



PARTICLE MEASUREMENT PROGRAMME

PMP-IWG

TASK FORCE 2 – BRAKE EMISSIONS

INTERLABORATORY STUDY - BACKGROUND

INTERLABORATORY STUDY - OBJECTIVES

- ✓ Verify the feasibility and applicability of the defined specifications for sampling and measuring brake emission particles (TF2 Output);
- ✓ Provide recommendations to the TF2 on further improving and/or extending the set of the defined specifications;
- ✓ Examine the repeatability and reproducibility of PM and PN emission measurements with the application of the defined specifications;
- ✓ Examine the repeatability and reproducibility of test conditions (i.e. speed, torque, temperature) with the application of the defined specifications;
- ✓ Propose alternatives that can improve the efficiency of some of the methods and specifications proposed (i.e. bedding procedure)

TASK FORCE 3 – SQUAD

Organization – Management

T. Grigoratos (JRC)

Steering Committee*

C. Agudelo (LINK), B. Giechaskiel (JRC), S. Gramstat (AUDI), J. Grochowicz (FORD), H. Kaminski (IUTA), T. Mamakos (AVL), M. Mathissen (FORD), H. Niemann (TUD), R. Vedula (LINK), J. Von-Wild (BMW)

Participating Labs: AUDI (S. Gramstat), AVL (T. Mamakos, M. Arndt), BMW (K. Kolbeck, J. Von-Wild), BREMBO (M. Federici), DRIV (M. Morbach, C. Koelsch), FORD (R. Vogt, J. Grochowicz, M. Mathissen), HORIBA (G. Kanae Filler, D. Lugovyy), IDIADA (A. Perez, J. Olive), ITT (A. Sin, S. Balestra), JARI (H. Hagino), LINK-EU (A. Hortet, C. Schmidt), LINK-US (C. Agudelo, R. Vedula), NIER (H. Chong), TMD (P. Nyhof), TU DARMSTADT (H. Niemann, H. Kaminski), TU ILMENAU (D. Hesse, C. Hamatschek), UTAC (P. Jouy, E. Collot)

OEM Brake providers: AUDI (S. Gramstat), BMW (K. Kolbeck), FORD (J. Grochowicz), STELLANTIS (O. Bausch, D. Ehrlich), VW (J. Niediek)

*The main role of the SC is 1. Support the preparations of the ILS; 2. Handle questions and feedback to TF3 colleagues related to various aspects during the testing campaign; 3. Assist with data processing and possible publications in peer-reviewed journals and conferences

TESTED BRAKES – MAIN CHARACTERISTICS

	OEM / Model	Axle [F/R]	Vehicle Test Mass [kg]	Nominal Dyno WL [kg]	Applied Dyno WL [kg]	Brake Force Dist. [%]	Rolling Radius [mm]	Nominal Inertia [kg/m ²]	Nominal Inertia [kg/m ²]	Disc or Drum	Pad Type	WL/DM [-]
Br1a	Ford Focus	Front	1600	572.8	498.3	71.6	314.5	56.7	49.3	Disc	ECE	88.1
Br1b	Ford Focus	Front	1600	572.8	498.3	71.6	314.5	56.7	49.3	Disc	NAO	88.1
Br2	Audi S4	Front	1668	567	493.2	68	321	58.4	50.8	Disc	ECE	44.6
Br3	BMW X7	Front	2623	878.5	764.3	67	383	128.9	112.1	Disc	ECE	50.7
Br4	Opel Corsa	Rear	1253	187.8	163.4	30	314	18.5	16.1	Drum	N/A	44.7
Br5a	VW Crafter	Front Nominal	2500	837.5	728.6	67	345	99.7	86.7	Disc	ECE	90.1
Br5b	VW Crafter	Front 90% PL	2390	1135.7	988	67	345	135.2	117.6	Disc	ECE	122.1

Mandatory

Optional

FINAL TESTING STATUS

Mandatory /Optional	M1 - Br1a	M2 - Br1b	M3 - Br2	O1 - Br3	O2 - Br4	O3 - Br5a	O4 - Br5b	O5 - Repeatability	O6 - Alt. Bedding
Lab-B	√	√	√	√				√	√
Lab-C	√	√	√	√					
Lab-D	√	√	√		√				
Lab-F	√	√	√	√	√	√	√		
Lab-G	√	√	√			√	√		
Lab-H	√	√	√						
Lab-J	√	√	√						
Lab-K	√	√	√					√	
Lab-L	√	√	√	√				√	√
Lab-M	√	√	√	√	√	√	√	√	
Lab-N	√	√	√	√	√	√	√		√
Lab-P	√	√	√						
Lab-Q	√	√	√					√	
Lab-R	√	√	√						
Lab-S	√	√	√	√					
Lab-T	√	√	√		√				
Lab-X	√	√	√			√	√		

