Monday, January 23

Keynote Speaker
Session Code: LDDKN
Room 150 A&B

Session Time: 1:00 p.m.

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<tr>
<th>Time</th>
<th>Paper No.</th>
<th>Title</th>
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<tr>
<td>1:00 p.m.</td>
<td>ORAL ONLY</td>
<td>Review and Status of EPA Tier 3, GHG, and Vehicle Compliance Programs</td>
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In this session, EPA will present a review and current status of the Tier 3 vehicle and gasoline fuel emission control program, the status of the EPA light-duty vehicle greenhouse gas standards, and an overview of EPA's vehicle emission compliance program, including the use of PEMS as a compliance tool.

William Charmley, US Environmental Protection Agency

Monday, January 23

Lean Emissions Control
Session Code: LDD100
Room 150 A&B

Session Time: 1:30 p.m.

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<tr>
<td>1:30 p.m.</td>
<td>ORAL ONLY</td>
<td>Lean Gasoline Direct Injection Engine Emission Control</td>
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Lean operation of gasoline direct injection (GDI) engines offers substantial fuel economy benefits over the common stoichiometric GDI engine. However, NOx emissions control for lean engines is more challenging. Passive selective catalytic reduction (SCR) is a potential pathway toward regulatory compliance, but fuel penalty and system cost must be minimized. Studies of lean GDI engine NOx control will be presented showing catalyst formulation and engine system effects.

James E. Parks, Oak Ridge National Laboratory

1:55 p.m.  ORAL ONLY  Potential Diesel Emission Control Systems for 2025

Urea SCR based systems have been proven an effective technology for diesel vehicles to meet current emission standards, but the tightening legislation for 2025 pose additional challenges on the systems. The trade-offs of different SCR system architectures will be discussed in relation to future legislation together with the addition of NOx storage based catalysts for enhanced system performance. The attributes of both Lean NOx Traps and dCSC (diesel cold start concept) catalysts will be highlighted for improving the system performance.

Julian P. Cox, Johnson Matthey Inc.
By 2025, the fleet average fuel economy of light duty vehicles will increase by 25-40%, driven by US CAFE standard, EU CO2 mandate and regulations in other regions. Compared to stoichiometric counterparts, lean-burn gasoline direct injection (GDI) vehicles provide a notably improved fuel efficiency at the cost of a more sophisticated emission control system. This talk begins with an overview of challenges of lean GDI catalyst systems. Emphasis will be placed on NOx abatement concepts covering gasoline lean NOx trap, passive catalytic selective reduction and control of N2O emission.

Xiaolai Zheng, BASF Corp.

2:45 p.m. Panel Q&A Panel with Speakers

Monday, January 23

Stoichiometric

Session Code: LDD200

Room 150 A&B  Session Time: 3:30 p.m.

Chairpersons - Louise Arnold, Johnson Matthey Inc.

Moderators - Louise Arnold, Johnson Matthey PLC

Time  Paper No.  Title

3:30 p.m.  ORAL ONLY  Sulfur Tolerance of Catalysts for Propane Engine Cold Start NOX Emissions Control

Propane is a cost-competitive, low CO2 alternative to gasoline. Today, stoichiometric engines operating on propane often use gasoline three-way catalyst formulations to effect emissions control. Nationally, the average sulfur level in propane fuel is about 40 mg/kg, leading to higher sulfur levels in the exhaust gasses than from Tier 3 gasoline. This study compares catalyst formulations and demonstrates that catalyst formulation and sulfur purge strategies are effective methods for reducing sulfur poisoning effects on NOX emissions control.

Michael G. Ross, Southwest Research Institute

3:55 p.m.  ORAL ONLY  Application of the Ultera® Dual Stage Catalyst System to Gasoline-Fueled Passenger Vehicles

Vehicle emission standards are becoming more stringent and Ultera technology, originally developed for stationary NG engines, has introduced a second catalyst for removing CO and NMOG, without NOx reformation. The technology was applied to gasoline DI vehicles subjected to dramatic transient loading. Compliant light duty vehicles were tested and showed significant reductions in NMOG and CO with no negative impact on fuel economy. Future work will focus on further NOx reduction through catalyst formulation and system integration.

