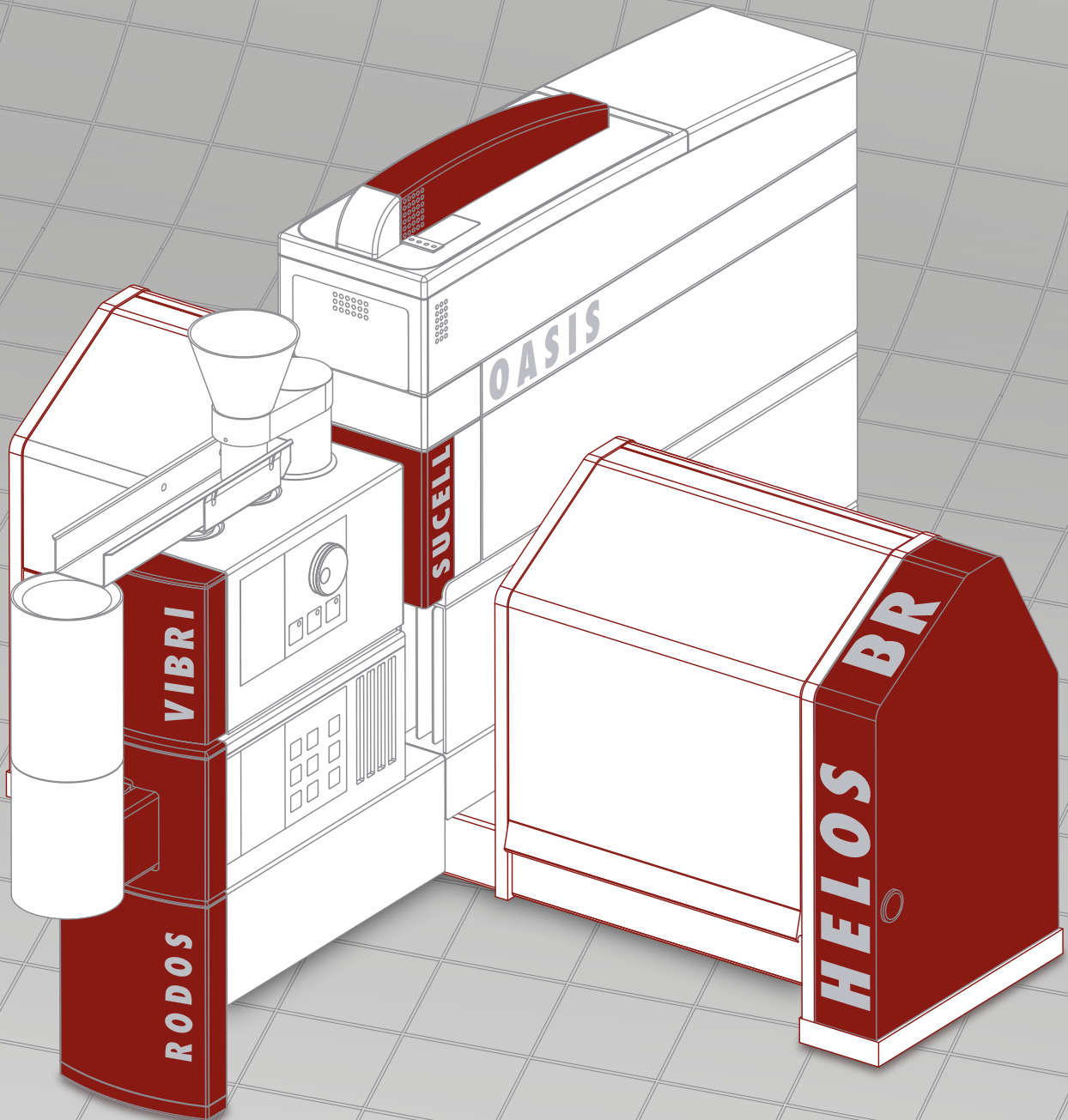


HELOS | RODOS & Co. | Laser Diffraction
Particle Measurement | Laboratory
Size and Distribution | $< 0.1 \mu\text{m}$ to $8,750 \mu\text{m}$



Technical Specifications



Technical Specifications

Modular Laser Diffraction Sensor for Particle Size Analysis

Sensor			
Label	HELOS/BR	HELOS/KR¹	HELOS/KR-Vario²
Overall measuring range	0.1 – 875 µm	0.1 – 8,750 µm	0.1 – 8,750 µm
Measuring range modules	5	8	8

Measuring principle

Laser diffraction	Forward scattering in parallel beam – classic optical Fourier set up (ISO 13320) – open measuring zone offering unique working distance
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Light source

Helium-neon laser	$\lambda = 632.8$ nm (red), $P_{out} \leq 5$ mW
Laser class	3R with open dispersion units 1 with closed dispersion units
Beam diameter	Automatic adjustment to measuring range
	R1 / R2 2.2 mm
	R3 / R4(T) / R5(T) 13.0 mm
	R6T / R7T 26.0 mm
	R6T / R7T / R8T 35.0 mm

Measuring ranges and optics

Discrete measuring ranges with highest precision and resolution³.

