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UNITED NATIONS

73rd 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***

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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)

Next f2f meeting: 12th -13th October 2016 (JRC-Ispra)

Current status

- The PMP IWG has been working since June 2013 (approval date of the existing ToR) on a number of issues related to both exhaust and non-exhaust particles (i.e. particles from brake and tyre/road wear)
- Main investigations :
  - Sub-23 nm exhaust particles: Nature, number, measurement feasibility
  - Non-exhaust particles: Literature survey and collection of information on test cycles, sampling/measurement methodologies, on-going projects
- All the information collected are available on the UNECE website / PMP webpage

Key messages

- Sub-23 nm exhaust particles:
  - There are particles <23nm - 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
- Brake wear particles:
  - Industry is very active in researching/developing low emission brake systems – Consensus on the usefulness of a common measurement procedure
- Particles from tyre/road wear:
  - Ultrafine particles generated only under extreme conditions - Many questions still open. Distinguishing the different sources (tyres/road/material deposited on the road) is a challenge

New mandate / ToR

- The PMP groups has submitted to GRPE an updated draft version of the ToR and request a new mandate with two new specific concrete objectives:

- 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

- Brake wear particles:
  - Development of a suggested common test procedure for sampling and assessing brake wear particles both in terms of mass and number:

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NON-EXHAUST PARTICLE EMISSIONS

Steps for Building a Common Method for Measuring Brake Wear Particles

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Development of a suggested common method for BW particle investigation – Steps

- Adoption/Development of an appropriate Braking Test Cycle
- Selection of the most suitable methodology for BW Particles Sampling
- Selection of the most suitable methodology for BW Particles Measurement and Characterization

Step 1 - Adoption / development of a braking test cycle

- ✓ WLTP Database Analysis (Concluded)
- ✓ Comparison of WLTP data with Existing Industrial Cycles (Deadline: January 2017)
- ✓ Development of a first version of a New Braking Cycle if necessary (Definition of the nature of the cycle – urban or mixed - duration of the cycle, number of repetitions required, preconditioning, etc.) (Deadline: June 2017)
- ✓ Testing and Validation of the New Cycle - Possible round robin (Repeatability assessment of the test cycle and reproducibility assessment on other dynos) (Deadline: To be defined depending on the progress)

Step 2 - Selection of the most suitable sampling method

- ✓ Selection of Functional Parameters (i.e. Temperature Tolerance, Inertial Load, Speed Variation, etc.) (Deadline: June 2017)
- ✓ Comparison of existing systems/test rig configurations (i.e. open vs. closed, sampling box vs. hose) (Deadline: June 2017)
- ✓ Selection of Sampling Parameters (i.e. Temperature, RH, Load, direction of cooling air, sub-23 nm particles, etc.)
- ✓ Testing and Validation of the Selected Configuration (Repeatability and reproducibility assessment) (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: January 2017)
- ✓ Selection/decision on the parameters/metrics to be considered (i.e. both mass and number)
- ✓ Selection of the most suitable methodologies based on the selected sampling configuration (Deadline: To be defined depending on the progress)
- ✓ Testing, Validation and Accuracy Study of the Selected Methodologies (Deadline: To be defined depending on the progress)
- ✓ Data processing method (Deadline: To be defined)

EXHAUST PARTICLE EMISSIONS

Objectives of a Round Robin with CS

- ✓ Demonstrate feasibility to measure sub23nm
- ✓ Examine the need of a catalytic stripper (CS)
- ✓ Confirm the draft requirements and calibration procedures of sub23nm protocol - Recommend a technology-independent, traceable calibration standard (including transfer system, VPR/CS/…, measuring device), if measurement technology has to be adapted.
- ✓ Evaluate measurement differences/uncertainties
- ✓ Evaluate sub23nm fraction of modern engines
- ✓ **Details and time frame to be discussed and agreed in the next f2f meeting**

PN system sub23nm (VPR)

Catalytic Stripper included

- VRE test to be defined (during RR and if CS necessary)
- Propane oxidation efficiency and monitoring

Calibration: Thermally stable particles >5000 p/cm3 (15 nm!)

PCRF(15nm)/PCRF(100nm)<2

- Desired also lower values: Input from instr. manufacturers

PCRF = average (30nm, 50nm, 100nm)

- It has to be understood and agreed that around 40% of sub23nm particles are not counted (i.e. a correction would be needed but the needed info will not be available in future systems as only one PNC will be counting) - Limit of detection on the low-end side and “peak-concentrations” on the high-end side must be also considered.

PN system 10nm (PNC)

Counting efficiency 10nm: =50% ± 12%

- To maximize the measurement of >10 nm particles
- Values to be defined also based on existing PNCs

Counting efficiency 15nm: >90%

Calibration: Emery oil or other equivalent

- Input from CPC calibration round robin

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

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