Brake wear PN measurements

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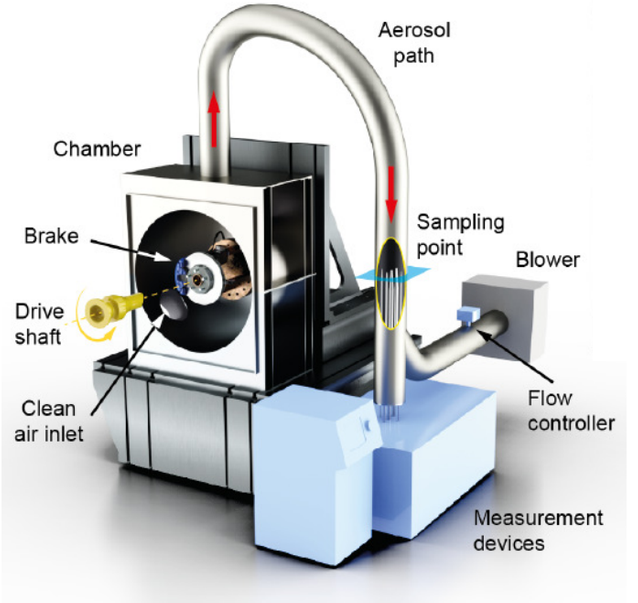
Measurement setup

- Fully enclosed setup
- HEPA filtered inlet air
- Constant volume flow, 275 m³/h



<u>Instrumentation</u>

PM

- DustTrak (real time Mass estimation + internal gravimetric Filter)
- PM10 Impactor (size-segregated gravimetric sampler)

PN

- EEPS (Particle size analyzer, 5 nm - 500 nm)
- APS (Particle size analyzer, 0.5 µm - 20 µm)
- CPC 3752 (Particle Counter, total concentration, D_{50}=4nm)

