

The European Commission's science and knowledge service

Joint Research Centre



79th UNECE GRPE session

PMP IWG Progress Report



UNITED NATIONS

Geneva, 21th -24th May 2019

PMP meetings in 2018

- 2019-01-10: PMP 49th (GRPE Geneva summary)
- 2019-02-26 Webconference
- 2019-04-03/04: PMP 50th (Brussels)

- NEXT F-2-F MEETING: **PMP 51st 29th – 30th October 2019** (Location: JRC Ispra - tbc)

EXHAUST PARTICLE EMISSIONS

Main activities

- Sub-23nm
- PN-PEMs 10 nm
- Raw exhaust sampling
- Round Robin PNC (Particle Number Counter)
- Horizon 2020 projects
- Particle emissions from gas engines
- WLTP low temperature PN testing
- Effect of fuel on PN

Sub23 nm

- In the 49th PMP meeting held on the 10th January 2019 the European Commission asked to finalize the work on the sub-23 nm particle measurement by developing a test procedure by June 2020 in view of the post-Euro 6/VI standards
- In the 50th PMP meeting the following main points have been addressed:
 - **Adaptated or optimized system ?**
 - **Evaporation tube or catalytic stripper?**
 - **PN-system calibration material/generation method**
 - **CPC counting efficiency**
- It has been decided, also on the basis of the available data, that the best option is to adapt the current methodology.
- A few points are still open and need additional data/discussion

Sub23 nm

- A working document has been prepared with the current text of the test procedure as laid down in GTR n.15 and proposed modifications
- The document has been circulated to the members of the group asking for inputs/comments by end of May
- The JRC will collect the inputs and prepare a summary that will be discussed in a next webconference

Sub23 nm Round Robin

- 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”.
- Two systems with CS and 10nm CPC were circulated
- Each lab PMP system plus a 10nm CPC (was circulated)
- One golden vehicle (Opel Astra GDI – no GPF)
 - The PMP group would have preferred 6d technology for the golden vehicle, this was not available in the program timing and will need investigation later
- **7 EU labs completed. Extension to China / Japan from June 2019**

Sub23 nm Round Robin

- Inter-LAB SolidParticleNumber-results comparable for SPN10 and SPN23
 - The variabilities for SPN10 and SPN23 at the same level
 - The reproducibilities were acceptable for SPN10 and SPN23
 - Reproducibility, s_R , between 11 % and 23 %
- Sub23nm-fractions varied heavily between the labs
 - Affected by the used SPN10 sampling method
 - LAB systems COLD start Sub23nm (9 ± 12)%, HOT start (26 ± 20)%
- For optimized system Sub23nm-fraction variability and reproducibility acceptable
 - COLD start Sub23nm (18 ± 4)% and HOT start (39 ± 6)%
- **Current methodology feasible for SPN10-measurements by only optimizing SPN10 sampling**

Extension of methodology to PN-PEMS

- Based on laboratory PMP systems penetrations, the PN-PEMS penetrations will be defined
- Newly adjusted PN-PEMS systems (and calibrated) will be tested at JRC at the end of the year
- Instrument manufacturers have already confirmed that such systems are ready
- The 50% margin has to be re-tested

PN Counting from Raw Exhaust via Fixed Dilution

Objective: Raw exhaust sampling via fixed dilution for type approval of heavy duty engines

The exercise covers:

- CNG, DPF regenerations, high bio-fuels
- Crankcase (open system) emissions connected to tailpipe
- Only calibrated systems (especially 10 nm CPCs)
- European timeline from week 41/2018 to week 27/2019 covering 6 OEMS
- Extension to China (VECC and CAAM) and USA under consideration

