

# Next Generation of Particle Number Instruments for Vehicle Type Approval and Quality Control of DPF Kerbside

Luis Cachón, Stefan Gerken



## INTRODUCTION and MOTIVATION

The latest news regarding Real Driving Emissions RDE for LDV are likely to have a great impact on policy maker decisions, development in the automotive industry and testing procedure for research and control organizations in general.

This study presents through several application examples of the current and next generation of particle number instruments for vehicle type approval and quality control of DPF Kerbside.

This latest portable nanoparticle instrumentation based on diffusion charging enables a new measuring procedure in automotive application to measure number concentration and diameter of nanometer sized particles in the size range 10 - 500 nm. Diffusion charging technology has been already satisfactory proved for personal exposure monitors. Since its measuring principle uses electrical charging to count particles, not only it enhances the quality of the global measurement, but also the cost of acquisition and costs per test are significant lower. The instrumentation is compact, easily portable and provides on-line response. Due to these properties it is a suitable technology for particle number concentration measurements in non-laboratory settings. It is battery operated and therefore appropriate for on-board and field measurements.

## CURRENT LEGISLATION ON PARTICLE EMISSIONS

- ❖ UNECE R83 → Euro 6 for LDV (Diesel since 2011, GDI from 2017)
- ❖ UNECE R49 → Euro VI HDV

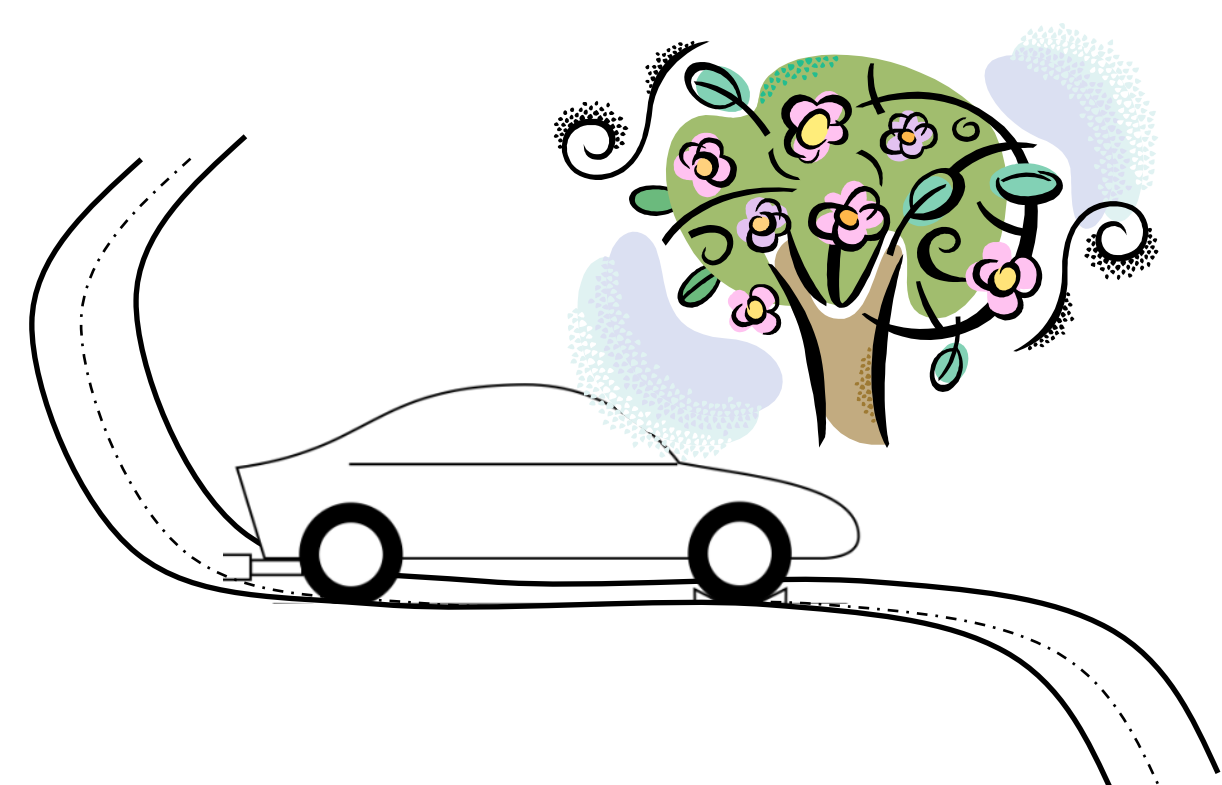


**testo ViPR + CPC:** PMP compliant measurement technology for chassis dyno

- Type approval UNECE R83 and R49
- R&D of diesel and gasoline engines
- R&D of diesel particle filter (DPF)
- Particle counting at chassis dyno and/or test bed.

