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26. Juli 2012

**In use compliance and real world emission test results of two Passat Diesel Euro 5b vehicles, TNO-060-DTM-2012-01373**

Dear [redacted]

In response to the meeting held on the above subject at TNO on April, 4th we would like to give the following statements on the questions raised during the meeting.

Q1: Check the possibility to extract data from the CANbus regarding the EGR cooler temperature.
A1: The EGR cooler is not equipped with a temperature sensor, therefore there is no such signal in the CANbus.

Q2: Check if there are similar COP experiences regarding the NOx strategy.
A2: Please refer to the attached graphic indicating COP results of the Passat BlueMotion 1.6/77kW.

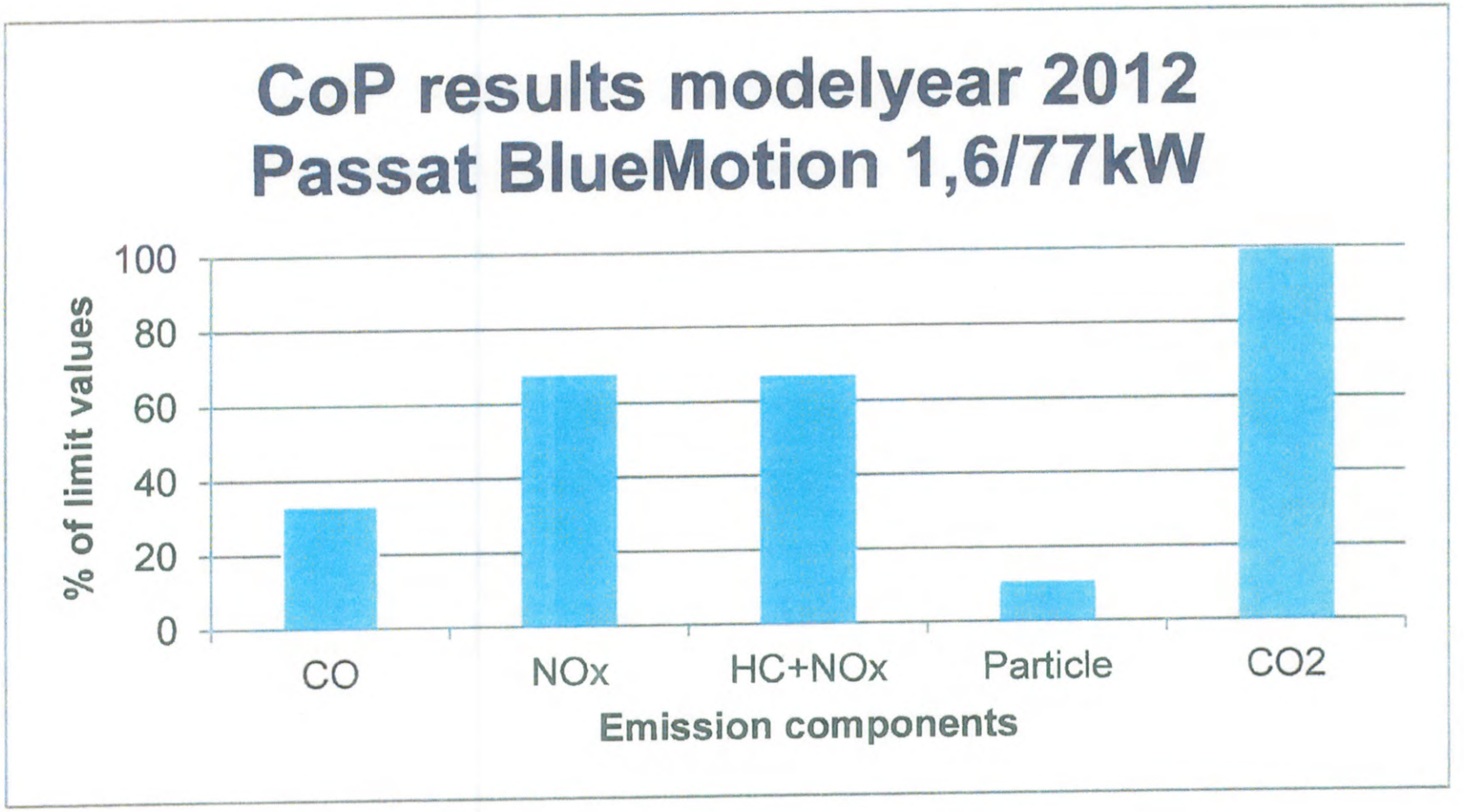
Q3: A description / explanation of the EGR system and a possible cause for the differences in the EGR strategy.
A3: Please refer to the attachment "Clarification of the EGR-Strategy".

