



The Golden PEMS: Technical Aspects and Outlook

Presented by Luis Cachón

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- **Motivation**

- **Measuring and technical requirements**

- **NanoMet3 technology**

- **Features and specifications**

- **Validation and performance**

- **Summary and outlook**

More than 10 years of solid particle counting

2004

2008

2011

2012

2013

2014

2017

- 2004 Matter delivers the golden instrument for the PMP tests
- 2011 Euro 5b PN for diesel LDV
- 2012 WHO identified soot nanoparticles as most dangerous pollutant
- 2013 PN in EU for HDV,
Switzerland periodic control on field for construction machinery,
EU requests feasibility study of PEMS-PN for RDE
- 2014 Euro 6 PN for GDI LDV,
Matter delivers the golden instrument for PEMS-PN
- 2017 RDE within EURO 6c

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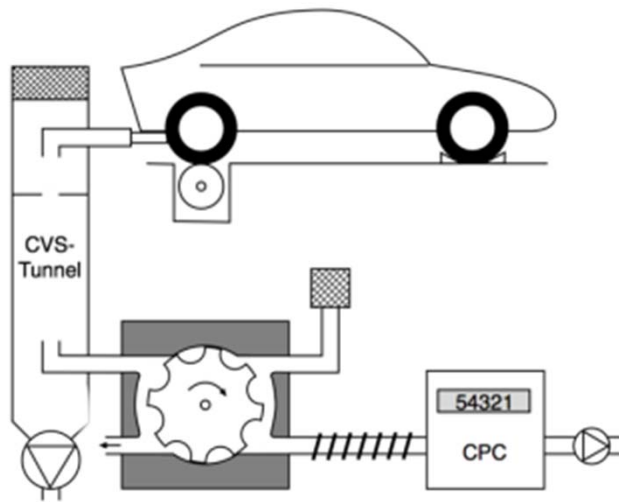
➤ Features and specifications

