

# Current Status of Legislation and Test Procedures for Tire Wear and Particle Emission

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# Agenda

1. Relevance of Tire wear and particle emission
2. Perspective of European Union
3. International perspective (UNECE TFTA)
4. Test methods – Overview and comparison
5. Outlook
6. Summary



# Relevance of tire wear

## 1. Microplastics

- It is estimated that **5 - 10 %** of the microplastics present in the **world's oceans** originate **from tire** particles [1]

## 2. Airborne particles

- Airborne particles can reach the lungs via the respiratory tract, penetrate the alveoli, and are then translocated via the blood to other organs
- The smallest particles below 100 nm can cross the blood-brain barrier to be permanently deposited causing neuroinflammation and neurodegeneration
- Airborne PM 10 tire emission particles accounted for up to 10 % of total tire wear (internal measurements) [2]

## 3. Toxicity

- Evidence that certain chemical elements used in tires such as 6-PPD to be carcinogenic [3], [4]



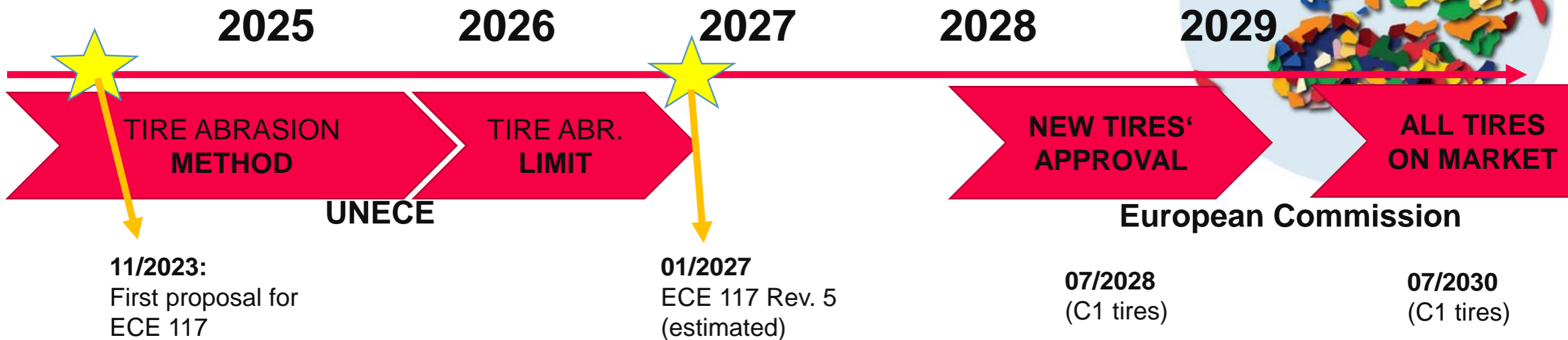
# Perspective of European Union



## Reduction in Microplastics Pollution

- European Green Deal
- Circular Economy Plan
- Zero Pollution Action Plan → Reduction of 30 % by 2030

## EU action against microplastics




# International perspective: UNECE TFTA

## Task Force on Tire Abrasion (TFTA) – Targets:

- **Robust test procedure** to measure tire abrasion
- Acceptable **uncertainty** and **uncertainty assessment** of tests
- Evaluation of **abrasion performance** of wide range of tires already available on market
- **Abrasion limits**
- Amendment to UN Regulation No 117 for type approval (Currently: tire rolling sound, adhesion on wet surface & rolling resistance → EU Tire Label)
- February 2024:  
**Proposal for two test methods** on tire abrasion:
  - **Outdoor test:** 8000 km driving distance
  - **Indoor test:** 5000 km driving distance

United Nations ECE/TRANS/WP.29/GRBP/2024/10

 **Economic and Social Council** Distr.: General  
23 November 2023  
Original: English

Informal document GRPE-90-40  
90<sup>th</sup> GRPE, 9-12 January 2024  
Agenda item 7.(c)

