



UNITED NATIONS

UN PMP Activities – Non-exhaust particles

**Cambridge Particle Meeting
June 2018**

**Presented by: Caro Hosier, Ford Motor Company
(Technical Secretary PMP)**

CONTENTS:

- Overview of the PMP group
- Non Exhaust Particle Emissions
- Exhaust Particle Emissions

PMP – AN OVERVIEW

PMP - Overview

- PMP = particle measurement procedure group
- PMP is a working group reporting to the UN Transport pollution and Energy group (GRPE)

PMP Participants (>60)

- Industry :
 - OEMS / Industry Associations
 - Suppliers / Supplier Associations
 - Test Labs / Measurement & Test Equipment manufacturers
- Governments / Contracting Parties
- SAE / ISO (braking)
- EU Com

PMP leadership team

- Chairperson: Giorgio Martini (EU Com JRC)
- Technical Secretary Caro Hosier, (OICA / Ford)
- Brake TF1-TF2 co-ordinator Theo Grigoratos (EU Com JRC)

- PMP traditionally focused on particle measurement procedures from tailpipe emissions (Exhaust Particle Emissions - EPE)
- 4 years ago, GRPE requested PMP to look into Non-Exhaust Particle Emissions (NEPE) – brake and tyre/road wear particles.

NON-EXHAUST PARTICLE EMISSIONS

- Brake Wear Particles**
- Tyre/Road Wear Particles**



Literature study : Main issues

- **Difficult to reconcile the many studies on the subject due to:**
 - **Many different sampling methodologies/locations and measurement techniques**
 - **Important differences between LD and HD vehicles**
 - **Influence of driving conditions**
 - **Lack of a clear definition of non-exhaust emissions especially for tyre and road wear and resuspended material**
- **Nevertheless, in general, there is consensus on the emission factors**



NON EXHAUST EMISSIONS - IMPORTANCE

- Exhaust and non-exhaust sources are estimated to contribute almost equally to total traffic-related PM₁₀ emissions (2010)
- The relative contribution of non-exhaust sources is expected to increase the forthcoming years due to the tendency of decrease of exhaust emissions

Contributions of specific sources to non-exhaust traffic-related PM₁₀ emissions

Source	PM ₁₀ (%)
Brake Wear	16-55*
Tyre Wear	5-30**
Resuspension	28-59

* Significantly lower contributions have been reported in freeways (~ 3%)

** Many studies don't distinguish from road wear

Selection/development of a braking test cycle

Requirement	Status
WLTP Database Analysis	Concluded – Report published by JRC
Comparison of WLTP data with Existing Industrial Cycles	Concluded – Results presented at the 41 st PMP
Development of a first version of a New Braking Cycle	1 st draft cycles on LACT and WLTP completed. Includes urban rural and motorway with urban dominating as per WLTP database
Testing and Validation of the Novel Cycle(s) - Possible round robin	Round Robin Dec 2017 to April 2018, 7 labs, Completion delayed – expected Dec 2018
Release of Technical Details of Braking Cycle	Available following publication in WEAR journal July2018

NON-EXHAUST PARTICLE EMISSIONS

DEVELOPMENT OF A NEW REAL-WORLD BRAKING CYCLE FOR

STUDYING BRAKE PARTICLE EMISSIONS



A new real-world braking cycle for studying brake particle emissions

Marcel Mathissen, Christian Schmidt, Jaroslaw Grochowicz, Rainer Vogt (Ford)