Setup

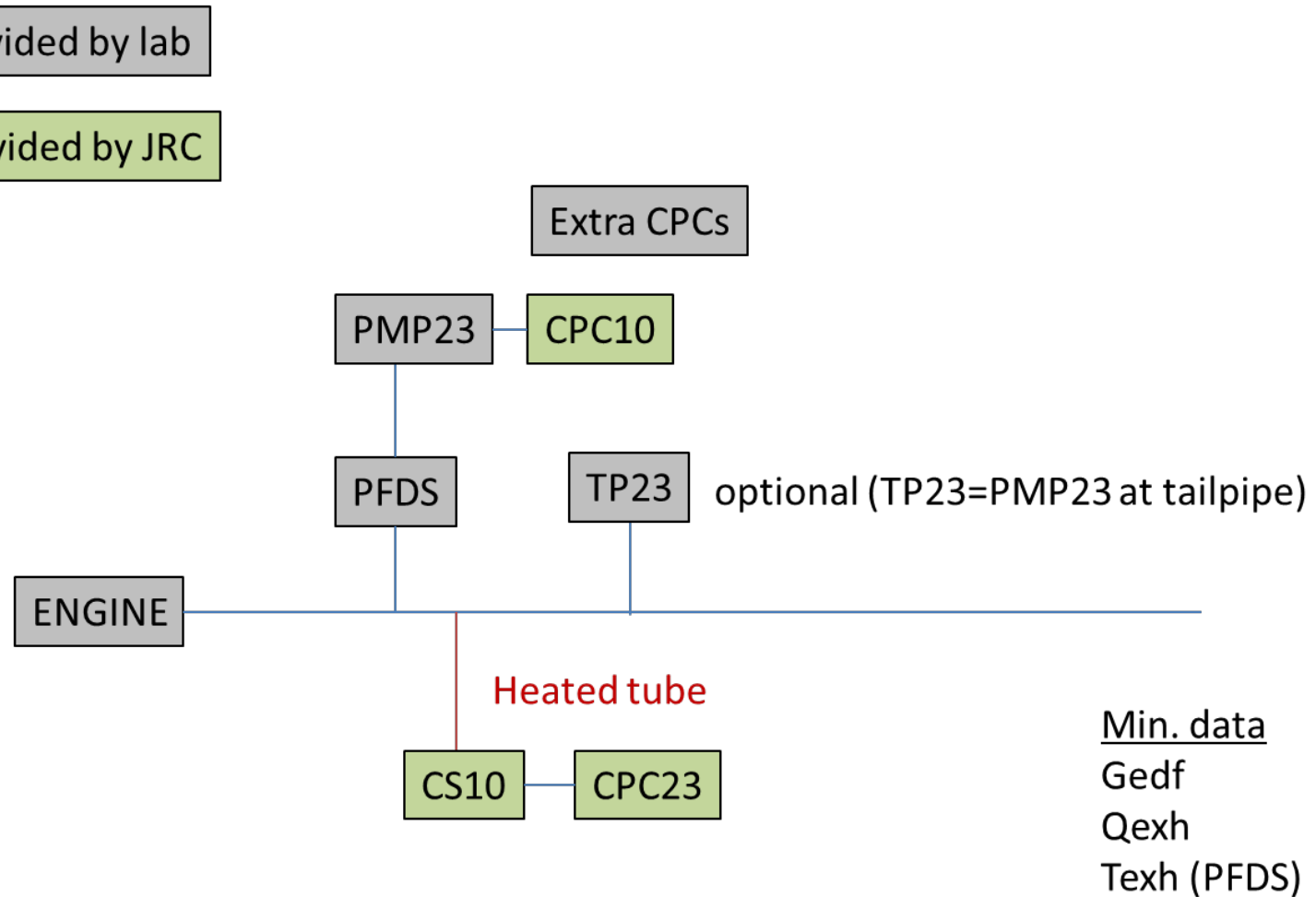
Provided by lab

Provided by JRC

A well designed experimental programme has been agreed between JRC and ACEA

Objectives:

- Assess raw exhaust sampling for type approval
- Uncertainty TP vs CVS or PFDS
- Robustness of TP systems
- Technical specifications
- Sub-23 nm
- Support PMP



Next steps

- Preliminary results at OEM1 show good results:
 - Excellent comparability partial flow – raw exhaust for both 23 and 10 nm CPCs
 - No artifacts from crankcase emissions
- System with (cold) pre-diluter is also tested at some OEM