For GRPE information and comments

### Economic Commission for Europe

Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

Working Party on Noise and Tyres

Seventy-ninth session

Geneva, 6-9 February 2024

Item 7 (f) of the provisional agenda

Tyres: Tyre abrasion

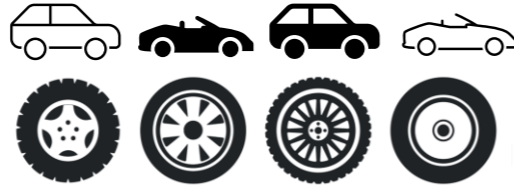
### Proposal for Supplement 02 to the 04 series of amendments to UN Regulation No. 117

Submitted by the Task Force on Tyres Abrasion\*

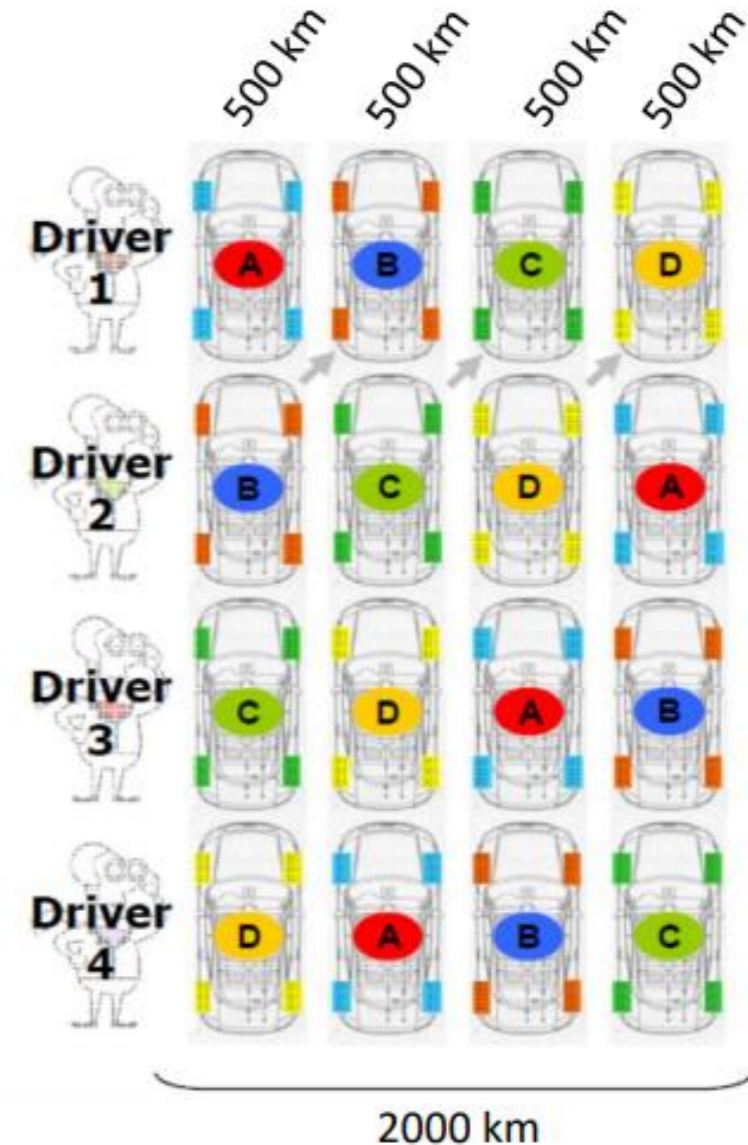
The text reproduced below was prepared by the expert from Task Force on Tyres Abrasion (TFTA). This document aims to introduce the test methods to measure tyre abrasion. The modifications to the current text of the Regulation are marked in bold for new or strikethrough for deleted characters.