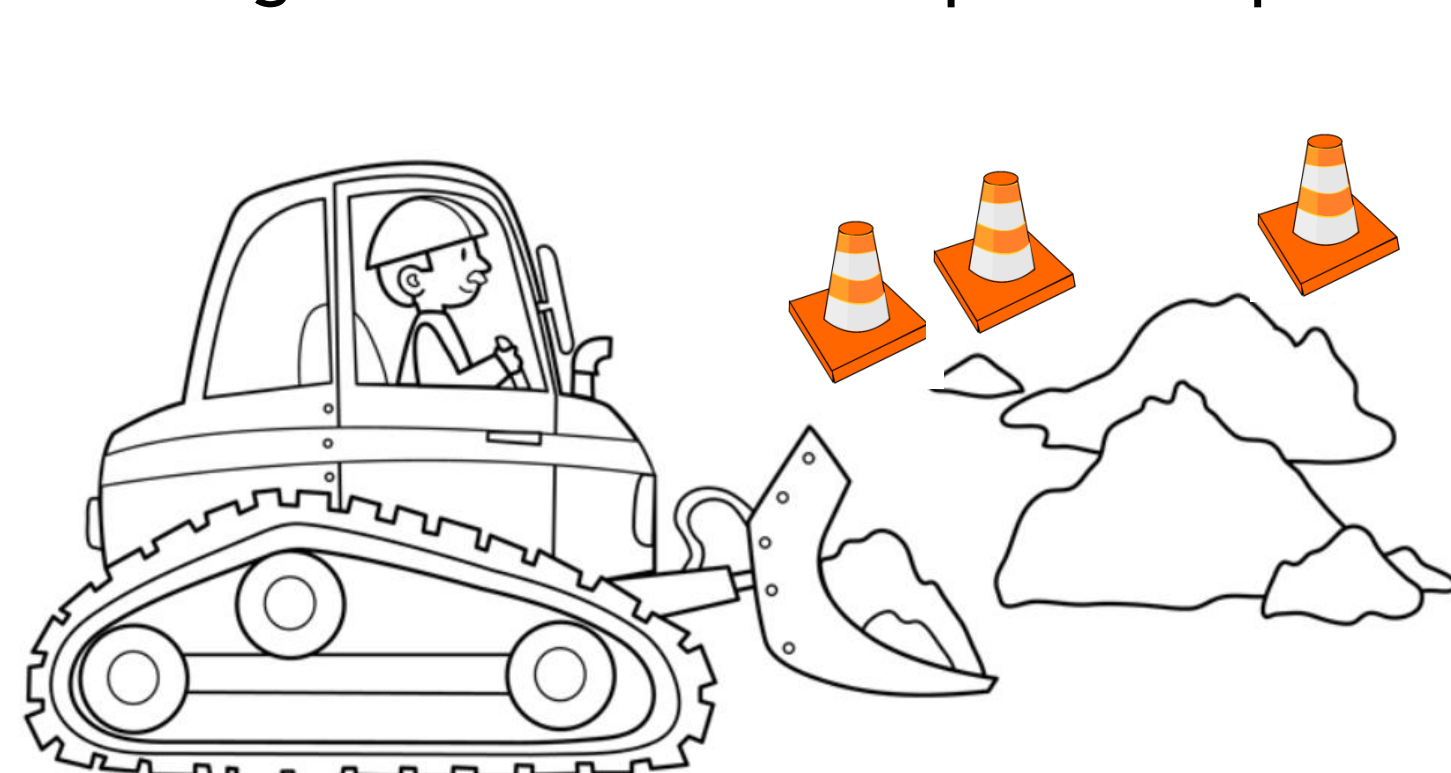
## ONCOMING LEGISLATION ON PARTICLE EMISSIONS

- ❖ RDE for LDV according to regulation 459/2012
- ❖ In-Service Conformity HDV according to regulation 64/2012
- ❖ Stage V Regulation for NRMM according to COM(2014) 581



**testo NanoMet3:** PEMS-PN compliant technology for on-board measurements

- Type approval RDE
- In-Service Conformity HDV
- R&D of diesel and gasoline engines
- R&D of diesel particle filter (DPF).
- ❖ Swiss legislation 941.242 on portable particle counters for construction machinery