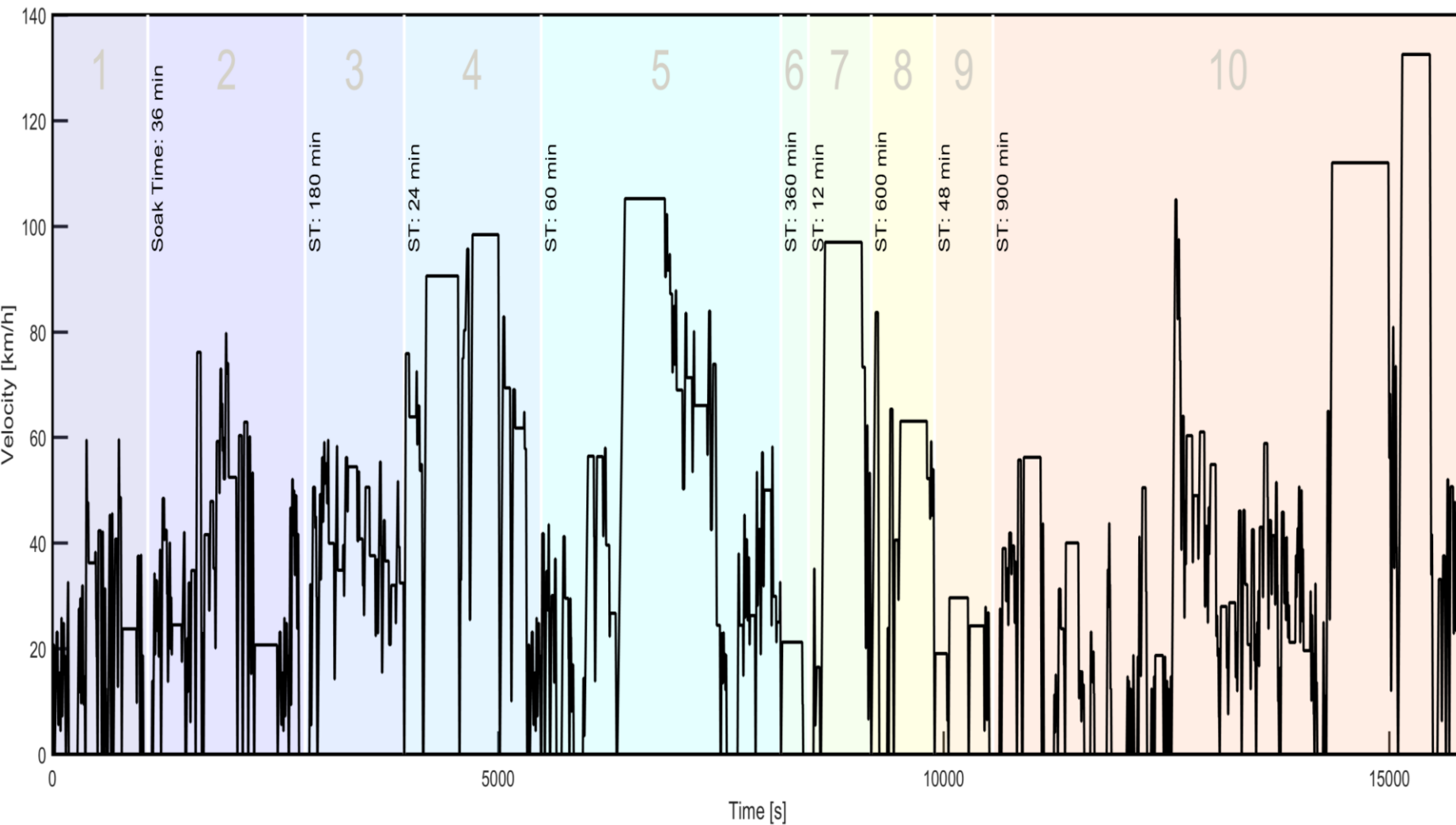
Heinz Steven (consultant)

Theodoros Grigoratos (JRC)

EB2018-VDT-027

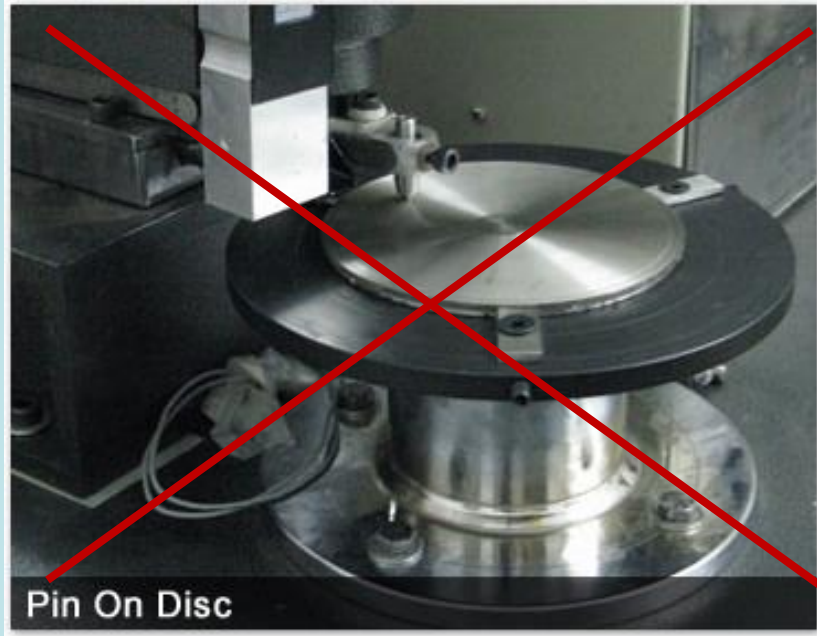
- FORD has concluded the development of the schedule in collaboration with Heinz Steven
- Technical details regarding the cycle have been presented in EuroBrake 2018
- The cycle will become available to the public after its acceptance to the WEAR Journal (June 2018)

