Session: NGVs – Keeping Pace with Fuel Efficiency Improvements

Presentation:

Fueling the Future with Natural Gas Powered Commercial Vehicles

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Fueling the Future with Natural Gas-Powered Commercial Vehicles

Powertrain Technology

- Emissions
- Performance
- Cost
- Packaging
- Requirements

Commercial Vehicles

- Off Highway (19-560kW)
- On Highway (MD, HD)

- Injection system
- Diagnosis & Service
- Measurement & test devices
- Engineering & calibration
- ETAS
- Engine control
- Exhaust after treatment

- Electr. Remote Control
- Pneumatics
- Air system
- Exhaust
- Filters
- Waste Heat Recovery
- Electric Hybrid

- Diesel Systems

CNG / Dual fuel

NGV GLOBAL 2014
Status Quo – Natural Gas Engines

- Inexpensive fuel
- Retrofits with basic fuel injection and no emissions requirements
- No on-board diagnostic (OBD) requirements
- Durability / reliability requirements to be improved
Future Requirements – Natural Gas Engines

• Remain competitive in case of rising fuel cost
• Provide reliable OEM solutions
• Meet OBD requirements
• Meet methane emission regulations
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Natural Gas Engines

Dual Fuel – Diesel/NG

Spark-Ignited NG

Different technologies are available

Diesel Systems
Various methods exist to introduce fuel to the engine

- **CPI: Central Point Injection**
- **MPI: Multi Point Injection**
- **DI: Direct Injection**
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Natural Gas Engine Configuration

Multi-point, spark-ignited, stoichiometric, with EGR to meet future requirements

Diesel Systems
Increasing NG Engine Efficiency

1. Exhaust Gas Recirculation
2. High Energy Ignition
3. Cylinder-Specific Injection
EGR – Exhaust Gas Recirculation

Reduces combustion temperature

EGR is an enabler for future requirements
EGR – Exhaust Gas Recirculation

Enables diesel engine peak torque with natural gas
EGR effect on NOx emissions

Engine out NOx

Increasing EGR

Spark Timing  Advance

Enabler to reduce NOx emissions
EGR effect on Fuel Economy

Increasing EGR

Fuel Consumption

Spark Timing  Advance

Enabler to improve efficiency
High Energy Ignition

Enabler for increased EGR
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High Energy Ignition

Increasing ignition energy benefits fuel efficiency and emissions

Diesel Systems

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Cylinder-Specific Injection

Enabler for combustion optimization
Types of Cylinder-Specific Injection

- **MPI: Multi Point Injection**
- **DI: Direct Injection**
- **MP-OVI: Multi-Point, Open Valve Injection**

Each has advantages and disadvantages.
MP-OVI: Multi Point – Open Valve Injection

OVI enables on-demand cylinder fueling with low injection pressure
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Bosch Systems

Mature product portfolio

Diesel Systems
Conclusion

Natural Gas is an attractive alternative primary energy source for transportation

- Potential for reduction of emissions
- Abundant supply in North America
- Attractive fuel prices

Different engine strategies being pursued in North America (SI & DF). Bosch technologies are available to support both paths.

Application of EGR, high-energy ignition, and advanced injection technology reduce emissions and improve efficiency.
Thank You!

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