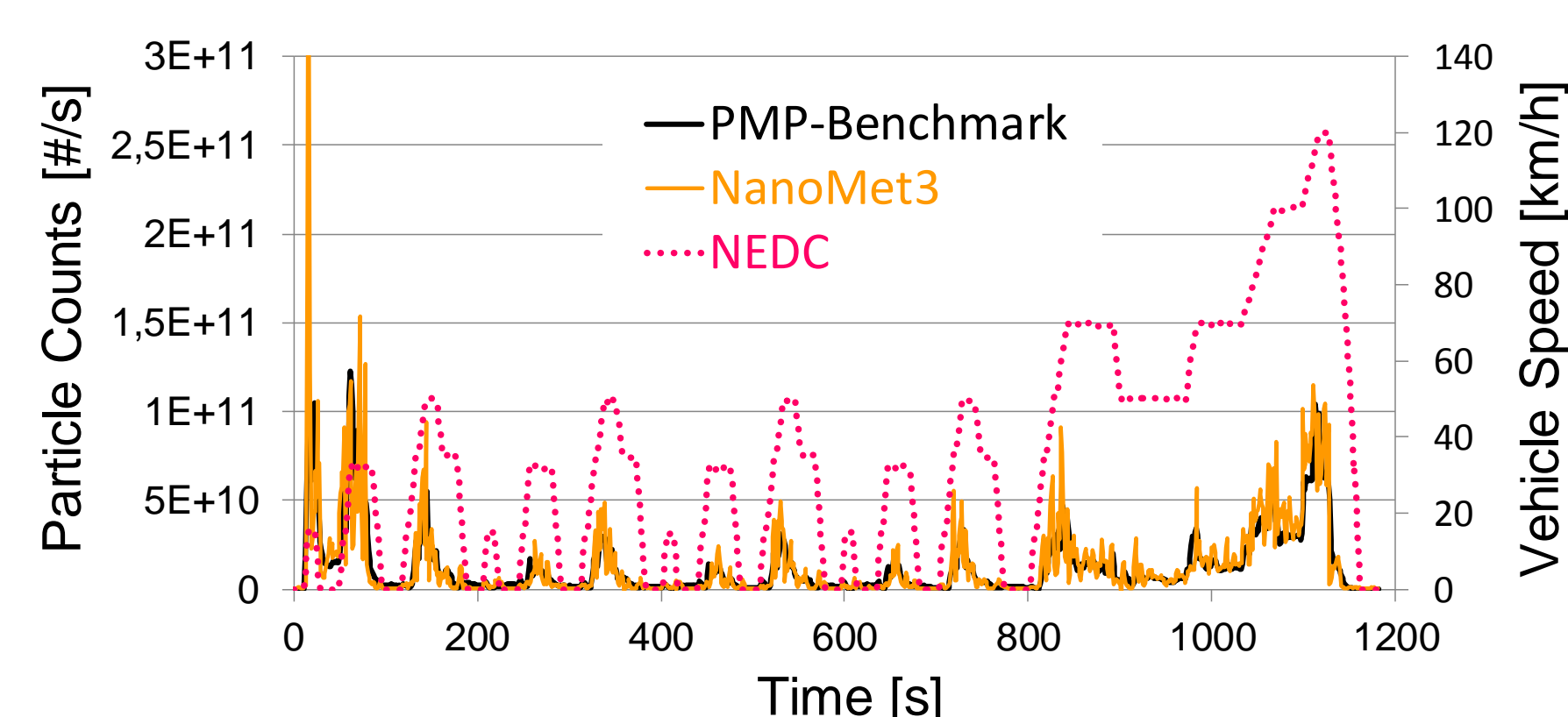
**testo PEPA:** Portable Emission Particle Analyzer for periodic technical inspection

- Periodic technical inspection in compliance with regulation SR 941.242
- In-Service Monitoring of NRMM according to COM(2014) 581

## EXPERIMENTAL RESULTS

### ➤ PEMS-PN application #1

JRC Inter Laboratory Comparison Exercise of the PEMS-PN measurement technology on behalf of the European Commission.

