



The HORIBA LA-960

Simple, Powerful, Reliable Particle Size Measurement



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Explore the future

Automotive Test Systems | Process & Environmental | Medical | Semiconductor | Scientific

HORIBA

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LA-960 Laser Particle Size Analyzer



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What we'll talk about

- **Ease of use**
 - **Software, automation, speed**
- **Performance**
- **Sample handlers**
- **Reliability & support**

LA-960: Laser Diffraction

- Simple, powerful, reliable particle size
- Tenth generation design
- Lowest total cost of ownership
- Ultra durable
- Suspension, emulsion, powder, paste, gel
- 10 nanometer – 5 mm



[Watch the 3 minute overview video](#)

History of the LA-Series

1980s

1990s

2000s

2010s



LA-500 (1988)



LA-700 (1991)



LA-910 (1993)



LA-750 (1997)



LA-920 (1997)



LA-300 (1999)



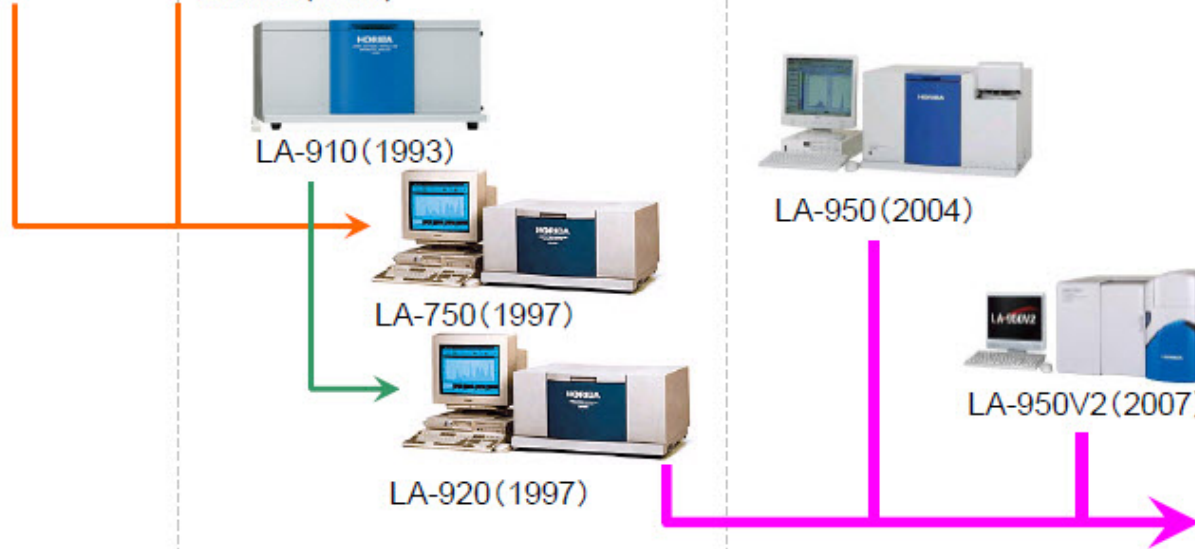
LA-950 (2004)



LA-950V2 (2007)

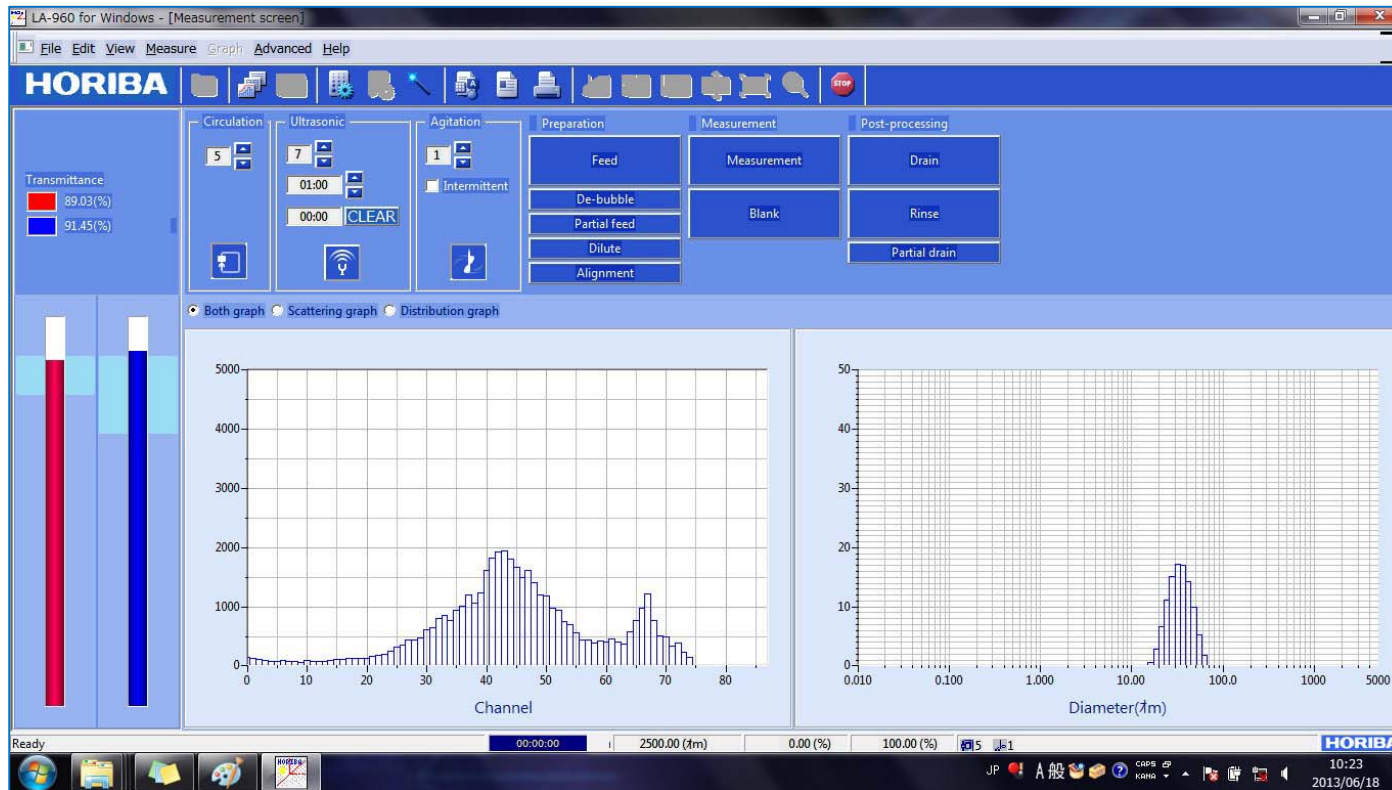


LA-960
(2014)



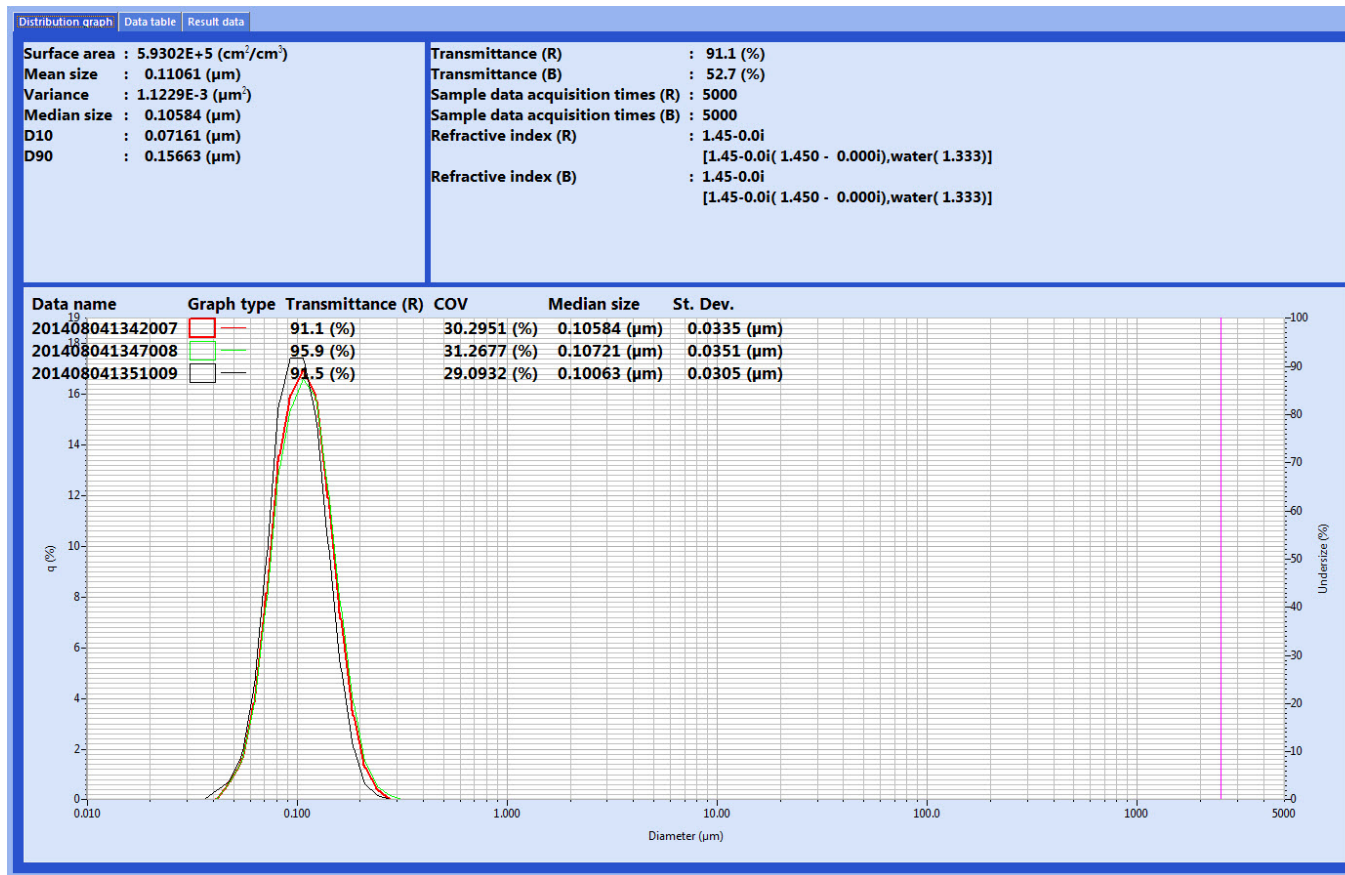
Software ease of use

- Real-time particle size distribution tells you when to make the measurement
- All controls on one screen



Software ease of use

- Quickly review measurement results
- All information is on one screen

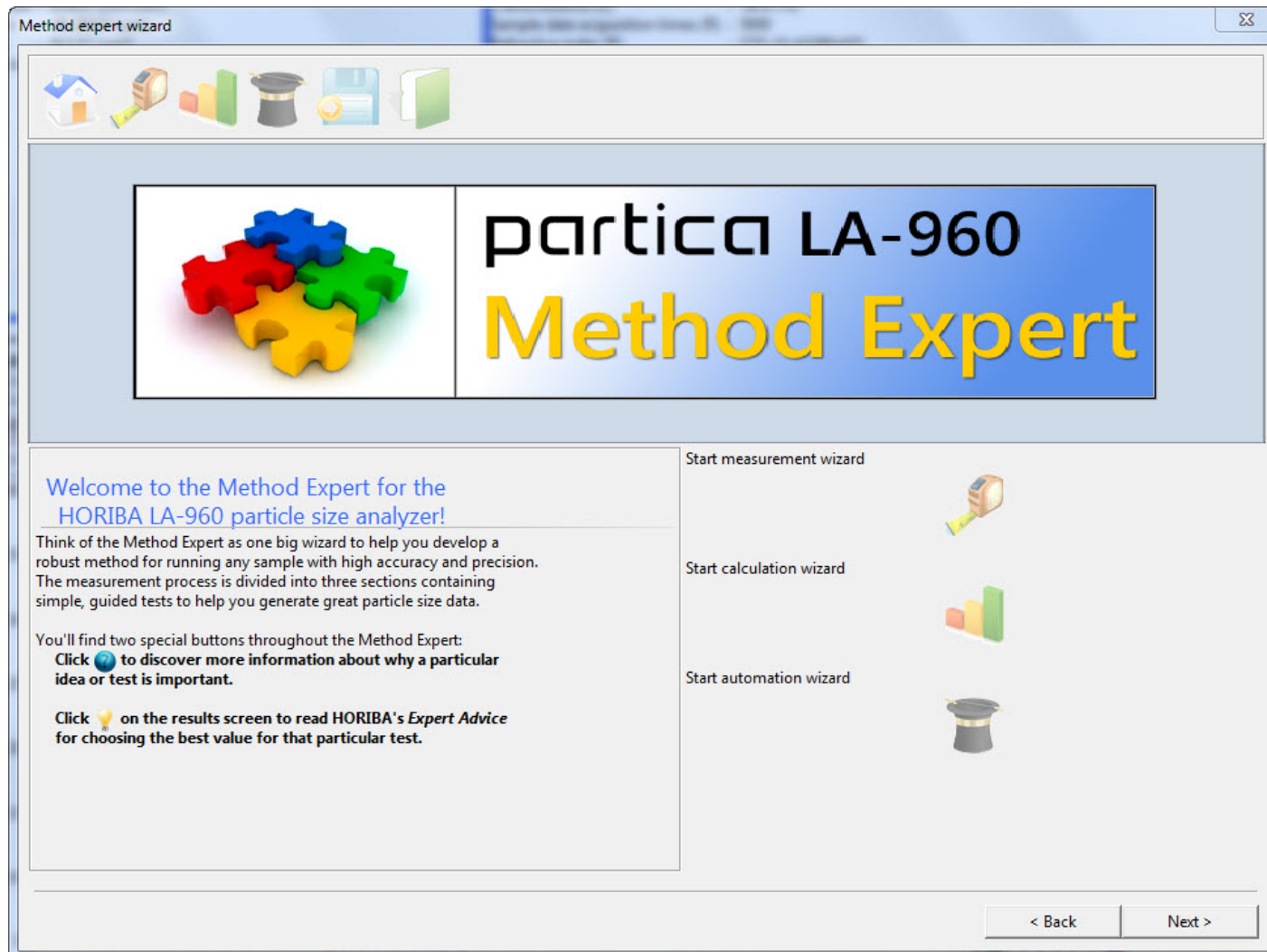


LA-960 Method Expert

- Unique guided method development
- Easily choose measurement and calculation conditions
- Choose the best refractive index
- Create “one button” Sequence SOPs



