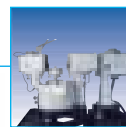
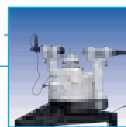
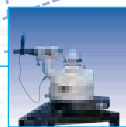
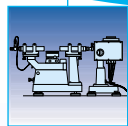
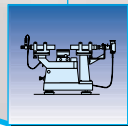
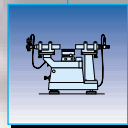
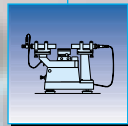


*Indispensable for manufacturing of
high-precision optics*

GONIOMETER- SPECTROMETER

*For precise angle
and refractive index
measurement*



MEASUREMENT TASKS

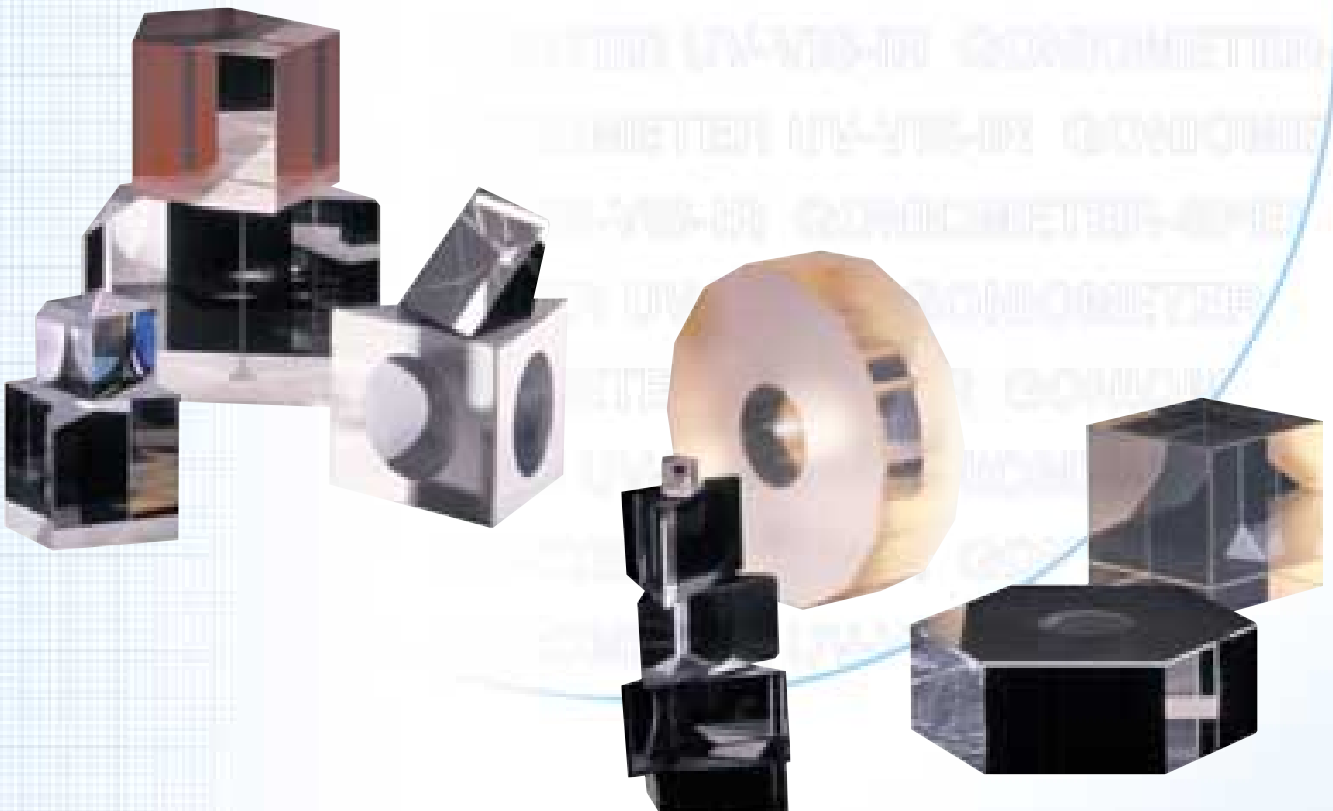
Indispensable for manufacturing of precision optics

MOELLER-WEDEL OPTICAL continues the proud tradition of MOELLER-WEDEL in the field of high precision Goniometers and Goniometer-Spectrometers for industrial and scientific applications. Goniometers are indispensable instruments for measuring and testing prism and polygon mirrors in production and in quality control. The primary advantage of MOELLER-Goniometers is that arbitrary prism angle can be measured in a simple quick and precise way.

