18th ETH-Conference on Combustion Generated Nanoparticles
June 22-25, 2014,
ETH Zurich, Switzerland

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OBD vs. Tailpipe Testing - Future Test Options for Emission Control Systems of Modern In-Use Vehicles

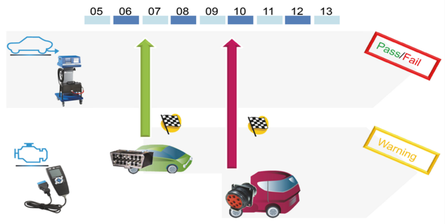
OBD vs. Tailpipe Testing - Future Test Options for Emission Control Systems of Modern In-Use Vehicles

A drastic reduction in the emissions of new vehicles has been achieved over the last 20 years, with the introduction of strict worldwide regulations for reduction of all exhaust emissions. In this context also, PTI (Periodic Technical Inspections) schemes have to follow the development of modern vehicle technology. PM as well NOx as measurement now seems due for a further stage of development.

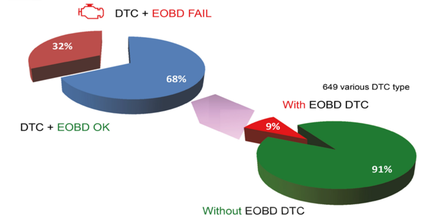
Both pollutants (PM and NOx) are reduced by complex exhaust after-treatment systems and engine internal solutions. High vehicle emission rates are often a result of component aging, component failure, or generally poor maintenance. There has also been an increasing in the tampering of emission systems over the last years to avoid high repair costs. PTI emission tests allow a quick and reliable evaluation of the whole emission related systems to determine whether in-service vehicles conform to their design emission levels. PTI emission test requirements and thresholds have not kept pace with development in vehicle technology and type approval procedures (especially for Euro 5 and 6). Updates to the legislation, instruments and procedures are therefore necessary.

Keywords: PM, NOx, Air Quality, OBD, Vehicle Emission Testing, Diesel and Petrol/Gasoline Emissions, Non-Road Emissions

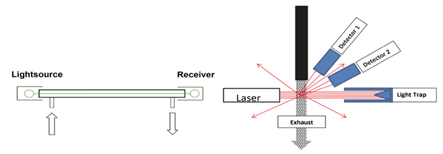
Comparison OBD/Tailpipe Measurement
Made by UTAC/OTC



Focus on EOBD DTC

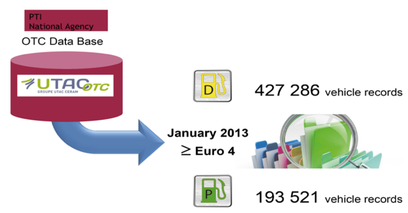


Opacimeter – Laser Scattering Device



Handling MET : Smart, Clear and Light

The French Landscape:
Sample's Extraction from OTC Data Base

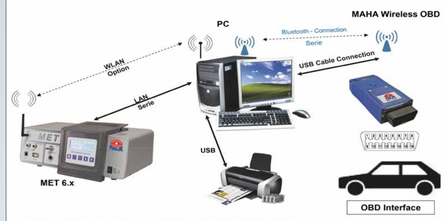


Comparison OBD/Tailpipe Measurement
Made by UTAC/OTC

This is a first level of analysis… more data are available (since 2007!).
Trucks data are also available.
Noticeable:

- No direct correlation between Tail pipe and EOBD for Diesel and Petrol.
- Tail pipe test is more severe.
- Diesel Tail pipe test are relevant on Euro 4 vehicle car park
- Ratio of MIL off when engine is off, and key on, are related to attempted fraud
- Visual MIL inspection are less efficient than electronic reading (delta between MIL KO Engine ON Visual and MIL KO Engine ON internal)
- Additional analysis might be required in order to understand the level of EOBD DTC presents without MIL trouble

Equipment configuration



All wireless connections are also available with cables.