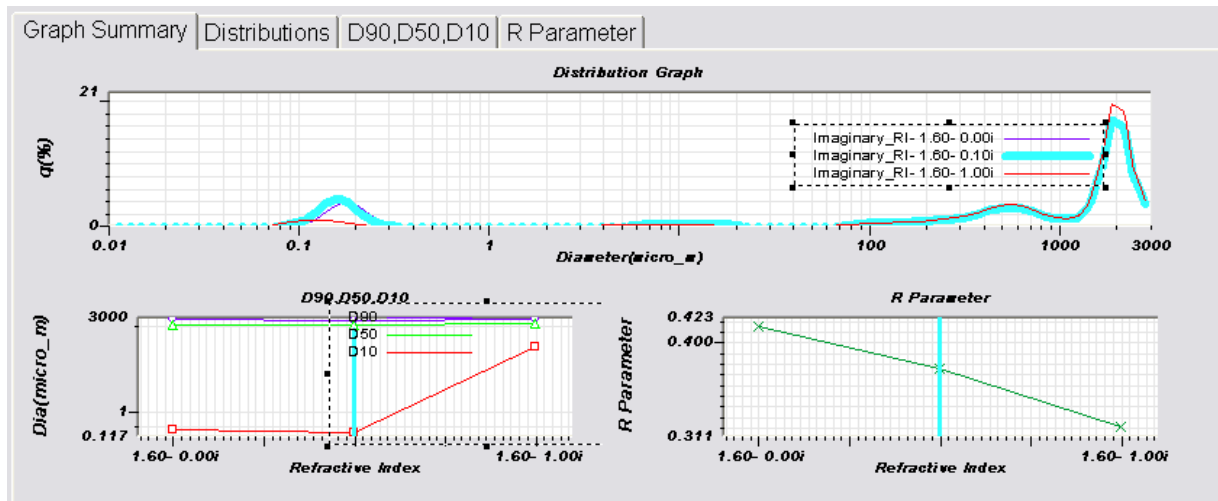
LA-960 Method Expert



LA-960 Method Expert

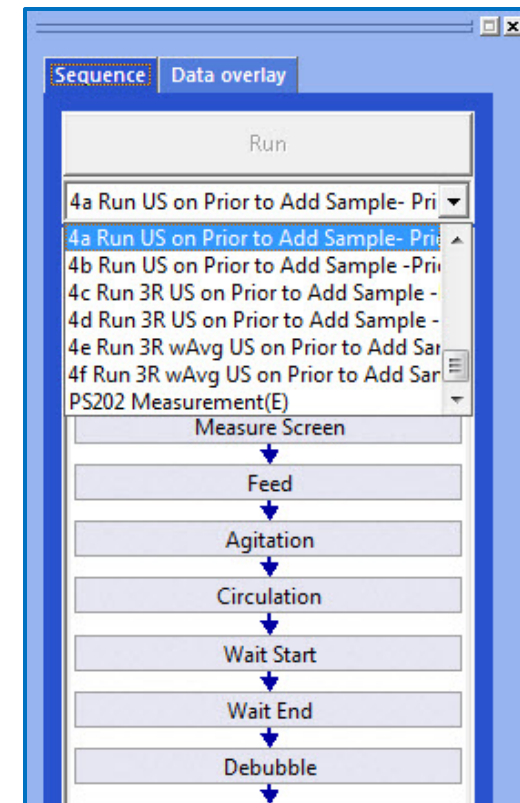
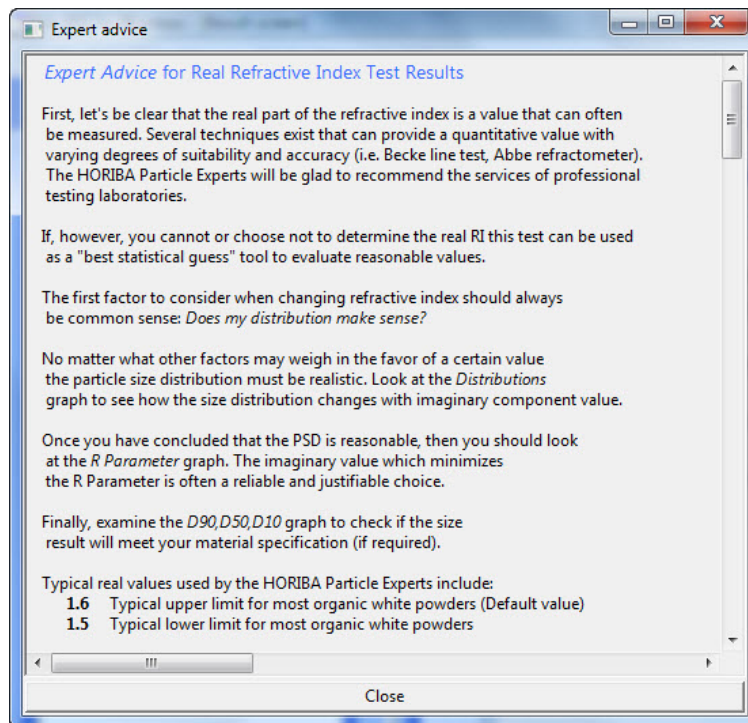
Method Expert guides user to prepare the LA-960 for each test

Results displayed in multiple formats:
PSD, D50, R-parameter



LA-960 Method Expert

- Built-in *Expert Advice* guides your decisions
- Quickly create Sequence files which fully automate the LA-960



Automated review



Verification Setting
✕

Parameter:

Specification:

Standard Value: (μm)

Tolerance: ± (μm)

Certified range of values:

D(v,0.5) ≥ 10μm ± %

D(v,0.5) < 10μm ± %

Result Display Setting

Pass:

Color:

Text:

Fail:

Color:

Text:

Distribution Graph		Data Table	Result Data
Mean Size	:	0.18408(μm)	
Variance	:	1.8988E-3(μm ²)	
Median Size	:	0.17730(μm)	
Mode Size	:	0.1649(μm)	
Std.Dev.	:	0.0436(μm)	
Chi Square	:	4.162519	
R Parameter	:	3.7379E-1	
Diameter on Cumulative %	:	(2)10.00 (%) - 0.1345(μm)	
	:	(9)90.00 (%) - 0.2450(μm)	
Cumulative % on Diameter	:	(1)850.0 (μm) - 100.000(%)	
	:	(2)600.0 (μm) - 100.000(%)	
	:	(3)425.0 (μm) - 100.000(%)	
	:	(4)300.0 (μm) - 100.000(%)	
	:	(5)212.0 (μm) - 100.000(%)	
	:	(6)150.0 (μm) - 100.000(%)	
	:	(7)106.0 (μm) - 100.000(%)	
	:	(8)75.00 (μm) - 100.000(%)	
	:	(9)53.00 (μm) - 100.000(%)	
	:	(10)38.00 (μm) - 100.000(%)	
Verification	:	1.OK 4.3% [D(v,0.5) 0.170 (μm)(± 6.000%)]	
	:	2.OK 3.5% [D(v,0.1) 0.130 (μm)(± 10.000%)]	
	:	3.OK 6.5% [D(v,0.9) 0.230 (μm)(± 10.000%)]	

Data Name	Graph Type	Transmittance(R)	Median Size	R Parameter
andy1'		88.3(%)	0.17730(μm)	0.373795
200801181026014		81.1(%)	9.35329(μm)	0.069234
andy1		88.3(%)	0.17730(μm)	0.373795

Automated review

Summary Report			
Export Summary	Print Summary	Best Fit Columns	
Sample name	D(v,0.1)	D(v,0.5)	D(v,0.9)
19A	34.448	102.355	456.759
19A	32.105	96.580	544.156
19A	30.371	86.317	382.367
Average	32.308	95.084	461.094
Std. Dev.	2.046	8.123	80.982
CV (%)	6.333	8.543	17.563
Custom (5.0, 3.0, 5.0)	FAILED	FAILED	FAILED

- Calculates COV and compares to ISO, USP, or custom standard
- Simple PASS/FAIL indicator notifies the user to check sampling and measurement conditions

- After a quick sampling adjustment, the user makes high precision measurements which easily pass

Summary Report			
Export Summary	Print Summary	Best Fit Columns	
Sample name	D(v,0.1)	D(v,0.5)	D(v,0.9)
19A	18.315	61.758	337.027
19A	17.995	61.016	335.442
19A	17.946	61.326	364.517
Average	18.085	61.367	345.662
Std. Dev.	0.200	0.373	16.348
CV (%)	1.108	0.607	4.730
Custom (5.0, 3.0, 5.0)	PASSED	PASSED	PASSED

What we'll talk about

- Ease of use

- **Performance**

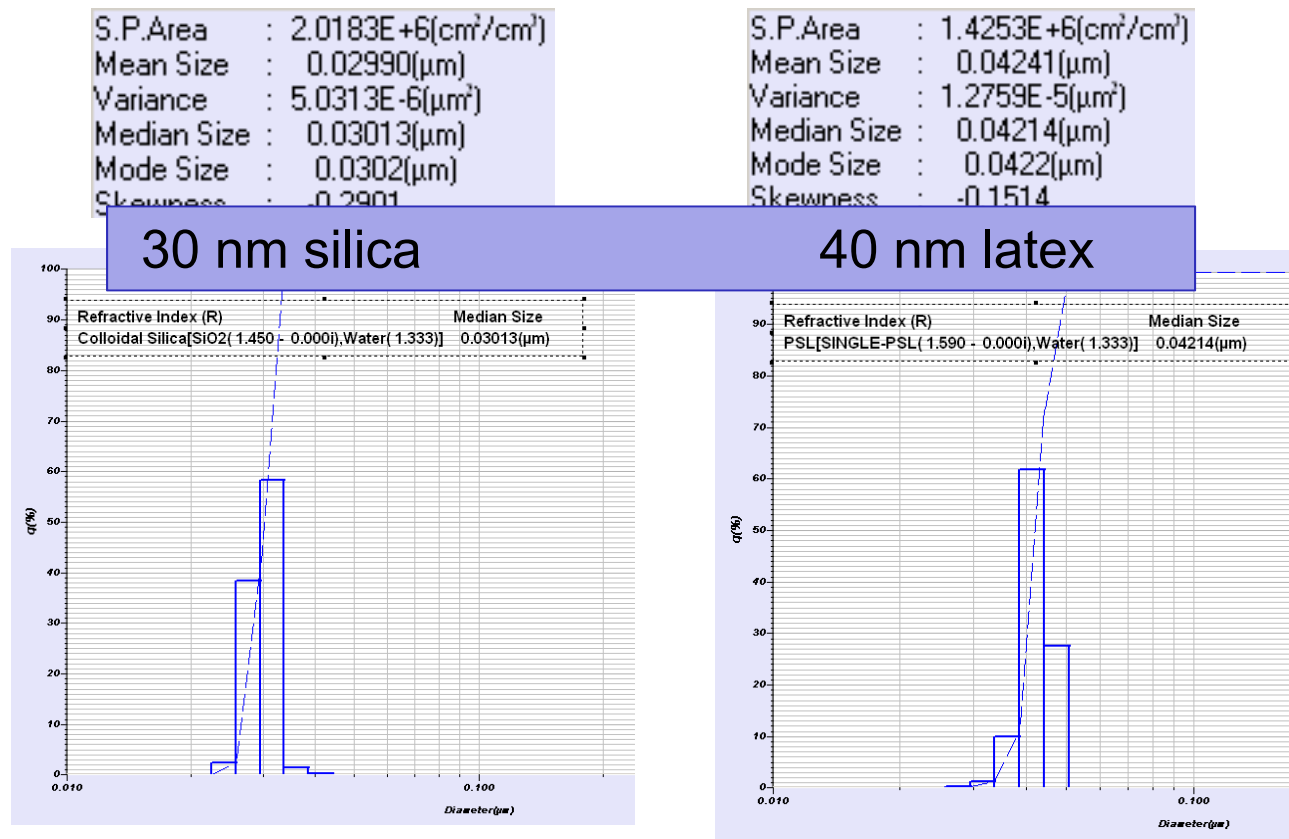
 - Sensitivity, Accuracy, Precision, Resolution

- Sample handlers

- Reliability & support

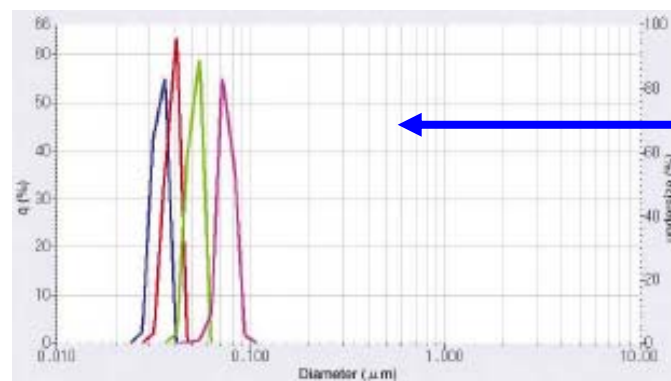
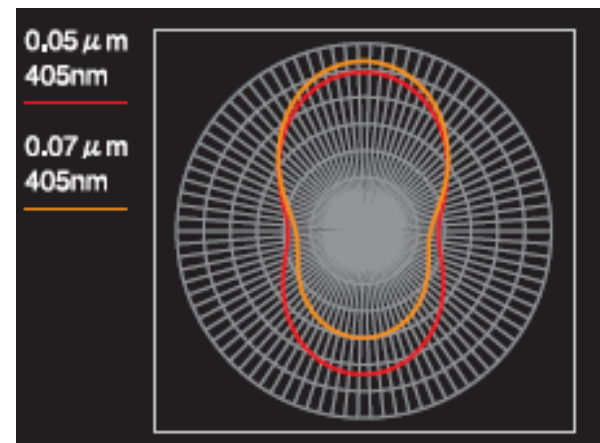
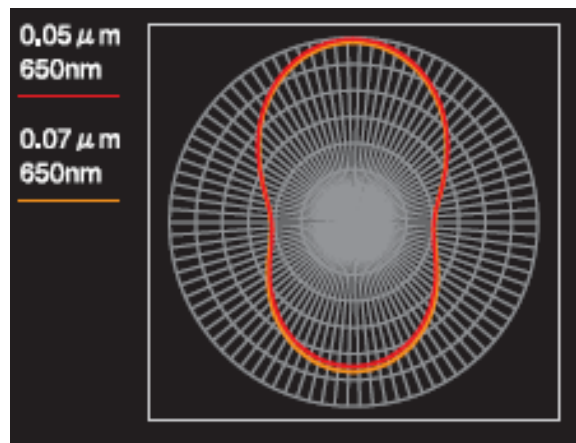
Dynamic range 0.01 – 5,000 μm

- Widest wet and dry measurement range
- Only system to measure 30 nm!



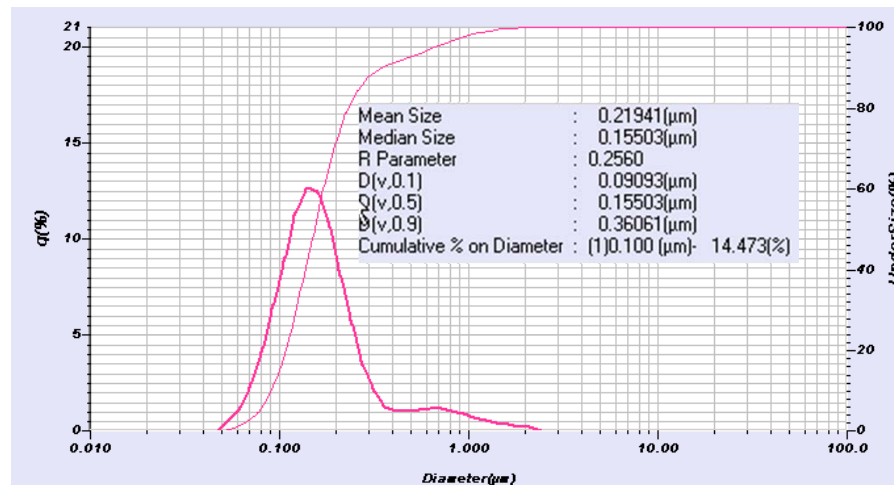
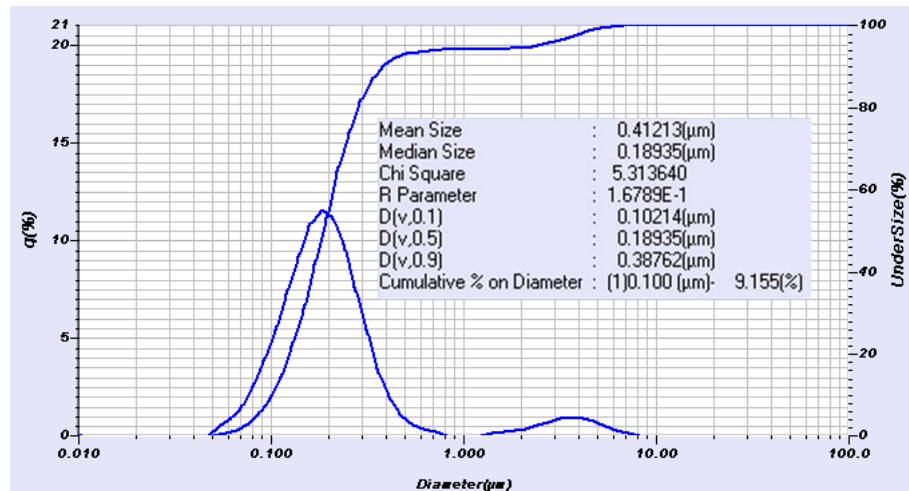
Nanoparticle sensitivity

- Shorter wavelength = better pattern
- 12 Wide angle detectors (4 backscatter)



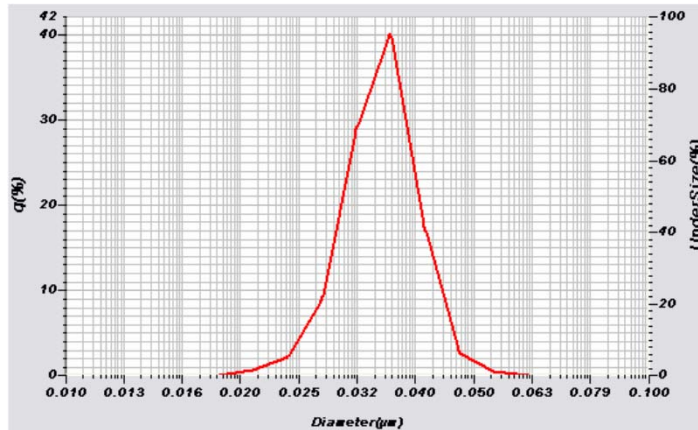
30, 40, 50, 70 nm latex standards overlay of individual runs