Additional information on topics discussed during the meeting.
1. Background information on the consequences of restarting the engine during the test cycle.
Please refer to the attachment "What happens when the ignition is switched at 230 seconds?".

2. Comment on the conclusion of TNO regarding the reproducing of the CO2 results.
Please refer to the attachment "CO2-figure reproducing".

Please feel free to contact us in case of any further need for clarification.

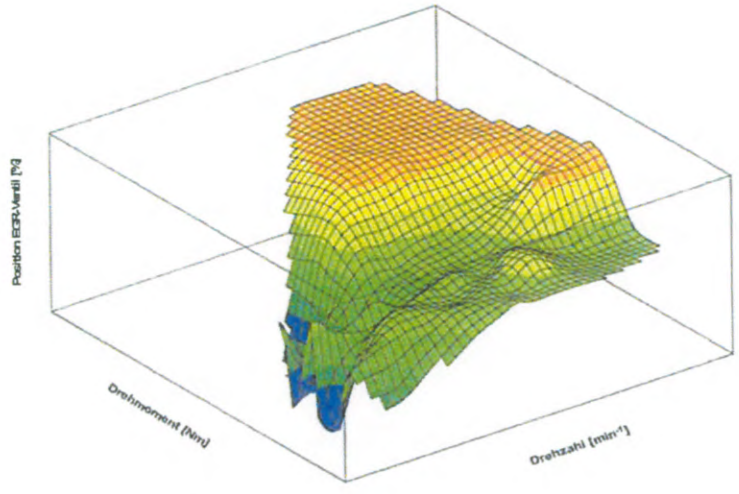
[redacted]


CoP results modelyear 2012
Passat BlueMotion 1,6/77kW
% of limit values
100
80
60
40
20
0
CO
NOx
HC+NOx
Particle
CO2
Emission components

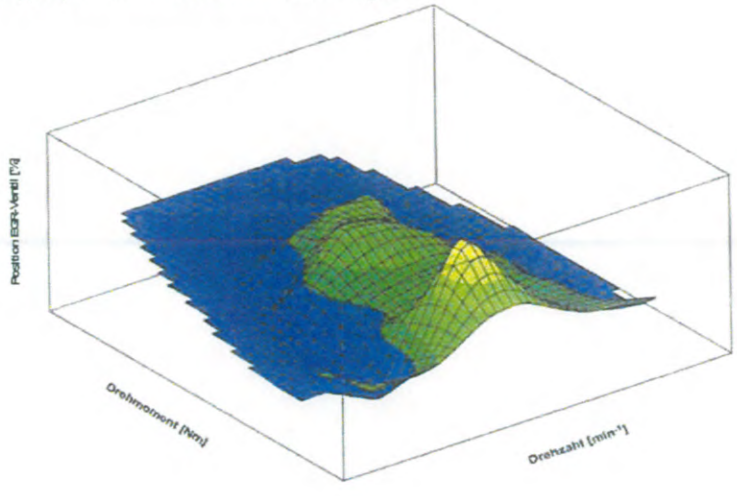
## Clarification of the EGR-Strategy

### Connection between EGR-Rate and engine load, speed and temperature

EGR capability reduces with increasing engine load and speed and in connection with the coolant temperature. Therefore the EGR rate is continuously amended to interpolated mapped values dependant on the engine load, speed and temperature. The EGR Rate depends on the position of the EGR valve and the pressure differential over the EGR routing. The engine management dictates the EGR valve position rather than the EGR rate. (CAN-Signal *EGR %*).




Graphic: Mapped position of the EGR valve for a cold engine




Graphic: Mapped position of the EGR valve for a warm engine

### Dependency on coolant circuit

The cooling performance of the EGR cooler is dependent on the temperature of the coolant. The potential NOx reduction is therefore also coolant temperature dependent and the EGR rate has to be modified in response to the coolant temperature.