Ahmed F. Ghoniem, Massachusetts Institute of Technology
4:20 p.m.  ORAL ONLY  Impact of LEV-III and Tier-III Emission Regulations
The roll-out of the LEV-III and Tier-III emission standards is underway along with the federal fuel economy standards. This work presents an example of a NA emission roll-out, and highlights the upcoming changes in vehicle certifications as fleet emissions are reduced by 7 mg/mile/year. It includes examples of recent improvements in cold start calibrations and proposes that TWC catalysts are not only designed for emissions but also fuel economy. CO2 emissions of various PZEV calibrated vehicles during FTP cold start will be presented and future PGM usage will be discussed.
Douglas Ball, Umicore Autocat USA Inc.; David Moser, Umicore Autocat USA Inc

4:45 p.m.  Panel  Q&A Panel with Speakers

Tuesday, January 24

Real World Emissions
Session Code:  LDD300
Room 150 A&B  Session Time:  9:00 a.m.
Chairpersons -  William Imoehl, Continental Corp.
Moderators -  William Imoehl, Continental Corp.

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<tr>
<td>9:00 a.m.</td>
<td>ORAL ONLY</td>
<td>Real World Driving: European Legislation, Testing and Possible Influence on Catalyst Selection</td>
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<td>With the increased focus on in-use driving emissions and the changes in European Legislation moving towards RDE 6d this presentation covers a review of the latest legislation, measurement methods and cycles and comments on the impact this may have on catalyst design and selection.</td>
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<td>Louise Arnold, Johnson Matthey PLC</td>
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<tr>
<td>9:25 a.m.</td>
<td>ORAL ONLY</td>
<td>PEMS Developments and Use Cases - An Instrument’s View of Real World Emissions for Light-Duty Vehicles</td>
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<td>Euro 6c Real Driving Emissions (RDE) regulations have introduced smaller, more compact Portable Emissions Measurement Systems (PEMS) to light-duty vehicles. AVL has developed the M.O.V.E iS product line consisting of both gaseous emissions and particle number measurement systems for testing and certifying these light-duty vehicles. As innovative engine and exhaust aftertreatment technologies are introduced to the market in response to increasingly lower or near-zero emission limits, PEMS must accommodate changing vehicle emissions levels and exhaust conditions. A brief overview of the measurement technologies is given followed by discussion of RDE challenges (e.g. temperature and altitude), data analysis methods, and research and development, which focuses on comparing real world to laboratory vehicle emissions.</td>
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<td>Benjamin C. Shade, AVL Test Systems Inc.</td>
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<td>9:50 a.m.</td>
<td>Panel</td>
<td>Q&amp;A Panel with Speakers</td>
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Tuesday, January 24

Engine/Powertrain Developments
**Session Code:** LDD400  
**Room 150 A&B**  
**Session Time:** 10:30 a.m.

**Chairpersons** - William Imoehl, Continental Corp.

**Moderators** - William Imoehl, Continental Corp.

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<tr>
<td>10:30 a.m.</td>
<td>ORAL ONLY</td>
<td><strong>The Opposed-Piston Engine: The Next Step in Vehicle Efficiency</strong></td>
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<td>The opposed-piston engine delivers a step-wise improvement in brake thermal efficiency over the most advanced conventional four-stroke engines and will help OEMs meet pending emissions and fuel economy regulations in a cost effective manner. This presentation will provide an overview of the Opposed-Piston Engine and its inherent efficiency benefits, as well as performance and emissions results from prototype engines. These results will demonstrate the OP Engine's ability to substantially improve fuel economy over the best engines in the same class, and comply with U.S. CAFE 2025 (Tier 3) emissions standards.</td>
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<td>Ashwin A. Salvi, Achates Power</td>
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<td>10:55 a.m.</td>
<td>ORAL ONLY</td>
<td><strong>Aftertreatment for Low-temperature Combustion and US Tier3 Bin30 Emissions</strong></td>
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<td>As part of a US DOE program, Delphi and partners are developing a Gasoline Direct Injection Compression Ignition (GDCI) engine that utilizes partially premixed compression ignition ¿fulltime¿ without combustion mode switching. This low-temperature combustion process produces diesel-like efficiency with low engine-out NOx and PM emissions over the full operating map. This talk will review emissions levels from Gen2 GDCI engines, aftertreatment requirements, and proposed aftertreatment systems.</td>
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<td>Mark C. Sellnau, Delphi Automotive Systems LLC</td>
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<td>11:20 a.m.</td>
<td>ORAL ONLY</td>
<td><strong>Boosting Technologies Development for Diesel and Gasoline to help meet CAFÉ/GHG 2025 Target</strong></td>
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<td>Emission and fuel economy regulations around the world are driving the switch from a naturally aspirated to a downsized turbocharged engine, Gasoline and Diesel mainly. The Presentation will look at the recent and future developments in engine technologies and synergies with key boosting technologies. A particular attention will be brought on emission control through usage of the boosting systems for Tier3 standard.</td>
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<td>Pierre-Jean Cancalon, Honeywell Turbo Technologies</td>
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<td>11:45 a.m.</td>
<td>Panel</td>
<td><strong>Q&amp;A Panel with Speakers</strong></td>
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**PM / PN Control**

