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

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## 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) |

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## Test vehicles

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<tbody>
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<td>Toyota</td>
<td>Avensis 2.0 D-Cat</td>
<td>Diesel</td>
<td>Direct</td>
<td>1995 / 4</td>
<td>85 / 3600</td>
<td>Catalyst particle &amp; NOx-trap (D-cat)</td>
<td>Corderite</td>
<td>Euro 4</td>
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<tr>
<td>Opel</td>
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<td>Diesel</td>
<td>Direct</td>
<td>1910 / 4</td>
<td>110 / 4000</td>
<td>Catalyst particle trap (CSF)</td>
<td>Si-SiC</td>
<td>Euro 4</td>
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<tr>
<td>VW</td>
<td>Passat 2.0 TDI</td>
<td>Diesel</td>
<td>Direct</td>
<td>1968 / 4</td>
<td>100 / 4000</td>
<td>Fuel borne (Fe) catalyst particle trap (FBC-DPF)</td>
<td>Si-SiC</td>
<td>Euro 4</td>
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<tr>
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<td>Gasoline</td>
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<td>85 / 5800</td>
<td>NOx-trap</td>
<td></td>
<td>Euro 4</td>
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Experimental Set-up

Evaporation tube (300 °C)

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}\text{-limit value}” after well defined pre-conditioning.
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A manuscript of this work was submitted to a scientific journal for publication. For the reason of copyright the results can not be present at this place.

Thank you for your understanding.