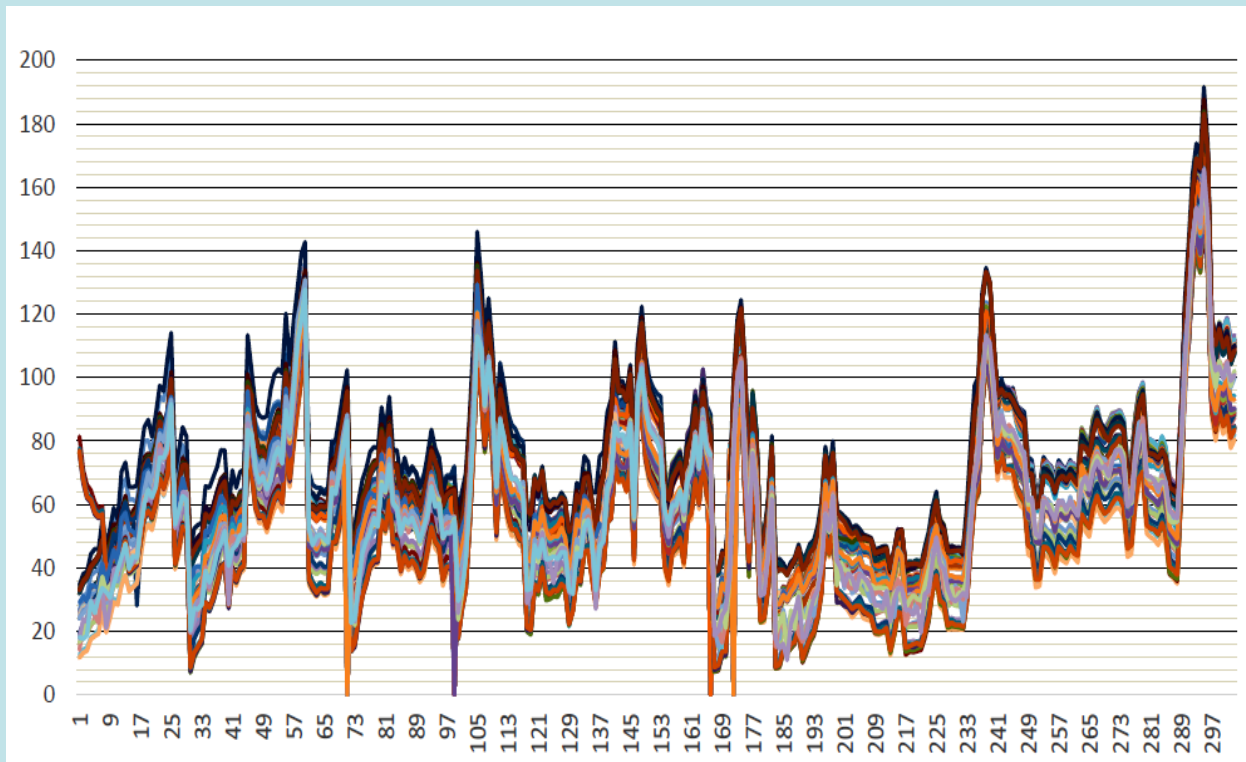
NON-EXHAUST PARTICLE EMISSIONS

BRAKE PARTICLE EMISSIONS

COMMON METHOD FOR MEASURING BRAKE WEAR PARTICLES

STEP 1 – DEVELOPMENT OF A NEW REAL-WORLD BRAKING CYCLE

- The development of the novel cycle has been concluded and the cycle has been evaluated through an extensive Round Robin campaign
- The results of the RR were presented to the 50th PMP Meeting and will be released in a report form in the next months
- There are some differences in the recorded brake temperatures between the labs mainly due to different air cooling speed adjustment



