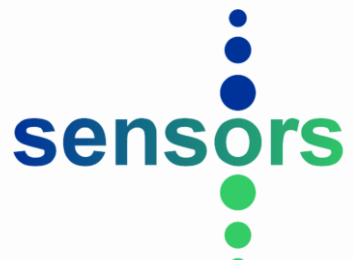


Sensors' Advances in PN PTI



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Sensors Europe GmbH Vert Focus Day 2026



Sensors' OEM PN PTI Products

Measurement Cell APB®: Low-cost, well established mixing type CPC (approx. 10000 units sold in Europe)



Patents:
US Pat. No. 11,686,6660
Other Patents Pending

Integration into Customer Products
(Example: Mahle PMU400)



Used as Reference PN Counter by METAS

Platform Demonstrator and Reference Particle Counter:
Sensors APA/RPA
(Automotive Particle Analyzer/
Reference Particle Analyzer)



Customer Branded Turnkey Analyzers, Examples: Bosch BEA090, SUN DSS-PN

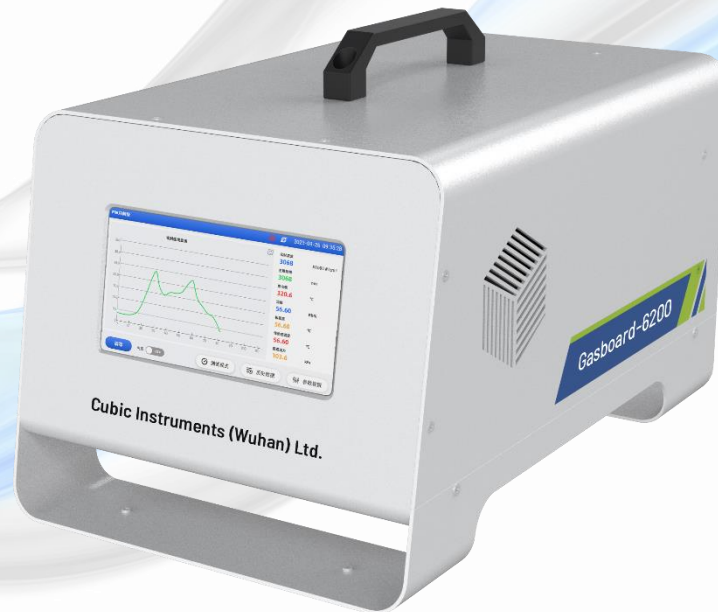
Participated as DUT in German PN Interlaboratory Comparison





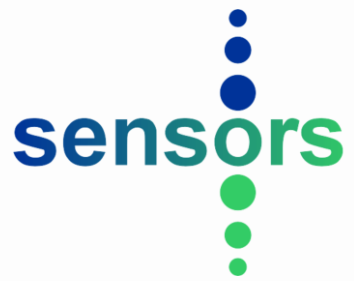
Adding DC Technology to the Portfolio

- As a well-established OEM supplier for PTI Emission Monitoring Components and Systems Sensors successfully entered the market with OEM CPCs and CPC based Analyzers.
- For customers who desire the integration of a DC based PN counter we partnered with **Cubic Instruments to complete our portfolio:**
- OEM DC PN Bench
- OEM DC PN Analyzer



Meets most stringent metrological requirements for PN PTI as laid out in PTB-A 12.16:

- RDE Counting Efficiency
- VPRE
- Etc.



Sensors' PN Calibration System

Sensors' APA Reference Counter + Topas FCS 249 Salt Particle Generator

Key Features APA

Analyzer Range:

0 to 1,000,000 #/cm³

(Up to 10,000,000 #/cm³ with optional secondary dilution)

Minimum Particle Size:

d50 approximately 23 nm

(10 nm optional upon request)

Accuracy:

±25% absolute

(calibrated as directed and compared to a reference CPC from an accredited laboratory)



Key Features Topas FCS 249

Robust GMD and GSD

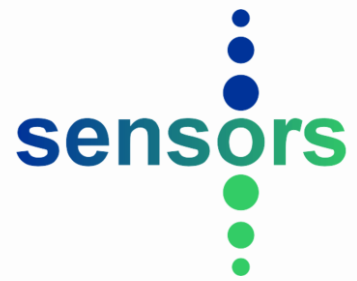
7 Pre-adjustable Concentration Points (fine tuneable)

Utilizes Off-the-Shelf NaCl solutions

Integrated Dilution System

Calibrates 2 DUTs at a time

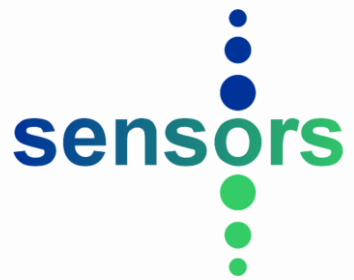
Set Compliant with German Calibration Guideline for PN PTI instruments



