



Particle Measurement Programme

PMP-IWG

Non-Exhaust Emissions Updates

*Theo Grigoratos and
Barouch Giechaskiel*

01 DEC 2021


AGENDA ITEM 3a

TIMELINE FOR THE GTR

Theo Grigoratos & Barouch Giechaskiel

GTR Preparation - Related Documents

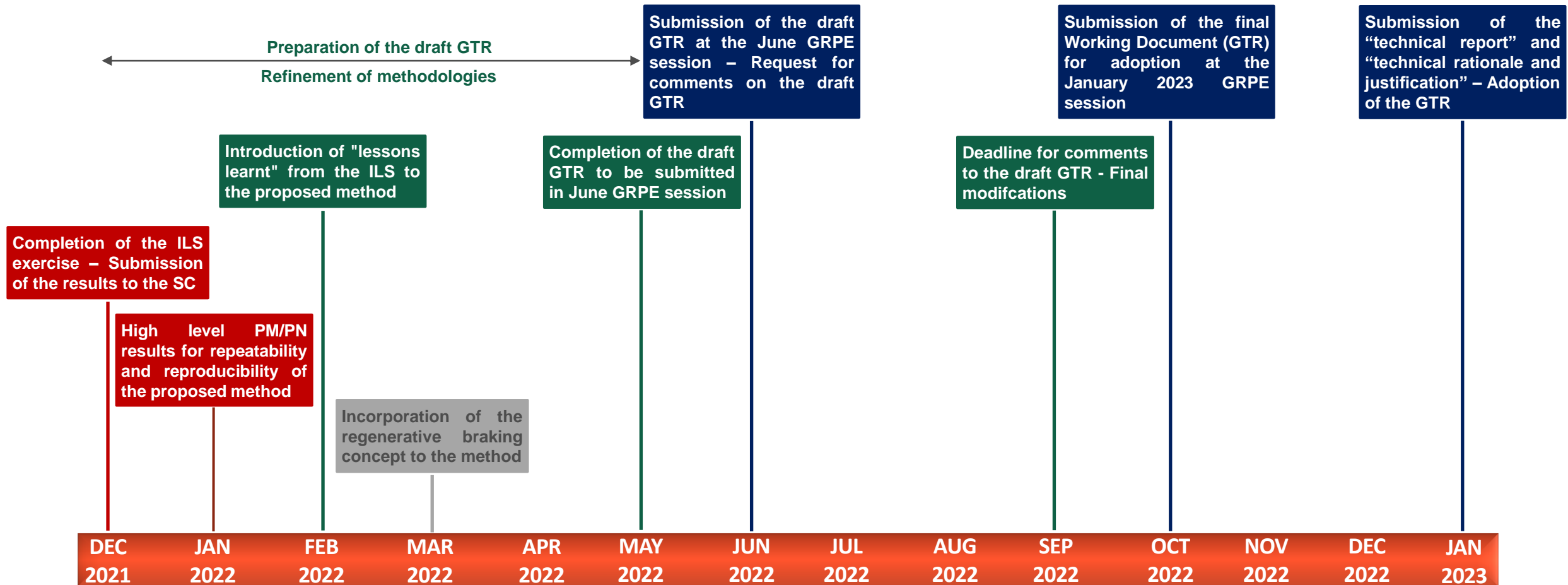
- ✓ A “technical report” that briefly describes the process used to develop the GTR – to be submitted as GRPE Informal Document at the JAN 2023 session;
- ✓ A “technical rationale and justification” which describes the technical issues to be solved with the GTR – to be submitted as GRPE Informal Document at the JAN 2023 session;
- ✓ The text of the GTR itself which is found right after the "technical rationale and justification".



