Brake Emission Workshop
GRPE Jan 2021

A contribution of car industry
The automotive Industry has well supported the development of a measurement procedure:

- Definition of Test Bench
- Definition of Particle Measurement Method
- Definition of Brake Cycle based on WLTP-Data

Current Status of work enables for Particle Measurement of Foundation Brakes on a test bench under specified (dynamic) braking conditions.
Questions for a possible regulatory approach

- Several fundamental questions need to be answered:
  - Shall we focus on component tests or vehicle tests?
  - Focus on M1/N1 or also M2/N2, M3/N3?
  - Which „Groupe de Rapporteurs“ will have the lead for the development of a regulatory approach?
  - How to account for new vehicle technologies – especially electrified vehicles?
  - How to account for technologies that reduce brake emissions, but are not covered yet by the test bench approach?
  - How to regulate components or spare parts?
  - How could a regulatory scheme look like? (limit value, fleet approach, classification,…)
  - How to derive reasonable limit values?
Scope of Regulation

- Concentration on those vehicle classes with highest impact
  - Definition of Test Bench
  - Investigations necessary on distribution of brake emissions across vehicle classes
  - Taking into account the human exposure and urban circumstances (densely populated areas, congested driving conditions, low speed, vehicle distribution)
  - How to handle the trade-off between road safety and emissions
  - Which vehicle class is the main contributor?
  - Do heavy duty brakes play a significant role in brake emissions?

**PMP should identify the main contributors in a first step!**

Further investigations/measurements needed

Vehicle Types with minor emission contribution (eg. BEVs) shall be treated separately.
A future regulation should focus on bench-testing

- In principle stable results achievable with current test set-ups
  - Brake dynamometer particle sampling approach with constant volume sampling. Minimize particle losses
  - WLTP derived realistic braking cycle close to on-road driving
  - Approach can be extended for hybrid electric vehicles, or electric vehicles
  - In principle measurement setup is applicable to Heavy-Duty vehicles

Component Test / Brake System Test

Proposed Approach is a brake system test considering vehicle specific parameters
Component Test / Brake System Test

System approach but component testing? The WHTC as good example?

Methode not mature but shows potential to handle different vehicle classes and approaches
How a regulatory scheme could look like

- Limit values on the basis of individual vehicles
  - Definition of Test Bench
  - Vehicle based limit preferable; Fleet value is a good approach, but too complex in a first step
  - Individual Vehicle Weight should be reflected
  - Compensation of emission reducing technologies (for example particle collecting systems)
  - Temperature is a very sensitive parameter and can influence emission behaviour
  - PMP-measurement procedure as basis for PM/PN-determination
Questions for a possible regulatory approach

- Shall we focus on component tests or vehicle tests?
- Focus on M1/N1 or also M2/N2, M3/N3/O?
- Which „Groupe de Rapporteurs“ will have the lead for the development of the approach?
- How to account for new vehicle technologies – especially electrified vehicles?
- How to account for technologies that reduce brake emissions, but are not covered yet by the test bench approach?
- How to regulate components or spare parts?
- How could a regulatory scheme look like? (limit value, fleet approach, classification, …)
- How to derive reasonable limit values?
- Focus on component test under consideration of vehicle parameters
- Not yet possible to decide, focus on main contributors. Further investigations needed.
- Brake experts have to be involved
- To be treated depending on contribution. To be investigated, based on achieved results of PMP
- To be considered as vehicle specific parameter
- To be investigated
- To be discussed. (e.g. trade off road safety (braking distance) vs. health (particle emissions))
- Not yet possible to decide
- Not yet possible to decide