Repeatibility, PN

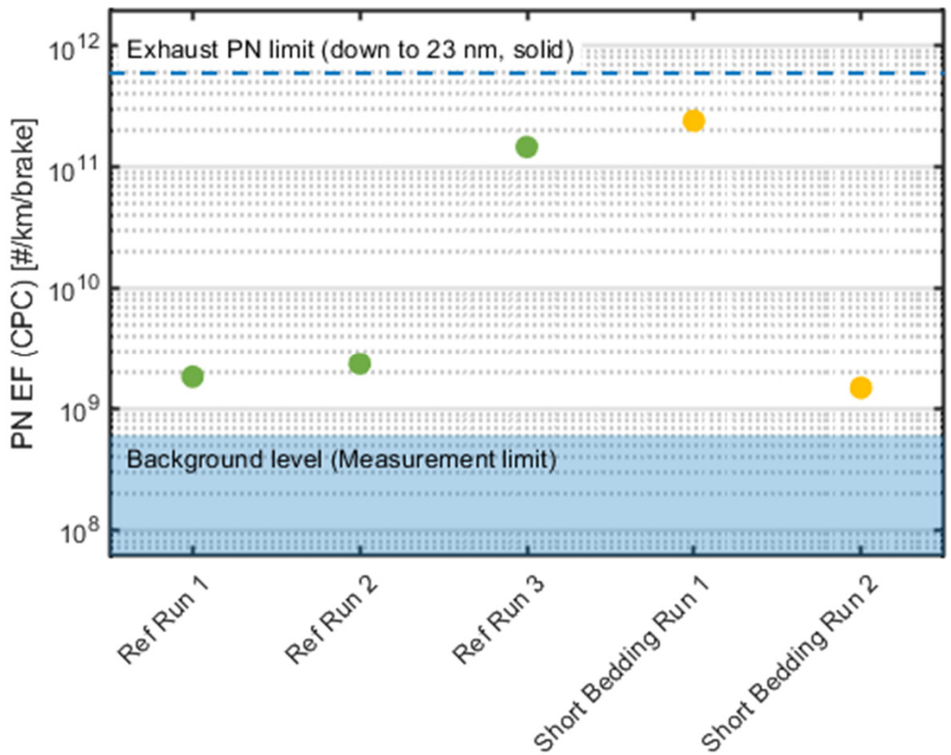
5 x nominal identical brake discs/pads

Bedding

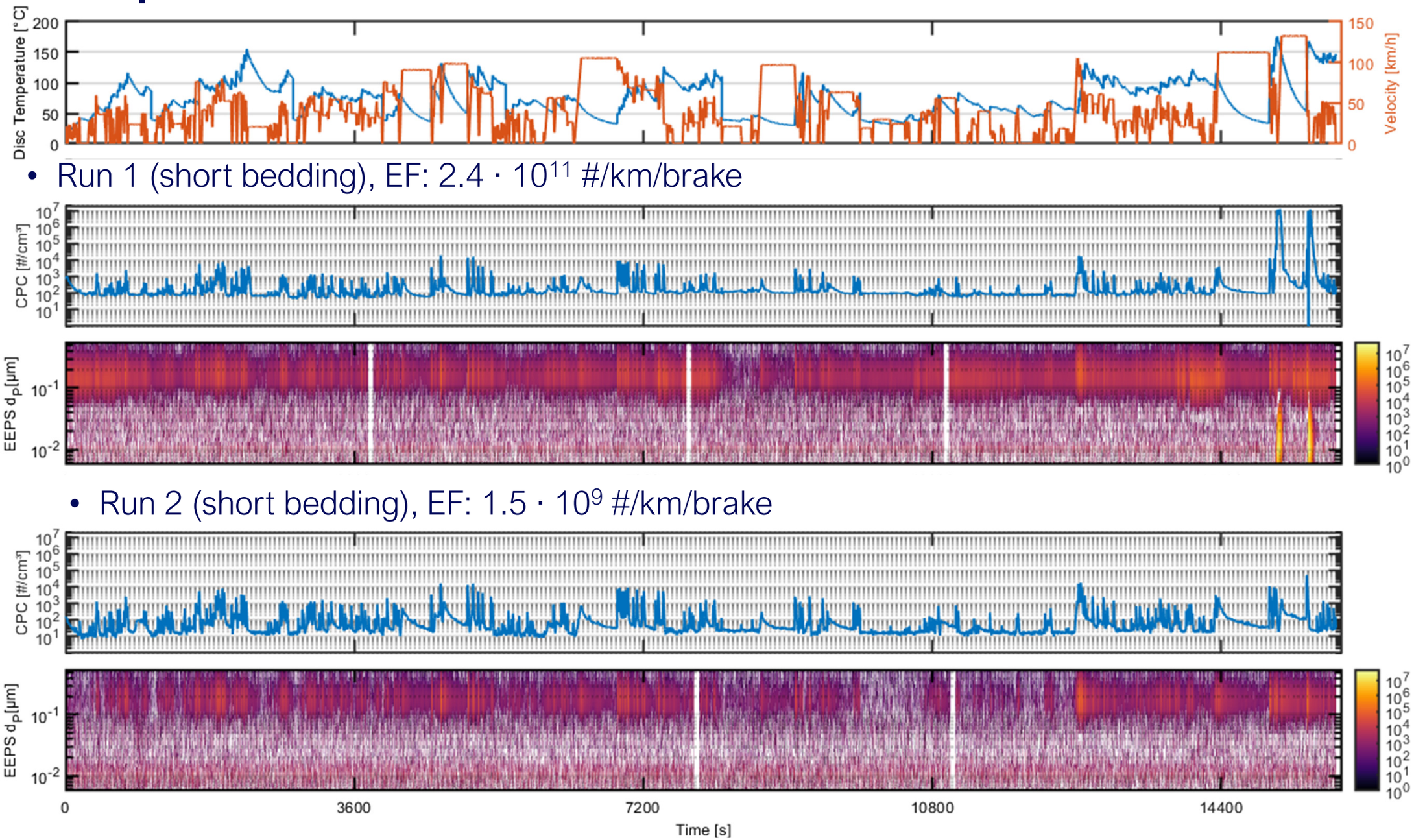
Ref Run: 5 Brake WLTP

Short Bedding: Reduced procedure based on AK Master

- High variation in PN emission
- Similar level of variation for both applied bedding procedures.
- EF may rise by orders of magnitude due to 2-3 emission events during high temperature brakings (next slide)
- PN dominated by ultrafine particles (UFP) in these events
- These UFP are likely volatile



