AVL M.O.V.E iS

A new solution for the upcoming EU6c - Real Driving Emissions (RDE) legislation

THE EU6c EMISSION REGULATION

The upcoming EU6c Emission Regulation is expected to implement major modifications and additional type approval tests in the 2017–2020 timeframe, including:

- Replacement of the NEDC by the WLTP for the determination of criteria emissions.
- Additional cold start test for Diesel vehicles including NO_x.
- Introduction of the new Real Driving Emission test in order to control the criteria emissions under all realistic driving conditions.

Here, AVL's comprehensive portfolio of solutions makes the difference. AVL can support a EU6c development project with instruments, test systems, simulation tools and services to support throughout the entire process.

AVL M.O.V.E iS

REAL DRIVING EMISSIONS (RDE)

LEGISLATIVE BACKGROUND - AIR QUALITY

Various independent sources show that the increasing stringency of the regulatory emission limits for passenger cars over the past decades has led to a considerable reduction of total emissions and, as a consequence, to improved air quality levels across Europe. However, the most recent reductions of the emission limits for nitric oxides (NO_x) and particulates (PM, PN) have not delivered further improvements. Recent air quality studies show significant exceedances for these pollutants, mainly in urban areas with high population where emissions are mainly contributed by road transport.

Today, passenger cars are still certified on emission test cycles which were designed more than twenty years ago. Recent benchmark studies clearly show that the real driving emissions of vehicles may massively exceed the regulatory emission limits which are used for the certification on the test cycles. It was found that this gap was even further increasing over the past decade.

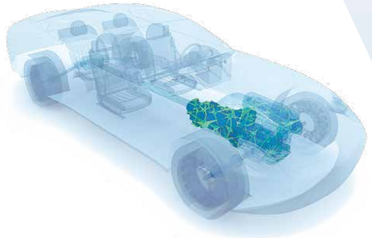
Today it is commonly agreed that a substantial reduction of the real driving emission levels is technically achievable. The upcoming EU6c - Real Driving Emission (RDE) legislation for Passenger Cars in Europe is designed to ensure that all required technical measures are implemented accordingly. Passenger car OEMs are requested to carry out tests on the road with Portable Emission Measurement Systems (PEMS) in order to prove compliance with the RDE regulation.

NEW CHALLENGES FOR ENGINES AND VEHICLE DEVELOPMENT

The Real Driving Emissions (RDE) legislation is adding the road as a new environment for emission testing and certification.

Compared to the current test environments, which are designed and optimized for perfect reproducibility and a removal of external influences, driving a vehicle on the road under "real-life" conditions will never be 100% reproducible. The influence of the road profile, the ambient conditions, the traffic situation as well as the behavior of the driver itself will significantly influence the results. One to one comparison of test results will not be possible; instead it is nessecary to handle and evaluate the test data using statistical methods.

The RDE legislation will require the engines to be clean under all operating conditions. This will impose significant challenges on the design and the calibration of engines. Here RDE can become a door opener for alternative technologies as well as for alternative development processes.



AVL OFFERS SIMULATION AND TESTING TOOLS FROM FIRST IDEAS TO OPEN ROAD

RDE is imposing new challenges and complexity on today's approach for the development of vehicles and engines.

There is certainly no single bullet to battle the ever increasing complexity but AVL's complete solution portfolio makes the difference. AVL can support any development project for RDE at all levels:

Instruments and Devices
Leading the market in various fields, AVL is committed to providing best in class performance, certified compliance with the legislations as well as easy integration in test systems.

Test Systems
AVL covers the full range of test environments, from first ideas in the office to the open road. Consistent operation across all test environments is ensured. AVL M.O.V.E iS is a tailored testing solution for the RDE on-road application.

Process Support
AVL software supports the test operation, calibration, model based development & data management through the entire development process.

AVL M.O.V.E iS - THE RIGHT TESTING SOLUTION FOR EU6C RDE

AVL M.O.V.E iS System is a complete and tailored solution for Real Driving Emissions testing of passenger cars.
It has been designed to support the manufacturer needs:

Complete
Seamless tool chain - from the installation on the vehicle, test execution up to data evaluation up to data exchange between different development stages.

Integrated
Device control, data recording and data visualisation via a central control unit. Workflows support efficent execution and evaluation of the test.

Safe
To avoid toxic exhaust gas in the vehicle, the system is designed to be installed inside but especially outside e. g. on the tow bar. There are also no dangerous carry-on gas bottles needed.

Quick and Easy
The pre-installed system can be quickly and easily mounted on a standard tow bar within less than 5 minutes.

