Physikalisch-Technische Bundesanstalt
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Metrology for Portable Emission Measurement Systems (PEMS): Challenges and pathways of traceable calibration for particle number (PN)

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METROPEMS PROJECT

WP2: Metrological validation and performance tests of PN-PEMS devices

The aim of this work package is to validate and determine the performance of the current the state of the art of the PEMS measurement devices by comparison with traceable PN calibration facilities. As part of this the project will investigate commercially available PN-PEMS devices including dilution systems upstream of the particle counters as well as volatile particle remover (VPR) systems which are used to remove volatile compounds from exhaust emissions. In addition, WP2 will develop validated and traceable calibration strategies for linearity, efficiency and penetration measurements for PN-PEMS.

METAS NPL National Physical Laboratory LNE VTT EURAMET METROPEMS metropems.ptb.de

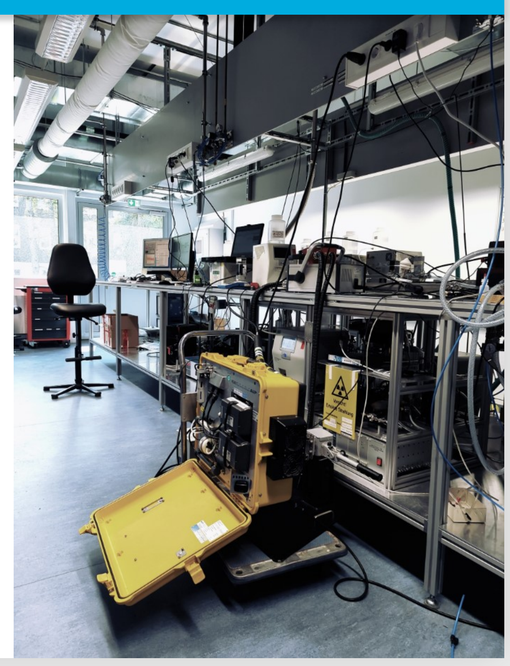
METROLOGY NEEDS

Provide a traceable calibration for particles from below 23 nm in mobility diameter to up to 200 nm.

Quantify the particle losses in the PEMS inlet configuration.

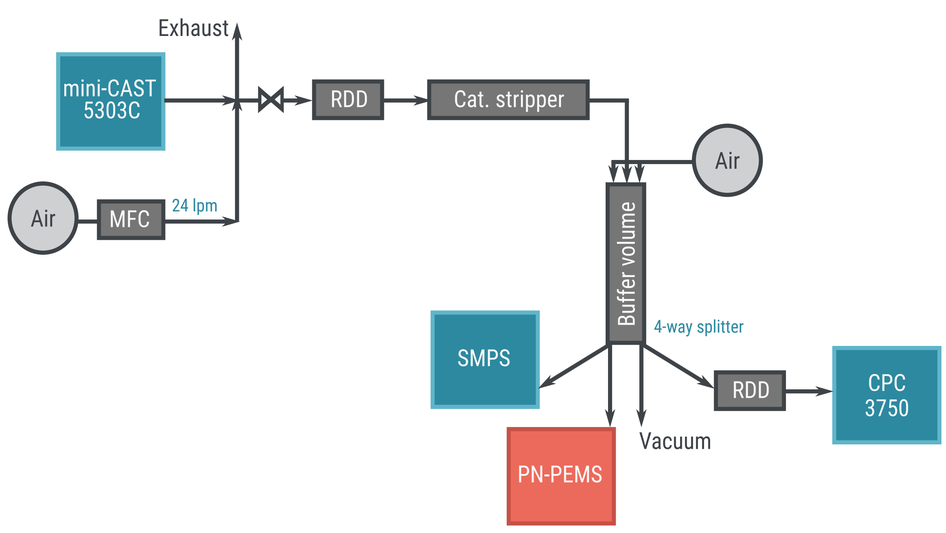
Determine the efficiency of the volatile particle removal system.

Provide a metrologically sound uncertainty budget for particle number.

