MÖLLER-WEDEL OPTICAL
A HAAG-STREIT COMPANY

TECHNICAL DATA

	ELCOMAT direct 90/40	ELCOMAT direct 140/40	ELCOMAT direct 200/40	ELCOMAT direct 300/40	ELCOMAT direct 500/40	ELCOMAT direct 300/65	ELCOMAT direct 500/65	ELCOMAT direct 500T/65	ELCOMAT direct 600/128
Order.-No.	229 851	229 852	229 853	229 854	229 855	229 856	229 857	229 858	229 859
Resolution, arcsec	0.005 up to 10; selectable								
Recommended minimum resolution, arcsec	0.5	0.2	0.2	0.1	0.05	0.1	0.05	0.05	0.05
Measuring uncertainty, arcsec	± 3	± 2	± 1.5	± 0.8	± 0.4	± 0.8	± 0.4	± 0.4	± 0.3
Measuring range, (X) x (Y), arcsec	6100 x 4800	3900 x 3100	2800 x 2200	1800 x 1400	1100 x 800	1800 x 1400	1100 x 800	1100 x 800	920 x 660
Maximum measuring, distance, m	0.25	0.75	1.2	1.8	2.8	3.0	5.3	5.9	12.5
Reproducibility, arcsec	0.4	0.3	0.2	0.1	0.05	0.1	0.05	0.05	0.05
Focal length, mm	90	140	200	300	500	300	500	500	600
Free aperture, mm	Ø 16	Ø 28	Ø 28	Ø 28	Ø 28	Ø 50	Ø 50	Ø 50	Ø 100
Min. reflector diameter, mm R > 85% R = 4 %	Ø 1.5 Ø 4	Ø 2 Ø 4	Ø 3 Ø 10	Ø 5 Ø 14	Ø 6 Ø 19	Ø 5 Ø 14	Ø 6 Ø 19	Ø 7 Ø 24	Ø 7 Ø 25
Min. detectable angle difference, arcsec*	21.5	13.8	9.6	6.4	3.8	6.4	3.8	3.8	3.2
Measuring frequency, Hz	1 up 35; selectable (Y-measuring range decreases, when measuring frequency greater than 15 Hz)								
Tube diameter, mm	Ø 40 f7	Ø 40 f7	Ø 40 f7	Ø 40 f7	Ø 40 f7	Ø 65 f7	Ø 65 f7	Ø 65 f7	Ø 128 f7
Dimension, mm	194 x 70 x 70	247 x 70 x 70	302 x 70 x 70	403 x 70 x 70	603 x 70 x 70	424 x 70 x 70	606 x 70 x 70	424 x 70 x 70	708 x 70 x 70
Weight, kg	1.1	1.2	1.4	1.8	2.4	2.7	3.9	3.1	7.0

*The minimum detectable angle difference is the minimum angle between two reflecting surfaces at which the ELCOdirect software recognizes two separate autocollimation images.

Please note, that there is an additional catalogue on the ELCOMAT product line available, which covers the stand-alone units.

MÖLLER-WEDEL OPTICAL GmbH
Rosengarten 10
D-22880 Wedel

Tel : +49 - 41 03 - 9 37 76 10
Fax: +49 - 41 03 - 9 37 76 60
www.moeller-wedel-optical.com
e-mail: info@moeller-wedel-optical.com

