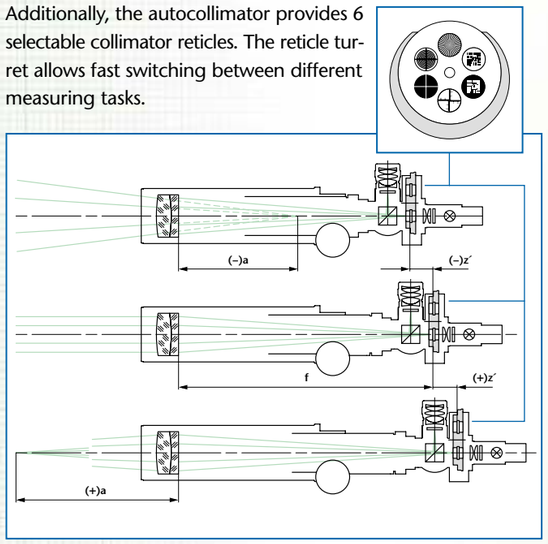
Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	Resolution	Distance range	L
229 596	AKGV 1100/105/14,7/±50 MDD	1100	78	±50	0,5°	0,1 arcsec	–∞...–23,7 m 25,8 m...+∞	202±50
229 597	AKGV 1100/105/14,7/+100 MDD	1100	78	+100	0,5°	0,1 arcsec	13,2 m...+∞	202^{+100}
229 598	AKGV 1100/105/14,7/–100 MDD	1100	78	–100	0,5°	0,5 arcsec	–∞...–12,0 m	202_{-100}

AUTOCOLLIMATORS

FOCUSABLE – 90°-VIEWING WITH RETICLE TURRET

Description:
For a general description of the principle of functioning of focusable autocollimators see page 43.

Additionally, the autocollimator provides 6 selectable collimator reticles. The reticle turret allows fast switching between different measuring tasks.



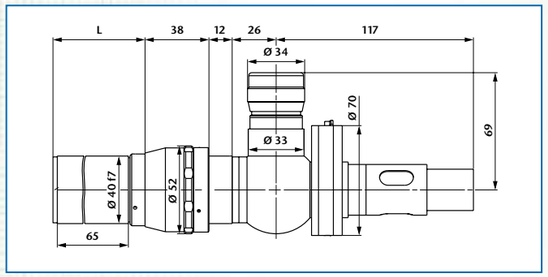
Application areas:
- Adjustment of optical and mechanical systems
- Qualitative testing of the imaging properties of optical elements and systems
- Measurement of large radii of curvature
- Infinity adjustment to other wavelengths

Notes on ordering:
- Optionally, the autocollimators can be equipped with an eyepiece having 10 mm or 25 mm focal length.
- The reticles, 6V/5W illumination w/cord, and eyepiece are included.
- The nomenclature of the adjustable autocollimators with 90°-viewing and with reticle turret is as follows:

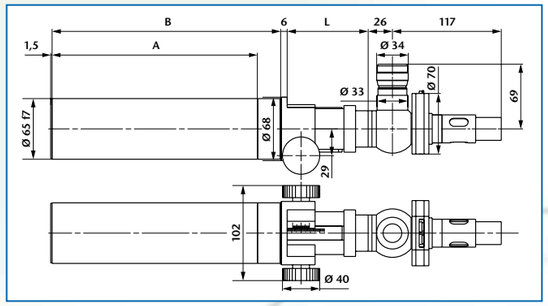
Example: AK R V 90/ 40/ 14,7 ±6 SW

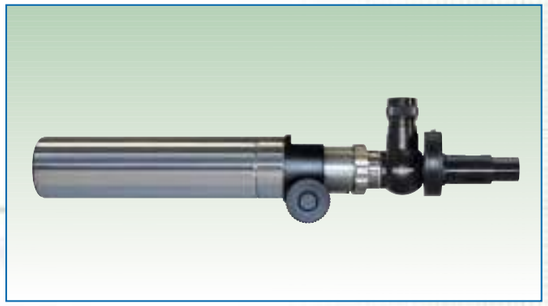
- AK – Autocollimator
- R – 90° viewing
- V – Variable
- 90/ – Focal length
- 40/ – Tube diameter
- 14,7 – Eyepiece focal length
- ±6 – Tube extension in mm
- SW – Reticle turret

Important:
Please specify six collimator reticles and one eyepiece reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.
Please specify direction of use if reticles with lettering (e.g. coordinate division etc.) are used so that the lettering will be right-side-up.