		Focal length	$x_{min, CLmin}$ x_{max}^{*}	
HELOS/BR	R1	(f=20 mm)	0.10 0.18 –	35.0 µm
	R2	(f=50 mm)	0.25 0.45 –	87.5 µm
	R3	(f=100 mm)	0.50 0.90 –	175.0 µm
	R4T	(f=200 mm)	0.50 1.80 –	350.0 µm
	R5T	(f=500 mm)	0.50 4.50 –	875.0 µm
HELOS/KR	R1	(f=20 mm)	0.10 0.18 –	35.0 µm
HELOS/KR-Vario	R2	(f=50 mm)	0.25 0.45 –	87.5 µm
	R3	(f=100 mm)	0.50 0.90 –	175.0 µm
	R4	(f=200 mm)	0.50 1.80 –	350.0 µm
	R5	(f=500 mm)	0.50 4.50 –	875.0 µm
	R6T	(f=1,000 mm)	0.50 9.00 –	1,750.0 µm
	R7T	(f=2,000 mm)	0.50 18.00 –	3,500.0 µm
	R8T	(f=5,000 mm)	0.50 45.00 –	8,750.0 µm

* Values indicate lower | upper limits of first class.

Typical measuring range combinations

Triple lens holding disc	R2 R4 R6T	0.25 0.45 –	1,750.0 µm
Quad lens holding disc	R1 R3 R5 R7T	0.10 0.18 –	3,500.0 µm

Detector and data acquisition

Multi-element detector	31 semi-circular segments (180°) for orientation-independent characterisation of even irregular shaped particles			
	3 centre elements for precise autofocus prior to every measurement and for continuous monitoring of optical concentration during measurement			
Acquisition rate	2,000 diffraction patterns per second			
Raw data recording	in up to 248 intensities			
Typical measuring times	Distribution width	Measuring time ⁴	Sample amount ⁴	Standard deviation ⁵
minimum	narrow ⁶	< 0.1-1 s	< 10-100 mg	< 1.0-1.5 %
	normal ⁷	< 0.1-1 s	< 0.1-1 g	< 1.5 %
	wide ⁸	< 1-10 s	< 1-10 g	< 2.0-2.5 %
recommended	narrow ⁶	1-3 s	< 0.1-2 g	< 1.0-1.5 %
	normal ⁷	2-10 s	< 1-10 g	< 1.0-1.5 %
	wide ⁸	5-30 s	< 10-100 g	< 1.5-2.0 %
	If continuous sample feeding is granted, sample amount as well as measuring time is virtually unlimited. In doing so, maximum standard deviation of three consecutive measurements always remains below 2.5 %.			

Evaluation modes

FREE	Fraunhofer Enhanced Evaluation (Fraunhofer diffraction, parameter free)
MIEE ²⁰	Mie Extended Evaluation (Mie Scattering, deploying the complex refractive index)
Combination of measuring ranges ²⁰	Automatic combination of up to 4 high-resolution measuring ranges capturing wide distributions (ratio $x_{90}/x_{10} > 1,000$) ⁹ Calculation of an aggregated particle size distribution with up to 57 size classes out of a maximum of 124 independent observations.

Quality of measuring results

Accuracy*	$\sigma < 1$ %	mean relative standard deviation to absolute value ($x_{10} \dots x_{90}$)
Repeatability ¹⁰	$\sigma < 0.04$ %	typical, wet measurement ¹¹
	$\sigma < 0.3$ %	typical, dry measurement ¹²
Comparability ¹³	$\sigma < 1$ %	mean relative standard deviation of median (x_{50})
	$ \Delta x_{50} < 2.5$ %	maximum relative deviation

* Evaluation of a picket fence distribution

1) For special applications also available with open measuring zone of doubled width (HELOS/KR+) for inclusion of up to two dispersing units. 2) Open and variable measuring zone. R8 with gravity disperser GRADIS only. 3) User defined configuration of up to four precision lens modules per lens holding disc. 4) By tendency, lower values apply to finer, upper values to coarser particulate systems, respectively. Stated amounts valid for densities up to 2 g/cm³.