➤ Validation and performance

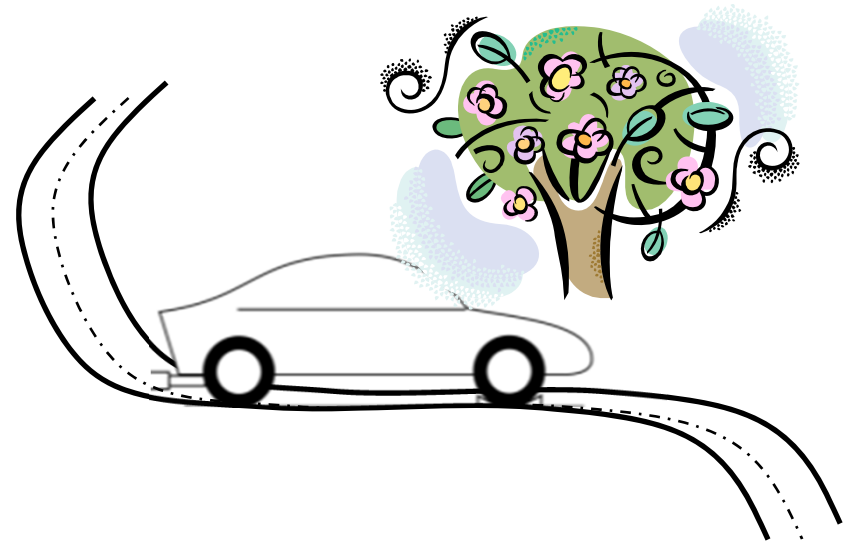
➤ Summary and outlook

2017 European Commission's PEMS-PN approach

PMP Measurement



Real Driving Emissions



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Matter Aerosol NanoMet3

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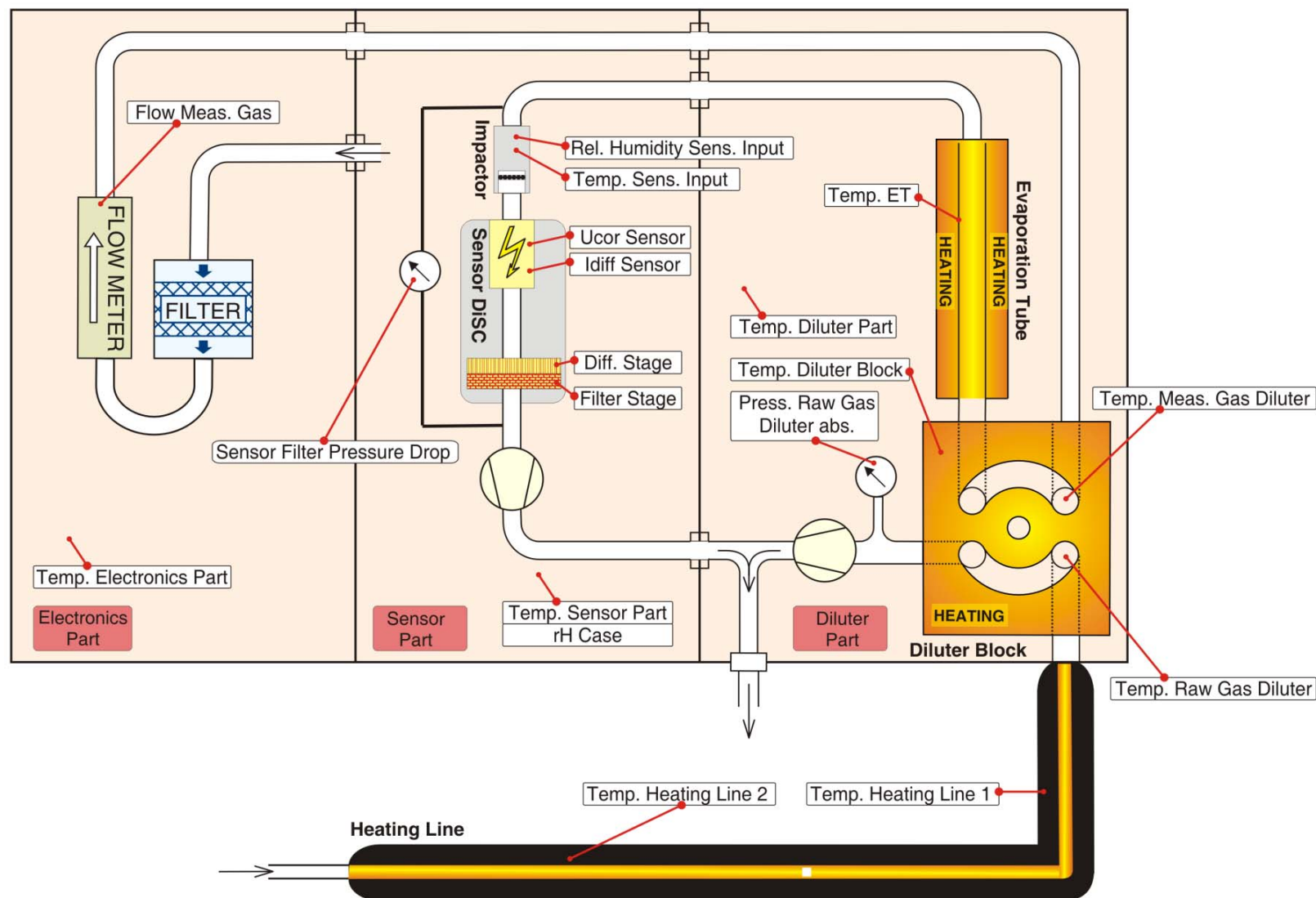
Recommended system features and performance

- **Proportional partial flow sampling system or constant dilution system**
- **Real time detector for PN determination**
- **Temperature control of the sampling system**
- **Ability to be used on-board: No safety issue, low mass and power consumption**
- **The candidate PEMS-PN instruments should come along with their calibration data.**