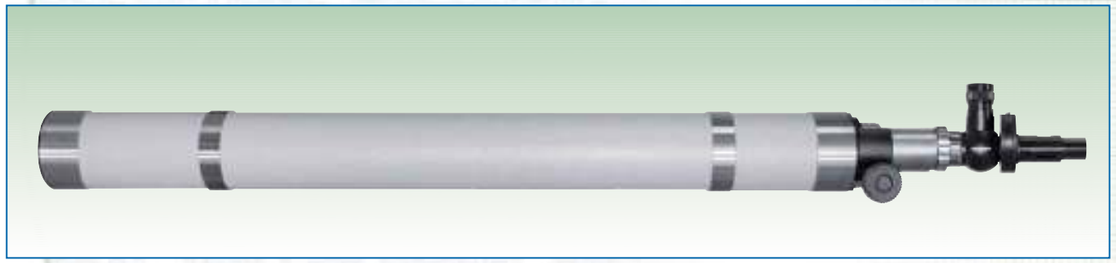


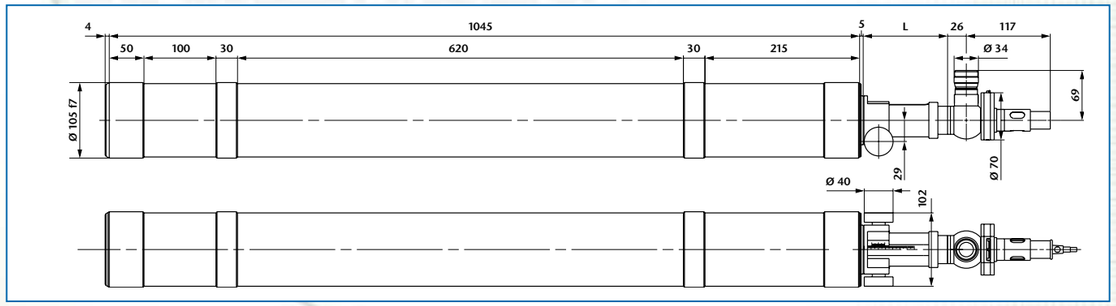
Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	Distance range	L
229 781	AKRV 90/40/14,7/±6 SW	90	16	±6	3,0°	–∞...–1,25 m 1,40 m...+∞	77±6
229 782	AKRV 90/40/14,7/+12 SW	90	16	+12	3,0°	0,80 m...+∞	71^{+12}
229 783	AKRV 90/40/14,7/–12 SW	90	16	–12	3,0°	–∞...–0,60 m	83_{-12}
229 784	AKRV 140/40/14,7/±6 SW	140	28	±6	2,0°	–∞...–3,10 m 3,30 m...+∞	77±6
229 785	AKRV 140/40/14,7/+12 SW	140	28	+12	2,0°	1,70 m...+∞	71^{+12}
229 786	AKRV 140/40/14,7/–12 SW	140	28	–12	2,0°	–∞...–1,40 m	83_{-12}





Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	Distance range	A	B	L
229 787	AKRV 300/65/14,7/±25 SW	300	50	±25	1,0°	–∞...–3,4 m 3,8 m...+∞	220	245	87±25
229 788	AKRV 300/65/14,7/+50 SW	300	50	+50	1,0°	2,1 m...+∞	220	270	62^{+50}
229 789	AKRV 300/65/14,7/–50 SW	300	50	–50	1,0°	–∞...–1,5 m	220	220	112_{-50}
229 790	AKRV 500/65/14,7/±50 SW	500	50	±50	0,5°	–∞...–4,5 m 5,4 m...+∞	310	360	112±50
229 791	AKRV 500/65/14,7/+100 SW	500	50	+100	0,5°	3,0 m...+∞	310	410	62^{+100}
229 792	AKRV 500/65/14,7/–100 SW	500	50	–100	0,5°	–∞...–1,5 m	310	310	162_{-100}





