Measurement of post-trap emissions by a particle number count method developed for possible future type approval purpose

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Content

- What limits the repeatability of post-trap number measurements?
- Is a modified mass measurement method an option?
- Is a number limit value of 10^{11} particles/km feasible?

Political background

Present Position of European Commission (14 July 2005)

The draft proposal for Euro 5 emission limits for passenger cars and light duty vehicles

- An 80% reduction in particulate matter (PM) emissions from diesel cars.
- Introduction of a particulate emission limit for lean burn direct injection petrol cars.
- Intention to introduce a particulate number standard

Government declines DPF obligation for new diesel passenger cars but will prepare an incentive payment system (4 March 2004)

- Introduction of number based particle measurement method is not decided yet

Swiss LD Test Programme

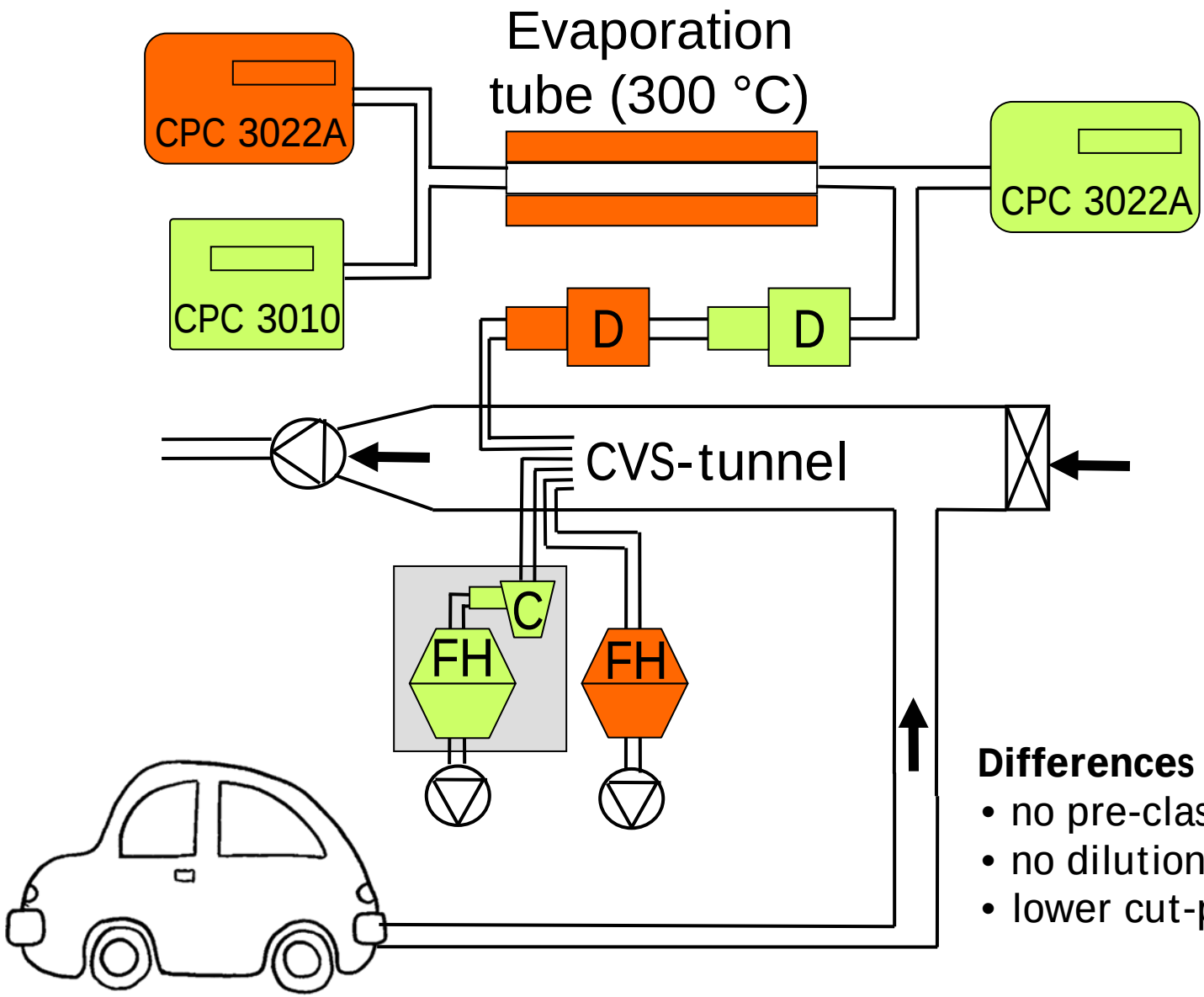
Evaluation of a Particle Number Measurement Procedure

Number of vehicles:	4
Test cycle:	NEDC (and many others but not considered here)
Fuel:	S < 10 ppm
Number of NEDC tests	6-16 per vehicle
Variables	Vehicle pre-conditioning CPC-model Filter sampling
Quality control	CPC calibration by Metas Daily CPC check with NaCl aerosol Gas calibration of dilution units Specification of evaporation tube Daily Background measurement (mean = $3.3*10^9$ km^{-1})

Test vehicles

				
Manufacturer Model	**Toyota** **Avensis** **2.0 D-Cat**	**Opel** **Vectra** **1.9CDTI 16V**	**VW** **Passat** **2.0 TDI**	**VW** **Touran** **1.6 FSI**
Fuel	Diesel	Diesel	Diesel	Gasoline
Injection	Direct	Direct	Direct	Direct
Displacement / Cyl.	1995 / 4	1910 / 4	1968 / 4	1598 / 4
Max. Power [kW]	85/3600	110/4000	100/4000	85/5800
Aftertreatment system	Catalyst particle & NOx-trap (D-cat)	Catalyst particle trap (CSF)	Fuel borne (Fe) catalyst particle trap (FBC-DPF)	NOx-trap
Material	Corderite	Si-SiC	Si-SiC	
Certification	Euro 4	Euro 4	Euro 4	Euro 4

Experimental Set-up



Differences to PMP

- no pre-classifier
- no dilution after ET
- lower cut-point of CPC

Conclusions

- The number measurement procedure is able to distinguish between different emission levels of vehicles with particle traps, whereas the standard and the modified mass procedure is not.

- Repeatability and reproducibility of the number based method is strongly affected by non-system related parameters
  Good repeatability is obtained for stable emission sources
  => pre-conditioning of vehicle and sampling line is very important

- Diesel vehicles with efficient DPF would meet a "10^{11}-limit value" after well defined pre-conditioning

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