Sensitivity: Nanoparticles

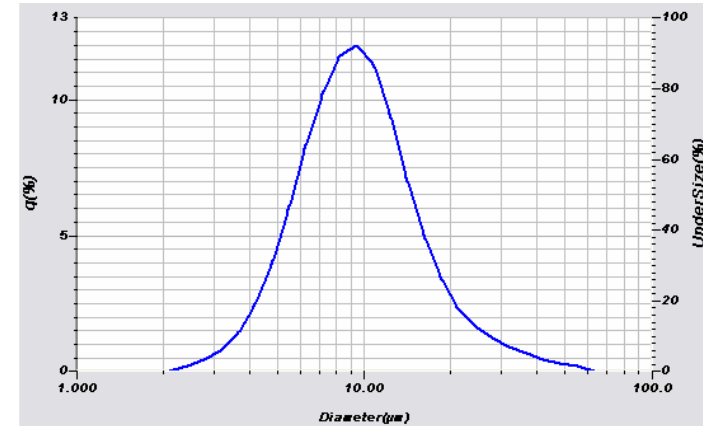


- Some concerns with particles < 100 nm in personal care products
- LA-960 superb at quantifying sub-100 nm
- Software can display % finer than any size
- Data shown is for skin cream containing TiO₂

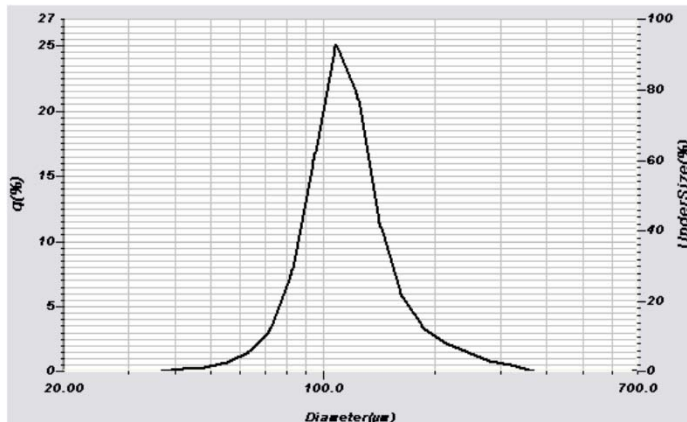
Sensitivity: Sample amount



Colloidal Silica (weak scatterer)
Median (D50): **35 nm**
Sample Amount: **132 mg**



Magnesium Stearate
Median (D50): **9.33 µm**
Sample Amount: **0.165 mg**

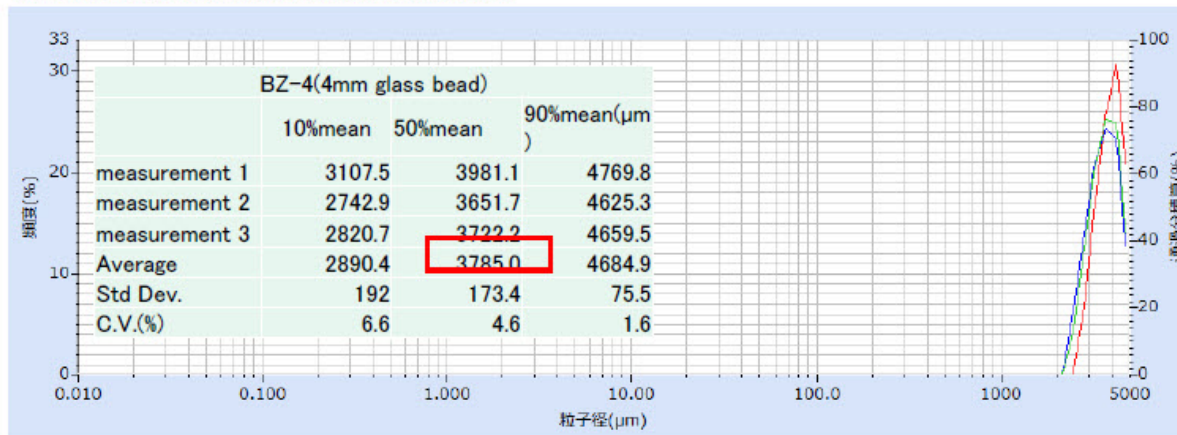


Bio-degradable Polymer
Median (D50): **114 µm**
Sample Amount: **1.29 mg**

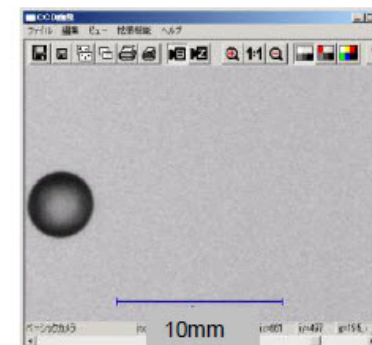
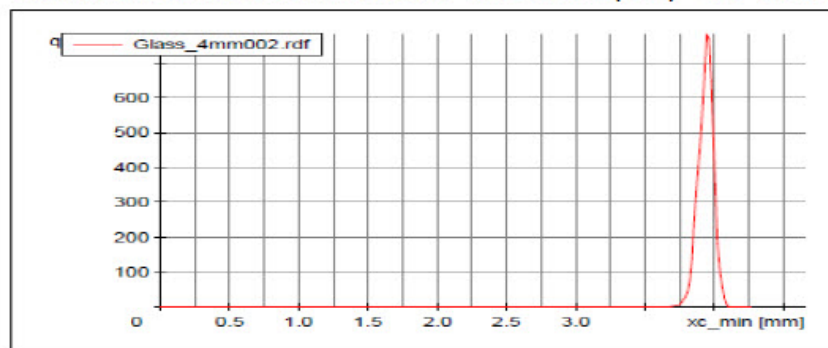
Large particle detection

- Need exceptionally stable optical bench
- Vertical design means no density limit for dry

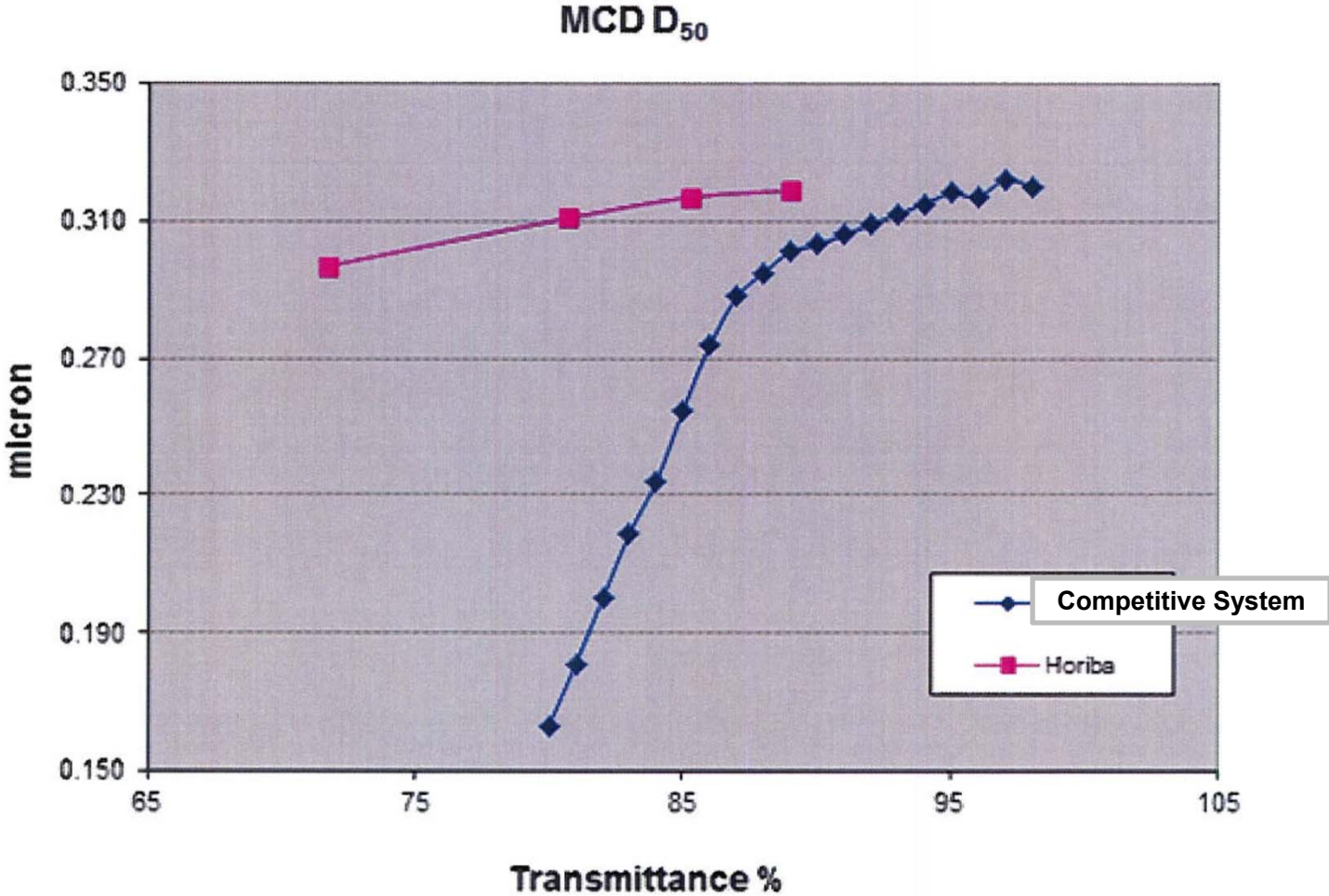
LA-960 Measurement Result



CAMSIZER Measurement Result D(50)=3943.0um

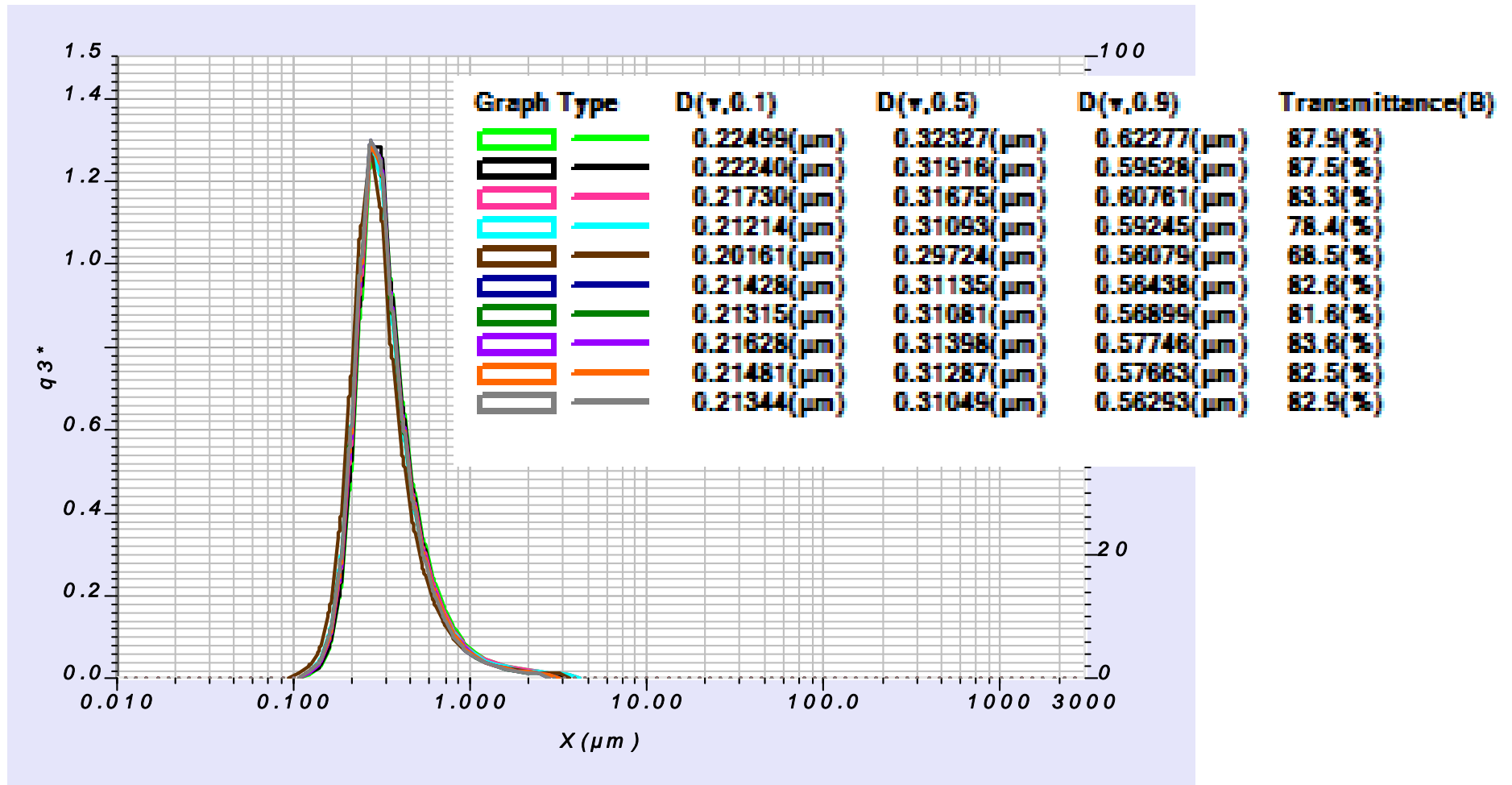


Concentration sensitivity



Concentration	Stable results for sample loading between 70 -90% Transmission.	Varying results based on sample concentration.
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Concentration sensitivity



Concentration

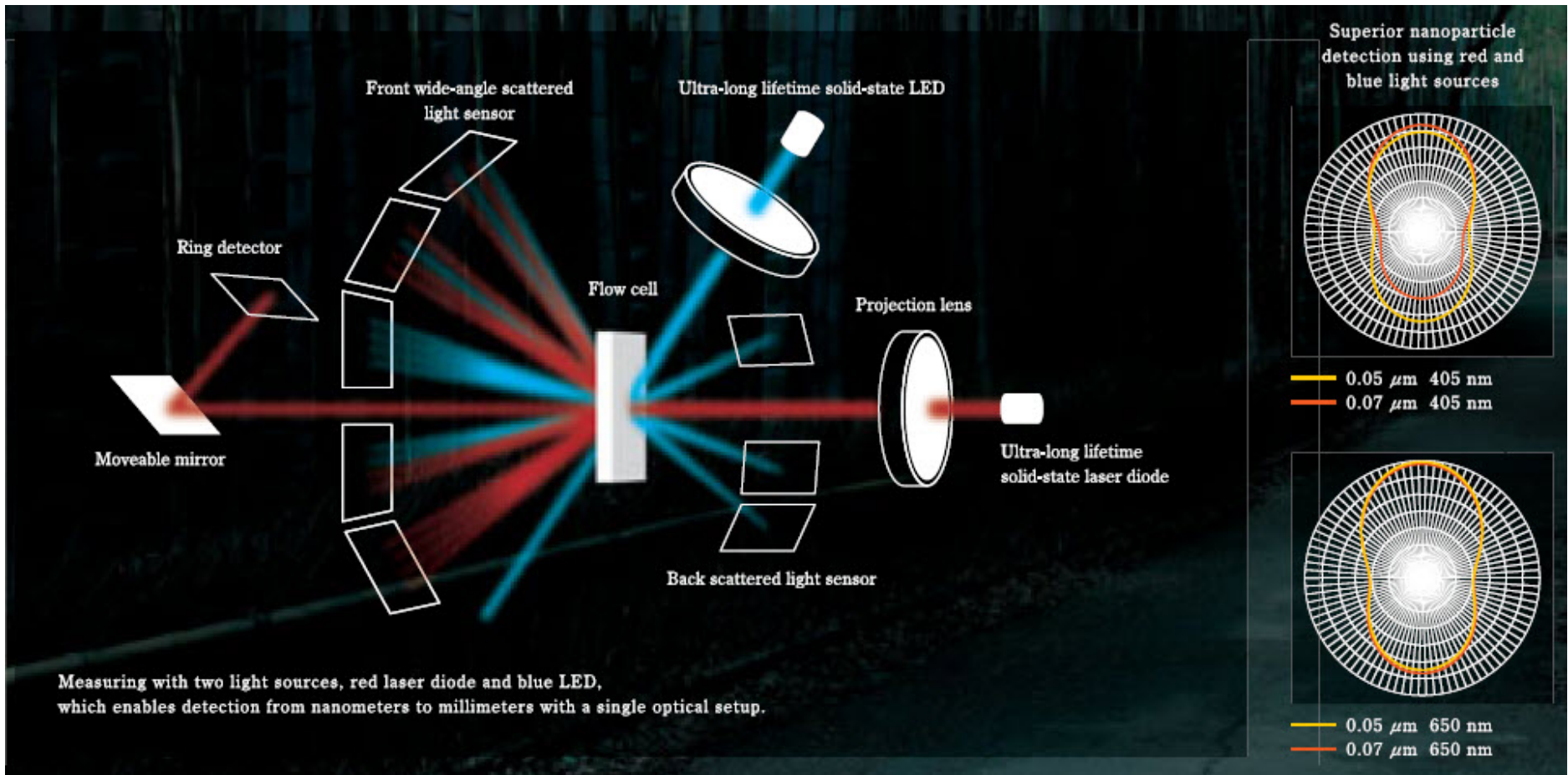
Stable results for sample loading between 70 -90% Transmission.