A draft version of the GTR to be submitted as Informal Document at the JUN 2022 session for consideration

Final GTR to be submitted as Working Document for OCT 2022 in order to be considered for JAN 2023

Roadmap to the GTR – Timeline



PMP Activities

TF2 Activities

TF3 Activities

TF4 Activity

AGENDA ITEM 3b

TF3 UPDATE ON THE ILS

Theo Grigoratos

InterLaboratory Study - Objectives

- ✓ Verify the feasibility and applicability of the defined minimum 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 at a Glance

Organization – Management

T. Grigoratos (JRC)

Steering Committee*

C. Agudelo (LINK), B. Giechaskiel (JRC), S. Gramstat (AUDI), J. Grochowicz (FORD), T. Mamakos (AVL) and M. Mathissen (FORD)

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. Ansaloni), 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), TU ILMENAU (D. Hesse, C. Hamatschek), UTAC (MA. Scorianz, E. Collot)

OEM Brake providers: AUDI (S. Gramstat), BMW (K. Kolbeck, J. Von-Wild), FORD (R. Vogt, J. Grochowicz, M. Mathissen), 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, and 3. Assist with data processing and possible publications

Hardware – Tested Brakes

	Mandatory Optional	OEM - Model	Axle	Vehicle Test Mass	Nominal Dyno WL	Applied Dyno WL	Brake Force Distrib.	Rolling Radius	Nominal Test Inertia	Applied Test Inertia	Disc or Drum	Calliper Type	Pad Type	DM	WL/DM
Brake 1a	M	Ford Focus	Front	1600	572.8	498.3	71.6	314.5	56.7	49.3	Disc	Fixed	ECE	6.5	88.1
Brake 1b	M	Ford Focus	Front	1600	572.8	498.3	71.6	314.5	56.7	49.3	Disc	Fixed	NAO	6.5	88.1
Brake 2	M	Audi S4	Front	1668	567.0	493.2	68.0	321	58.4	50.8	Disc	Fixed	ECE	12.7	44.6
Brake 3	O	BMW X7	Front	2623	878.5	764.3	67.0	383	128.9	112.1	Disc	Fixed	ECE	17.3	50.7
Brake 4a	N/A	Opel Corsa	Front	1253	409.5	356.3	70.0	316	43.8	38.1	Disc	Slide	ECE	5.0	81.5
Brake 4b	O	Opel Corsa	Rear	1253	187.8	163.4	30.0	314	18.5	16.1	Drum	N/A	N/A	4.2	44.7
Brake 5a	O	VW Crafter	Front	2500	837.5	728.6	67.0	345	99.7	86.7	Disc	Floating	ECE	9.3	90.1
Brake 5b	O	VW Crafter	Front 90%	3390	1135.7	988.0	67.0	345	135.2	117.6	Disc	Floating	ECE	9.3	122.1

Mandatory

Optional

ILS – Current Status (26.11.2021)

Tested Brake	Ford Focus ECE	Ford Focus NAO	Audi S4	BMW X7	Stellantis Drum	VW Crafter	VW Crafter	Repeatability	10 Trips #10 Bedding
Testing Payload	Nominal as per TF2	Nominal as per TF2	Nominal as per TF2	Nominal as per TF2	Nominal as per TF2	Nominal as per TF2	90% of Max	Nominal as per TF2	Nominal as per TF2
Lab #1	√	√	√			√	√	√	√
Lab #2	√	√	√	√					
Lab #3	√	√	√	√				√	√
Lab #4	√	√	√					√	
Lab #5	√	√	√	√				√	√
Lab #6	√	√	√	√	√	√	√	√	
Lab #7	√	√	√	√					
Lab #8	√	√	√	√					
Lab #9	√	√	√		√				
Lab #10	√	√	√	√	√	√	√	√	
Lab #11	√	√	√	√	√	√	√	√	√
Lab #12	√	√	√	√	√	√	√	√	√
Lab #13	√	√	√						√
Lab #14	√	√	√						
Lab #15	√	√	√					√	
Lab #16	√	√	√		√				
Lab #17	√	√	√					√	√

Completed tests 34%

On-going tests 9%

Test Completed Test On-going Not decided Lab Completed

AGENDA ITEM 3c

UPDATE ON TF4 ACTIVITY

Jarek Grochowicz & Theo Grigoratos

Task Force 4 – Overview

- ✓ TF4 aims in proposing a simplified approach for generalizing the PMP brake emissions testing procedure to electrified vehicles featuring regenerative braking (Mild-Hybrids, Full Hybrids, PHEVs, and BEVs)
- ✓ The TF4 group is moderated by FORD (J. GROCHOWICZ) and JRC (T. GRIGORATOS). TF4 includes 125 participants from 59 entities, worldwide – So far, an average number of 57 participants attended the meetings
- ✓ Six TF4 meetings have already taken place – the group meets on a weekly basis since the beginning of November. The aim is to submit the final proposal to the PMP IWG by the end of March 2022
- ✓ The minutes of the meetings, technical presentations, and other material related to the testing specifications are available on TEAMS and will become available on the PMP website

