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Traceable Particle Number calibrations

An AIP approach

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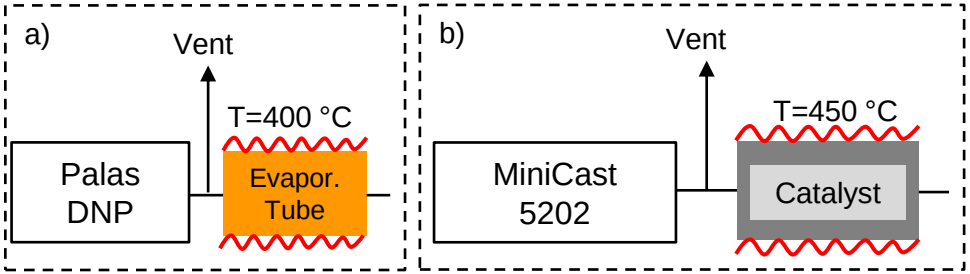
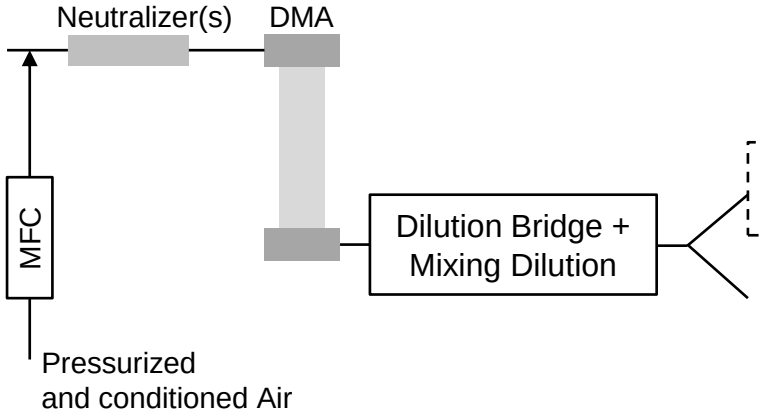
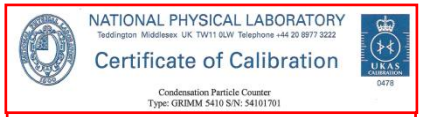
PN Calibration Setup at AIP



- Cast-Model with high Propane-Flow and high internal dilution
- **Thermal aftertreatment of aerosol**
- DMA calibration with PSL at NPL
- Calibration of reference devices at NPL, method within CIPM MRA
- Traceability to electrometer charge concentration (METAS, PTB with similar CMCs)





NPL CMCs:
Dp: 10 to 200 nm
Numb conc.: 100 to 20000 1/cm3
Charge conc: 0,1 to 3 fC/cm3

a) AIP SPC

b) AIP PN PEMS

CPC

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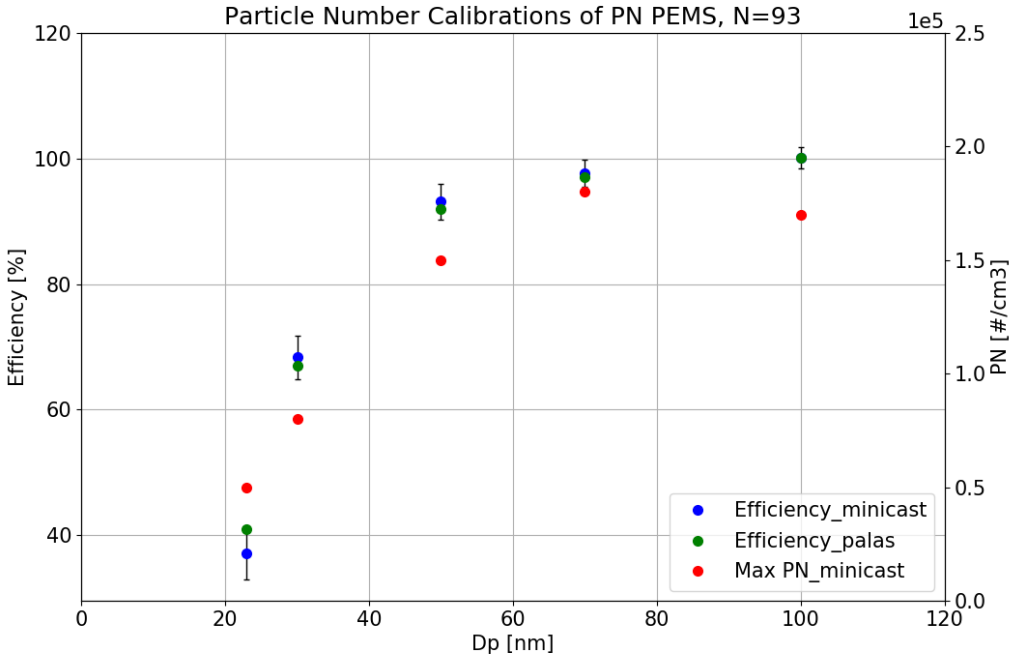
PN PEMS calibrations