## Outdoor test: “Convoy test”

- Up to **4 vehicles** driving on public roads along a selected circuit

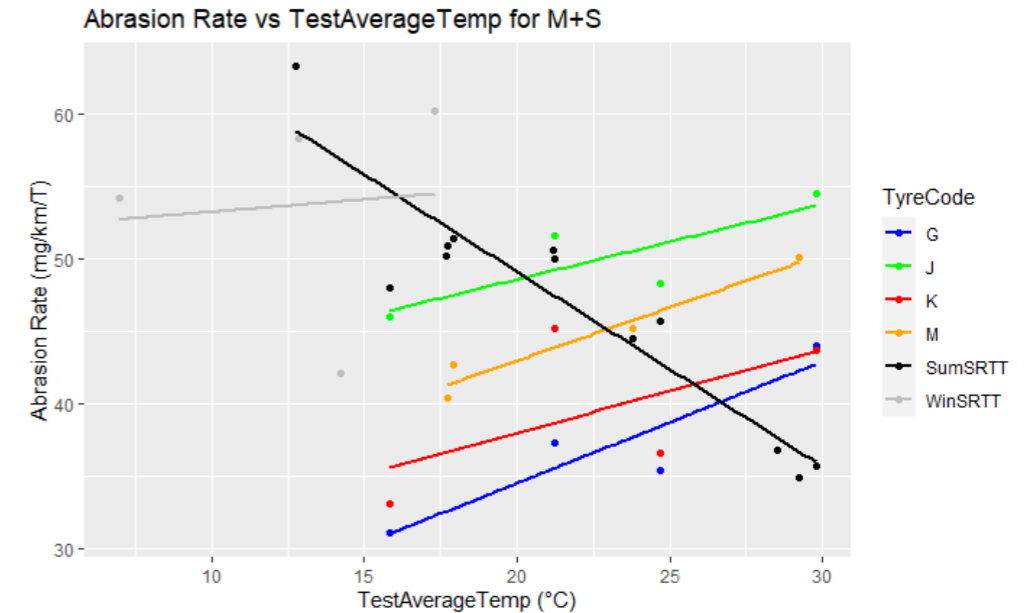
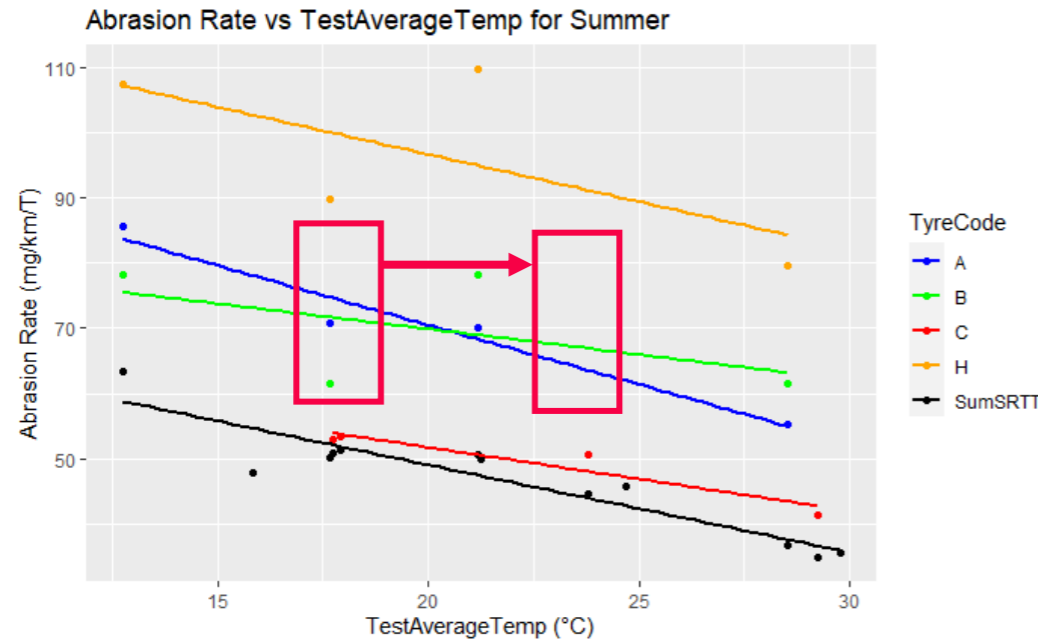


- All tires are evaluated **relative to a reference tire** (SRTT) and all experience **same conditions**:
  - Same weather
  - Same road condition
  - Similar speed and accelerations in convoy (max. 140 km/h, max. 5 m/s<sup>2</sup> long. and lat. acc.)
  - Variation of drivers and position in the convoy
  - Homogenous convoy with regard to type of architecture (FWD, RWD and AWD) and type of engine (ICE or EV)
- Mass loss** for 1 tire is measured **from average of 4 tires**
- Driving distance:** 8000 km



# Convoy Test - Correction factors for temperature

- Temperature influence



- Abrasion rate decreases with increasing temperature
- Linear trend for all tires, including reference (black), but with high partly high deviations (e.g. tire H, yellow)
- In case of tire A (blue) and tire B (green), the ranking changes
- Winter tires → opposite trend with temperature in general. Another reference tire required.

