

PMP – Particle Measurement Program Informal Working Group Task Force 2– Brake Dust Sampling and Measurement

Meeting #34 – Thursday 10 JUNE 2021 15:00 – 16:00 CEST

Minutes of Meeting – Final Version

1. Participants: As in the file “*34th TF2 Meeting Attendance*” uploaded in TEAMS.

2. Background: This is the 3rd meeting related to the PN measurement approach. TG announced that one more meeting will take place most probably in a couple of weeks with the aim of addressing other minor topics. A short discussion on the need to introduce further specifications for the classifiers used for the PM mass measurement took place. TG proposed to examine the necessity for defining accurate cut-off points for the classifiers after the ILS.

3. PN measurement Discussion: HH presented JARI’s system as well as their recommendations for the PN measurement. HH introduced the discussion highlighting the uncertainty in PN measurements observed during their internal RR study. This uncertainty was mainly attributed to clogging phenomena and the lack of appropriate dilution in the measurement system of one of the participants. HH highlighted the importance of lower mass vehicles and therefore smaller brake systems for the Japanese fleet. According to JARI’s calculations, the residence time does not heavily affect PN emissions, while the enclosure design also seems not to play a major role. Overall, the residence time of particles in JARI’s system is calculated to be approximately 4.6 s. PM and PN emissions tend to increase with vehicle weight; whereas, average and max brake temperatures do not follow a “regular” trend. Transport efficiency is shown to be high; whereas, 90° bends can be applied during sampling provided that appropriate isokinetic nozzles are used. The use of a capillary diluter downstream of the PM_{2.5} cyclone is highly recommended to avoid clogging phenomena. The importance of off-brake emissions was demonstrated. Finally, HH highlighted that sub-10 nm particles might be present but in very low concentrations; therefore, it is would be adequate to use a 10 nm CPC for the PN measurement.

JG asked for a clarification related to the emission levels depicted in Slide 7 of the attached presentation. HH will provide additional data to the TF2 on a confidential basis. A discussion on Slide 10 and the possibility of extracting the sample under a 90° bend followed. The density applied to the calculations was 1 mg/cm³. Additionally, the losses of bigger particles were discussed. FR commented that the graph probably reflects the inertial deposition of bigger particles to the sides. TG added that sample extraction under bend is not prohibited; however, it is not recommended. CA asked for a clarification related to the difference between residence and response times as well as for an explanation regarding the 60 s response time of the SMPS.

RV presented Ford’s experience with PN measurements. RV briefly introduced the group to Ford’s dyno (already presented in the past in several occasions) and the measurement equipment used for PM and PN characterization. Repeatability tests showed a high deviation regardless the bedding-in procedure. Some tests exhibited very high PN emission concentrations due to the presence of ultrafine particles in a few braking events in trip #10. The nature of these particles was not defined; however RV stated that based on previous campaigns these are probably volatiles. Slides 4 and 5

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provide some insights to the EEPS and CPC measurements. RV closed Ford's presentation highlighting the high PN variability and the need for countermeasures to reduce it. Ford suggested that the measurement of solid-only particles might reduce the variability.

A follow-up discussion trying to address the source of the presented variation took place. JG explained in detail the testing protocol and clarified that the difference cannot be attributed to bedding-in or any amendment between the different emission tests. AM pointed out that emission levels might have been underestimated in some of the measurements due to instruments' saturation. No dilution was applied in these measurements. TG asked how the lack of dilution may influence PN measurements. BMW mentioned that similar effects were observed also in their internal campaigns. TG concluded that the upcoming ILS will provide more data for both total PN and solid PN measurements and thus more robust conclusions are expected to be reached.

4. Next Meetings: The next meeting will take place on Thursday 24.06.2021 or 31.06.2021. The agenda will follow soon.