5) Maximum standard deviation in any size class of three consecutive measurements (repeatability). Sample splitting error < 0.5 %. 6) $x_{min} \dots x_{max}$: 1 decade (e.g., 1 ... 10 µm). 7) $x_{min} \dots x_{max}$: 2 decades (e.g., 1 ... 100 µm). 8) $x_{min} \dots x_{max}$: more than two decades (e.g., 1 ... 1,000 µm). 9) Using a single lens holding disc. By using another lens holding disc further measuring ranges may be added. 10) The given values are valid for measurements with reference material SIC P600 related to the

Adaptable Dispersion Units

for Powders, Granules, Aerosols, Sprays, Inhalants, Suspensions, Emulsions, Bubbles, Gels, ...

Dispersing Units and Feeder¹⁴

Dry¹⁵

	Dispersing range	Sample amount per analysis
RODOS Injection disperser for finest, even cohesive powders	< 0.1 - 3,500 µm	< 1 mg - 1,000 g
GRADIS Gravity disperser for coarser, even fragile particulate systems	0.5 - 8,750 µm	10 - 1,000 g
VIBRI ¹⁶ vibratory feeder for precise dosing and feeding of dry particulate systems	< 0.1 - 15,000 µm	1 mg - 1,000 g
ASPIROS ¹⁶ micro dosing system for feeding small amounts of precious or toxic dry substances in encapsulated sample vials ¹⁷	< 0.1 - 875 µm	< 1 mg - 1 g

Dry and wet

OASIS Combines RODOS and SUCELL; small volume adapter (SVA) ²⁰	< 0.1 - 3,500 µm 0.1 - 1,750 µm	< 1 mg - 1,000 g 500 ml 50 ml
VIBRI or ASPIROS for feeding of dry samples ¹⁶		



RODOS



GRADIS



RODOS/L

Wet¹⁸

	Dispersing range	Analysis volume
SUCELL Closed loop flow-through cell for suspensions and emulsions; built-in sonication (0-72 W); small volume adapter (SVA) ²⁰	0.1 - 1,750 µm	500 ml 50 ml
QUIXEL Closed loop flow-through cell for suspensions and emulsions, even with coarser, high density particles; built-in sonication (0-72 W); heatable ²⁰	0.1 - 3,500 µm	300 - 1,000 ml
CUVETTE	Module integration platform	
For small quantities of precious suspensions and emulsions		
SYSIPHUS Circulation cell* Stainless steel	0.1 - 875 µm	50 ml
CUVETTE 50 Stand cell* Quartz glass	0.25 - 3,500 µm	50 ml
* With sonication and magnetic stirrer		
CUVETTE 6 Stand cell** Quartz glass	0.1 - 87.5 µm	6 ml
** Smallest volume with manual stirrer		

Sprays and Inhalants

SPRAYER Adapter for nasal and pharyngeal pump sprays with SMACTOR ¹⁹ actuator	0.25 - 875 µm	1 dose
SMACTOR ¹⁹ Actuator with universal rack for flexible spray applications	0.25 - 1,750 µm	1 dose
INHALER Vacuum controlled adapter for aerosol analysis of DPIs, MDIs and nebulizers	0.25 - 1,750 µm	1 dose



CUVETTE



SUCELL



OASIS

¹⁰ x_{50} -value. ¹¹ Repeated wet measurement of the same sample in closed-loop SUCELL. ¹² Repeated dry measurement of riffler sample with RODOS. ¹³ System-to-system reproducibility. ¹⁴ Stated size ranges are application dependent. ¹⁵ Recommended optical concentration for particle size analysis with dry dispersing units: c_{opt} =5-15 %, ideally c_{opt} =8-12 %. ¹⁶ RODOS and GRADIS typically with dry feeding unit VIBRI. Feeding of RODOS with ASPIROS,

alternatively. ¹⁷ When using hazardous or toxic substances, additional safety measures must be taken by the operator at the installation site. ¹⁸ Recommended optical concentration for particle size analysis with wet dispersing units: c_{opt} =15-25 %. ¹⁹ With force and trajectory mode; stroke length: 1 - 20 mm, force: 10 - 70 N, maximum velocity: 10 - 250 mm/s. ²⁰ Optional.

