



Berne University of Applied Sciences Biel-Bienne | Switzerland AFHB | IC-Engines and Exhaust Gas Control



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Abstract

Due to possible malfunctions of the exhaust aftertreatment systems the stability of Diesel engines emissions should be periodically controlled. VERT has developed inspection methods for retrofit emission-control devices, which have been proven so efficient, reliable and cost effective that they are to be recommended herewith for all engines and applications:

Diesel Oxidation Catalyst (DOC)



TeVeNOx Testing of Vehicles with NO_x Reduction Systems (SAE 2014-01-1569)

<u>3 Types of Vehicle Tests</u>

TEST TYPE 1

Selective Catalytic Reduction of NO_x (SCR)

• HD Chassis Dynamometer

TEST TYPE 2

• Parcours on the Road (real world operation)

TEST TYPE 3

• Simple Function Test (short operation on the road)

DOC might be covered by soot





DOC Light Off test set-up

Vehicle E on the MAN HD chassis dynamometer with OEM SCR & retrofitted DPF



SAMPLING POSITIONS ON VEHICLE F



DOC, Conversion Efficiency: A DOC may be part either of a DPF-system or of an SCR-system or even standing alone. It may be inhibited by thermal or chemical poisoning or contamination. DOC-conversion efficiency depends primarily on temperature: In oxygen rich Diesel exhaust, conversion of CO to CO₂ starts at about 170°C and it reaches its full conversion level at about 210°C (light-off). By means of a load step at constant rpm, conversion capability of a DOC is determined very accurately and in very short time: Heating the exhaust gas up to 250°C on a simple roller-dyno and measuring the CO concentration curve during cooling down at the tail pipe – or inverse. This procedure reveals the exact status of the DOC within a few minutes.

SCR, Functionality of Selective Catalytic NO_x-Reduction: Functionality requires both, proper catalytic conversion of the SCR-catalyst system and the accurate injection of the urea-water solution "Adblue" to be done at the minimum permissible temperature. Again a simple load step enables to check all functions in one single run. Either heating the exhaust gas from idling temperature 150°C to 250°C, or following the cooling curve from 250° C to idle with a NO_x sensor at the tail pipe reveals, whether urea is injected, whether the right amount is injected, whether it is injected at the right temperature and whether the catalyst conversion is on the expected level. After this simple test, at any engine speed selected all required information is available. An even more precise control test is possible by an additional NO_x -measurement (sensor) upstream of the SCR.

Conclusions

CO-conversion test during engine cooling at idle after road operation

 \rightarrow is easy to perform and fast

 \rightarrow confirms proper function of DOC

\rightarrow detects malfunctions

- → Supplies quantitative data to either clean or replace the CRT-DOC
- \rightarrow if there is a coated DPF it needs measuring access after DOC

Conclusions

- The switch-on test & the OEM NO_x-sensors are appropriated tools for the in-use control
- For OEM: SWOFF at idling not possible but special test procedures possible
- The SCR-systems are not active at lower temperatures < 200°C

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