Varying results based on sample concentration.

State of the art optical design

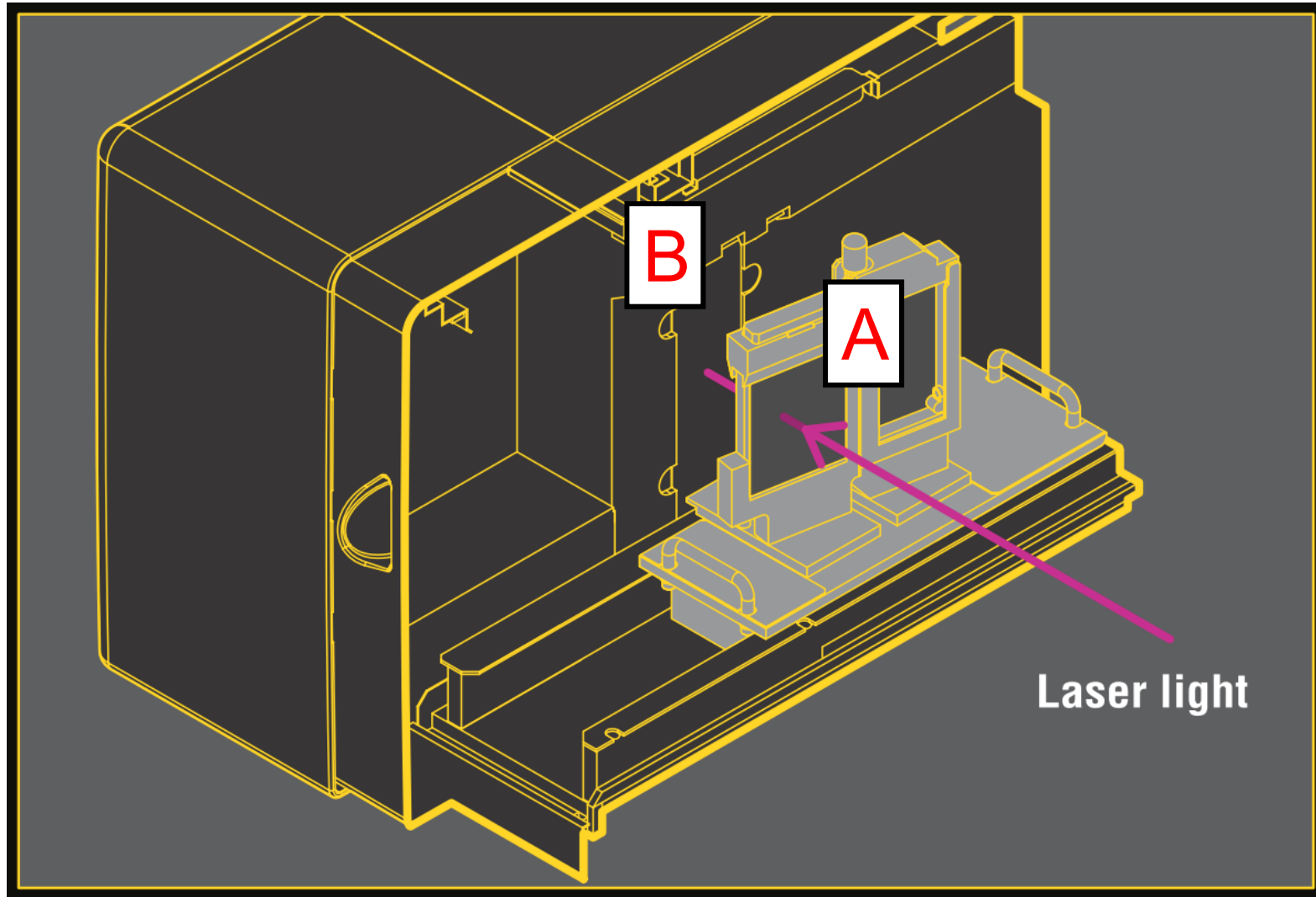
- 87 silicon photodiode detectors covering 0.010 – 166 degrees
- Entire optic system enclosed within LA-960, prevents dust contamination
- Optic system mounted on cast aluminum supports including 1” thick base → low maintenance, better large particle detection
- Ultra fast alignment in 1-10 seconds

Superior optical design

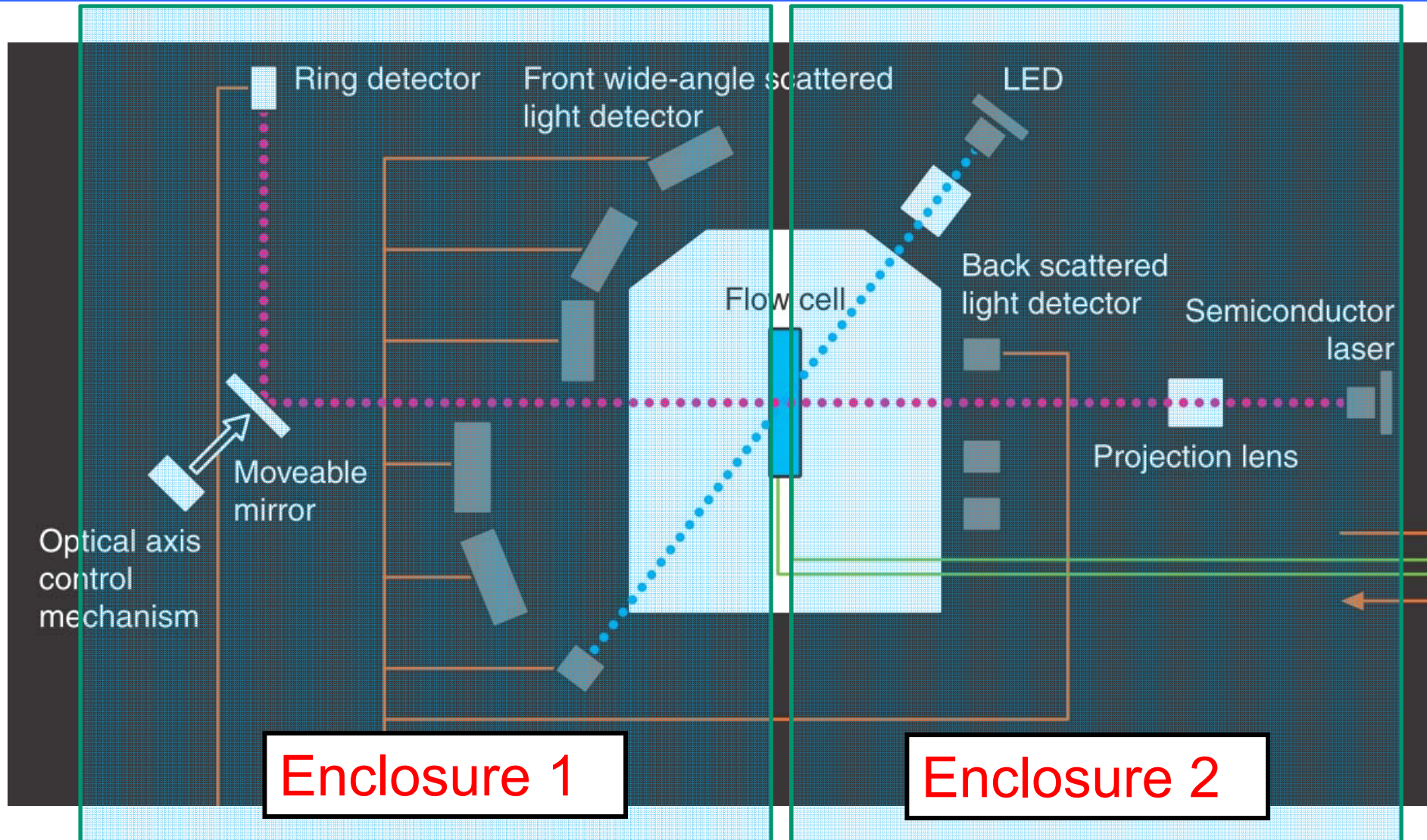


Decades of design improvements and a drive to be the best

Tilted cell reduces stray light

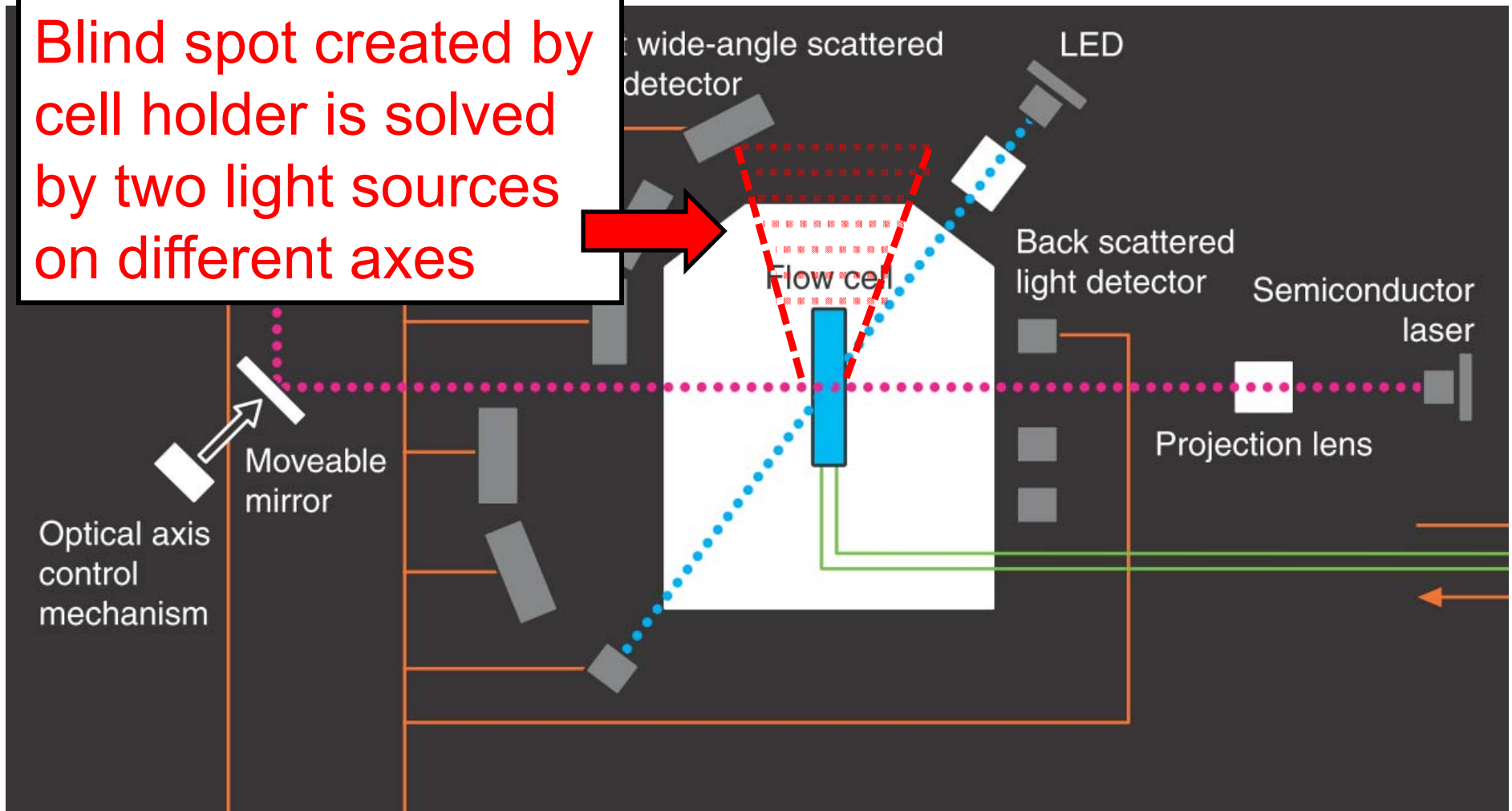


Enclosed optical system



No blind spots

Blind spot created by cell holder is solved by two light sources on different axes



Accuracy & precision specifications

Accuracy – Guaranteed!

- +/- 0.6% on NIST-traceable polystyrene latex calibration standards
 - 3% on d50 (median) for broad-distribution glass bead standards
 - 5% on d10 and d90 for broad-distribution glass bead standards
- Meets or exceeds all requirements of ISO 13320 and USP 429

Precision – 0.1%

The combination of a rigid optical bench, stable, high-intensity light sources, optimized detectors, and highly-refined electronics virtually eliminates variability in the background noise and fluctuations in the response of the instrument. The *Partica* LA-950 has a guaranteed precision of 0.1% on polystyrene latex calibration standards

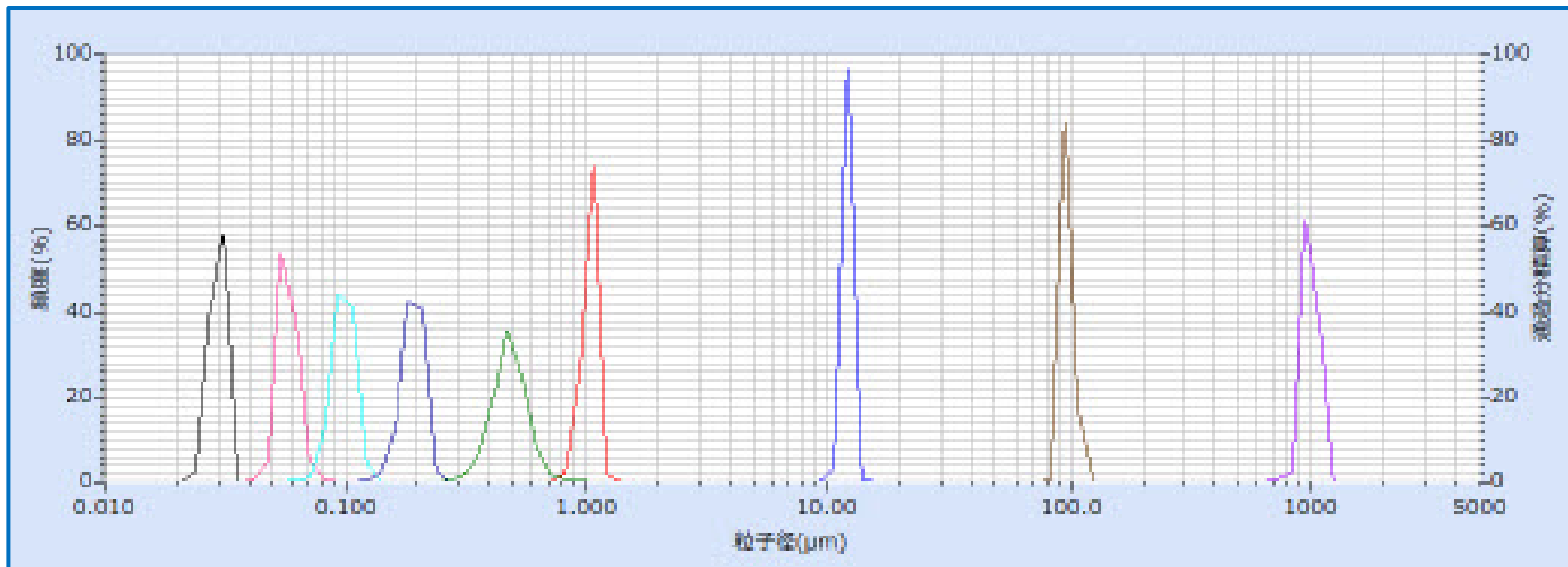
Accuracy

- Comparison to referee technique
 - Microscope (image analysis) is referee technique for particle characterization
- Challenged with particle size standards
 - Monodisperse latex spheres
 - Verifies optics
 - May pass even if problems with sampler
 - Polydisperse glass spheres
 - Verifies complete system
 - Should find problems with samplers



