

## Dual particle counter for measuring simultaneously automotive exhaust solid particle number emissions larger than 10 nm and 23 nm

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### >Introduction and Background

The Solid Particle Number (SPN) emissions of Light Duty (LD) vehicles are regulated in Europe since 2014. The tests are conducted by sampling diluted exhaust from a Constant Volume Sampling (CVS) system. Current legislation (UNECE R83) requires a Volatile Particle Remover (VPR) which consists of an Evaporation Tube (ET) and a Condensation Particle Counter (CPC) with a cut-off of 23 nm. The latest Amendment of the Global Technical Regulation for certifying LD vehicles specifies a catalytic stripper (CS) instead of the ET and a CPC with a cut-off of 10 nm instead of 23 nm.

### Methodology

A dual line SPN system (APC xApp) was developed to allow for parallel measurements with an AVL 10 nm and an AVL 23 nm CPC. The APC xApp was employed in parallel to a system fully compliant with the UNECE R83 regulation (APC<sup>plus</sup> [1]) in measurements of Gasoline Direct Injection (G-DI) LD vehicles from a CVS. The APC<sup>plus</sup> employs an ET and a 23 nm AVL CPC. The vehicles were tested under the Worldwide harmonized Light vehicles Test Procedure (WLTP) and other driving protocols. The study investigates the influence of the CS on the > 23 nm, as well as the ratio of the SPN 23 to SPN 10 emissions.

### Results and Conclusions

The ratio SPN 10 to SPN 23 ranged from 1.1 to 1.5, in line with already reported literature figures [2, 3]. The SPN >23 nm differences between APC<sup>plus</sup> (ET) and APC xApp (CS) were found to be confined within  $\pm 10\%$ . The observed differences were within the measurement uncertainty (e.g. originating from calibration [1]), and showed no dependence on the ratio of 10 to 23 nm concentrations (and therefore size of emitted particles). The results verify that the use of a CS has no effect on SPN > 23 nm, in good agreement with what anticipated from the efficiency curves of the CPCs and APCs.

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