Application focused design
No influences on the vehicle are achieved due to the lightweight, compact & aerodynamic design of the system, which doesn't require any modifications on the vehicle. The system supports an operation with or without exhaust flow meter.

M.O.V.E iS – INTEGRATED, QUICK AND SAFE

USER GUIDED TEST EXECUTION AND DATA EVALUATION

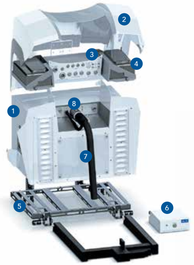
The accurate and reliable measurement of real world emissions is only one element of the overall RDE package. There are many other important elements the user needs to handle:

- Exact test execution according to legislative requirements
- Recording and automatic time alignment of data from different devices
- Fast & reliable data post processing based on the RDE standards
- Smooth data exchange between different development stages

The AVL M.O.V.E iS System covers all of these aspects by making use of a central data control system (System Control Unit) which offers the user an intuitive and graphical user interface with step-by-step guidance through the relevant legislative testing procedures.

With AVLs "CONCERTO M.O.V.E POST PROCESSING" software, evaluation of test data is made easy, even for non-expert users. The software is capable of evaluating the test data according the European RDE standards with just a few mouse clicks.

Outside installation on a tow bar. Trunk: System Control with Notebook PC



M.O.V.E iS Gaseous System Overview
1. AVL GAS PEMS iS
2. Aerodynamic Outer Cover
3. Central Power Distribution (E-Box)
4. Battery
5. Tow bar carrier
6. e-Cal iS (external calibration unit)
7. Heated Sampling Line
8. Heated Filter

Concerto M.O.V.E Evaluation Screen

QUICK, EASY AND SAFE

Safe
The M.O.V.E iS System has been designed to allow the installation either inside the car or outside on a standard tow bar. The outside installation eliminates any risks of sucking toxic exhaust gas inside the passenger cabin e. g. through the open trunk lid. Also the batteries can be installed outside the car (integrated in the aerodynamic protection cover of the GAS or PN PEMS). The system is able to operate with or without an exhaust flow meter which is seen as a potential safety issue for pedestrians due to hot surfaces.

Quick and easy installation
Beside the tow bar mount, the M.O.V.E iS system does not require any modifications to the test vehicle at all. With a little preparation, the system can be installed on a vehicle and is ready-to-go in less than 5 minutes.

A special designed tow bar carrier allows a pre-installation & warm-up of the entire system before mounting it with one-click to the vehicle. The sample probe is fixed with a special support frame near the tailpipe duct.

M.O.V.E iS – ACCURATE AND ROBUST PEMS SYSTEMS FOR RDE

AVL M.O.V.E GAS PEMS iS

The AVL M.O.V.E GAS PEMS iS Portable Emission Measurement System (PEMS) is designed to measure the NO/NO_2 and CO/CO_2 concentrations within the exhaust gas of Diesel and Gasoline vehicles. It features a compact, lightweight and robust design. Due to the low drift of the chosen analyzers there is no need to carry along calibration gas bottles in the vehicle during the test. Another time saving feature is the automated span calibration with the external calibration unit e-Cal iS.) The option e-Cal iS Advanced offers a fully automated linearity check (up to 7 gas bottles).

Benefits at a glance
- Optimized & complete solution for the RDE application
- Compact and light weight system design
- Quick (< 5 minutes) and easy installation inside or outside of the car
- No additional damping plates required for passenger car applications
- Wide operating temperature range
- High measurement accuracy and low drift acc. Euro 6c
- Low maintenance effort and easy access to all consumables
- Automated span checks with e-Cal iS
- Automated linearity checks with e-Cal iS Advanced (gas divider required)