## Indoor test: “JASIC Cycle”

### Japan Automobile Standards Internationalization Center (JASIC)

- Cycle is **based on WLTC** with an addition of **cornering** maneuvers and **road slopes** (based on measurements on public roads)
- The frequency distribution of **lateral and longitudinal accelerations** was evaluated
- An **artificial cycle** for the drum roll was generated that fits this frequency distribution
- **Reference tire** is still required
- **Test requirements:**
  - Drum roll with at least 1.7 m up to 3 m
  - Driving distance: 5000 km
  - Constant speeds: 60 km/h and 100 km/h
  - Tire load is 80 % of Load Index of tire
  - Surface is defined by roughness range, documentation required
  - Temperature range defined

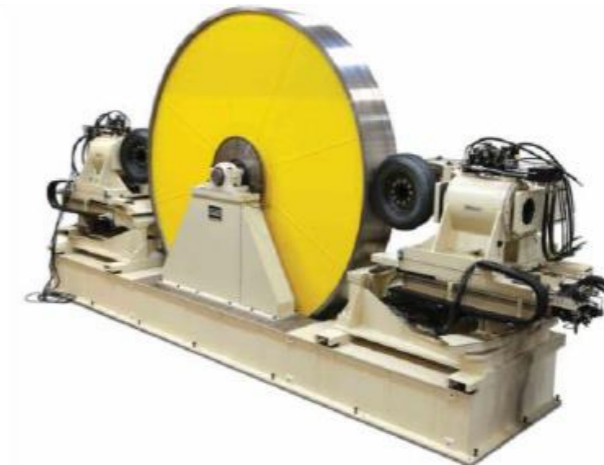
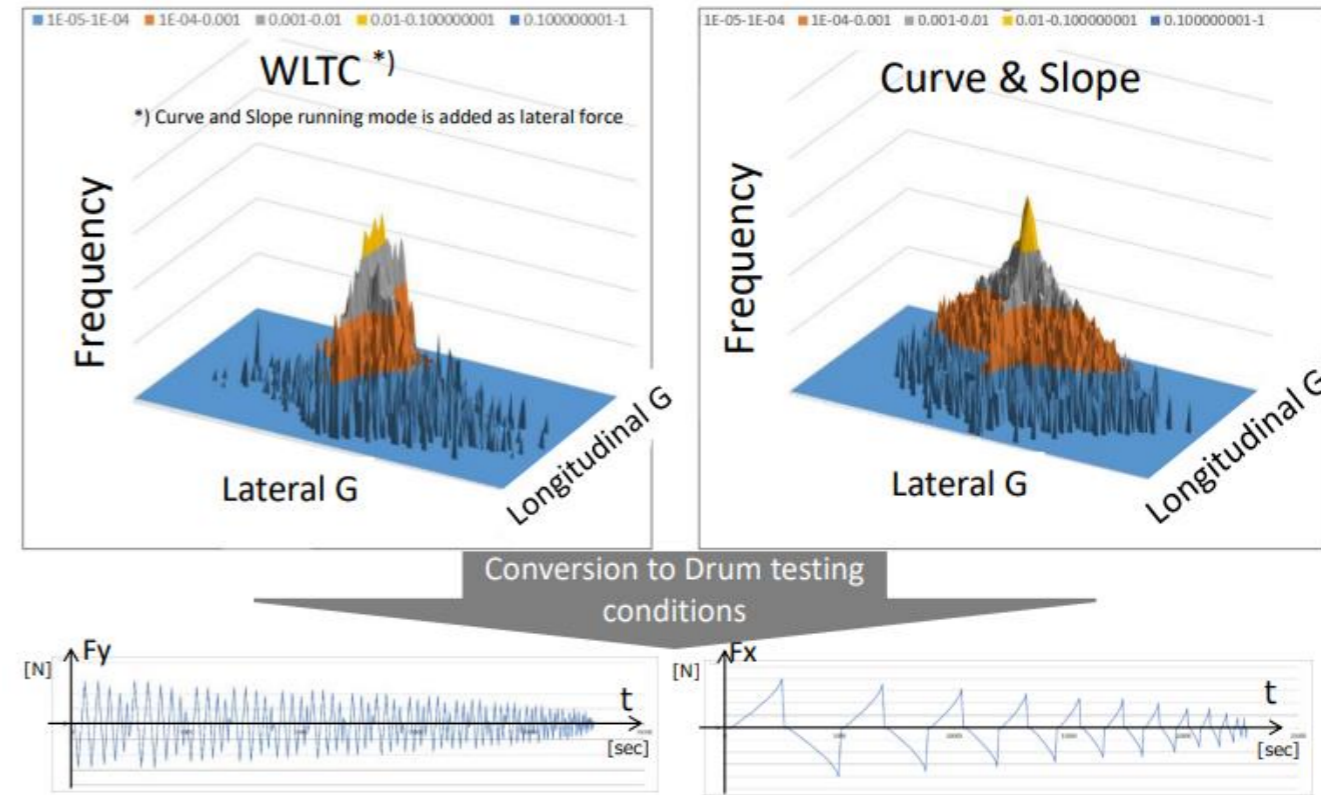