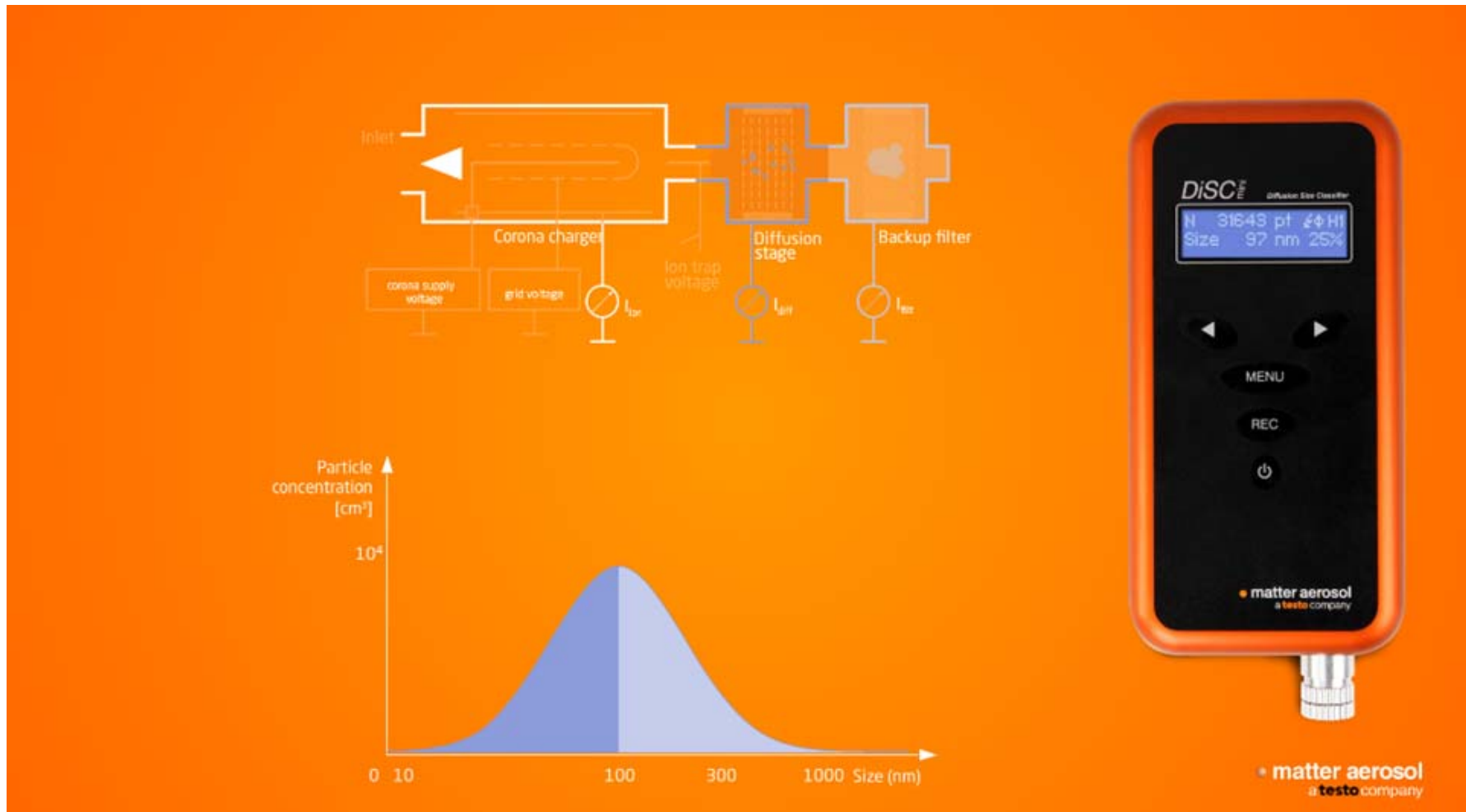
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NanoMet3 Technology