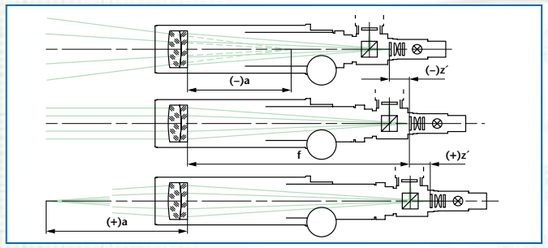
Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range	Distance range	L
229 796	AKRV 1100/105/14,7/±50 SW	1100	78	±50	0,5°	–∞...–23,7 m 25,8 m...+∞	202±50
229 797	AKRV 1100/105/14,7/+100 SW	1100	78	+100	0,5°	13,2 m...+∞	202^{+100}
229 798	AKRV 1100/105/14,7/–100 SW	1100	78	–100	0,5°	–∞...–12,0 m	202_{-100}

AUTOCOLLIMATORS

FOCUSABLE – WITH CCD-CAMERA MOUNT

Description:
For a general description of the principle of functioning of focusable autocollimators see page 43.

The eyepiece and the eyepiece reticle are replaced by a mount for a C-Mount-CCD-camera and the autocollimation image is directly imaged on the camera chip when it is mounted.



Application areas:
- Adjustment of optical and mechanical systems
- Qualitative testing of the imaging properties of optical elements and systems
- Measurement of large radii of curvature
- Infinity adjustment to other wavelengths

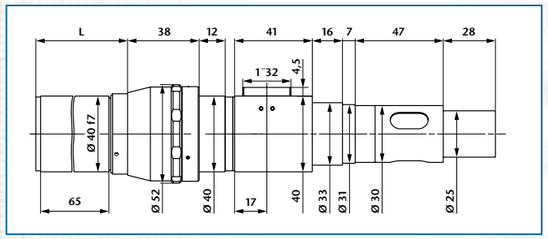
Notes on ordering:
- **The CCD-camera and computer hardware/software are NOT included.**
- As this type of autocollimator does not have an eyepiece reticle a direct measurement of the reticle displacement is impossible. Additional computer with software and frame grabber is needed.

More notes on ordering:
- Collimator reticle and 6V/5W illumination w/cord are included.
- For angular measurement the autocollimator should be equipped with a negative crosshair reticle (see page 83). For testing of imaging quality use resolution target or Siemens Star (see page 87).
- The nomenclature of the adjustable autocollimators with CCD-camera mount is as follows:

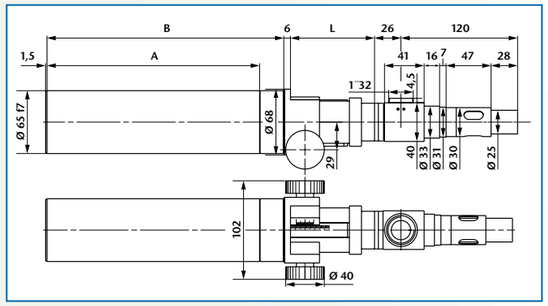
Example: AK R V 90/ 40/ ±6 CCD

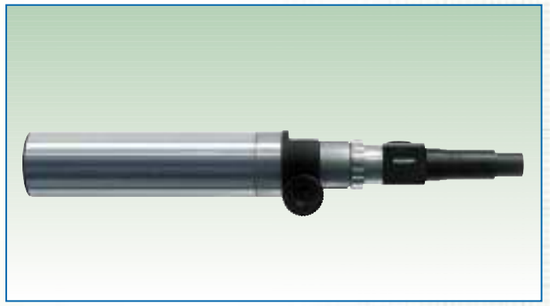
- AK – Autocollimator
- R – 90° viewing
- V – Variable
- 90/ – Focal length
- 40/ – Tube diameter
- ±6 – Tube extension in mm
- CCD – CCD-Camera mount

Impotant:
Please specify collimator reticle (see page 82) as well as illumination (LED-, bulb- or cold light, see page 81) when ordering.

