Status European RDE emission legislation

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Association for Emissions Control by Catalyst (AECC AISBL)

AECC members: European Emissions Control companies

Exhaust emissions control technologies for original equipment, retrofit and aftermarket for all new cars, commercial vehicles, motorcycles, and non-road mobile machinery
Content

- EU-RDE legislation
- Global RDE developments
- AECC RDE testing experience
EU-RDE legislation to close the gap between lab and real-world emissions

**Diesel NOx**

![Graph showing average on-road diesel NOx emissions, the ICCT](chart1)

**Gasoline Direct Injection (GDI) PN**

![Graph showing PN emissions, WLTP vs RDE worst-case conditions](chart2)

*Source: average on-road diesel NOx emissions, the ICCT*

*Source: Gasoline Particulate Filters Market and Technology Trends and their Impact on Calibration, FEV, SIA powertrain 2017*
EU-RDE legislation to close the gap between lab and real-world emissions

- Not To Exceed limit (NTE) = Euro 6 limit x Conformity Factor (CF)
  - CF defined for NOx and PN
  - CF applies to urban part and total trip
  - CF in final step accounts for PEMS error margin (Portable Emissions Measurement Systems)
- Two stages added to Euro 6 legislation: 6dTemp and 6d

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<tbody>
<tr>
<td>RDE monitoring phase</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>NOx CF requirements</td>
<td>NT</td>
<td>NT</td>
<td>Euro 6-dTemp NOx CF = 2.1</td>
<td>NT</td>
<td>Euro 6d NOx CF = 1.0 + 0.43 error margin</td>
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<tr>
<td>PN CF requirements</td>
<td>NT</td>
<td>NT</td>
<td>All</td>
<td>NT</td>
<td>All</td>
<td>All</td>
<td>All</td>
<td>All</td>
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<tr>
<td>NT: New Types</td>
<td>All: All Types</td>
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PEMS equipment used to measure emissions on the road
RDE boundary conditions define normal driving

To capture 90% of European driving conditions around WLTP reference

Route criteria

Trip duration (min)

Distance share (%)
(>16 km)

urban (<60km/h) 29 34 44
rural (>60 & <90km/h) 23 33 43
motorway (>90km/h) 23 33 43

Urban requirements

Average speed (km/h) 15 40
Time share of stops (%) 6 30
RDE boundary conditions define normal driving
To capture 90% of European driving conditions around WLTP reference

Ambient conditions

- Temperature
- Altitude

Higher emissions allowed (measured values divided by 1.6)
RDE boundary conditions define normal driving
To capture 90% of European driving conditions around WLTP reference

Driving dynamic conditions

Altitude accumulation (<1200m/100km)

Excess or absence of accelerations

630/80*100 = 788m/100km
RDE boundary conditions define normal driving
To capture 90% of European driving conditions around WLTP reference

Driving dynamic conditions

- Based on measured CO₂ emissions
  - Moving Average Window principle (EMROAD tool)
  - 50% of Windows need to be within normal band around WLTC reference
RDE post-processing of PEMS data

- Correction of pollutant emissions depending on RDE/WLTC CO₂ ratio
  - Area A: no correction, raw measured PEMS data to be reported
  - Area B: correction based on RDE/WLTC CO₂ ratio
- Additional factor for Plug-In Hybrids
  - RDE/WLTC CO₂ x WLTC/RDE distance share on ICE
  - WLTC reference distance share on ICE: 85%

ICE: Internal Combustion Engine
In-Service Conformity and Market Surveillance are key
 Defined in 4th legislative EU-RDE package

- Applies to New Types as of 1 January 2019 and All New Vehicles as of 1 September 2019
- Mandatory tests
  - Type 1: RDE
  - Type 1: WLTP
- Optional tests
  - Type 4: evaporative emissions
  - Type 6: low ambient temperature
- Some examples of process flow in next 2 slides
In-Service Conformity and Market Surveillance are key
Defined in 4th legislative EU-RDE package

Example of the new system for In-service conformity
Evidence through remote sensing, PEMS, SEMS, etc..
Actors: Anybody

Validation of collected data
(scope: remove wrong data, biased testing, etc..)