The well designed mechanics of the Goniometers allow maintenance-free operation over many years even under production conditions. A Goniometer-Spectrometer is used when refractive indices of optical materials are to be determined with high accuracy.

Conventionally the measurement of refractive indices is carried out with a dispersion prism made from the material to be tested. For measurement of fluids a hollow prism is used which is filled with the fluid.

The software GonioWin is orientated towards practical applications. It guides the user through the measurement process from the data acquisition to documentation.



Measurement Task

Definition of the Angles

Example

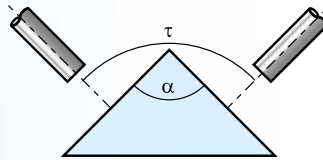
Measurement of Prism Angles

Internal angle α

$$\alpha = 180^\circ - \tau$$

Autocollimator
Position 1

Autocollimator
Position 2



α - Prism angle
 τ - Swing angle



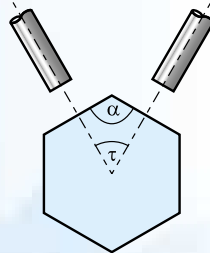
External Angle Measurement

External angle τ

(Polygon angle)

Autocollimator
Position 1

Autocollimator
Position 2



α - Prism angle
 τ - Swing angle

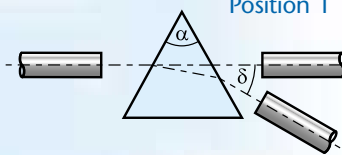


Measurement of Deflection Angle

Deflection angle δ

Collimator

Autocollimator/
Telescope
Position 1



α - Prism angle
 δ - Deflection angle

Autocollimator/
Telescope
Position 2



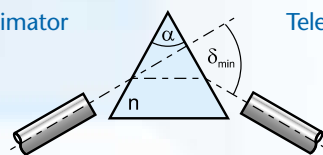
Measurement of Refractive Index

Refractive index n

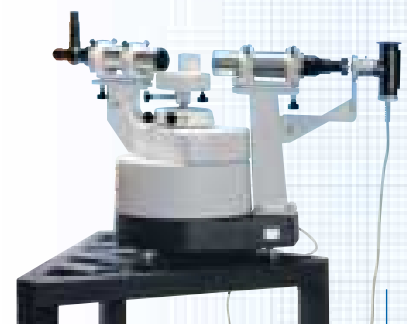
$$n = \frac{\sin(0.5(\delta_{\min} + \alpha))}{\sin(0.5\alpha)}$$

Collimator

Telescope

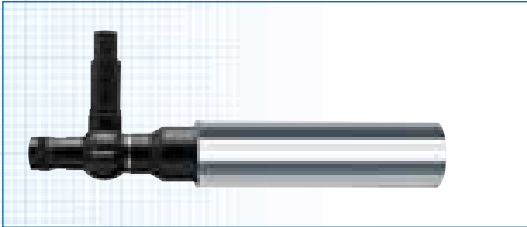


α - Prism angle
 δ_{\min} - Angle of minimum deflection
 n - Refractive index



ANGLE MEASUREMENT

Autocollimators

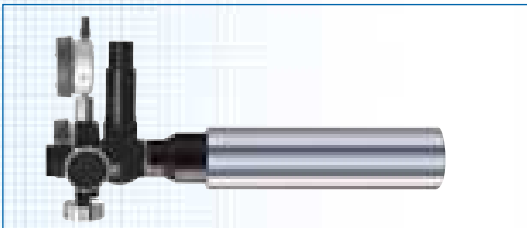


AKG 300/65/14,7

Autocollimator with straight viewing and 300 mm focal length:

- Light source: see opposite page for possible choices
- Adjustment accuracy: approx. 0.5 arcsec in reflection and 1 arcsec in transmission

Application areas: Measurement of dihedral and deflection angles in horizontal direction.