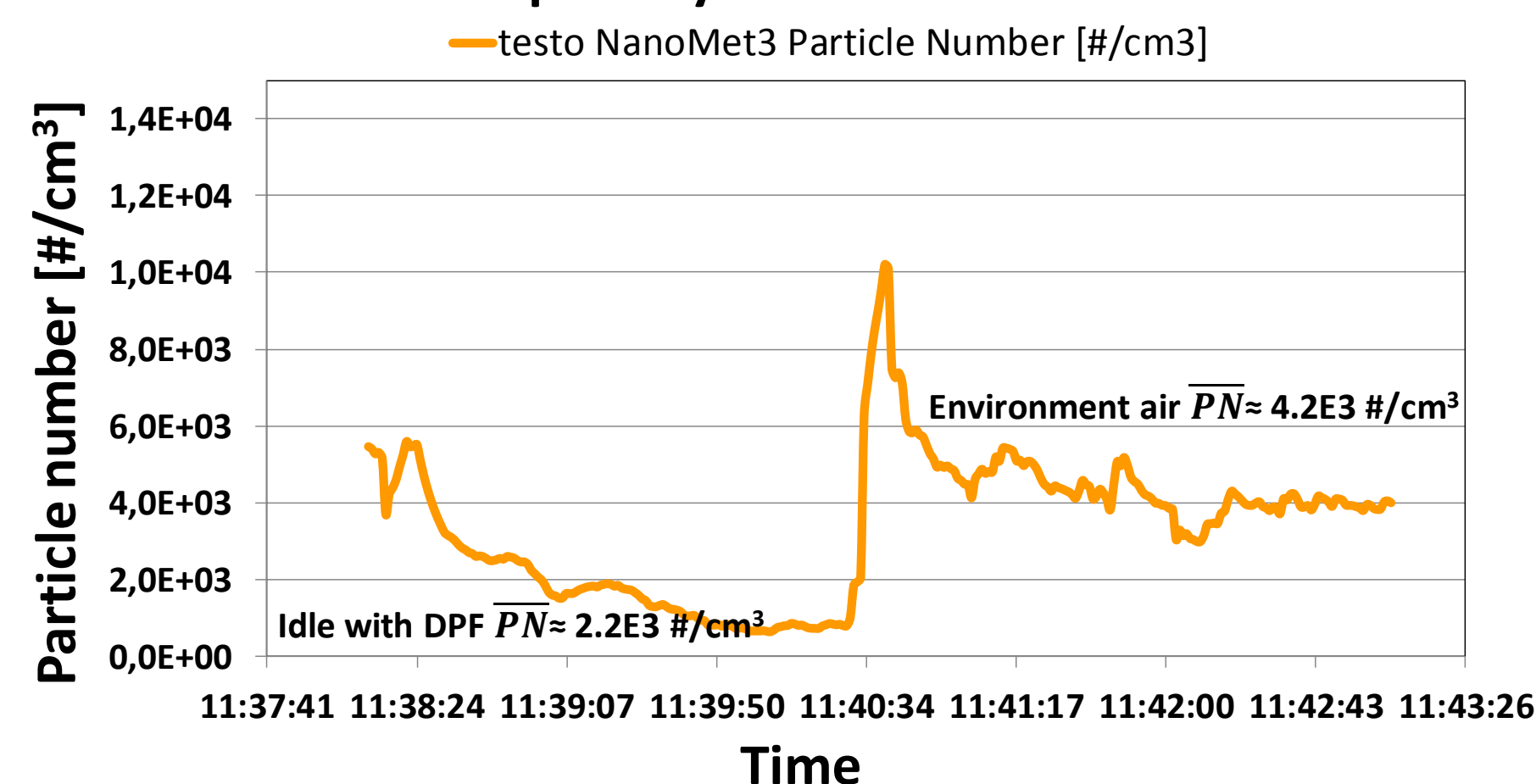


**Figure 1:** PN concentration and correlation measured with NanoMet3 and PMP-Benchmark on a New European Driving Cycle - NEDC

