

Particle Measurement Programme - Report

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PMP Chairman

Current Status

- Following the conclusion of work on developing PN measurement procedures for Regulations 49 & 83, the PMP Informal Group was kept open for discussion of experience with the PN measurement procedures.
- Two active measurement programmes continue to run in the background
 - Heavy Duty Round Robin programme
 - Industry led, labs' own PNMS, no Golden Engineer
 - Volatile Particle Remover calibration Round Robin
 - Investigating effects of aerosol material, aerosol generation method and test set-up on PCRF measurement

26th PMP Informal Meeting

- Held at JRC on 6th December
- Issues discussed were;
 - VPR Calibration Round Robin progress and experience of 2 participating labs
 - PNC Calibration & stability: JRC study, AVL and Scania experience
 - European Metrology Research Programme
 - Measurement of sub 23nm particles: UCR, TTM and JRC studies
 - Heavy Duty Round Robin status

26th PMP Informal Meeting

VPR Round Robin progress

Lab	Test Date	Status
JRC	August 2010	Complete & data submitted
LAT	October 2010	Complete & data submitted
AVL	January 2011	Complete & data submitted
HORIBA	February 2011	Complete & data submitted
EMPA	April 2011	Complete & data submitted
MATTER	May 2011	Complete
NPL	September 2011	Complete & data submitted
AEA	October 2011	Complete
VW	December 2011	
MAHA	February 2012	

26th PMP Meeting

PNC Calibration Experience

- *AVL experience of calibrating 40+ PNCs:*
 - some non-linearity, but $\leq \pm 3\%$
 - loss of counting efficiency found in some PNCs, restored by changing wick
- *Scania experience:*
 - 4 PNCs failed calibration due to loss of counting efficiency, now instituting routine wick changes
- *JRC study:*
 - investigated extending calibration v electrometer down to 300cm^3 by using double charged aerosol and increased flow rates
 - Found counting efficiency dependency on aerosol even above D_{90}

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European Metrology Research Project

- *Work Package 1*: developing standard aerosols (materials & generation methods) for PNC and VPR calibration.
- Delivering recommendations on;
 - PNC linearity calibration aerosol, May 2012
 - (VPR pcrf) temperature resistant 30nm, 50nm & 100nm aerosols, November 2012
 - (PNC D_{50}) Soot-like aerosols, May 2013
- National standards, November 2013
- PNC calibration Round Robin, May 2014

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Sub 23nm Measurement

- URC studies with range of pre-treatment and D₅₀ PNCs on DPF diesel found:
 - No 10-23nm particles post-VPR
 - Significant 2.5-10nm particle concentrations post-VPR
 - Initially, no 2.5-10nm particles post Catalytic Stripper, but, at high load, some appear over time
 - Lab experiments showed Catalytic Stripper to be substantially more effective than a Thermodenuder at removing heavy HCs and Sulphuric Acid, plus some evidence sub 23nm solid particles can be formed in Thermodenuder
- TTM studies found significant sub 30nm, metallic particle formation on diesels & petrols. DPF c.99% efficient at removing these.
- JRC study with a range of D₅₀ PNCs post VPR found:
 - NEDC: 10-20% (GDI), 35-56% (PFI), 26-45% (DPF) [*probably volatile?*] in 10-23nm range. Few sub 10nm particles
 - CADC: similar percentages in 10-23nm range. Also significant 4.5-10nm particles, but reduced at higher pcrf
 - Further measurements including use of Catalytic Stripper in WLTP Validation 2
- **Summary:** excluding volatiles below sub-23nm may challenge capability of current VPR, measurement below 10nm may not be possible. DPFs appear to effectively remove sub 23nm particles, but sub 23nm may be of interest for GDI and PFI.

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Heavy Duty Round Robin status

Lab	Status
TUV	Complete
Ricardo	Complete
NTSEL	Complete
JARI	Complete
NIER	Complete
Volvo	Complete
UTAC	Complete
VTT	Complete
Scania	Complete
Environment Canada	Complete
JRC	Start of test mid-late January

Next Steps

- Next (possibly 2 day) meeting April/May 2012
 - Discuss VPR Round Robin results
 - Discuss HD Round Robin results
 - Update on ISO & EMRP Calibration Work
- GRPE view on sub 23nm particle measurement?
 - PMP to act as forum for discussion of further studies?
 - PMP to investigate potential measurement procedures?
- Improving calibration procedures
 - Under consideration in WLTP-DTP-PMPN also.
 - EMRP and ISO both active in this area.
 - Discuss improvements to calibration procedures in joint PMP/PM-PN subgroup to meetings.