Particle Counting: Diffusion Size Classifier



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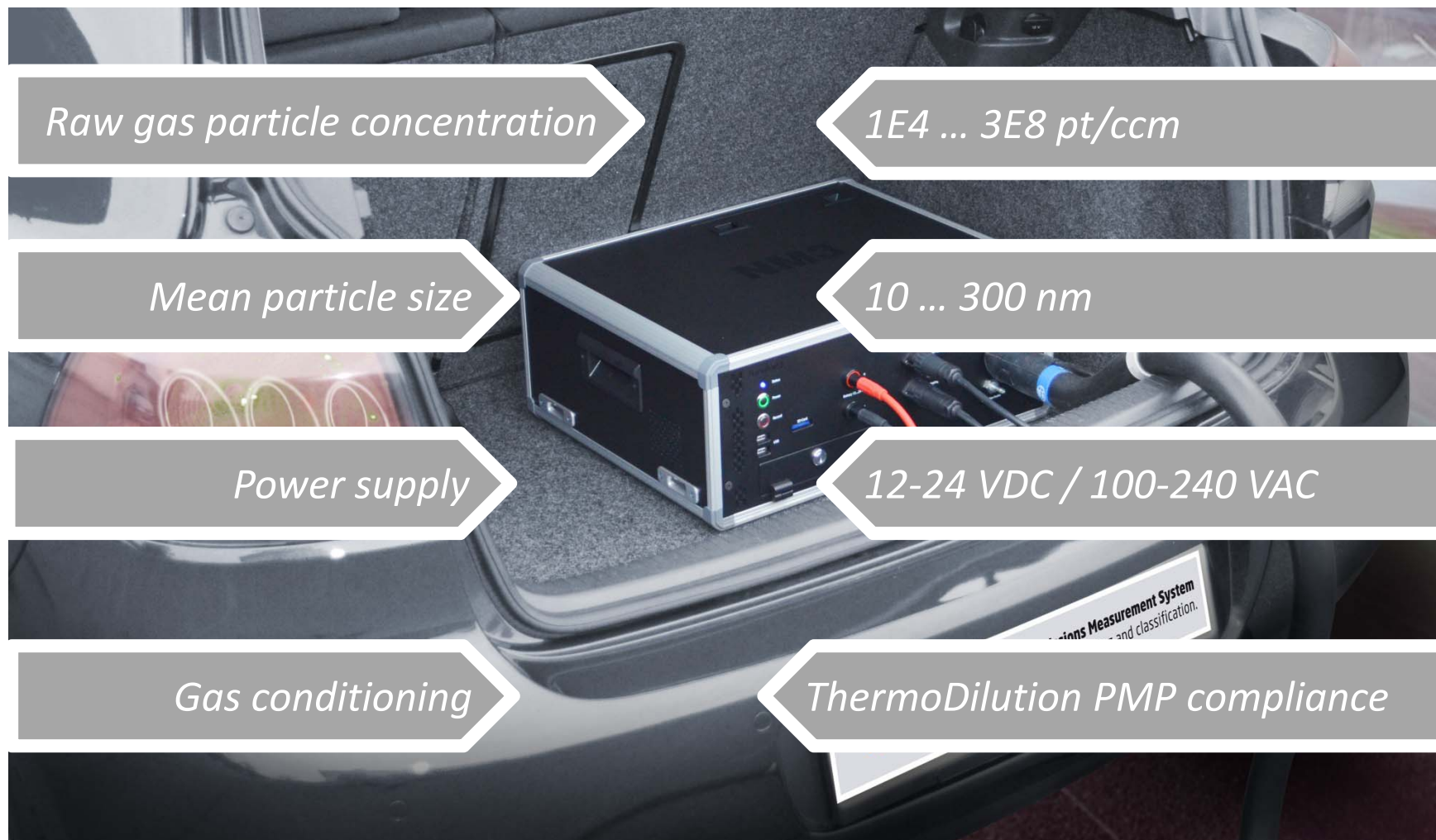
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Measuring Data

- Particle number concentration $[\#/cm^3]$ or $[\#/s]$ with flow meter
- Average particle diameter $[nm]$
- Calculated particle mass $[mg/m^3]$
- Lung deposition surface area $[\mu m^2/cm^3]$