### ➤ PEMS-PN application #2

Periodic technical inspection in Switzerland

**Street sweeper Citycat 2020 Diesel after DPF**

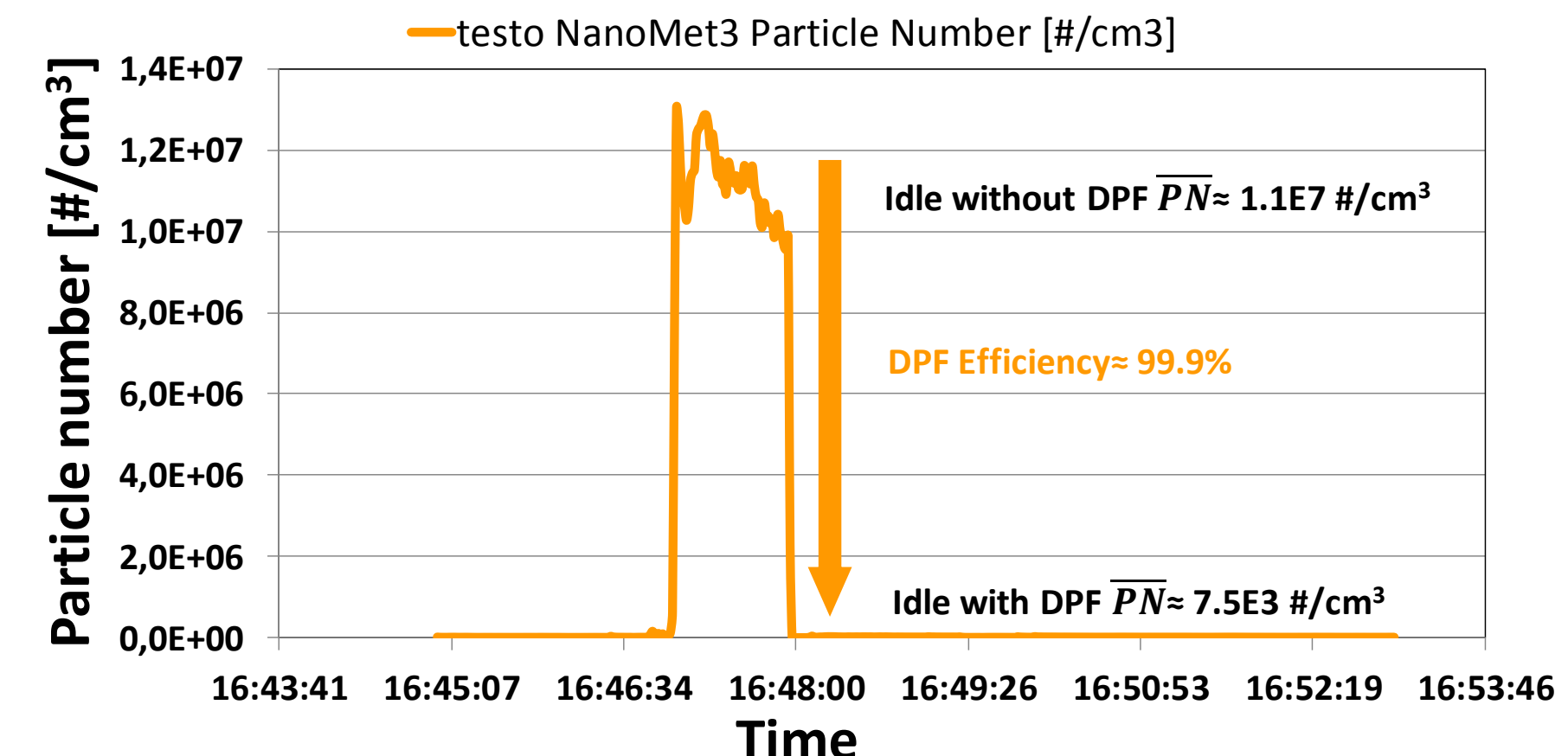


**Figure 2:** PN concentration with testo NanoMet3 of a street Citycat 2020 diesel after DPF during periodic technical inspection on field.

### ➤ PEMS-PN application #3

DPF Retrofit project in Colombia, Santiago de Chile, China, Iran, Israel, Mexico...