AKG 300/65/14,7 MD digital

Autocollimator with straight viewing 300 mm focal length and two programmable digital gauges:

- Light source: see opposite page for possible choices
- Adjustment accuracy: approx. 0.5 arcsec in reflection and 1 arcsec in transmission

Application areas: Measurement of dihedral and deflection angles in horizontal and vertical direction (pyramidal error).



Base Unit



Base Unit

Base unit with sturdy design in order to achieve thermal stability and long-term accuracy:

- Consisting of base plate, housing, swinging arm, adjustable supporting table, high precision axis, incremental divided circle with photoelectric reading, collimator stand
- Swinging arm 360° rotatable (with separate collimator stand)
- Collimator stand for mounting of a collimator or autocollimator with 65 mm tube diameter
- Autocollimator holder (swinging arm) an collimator holder (fixed collimator stand)



Measurement Tasks

- Measurement of deflection angles of plane-optical components and of optical prisms
- Measurement of deflection angle of optical prism
- Exact angle measurement of regular and irregular polygon mirrors
- Determination of pyramidal error of prism and polygon mirrors

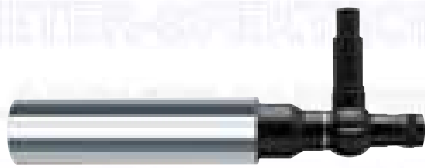
Collimators/Autocollimators



K 300/65

Collimator with 300 mm focal length:

Application areas: Measurement of deflection angles.



AKG 300/65/14,7

Autocollimator with straight viewing and 300 mm focal length:

- Adjustment accuracy: approx. 0.5 arcsec in reflection and 1 arcsec in transmission

Application areas: Measurement of deflection and relative angles.



Goniometer Stand

- Height of the eyepiece easily and comfortably adjustable by electrical motor-driven height adjustment

Features of the stand:

- Minimum table height: 100 cm
- Maximum table height: 148 cm
- Minimum eye lens height: 150 cm
- Maximum eye lens height: 198 cm
- Maximum load: 2000 N



Light Sources

For illumination of the collimators and autocollimators four types of light sources are available:

Incandescent Bulb Illumination 6V/5W

Features:

- Brightness adjustable in five levels

LED-Illumination, green

Features:

- Brightness continuously adjustable
- Approx. 5x brighter than incandescent illumination

Cold Light Source 20 W

Features:

- Brightness adjustable in three levels
- Approx. 7x brighter than incandescent illumination

Cold Light Source 150 W

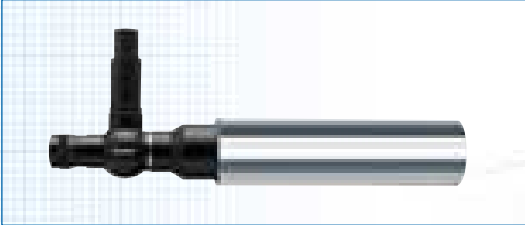
Features:

- Brightness continuously adjustable
- Approx. 50x brighter than incandescent illumination



REFRACTIVE INDEX MEASUREMENT

Autocollimators/Telescopes



AKG 300/65/14,7

Autocollimator with 300 mm focal length and refractive optics (for refractive index measurements it is used as a telescope)

- Adjustment accuracy: approx. 0.5 arcsec in reflection and 1 arcsec in transmission

Application areas: Measurement of dihedral angles, measurement of refractive index in the visual range (436 nm ... 650 nm).



Autocollimator with Reflective Optics

Autocollimator with 300 mm focal length and off-axis mirror optics:

- UV-VIS-NIR: CCD-camera/IR: PbS-detector
- Adjustment accuracy: approx. 0.5 arcsec in reflection and 1 arcsec in transmission

Application areas: Measurement of dihedral angles, measurement of refractive index in from UV to IR (254 nm ... 2325 nm).