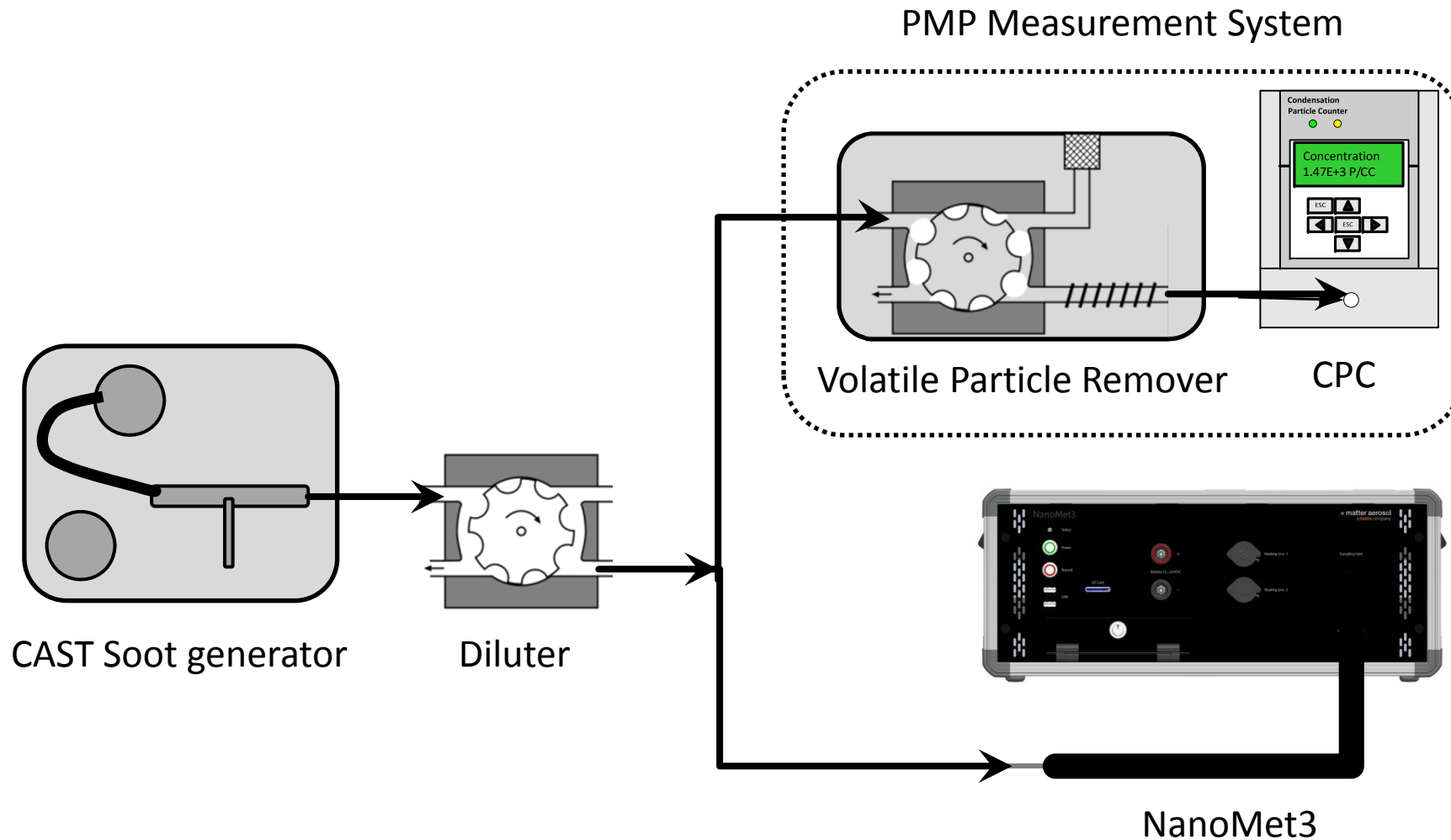
NanoMet3 specifications



