



UNITED NATIONS

74th UNECE GRPE session

PMP IWG Progress Report

Joint Research Centre
the European Commission's
in-house science service

 JRC Science Hub: ec.europa.eu/jrc



PMP meetings in 2016

13th January 2016 (Geneva) : 38th PMP meeting

9th-10th March 2016 (Brussels) : 39th PMP meeting

27th April – 3rd May (Web/phone conference): 40th meeting

31st May (Web/phone conference)

12th-13th October (JRC-Ispra) : 41st meeting

NEXT MEETING: 15th – 16th March 2017

(Meeting rooms booked in Ispra)



EXHAUST PARTICLE EMISSIONS

Main open points

- Round Robin Sub-23nm
- Raw exhaust sampling
- Round Robin PNC (Particle Number Counter)
- Horizon 2020 projects

Key messages

- Sub-23 nm exhaust particles:
 - There are particles $<23\text{nm}$ - Sometimes they are an artifact
 - Particle not counted with the current PMP method: GDIs 30-40%, motorcycles (2-s engines) up to $>200\%$, PFIs 50-100%, DPFs 5%.
 - High emitters are still detected by PMP23nm - Thus not critical yet for current engine technologies to which the PN limit is applicable
 - Measuring particles down to 10 nm appears possible with “limited” changes to the existing methodology



New mandate / ToR

- The PMP groups has submitted to GRPE in June 2016 an updated draft version of the ToR and request a new mandate with a new specific concrete objective:
- Sub 23 nm exhaust particles:
 - Demonstrate the feasibility to measure sub23nm particles with the existing PMP methodology with appropriate modifications and assess measurement differences/uncertainties by means of a round robin (RR)
- The objectives of the proposed RR have been further discussed in the October meeting considering also new available information on new research projects
- A new document describing the RR scope and objectives has been prepared and it will be uploaded on the PMP website
- The details of the RR will be discussed during the next face-to-face meeting

Scope of the Round Robin

Development of a sub23nm (cut-off size: ~ 10 nm) particle number measurement procedure based on the existing PMP methodology conveniently adapted.

Main purpose: Monitoring particle emissions of new engine/after-treatment technologies.

Assessment of the repeatability/reproducibility of the proposed particle counting methodology by means of a “round robin”.

Objectives of the Round Robin

1. Identify the modifications to the existing measurement equipment

Expected Result: The main objective is to identify the modifications to the equipment/procedure needed to measure from 10 nm and to determine whether existing systems can (or cannot) be adjusted during an annual maintenance with a relatively low cost.

2. Assess the need of a catalytic stripper (CS)

3. Evaluate sub23nm fraction of modern engines

Expected result: The fraction (percentage) of sub-23 nm particles from latest engines will be reported.

Objectives of the Round Robin

4. Evaluate measurement differences/ uncertainties.
Confirm the specification of the modified systems

Expected result: The measurement uncertainty will be reported based on the RR-10 and it will be related to the technical specifications of the systems that will circulate. The need of better systems (or not) will be discussed.

5. Calibration procedures of sub23nm protocol.

6. NEW: Check measurement uncertainty of existing PMP-23nm systems.

7. NEW: Check differences between tailpipe and CVS

Expected result: The uncertainty of the 'location' will be quantified, especially for 10 nm systems.



Investigation of sub23nm protocol

One system with CS and 10nm CPC to circulate

Each lab PMP system plus a 10nm CPC (to circulate?)

One golden vehicle

Different labs will test different engine technologies

PN Counting from Raw Exhaust via Fixed Dilution

- Interest in this approach confirmed by some engine manufacturers and some instrument manufacturers
- 01 Series of amendments to Reg. 132 already includes such possibility but the procedure is not defined
- First analysis of potential benefits/issues presented during the last meetings
- Correlation with other methods (CVS and partial flow system) and advantages/disadvantages to be checked – Additional data required