Base Unit



Base Unit

Feature and design of the base unit for the Goniometer/Spectrometer VIS or UV-VIS-IR correspond essentially to those of the base unit for angle measurement.

- For the Spectrometer UV-VIS-IR a modified mounting and stand for the reflective optics collimator is required. A conversion of the Spectrometer VIS to Spectrometer UV-VIS-IR at a later time is not possible
- For the base unit UV-VIS-IR a special stand is required



Measurement Tasks

- Measurement of refractive index of optical glasses and crystals (dispersion prisms) or fluids (hollow prisms) in the wavelength range from UV to IR
- Measurement of angles of plane optical components
- Exact angle measurement of polygon mirrors
- Measurement of prism angles
- Measurement of deflection angles of optical prisms

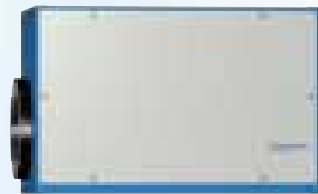
Collimators



K 300/65

Collimator with 300 mm focal length and refractive optics.

Application areas: Measurement of refractive indices in the visual range, measurement of deflection angles.



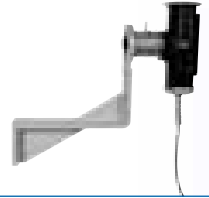
Collimator with Reflective Optics

Collimator with 300 mm focal length and off-axis mirror optics as well as precision slit.

Application areas: Measurement of refractive indices from the UV to IR (254 nm ... 2325 nm), measurement of deflection angles.



Spectral Lamp Unit



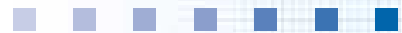
Spectral Lamp Unit VIS

- Hg/Cd with filter turret for three interference filters and condenser
- Adjustable symmetrical precision slit for the collimator



Spectral Lamp Unit UV-VIS-IR

- Up to 6 spectral lamps (e.g. Hg/Cd, Hg, Cs, Cd, He) incl. power supply
- Filter turret with up to 18 interference filters
- Condenser



Assignment Spectral Lines – Spectral Lamps

Wavelength [nm]	Symbol	Spectral lamp
2325.4	-	Hg
1970.1	-	Hg
1529.6	-	Hg
1014.0	t	Hg
852.1	s	Cs
706.5	r	He
643.8	C'	Cd

Wavelength [nm]	Symbol	Spectral lamp
587.6	d	He
546.1	e	Hg
480.0	F'	Cd
435.8	g	Hg
404.7	h	Hg
365.0	i	Hg
253.6	-	Hg

GONIOWIN - SOFTWARE

GonioWin is a software program consisting of a module for angle measurement of prisms and polygons and a module for determination of refractive indices. It runs exclusively on PCs with WINDOWS® operating system. The program reads, displays, and processes the angle from the

Goniometer, allows the protocol generation and the export of the data to other applications (e.g. spreadsheet programs).

Software Module for Angle Measurement

- Measurement of internal and external angles
- Automatic calculation of dihedral angles
- Protocol generation

Measuring No	Circle position	Angle 1	Angle 2	Angle 3
1 <-->	0°	29.99875°	65.00132°	85.00232°
2 <<-->	0°	29.99937°	65.00088°	85.00199°
mean (°)		29.99906°	65.00110°	85.00216°
mean (° ' '')		29°59'56.6''	65°0'3.9''	85°0'7.7''
st. deviation (°)		0.00044°	0.00031°	0.00023°
st. deviation (° ' '')		1.6''	1.1''	0.8''

Software Module for Refractive Index Measurement

- Measurement of refraction by the method of minimum deflection angle of a dispersion prism
- Calculation of the refractive index for standard environmental conditions (numerical compensation of climate conditions)
- Measurement after single-sided and side-by-side method possible
- Protocol generation