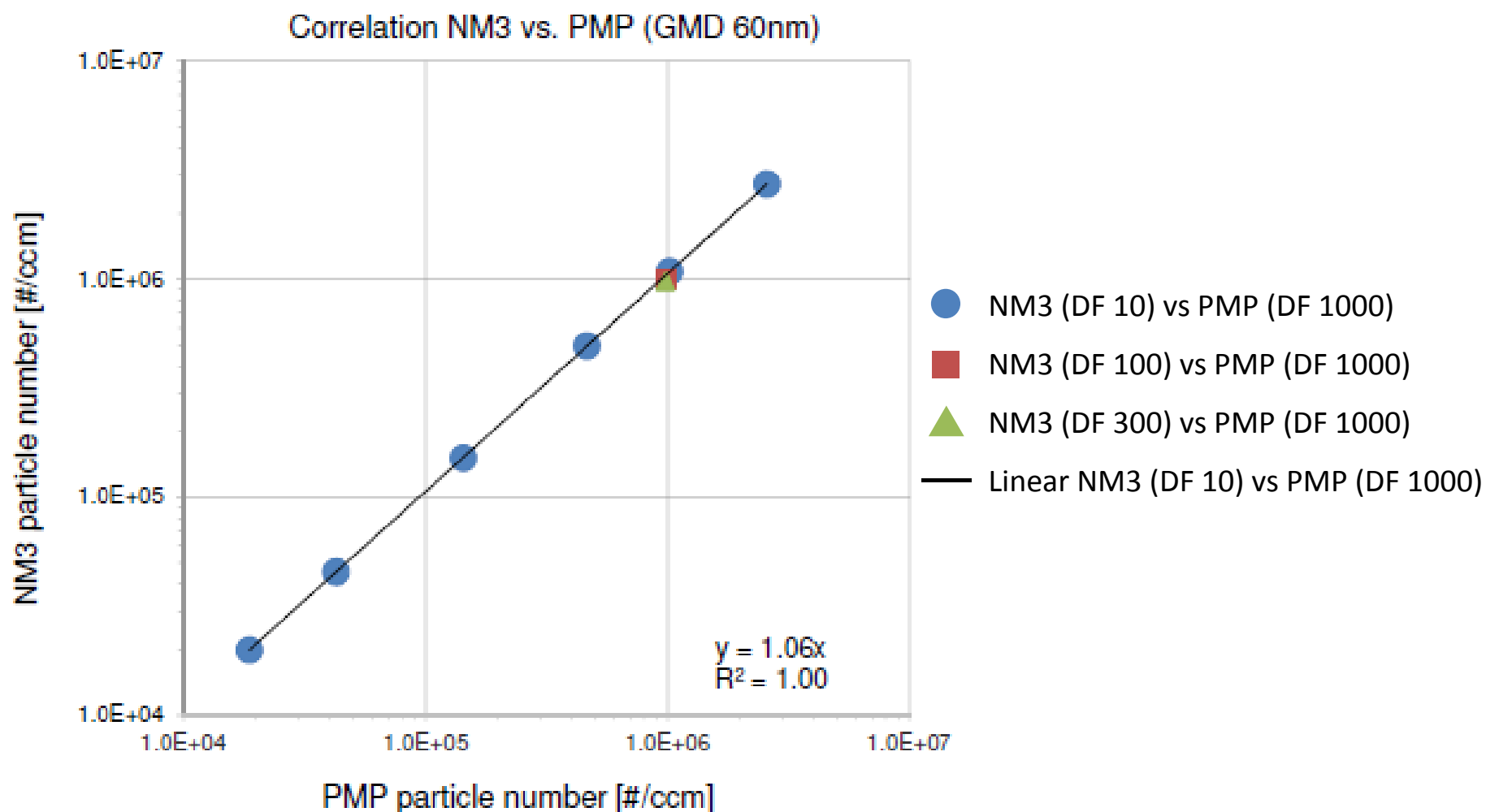
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