Evaluation of measuring methods for particle emissions from modern diesel vehicles in periodic emission control

A. Jordan-Gerkens¹, A. Nowak¹, A. Marmakos², A. Krasenbrink³, N. Böse¹, V. Ebert¹

¹ Physikalisch-Technische Bundesanstalt (PTB), 38116 Braunschweig, Germany
² Joint Research Centre - Institute for Energy and Transport, JRC-IET, EC, Via E. Fermi 2749, I-21027 Ispra (VA), Italy
³ Center of Smart Interfaces, TU Darmstadt, Petersenstraße 32, 64287 Darmstadt

Motivation:
Since 1992 exhaust gas emission testing in regular periodic inspection checks in the EU [92/55/EEC]
- ensuring low level emissions over the useful life of the vehicle
- harmonizing the test procedures
- opacity of the diesel exhaust fumes as an adequate indicator (simpler, quicker and less expensive procedure)

"This Directive will be adapted from time to time to take into account developments in vehicle construction which facilitate in-service testing and in test methods which reflect more closely the actual conditions in which a vehicle is used".

Objectives:
- Metrological background for the measurement of particle concentration in exhaust gases of diesel vehicles in periodic emission control
- Validation of novel instruments provides ideas for new developments of instruments
- Support for the adaption of the periodic exhaust emission control to technical progress
- Trusted periodic emission control

Research activities:
Evaluation of measurement devices and metrological procedures for the periodic emissions inspection of modern diesel vehicles.

The various candidate instruments operate on different physical principles, therefore, measure different aerosol properties. Hence, the candidate instrumentation will be assessed via comparative measurements of the particle number concentration (PN) and/or the aerosol opacity.

Your expertise in new devices measuring particle concentration in PTI

If you are developing or have already developed such instrumentation (even as a prototype) and you are interested in participating in the measurement campaign, please get in touch with us.

Candidate Instrumentation

Report:
Consistent requirements specified for novel measuring instruments (prototypes) and comparison with European legislative requirements
published 03/2012 at the ENV02-website

Planned activities:

Laboratory tests at METAS, MIKES and PTB:

Performance characteristics:
- measurement accuracy
- sensitivity
- dynamic response
- sample pressure or temperature effects on the instrument response will be assessed for the complete system, including necessary sampling and conditioning devices.

Calibration aerosol:
- soot aerosol from CAST or other combustion sources
- number concentrations: \(10^2\) to \(10^5\) cm\(^{-3}\)
- light extinction coefficients: \(0.01\) m to \(3.0\) m\(^{-1}\)
- polydisperse aerosols with geometric mean diameter of 50 to 100 nm and geometric standard deviation of 1.6 to 2.0

Applicability of novel measuring instruments in field tests:
- Suitable instruments identified in the laboratory have to be tested in field measurements at JRC/IE
- User handling experience with the novel instruments under service conditions at service organisations in cooperation with PTB

Acknowledgement:
We thank the other ENV02WP2-partners, Jürg Schlatter and Felix Lüönd from METAS (CH) and Richard Högström from MIKES (FIN) for the fruitful discussions.