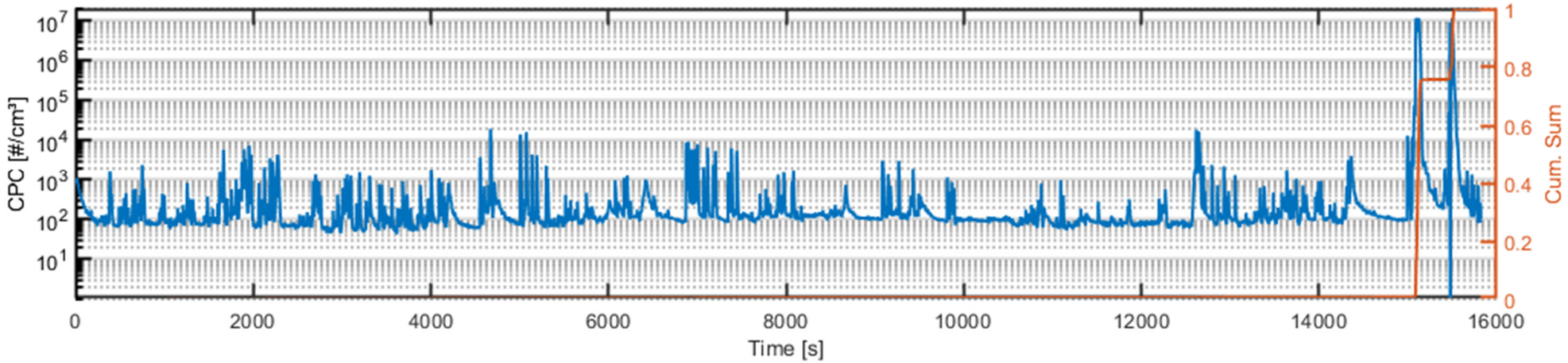
PN comparison between two runs



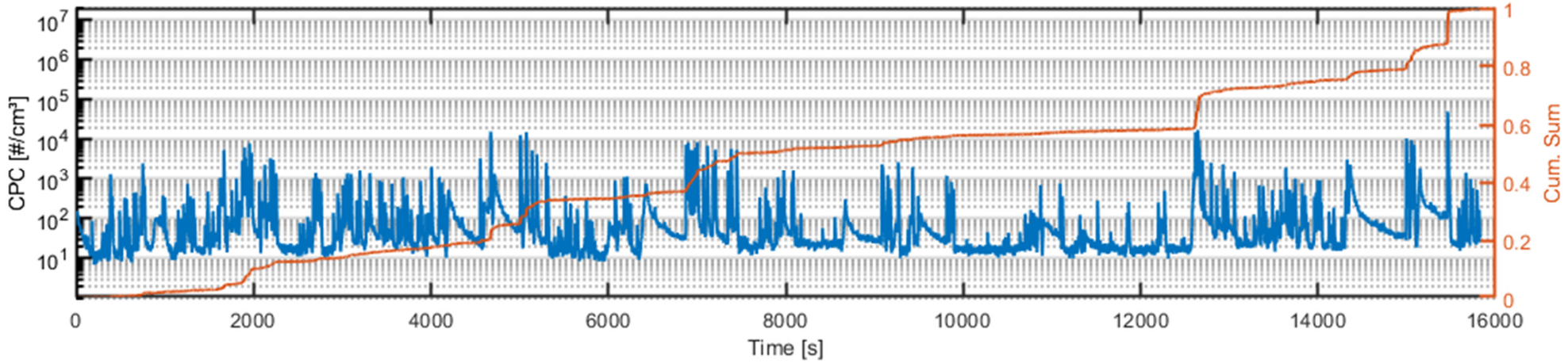
- Run 1 (short bedding), EF: $2.4 \cdot 10^{11}$ #/km/brake
- Run 2 (short bedding), EF: $1.5 \cdot 10^{9}$ #/km/brake

PN comparison between two runs

- Run 1(short bedding), EF: 2.4 · 10^{11} #/km/brake



- Run 2 (short bedding), EF: 1.5 · 10^{9} #/km/brake



Summary

- UFP formation due to burning of pad binder
- Local temperature hot spots might occur
- High variability for PN observed, and without countermeasures also expected
- Solid particle number measurement may reduce variability significantly