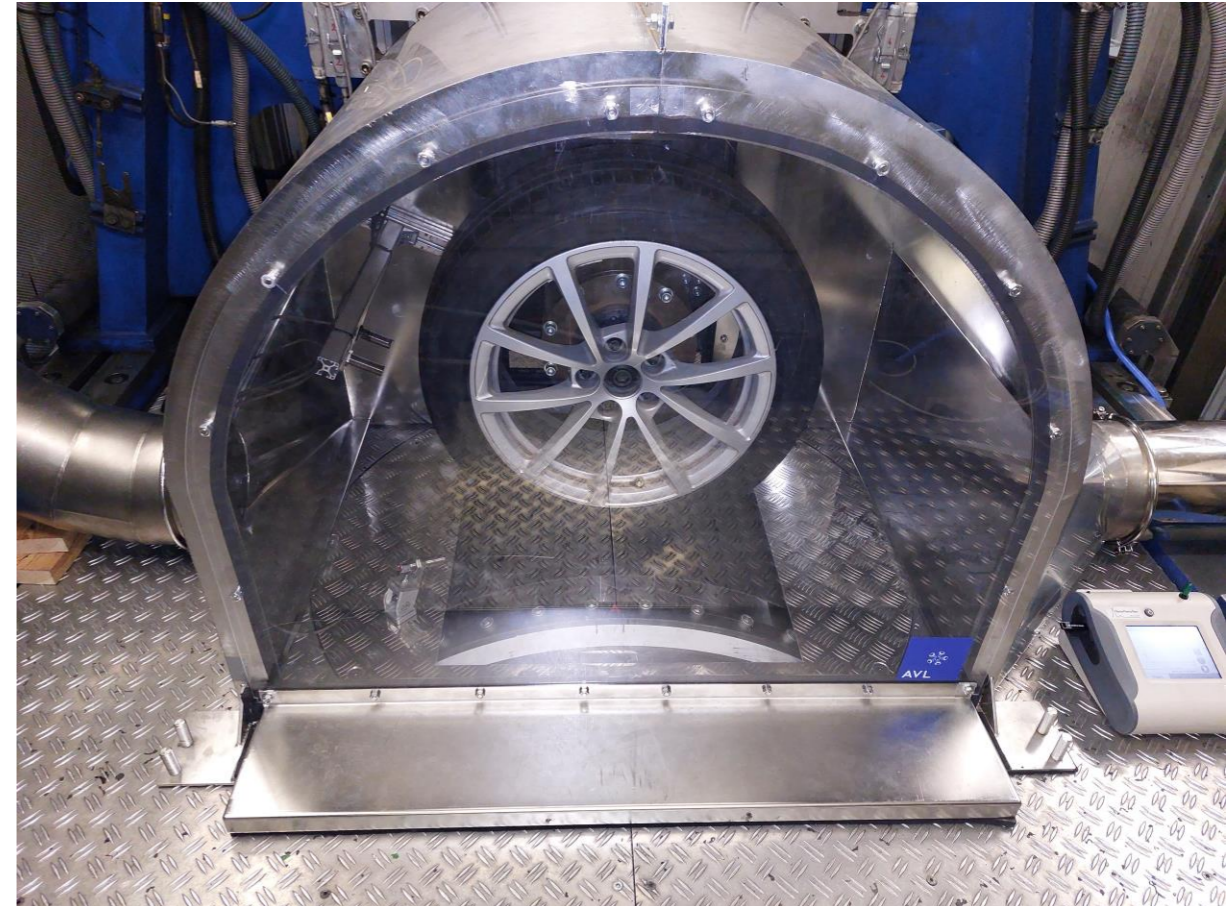
Figure Sources: UNECE, JASIC, TA-04-05  
Eco-Mobility Vienna, 15.11.2024