Raw exhaust (tailpipe) sampling

Experimental program

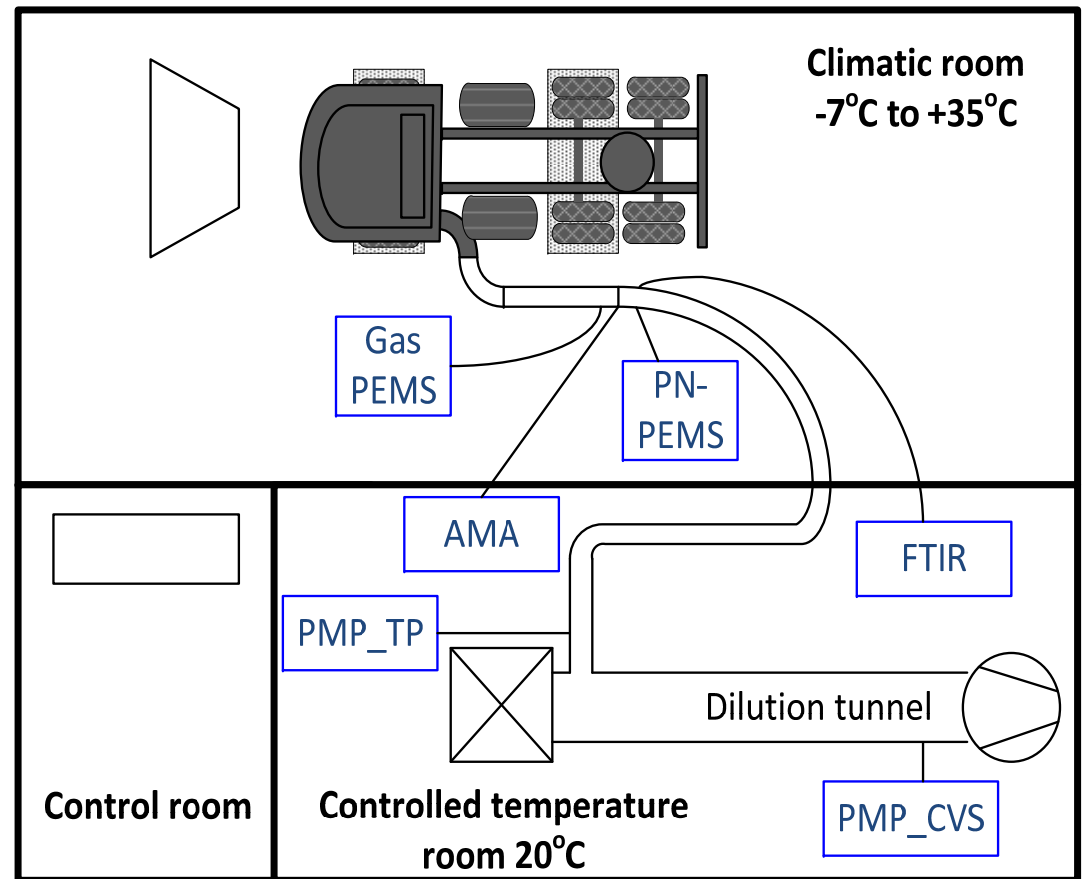
- Primary dilution
- Losses
- Volatile removal efficiency
- Pressure effects
- Time alignment

JRC will wait for experimental data

Limited number of tests carried out at JRC in the context of PN-PEMS for HD program

Experimental setup (JRC)

Not engine test bed
Euro VI vehicles
Low (thermophoretic)
losses due to position
of PMP_TP
EFM uncertainty <5%



Raw exhaust sampling

Preliminary results show 20% differences

Input from others is necessary

Theoretical investigation of uncertainty

(According to recent information industry will try to generate some more data)



PNC Calibration Round Robin

- Confirm that the k factor can be included in the final counting efficiencies
- Investigate the possibility to change the calibration material
- Applicability to PN-PEMS procedures
- Investigate the possibility to calibrate at 10 nm



Participants presentations during 41st PMP meeting

BMW – AVL – VW

Available on the PMP website

Final results could be available for the next face-to-face meeting



HORIZON 2020

Participants presentations

- DownToTen
- PEMS4nano
- SUREAL-23

HORIZON 2020 projects

Topic	DownToTen	PEMS4nano	SUREAL-23
Objective	Instrumentation	Fuel efficient G-DI engine	Instrumentation + vehicle testing
Size [nm]	>5-10	>10	>1
Technology	tbd	CPC	tbd
Prototype	2018	2019 Jan	2018 start
Testing	many	Single cylinder and other	Super Low Emission Vehicles
		Validation of instrument	Prototype limited availability to others
PMP link	Important	Medium	Important



NON-EXHAUST PARTICLE EMISSIONS

Steps for Building a Common Method for Measuring Brake Wear Particles

Step 1 - Selection/development of a braking test cycle

- ✓ WLTP Database Analysis (Concluded – Report published by JRC)
- ✓ Comparison of WLTP data with Existing Industrial Cycles (Concluded – Results presented at the 41st PMP meeting)
- ✓ Development of a first version of a New Braking Cycle (Deadline: June 2017 – On-going work by a dedicated Task Force)
 - ❑ *Task Force is coordinated by JRC but includes the main experts from industry – phone conferences are regularly held (4 so far) – progress report to be presented at the next meeting*
- ✓ Testing and Validation of the New Cycle - Possible round robin (January 2018)

Step 2 - Selection of the most suitable sampling method

- ✓ Comparison of existing systems/test rig configurations (Deadline: June 2017 – On-going work by the group)
- ✓ Selection of Functional Parameters (Deadline: June 2017 – On-going work by the group)
- ✓ Selection of Testing Parameters (Deadline: January 2018)
- ✓ Testing and Validation of the Selected Configuration (Deadline: To be defined depending on the progress)

Step 3 - Selection of the most suitable methodology for BW Particles Measurement and Characterization

- ✓ Comparison of Existing Methodologies (Deadline: June 2017 – Work postponed due to prioritization of steps 1 and 2)
- ✓ Selection of the most suitable methodologies based on the selected sampling configuration (Deadline: June 2018)
- ✓ Testing and Validation of the Selected Methodologies (Deadline: To be defined depending on the progress)
- ✓ Data processing method (Deadline: To be defined)



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