- Efficiency calibrations of 93 PN PEMS with „Minicast“ setup
- One set of operating points for MiniCast flows per particle size
- 2*Std.dev <7 % (23 nm)
- High maximum PN concentrations for all particle sizes
- Calibrations with sparkdischarge generator show similar results

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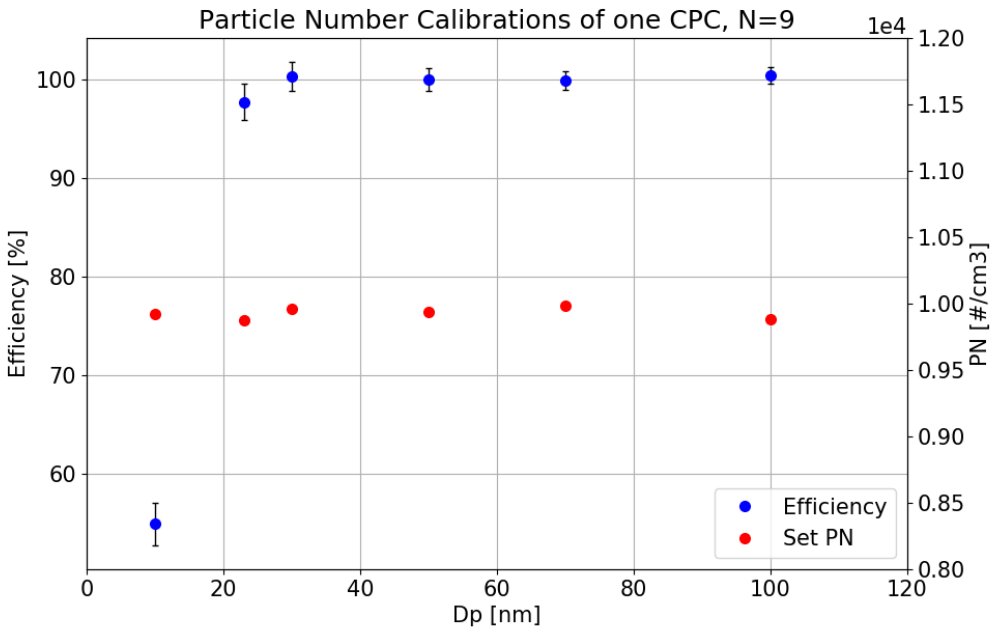
CPC calibrations Sub-23 nm



- Repeated Efficiency calibrations of one PEMS CPC for Sub-23 nm measurements
- One set of operation points for MiniCast flows per particle size
- 2*Std. dev <7 % (10 nm)
- Sufficient PN concentration for all particle sizes