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Electronic Autocollimators

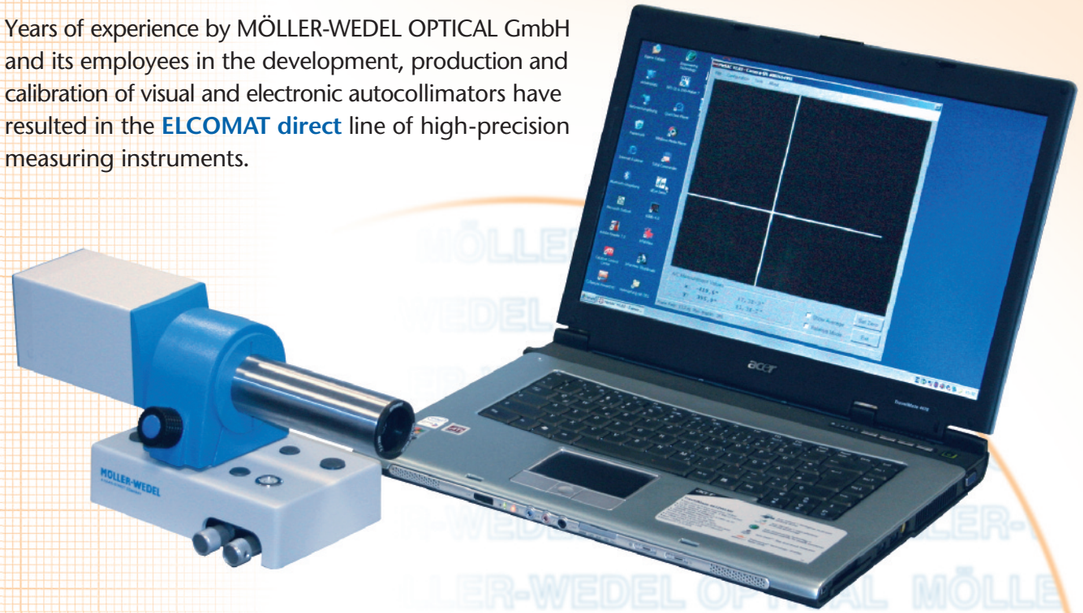
ELCOMAT direct

for direct PC-connection

MÖLLER-WEDEL OPTICAL
A HAAG-STREIT COMPANY

OVERVIEW

Years of experience by MÖLLER-WEDEL OPTICAL GmbH and its employees in the development, production and calibration of visual and electronic autocollimators have resulted in the **ELCOMAT direct** line of high-precision measuring instruments.



The main features are:

- Quick and easy measurement of angles with high accuracy
- Multiple autocollimation image evaluation
- Computer-based evaluation
- Connection to computer via USB 2.0 port
- Control of angular position
- Easily embeddable within automated processes

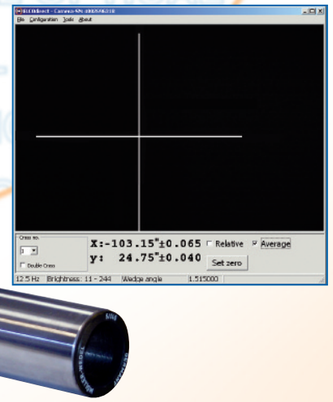
Wide range of focal lengths available to match needs of measuring range and accuracy.

The **ELCOMAT direct** is intended mainly for the use in the optical workshop.

ELCOMAT direct autocollimators are specifically designed for the following measurement tasks:

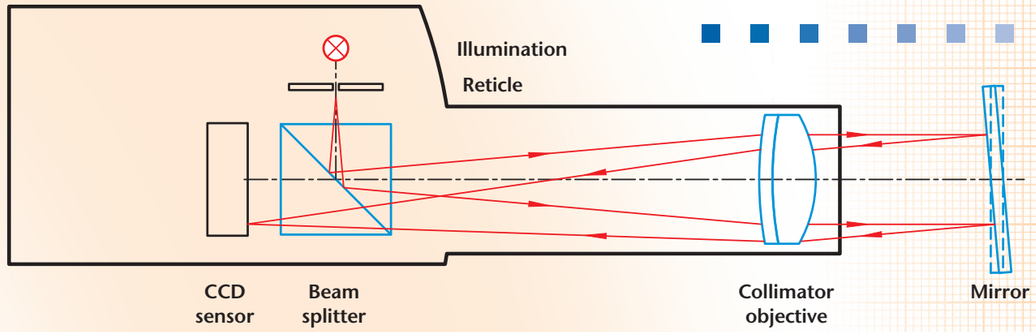
- Measurement of small angles
- Ultra precision angular adjustment and calibration
- Automation in assembly
- Wedge and prism measurement
- Control of angular position

Each **ELCOMAT direct** consists of the autocollimation sensor and the software **ELCOdirect**. **ELCOdirect** runs under Microsoft® Windows XP on up-to-date PCs, laptops or notebooks with an USB 2.0 port. The autocollimation sensor is connected to the computer directly via the USB-port. A Microsoft Windows® dynamic link library (DLL), which covers the autocollimator functions for integration in your own software, is part of **ELCOdirect**.