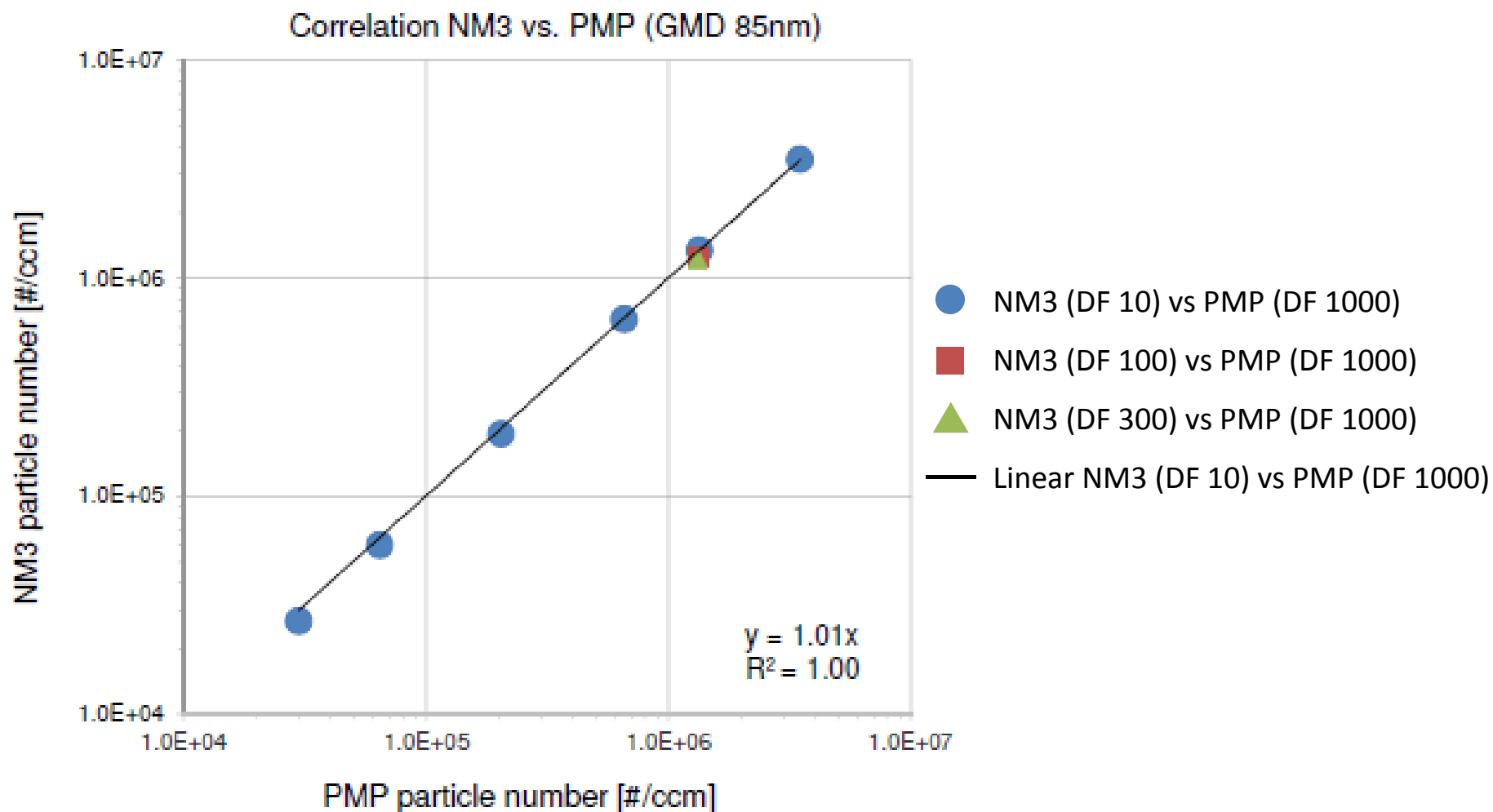
NanoMet3 Validation Setup



