

Swiss Light Duty Test Programme Results

# Evaluation of a Particle Number Measurement Procedure

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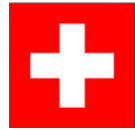
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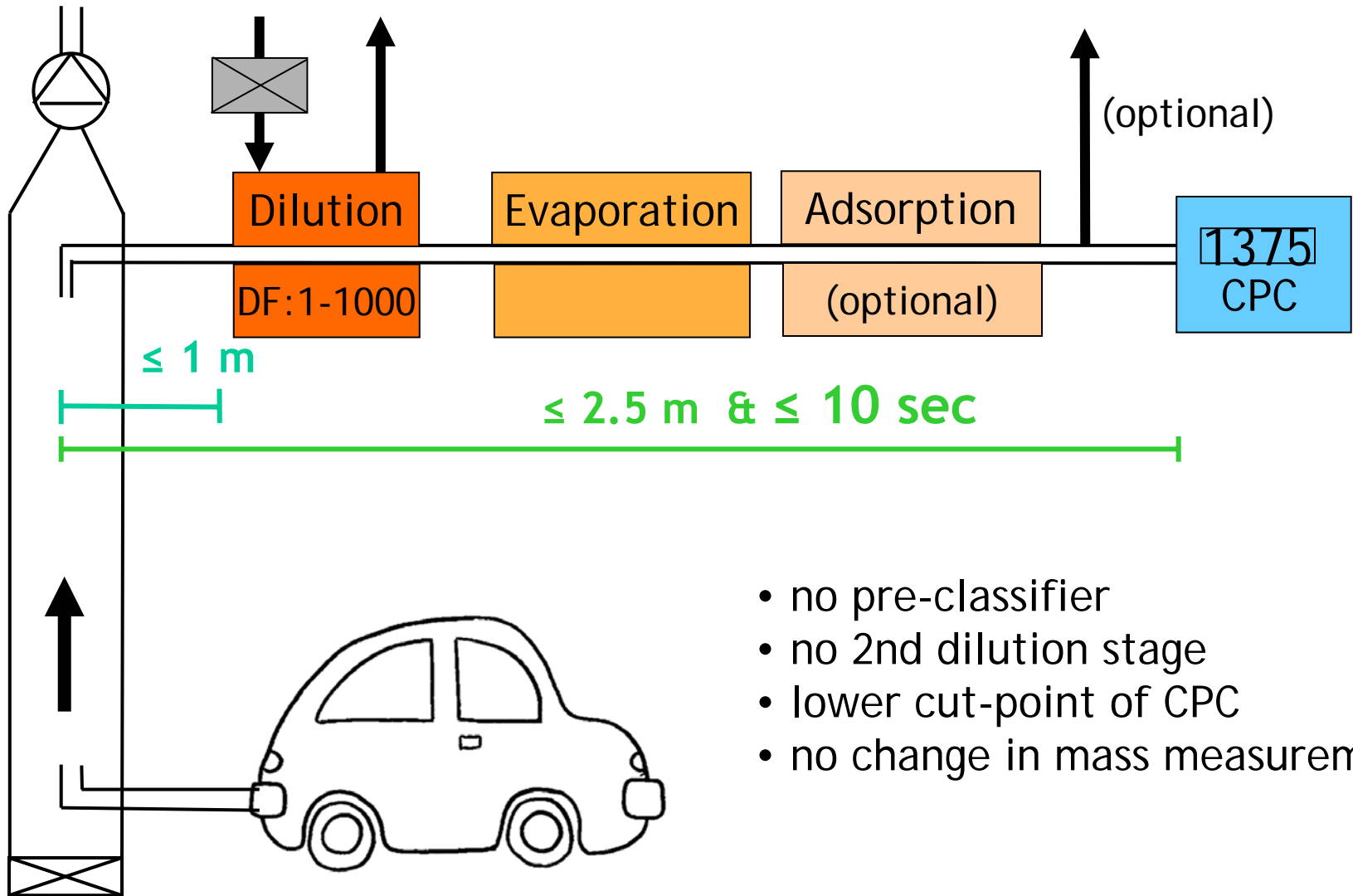
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# Background



