TF2 - SCOPE

Based on the mandate received by the UN GRPE in June 2016, the PMP group is working on the development of a suggested common test procedure for sampling and assessing brake wear particles both in terms of mass and number emissions. Three steps have been identified as fundamental in order to achieve this objective: The selection/development of a braking test cycle appropriate for the investigation of particle emissions from brake wear; selection of an appropriate methodology for particles generation and sampling; and the selection of the appropriate instrumentation for the measurement and characterization of brake wear particles.

During the 43[d] face-to-face meeting data and results of several studies were presented as well as different approaches regarding the sampling and measurement procedures. During the discussion it became clear that it is necessary to better define the scope and the objectives of the methodology to be developed within the PMP group. Moreover a better coordination among different projects and initiatives is desirable in order to get the maximum out of them and avoid duplication of the work as much as possible.

JRC has therefore proposed to establish a second Task Force focusing on the particle measurement related aspects comprising the experts in this specific field.

The present document lists some of the open issues that could be the starting point for analysis and the discussion in the dedicated Task Force. The main points are summarized in the form of a Table along with some explanatory notes.

<table>
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<tr><td>Position of the tested brake system[1]</td><td>PM and PN Emission Factors[5]</td><td rowspan="3">Sampling system suitable both for PM and PN measurements as described in Target Parameters[7]
Efficiency of collection of Brake Dust (PN and/or PM) and Particle losses due to sampling procedure[7]
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<tr><td>Vehicle size and load[2,3]</td><td>PM online and gravimetrical[6]</td><td>High limit for PM and PN[11]</td></tr>
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* To be addressed by the Task Force already dealing with the cycle.

** Target to total (including organics and volatiles) or only solid particles?

*** PMP decision to focus on the brake dyno method. Many open questions – only some of them are listed here.

**** To be addressed by a dedicated Task Force which will be created the following weeks.

[1] Different testing options: left, right, front or rear. We expect difference in such measurements (Reference presentation from LINK - 41st PMP IWG Meeting p. 17). Need to standardize the relative position for all tests to avoid the brake orientation to become an influencing factor on efficiency and particle transport losses. Enabling freedom on orientation, will compromise the ability to compare test results.

[2] Obviously the method will test all kinds of braking systems but there should be a reference (i.e. Medium size Sedan) at least at the development phase. Also the vehicle's load should be taken into account based on European statistics (i.e. 1.5 persons per vehicle in Germany).

[3] Include a standard method to determine the test inertia once the vehicle weight is established, and the calculation of the tire rolling radius as a function of the tire specification. Potential references: SAE J2798 and ECE R90 for M1 vehicles

[4] Temperature and relative humidity shall be defined. Harmonization with other industry practices for inertia dynamometer testing with two main options: Ambient air with a range of allowed test conditions (10-30°C, no humidity control) or Standard conditions with climatic controls: 20±5°C, 50 ± 10% RH.

[5] Should be able to calculate PM Emission Factors. More specifically, PM_{10} and $PM_{2.5}$ [mg/km] and [#/km] for the cycle and not mg and # for individual braking events

[6] Gravimetric collection of PM shall allow the post-collection analysis (chemical or elemental composition) of the brake particles if and when it will be required

[7] Several different approaches are currently available. Some of them are not suitable for both PM and PN measurements. Several configurations have been proposed also at the last EuroBrake. Some of them are based on sampling system with a dilution or mini dilution tunnel? Investigate pros and cons of each methodology.

[8] In conjunction with the previous point. Air velocity and quality for the ventilation at the brake dyno (filtering of the incoming air, minimum and maximum flowrate, dilution factor, cooling rate of the friction couple)

[9] Would be enough to check a parameter like friction coefficient or we shall be able to reproduce PM and PN results? Shall we consider the possibility of determining one or two reference brake packages for system evaluation using actual production friction couple(s) and standard test cycle(s)?

[10] The minimum specifications shall include the dyno capabilities (torque, speed, deceleration, cycle control, cooling air, etc.), the enclosure design for allowed geometries, sizes, air filtering, brake orientation relative to cooling air ducts, enclosure material, etc.

[11] Based on the need of separating time-resolved test-cycle sections maybe real-time measurements will be required.

[12] Based on the currently available instrumentation and on developments that will come in the near future on particle collection systems (i.e. 3 on-going projects for sub 23 nm particles) we need to define our targets for PM and PN collection. Will it be from 23 nm to 10 µm? Will sub 23 nm particles be considered? Should particles larger than 10 µm be considered (they account about 50% of total

brake wear)? Will the volatile part be taken into account? Of course we need to take into account the physicochemical characteristics of the brake wear particles as well as previous studies for their size distributions.