Sensors Europe's PN Calibration Laboratory

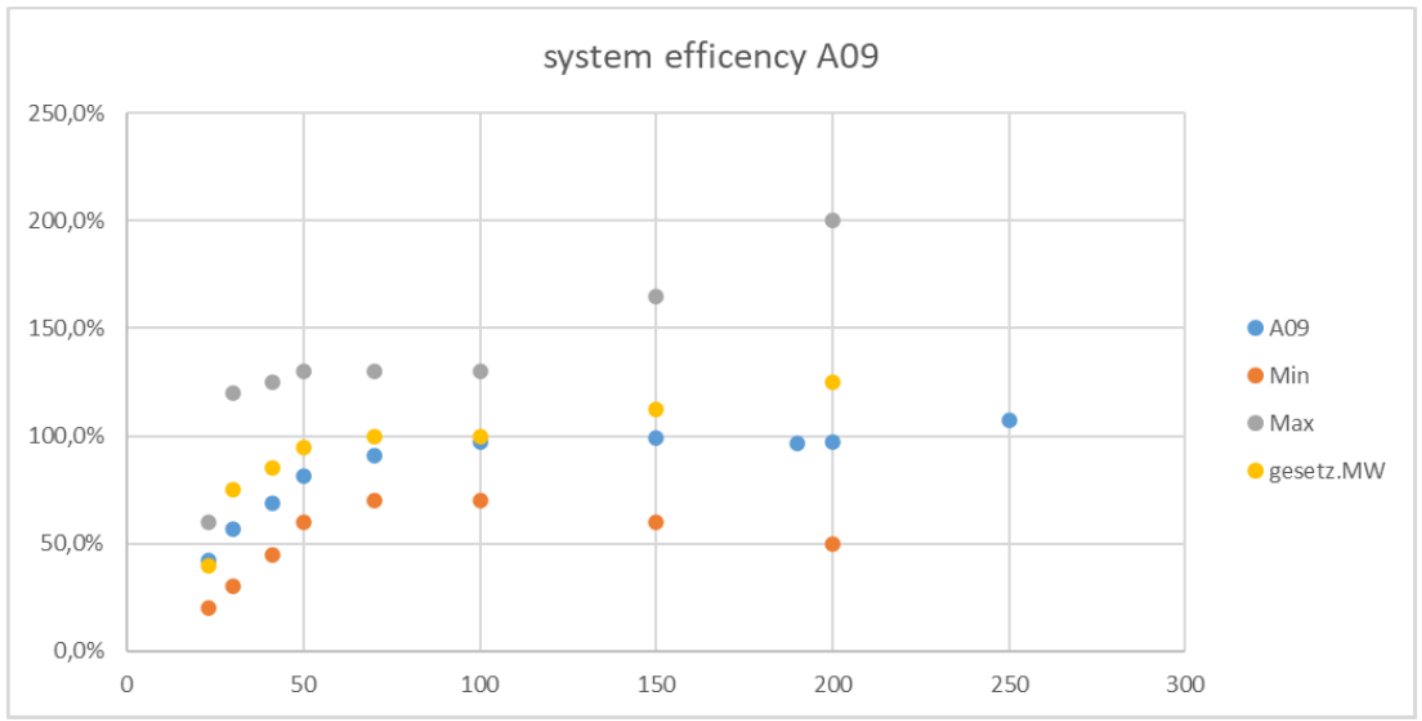


- State-of-the-Art Aerosol Lab
- ISO 17025 accredited
- Calibration of PEMS and PN PTI Analyzers
- Monodisperse Calibration Capability
- Salt and Soot Particle Generators
- Down-to-10 nm Calibration Capability

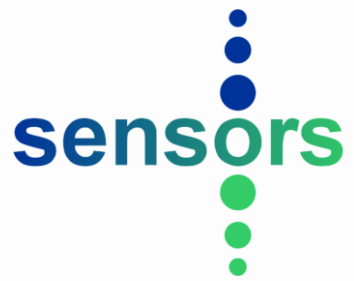


Typical APA Counting Efficiency Data

Dp [nm]	Ref [#/cm ³]	A09 [#/cm ³]	Dp [nm]	A09 [%]	gesetzl. Vorgaben		
					Min	Max	Mittelwert
23	12935,6	5421,2	23	41,9%	20%	60%	40%
30	8551,8	4851,5	30	56,7%	30%	120%	75%
41	12313,6	8501,8	41	69,0%	45%	125%	85%
50	9339,6	7594,4	50	81,3%	60%	130%	95%
70	13111,7	11913,1	70	90,9%	70%	130%	100%
100	10976,3	10642,9	100	97,0%	70%	130%	100%
150	8673,9	8586,2	150	99,0%	60%	165%	113%
190	7563,7	7298,5	190	96,5%			
200	6153,7	5972,6	200	97,1%	50%	200%	125%
250	2158,4	2313,2	250	107,2%			