71
Completed tests
89%

Not Completed Completed

COMPLETED TESTS AND COLLECTED FILES

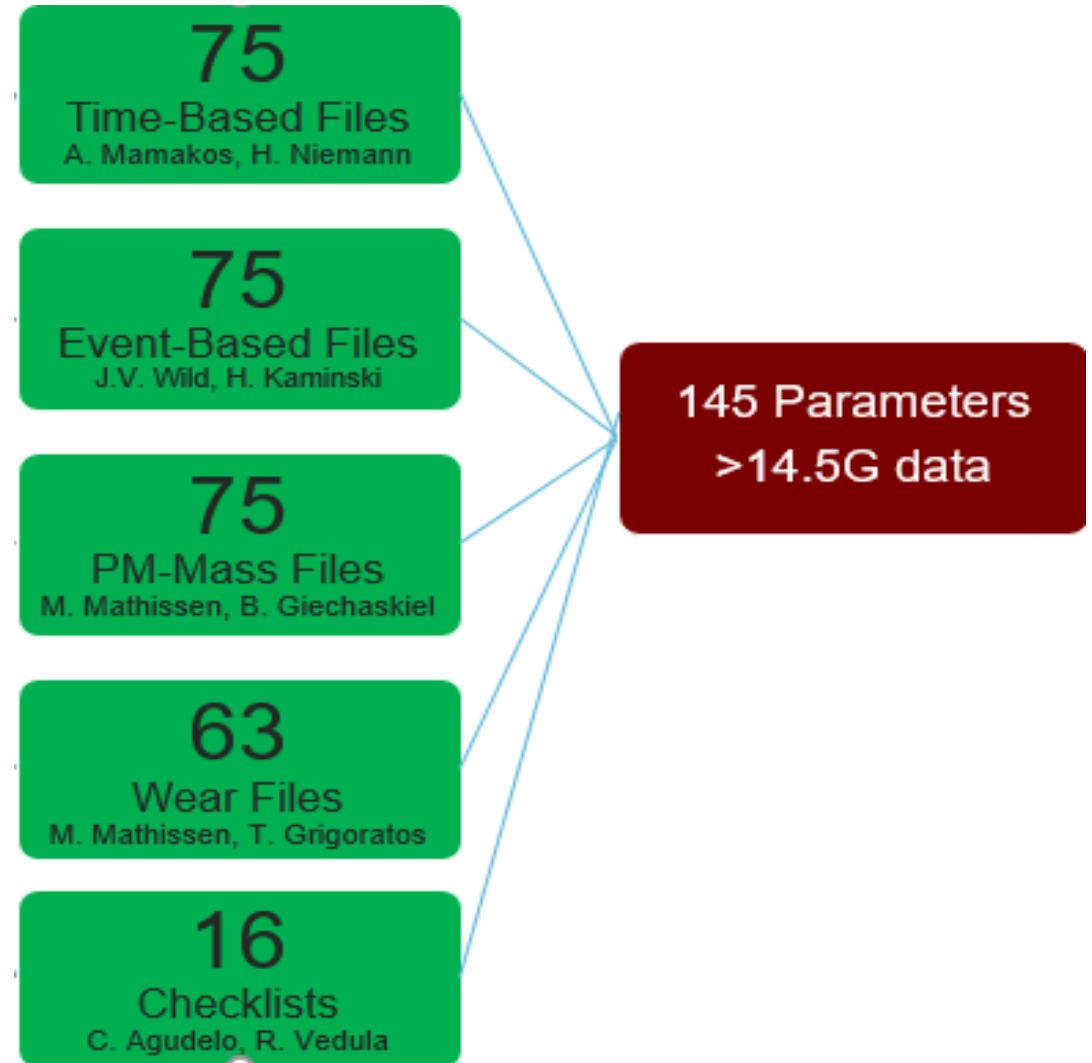
A total of 71 full tests (Bedding + Emissions) were completed – In some cases, Lab-L performed Repeatability and Alternative Bedding tests with more than one Brakes resulting in a total of 75 completed tests

- ✓ A total of 16 Checklist excel files were submitted – These provide a detailed description of the setup capabilities and the fulfillment of the main specs;
- ✓ 75 Time-Based Files (EED-like) were submitted – These provide 1Hz data for 25 parameters including PN emissions;
- ✓ 75 Event-Based Files (EEC-like) were submitted – Information on the individual brake events of the WLTP-Brake cycle is provided for bedding and emission tests in these files;
- ✓ 75 PM-Mass Files were submitted – These provide data for PM measurement related parameters including the actual PM10 and PM2.5 EFs;
- ✓ 63 Wear Files were submitted – They provide information on the total brake wear throughout the testing procedure (Bedding + Emissions) – Labs C, R, S did not submit wear data.

COMPLETED TESTS AND COLLECTED FILES

During the quality check, the SC realized that many files were submitted with errors. A revision procedure in collaboration with the Labs followed:

- ✓ Checklist excel files – Revised once with additional info and explanations from Labs;
- ✓ Time-Based files – Serious alignment and other issues. Revised twice to be brought to a comparable format;
- ✓ Event-Based files – Contained cooling sections and zero-negative values. Revised twice to be brought to a comparable format;
- ✓ PM-Mass Files – Most of the files were revised once to correct erroneous data and be brought to a comparable format



Thank you



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