Some Pilot Programs Worldwide

Austria	France	Poland
Australia	Germany	Portugal
Belgium	Ireland	Singapore
Czech Republic	Italy	Spain
Chile	Japan	Sweden
Ecuador	Korea	Switzerland
Denmark	Netherlands	United Kingdom
Hungary	Norway	United States

Exposure Levels in the EU

Percentage of the urban population in the EU exposed to air pollutant **concentrations above the EU and WHO reference levels (2008–2010)**

Pollutant	EU reference value	Exposure estimate (%)	WHO reference level	Exposure estimate (%)
$PM_{2.5}$	Year (20)	16–30	Year (10)	90–95
PM_{10}	Day (50)	18–21	Year (20)	80–81
O_3	8-hour (120)	15–17	8-hour (100)	> 97
NO_2	Year (40)	6–12	Year (40)	6–12
BaP	Year (1 ng/m³)	20–20	Year (0,12 ng/m³)	93–94
SO_2	Day (125)	< 1	Day (20)	58–61
CO	8-hour (10 mg/m³)	0–2	8-hour (10 mg/m³)	0–2
Pb	Year (0.5)	< 1	Year (0.5)	< 1
C_6H_6	Year (5)	< 1	Year (1.7)	7–8

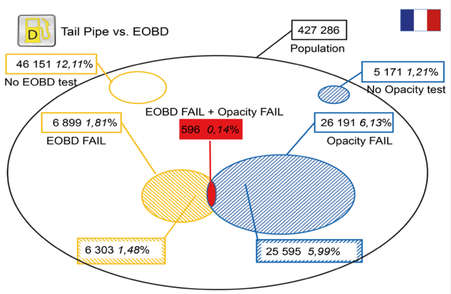
Colour coding of exposure estimates fraction of urban population exposed to concentrations above the reference levels:

< 10 %	10–50 %	50–90 %	> 90 %

Source: Air Quality in Europe – 2011 Report from European Environment Agency

European Environment Agency

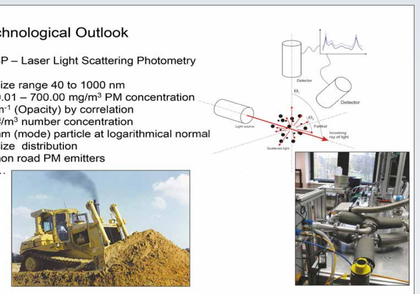
Tail Pipe vs. EOBD



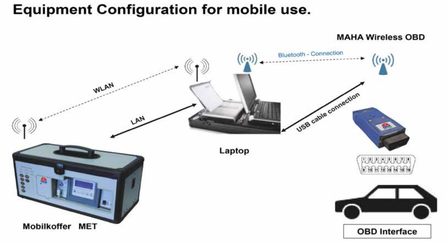
Technological Outlook

LLSP – Laser Light Scattering Photometry

- size range 40 to 1000 nm
- 0.01 – 700.00 mg/m³ PM concentration
- m^{-1} (Opacity) by correlation
- #/m^3 number concentration
- nm (mode) particle at logarithmical normal size distribution
- non road PM emitters
- …



Equipment Configuration for mobile use.

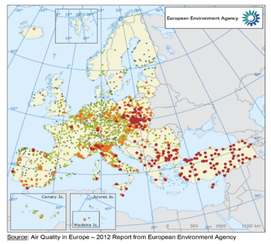


All wireless connections are also available with cables.

Technical Data MET 6.3

Gas Analyzer	
Gas	HC, CO, CO_2, O_2, NO_x ($NO+NO_2$), NH_3 Lambda
Measurement principle: - Infrared - Electro chemical - Chemical	HC, CO, CO_2 O_2, NO NO_x, NH_3
Power supply	110 – 230 V/ 50/60 Hz 10 – 32 V
Measurement accuracy class	0 OIML
Dimensions (L x W x H)	406 x 225 x 160 mm
Weight	5 kg
PM / Opacity Analyzer	
Measurement principle	Laser Light Scattering
Measurement range PM	0,01 – 700,00 mg/m³
Measurement range Opacity	0-100 % (0-9,99 k value)

Exceeding PM_{10} Limits in Europe



Annual mean particulate matter (PM_{10}) 2010, based on daily average with percentage of valid measurements ≥ 75 % in µg/m³
- ≤ 20
- 20–31
- 31–40
- > 40
- Countries/regions not included in the data exchange process

The red dots indicate stations reporting exceedances of the 2005 annual limit value (40 µg/m³), as set out in the Air Quality Directive (EU, 2008c).