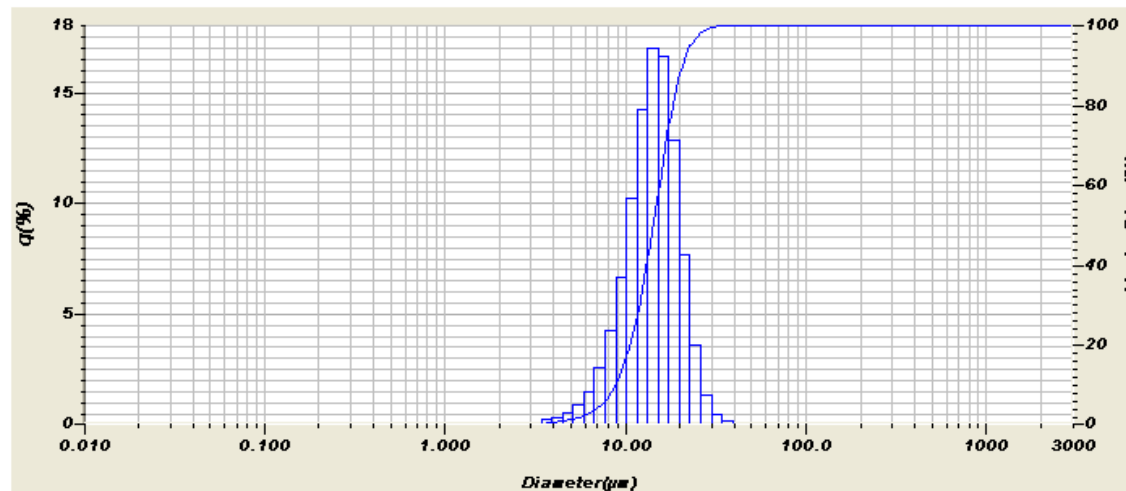
Accuracy through the size range

- PSL results at 0.03, 0.06, 0.1, 0.2, 0.5, 1.0, 10, 100, and 1,000 microns
- Quality acceptance test for every LA-960



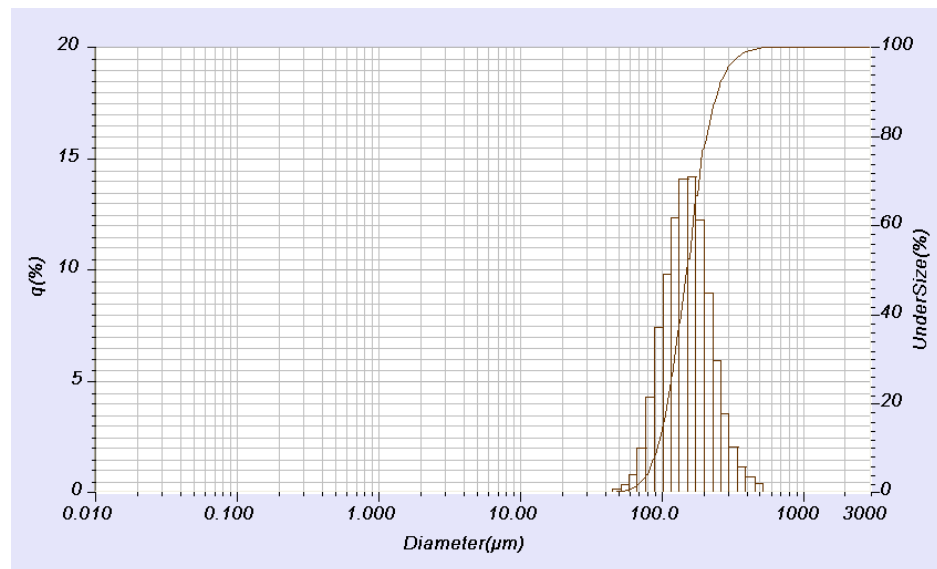
Accuracy Test: PS202

PS202 (3-30 μ m)	D10	D50	D90
Standard Value (μ m)	9.14	13.43	20.34
Uncertainty (μ m)	0.86	0.86	1.44
ISO standard error	5%	3%	5%
Lower limit (μ m)	7.866	12.193	17.955
Measured Result (μ m)	9.721	13.916	18.959
Upper Limit (μ m)	10.500	14.719	22.869



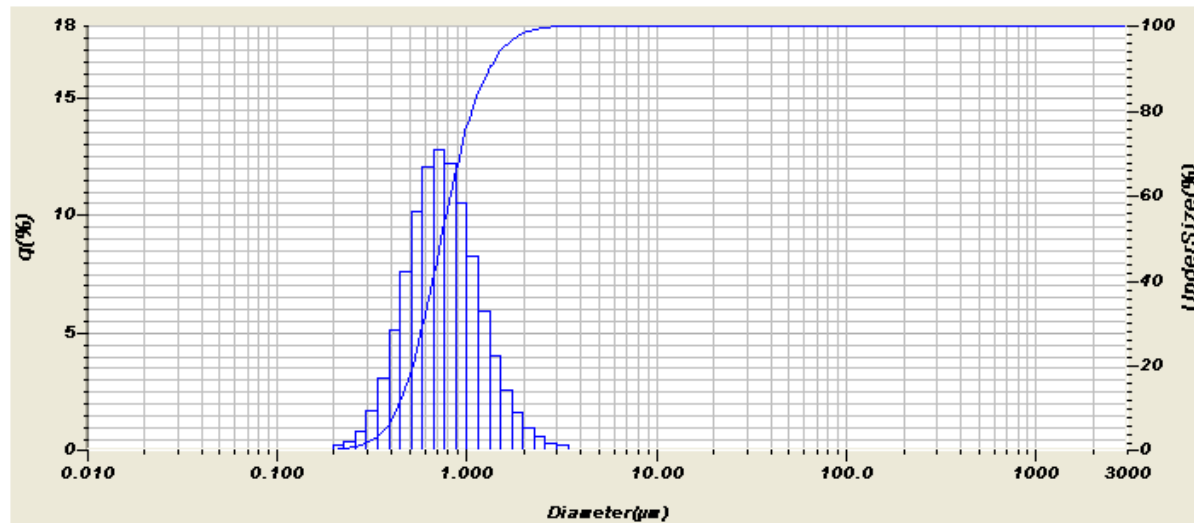
Accuracy Test: PS 225

PS225 (50-350 μ m)	D10	D50	D90
Standard Value (μ m)	93.7	150.5	238.8
Uncertainty (μ m)	3.54	2.52	6.02
ISO standard error	5%	3%	5%
Lower limit (μ m)	85.652	143.541	221.141
Measured Result (μ m)	94.217	153.815	252.542
Upper Limit (μ m)	102.102	157.611	257.061

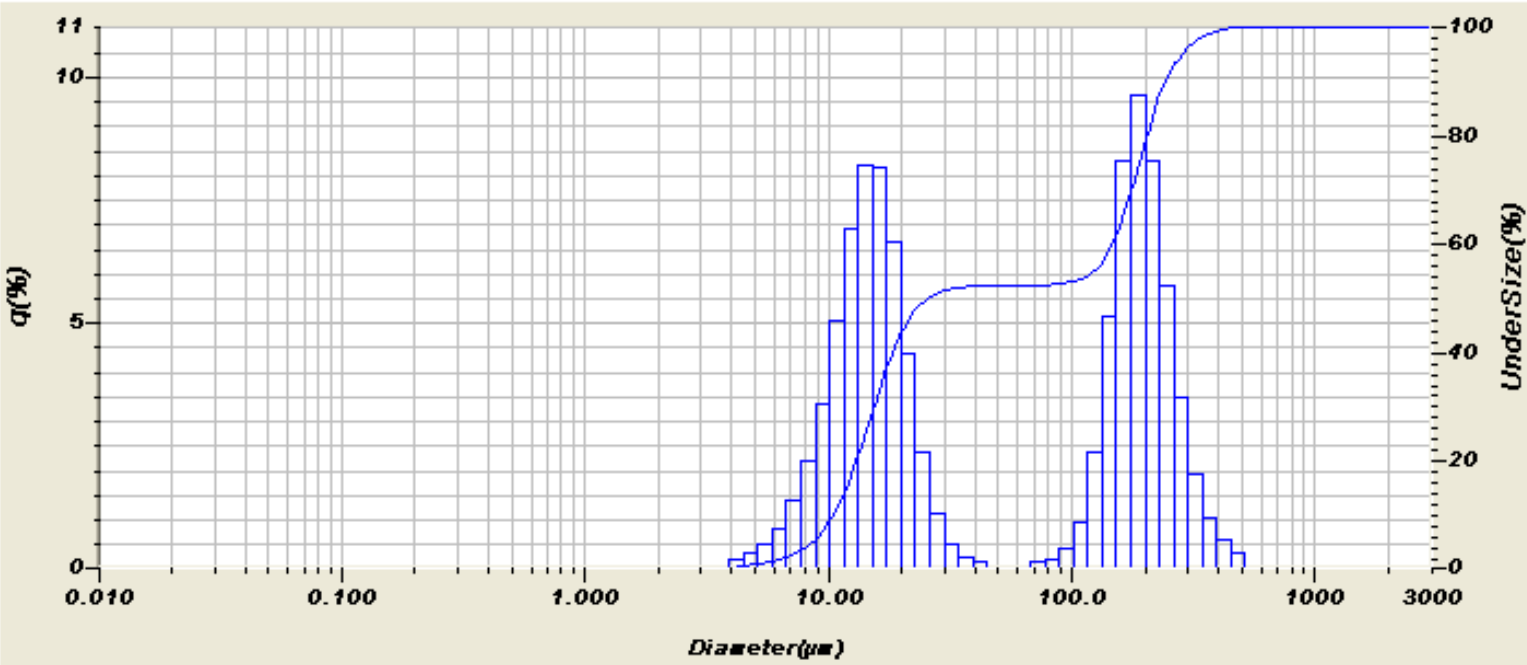


Accuracy Test: PS 181

PS181 (0.1-1 μ m)	D10	D50	D90
Standard Value (μ m)	0.36	0.65	1.11
Uncertainty (μ m)	0.06	0.06	0.13
ISO standard error	5%	3%	5%
Lower limit (μ m)	0.285	0.5723	0.931
Measured Result (μ m)	0.434	0.709	1.296
Upper Limit (μ m)	0.441	0.7313	1.302

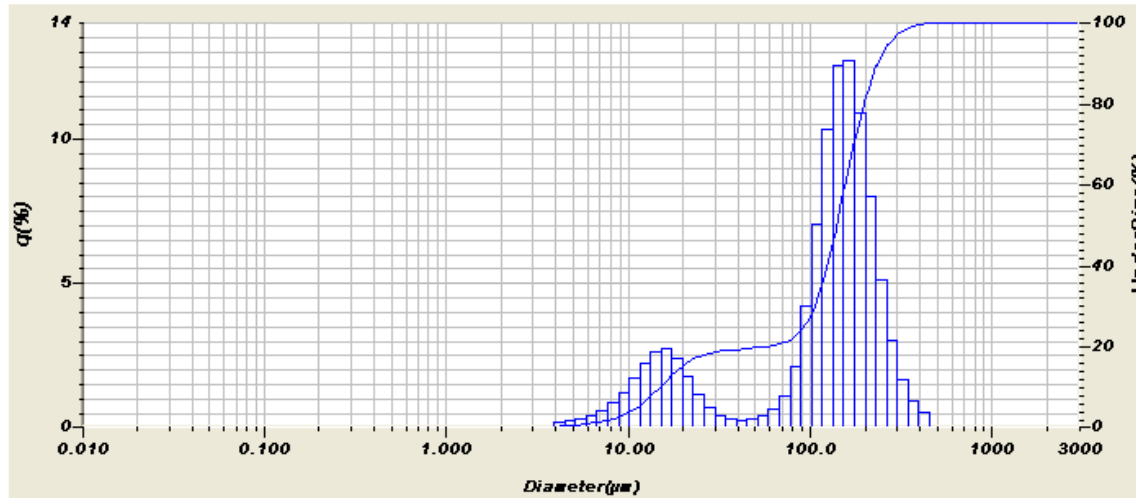


Mix of 50/50 PS202 & 225

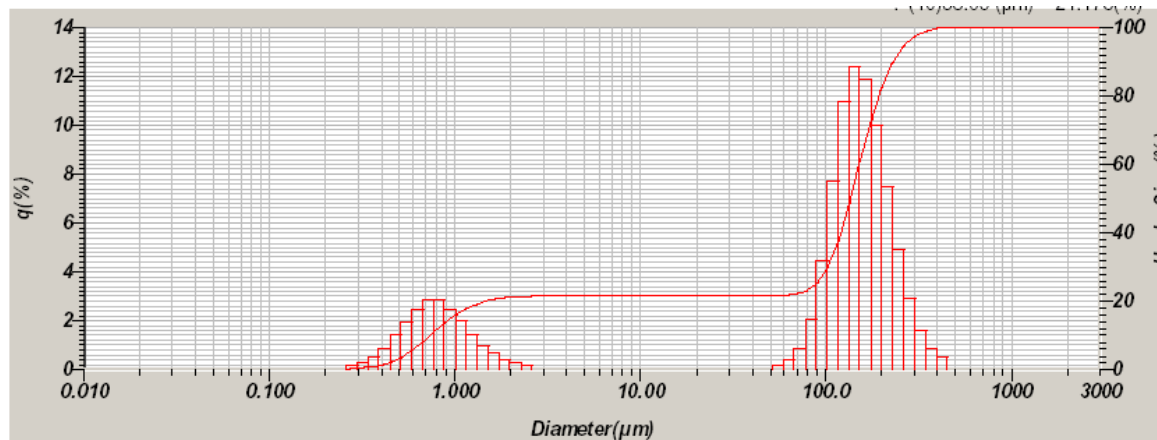


Excellent baseline resolution: 48/52 calculated proportions

Mixed standards

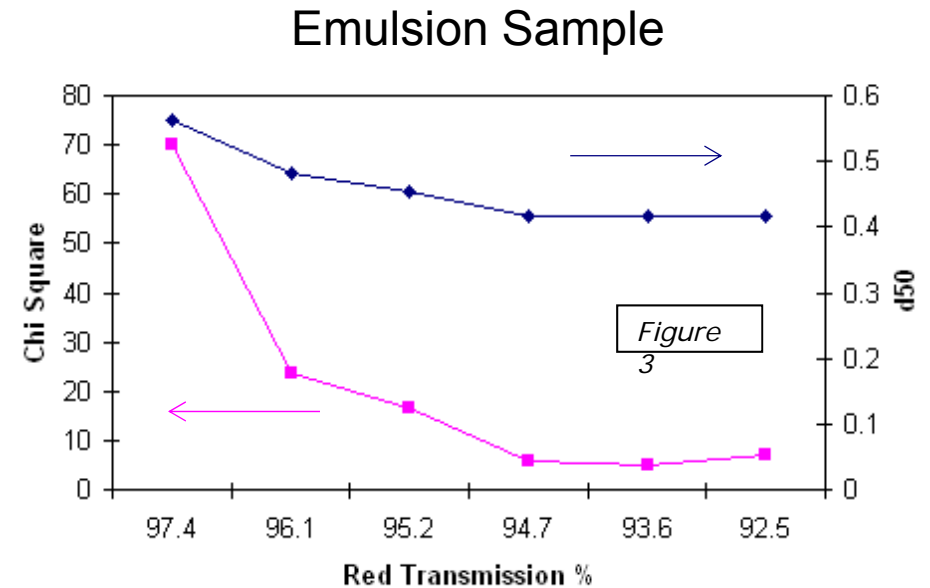
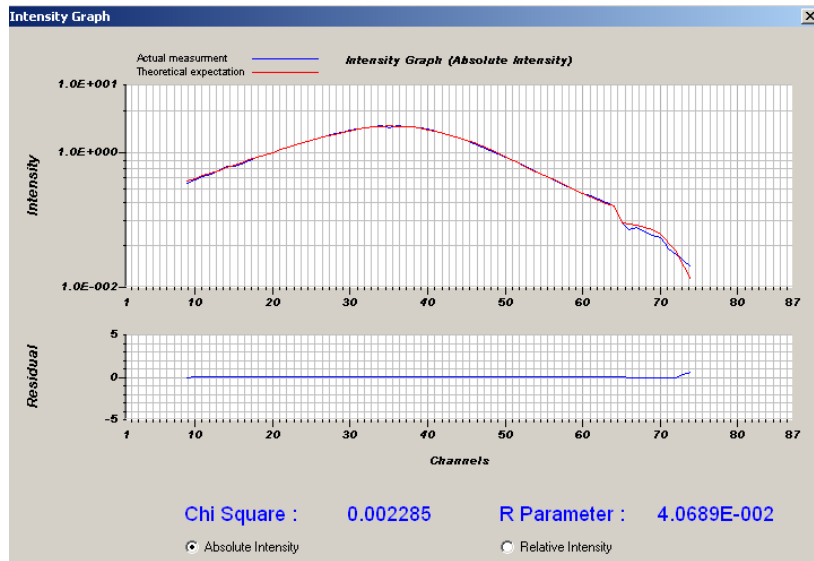


4 parts PS225 to
1 part PS202



4 parts PS225 to
1 part PS181

Accuracy: Error calculations



$$\chi^2 = \sum \left\{ \frac{1}{\sigma_i^2} [y_i - y(x_i)]^2 \right\} \quad R = \frac{1}{N} \sum_{i=1}^N \left\{ \frac{1}{y(x_i)} |y_i - y(x_i)| \right\}$$

- y_i The measured scattered light at each channel (i) of the detector.
- $y(x_i)$ The calculated scattered light at each channel (i) of the detector based on the chosen refractive index kernel and reported particle size distribution.
- σ_i The standard deviation of the scattered light intensity at each channel (i) of the detector. A larger σ_i indicates lower reliability of the signal on a given detector.
- N The number of detectors used for the calculation

What is reproducibility?