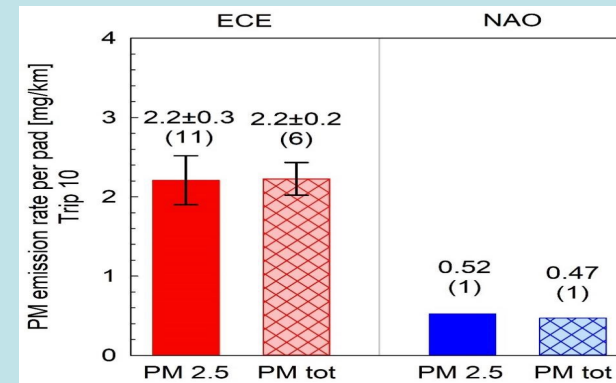
Lab-to-lab variation of the rotor temperature for all 303 braking events of the cycle

BRAKE PARTICLE EMISSIONS

COMMON METHOD FOR MEASURING BRAKE WEAR PARTICLES

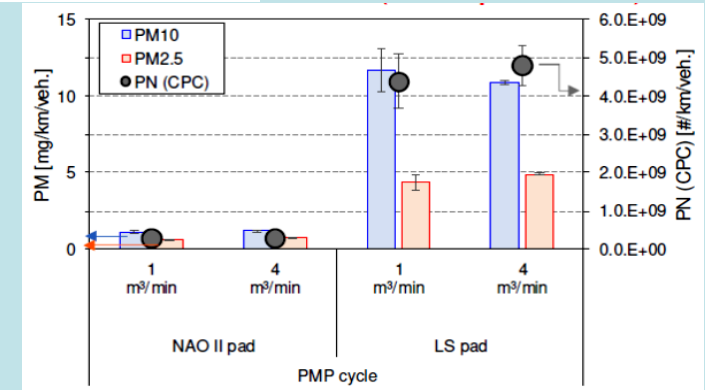
STEP 2 – DEFINITION OF MINIMUM REQUIREMENTS FOR THE EMISSIONS MEASUREMENT

- PM_{10} , $PM_{2.5}$ as well as PN brake particle emissions are being investigated within TF2
- Results presented to the 50th PMP Meeting suggest different **PM emission levels** as well as different **particle size distributions** for different types of pads (NAO vs. Low-Met)
- TF2 is currently assessing i. the influence of different types of pads on emissions, ii. volatile removal for PN measurement, iii. reduction of soak times



Mamakos et al. 2019
50th PMP Meeting

Hagino et al. 2019
50th PMP Meeting



PM and PN brake emissions from different types of pads

TYRE WEAR PARTICLE EMISSIONS

CURRENT STATUS AND FUTURE OUTLOOK

- No experimental results were presented to the 50th PMP Meeting. Results from two on-going campaigns had been presented to the 48th PMP Meeting
- The EC has mandated the development of a methodology for measuring tyres abrasion rate. DG-GROW will lead this task
- After the development of the methodology the PMP could investigate the relationship between tyre wear PM emissions and their abrasion rate
- For the time being the PMP will continue monitoring on-going projects and published data regarding the physical nature and size distribution of particle emissions from tyre/road wear

PMP NEXT STEPS

PMP Mandate

Current mandate expires in June 2019

The PMP group has submitted an updated draft version of the ToR (informal document) and requests a new mandate with the following main concrete objectives:

- **Sub 23 nm exhaust particles:**
 - Develop by June 2020 a methodology to measure sub-23 nm particle
- Provide robust data for the validation of **direct raw exhaust sampling** for PN measurement for HD engines
- Development of a suggested common test procedure for sampling and assessing **brake wear particles** both in terms of mass and number

NON-EXHAUST PARTICLE EMISSIONS

NEXT STEPS – PROPOSED ToR Brakes and Tyres

- Validation of the developed novel test cycle (publication of the report) and application to the investigation of brake wear particle PM and PN emissions
- Definition of the minimum requirements for brake wear particles generation, sampling and measurement (TF2 – Possible timeline end of 2019)
- Validation of the proposed approach for the measurement and characterization of brake wear particles (Possible Round Robin activity – Possible timeline mid of 2020)
- Continue monitoring on-going projects and published data regarding the physical nature and size distribution of particle emissions from tyre/road wear



Any questions?

You can find the PMP leadership team at

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