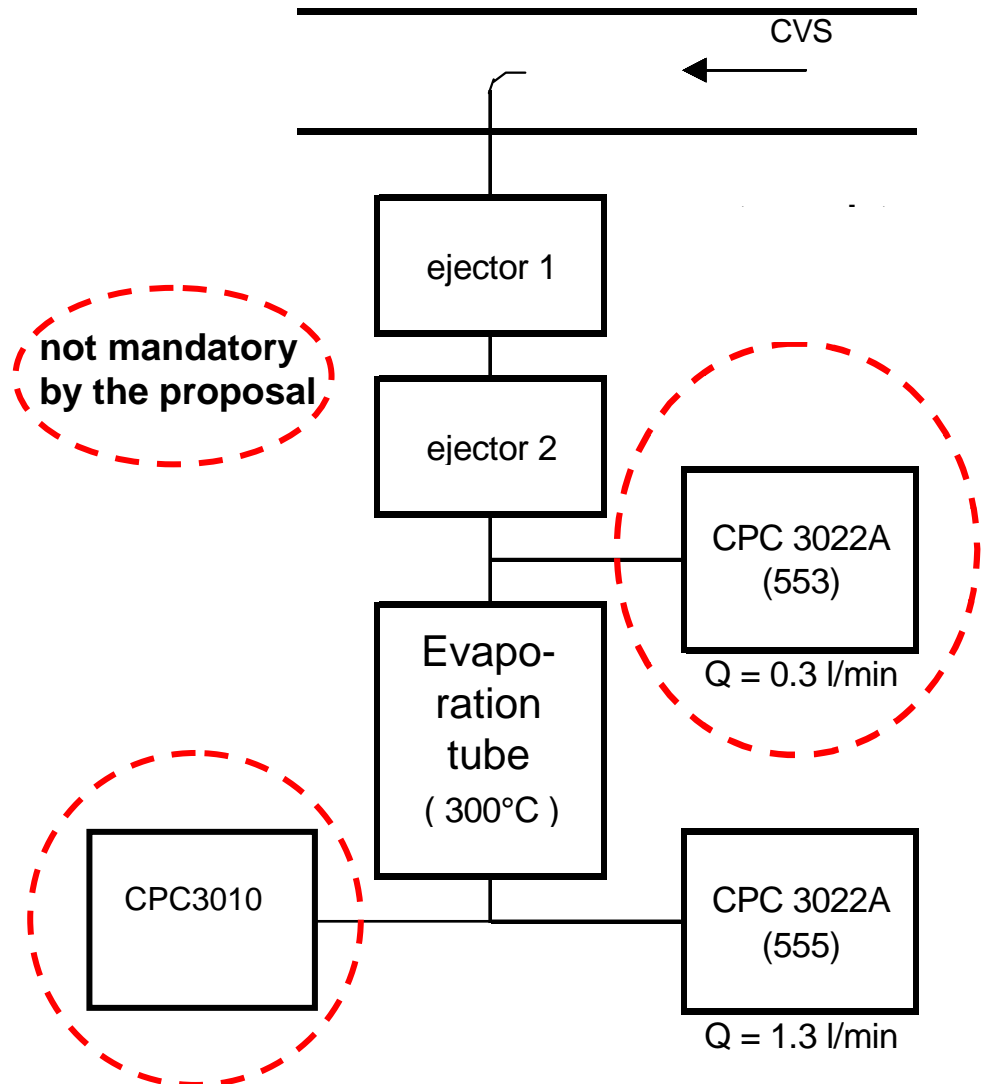
- Swiss government intends to introduce an incentive payment system for diesel passenger cars with particle trap (4 March 2005)
- On behalf of Swiss Agency for the Environment, Forests and Landscape (SAEFL), EMPA and experts from other institutes are developing a procedure for particle number measurement for passenger cars to introduce a limit value for particle number
- The procedure is based on the initial findings of the PMP Expert Group, but details had to be decided before a PMP draft was available, due to a proposal of the Environmental Commission of the National Council

# Schematic of experimental set-up



- no pre-classifier
- no 2nd dilution stage
- lower cut-point of CPC
- no change in mass measurement

# Set-up at EMPA



# Measurement Programme

Number of vehicles: 4  
Test cycle: NEDC  
Fuel: S < 10 ppm  
Number of tests/vehicle:  $\geq 6$

Variables pre-conditioning  
CPC-model

Inter-lab comparison with AFHB Biel

Quality control  
CPC calibration by Metas  
Daily CPC check with NaCl aerosol  
Gas calibration of dilution units  
Specification of evaporation tube

# 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  
Injection  
Displacement / Cyl.  
Max. Power [kW]

Diesel  
Direct  
1995 / 4  
85/3600

Diesel  
Direct  
1910 / 4  
110/4000

Diesel  
Direct  
1968 / 4  
100/4000

Gasoline  
Direct  
1598 / 4  
85/5800

Aftertreatment  
system

Catalyst  
particle &  
NOx-trap

Catalyst  
particle trap

Fuel borne  
(Fe) catalyst  
particle trap

NOx-trap

Material

Corderite

Si-SiC

Si-SiC

Certification

Euro 4

Euro 4

Euro 4

Euro 4

# Conclusions

- During the 3 month programme the measurement system was observed to be robust and long-term stable
- The number measurement procedure was able to distinguish between different emission levels of vehicles with particle traps, whereas the mass procedure was not.
- Repeatability and reproducibility of the measurement system was strongly affected by non-system related parameters (trap loading, background concentration, contamination of the sampling lines, engine control)  
=> pre-conditioning of vehicle and sampling line is very important
- Good repeatability (ca. 10% rel. stdev) was obtained for a stable emission source (GDI) or referred to a proposed limit value of  $10^{11} \text{ km}^{-1}$
- It is not the best approach to use a „zero-emission“ source to evaluate a measurement system