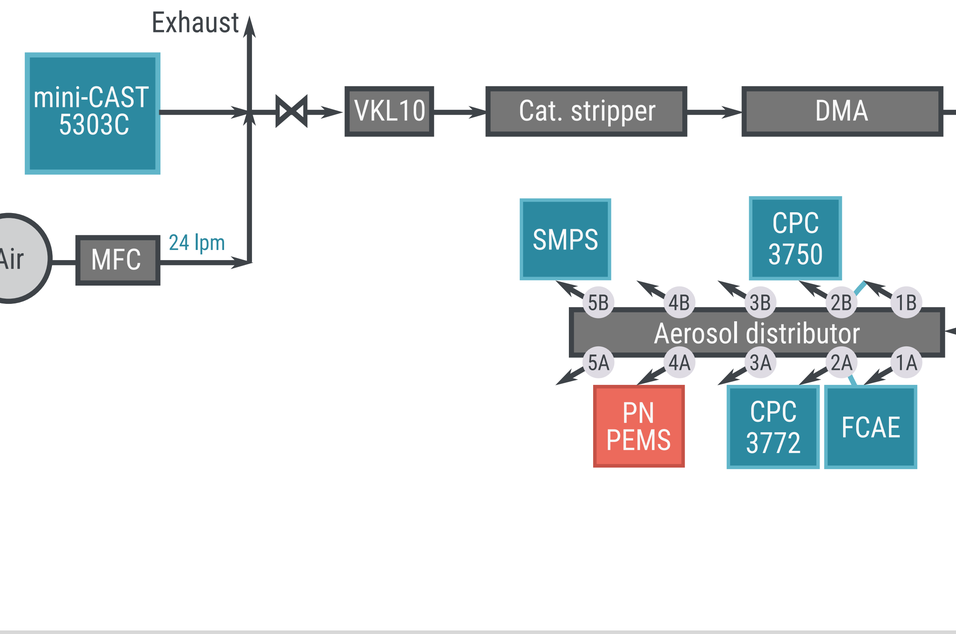


EXPERIMENTAL SETUP

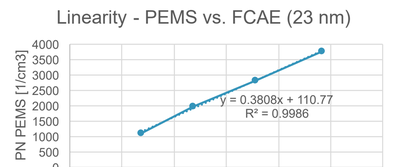
Polydisperse aerosol - linearity test
For up to 500k particles cm^{-3}

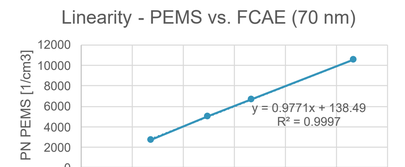


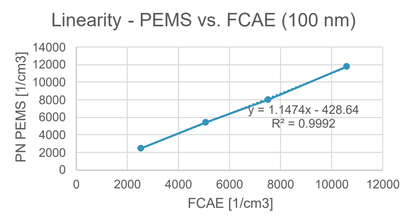
Monodisperse aerosol - counting efficiency test
Mobility diameter: 17, 23, 30, 50, 70, 100, and 200 nm

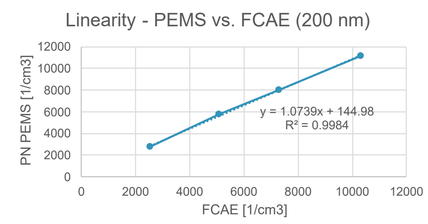


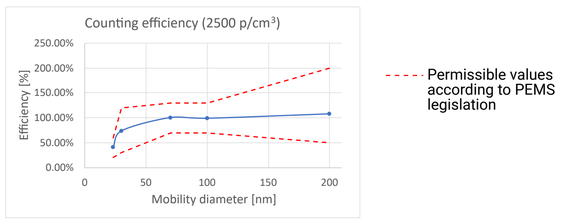
RESULTS: LINEARITY and COUNTING EFFICIENCY











Multiple charge correction is done based on collocated SMPS system measurements downstream (online Twin approach).

The Dp_{50}, or mobility diameter where efficieny reaches 50 %, is set to 23 nm for commercial PEMS devices.

OUTLOOK

- Clear calibration guidelines will be published as a MetroPEMS deliverable on PN-PEMS calibration and distributed among the stakeholder community.

- An uncertainty budget based on the laboratory measurements will be made available and will include a series of recommendations to improve the PN determination by PEMS.

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