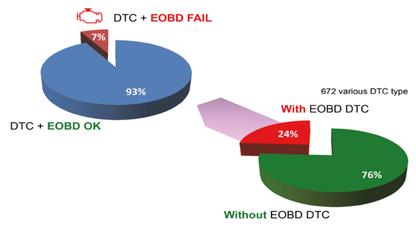
The orange dots indicate stations reporting exceedances of a statistically derived level (31 µg/m³) corresponding to the 24-hour limit value, as set out in the Air Quality Directive (EU, 2008c).

The pale green dots indicate stations reporting exceedances of the WHO air quality guideline for PM_{10} of less than 20 µg/m³ but not in exceedance of limit values as set out in the Air Quality Directive (EU, 2008c).

The dark green dots indicate stations reporting concentrations below the WHO air quality guideline for PM_{10} and implicitly below the limit values as set out in the Air Quality Directive (EU, 2008c).

Source: Air Quality in Europe – 2012 Report from European Environment Agency

Focus on EOBD DTC



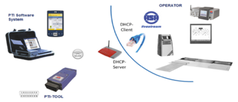
Summary

For an Environmental effective Diesel and Petrol Emission Test it is necessary to have a modern Mechatronic System.

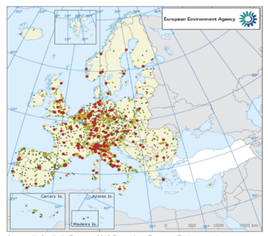
OBD + Tail Pipe = is the **U**ltimate **D**iesel and **P**etrol **E**mission **T**est **S**ystem **for an 100% PTI or garage test for Diesel and Petrol Emissions.**

Especially for modern diesel-powered vehicles equipped with a emission after treatment system such as a diesel particulate filter, SRC, SRCT,…, only this combination of tests ensure the effectiveness of the emission test during PTI.

The above mentioned measuring instruments are available today.



Exceeding NO_2 (Nitrogen Dioxide) Limits in Europe



Annual mean nitrogen dioxide 2010, based on hourly average with percentage of valid measurements ≥ 75 % in µg/m³
- ≤ 20
- 20–40
- 40–45
- > 45
- No data
- Countries/regions not included in the data exchange process

Red dots correspond to exceedances of the annual limit value + 5 µg/m³.

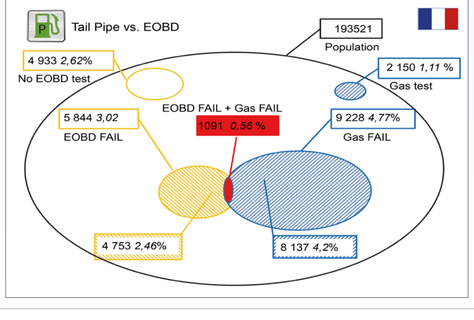
Orange and red dots correspond to exceedances of the annual limit value (40 µg/m³).

The pale green dots indicate stations reporting exceedances of the WHO air quality guideline for NO_2 but not in exceedance of limit values as set out in the Air Quality Directive (EU, 2008c).

The dark green dots indicate stations reporting concentrations below the WHO air quality guideline for PM_{10} and implicitly below the limit values as set out in the Air Quality Directive (EU, 2008c).

Source: Air Quality in Europe – 2012 Report from European Environment Agency

Tail Pipe vs. EOBD



Emission Test Sticker – European Directive 2010/48

- So far no particular place where the information has to be found e.g. Type Plate, Door Frame, etc.
- Emission Directive: Turbidity from the **Plate Value (here 0.80)**; in case this value is not available or because of a technical reason not applicable the following values are given:

Registration before 1.10.2006 max. 2,5 1/m
Registration after 1.10.2006 max. 1,5 1/m (Modus B)

Quelle: TÜV NORD