

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

Meeting #36 – Wednesday 23 MARCH 2021 15:00 – 17:00 CEST

Minutes of Meeting – Final Version

- 1. Participants:** As in the file *“36th TF2 Meeting Attendance”* uploaded in TEAMS.
- 2. Introduction:** Theo Grigoratos (TG) welcomed the TF2 members back in regular meetings after 9 months. TG explained that the aim of this “first” meeting is to briefly present the ILS campaign results and agree on the way forward. All presentations will become available on TEAMS.
- 3. Introduction to the ILS:** TG presented some introductory slides related to the ILS exercise. Very high-level information including the ILS objectives, participating labs, applied brakes, data collected, and completed tests were shown. A total of 75 tests were finalized accounting for 89% of the initially planned tests.
- 4. Laboratory Checklists:** Ravi Vedula (RV) presented the most important information extracted from the Checklists. These provide a detailed description of the setup capabilities and investigate the fulfilment of the main protocol specifications. RV highlighted the most important non-compliant parts for all labs. Carlos Agudelo (CA) commented that this information can also be used to identify non-important parameters in the protocol. TG explained that a high number of “violations” does not necessarily mean worse PM and/or PN measurement performance compared to less “violations” – the measurement performance is a qualitative rather than a quantitative exercise.
- 5. Time-based files:** Thanasis Mamakos (TM) provided a high-level overview of the submitted time-based files. He explained the format of the presented data and discussed some parameters, indicatively. TM highlighted the importance of maximum total PN tunnel concentrations and explained that certain labs with very high background concentration levels provided unreliable PN results. He highlighted the need for introducing a parameter to perform leak checks and control the flow. Heinz Bacher (HB) asked about the presence of volatile particles – TM explained that they were detected only by one laboratory when testing Br1a. HB asked to add a clarification that the presented emission levels correspond to a brake corner. CA asked what would be a reliable background level – TM replied that observed 10^3 #/cm³ levels in some labs are high, reliable background levels shall be much lower.
- 6. Event-based files:** Jürgen Von Wild (JvW) provided a high-level overview of the submitted event-based files. JvW presented some high level information on the files and discussed the problems encountered during the files’ quality check and the need for deriving files’ revised versions. JvW presented high-level results for several parameters including air temperature and humidity, brake speed profiles, cooling air speed, brake pressure and friction work, and disc temperatures. Very interesting findings for disc temperatures were briefly discussed. HB commented that cooling settings might be better to tackle not with predefined steps but following a correlation line – TG replied that the group had opted for this approach; however, the topic will be discussed again soon. RV mentioned that definite conclusions regarding average trip #10 temperatures shall be extracted from the time-based and not the event-based. JvW added that only emission tests results are shown and not the bedding part of the procedure.

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7. PM-Files: TG briefly presented some high-level PM results following the analysis performed by Marcel Mathissen (MM). PM₁₀ data from all brakes and labs were presented first – TG commented that there is a high deviation in the PM emissions among the different labs. Then, some indicative ratios – PM₁₀/PM_{2.5} and PM₁₀/WEAR were examined – TG highlighted their importance in detecting possible measurement issues. Data for Brakes 1a, 1b, and 2 were illustrated separately. Finally, repeatability tests were shown separately.

8. Preliminary analysis: TG presented a preliminary analysis that was carried out with the aim of understanding the labs' capabilities for correctly measuring PM emissions. TG explained that the measured PM₁₀ and PM_{2.5} levels deviate significantly. *This does not allow for a meaningful in-depth analysis to understand the influence of various parameters on PM emissions.* There is a need to investigate whether the Labs carried out the ILS exercise correctly and confirm the validity of the observed PM levels. Christophe Jouy (CJ) asked what happens if a lab can achieve the cooling requirements with different air flows and if there is a plan to further regulate this part in the method – TG replied that as long as all other specs are met there should not be a problem and invited CJ to submit data. RV asked if wear data for Br1a are available – TG commented that the wear behaviour of Br1a is very stable among the labs.

The analysis was carried out using data from standard emissions tests with Br1a and was verified with data from Br2. TG explained that three major factors were taken into account: 1. Possible Labs' request to withdraw from the analysis; 2. Check of possible non-compliance of the labs with the TF2 specifications; 3. Use of PM_{2.5}/PM₁₀ and PM₁₀/Wear ratios as possible indicators for bigger particle losses in comparison with actual PM emission levels. TG highlighted that one single parameter alone would not suffice to filter one lab's data; however, a combination of low PM emission levels, high PM_{2.5}/PM₁₀ or low PM₁₀/Wear ratios (>75th or <25th percentile), and possible non-compliance with significant protocol specifications would give a strong indication towards sampling or measurement errors. The details of the overall analysis are given in the presentation.

Indeed, the analysis was able to identify seven "candidate" labs that faced issues performing PM sampling and/or measurement correctly. The results were verified also using Br2. The next step would be to run a statistical analysis to identify possible outliers and investigate correlations between several factors and PM/PN emissions using the filtered data. Also, possible losses of smaller particles shall be investigated, too, since this first analysis mainly focused on bigger particles.

9. Proposed approach: TG presented a plan for the next TF2 meetings. The idea is that JRC submits a proposal for amendments in each protocol's Clause on a weekly basis. TF2 members will have one week to comment on the proposals and if necessary come up with proposed changes supported by data. The remaining open points will be addressed and finalized during one workshop that will be organized in mid-May. The proposal was well received by the group.

10. Next Meeting: The next meeting will take place on Wednesday 30.03.2022 at 15.00-17.00. The topic will be Clause 1 of the TF2 protocol