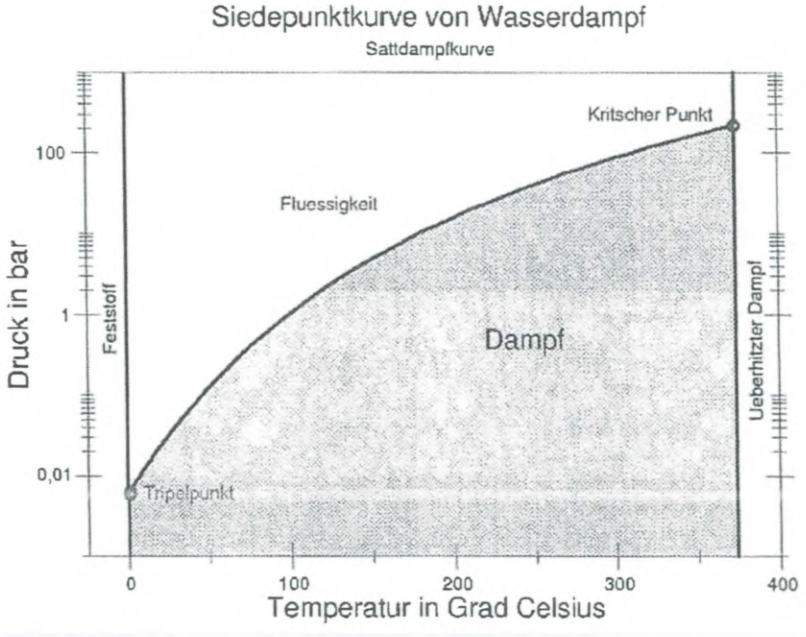
### Brief closing of the EGR valve during drive away

The EGR valve can be briefly closed at drive away in order to prevent excessive particulate emissions, improve driveability and to support the build-up of turbo pressure.

### Closing of the EGR valve during overrun

During overrun the EGR valve will be closed to permit an OBD monitor of the air flow meter (no combustion, no influence on emissions). Due to the required level of precision, this monitoring is only performed with a fully warm engine.

### Avoidance of acids and condensation




Graphic: Water status

Below the dew point there is a risk of production of chemically aggressive condensates in the EGR cooler, very small quantities of which can lead to component damage. These condensates are generated below 180°C. In order to fully prevent these products the EGR rate has to be modified and the EGR cooler bypass used in response to exterior temperature, coolant temperature and intake air temperature.

### Varnish and soot accumulation

At low operating temperatures, products of combustion can be deposited on components, deteriorating their functionality. In order to avoid this deposition, the EGR rate has to be modified and the EGR cooler bypass used in response to exterior temperature, coolant temperature and intake air temperature.

## Freezing

When the exhaust gas temperature is below the dew point there is the risk of water condensation which can form ice on cold components thereby disrupting their functionality. In order to prevent this the EGR rate has to be modified and the EGR cooler bypass used in response to exterior temperature, coolant temperature and intake air temperature..

**What happens when the ignition is switched at 230 seconds?**

The electrical heating of the lambda sensor may only be switched on when the sensor is dry and will remain dry in order to prevent damage through thermal stress. Therefore a model is started at engine start to predict whether water could be present in liquid form. Once the dew point has been reliably exceeded, the lambda sensor is released for use. Diesel engines need considerably more time for this dew point level recognition due to the mass and volume flow rates. If a drive cycle is ended with the ignition switch before the dew point has been exceeded, the risk of component damage due to condensate on the lambda sensor and other exhaust system components is elevated. Due to the higher aggressivity of warm condensates and the raised concentrations after repeated short drive cycles, the EGR rate also has to be adapted for repeated warm starts. In the case of repeated cold starts, the condensates are re-cooled and the base strategy can be retained. In regular start stop operation the engine ECU remains powered whilst the engine is off and continues to model water content and temperature. In this case the component protection mechanisms are considered.

**CO2 figure reproducing**

The different emissions in the emission test are not comprehensible to us. There is a difference in CO2 emissions of around 10% between the 5th and the 13th of December despite identical preconditioning according to the paperwork. Reasons could be implausible vehicle reactions due to non activated dyno mode in combination with inconsistent battery charge status. We rule out the influence of different types of pre conditioning.