**MAN Solobus Diesel EURO III before and after DPF**

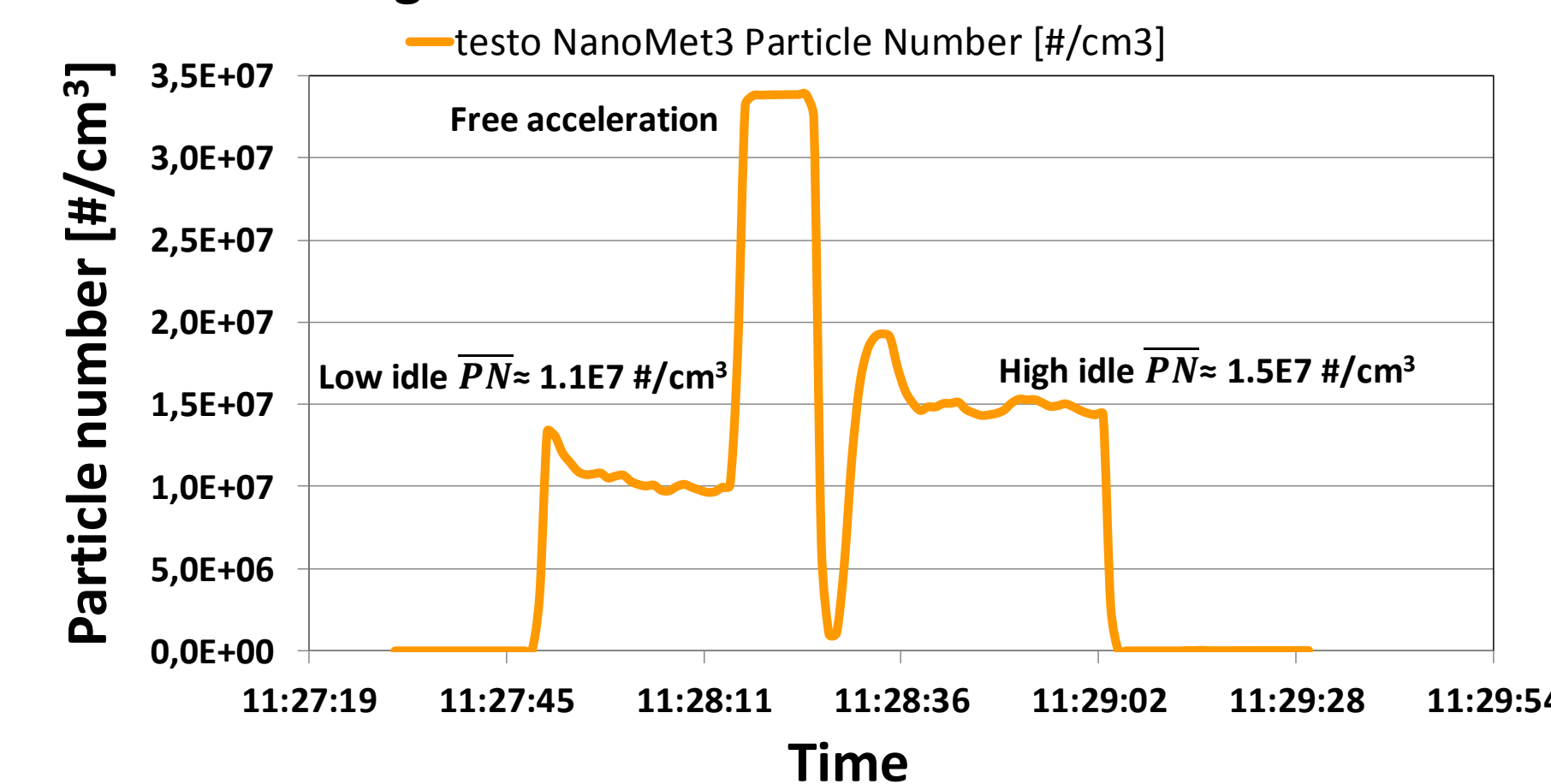


**Figure 3:** PN concentration with testo NanoMet3 of solobus MAN diesel EURO III after DPF retrofit during periodic technical inspection on field.

### ➤ PEMS-PN application #4

Detection of defective DPF

**Peugeot Partner Diesel with defective DPF**



**Figure 4:** PN concentration with testo NanoMet3 of Peugeot Partner Diesel with defective DPF at periodic technical inspection on field. **Note:** After replacement of defective DPF in this vehicle the measured concentration at idle ( $\overline{PN}$ ) < 1E4 #/cm<sup>3</sup>. Neither defective nor functioning DPF are detected by OBD in the vehicle.

## CONCLUSIONS

Portable nanoparticle instrumentation based on diffusion charging constitutes a new measuring procedure in automotive application to measure number concentration and diameter of nanometer sized particles in the size range 10 - 500 nm. Since its measuring principle uses electrical charging to count particles, not only it enhances the quality of the global measurement, but also the cost of acquisition and costs per test are significant lower. The instrumentation is compact, easily portable and provides on-line response. Due to these properties it is a suitable technology for particle number concentration measurements in non-laboratory settings.



## CONTACT

Luis Cachón  
E-mail: [sales-nanoparticle@testo.de](mailto:sales-nanoparticle@testo.de)  
Phone: +49 7653 681 5062