DEVELOPMENT OF A NEW REAL-WORLD BRAKING CYCLE FOR STUDYING BRAKE PARTICLE EMISSIONS NOVEL CYCLE

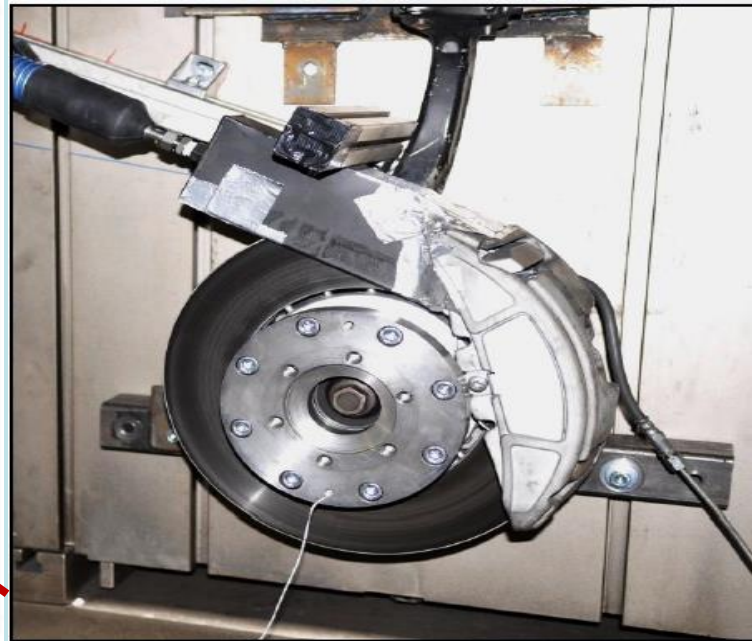


- 303 stops at a distance of 192 km
- 4h 24min duration
- Average speed of 44 km/h and maximum speed of 133 km/h
- Deceleration 0.49 – 2.18 m/s² (mean of 0.97 m/s²)

BRAKE DUST SAMPLING AND MEASUREMENT SELECTION OF THE TESTING METHODOLOGY



Pin-on-disc



Brake dyno



Chassis dyno

✓ **Also, different on-road approaches have been employed by several researchers**

BRAKING TEST CYCLE – OPEN ISSUES

- ✓ Low flow dynamometer testing will lead to higher maximum temperatures than observed in the field. How can we reproduce correct temperature levels?
- ✓ Which temperature will be achieved for other vehicles (vehicle classes)
- ✓ How to adapt cycle to other vehicle classes?
- ✓ Influence of breaks between the trips
- ✓ Temperature level and cooling influence on other test setups for emission testing

Selection of most suitable sampling / measurements methodology for Brake Wear Particles Measurement and Characterization

Issues Identified :

- *PN and PM+ require different sampling setups – need to avoid having to run cycle on 2 separate rigs*
- *Preconditioning (running-in / bedding-in) of discs important as coatings and temperatures seen during preconditioning impact particulate / particle generation*
- *More work required to characterize brake particles*

New Technologies:

- *UK (Jan 2018) requested brake particle measurement take account of new technologies eg regenerative braking.*
- *VDA delivered presentation at PMP-47 on new technologies reducing friction braking need*
- *PMP preferred to consider future concept similar to eco-innovations rather than delay the fundamental measurement cycle / procedure*

Tyre / Road Wear Particles Status

- JRC 2015 literature survey showed tyre/road wear particle emissions are not comparable between studies due to different materials / test conditions / measurement. In several cases results are contradictory.
- PMP current terms of reference include need to monitor TRWP state of knowledge
- PMP leadership team restarted the TRWP discussion at PMP-47, noting the EU Com call for a standardised tyre abrasion methodology as part of the microplastics investigation activities.
- PMP Nov 2018 objective to define new mandate / workplan relating to TRWP

EXHAUST PARTICLE EMISSIONS

- Status of Sub-23nm Activities**

Sub-23nm

- PMP developing sub-23nm method for future use in exhaust measurements (likely D_{50} 10nm)
- Currently round robin underway with 7 labs (EU and Japan), golden vehicle / instruments circulating – report due end 2018.
- Objectives of the exercise is to uncertainties PMP-23nm and PMP-10nm, the need of a catalytic stripper (CS) and data for sub23nm
- **PMP is developing a roadmap to a robust regulatory future process including decisions on calibration materials / particle conditioning / system uncertainties.**



Any questions?

You can find us at

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