- Prepare sample, measure, drain, repeat
- What would be good reproducibility?
- Test COV according to ISO13320
 - CV < 3% at D_{50}
 - CV < 5% at D_{10} & D_{90}
 - Double values if $D_{50} < 10 \mu\text{m}$
- Test COV according to USP<429>
 - CV < 10% at D_{50}
 - CV < 15% at D_{10} & D_{90}
 - Double values if $D_{50} < 10 \mu\text{m}$

Class leading precision

- 3-30 μm and 10-100 μm NIST-traceable glass beads
- 40 randomly selected units
- Manufactured over 2 years
- 6 different operators
- 2 different locations

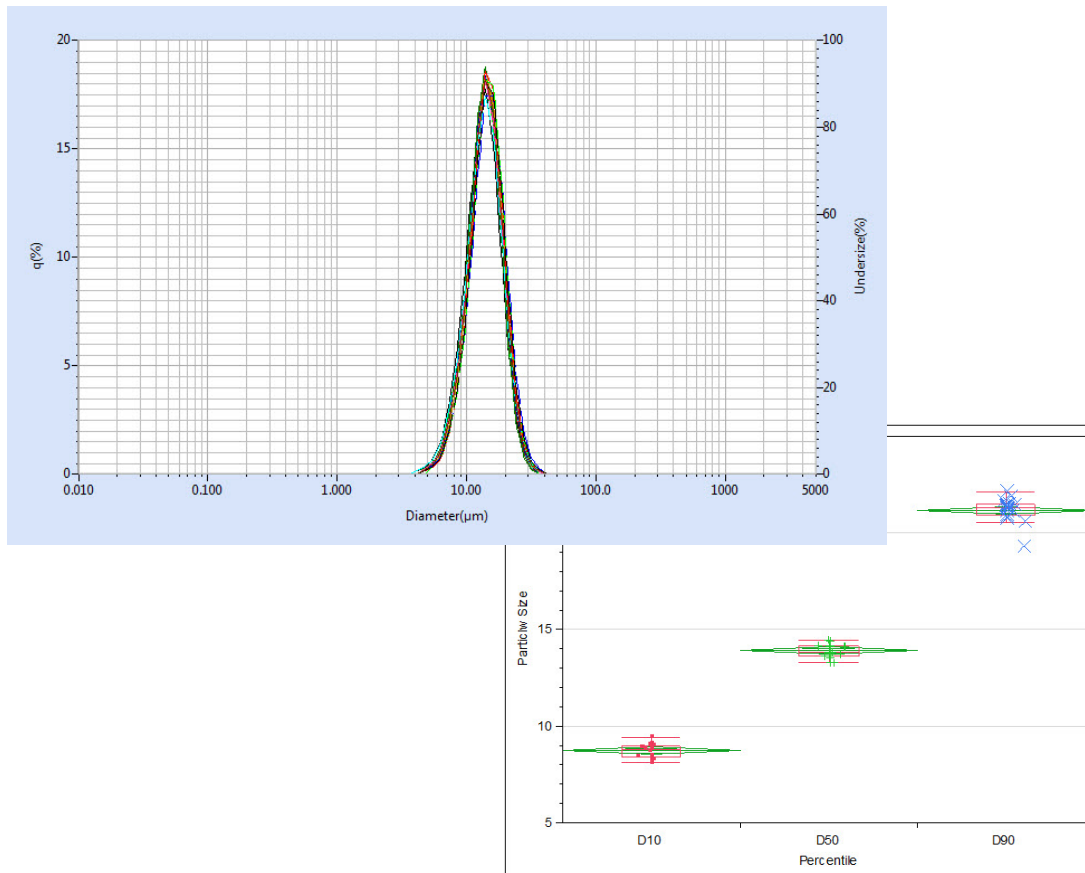
	Repeatability Condition	Intermediate Precision Condition	Reproducibility Condition
Laboratory	Same	Same	Different
Operator	Same	Different	Different
Apparatus	Same	Same*	Different
Time between Tests	Short**	Multiple Days	Not Specified

* This situation can be different instruments meeting the same design requirement.

** Standard test method dependent, typically does not exceed one day.

Repeatability & reproducibility

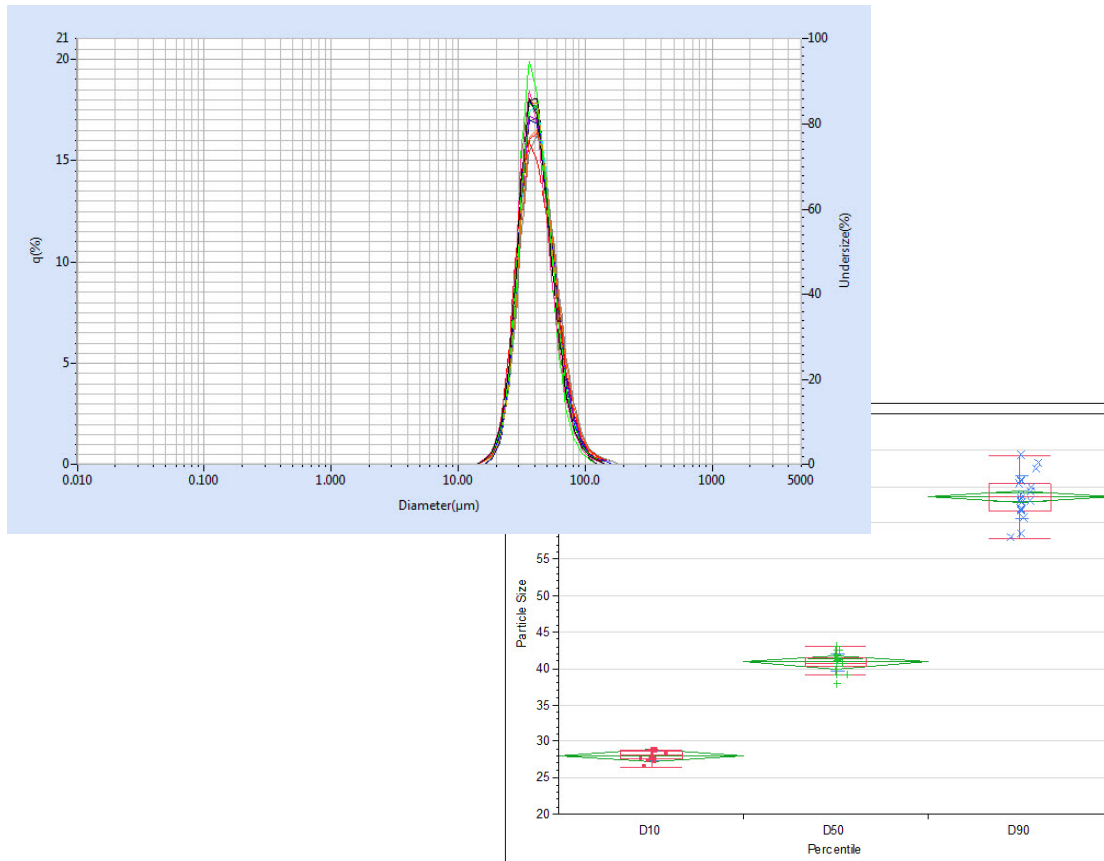
- 20 wet results on the LA-960 flow system



PS-202 (μm)			
	D10	D50	D90
PS202 (U2A).NGB	8.08	13.29	20.50
PS202 (W03).NGB	8.86	14.16	22.12
PS202 (CA2).NGB	8.39	13.75	21.39
PS202 (SY9).NGB	8.26	13.54	20.75
PS202 (U19).NGB	8.46	13.68	20.87
PS202 (DEE).NGB	9.09	13.82	21.83
PS202 (X4T).NGB	8.45	13.76	21.06
PS202 (V5T).NGB	8.77	14.08	21.30
PS202 (TV).NGB	8.94	14.12	21.23
PS202 (RPR).NGB	8.91	14.14	21.48
PS202 (U9U).NGB	8.79	13.86	21.07
PS202 (XYN).NGB	8.98	14.07	21.48
PS202 (ABG).NGB	8.80	14.06	21.21
PS202 (67S).NGB	9.42	14.48	21.57
PS202 (YET).NGB	8.78	13.80	21.35
PS202 (SS7).NGB	9.04	14.41	21.34
PS202 (UDH).NGB	8.26	13.64	20.88
PS202 (WRT).NGB	9.05	14.15	21.48
PS202 (PLS).NGB	8.24	13.62	20.71
PS202 (NKU).NGB	8.72	13.24	19.25
Average	8.71	13.88	21.14
Std. Dev.	0.351	0.333	0.591
CV (%)	4.03	2.40	2.79

Repeatability & reproducibility

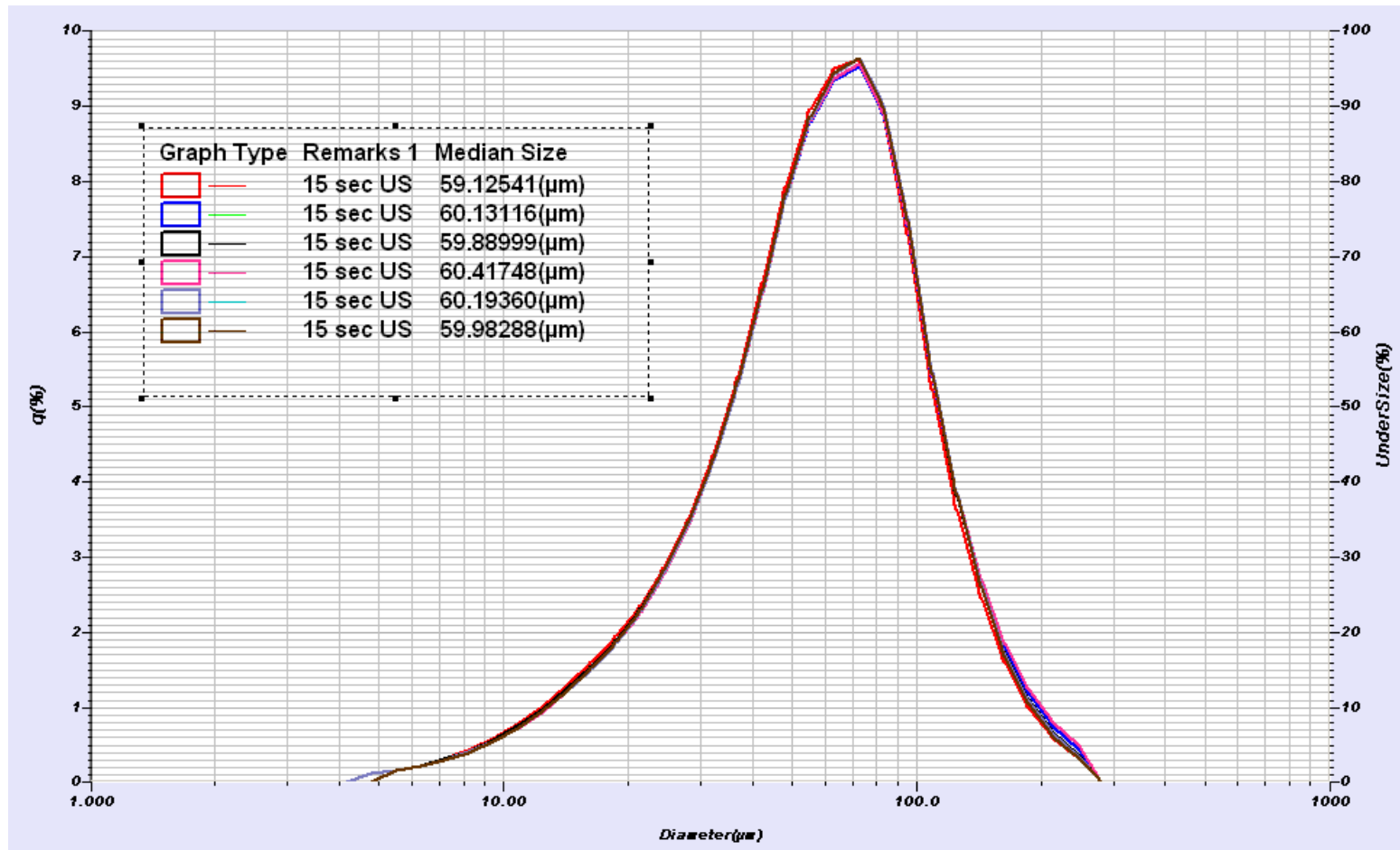
- 20 dry results on the LA-960 PowderJet



PS215 (μm)			
	D10	D50	D90
PS215 (VGR).NGB	28.66	42.48	68.04
PS215 (XM3).NGB	27.20	40.34	65.68
PS215 (R8C).NGB	28.20	40.76	61.60
PS215 (U0A).NGB	28.66	41.53	65.52
PS215 (TGV).NGB	28.69	42.41	67.34
PS215 (TLB).NGB	27.98	40.70	62.85
PS215 (PGC).NGB	27.91	39.22	58.28
PS215 (W1X).NGB	27.15	39.12	60.51
PS215 (VRF).NGB	28.58	41.11	63.27
PS215 (PSA).NGB	28.79	41.80	65.29
PS215 (TBA).NGB	28.24	41.24	64.75
PS215 (RJC).NGB	28.51	41.15	63.72
PS215 (SV3).NGB	27.56	40.03	61.80
PS15 (AB6).NGB	26.45	37.99	57.87
PS215 (G07).NGB	27.81	40.80	62.96
POS215 (XES).NGB	28.23	40.82	63.64
PS215 (X1G).NGB	28.71	41.63	64.22
PS215 (CKS).NGB	27.61	40.21	61.45
PS215 (T9X).NGB	27.49	40.67	62.82
PS251 (Y4B).NGB	28.81	43.09	69.22
Average	28.06	40.85	63.54
Std. Dev.	0.658	1.21	2.92
CV (%)	2.35	2.95	4.60

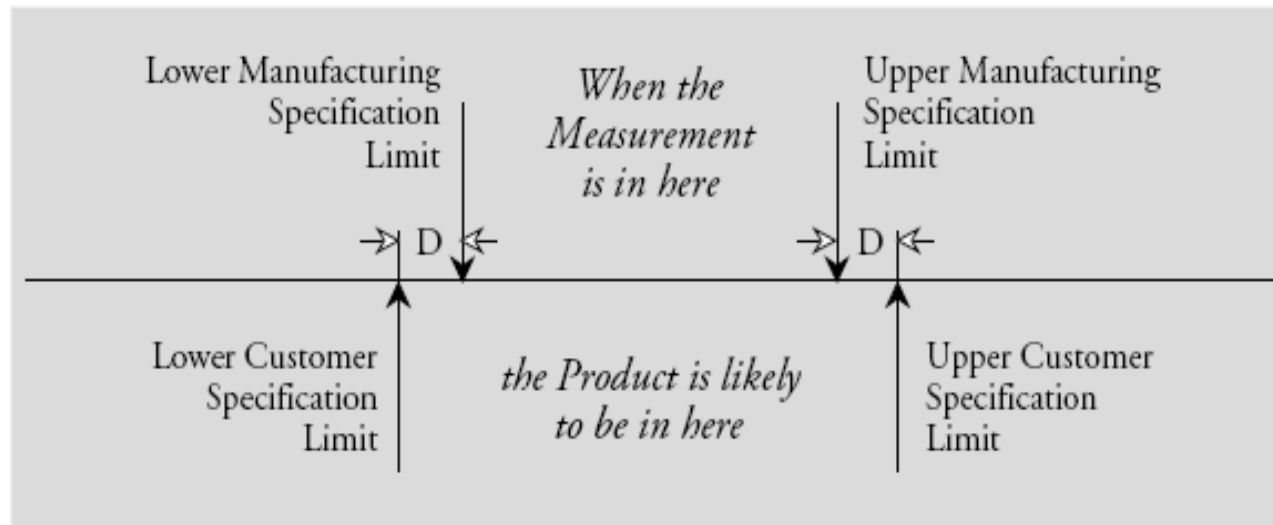
Reproducibility: Customer sample

Microcrystalline cellulose (MCC)