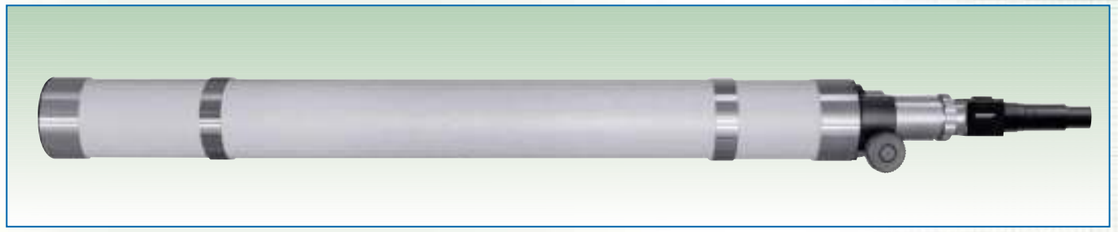


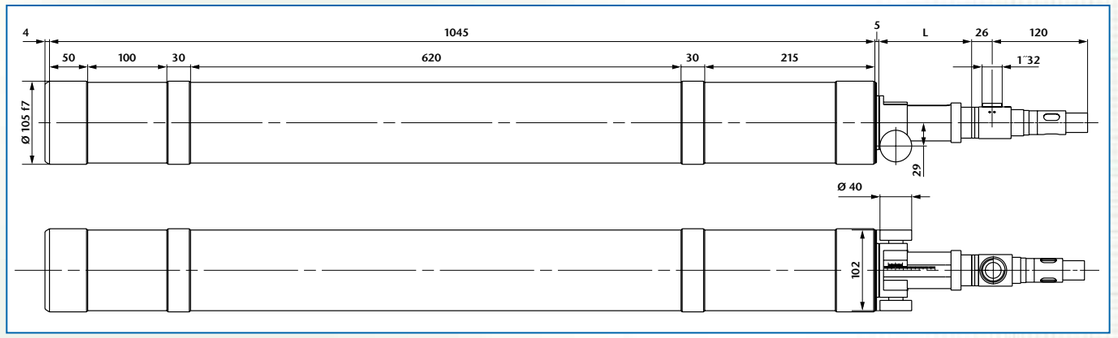
Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range*	Distance range	L
229 471	AKRV 90/40/±6 CCD	90	16	±6	x:2,50° y:1,80°	–∞...–1,25 m 1,40 m...+∞	77±6
229 472	AKRV 90/40/+12 CCD	90	16	+12	x:2,50° y:1,80°	0,80 m...+∞	71^{+12}
229 473	AKRV 90/40/–12 CCD	90	16	–12	x:2,50° y:1,80°	–∞...–0,60 m	83_{-12}
229 474	AKRV 140/40/±6 CCD	140	28	±6	x:1,60° y:1,20°	–∞...–3,10 m 3,30 m...+∞	77±6
229 475	AKRV 140/40/+12 CCD	140	28	+12	x:1,60° y:1,20°	1,70 m...+∞	71^{+12}
229 476	AKRV 140/40/–12 CCD	140	28	–12	x:1,60° y:1,20°	∞...–1,40 m	83_{-12}





Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range*	Distance range	A	B	L
229 477	AKRV 300/65/±25 CCD	300	50	±25	x:2,50° y:1,80°	–∞...–3,4 m 3,8 m...+∞	220	245	87±25
229 478	AKRV 300/65/+50 CCD	300	50	+50	x:2,50° y:1,80°	2,1 m...+∞	220	270	62^{+50}
229 479	AKRV 300/65/–50 CCD	300	50	–50	x:2,50° y:1,80°	–∞...–1,5 m	220	220	112_{-50}
229 480	AKRV 500/65/±50 CCD	500	50	±50	x:2,50° y:1,80°	–∞...–4,5 m 5,4 m...+∞	310	360	112±50
229 481	AKRV 500/65/+100 CCD	500	50	+100	x:2,50° y:1,80°	3,0 m...+∞	310	410	62^{+100}
229 482	AKRV 500/65/–100 CCD	500	50	–100	x:2,50° y:1,80°	–∞...–1,5 m	310	310	162_{-100}





Ord.-No.	Description	Focal length	Free aperture	Tube extension	Meas. range*	Distance range	L
229 486	AKRV 1100/105/±50 CCD	1100	78	±50	x:0,20° y:0,14°	–∞...–23,7 m 25,8 m...+∞	177±50
229 487	AKRV 1100/105/+100 CCD	1100	78	+100	x:0,20° y:0,14°	13,2 m...+∞	117^{+12}
229 488	AKRV 1100/105/–100 CCD	1100	78	–100	x:0,20° y:0,14°	–∞...–12,0 m	117_{-12}

* mit 2/3" CCD-Kamera