Open questions for defining the test procedure

1. Diffusion test - can all vehicle tyres be deflated in a reasonable time period?
   What is a reasonable time period, to minimise pressure changes due to temperature changes?

2. How long does it take for tyre temperatures to stabilise during the learning phases? Is this influenced by driving speed?

3. What is the effect of vehicle loading on warming up time?

4. Can the proposed test procedures be carried out repeatably, reliably, practically?

5. Any other lessons?
Test location and vehicles

Tractor unit 3 axle – steer + drive twin + lift
315/70 R22.5 tyres – 5 brands
Trailer 3 axle
One brand 385/65 R22.5 tyres

Bus 4x2 axle configuration
One brand 275/70 R22.5 tyres
TPMS used

1. Tire Sensor
2. Central Control Unit (CCU)
3. Display
4. Additional Receiver

Includes temperature measurement
<table>
<thead>
<tr>
<th>Date</th>
<th>Test</th>
<th>Vehicle</th>
<th>Warmup speed (kph)</th>
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<td>TPMS installation</td>
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Open questions for defining the test procedure

**Question 1**
Diffusion test - can all vehicle tyres be deflated in a reasonable time period?
What is a reasonable time period, to minimise pressure changes due to temperature changes?
Tyre deflation – how long does it take?

Initial test with bus:
To reduce by 20% ≈ 80 seconds

Deflation times for -20% were measured in the diffusion tests:
Bus:
6 tyres / 2 people = 10:53 mins
Truck:
8 tyres / 2 people = 13:48 mins

⇒ 3.5 mins / tyre / person
Additional people were needed for timing and recording

(For reference: 1 psi = 69 mBar)
Tyre deflation – temperature / pressure effects with time

Bus and truck cooling

Bus:
- Reduction of 3 psi average in 30 mins
- $= 0.11 \text{ psi} / \text{min}$

Truck:
- Reductions of 1.1 – 2.9 psi
- $= 0.05 – 0.11 \text{ psi} / \text{min}$
- $= 0.6 – 1.1 \%$ in 15 min
2.5.2

Procedure for the diffusion test to verify the requirements of paragraph 5.3. to this Regulation.

Deflate all tyres within five minutes of measuring the warm pressure as described in paragraph 2.4.3. above for vehicles of category M1 and N1 and 15 minutes for vehicles of category N2, N3, M2, M3, O3 and O4, until the deflated tyres are at P_{\text{warm}} - 20\% \text{ per cent, plus a further deflation of 7 kPa, namely } P_{\text{test}}. \text{ Following a stabilisation period of between two and five minutes, the pressure } P_{\text{test}} \text{ shall be rechecked and adjusted if necessary.}
Open questions for defining the test procedure

Question 2

How long does it take for tyre temperatures to stabilise during the learning phases? Is this influenced by driving speed?
Tyre warming

Bus puncture test
Temperatures stabilise after
~ 1.25 hour
Tyre warming

Truck and trailer diffusion test
Temperatures stabilise after ~ 1 hour
Tyre warming

Bus tests compared:
Temperatures stabilise after
\(~1.25 – 1.5\) hour
Speed effect is insignificant

Ambient temperature adds to the tyre temperature
2.4.1.

For vehicles of category N2, N3, M2, M3, O3 and O4, drive the vehicle for a minimum of 180 minutes at a speed of fifty-seven km/h ±10 km/h.

180 minutes to allow for variations in vehicle type and ambient conditions.

57km/h as mid-point of speed range
Open questions for defining the test procedure

Question 3

What is the effect of vehicle loading on warming up time?
Tyre load

Little effect on warmup time
Temperature reached is higher
1.5.1. Test weight

The vehicle may be tested at any condition of load, the distribution of the mass among the axles being that stated by the vehicle manufacturer without exceeding any of the maximum permissible mass for each axle.

*No changes to existing R141 text required*
Open questions for defining the test procedure

Question 4
Can the proposed test procedures be carried out repeatably, reliably, practically?

The test procedures (puncture, diffusion, malfunction) were followed successfully and repeatably on multiple vehicle types using speed ranges agreed by stakeholders.

Simple equipment and a small number of personnel were required.
Open questions for defining the test procedure

Question 5
Any other learning

*Pressure gauges should be used with a high deflation flow rate, or with an additional system for releasing pressure (e.g. an additional valve)*

*Soak time should be increased – 1 hour is not enough*
Paragraph 2.1.

Before inflating the vehicle's tyres, leave the vehicle stationary outside at ambient temperature with the engine off shaded from direct sunlight and not exposed to wind or other heating or chilling influences for at least one hour for vehicles of category M1 and N1 and 4 hours for vehicles of category M2, M3, N2, N3, O3 and O4.