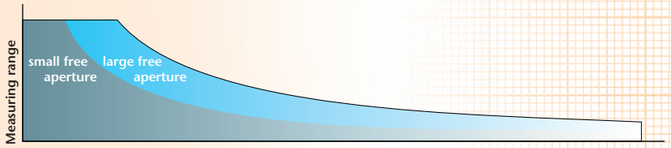
Measuring Principle

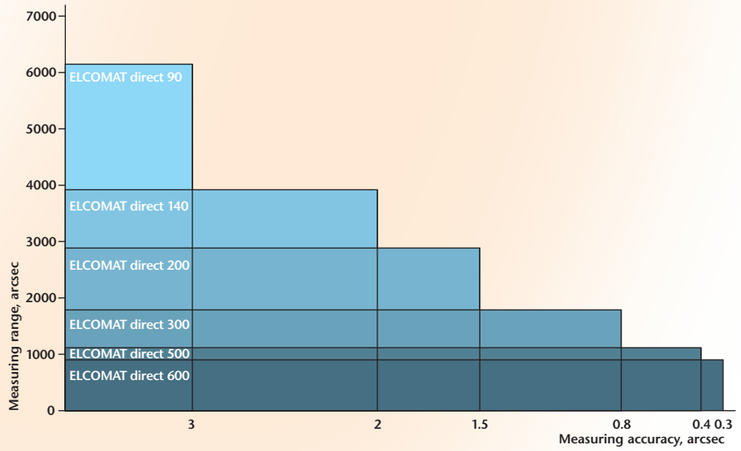
The measuring principle is illustrated in the following figure.



Measuring Range And Distance

As with all autocollimators the measuring range of the **ELCOMAT direct** is constant up to a certain distance and then decreases with increasing distance between autocollimator and reflector due to vignetting. This effect depends on the focal length and free aperture of the autocollimator. Since the vignetting affects the accuracy, as well, we recommend to use the **ELCOMAT direct** autocollimators only up to the maximum measuring distance given in the overview table on the back of the catalogue.





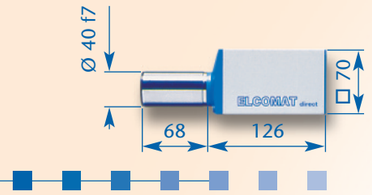
Selection Criteria

Every application has particular demands on measuring accuracy and measuring range. The illustration opposite allows you to choose a suitable **ELCOMAT direct** for your measurement task.

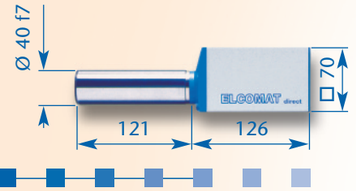
ELCOMAT direct

The **ELCOMAT direct** autocollimation sensors can be supplied with a wide variety of objective tubes.
This variety allows the choice of the most suitable **ELCOMAT direct** for the measuring task.
The **ELCOMAT direct** housing has two sockets: one for the connection to the USB port of a computer (cable length 1.5 m) and one for the connection of the laser attachment (Ord.-No. 219 757 or 219 767).

