

Summary

Light Duty vehicles (LDVs), such as cars and vans, emit substantially more pollution on the road than what is permitted in emissions legislation, endangering citizens' health and the environment. This is because emissions are currently only measured in the laboratory. Real driving tests should be introduced to solve this problem. Tests need to cover all driving events with which drivers are regularly confronted (for example, city and highway driving, high instant accelerations, gradients of up to 4%, cold starts) and weather conditions in Member states. Emissions have to be measured in the most accurate way and no data from real driving measurement should be excluded. Otherwise the introduction of these additional tests will fail to meet its purpose.

Context

LDVs emit more pollutants on the road than in laboratory conditions. In order to solve this problem the Commission decided to introduce complementary type-approval procedures to measure gaseous and particulate emissions during real driving to make sure that they are similar to legal emission limits. To achieve this, the Real-Driving Emissions-Light Duty Vehicles (RDE-LDV) working group was created in 2011. Work in this group is currently focused on RDE tests during initial type approval.

This paper has been prepared by Transport and Environment (T&E) to aid the work of this group. The paper considers the main topics of discussion: data analysis methods, boundary conditions, conformity factor, equipment (portable emissions measurement system – PEMS) and scope.

The data analysis method should not exclude any data

The Commission is selecting the method for analysing data from the PEMS trips in order to make it comparable to data obtained in the laboratory under the test cycle. Whatever the chosen method is, important emitting events (positive gradient, high instantaneous acceleration) should not be excluded or underweighted when analysing the data. Excluding or reducing the importance of high emitting events could see non-compliant vehicles being labeled as compliant.

The lower frequency of some driving events cannot justify excluding them from or underweighting them in the data analysis method. This is because most of the NO_x emissions in a PEMS trip happen in a short amount of time during the trip. Furthermore the definition of two sets of boundary conditions already differentiates driving events in terms of their frequency.

Driving events with high pollutant emissions – positive gradient, high instantaneous acceleration – should not be excluded or underweighted when analyzing the data.

'Normal' boundary conditions must be representative of real driving

Boundary conditions allow for distinguishing between a valid and an invalid test. They can be divided between dynamic boundary conditions related to the drive (such as the load) and ambient boundary conditions (altitude, temperature and humidity). The Commission is considering the definition of two sets of boundary conditions. The first one, with a lower associated conformity factor, would correspond to 'normal' driving conditions. The second one, with a higher conformity factor, would correspond to 'extended' driving conditions.

'Normal' boundary conditions should include the full range of driving parameters occurring during the Worldwide Harmonized Light Duty Driving Test Cycle (WLTC)¹. While it is clearly not practicable to repeat the WLTC cycle, it is possible to ensure that a test includes low, medium, high and very high speed components plus the range of accelerations, decelerations and stops consistent with the WLTC. High accelerations and gradients of up to 4% emit greater amounts of NO_x and therefore should be included. The definition of the minimum temperature should take into account the average minimum temperature in the different Member States.

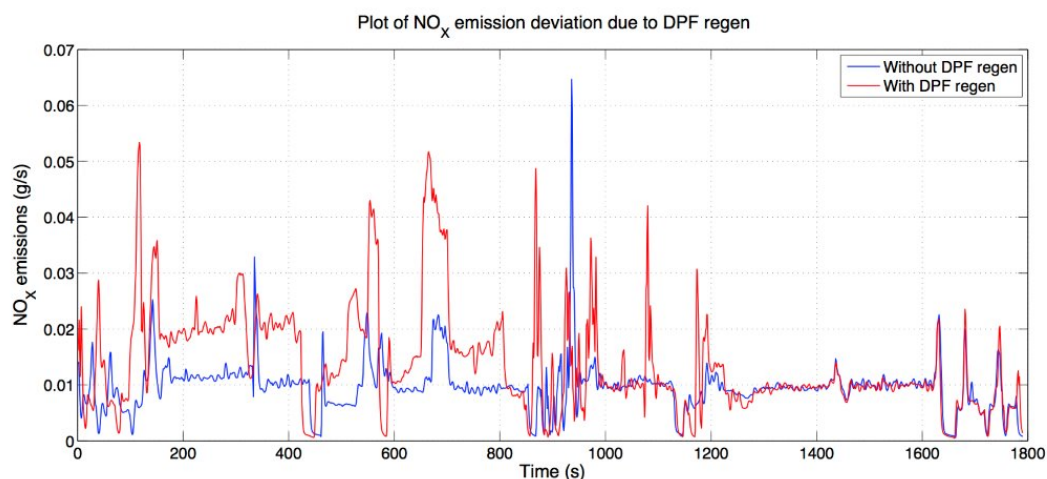
A conformity factor of 1, or very close to 1, should be applied to the 'normal' boundary conditions. These tests should be performed on a large number of vehicles with the vehicle family² approach defined tightly. Tests performed under the 'extended' boundary conditions could apply a higher conformity factor and a broader vehicle family definition.