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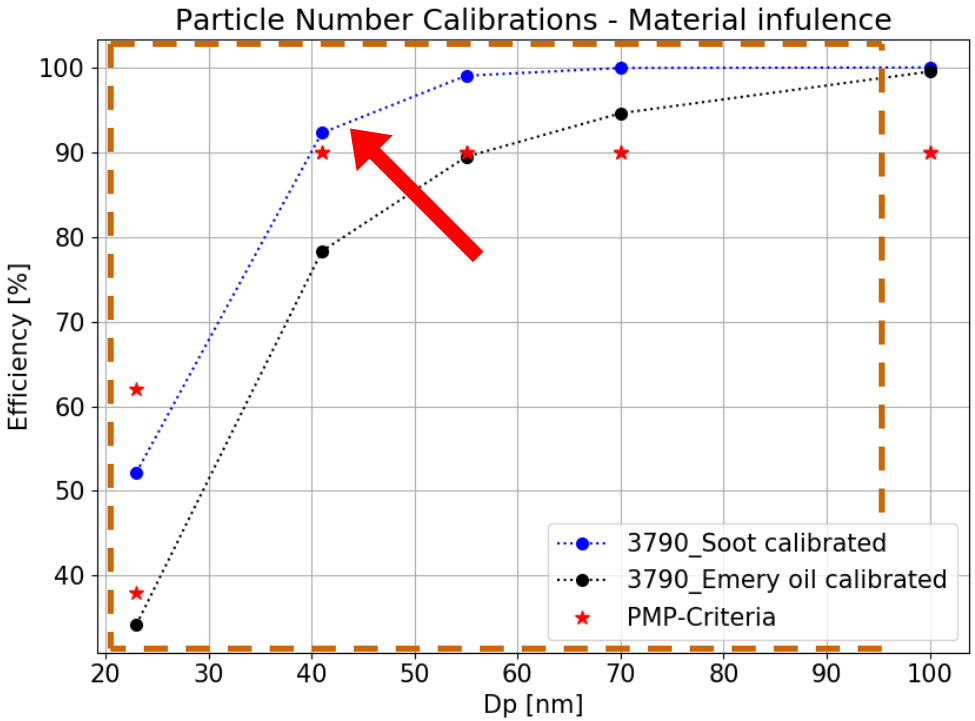
PMP criteria and material influence



- Different calibration material can result in different evaluation of conformity for one CPC
- AIP: adjustment for traceability to NMI if required
- Different calibration material might have high impact on results of real exhaust measurements→deviation over the whole size range of interest

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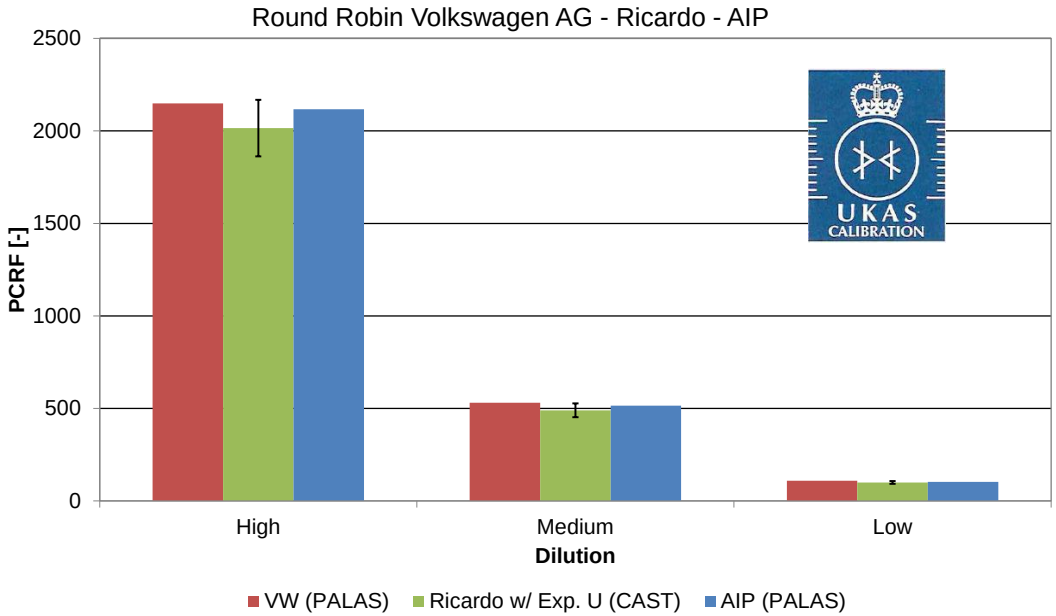
PCRF calibrations – Round Robin



- One AIP SPC PMP-System circulated three labs for PCRF calibration
- Ricardo is UKAS accredited for PN calibrations in the scope of PMP with thermally treated cast aerosol and traceability to NPL (Exp. measurement uncertainty of 7.5 %)
- Volkswagen and AIP used Palas spark discharge soot aerosol
- All results are within the reported measurement uncertainty

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Summary

- Soot from Propane-Diffusion flame is feasible for Sub-23 nm calibrations
  - Good repeatability and reproducibility
  - Traceability in principle to NMI is possible
  - Generation and aftertreatment procedure have to be defined clearly
- One aerosol generation method for CPC-, PCRF- and PN PEMS-calibrations is desirable to raise comparibility between labs and applications
  - Inconsistencies in material have crucial influence on CPC calibration results (pass/fail)
  - Possible high systematic „error“ in field measurements between systems with differently calibrated CPCs

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