The Modular Classic

Systems for Particle Size Analysis

Sensors | Dispersers | Evaluation | Quality

Quality assurance system

Certification	Standardised test procedure
Reference material	SiC-F1200 ($x_{50} \approx 4.5 \mu\text{m}$)
	SiC-P600 ($x_{50} \approx 27 \mu\text{m}$)
	SiC-P80 ($x_{50} \approx 260 \mu\text{m}$)
	SiC-P50 ($x_{50} \approx 430 \mu\text{m}$)
Validation	according to FDA regulations

Software

PAQXOS	PC or remote control of application in terms of sensor, dispersing units and sample feeding
Control and evaluation software for particle size analysis	Evaluation <ul style="list-style-type: none"> - Fraunhofer Enhanced Evaluation (FREE) - Mie Extended Evaluation (MIEE)²⁰ - mean values and standard deviations - combination of measuring ranges²⁰ Presentation of results based on user defined reports and templates <ul style="list-style-type: none"> - diagrams (distribution curves, trend graphs) - tables - characteristic values
	Powerful programming interface for scripting and customized applications
	Facilitated processing control
	Step-by-step wizard for quick and successful measurements
	Intuitive SOP management
	User-friendly, individual user interface

Compliance

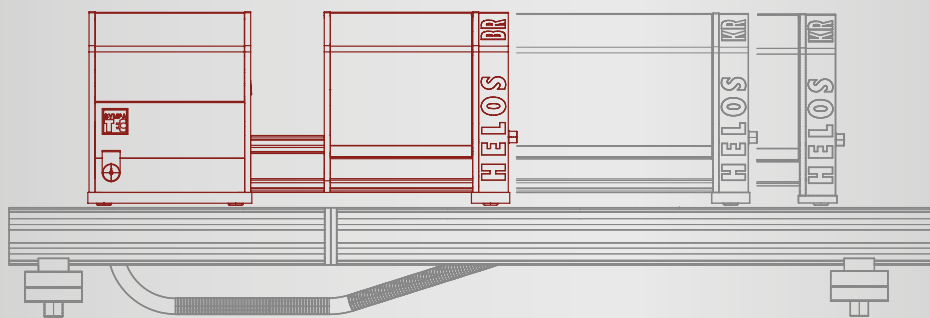
ISO 13320	The ISO standard requirements concerning "Particle size analysis - Laser diffraction methods" are met or even partially exceeded.
FDA 21 CFR Part 11	The compliance to FDA rule standards concerning electronic records and electronic signatures is provided.

System specifications

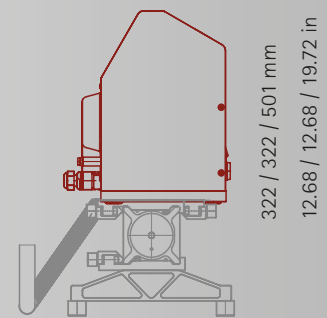
	HELOS/BR	HELOS/KR	HELOS/KR-Vario
Dimensions (L/W/H) mm	705/279/322	1,102/279/322	2,020/279/501
Measuring zone mm	123	123	123 to 1,400
			variable
Weight kg	30	35	70
Supply voltage	90 - 250 V AC @ 50-60 Hz		
Power consumption	Standby	0.1 W	
	Laser mode	31 W	
Compressed air ²¹	Supply	max. 6 bar ISO 8573-1 Class 3	
	Consumption	typical 200 l/min max. 300 l/min	
Extraction ²²	Application dependent industrial extraction unit		

Computer specifications

Operating system ²³	Microsoft® Windows® 10 Professional (64 Bit)
Hardware specification ²⁴	Up-to-date desktop PC, e.g., Intel® Core™ i7, min. 3.6 GHz, 8 GB RAM, 8 MB Cache, SSD PCIe 512 GB, Intel® HD Graphics 630 (integrated), DVD±RW
Display	27" Full HD (2,560 x 1,440 px)
Interfaces	Ethernet LAN connection (100 MBit/s)



BR / KR / KR-Vario 705 / 1,102 / 2,020 mm 27.76 / 43.68 / 79.52 in



279 mm 10.98 in
322 / 322 / 501 mm
12.68 / 12.68 / 19.72 in

Dimension sheet

²¹ Required in conjunction with injection disperser RODOS (resp. OASIS). ²² Required in conjunction with dry dispersers RODOS (resp. OASIS) and GRADIS. ²³ Microsoft® Windows® 7 Professional (64 Bit) supported. ²⁴ Sympatec reserves the right to supply equivalent or better specified personal computers.
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