AVL GAS PEMS iS with y-type heated line for dual tailpipe configurations

AVL PN PEMS iS with the GAS PEMS on top

Coming soon - Final product timing depends on legislative situation

AVL M.O.V.E PN PEMS iS

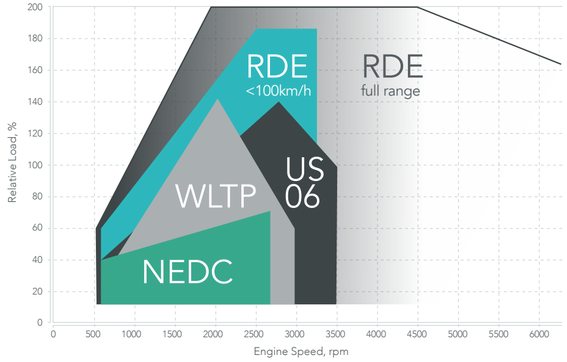
The AVL M.O.V.E PN PEMS iS is a compact and robust continuous particle number [#/cm³] measurement device for on-road application. This low weight and low power PN PEMS solution is especially designed to meet the Real Driving Emissions (RDE) requirements for LD vehicles. The design enables the smart integration into the M.O.V.E iS platform and completes the AVL RDE solution for Passenger Cars. The PN PEMS incorporates AVL's broad expertise in particle number measurement methodology. The system includes a temperature controlled and diluted exhaust sampling unit, a volatile particle removing unit to minimize particle losses and enables an optimum correlation to existing PMP- compliant particle number (PN) instruments on the test bed.

Benefits at a glance
- Compact, lightweight and robust solution optimized for RDE
- Innovative exhaust sample treatment to reduce particle losses and to improve the correlation to existing PN instruments
- Modular concept: The PN PEMS iS can be operated both, as a standalone device or integrated into the iS platform in combination with the Gas PEMS iS module

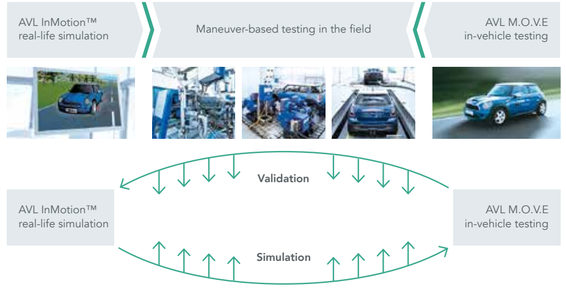
Prototypes for pilot customers from 09/2014

AVL REAL LIFE TESTING

RDE - ENGINE MAP REQURIEMENTS



AVL REAL-LIFE TESTING. BRINGING REALITY TO THE TESTBED.



BRINGING RDE TO THE TEST BED

In the future the main challenge for the calibration engineer will be the loss of the reproducibility. Driving a vehicle on the road under "real-life" conditions will always be influenced by parameters which cannot kept 100% under control, e.g. driving style, traffic situation and ambient conditions. Without having a reproduce able situation, direct RDE calibration on road will be hard to achieve.

A logical step will be to feedback the RDE road results back to your development environment e.g. engine test bed or chassis dyno test bed where with the support of real life simulation tools you can generate your reproducible RDE test environment. Now you can optimize your calibration, simulate different driving styles, routes and vehicle setups and finally even improve your simulation models.

The key is to be consistent in the way you test, measure and exchange your data.

AVL offers a complete tool chain – from simulation over test beds until road - optimized for a seamless frontloading approach, allowing you to become most efficient to quickly identify and solve your RDE challenge.

14 Hotlines **3** CARElines **9** Skill Centers **7** Repair Centers **6** eSpares Hubs

400 Service Engineers **170** Resident Sevice Engineers **70** Application Engineers **23** Tech Centers

AVL - YOUR STRONG SERVICE PARTNER

AVL CUSTOMER SERVICES – EXPERIENCE THE ADDED VALUE

RDE Testing will happen on the road, in cities, on highways, in rural areas as well as remote locations and even in different countries. This will remove you and your test equipment from your usual facilities and infrastructure. It is therefore key to have a global service partner who can support at any location, worldwide, at any time.

AVL Customer Services represents a worldwide network of service centers comprising of hundreds of qualified service employees. Global standards, proven processes and an IT infrastructure ensure professional and high quality services. Individual service packages are tailored to meet customers' RDE requirements.

AVL POWERTRAIN ENGINEERING

METHODOLOGY AND PROCESS SUPPORT FOR DOING THE RIGHT THINGS IN THE RIGHT WAY

Euro 6c will phase in Real-World-Driving Emissions and become a part of the homologation. Even though there are currently no defined limitations or cycles to be met, the legislation authority has set actually In Use Testing with portable PEMS analyzers.

Therefore performing enhanced emission tests on the road will become mandatory to be competitive in the future. AVL Powertrain Engineering is able to support you globally in performing your testing demands with overall expertise including legal requirements, measurement instrumentation, testing and finally powertrain optimization to support you achieving your RDE limits.

FOR FURTHER INFORMATION PLEASE CONTACT:

AVL List GmbH, Hans-List-Platz 1, A-8020 Graz, Austria
Phone: +43 316 787-0, Fax: +43 315 787-400, E-mail: info@avl.com, www.avl.com

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