# Tire particle emission testing 1

Working groups are currently **not even discussing tire particle** limits and test methods for type approval:

- Microplastics and airborne particle emission are main reason for limitation (Euro 7)
- Still, the regulation will „only“ include abrasion mass limits for tires (in contrast to brakes)
- **Why?**
  - Tests for mass abrasion with accuracy that enables **reproducibility and low uncertainty for legislation** is enough of a challenge for now.
  - Tire particle emissions tests **increase complexity**:
    - Tire is harder to „house“ (compared to brake) both on test bench (rotating drum) and in vehicle
    - Re-Suspension on road



Suspension test drum at TU Graz with tire particle housing that was designed with AVL

## Tire particle emission testing 2

### Exemplary research prototypes - outdoor tests

- **ZEDU-1:**
  - Zero Emission Drive Unit of DLR
  - Electric propulsion
  - Brake is a multi-disc brake integrated in closed gearbox unit with optimized recuperation strategy
  - Most of tire abrasion in the closed wheel is transported through a filter with the use of a fan
- **Michelin** (Charbouillot et al 2023)

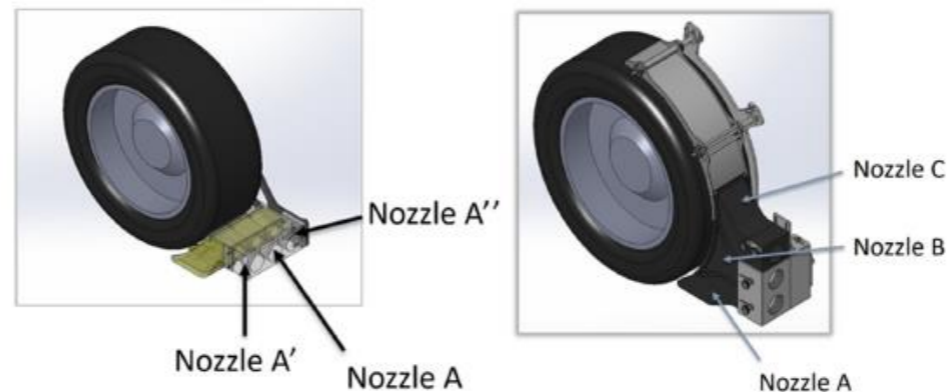
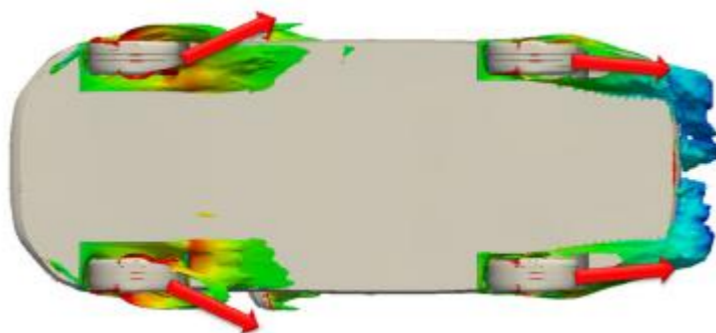
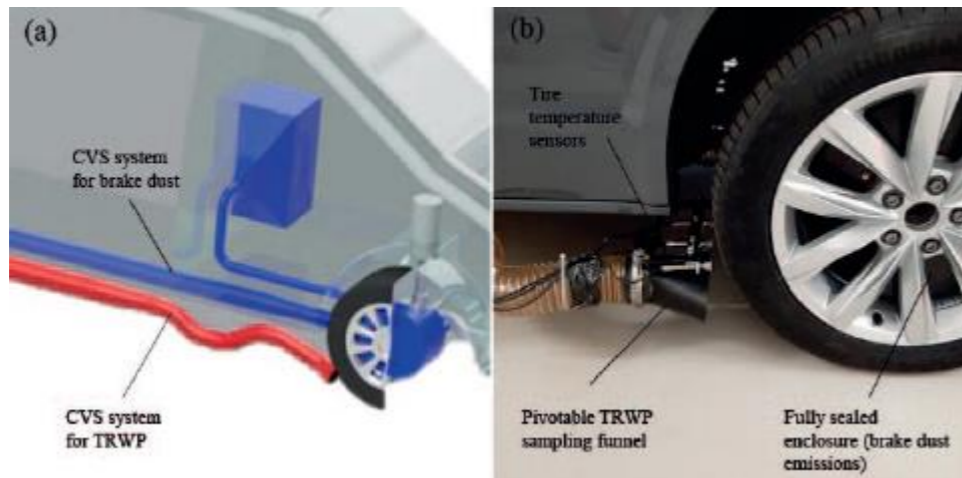


Figure Sources: DLR // Charbouillot et al 2023.  
Eco-Mobility Vienna, 15.11.2024

## Tire particle emission testing 3

### Exemplary research prototypes - outdoor tests



TU Ilmenau and Audi (Feißel et al 2024)



Ford and Bergische Universität Wuppertal  
(Mathissen et al 2012)

## Outlook 2

### 1) How will the legal limit be defined?

- Abrasion level: mg/km/t
- Abrasion rate: mg/km