Wavelength	Temp.-Coeff	#	Angle1	Angle2	Deviation	Ref. Index	Normalized
435.8	0	1	13.02459	39.00982	12.99262°	1.209703	1.209701
	0	2	13.02453	39.00985	12.99266°	1.209704	1.209701
	0	3	13.02452	39.00989	12.99268°	1.209704	1.209702
	0	4	13.02460	39.00983	12.99262°	1.209703	1.209701
		Meanvalue				1.209703	1.209701
546.1	0	1	13.02483	39.00962	12.99240°	1.209699	1.209697
	0	2	13.02484	39.00957	12.99236°	1.209699	1.209697
	0	3	13.02481	39.00962	12.99240°	1.209700	1.209697
	0	4	13.02481	39.00961	12.99240°	1.209699	1.209697
		Meanvalue				1.209699	1.209697
643.8	0	1	13.02503	39.00922	12.99210°	1.209695	1.209693
	0	2	13.02499	39.00927	12.99214°	1.209695	1.209693
	0	3	13.02504	39.00923	12.99210°	1.209695	1.209693
	0	4	13.02501	39.00925	12.99212°	1.209695	1.209693
		Meanvalue				1.209695	1.209693

RELATIVGONIOMETER

Relativ Goniometer

The Relative Goniometer represents an inexpensive alternative to the Goniometer II. With this Goniometer the dihedral angles of a prism are compared to those of a master prism, thus it is measuring relative angles. The accuracy of 2 arcsec achieved with visual autocollimators is sufficient in most of cases. If higher accuracy is required, electronic autocollimators can be used.

The Relative Goniometer consists of the following components:

- Swivelling arm with prism supporting table, holder and base plate
- Autocollimator (e.g. AKR 300/40/14.7)
- Autocollimator with two programmable digital gauges (e.g. AKG 300/40/14.7 MD digital)
- TV-Set (2x)



Swivelling Holder

Swivelling holder for autocollimation telescopes with tube diameter D40 or D65. The swivelling range $\pm 90^\circ$.

Consisting of:

- Swivelling base
- Swivelling arm
- Tilttable
- Mount for D40 or D65

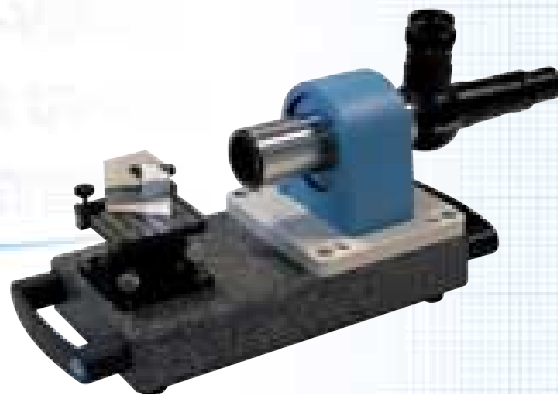
For completion of the workstation an autocollimator has to be ordered. The choice of the autocollimator depends on the measurement task (type of prism, demands on accuracy).

It will be a pleasure to assist you in choosing the autocollimator.



Prism Measuring Unit

The prism measuring unit is used for accurate, fast, and inexpensive testing of the prism angle of 90° -prisms under production conditions. The achievable accuracy is 1 arcsec. If necessary, the accuracy can be increased by a computer aided evaluation with a special software. The choice of the autocollimator depends on the measurement task (type of prism, demands on accuracy). It will be a pleasure to assist you in choosing the autocollimator.



CONFIGURATION

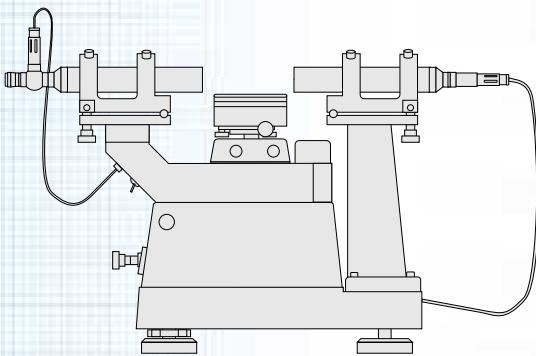
Five methods that lead to precise results

The Goniometer/Goniometer-Spectrometer is available in five different configurations.

The two illustrations below show the Goniometer in the configuration for prism angle measurements. The three illustrations to the right show the Goniometer-Spectrometer, which is able to measure prism angles as well as refractive indices.

