

# PMP – Particle Measurement Program Informal Working Group

## Task Force 2– Brake Dust Sampling and Measurement

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**Meeting #41 – Wednesday 27 APRIL 2022 15:00 – 17:00 CEST**

### **Minutes of Meeting – Final Version**

**1. Participants:** As in the file ***“41<sup>st</sup> TF2 Meeting Attendance”*** uploaded in TEAMS.

**2. Introduction:** Theo Grigoratos (TG) welcomed the TF2 members and summarized the status of the previous clauses. A clean version of Clause 1 and Clause 2 will be circulated on Thursday 28.04 including last minute comments from LINK and BMW. Comments on Clauses 3-5 have been received and are being elaborated – the final text will be circulated via email and posted on TEAMS on Friday 29.04. Comments on Clause 6 are due to Friday 29.04. Today’s discussion was dedicated to the design of the enclosure. However, the general concept of ducts and sampling planes was also introduced. The proposed text on the revised Clause 7 will be submitted to TEAMS and comments are requested by Friday 06.05 COB.

**3. Clause 7 presentations:** Heinz Bacher presented BMW’s general view on the proposed method. An introduction on the legal requirements for homologation was followed by an explanatory note on why the ILS data do not qualify for certification of the setup and the procedure. The overall proposal aims in reducing the differences among the labs by imposing stricter boundaries and limiting testing options – new equipment will be required. A general schematic of the proposed layout was shown and the different compartments were introduced. HB repeated BMW’s suggestions to opt for  $23\pm3^{\circ}\text{C}$  and absolute humidity for the air conditioning.

Some general geometric definitions were provided to facilitate the discussion on the dimensions. A layout of the proposed enclosure was presented and is shown in Slide 9 of the attached presentation – a suggestion to introduce a flow-straightener at the inlet was introduced – HB highlighted that the proposed layout has not been validated and there are more things that need to be elaborated. The dimensions will be defined based on the market available brakes; however, indicative lengths were proposed.

A discussion regarding the sampling positions followed. HB referenced ISO 9096 and explained that a duct of at least 180 mm will be required to measure PM and PN emissions. More details on the proposed dimensions are available in Slide 12 of the attached presentation. HB concluded that stricter requirements are needed to improve comparability and that larger duct diameters are not suitable due to low flow speed. A discussion on the need for different nozzles followed – HB highlighted the need for many different nozzles and wondered how the testing party will be in the position to verify/prove they used the correct size.

Some general suggestions on the PM and PN sampling requirements followed. These will be revisited when the corresponding chapters will be discussed. HB concluded the presentation by highlighting some open issues and stating that an optimization of the procedure for industrial testing is required.

During the follow-up discussion Bob Anderson (BA) mentioned that bends will be tricky mostly for PM<sub>10</sub>. Carlos Agudelo (CA) pointed that ISO 9096 indicates 1.5d for the radius of the bends – HB replied that the higher this number is the better. CA added that ISO 9096 defines the distances from the Outer Diameter of the nozzle – further elaboration on this topic is expected in the next meeting.



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TG welcomed BMW's proposals related to the ducts and sampling; however, expressed concerns regarding the viability of the proposal for an almost completely new layout for the enclosure.

TG provided a presentation related to the enclosure design. The details of the proposal and the data-supported evidence are summarized in the attached presentation "GTR - Clause 7". The amended text is available in the submitted document "PMP Brake Protocol - Clause 7 Clean". Three different sub-clauses have been introduced in the newly formulated Clause 7:

Clause 7.1: Describes the general elements related to the brake enclosure – A "universal" shape is proposed for harmonization purposes – Specifications regarding the materials and the surfaces are specified – Minimum specs for the cross-section area are also defined.

Clause 7.2.: Describes the proposed principal dimensions of the enclosure – Specifications for the maximum length, height, and depth are defined based on available setups used during the ILS – Other dimensions are defined and generic guidance is provided.

Clause 7.3.: Discusses the positioning of the brake in the enclosure – Discusses the proposal for the allowed fixture styles – Confirms the rotation direction of the brake relative to the direction of the evacuation – Provides a common calliper position for harmonization purposes.

TG proposed a "universal" rhombus shape for harmonizing the enclosure design and highlighted that many labs followed this design during the ILS while others have already opted for a similar design. Details on the proposed shape can be found to the attached word document. Further specifications were discussed, while TG asked the group if a horizontal layout shall be mandated for harmonization purposes. Then, TG described the main dimensions and provided some specifications for the maximum length, height, and depth of the enclosure – the minimum values will anyway be dictated by the market available brakes. A discussion on whether the inlet and outlet designs shall be identical or not followed. TG requested the group to provide experimental data supporting either opinion. Then, TG presented proposals on different "positioning" aspects. Firstly, discussed a universal central positioning of the brake, proposed to mandate the use of Universal-style and post-style fixtures, and suggested a common 12 o'clock positioning of the caliper. TG went through some ILS emissions data which do not seem to correlate with the enclosure design. Finally, TG showed that the proposed enclosure design does not introduce significant particle residence times ( $<0.5s$ ); therefore, suggested not to mandate a minimum residence time.

During the follow-up discussion, HB mentioned that aluminium surfaces have been proven problematic for cleaning and strongly suggested stainless steel. Additionally, HB added that flow straighteners will be absolutely necessary to make the flow homogenous at the contact point with the brake. CA, suggested not to mandate completely symmetrical enclosures and added that there should be no problem with them – TG asked why shall we leave room for experimentations that might not work and added that the proposal follows the need for harmonization. A discussion on BMW's proposal for the enclosure followed – TG explained that the concept is still under investigation and we cannot afford waiting for it to be experimentally validated. Ian Hadley (IH) highlighted that the proposed concept would impose different losses for different brakes based on their sizes – TG replied that this could be the case for other enclosure designs, too, without the pro



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of being “harmonized”. Dmytro Lugovyy (DL) commented that vertical layouts could work but only from down to up similar like Ford’s design. DL added that JARI’s enclosure design could be used as reference (TG’s addition in the MoM – info from JARI’s design were used to derive the presented proposal). DL asked about the use of flow straighteners – TG replied that is not against; however, there is a need to see this. TG requested feedback also on this topic.

**4. Other business:** TG informed the group about JRC’s intention regarding the next meetings related to PM and PN measurement. TG explained that JRC believes that PM<sub>2.5</sub> and PM<sub>10</sub> shall be measured separately using two different probes. Additionally, both total and solid PN concentrations shall be measured; however, using the same probe. The proposals regarding the ducts and the sampling plane will be based on this principle. The discussion will be resumed in the next meeting starting with a presentation from Ford related to the losses in the ducts.

**5. Next Meeting:** The next meeting will take place on Wednesday 04.05.2022 from 15.00-17.00. The topic will be related to the ducts and general setup requirements. The group will also start discussing PM measurement.