- Abrasion index (AICT):  
abrasion level of tire with respect to reference tire (dimensionless unit)

→ Dimensionless abrasion index is proposed in ECE 117:

1.11.13.5. The abrasion index of the candidate tyre shall be independent from the average test temperature and is calculated from the following equation:

$$AICT = \frac{ARCT}{ARRT}$$

Where:

**AICT** is the abrasion index of the candidate tyre;

**ARCT** is the abrasion rate of the candidate tyre at test average temperature in mg/kg/t;

### 2) Application to different tire types?

- Summer tires, M+S tires and winter tires
- Proposal currently only for C1 tires
- C2 tire time line strongly depends if test methods from C1 prove suitable
- C3 first tests targeted



ECE/TRANS/WP.29/GRBP/2024/10

#### I. Proposal

Paragraph 1.1., amend to read:

“1.1. This Regulation applies to new pneumatic tyres \* of classes C1, C2 and C3 in new state with regard to their sound emissions, rolling resistance and to adhesion performance on wet surfaces (wet adhesion) and for class C1 tyres in worn state with regard to adhesion performance on wet surfaces (wet adhesion). **It also applies to C1 tyres in new state with regards to their tyre abrasion.** It does not, however, apply to:”

# Outlook 2

## 3) What value will the threshold have?

- Proposal from UNECE TFTA awaited soon (early 2025)
- Depends on market assessment tests (conducted both outdoor and indoor)

### To get a feeling for typical values of wear rates:

- **German ADAC** conducted a study on
- the weight loss of tires in g/1000 km
- related to the entire vehicle
- 15.000 km,
- 60 % urban and country roads
- 40 % highway
- 5 convoys with 4 vehicles each (1 ref. tyre)