For a precise angle measurement it is generally recommended to measure the dihedral angles at different positions of the divided circle, in order

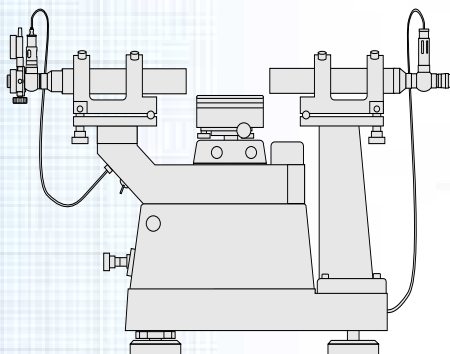
to minimise the harmonic error (series measurement). In order to achieve the accuracy of 1×10^{-5} in refractive index measurement it is necessary to measure the environmental conditions precisely with the appropriate instruments (not included).



Digital Goniometer II Standard

The optimum instrument for optical production and laboratory for the measurement of dihedral and deflection angles of prisms. The measuring range for dihedral angles is 360° (when collimator stand is removed). The measuring range for deflection angles is approx. $\pm 135^\circ$.

Description	Ord.-No.
Goniometer II Standard	241 021



Digital Goniometer II Universal

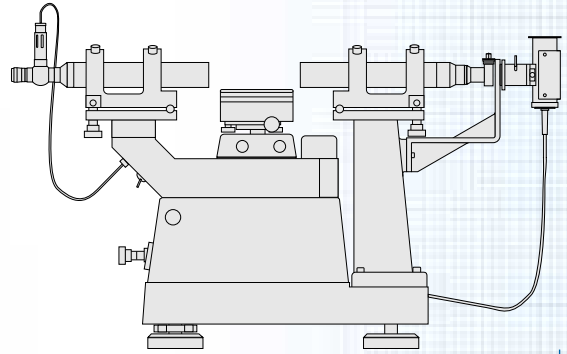
In contrast to the Goniometer II Standard this Goniometer is equipped with two autocollimators: one AKG 300/65/14.7 and one AKG 300/65/14.7 MD digital. Thereby this Goniometer can be used to measure dihedral and deflection angles as well the pyramidal error of prisms. The combination of the two autocollimators allows the use as a relativ Goniometer, too. In this case no master prism is required.

Description	Ord.-No.
Goniometer II Universal	241 022

Digital Goniometer-Spectrometer II VIS

The Goniometer-Spectrometer II VIS consists of a Goniometer II and the spectral equipment VIS. With the Goniometer-Spectrometer refractive indices of glasses, optical crystals and fluids at the wavelengths 480 nm, 546 nm and 644 nm can be determined. In addition, the measuring tasks of the Goniometer II are included, as well.

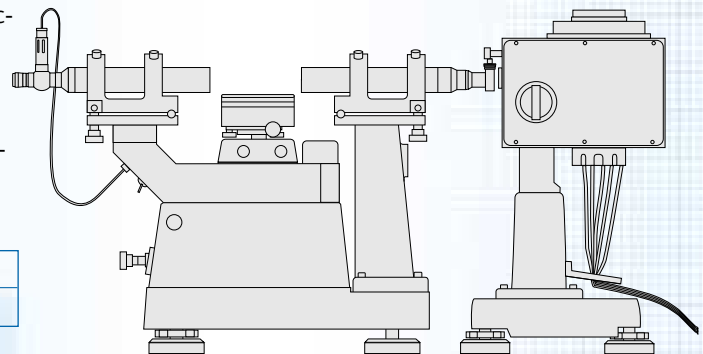
Description	Ord.-No.
Goniometer-Spectrometer II VIS	241 023



Digital Goniometer-Spectrometer II NIR-VIS

The Goniometer-Spectrometer NIR-VIS represents an extension of the Goniometer-Spectrometer VIS. By use of a special spectral lamp unit refractive indices at the wavelengths 436 nm, 480 nm, 546 nm, 644 nm, 707 nm and 852 nm can be determined. By dedicated optical measures the chromatic aberration of the autocollimator and collimator are compensated. A later upgrade of the Goniometer-Spectrometer VIS to Goniometer-Spectrometer NIR-VIS is possible.