Why reproducibility matters

www.zeallsoft.com

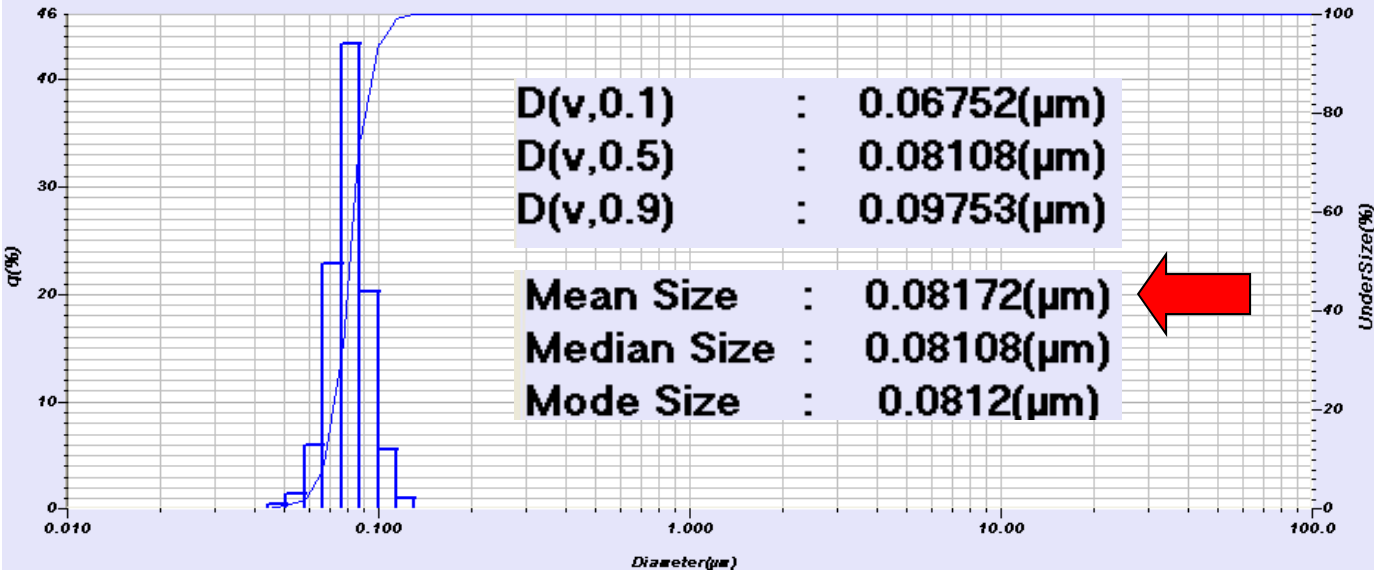


Better reproducibility = Wider internal margins

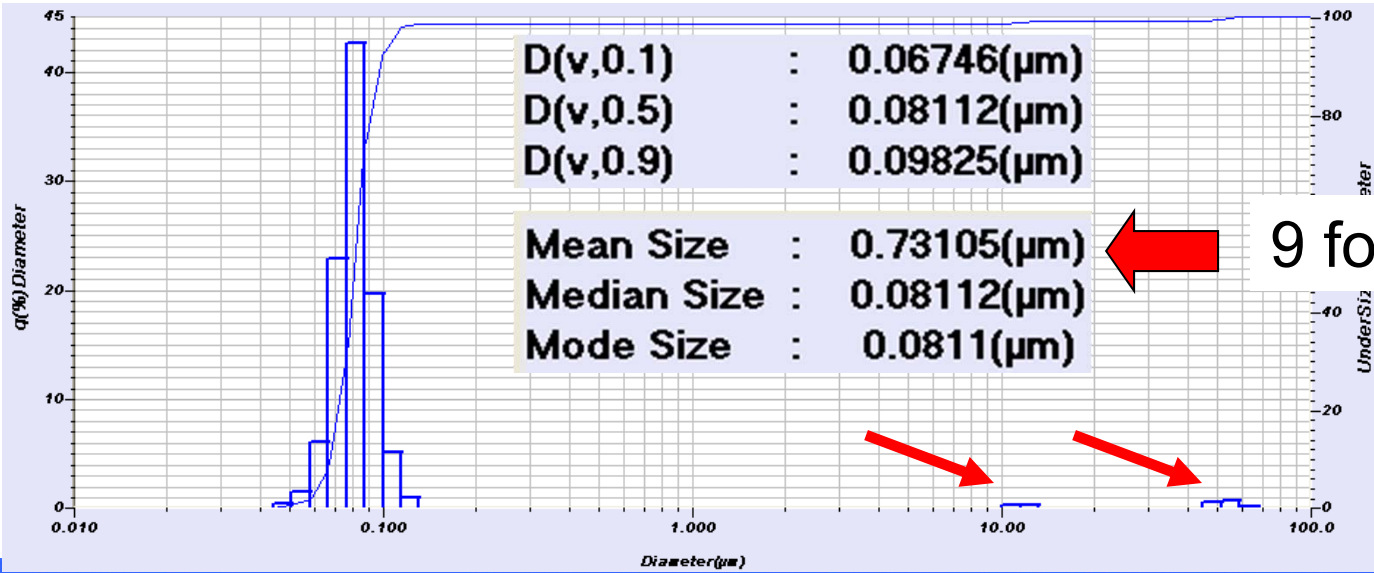
What is resolution?

- Ability to measure small differences in particle size
- Small differences between successive samples (different production lots) are most important
- Detection limit of small amount of material outside of main size distribution
- Best defined by user's real-world requirements

PLA nanoparticles for drug delivery



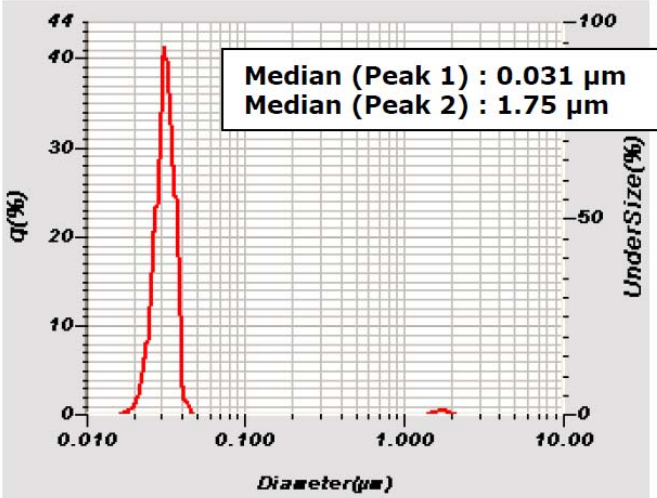
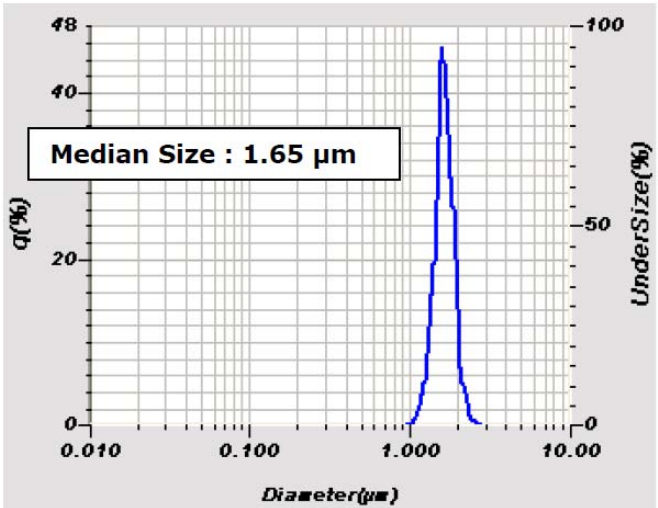
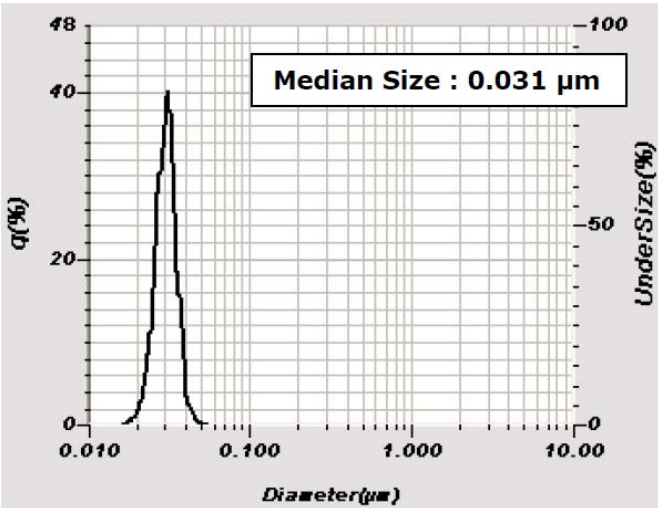
Good batch



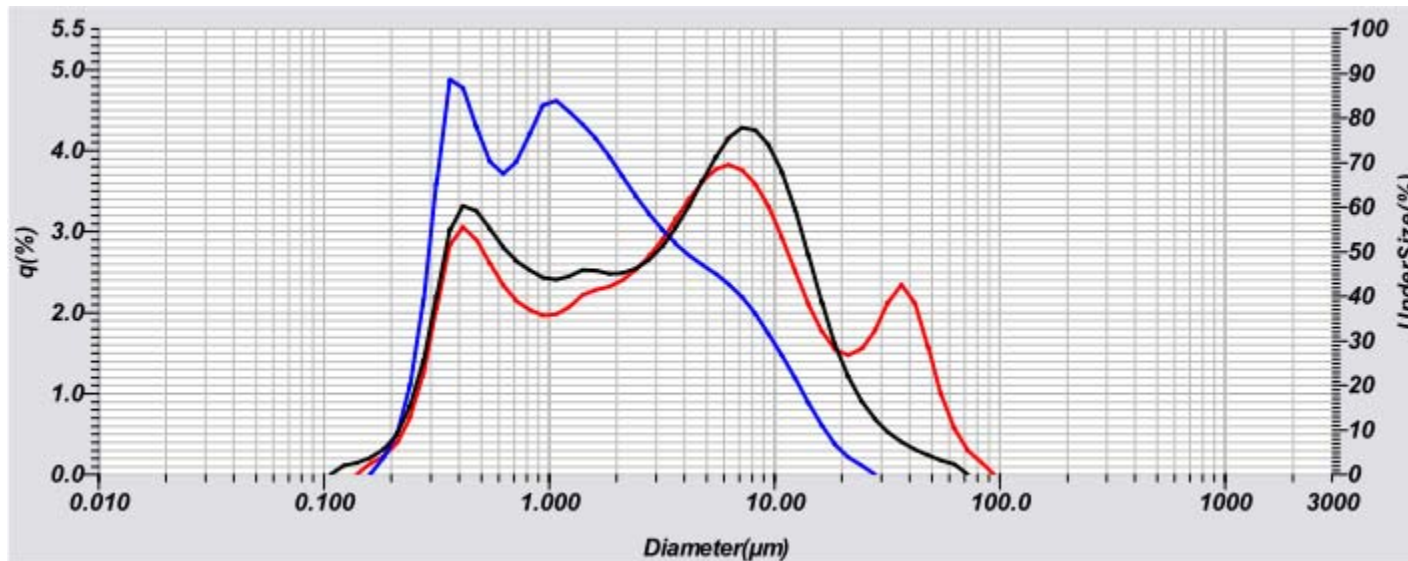
Bad batch

9 fold increase

Resolution: Outliers



Resolution: Real world sample



- **Black** size distribution is internal standard
- **Red** result is considered a passing batch
- **Blue** result is a bad batch
- Highlights problem in production
- All accomplished with complex product formulation

What we'll talk about

- Ease of use

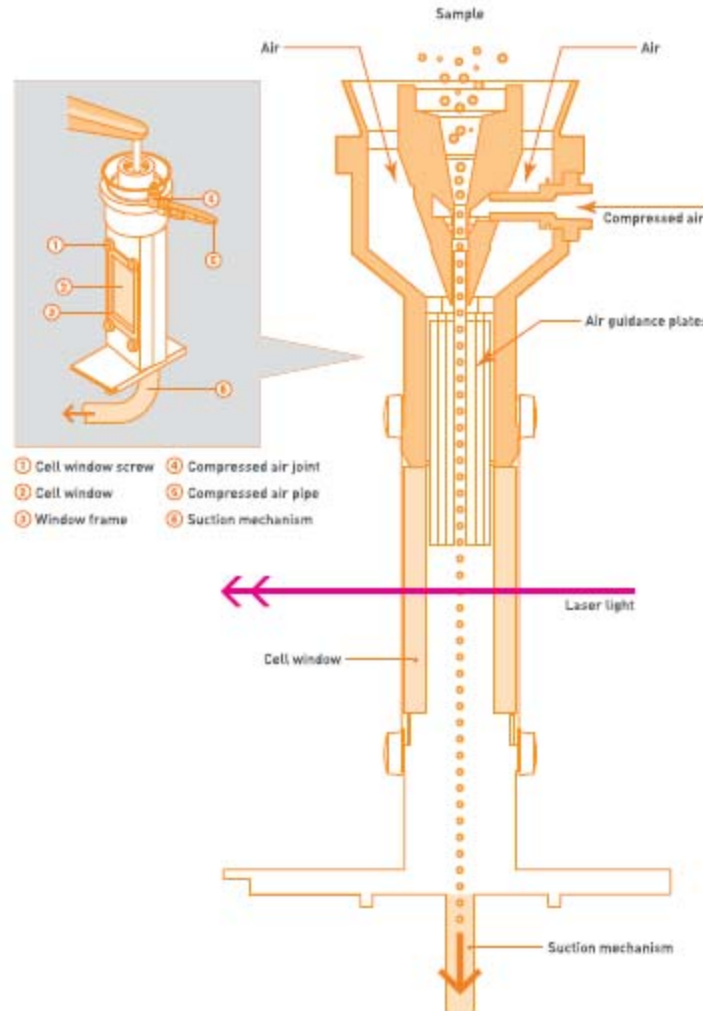
- Performance

- **Sample handlers**

- **Powders, precious samples, throughput, pastes**

- Reliability & support

Superior dry powder feeder

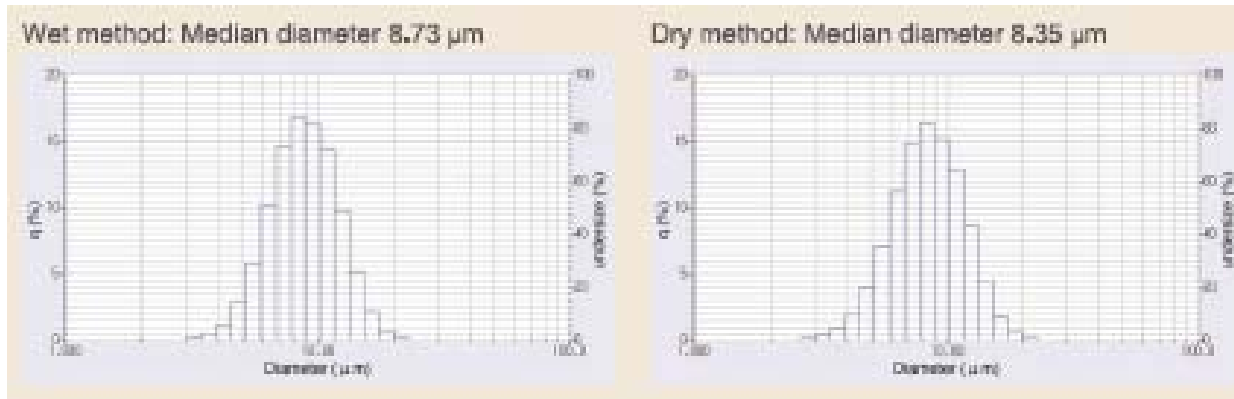


Direct flow of powder down to cell rather than turn 90°, then around plastic tube, no density restriction like horizontal units, zero impact surfaces means good dispersion w/o comminution

