

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

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Meeting #16 – Thursday 06 September, 2018, 14:00 – 15:00

## Minutes of Meeting – Final Version

**1. Tour de table:** Participants: AUDI-(SG) Sebastian GRAMSTAT; AVL-(TM) Thanasis MAMAKOS; AVL-(MA) Michael ARNDT; BAM-(SS) Stefan SEEGER; BMW-(KL) Katharina LAMMEL; BREMBO-(MA) Mattia ALEMANI; CARB-(SC) Sonya COLLIER; DEKATI-(MM) Mikko MOISIO; Ford-(JG) Jarek GROCHOWICZ; Ford-(CS) Christian SCHMIDT; Federal Mogul-(MM) Marcus MORBACH; General Motors-(MR) Matt ROBERE; HORIBA-(DL) Dmytro LUGOVYY; HORIBA-(YO) Yoshinori OTSUKI; ITT-(AS) Agusti SIN; JARI-(HH) Hiro HAGINO; JRC-(TG) Theodoros GRIGORATOS; Link-(CA) Carlos AGUDELO; Opel-(OB) Olaf BAUSCH; TMD Friction-(IP) Ilja PLENNE; TSI-(SP) Stephan PERCOT; TU Ilmenau-(DH) David HESSE; TU Ilmenau-(TF) Toni FEISSEL.

**2a. Discussion on the document “Common Parameters for Testing”:** **Discussion on whether the cycle should be time or temperature controlled.** TMD, Horiba and Ford support a temperature controlled cycle in order to get comparable temperature levels to all dynos. JG demonstrated a Figure showing a difference in the temperatures of up to 50°C when the time controlled schedule is applied to the emissions set-up compared to real-world application. TM mentioned some practical aspects regarding particle measurements. Time based cycle is more straightforward compared to temperature controlled. DL mentioned that background level takes more time to stabilize when the time based cycle is applied. This could lead to misinterpretation of results. CA introduced some practical aspects against the temperature control solution. While in this first testing attempt the benchmark will be Ford’s tests on the proving ground, there are no similar data (and neither can be produced) for other vehicles/brake systems. JG mentioned that a possible solution could be to introduce an additional step in the procedure by running a test to the dyno without the emissions set-up. One additional issue has to do with the temperature measurement which is not standardized. **It was commonly agreed that experimental data will be required to evaluate the situation and decide whether temperature or time controlled solution will be adopted. For the time being it seems that the setup of the dynos should be based on the temperature controlled schedule at least for the first round of testing.** Ford also proposed to apply another set of brake stops to initially setup the emissions set-up (check document for the proposal). This set of stops will be complementary to the novel cycle and will help to adjust the cooling air flowrate.

**Q1: Is there any other point missed in the discussion regarding the cycle?**

**Q2: Are there labs willing to run both options in the next weeks and report back their findings?**

**3. Discussion on Horiba’s questions regarding the cycle:** First topic was the definition of parasitic drag. The novel cycle comes with a different approach with respect to the exhaust WLTP cycle. In this case – and in contrary to the WLTP exhaust protocol – parasitic drag has been included in the cycle based on the coast-down tests performed to the vehicle. Therefore, the value is vehicle specific and is a compromise when applied to other vehicles. Horiba asked if the parasitic drag calculation will have to be performed for every vehicle. TG stated that this would be an overkill and for the time being suggested to live with the compromise described above. TG suggests that maybe a correction factor could be applied in the future when experimental data from other vehicles become available and IF it

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turns out that the value is not realistic for some vehicles. **Ford will distribute the parasitic drag curve to the TF2.**

Next topic was about the use of “SecondbySecond” or “Stop\_Overview” files as master files. This will depend on the selection of the control of the cycle. Link is working on fine-tuning the alignment of both files for running the time controlled based cycle in the TF1 RR.

SG asked for a clarification on the frequency applied for the dyno control. CA mentioned that according to their experience 1Hz should be OK. JG clarified that this is different than the data-logging resolution. There, 10Hz (or other values) can be applied. SG asked if pressure will be applied during soak time. No pressure shall be applied. TG asked if it would be possible to accelerate disc cooling by applying higher air-flow during soak time. JG stated that the change of air-flow could be applied only when emission measurement is not taking place. DL mentioned that any change in the flow rate is not recommended as it influences the particle measurement (data provided by email). MR suggested that we should try to avoid long waiting times during soaking and try to cool down the brake as quickly as possible.

**Q3: Are there labs willing to run temperature control tests with stable and variable cooling air DURING SOAKING the next weeks and report back their findings? DL provided some data and strongly recommended to use constant air flow during the tests in order to avoid introducing a lot of uncertainty.**

Next clarification was given about vehicle conditions. A list of parameters has been requested from Horiba (i.e. vehicle mass, brake distribution, piston area, effective radius, etc.). Inertia: 56.7 kgm<sup>2</sup>, Effective Radius: 113 mm, Piston Diameter: 57 mm to be applied for testing. The rest of the parameters are irrelevant to dyno tests. JG clarified that no dynamic load change applies throughout the test procedure.

**TF1 members are working on the template for reporting the test results and will come back with a proposal (to be slightly adjusted in case of particle measurements).**

**2b. Discussion on the document “Common Parameters for Testing”:** **Discussion on background/blank concentration check.** TG mentioned the agreed options for the check. Each Lab shall report the applied method for the blank evaluation. TM asked what should be the frequency of the background check. DL mentioned that it should take place after the end of the cycle. To be elaborated if another proposal comes up.

**Discussion on defined range of cooling air temperature and RH.** There is an agreement regarding the temperature and RH of the cooling air. There was a suggestion to set some limits regarding the air-flow measurement, however, it was decided to just report the measuring principle and position for the flowrate. Discussion about the orientation. DL stated that it will not be possible for labs to change their orientation in few weeks. Therefore, we will proceed with existing solutions and try to compare similar geometries. **CA to make a short presentation about this topic based on experimental data.**

**Discussion on common brake system for the first round of experiments.** Discussion regarding the use (or not) of spreader springs. TU Ilmenau supports the use of the spreader springs. JG mentioned that the generic set-up comes without spreader-springs and we will have to perform testing like this. All dynos should execute the tests with the same “car” parameters. AUDI has offered the possibility to distribute parts for all participants. Ford could do the same if we agree to go on with NAO pads. Each lab will use their own knuckle fixture.