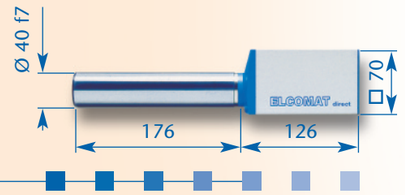
ELCOMAT direct 90/40
Ord.-No. 229 851



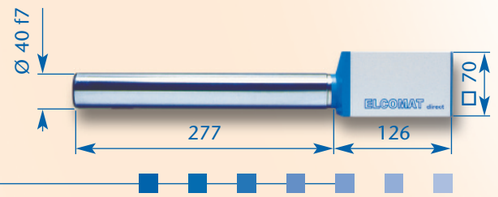
ELCOMAT direct 140/40
Ord.-No. 229 852



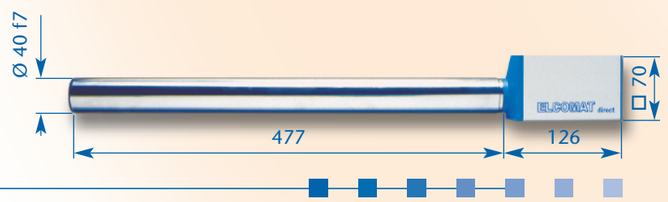
ELCOMAT direct 200/40
Ord.-No. 229 853



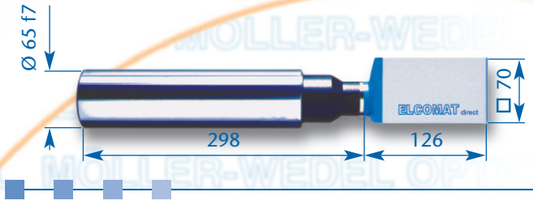
ELCOMAT direct 300/40
Ord.-No. 229 854



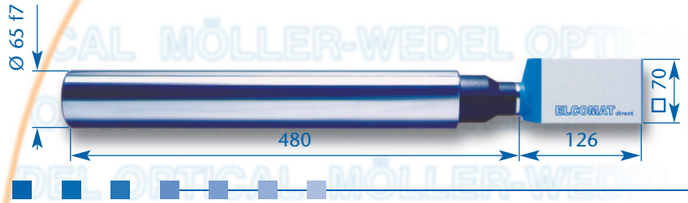
ELCOMAT direct 500/40
Ord.-No. 229 855



ELCOMAT direct 300/65
Ord.-No. 229 856



ELCOMAT direct 500/65
Ord.-No. 229 857

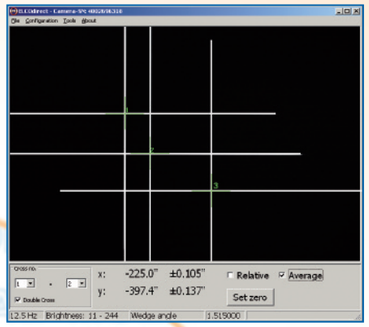


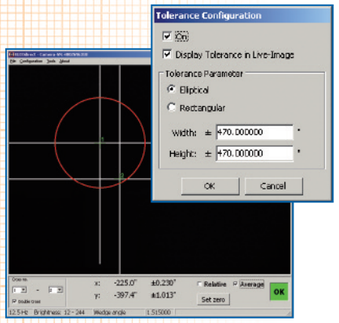
ELCOMAT direct 500T/65
Ord.-No. 229 858

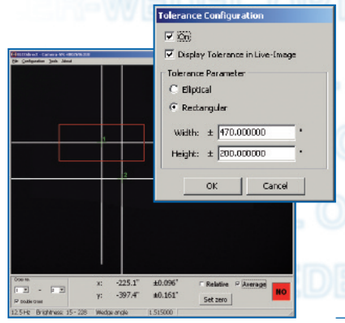
ELCOMAT direct 600/128
Ord.-No. 229 859

SOFTWARE ELCOdirect

The **ELCOdirect** software can automatically and simultaneously detect up to 10 cross positions. From the positions wedge angle or the error of the 90° angle of 90°-prisms can be calculated automatically.

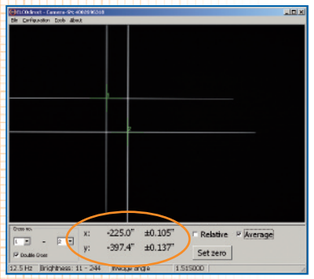


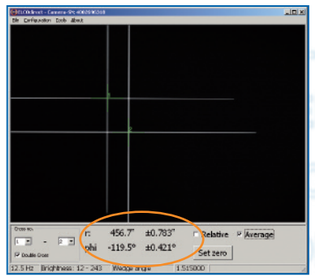




Go/NoGo tolerances can be displayed for quick and easy assessment of the measurement results.

The software allows the flexible configuration of the area of interest of the camera and the measuring frequency. For example, by choosing a smaller area of interest, the measuring frequency can be increased. The exposure time is adapted automatically to the brightness of the crosses for optimal evaluation conditions.





The display can be configured to show angular values, wedge angles or height differences with respect to a certain base length. The values can be indicated in Cartesian or polar coordinates.