Superior dry powder feeder

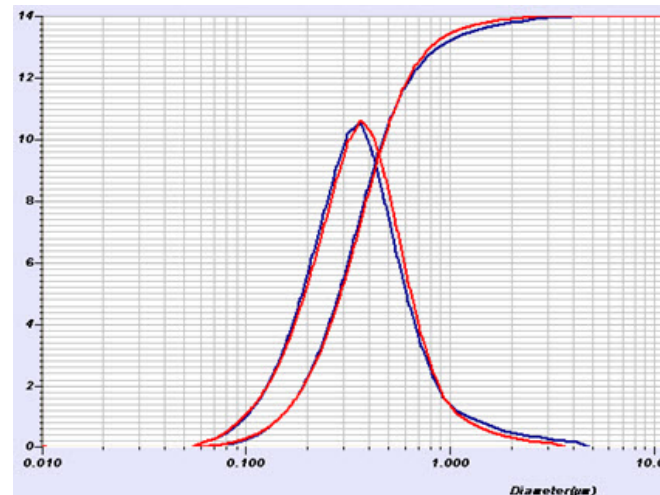
- Automatic control of sample feed rate
 - LA-960 monitors amount of sample supplied by the vibratory feeder. Automatic feed back control keeps constant mass flow rate of powder during measurement
 - This is CRITICAL
 - More reproducible, robust
 - No ghost peaks
 - No cutting off results
 - Fewer headaches!
 - Unique to HORIBA

Wet vs. dry results



Abrasive

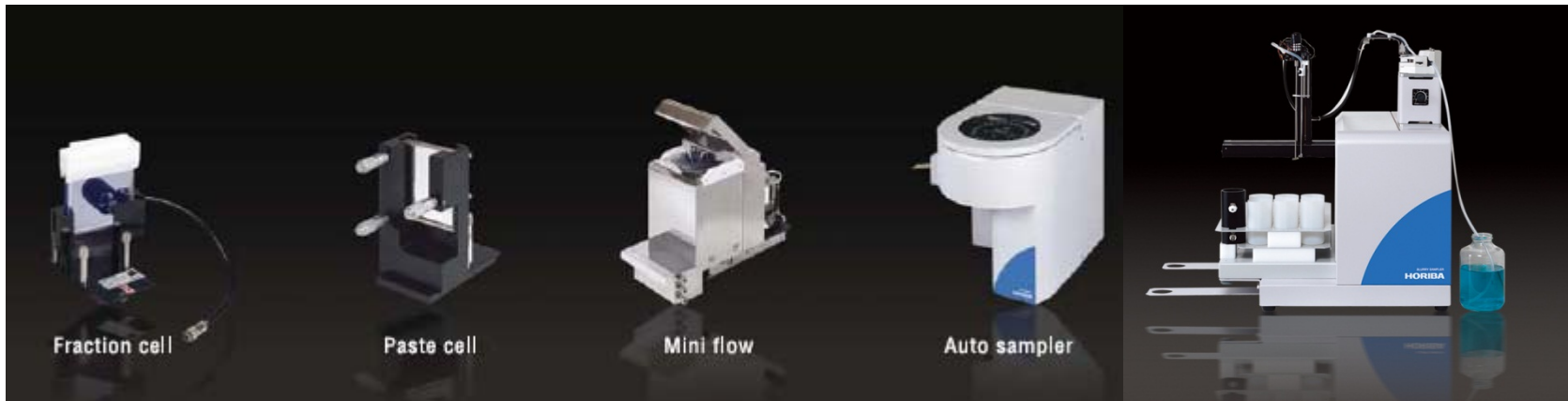
- Red: Wet measurement using ultrasonic dispersion
- Blue: Dry measurement using compressed air dispersion



TiO₂ (anatase)

Solution for every application

HORIBA
Scientific



5 mL

< 2 mL

35 mL

100 mL

variable

- Widest range of wet sample handlers
- Excellent S/N minimizes sample quantity
- Unique FractionCell, PasteCell, MiniFlow, and Slurry Sampler
- Temperature Control available

What we'll talk about

- Ease of use

- Performance

- Sample handlers

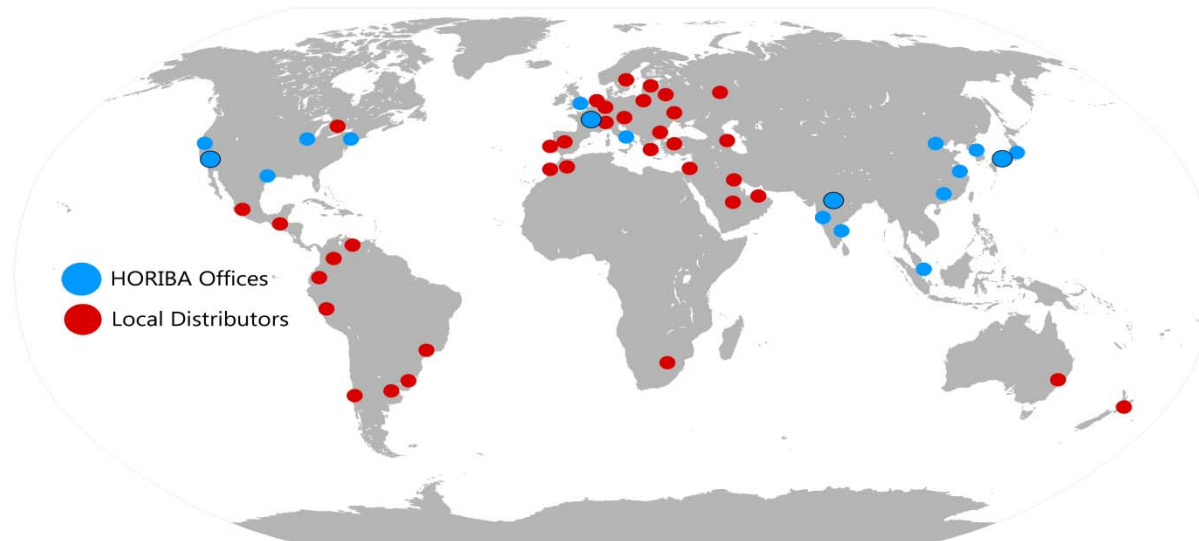
- **Reliability & support**

- Applications Labs, build quality, TCO

Our expertise = Your solution



- HORIBA's experienced staff of technical and applications specialists support the LA-960 in 54 offices across 45 countries
- We are committed to the satisfaction of our users and to the education of the greater industry and provide many channels of support including:
 - Sample analysis via the many Applications Lab around the world
 - Free software updates, webinars, technical notes, and much more in the Download Center
 - Instant support via phone, e-mail, and online meeting
 - On-site and in-house user training courses
 - Service contracts, verifications, and validations to fit every requirement
 - Advanced software tools to correlate data from other particle size analyzers to maintain historic specifications



Long lifetime parts

- 5mW 650nm laser diode (LD)
 - LD lasts much longer than gas lasers
 - LD put in low-power mode between measurements to slow aging
 - Gas lasers have no low-power option
 - Typical gas laser lasts 3-5 years
 - LD in LA-300, LA-950 lasts 11+ years
- Zero LD failures since LA-300 launched (12+ years)

Long lifetime parts

- 3mW 405nm blue LED
 - LED has effectively zero warm-up, can be turned on right before measurement, means very slow aging
 - Expected lifetime 10+ years
- Zero LED failures since LA-950 launched (9 years)
- Low wavelength is key to acquiring useful scattering pattern
 - Wavelength more critical than power

Ease of service

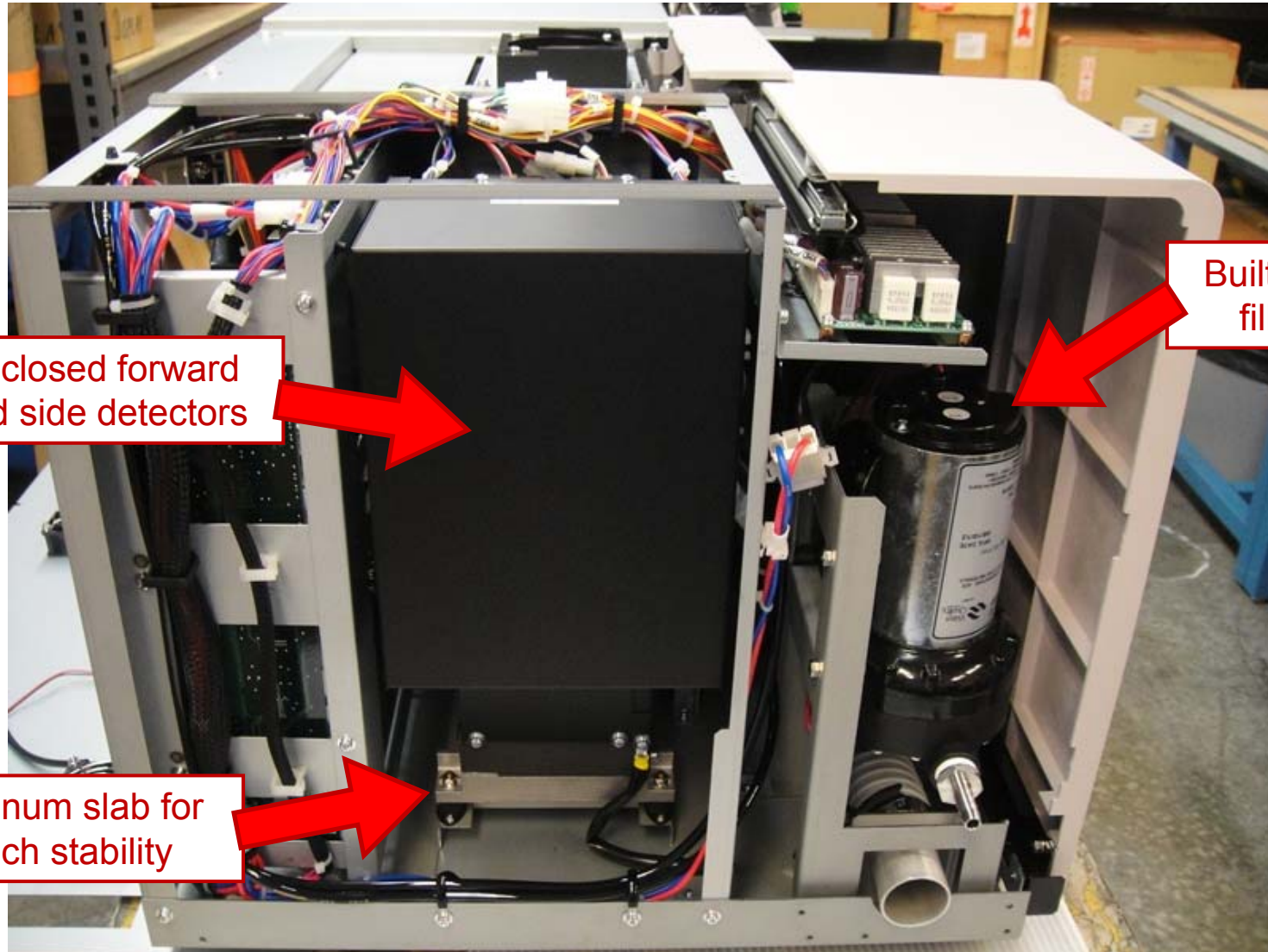
- HORIBA LA-950S2
 - Average repair cost, parts and labor, over first three years is 0.1% of initial purchase price
 - Measurement cells can be replaced without needing calibration
 - HORIBA offers either on-site service or return to Irvine, Chicago, Houston
- Expect the same with the LA-960

Why does this matter?

- Gas lasers **fade** as they age
 - Lower output → lower scattering
 - Lower scattering → changing size results
- Laser replacements are **expensive**



Build quality

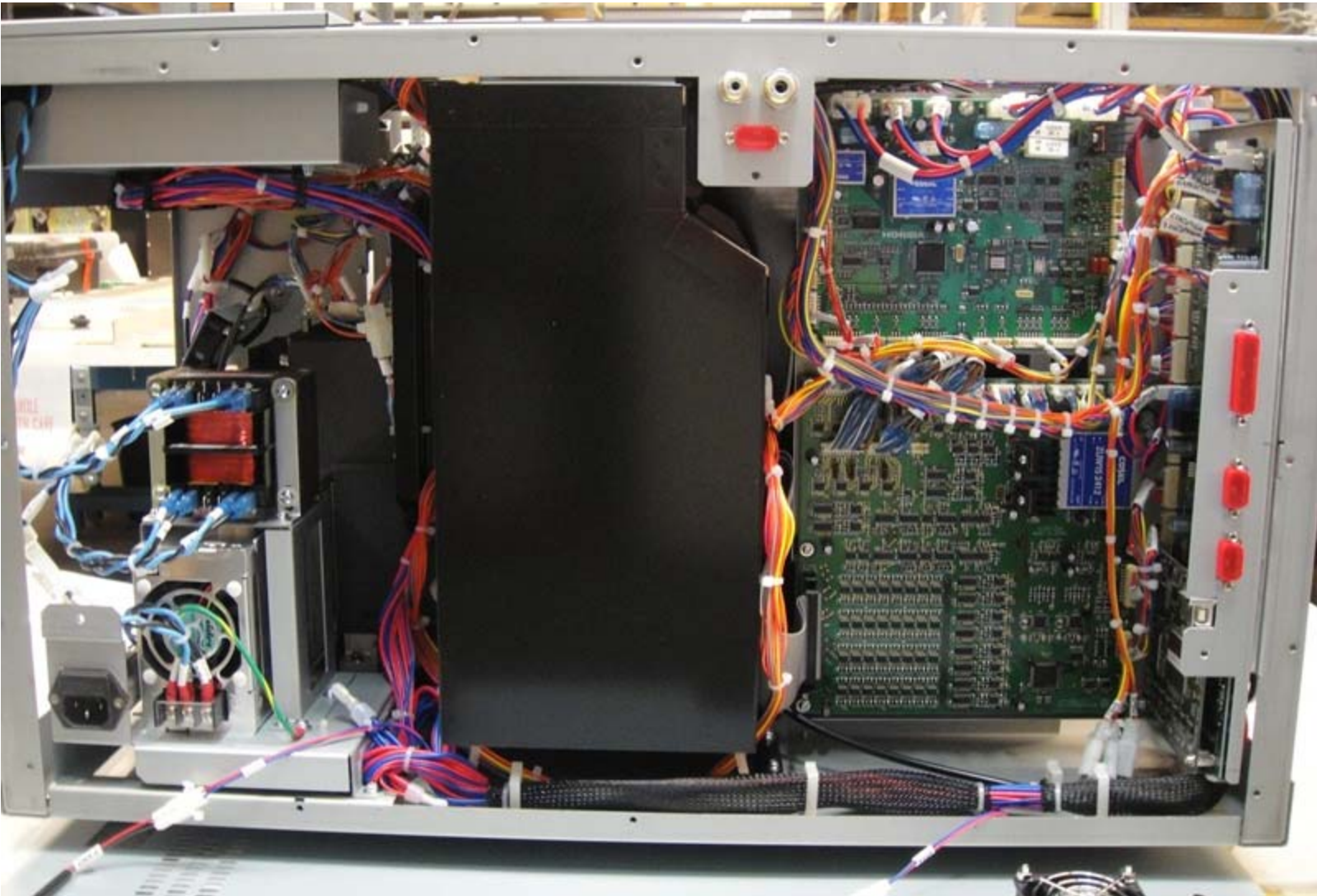


Enclosed forward and side detectors

Built-in liquid fill pump

Aluminum slab for bench stability

Build quality



Summary

- The LA-960 simplifies the challenging science of particle size analysis
- Refined software makes it easy to make and review actionable measurements
- Decades of experience have created the world's most advanced optical system
 - Highly accurate
 - Excellent reproducibility
 - Unmatched resolution
- Widest range of sample handlers to solve every application
- HORIBA's global support and build quality for the LA-960 mean users make better measurements with less effort

Thank you

ありがとうございました

Dziękuję

ขอบคุณครับ

谢谢

Cảm ơn

Gracias

اشكر

Σας ευχαριστούμε

धन्यवाद

Grazie

Tacka

Danke

Merci

நன்றி

감사합니다

Большое спасибо

Obrigado

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labinfo@horiba.com

← Receive news of updates

← View application & technical notes (170+), webinars (60+), white papers.