**Session Code:** LDD500  
**Room 150 A&B**  
**Session Time:** 1:30 p.m.

**Chairpersons** - Louise Arnold, Johnson Matthey Inc.

**Moderators** - Louise Arnold, Johnson Matthey PLC

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1:30 p.m.  ORAL ONLY  Reduction of Particulate Emissions via Novel Fuels Additive Technology

Particulate emissions from DISI engines can be reduced via fuels additive technology. PM and injector tip deposit clean-up were studied in three identical vehicles. It was observed that the base fuel gave rise to an increase in particulate emissions indicative of DISI injector deposit build-up. Whereas, the test fuel showed significant reduction in particulate emissions for all three vehicles. The results observed are attributed to the thermal stability and the dosage of the additive technology.

Arjun Prakash, Shell Global Solutions (US) Inc.

1:55 p.m.  ORAL ONLY  Emerging Trends in Light-Duty Emission Control and Efficiency

This presentation will review the latest trends in light-duty engine efficiency and emission control with the intent of highlighting representative studies that illustrate the state-of-the-art. First, the authors review regulatory requirements and general engine technology approaches for light-duty diesel and gasoline applications. The presentation then reviews: gasoline and diesel particulate filter (GPF, DPF) technology; NOx control by SCR (selective catalytic reduction) and HC-based approaches; and gaseous emissions catalysts (DOC and TWC).

Timothy Johnson, Corning Inc.

2:20 p.m.  ORAL ONLY  Gasoline DI-System for EU6c Legislation and Beyond

The market share of gasoline DI engines is continuously increasing due to their high CO2 reduction potential. The challenge is to master particulate number emission requirements, especially with more severe test cycles such as the WLTC or the RDE. Continental follows a holistic approach: Fuel injection and charging are refined by the consideration of GDI engine combustion, engine controls and validated air and fuel flow CFD models. Test results have validated the effectiveness of the individual measures and the benefits resulting from the holistic system approach.

William Imoehl, Continental Corp.

2:45 p.m.  Panel  Q&A Panel with Speakers

Tuesday, January 24

Sensors, Modeling, Control

Session Code:  LDD600

Room 150 A&B  Session Time:  3:30 p.m.

Chairpersons - Pramod K. Ravindran, BASF Corp.

Moderators - Pramod K. Ravindran, BASF Corp.

Time  Paper No.  Title

3:30 p.m.  ORAL ONLY  Spray and Flow Diagnostics of Flash Boiling SCR Urea Sprays

SCR systems are helping automakers meet NOx emissions limits worldwide. Understanding AUS-32 injector sprays is critical for SCR system optimization. Better knowledge is required of urea sprays under operating conditions including those where fluid temperatures exceed the atmospheric fluid boiling point. This presentation surveys results from multiple spray and flow diagnostic techniques which further this understanding of flash boiling fluids for SCR systems.

Nic Van Vuuren, Continental Automotive Systems US Inc.
3:55 p.m.  ORAL ONLY  **SwRI's Universal SCR Model Based Controller**

Increasingly stringent emission regulations are requiring significant improvements in the control of lean-burn aftertreatment systems. The primary means of controlling NOX emissions from lean-burn combustion sources is expected to be the use of selective catalytic reduction (SCR) systems. These SCR systems require accurate and precise control of the delivery of diesel exhaust fluid (DEF) to operate at peak NOX conversion efficiency, while also minimizing NH3 slip and N2O production. This presentation will discuss the development of an advanced model based DEF dosing controller meant to provide a means of achieving LEV-III and Tier 3 NOX emission standards. This controller is designed as a universal module, which can be applied to a variety of system level architectures and sensor packages depending on the overall level of NOX control required.

*Cary Henry, Southwest Research Institute*

4:20 p.m.  Panel  **Q&A Panel with Speakers**