The angular measurement values can be send to another computer via the RS232-port. The baud rate and the other communications settings of RS232 interface are fully configurable in the software. Additionally, it is possible to send the measurement values to another program (e.g. ELCOWIN) on the same computer via the clipboard.

ACCESSORIES

Article description	Ord.-No.
Clamp fixture D40, one-sided	223 002

Clamp fixture D40

for integration of ELCOMAT direct
with tube diameter 40 mm
Height of axis: 40mm
Mounting with 4 screws M6 possible

Article description	Ord.-No.
Clamp fixture D40 double-sided	223 008

Clamp fixture D40

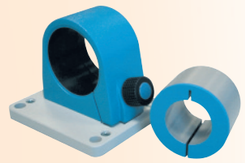
for integration of ELCOMAT direct
with tube diameter 40 mm
Height of axis: 60 mm
Mounting with 4 screws M6 possible

Article description	Ord.-No.
Clamp fixture D65 double-sided	223 003

Clamp fixture D65

for integration of ELCOMAT direct
with tube diameter 65 mm
Height of axis: 60 mm
Mounting with 4 screws M8 possible

Article description	Ord.-No.
Clamp fixture D40 (223 037+223 035 01)	223 035
Clamp fixture D65	223 037
Adapter D40	223 035 01



Clamp fixture D40/D65

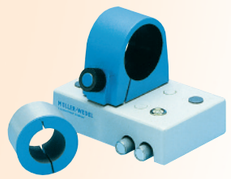
for integration of ELCOMAT direct
with tube diameter 40 or 65 mm
Height of axis: 62 mm
Mounting with 4 screws M6 possible

Article description	Ord.-No.
Fixture D128 (2 pieces required)	223 048

Fixture D128

for integration of ELCOMAT direct
with tube diameter 128 mm
Height of axis: 100 mm
Mounting with 2 screws M6 possible

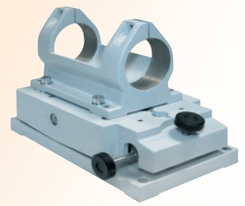
Article description	Ord.-No.
Adjustable holder D65	223 056
Adapter D40	223 035 01



Adjustable holder D40/D65

for adjustable mounting of ELCOMAT direct, also for attaching to the tripod (Ord.-No. 223 082)
Adjustment range ±2° in both axes
Height of axis: 100 mm

Article description	Ord.-No.
Adjustable holder D40	223 023
Adjustable holder D65	223 024



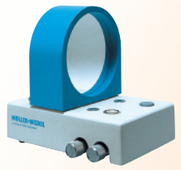
Adjustable holder D40/D65 (alternative)

for adjustable mounting of ELCOMAT direct for high demands on stability and adjustment accuracy, also for attaching to the tripod (Ord.-No. 223 081)
Adjustment range ±4° in both axes
Height of axis: 132 mm

ACCESSORIES

Mirror D100, adjustable

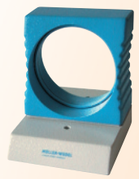
for use as auxiliary or turning mirror
Adjustment range ± 2° in both axes
Height of the mirror center: 100 mm



Article description	Ord.-No.
Mirror D100 adjustable, double-sided	223 221

Mirror D63 in mount

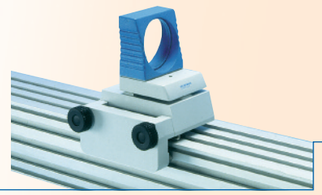
combinable with base (Ord.-No. 223 264)
or with magnetic base (Ord.-No. 223 282)
for measurement of straightness, squareness, parallelism and flatness
Height of mirror center: 55 mm



Article description	Ord.-No.
Mirror in mount, one-sided	223 260
Mirror in mount, double-sided	223 262

Base with stop bar

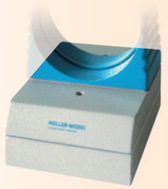
combinable with mirror in mount
(Ord.-No. 223 260 or 223 262)
for measurement of straightness, squareness and parallelism
Height of mirror center: 100 mm



Article description	Ord.-No.
Base 100/50	223 264
Stop bar for base 100/50	223 269

