



Informal document **GRVA-09-17**
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Provisional agenda item 7

Proposal to amend the PBC reference for AEBS M1/N1



Proposal to adopt the Peak Braking Coefficient (PBC)



Two different PBC methods:

UN R152 refers in § 6.1.1.2 and 6.1.1.3 to 2 PBC demonstration methods:

- The American Society for Testing and Materials (ASTM) E1136 standard reference test tyre in accordance with ASTM Method E1337 90 or
- The k-test method specified in Appendix 2 to Annex 6 of Regulation No. 13-H (with vehicle with state of the art OEM production tires).

Conclusion for both methods: PBC needs to be adapted for today's tyres

- Over the last decades tyres have reached a higher grip. So we ought to adopt to higher friction on average tyre-road-combinations.

ASTM already recognises this progress, replacing the standard reference tyre E1136 with F2493.

- The ASTM E1337-90 determines a conversion factor, because tests with different tyres (e.g. E1136 or F2493) on the same track will result in different PBC values.



E1136 – 14 (Old ASTM Test Tyre)

Front View: P195/75R14
Radial Standard Reference Test Tyre



F2493 – 14 (New ASTM Test Tyre)

Front View: P225/60R16 97S
Radial Standard Reference Test Tyre

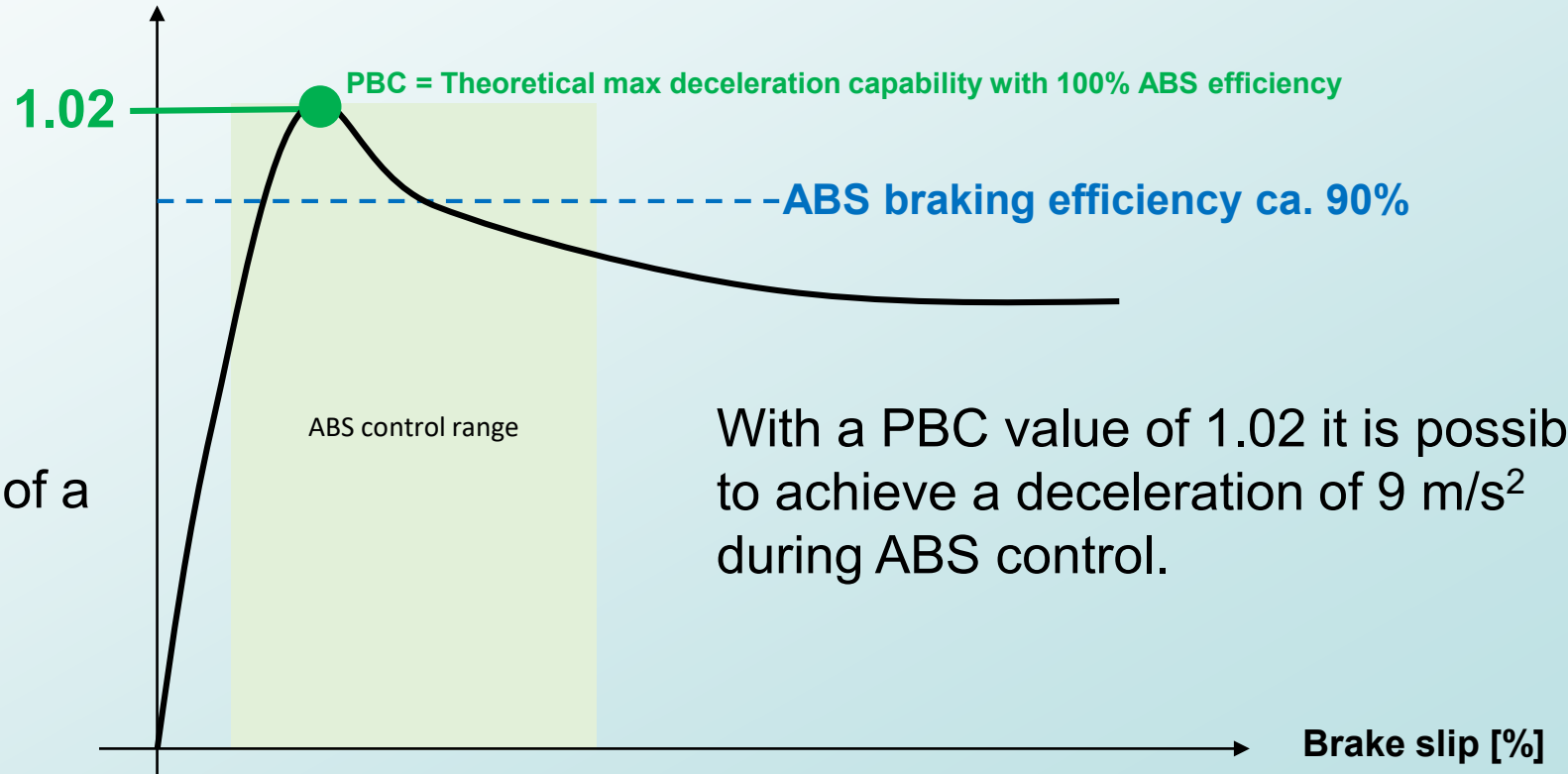
- Example - a of PBC 0.9 based on the E1136 can be converted to 1.017 with the **F2493 tyre as follows:**

$$(0.9 \times 1.17) - 0.0360 = 1.017. \rightarrow \mathbf{1.017 \text{ is the preferred PBC using the ASTM method}}$$



Peak Braking Coefficient (PBC), determination with k-value method

$$\text{PBC} = \mu = \frac{\text{max. Braking Force}}{\text{Nominal Load}} = \frac{9}{9.81} \frac{\text{m/s}^2}{\text{m/s}^2} = 1.02$$



Adhesion (PBC=Peak Braking Coefficient) is always the result of a tyre-road-combination.

→ 1.02 is the preferred PBC using the k-value method.



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Justification:

Over the last years tyre/road friction parameters have improved and PBC values should be adapted accordingly.

Considering the ASTM method E1337-90 (12.4.2) and the UTAC measurements comparing both standard reference tyres on same tracks (AEBS-11-11) the PBC values should be as follows:

PBC = 0.9 with „old“ ASTM standard reference tire E1136 (P195/75R14)

PBC = 1.017 with „new“ ASTM standard reference tire F2493 (P225/60R16 97S)

For the k-test method with „vehicle under test“ production tires the PBC = 1.017 is also reasonable.



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Proposal:

- 2.13. "Dry road" means a road with a nominal peak braking coefficient of ~~0.9~~ **[as specified in par. xxx]** **or alternatively** **[that permits a mean fully developed deceleration of 9m/s²].**
- 6.1.1.1. The road test surface shall have a consistent slope between level and 1 per cent and have a nominal peak braking coefficient (PBC) of
- **0.9 unless otherwise specified, when measured using the American Society for Testing and Materials (ASTM) of E1136 standard reference test tyre in accordance with ASTM Method E1337 90 at a speed of 40 mph**
 - **1.017 unless otherwise specified, when measured using either:**
 - a) **The American Society for Testing and Materials (ASTM) of F2493 standard reference test tyre in accordance with ASTM Method E1337 90 at a speed of 40 mph; or**
 - b) **The k-test method specified in Appendix 2 to Annex 6 of Regulation No. 13-H.**