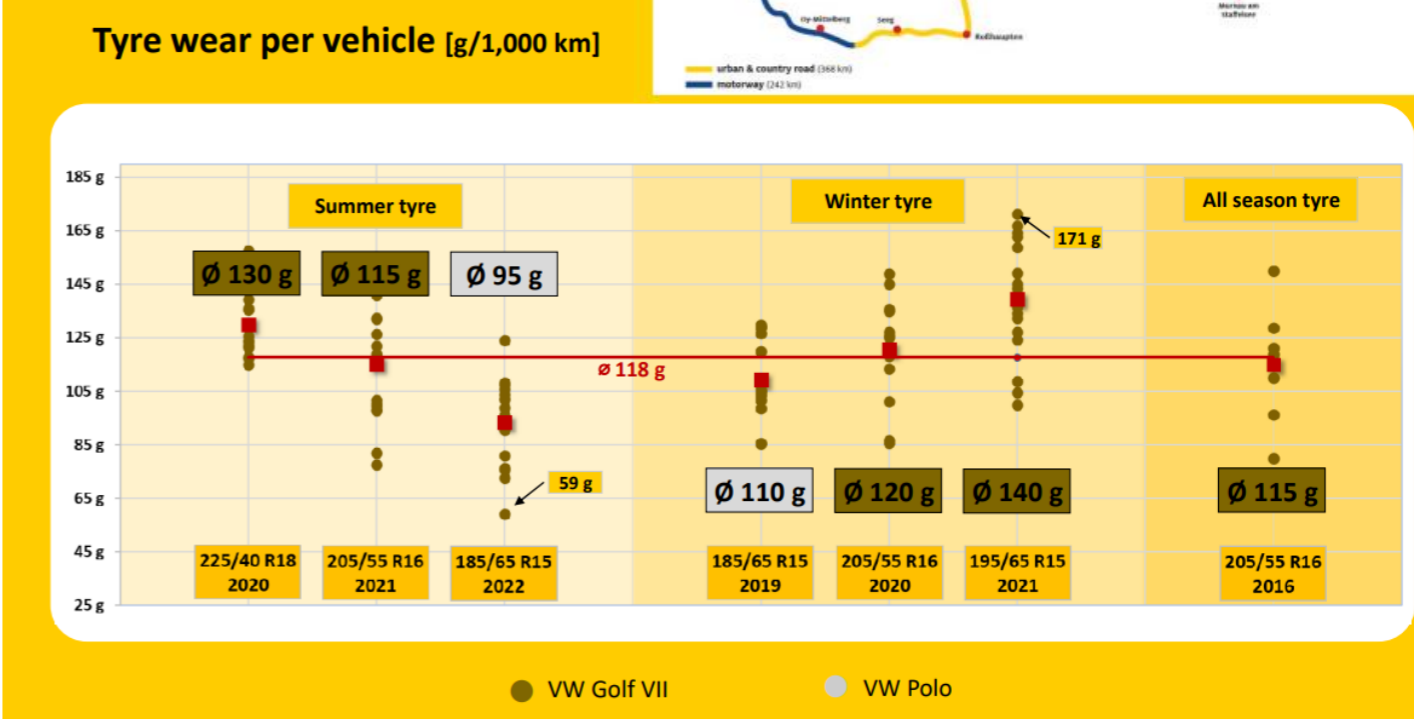


Figure Sources: Silvestro, ADAC, 2022  
Eco-Mobility Vienna, 15.11.2024

# Summary

- **Limits for the tire abrasion:**
  - First proposals awaited in 2025
  - May be in revision of ECE 117 by 01/2027
  - EU may adopt it for new tire approval by 2028/2029
- Most **likely test procedures for approval (UN Reg. No. 117):**
  - **Outdoor: Convoy tests**
  - **Indoor: JASIC cycle**
- Both the value for the **legal limit** and the **accuracy of the test methods** are still under discussion and will depend on the results of the **market assessment tests**
- Both indoor and outdoor tests are **time consuming** and **shortening the cycles is desirable**, but they must not jeopardize reproducibility
- Extension to **C2 and C3 tires** as a next step

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