

Terms of reference and rules of procedure for the Informal Working Group on the Particle Measurement Programme

1. Background
 - 1.1. Since the inception of the Particle Measurement Programme (PMP) group, the activities focused on development of an alternative metric with increased sensitivity compared to the existing Particulate Matter (PM) mass measurement system for Heavy Duty (HD) and Light Duty (LD) engines/vehicles (M and N category vehicles).
 - 1.2. This phase concluded with the developed and adoption into UN Regulations Nos. 83 (emissions of M_1 and N_1 vehicles) (R83) and 49 (emissions of compression ignition and positive ignition (LPG and CNG) engines) (R49) of a particle number (PN) counting method for ultrafine solid particles, together with enhancements to the PM measurement procedure for R83. Initially the PN protocol was applied for diesel engines/vehicles only in the 06 series of amendments of R83 (R83.06) and R49 (R49.06) and subsequently has been extended to cover vehicles using spark ignition direct injection engines in R83.06.
2. Terms of Reference (TOR)
 - 2.1. The European Union (EU) and Switzerland have requested further investigation of particle number emissions from spark ignition engines relating to particle size (reduction of the 50% cut off specification d_{50}) and to emissions under rich operation conditions. Further activities to adapt the procedures/measurement equipment and establish appropriate limit values may be necessary based on the results of these investigations.
 - 2.2. It has also been requested to consider whether there is a need to extend particle measurement procedures to additional sources such as tyre and brake wear. Whilst the health effect investigation aspects are outside the competence of the measurement experts, the group should be prepared to take on development of measurement procedures if it is established there is a clear need.
 - 2.3. The group should prepare the update and integration of test procedure updates into UN Regulations Nos. 83, 49 and 96 (diesel emission (agricultural tractors)) as appropriate.
 - 2.4. The group may consider, at a later stage, the transposition of the developed procedures into the UN Global Technical Regulation (UN GTR) No. 4 and the expected forthcoming UN GTR covering the Worldwide harmonized Light vehicles Test Procedure (WLTP) and Test Cycle (WLTC).
3. Timeline
 - 3.1. The work of the group on Particle Measurement Programme should be completed by June 2017. A prolongation and extension of the mandate of the group, in relation to the development and validation of new test procedures, e.g. in relation to PN measurement systems compatible with PEMS, tyre/brake wear if necessary, should be considered in due time by GRPE.
4. Scope and work items
 - 4.1. PM mass exhaust measurement

Note:

- (a) HD and Non-Road Mobile Machinery (NRMM) PM measurement excluded from PMP TOR as have recently been extensively revised in the respective UN GTRs. It is not foreseen that further major technical adaptation is required in the near term.
- (b) LD could also be excluded on a similar basis owing to recent revisions into the WLTP draft UN GTR. It is not foreseen that further major technical adaptation is required in the near term.

4.2. PN exhaust measurement

4.2.1. Existing scope of PN measurements to be adapted to technical progress, as appropriate.

- (a) LD Compression Ignition (CI) vehicles.
- (b) HD CI engines/vehicles.
- (c) LD Positive Ignition (PI) direct injection engines/vehicles.
- (d) HD PI direct injection engines/vehicles.

4.2.2. Extension of scope

- (a) Investigate PN measurements for NRMM exhaust emissions. Prepare report for GRPE.
- (b) Determine whether LD diesel regeneration measurements can be accurately, reliably, repeatably and reproducibly made using PMP equipment with $d_{50} = 23\text{nm}$.
- (c) Investigate particle number emissions from vehicles equipped with PI direct injection engines/vehicles during regeneration when vehicles with such technology are available on the market.
- (d) Engine dyno raw exhaust PN measurements for HD for use at Type Approval.

4.3. PN measurement equipment – HD and LD

4.3.1. Existing PMP PN measurement equipment d_{50} reduction.

- (a) Investigate as a first step, the size distribution of particles emitted by LD PI and CI vehicles HD PI and CI engines/vehicles.
- (b) Determine for both HD and LD engines/vehicles whether there is a clear need to revise the lower particle size d_{50} cut-off of the PMP of 23 nm.
- (c) If so, determine appropriate revised d_{50} and develop practical/appropriate measurement methodology and establish revised PN limit values.
Objective: NRMM/HD/LD common measurement system.
- (d) Determine whether LD diesel regeneration measurements can be accurately, reliably, repeatably and reproducibly made using the new cut-off size.
- (e) Develop Type Approval Raw exhaust PN measurement method suitable for engine dyno HD and NRMM.

4.4. Calibration Guidelines

4.4.1. Update of existing calibration guidelines.

- (a) Review and update of the calibration guidance documents relating to the Particle Number Counting (PNC) and VPR (Volatile Particle Remover), taking into account of:
 - (i) technical progress;
 - (ii) the work of European Metrology Research Programme (EMRP) ENV-02;
 - (iii) ISO 27891;
 - (iv) VPR Round Robin (RR): fundamental calibration of the condensation particle counter (CPC) and recommendations on LD aerosols.
- (b) Compilation of relevant calibration literature and review for inclusion of best practices.
- (c) Review and update of the calibration guidelines for CPC and VPR if the lower particle size d_{50} cutoff of the PMP of 23 nm is reduced.

4.5. Investigations

- (a) Physical nature of exhaust particles emitted by PI and CI engined vehicles.
- (b) Exhaust particle emissions of port fuel injection vehicles, currently exempt from Euro 6 PN emission limits, in particular under rich operation conditions (e.g. cold start, high load).
- (c) Literature survey to compile and summarise the current knowledge regarding the physical nature and size distribution of particle emissions from brake and tyre wear.

5. Rules of procedure

- 5.1. The informal group is open to all participants of GRPE. A limitation of the number of participants from any country or organisation to participate in the informal group is actually not foreseen.
- 5.2. A Chair and a Secretary will manage the informal group.
- 5.3. The working language of the informal group will be English.
- 5.4. All documents and/or proposals shall be submitted to the Secretary of the group in a suitable electronic format, preferably in line with the UNECE guidelines in advance of the meetings. The group may refuse to discuss any item or proposal which has not been circulated 5 working days in advance of the scheduled meeting.
- 5.5. The informal group shall meet regularly at the GRPE meetings in Geneva. Additional meetings will be organised upon demand.
- 5.6. An agenda and related documents will be circulated to all members of the informal group in advance of all scheduled meetings.
- 5.7. The work process will be developed by consensus. When consensus cannot be reached, the Chair of the informal group shall present the different points of view to GRPE. The Chair may seek guidance from GRPE as appropriate.
- 5.8. The progress of the informal group will be routinely reported to GRPE orally or as an informal document by the Chair or the Secretary.
- 5.9. All working documents shall be distributed in digital format. The specific PMP section on the UNECE website shall continue to be utilised.