Magnetic base

combinable with mirror in mount
(Ord.-No. 223 260 or 223 262)
for mounting to any magnetic surface
Height of mirror center: 100 mm



Article description	Ord.-No.
Magnetic base for mirror 223 260; 223 262	223 282

Adjustable magnetic mirror D63

for use as auxiliary or turning mirror
Adjustment range approx. ±2.5° in both axes
Mounting to any magnetic surface or with 4 screws M4 possible

Article description	Ord.-No.
Adjustable mirror D63, permanent magnetic clamp	223 210

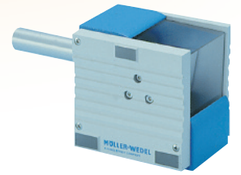
Polygon mirror 8/12

master for measurement of the angular position uncertainty of index or rotary table
Free diameter of mirror:
38 mm (Ord.-No. 205 307)
25 mm (Ord.-No. 205 313)

Article description	Ord.-No.
Polygon mirror 8 faces 2˝	205 307
Polygon mirror 12 faces 2˝	205 313

Pentaprism (Optical square)

combinable with base (Ord.-No. 221 027) or with holder (Ord.-No. 221 023) for integration in existing set-ups for deflection of measuring direction precisely through 90°



Article description	Ord.-No.
Pentaprism 2˝ in mount	221 015
Pentaprism 2˝ with wedge in mount	221 016

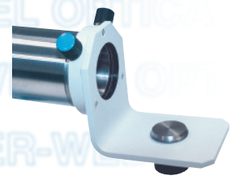
Base for pentaprism

for mounting the pentaprism (Ord.-No. 221 015 or 221 016)
Application:
measurement of squareness and parallelism
Height of axis: 100 mm

Article description	Ord.-No.
Base for pentaprism	221 027

Holder for pentaprism

for mounting the pentaprism (Ord.-No. 221 015 or 221 016) onto 65 mm diameter objective tube
Application:
measurement of squareness



Article description	Ord.-No.
Holder D65 for pentaprism	221 023

Achromat attachments	Ord.-No.
f=50 D12 M36x0.75	221 048
f=90 D16 M36x0.75	221 051
f=140 D28 M36x0.75	221 053
f=200 D28 M36x0.75	221 055
f=300 D28 M36x0.75	221 059
f=500 D28 M36x0.75	221 063
f=600 D28 M36x0.75	221 067
f=300 D50 M60x1	221 061
f=500 D50 M60x1	221 065

Achromat attachment

mounted onto 40 or 65 mm diameter objective tube for focussing of collimation beam
Application:
measurement of centration

Laser attachment D40/D65

for quick and easy alignment of ELCOMAT direct with 40 or 65 mm objective tube to target mirror

Article description	Ord.-No.
Laser attachment D40	219 767
Laser attachment D65	219 757

Tripod

for use with adjustable holders
(Ord.-No. 223 056 or 223 023/024)
Min. height 630 mm
Max. height 1320 mm

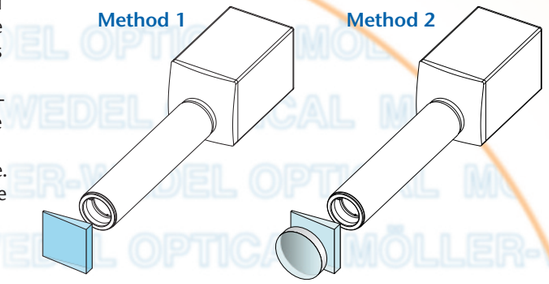
Article description	Ord.-No.
Tripod for 223 023; 223 024	223 081
Tripod for 223 056	223 082

APPLICATIONS

The **ELCOMAT direct** can be used in all applications where electronic autocollimators of the **ELCOMAT** product series are utilized. Since multiple autocollimation images can be detected and evaluated simultaneously with the ELCOMAT direct, it additionally offers some applications like e.g. measurement of wedges or 90° prism angles. Some of the possible applications are described below.