1. Yearly Publication of validated surveillance data

Source: Z. Kregar, “Update on EU Air Quality and vehicle emissions policies”, EIONET meeting on environment and transport, 2018, Copenhagen
In-Service Conformity and Market Surveillance are key
Defined in 4th legislative EU-RDE package

Source: Z. Kregar, “Update on EU Air Quality and vehicle emissions policies”, EIONET meeting on environment and transport, 2018, Copenhagen
EU-RDE significantly reduces real-world gap
Declared emissions from Euro6d-Temp vehicles well within standards

Source: PEMS results and maximum declared values from ACEA RDE database consulted on 28 August 2018
Content

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Global RDE developments at UNECE

- A new GRPE Informal Working Group on Real-Driving Emissions (IWG on RDE) was created after approval by WP.29 in June 2018.
- The kick-off meeting was held on 11-12 September 2018 in Brussels. It explored interests from contracting parties and possible development of a new Global Technical Regulation (GTR) under the UN 1998 Agreement to address ‘Global RDE’.
- The new RDE IWG is chaired by the European Commission with Japan and Korea as co-vice-chairs. The technical secretariat is held by OICA and Japan (JASIC).
- An initial draft GTR text, prepared by the European Commission services, was already considered. Further work will continue.
- Information and documents can be found at https://wiki.unece.org/pages/viewpage.action?pageId=63308214
Content

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- Global RDE developments
- AECC RDE testing experience
### AECC RDE testing experience

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Year</th>
<th>Type</th>
<th>Series production/demonstrator</th>
<th>Comment</th>
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<tbody>
<tr>
<td>5</td>
<td>2014</td>
<td>Diesel</td>
<td>Demonstrator NOx CF&lt;1.5</td>
<td>SCR on DPF</td>
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<tr>
<td>6</td>
<td>2015</td>
<td>Diesel</td>
<td>Series NOx CF&lt;1.5</td>
<td>SCR on DPF</td>
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<tr>
<td>7</td>
<td>2015</td>
<td>GDI</td>
<td>Series NOx and PN CF&lt;1</td>
<td>With GPF</td>
</tr>
<tr>
<td>8</td>
<td>2016</td>
<td>GDI</td>
<td>Series + Demonstrator</td>
<td>Without GPF</td>
</tr>
<tr>
<td>9</td>
<td>2017</td>
<td>PHEV</td>
<td>Series + Demonstrator</td>
<td>Without GPF</td>
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**GDI:** Gasoline Direct Injection  
**GPF:** Gasoline Particulate Filter  
**SCR:** Selective Catalytic Reduction  
**DPF:** Diesel Particulate Filter
AECC RDE testing experience

Data within moderate boundary conditions

Excess or absence of driving dynamics (e.g. PHEV, vehicle 9)
AECC RDE testing experience

Impact of RDE boundary conditions tested on the chassis dyno (visualized with GDI data, vehicle 8)

1. Change accelerations
2. Change dyno load
3. Change ambient temperature
GDI test programme set-up (vehicle 8)

- Objective: investigate NOx & PN RDE without and with Gasoline Particulate Filter (GPF)

- Vehicle
  - C-segment, 1.4l engine
  - Market representative GDI technology targeting Euro 6c → only Euro 6b available
  - Original configuration w/o GPF
  - Add coated GPF demonstrator underfloor

- HORIBA PEMS equipment
  - Gaseous PEMS (CO₂, CO, NOx)
  - PEMS-PN demo unit
PN w/o GPF increases above NTE limit towards RDE boundary

- Euro 6d NTE limit
- Measurement range 3x RDE
PN with GPF remains below Euro 6d NTE limit

Euro 6d NTE limit

Measurement range 3x RDE
THANK YOU!

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