The "normal" boundary conditions should include the full range of conditions experienced regularly by drivers including high instant accelerations and gradient.

Cold start and DPF regeneration need to be included

Cold start and diesel particulate filter (DPF) regeneration are high-emitting events that occur during 'normal driving' and should therefore be included within the 'normal' boundary conditions. If underrepresented in a single PEMS trips, a correction factor may have to be considered for correcting the PEMS trips results.

The effect of active DPF regeneration on NO_x emissions is illustrated below.



Source: <http://emissionsanalytics.com/dpf-regeneration-mysteries>. Graph by Joseph Ruxton, Imperial College London

¹ Work to replace the current New European Driving Cycle (NEDC) by the WLTC is currently being carried out by the Commission.

² A vehicle family is a group of vehicles that differs in certain essential respects to previously approved types. The definition of family allows for a reduction in the number of tests carried out.

Cold start and DPF regeneration should be included in the 'normal' boundary conditions.

Data from PEMS measurement should be publicly available

Data from the Type 1 test (pollutant emissions measurement during initial type approval) is currently available in the Certificate of Conformity (CoC) of every vehicle. For the sake of transparency, PEMS data should also be made available both in the CoC and online.

PEMS equipment should measure emissions directly

PEMS equipment includes, among other elements, a flow meter located outside the vehicle and connected to the exhaust pipe that measures the total airstream (total volume) of the exhaust gas.

Car manufacturers want to replace the flow meter with the vehicle on-board diagnostics (OBD). T&E opposes the use of the OBD as it could be subject to gaming. Only direct measurement will suffice – with a flow meter.

All pollutants have to be measured

The Commission is considering not measuring hydrocarbon (HC) emissions. HC emissions result from unburnt fuel and are higher at low temperatures (cold start and low temperatures). Furthermore HC emissions are to become increasingly important. Methane (CH₄) emissions, a type of HC, will increase substantially with the introduction of gas-powered vehicles. In this context the Commission will have to define CH₄ emission limits and will have to ensure compliance in real driving conditions. This is why it is necessary to measure HC and CH₄ emissions in real life. Both are measured using the same PEMS equipment – a flame ionisation detector (FID).

Given the increase in gas vehicles and their methane emissions, hydrocarbon emissions need to be measured.

A coherent and global approach for air pollutants and CO₂ checks is needed

Introducing emissions tests in real life should be part of a wider strategy on emission checks by the Commission.

The RDE initiative complements the introduction of a new test cycle for measuring pollutant emissions in the laboratory – the World Light Duty Test Cycle and Procedures (WLTC/P). The introduction of a new test cycle is necessary because CO₂ emissions are on average 23% higher than test values and that this disparity is growing. There are two main reasons for this:

- The test is over 30 years old and unrepresentative of real-world driving.
- The test procedures are outdated and lax and contain many loopholes that carmakers are increasingly exploiting to lower the test results ('cycle beating').

However, even these two developments during the initial type approval stage are not enough. T&E advocates improvements at multiple stages in the process of monitoring as illustrated on the next page.

Type approval <i>framework</i>	<ul style="list-style-type: none"> • Establishment of a European Type Approval (TA) Authority with oversight of National TA Authorities and Test Services • OEMs to be made responsible for performance of new vehicles <i>on the road</i>
Initial Type Approval	<ul style="list-style-type: none"> • WLTC introduced for CO2 and air pollutants emissions from 2017 • On-road vehicle PEMS testing for air pollutants and CO2 emissions
Production conformity	<ul style="list-style-type: none"> • Increased inspection regime
In-service conformity	<ul style="list-style-type: none"> • On-road vehicle PEMS testing for air pollutants and CO2 emissions • Surveillance by Member States
Periodic technical inspection	<ul style="list-style-type: none"> • Strengthened testing • Complement with remote emission sensing for big polluters
Driver information	<ul style="list-style-type: none"> • Improved driver information on air pollutant and CO2 emissions and fuel economy • On-board information on emissions exceedances

Conclusions

For T&E, tackling real world emissions from cars require the following conditions:

- A PEMS data evaluation method that does not exclude or underweight important emitting events (for example, gradient, acceleration). The method should be easily applicable by third parties for verification purposes.
- Normal boundary conditions that adequately represent driving conditions experienced by drivers in real life (such as city and highway driving, gradient, acceleration, cold start, etc).
- A conformity factor that allows PEMS emissions to be compared to emissions measured under controlled laboratory conditions, by taking into account real-world sources of variability. The conformity factor should be as close as one as possible.
- Reliable PEMS equipment with direct emissions measurements.
- A coherent global approach for measuring air pollutants and CO2 emissions including a new test cycle (WLTC) and improved checks during type approval and periodical technical inspections.

Further information

Eva Corral
eva.corral@transportenvironment.org
+32 (0) 851 02 26