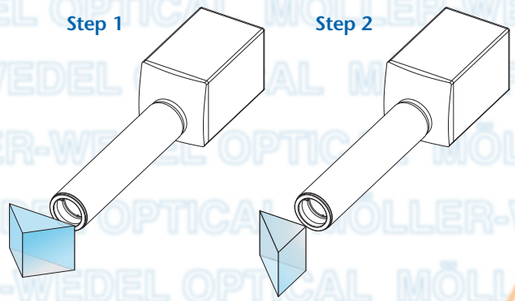
Wedge angle measurement

Measurement of wedge angles is possible by evaluation of either double cross or deflection angle. The first method offers higher accuracy over the second and doesn't require an additional mirror. The downside of the first method is the fact that it requires the separation of the autocollimation images to be in the order of the minimum detectable angle difference given in the overview table on the back of the catalogue. This results in the restriction, that the wedge angle has to exceed a certain minimum value. The second method doesn't have this restriction. It can be applied to wedges with smaller wedge angles, as well.



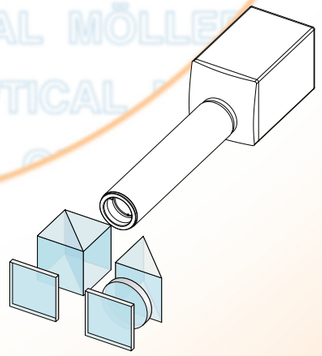
Angle measurement of 90°-prisms

Measurement of the error of the 90° and 45° angles of 90°-prisms in two steps. Firstly the 90° angle is determined. In a second step the errors of the 45° angles are measured. Like the wedge angle measurement with double cross this method relies on the multiple autocollimation image evaluation and thus underlies the same restriction, that it requires the separation of the autocollimation images to be in the order of the minimum detectable angle difference given in the overview table on the back of the catalogue. This results in the restriction, that the prism angle error has to exceed a certain minimum value.



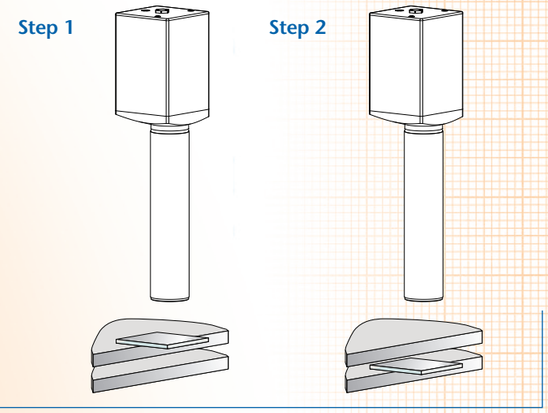
Adjustment

Adjustment of optical components (e.g. prisms and mirrors). Due to the possibility of multiple cross evaluation it is possible to align components even if there are autocollimation images from other components appearing in the camera image.



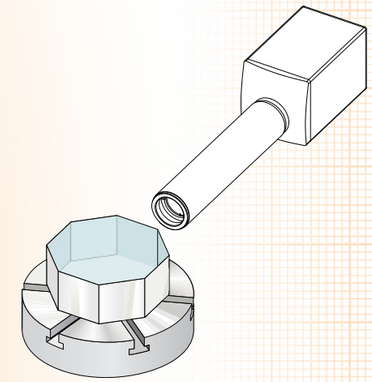
Parallelism of two surfaces

The ELCOMAT direct can be used to measure the parallelism of two or more parallel surfaces in two axes. A plane parallel mirror is required, additionally.



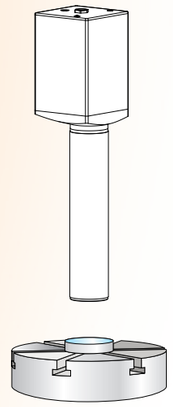
Position uncertainty

Testing of the position uncertainty of index and rotary tables, measurement of polygon mirrors. Accuracy up to 0.4 arcsec. (requires RTM software, also available from MOELLER-WEDEL OPTICAL GmbH).



Wobble

Measurement of wobble of spindles and rotation tables (requires centration option of ELCOdirect software).



Centring

The ELCOMAT direct allows an easy to use and fast measurement of the centration error in reflection as well as in transmission also during assembly of lens systems from single lenses. (requires centration option of ELCOdirect software).