

PMP – Particle Measurement Program Informal Working Group

Task Force 2– Brake Dust Sampling and Measurement

Meeting #21 – Thursday 16 May, 2019, 14:00 – 15:00

Minutes of Meeting – Final Version

1. Tour de table: Participants: AUDI-(SG) Sebastian GRAMSTAT; AVL-(MA) Michael ARNDT; BMW-(RL) Rasmus LEICHT; BREMBO-(FR) Francesco RICCOBONO; BREMBO-(MA) Mattia ALEMANI; DEKATI-(MM) Mikko MOISIO; Ford-(JG) Jarek GROCHOWICZ; Federal Mogul-(CK) Christof KOLSCH; GM-(MR) Matt ROBERE; HORIBA-(DL) Dmytro LUGOVYY; ITT-(SA) Simone ANSALONI; JARI-(HH) Hiro HAGINO; JRC-(TG) Theodoros GRIGORATOS; OPEL-(OB) Olaf BAUSCH; TMD Friction-(AP) Andreas PAULUS; TSI-(RA) Bob ANDERSON; TU ILMENAU-(KA) Klaus AUGSBURG; TU ILMENAU-(DH) David HESSE; TU ILMENAU-(TF) Toni FEISSEL.

2. Soak time of novel cycle: Resume of the discussion of Meetings #19 and #20 on soak time. TG briefly reminded the topic. DH (TU Ilmenau) presented a targeted campaign measurement on the topic. More specifically, TU Ilmenau studied the temperature behavior over the novel brake cycle with the reference brake system by varying the cooling time and the cooling conditions. The main results of the campaign are summarized to the following Table (one should be cautious with the total time reported with full soak time – **w soak time** – as it represents the field measurement conducted with the vehicle and are artificially prolonged). The key finding is that increasing the initial trip temperature to 35°C-40°C does not significantly influence the average and peak temperature of the individual trips as well as of the overall cycle. On the other hand, it can reduce the overall testing time significantly depending on the applied cooling air speed.

Mean value per section

	without cooling air - mean temperature per section [°C]										mean (total) [°C]	time (total)
	1	2	3	4	5	6	7	8	9	10		
w/o soak time	77.1	118.7	112.5	93.1	94.5	106.4	68.7	109.2	77.7	95.5	96.5	4h24min
<u>Init 35Grad</u>	76.2	96.2	71.8	77.8	79.0	33.9	41.3	66.2	36.1	90.1	78.9	10h08min
w soak time	77.0	100.2	65.7	79.8	78.9	28.1	38.7	60.1	30.8	87.6	77.6	41h24min

	CVS 850m³/h - mean temperature per section [°C]										mean (total) [°C]	time (total)
	1	2	3	4	5	6	7	8	9	10		
w/o soak time	76.2	115.0	107.6	87.4	89.2	101.6	63.2	104.2	72.7	90.0	91.6	4h24min
<u>Init 35Grad</u>	75.6	93.6	69.8	74.4	76.2	33.4	39.7	64.4	35.2	86.0	76.0	8h27min
w soak time	77.9	93.6	63.1	75.2	74.5	22.3	33.8	56.2	29.0	83.7	73.4	41h24min

	Cooling air speed: 25kph - mean temperature per section [°C]										mean (total) [°C]	time (total)
	1	2	3	4	5	6	7	8	9	10		
w/o soak time	66.1	87.0	80.2	76.1	71.5	71.9	46.0	87.9	53.1	70.5	72.4	4h24min
<u>Init 35Grad</u>	64.4	77.9	62.0	69.4	65.7	31.5	36.5	58.3	31.7	69.7	64.7	5h30min
w soak time	64.5	74.0	57.0	67.1	63.2	21.4	32.5	52.1	24.6	68.4	61.9	41h24min

	Cooling air speed: 50kph - mean temperature per section [°C]										mean (total) [°C]	time (total)
	1	2	3	4	5	6	7	8	9	10		
w/o soak time	57.8	74.1	67.2	66.7	61.8	59.0	39.5	75.9	44.1	61.5	62.5	4h24min
<u>Init 35Grad</u>	55.6	67.4	56.2	63.3	58.6	30.4	34.7	53.5	30.3	61.8	57.7	5h09min
w soak time	55.0	64.8	53.2	60.3	57.3	21.3	30.9	49.4	24.3	60.7	55.7	41h24min

These findings are in line with findings presented in previous meetings. RA stated that – among others – TF2 should investigate the influence of increasing the initial temperature to the repeatability and reproducibility of emission tests. JG stated that increasing the initial temperature to 40°C seems a reasonable approach. SG expressed some concerns for systems with higher cooling air speed and how they would be affected by the reduced soak time. Based on the overall findings and discussion it

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

was agreed to **increase the target starting temperature of the brake system at 40°C. This applies to all TF2 emission measurements to be conducted in the future.**

3. Volatile removal: TG briefly introduced the topic. TG mentioned that more results are expected to be published after EuroBrake and there will be an effort to bring these results for in depth analysis to the next TF2 meetings.

DL briefly presented some preliminary results obtained with the application of a catalytic stripper over two different temperatures (190°C – 350°C). PN emissions of NAO and ECE pads differ substantially. There seem to be a visible effect of the volatile content when ECE pads are examined (30% higher PN emissions when 190°C is applied compared to 350°C). This effect is not found with NAO pads. Both measurements (190°C – 350°C) showed similar levels of repeatability. More details regarding this exercise will be published later in the year.

RA stated that diffusion losses are possible when the catalytic stripper is applied. SG mentioned that there is a clear need to investigate different materials as they might behave differently; therefore, one approach (i.e. removal of volatiles) could prove correct for one type of materials but not for another. RA reminded that Japan is trying to correlate PM and PN emissions; therefore, volatiles removal would compromise this exercise. Also the current status in US dictates the measurement of total particles. TG stated that the objective is to propose a commonly accepted approach which will cover all types of materials (if possible).

4. Next Meeting: Next TF2 meeting will take place after the EuroBrake. Possible date is the 6th of June.