Task Force 4 – Roadmap (Completed and Ongoing Items)

- ✓ High Level Approach: Brake Community in agreement with Powertrain Departments proposes a simplified methodology for testing of electrified vehicles*, relying on literature/norms for the method definition whenever possible:
 - Agreement on powertrain types to be reflected in the procedure (Completed)
 - Agreement on the test setup: Identical setup as for the Internal Combustion Engine (ICE) vehicles (Completed)
 - Agreement on test cycle: Same test cycle as for ICE vehicles – Bedding procedure similar to that of ICE vehicles (Completed)
 - Recuperation strategies must be replicated on brake dynamometer (Updated recuperation simulation algorithms designed and implemented on one dyno type). Proposal of TF4: Other dyno manufacturers follow this or a similar/equivalent dyno functionality approach (Ongoing)
- ✓ Team decision (UNECE PMP Group) if this is a feasible/reasonable approach
- ✓ Conduct a small scale measurement campaign to test robustness of the procedure

Task Force 4 – Roadmap (Next Steps)

- ✓ High Level Approach: Brake Community in agreement with Powertrain Departments proposes a simplified methodology for testing of electrified vehicles*, relying on literature/norms for the method definition whenever possible:
 - Agree with Powertrain Representatives on realistic boundary conditions and settings for parameters specific for EVs.
 - Ensure that the test can be run by independent laboratories
 - Estimate to which degree this approach represents real vehicle behavior: Target to be discussed and defined xx% (e.g. dissipated energy and in-stop brake behaviour)
- ✓ Team decision (UNECE PMP Group) if this is a feasible/reasonable approach
- ✓ Conduct a small scale measurement campaign to test robustness of the procedure

AGENDA ITEM 1b

TYRES AND GRBP

Theo Grigoratos & Barouch Giechaskiel

Abrasion Rate – GRBP

- ✓ The GRBP (Groupe Rapporteur Bruit et Pneumatiques – Working Party on Noise and Tyres) has prioritised the development of a Tyre Abrasion Test method.
 - 1) Method for rating tyres based on their abrasion performance
 - 2) Quantification of microplastic emissions from tyres
 - 3) Correlation between abrasion rate and durability of tyres
- ✓ A common Task Force between GRBP and GRPE will address the issue of tyre abrasion and particle emissions from tyre wear following the development of the method and in collaboration with the LEON-Project (2nd Phase – Beyond 2023).
- ✓ Proposal: A small group (5 members) from the PMP to actively participate at the relative GRBP Working Group meetings – Expression of interest to Theo Grigoratos (Note At the PMP ToR: Only monitoring)

AGENDA ITEM 4

ANY OTHER BUSINESS

David Hesse and Philipp Eichler

German Environment Agency

On-going project with TU Ilmenau (Germany)

- ✓ Project goal: Contribution to the environmental impact of brake wear particles of different brake systems available on the market as well as the reduction potential of new technologies:
 - Disc and drum brakes of different dimensions; Comparison of front and rear axle brakes
 - Alternative friction materials (Coated and Grey Cast Iron Discs; variation of brake pad mixture)
 - Potentials of emission reduction through regenerative braking (PHEV + BEV)
- ✓ Measurements according to the PMP brake emission protocol (and use of additional measuring devices); Identification of characteristics/properties per tested brake (emission factors, particle size distribution, bedding-in, ...) and support of PMP activities with the generated results
- ✓ Time frame of the project: 02/2021 to 01/2024 - From Q3/2022 Tire Emissions: Application and validation of a proposed abrasion rate method; Determination of wear emission factors from different tire types/dimensions; Option: PM₁₀ and PM_{2.5} fractions

Thank you



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