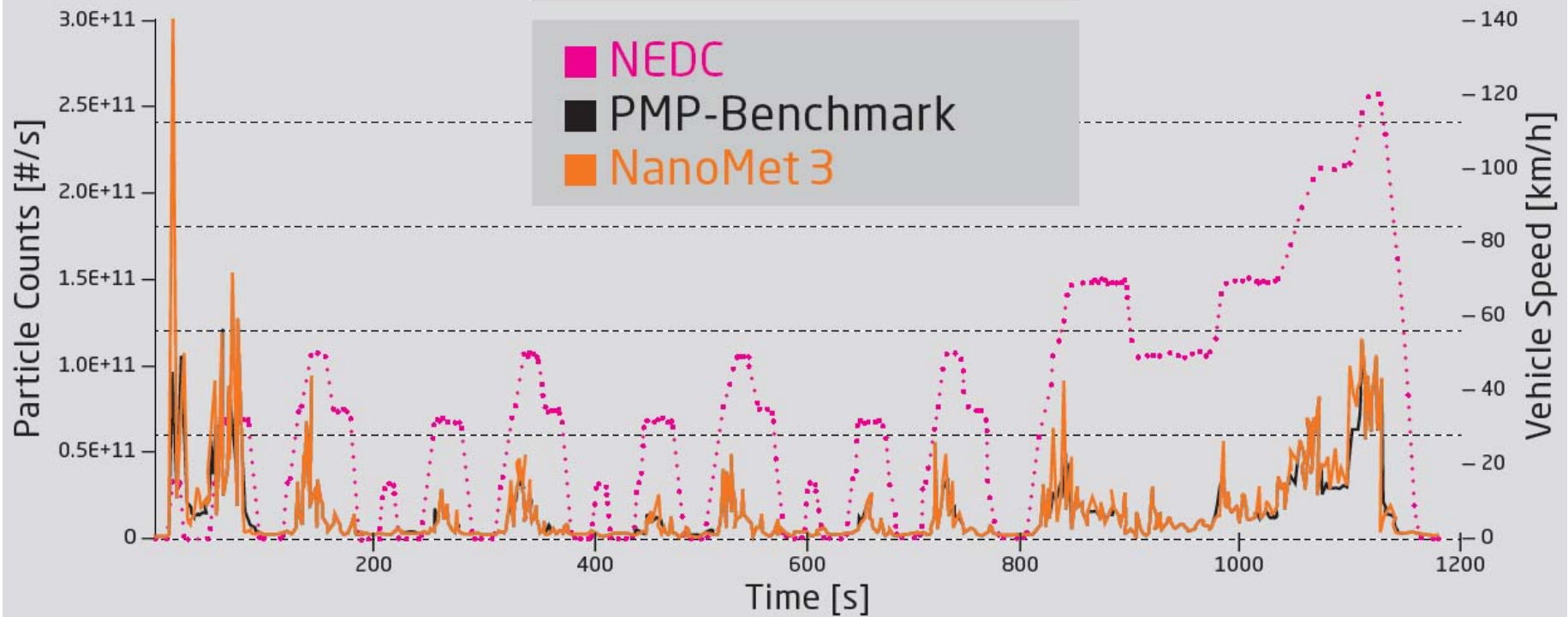
NanoMet3 validation @ 60nm



NanoMet3 validation @ 85nm



NanoMet 3 vs PMP



NanoMet 3, DF=300

ECE: PN_{avg} : 2 E+12 #/km,

EUDC: PN_{avg} : 1,1 E+12 #/km,

**Benchmark, DF=300
(20x15)**

ECE: PN_{avg} : 1,9 E+12 #/km

EUDC: PN_{vg} : 1,2 E+12 #/km

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Summary

- **Matter Aerosol develops the NanoMet3: a PEMS-PN from our experience in the PMP establishment**
- **It is compact, easily portable and provides on-line response**
- **PMP compliance Thermo-Dilution to remove droplets from exhaust sample**
- **Particle counting principle based on Diffusion Size Classifier**
- **Very good correlation in comparison with PMP benchmark.**
- **NanoMet3 is golden instrument for oncoming PEMS type approval as well as for in-use-compliance testing**

Outlook

- **Determination of the PN limit value and tolerances for the RDE**
- **Definition of boundary conditions for the RDE measurement**
- **Setting of PEMS on the vehicle (cabin/outside)**
- **Calculation of the exhaust gas volume flow (ECU/flow meter) for conversion of concentrations in particles per kilometer**
- **Definition of a validation method to enable reproducibility**
- **Definition of a calibration method to ensure repeatability**

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NanoMet3: available now
Thank you for your attention!