



## Basics of Exhaust Gas Purification

Proposal for 2-day in-house workshop / 4 or more people  
Date according to individual arrangement

Speaker: Stefan Carstens, Director, EngineSens Motorsensor GmbH

### First Day:

#### Pollutant formation, legal framework, Gasoline engine exhaust treatment

- ❖ Pollutant-formation mechanisms
- ❖ Emission legislation: Europe and USA
- ❖ Driving cycles in Europe and USA
- ❖ Requirements for today's exhaust systems
- ❖ Current status of engine concepts and systems for exhaust
- ❖ Existing concepts and combinations of different systems in relation to future emission legislation
- ❖ CO<sub>2</sub> – The global challenge for the Automotive industry
- ❖ Emission control of stoichiometric gasoline engines and of modern stratified charge combustion

### Second Day:

#### Exhaust aftertreatment of diesel engines

- ❖ Emission control for diesel engines
- ❖ Presentation of different filter systems from metals to ceramics with specific application requirements
- ❖ Regeneration and methods of operation
- ❖ Interaction between the motor control and particulate filter system with soot loading models
- ❖ Importance of sensors for exhaust gas aftertreatment systems
- ❖ Sensors related to emissions must be controlled
- ❖ The next generation of diesel vehicles. First particle sensors – Functional and application notes

Compliance with current and future emission limits, and the continuous reduction of CO<sub>2</sub> - Emissions are current issues facing the automotive industry. This requires optimizing the Interplay of internal engine modifications and aftertreatment of exhaust gases.

Exhaust gas aftertreatment still is under development in cars and trucks. Changing conditions are creating new challenges for development engineers. Learn about optimal methods or alternative approaches.

The future emission limits for diesel engines require a further reduction in particulates and nitrogen oxide emission while reducing carbon dioxide. To comply with emission limits, a development of catalytic exhaust gas treatment in conjunction with new DeNO<sub>x</sub> – systems becomes essential.

*Get to know the emission control measures at this seminar and learn about different methods to achieve Present and future limits.*

## First day of the seminar:

### Pollutant formation, legal framework, gasoline engine exhaust treatment

#### Welcome and Introduction

#### Pollutant Formation

- ❖ conflict nitrogen oxides - ozone
- ❖ Particles forming agglomerates
- ❖ Effects on the environment

#### Emission standards and limits in Europe and the U.S.

- ❖ EU legislation
- ❖ U.S. CARB
- ❖ U.S. Federal

#### Driving cycles

- ❖ NEDC for Europe
- ❖ The advanced European 13-step test ESC for trucks
- ❖ U.S. driving cycles (FTP-75, U.S. 06)

#### Emission aftertreatment for spark engines with stratified charge

- ❖ Strategy of the exhaust aftertreatment
- ❖ Capabilities and limitations of the NO<sub>x</sub>-Trap

#### Diesel particulate filter (DPF)

- ❖ Importance of the oxidation catalyst for the DPF
- ❖ Temperature management
- ❖ Types of DPF (geometry, filter materials)

#### Additive systems

- ❖ The French FAP-System®
- ❖ Filter regeneration and ashes
- ❖ Methods to increase exhaust gas temperature
- ❖ Retrofit solutions for off-road applications
- ❖ Importance of the oxidation catalyst for the downstream DPF system

#### Ceramic wall-flow filter

- ❖ Silicon carbide, cordierite, aluminum titanate catalytic coating
- ❖ Filter regeneration

#### Metal substrate systems

- ❖ Sintered metal
- ❖ Metal foams
- ❖ Filter catalyst systems (z.B. PM-Kat)



## Second day of the seminar:

### Exhaust aftertreatment for diesel engine

#### Catalytic DPF systems

- ❖ Practical examples
- ❖ Implementation of related sensors
- ❖ Filter monitoring, load model
- ❖ Regeneration, regeneration interrupted of soot loading model
- ❖ Influence of geometry on ash storage behavior
- ❖ Combined systems: e.g. Toyota DPNR®

#### Methods of De NO<sub>x</sub>

- ❖ The SCR system as a panacea?
- ❖ Which additives are possible?
- ❖ The commercial vehicle industry as a leader?
- ❖ High and low pressure EGR: advantages and constraints
- ❖ SCR for gasoline engines

#### Combination systems

- ❖ With DPF and SCR to the next level of emissions
- ❖ T2B5 vehicles in U.S.
- ❖ Trends and developments

#### Absolute or differential pressure measurement?

- ❖ Application of diesel particulate filters
- ❖ Function and structure
- ❖ Installation instructions
- ❖ Signal processing

#### Soot sensors

- ❖ Possibilities and methods of particle sizing
- ❖ Soon in series? Soot sensor with IDC and resistance measurement capabilities and limitations
- ❖ Installation instructions
- ❖ The choice of substrates: crucial for the OBD?

#### Looking to the future?

- ❖ Electric vehicles with range extenders



### Your Speaker

**Stefan Carstens** started his career in 1990 at a company near Pforzheim specialized in antenna technology. Three years later he moved to the Heraeus Group and in the latter's sensor technology division. He passed through numerous departments, including production engineering and control, before taking over the group's Freiberg am Neckar sales office as key account manager for exhaust gas sensors. In March 2001 he was put in charge of a sensor company located in Mannheim. In May 2010 he founded EngineSens Motorsensor in Viernheim with the main focus on sensors for exhaust gas aftertreatment systems for the automotive industry, power stations and renewable energies. He studied engineering at the former TH Darmstadt and left with a diploma.

### Timetable of the seminar

08:30	Beginning
10:00	Coffee break
12:00	Lunch
15:00	Coffee break
17:00	End