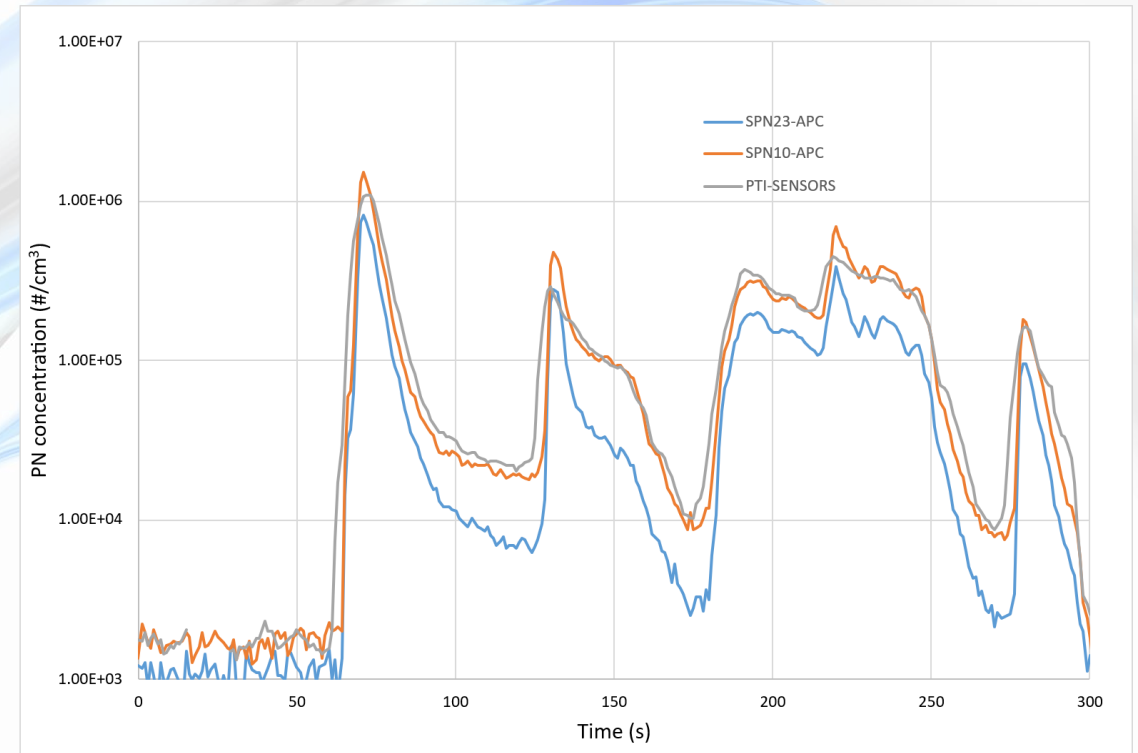
Data kindly provided by



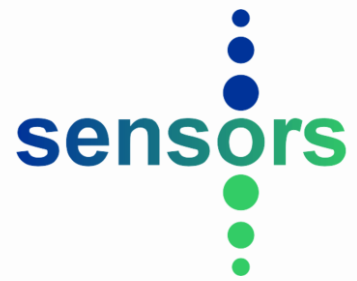
“Down-to-10” PN measurements on GDIs

- Robustness of Sensors’ APA (and derivatives) for Gasoline PN PTI was proven by extensive GDI testing prior to market entry in 2022.
- Due to simple instrument modification (omission of Diffusion Screen) 10 nm readiness can be achieved:

Readiness of Sensors’ CPC based PN PTI Analyzers for Gasoline and Down-to-10nm-Measurements was demonstrated.



Data kindly provided by JRC

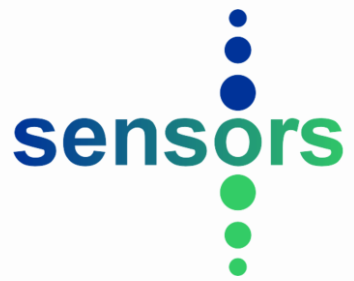


NPTI is also NOx-PTI

- NOx PTI is addressed in the Draft EU Roadworthiness Directive (amending 2014/45/EU) with challenging envisaged Pass/Fail threshold of 40 ppm.
- UV Technology for NOx in the pipeline:
 - Direct measurement of NO and NO₂
 - No cross-interference from H₂, O₂, NH₃, CO₂
 - No consumables – low long-term operating cost
 - Ranges: NO: 500 ppm, NO₂: 500 ppm



Like in PN PTI a technology-neutral approach for regulatory instrument requirements is key for a successful implementation of NOx-PTI!



Sensors - Worldwide

For further information please see us in our booth or contact:

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Thank you for your attention!