Description	Ord.-No.
Goniometer-Spectrometer II VIS-NIR	241 024

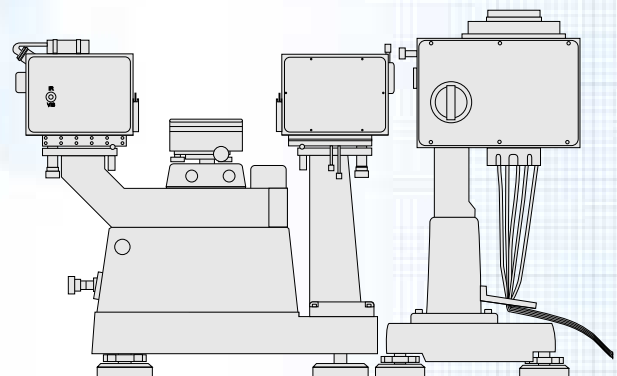


Digital Goniometer-Spectrometer II VIS-IR Digital Goniometer-Spectrometer II UV-VIS-IR

These Goniometer-Spectrometers are used for characterisation of refractive indices at manufactures of optical glasses and crystals, or at national calibration institutes. In the version VIS-IR refractive indices in the wavelength range from 405 nm to 2325 nm can be measured (see also table on page 7).

In the version UV-VIS-IR the wavelength range is extended by the UV-lines 254 nm and 365 nm. Due to the special construction of these instruments production is only possible on demand.

Description	Ord.-No.
Goniometer-Spectrometer II VIS-IR	241 010
Goniometer-Spectrometer II UV-VIS-IR	241 014



Technical Data and Accessories

	Goniometer		Goniometer-Spectrometer		
			VIS	VIS-NIR	UV-VIS-IR
Measuring Principle					
- Adjustment	optical	optical	optical	optical	optical
- Angle measurement	Photo-electronic with electronic signal processing				
Divided circle	Glass	Glass	Glass	Glass	Glass
- Division	Radial grating	Radial grating	Radial grating	Radial grating	Radial grating
- Number of lines	36.000	36.000	36.000	36.000	36.000
- Number of sensors	2	2	2	2	2
Swivelling range	360°	360°	360°	360°	360°
	approx. 270° (with spectral unit or collimator)				
Angular resolution	0.00001°/0.036"	0.00001°/0.036"	0.00001°/0.036"	0.00001°/0.036"	0.00001°/0.036"
Accuracy/ Angle Measurement					
- Accuracy of single measurement	2 arcsec	2 arcsec	2 arcsec	2 arcsec	2 arcsec
- Mean error of a series measurement	0.6 arcsec	0.6 arcsec	0.6 arcsec	0.6 arcsec	0.6 arcsec
Autocollimator/ Collimator	Lens optics	Lens optics	Lens optics	Mirror optics	
Spectral range		480-644 nm	436-852 nm	254-2325 nm	
Adjustment	Eyepiece visual (optional CCD-Camera)	Eyepiece visual (optional CCD-Camera)	CCD-Camera	CCD-Camera PbS-Detector with computer assisted evaluation	
Data acquisition	PC (incl. Software)		PC (incl. Software)		

Accessories		
For Goniometer, Goniometer-Spectrometer VIS, Goniometer-Spectrometer VIS-NIR		
Ord.-No.	Description	Usage
241 190	Motorised Goniometer Stand	Adaptation of the working height to the height of the operator
219 113	Autocollimation eyepiece AKG f=14,7 MD digital	For the determination of the pyramidal error of prisms and parallelism of plane plates
217 010	Eyepiece f=10 mm	Magnification 25x, exchangeable for eyepiece f=14,7 mm
217 015	Eyepiece f=25 mm	Magnification 10x, exchangeable for eyepiece f=14,7 mm
215 023	Adapt. sleeve with reticle turret and 6 reticles	For collimator, extension of the measurement capabilities (determination of the imaging qualities of optical components)
217 305	Incandescent illumination 6V/5W	Light sources for visual autocollimators or collimators
217 321	LED-illumination, green	
217 331	Cold light source 150 W	
217 333	Cold light source 20W	

