

REAL WORLD DRIVING

Fuel Efficiency & Emissions Testing

Prepared for the Australian Automobile Association - 2016



Australian
Automobile
Association

ABMARC

© 2016 ABMARC

Disclaimer

By accepting this report from ABMARC you acknowledge and agree to the terms as set out below. This Disclaimer and denial of Liability will continue and shall apply to all dealings of whatsoever nature conducted between ABMARC and yourselves relevant to this report unless specifically varied in writing.

ABMARC has no means of knowing how the report's recommendations and or information provided to you will be applied and or used and therefore denies any liability for any losses, damages or otherwise as may be suffered by you as a result of your use of same.

Reports, recommendations made or information provided to you by ABMARC are based on extensive and careful research of information some of which may be provided by yourselves and or third parties to ABMARC. Information is constantly changing and therefore ABMARC accepts no responsibility to you for its continuing accuracy and or reliability. Our Reports are based on the best available information obtainable at the time but due to circumstances and factors out of our control could change significantly very quickly.

Care should be taken by you in ensuring that the report is appropriate for your needs and purposes and ABMARC makes no warranty that it is.

You acknowledge and agree that this Disclaimer and Denial of Liability extends to all Employees and or Contractors working for ABMARC.

You agree that any rights or remedies available to you pursuant to relevant Legislation shall be limited to the Laws of the State of Victoria and to the extent permitted by law shall be limited to such monies as paid by you for the relevant report, recommendations and or information.



Real World Driving

Fuel Efficiency & Emissions Testing

Preliminary Report November 2016 For the Australian Automobile Association

ABMARC

www.abmarc.com.au

Phone: +61 3 9729 5129

Email: info@abmarc.com.au

Address: 7/51 Kalman Drive
Boronia, VIC, 3155

PRELIMINARY FINDINGS

OVERVIEW:

This report presents the emissions and fuel consumption summary test results from ten different passenger and light commercial vehicles (“light duty vehicles”), measured with a Portable Emissions Measurement System on Australian Roads. Testing was conducted by ABMARC for the Australian Automobile Association, generally in accordance with EC No 2016_427 and the draft Real Driving Emissions (RDE) procedure, adapted to suit Australia’s unique roads and conditions. Each vehicle was tested twice, with one cold start and one warm start per test sequence. The testing was conducted on Melbourne roads between May and October 2016.

The current new vehicle emissions standard in Australia for both petrol and diesel is Euro 5.

PROJECT BACKGROUND:

Real world vehicle emissions testing by various agencies overseas has confirmed that the emissions from certain light duty vehicles are substantially higher when measured on the road than when measured in a controlled laboratory environment. Pollutants, such as NO_x (oxides of nitrogen) from diesel cars, have regularly been found to exceed the permitted test-cycle emissions limits by 4 to 8 times. The disconnect between road and laboratory emissions was first identified as an air quality issue in Europe; reductions in permissible NO_x emissions from road transport vehicles were not as effective at improving air quality as the regulations had anticipated. Similarly, official fuel consumption figures were often not reflective of what motorists were able to achieve. The discrepancy between official figures and the real world fuel consumption figures has been increasing over time, most likely as a result of manufacturers optimising technologies to ensure compliance with their CO₂ obligations. To improve compliance with emissions requirements, the European Commission’s Joint Research Centre (JRC) has developed a test procedure with Portable Emissions Measurement Systems (PEMS) for mandatory Real Driving Emissions (RDE) testing at type approval of new vehicles. The RDE testing is applicable from Euro 6c. The JRC was consulted in adapting this test procedure for Australian conditions.

Real world measurement of emissions and fuel consumption enables a vehicle to be tested in the same road and environmental conditions it will be subjected to during normal operation. This testing reduces the ability of manufacturers to implement “defeat devices”, and limits the use of emissions reduction technologies that are more effective on the test drive cycle than in real world use.

The Australian Government is currently considering adopting Euro 6 emissions and CO₂ standards, in addition to reviewing Australian fuel quality standards. Presently, European regulation requires testing with PEMS on European roads only. The Australian market has a number of vehicles with engine configurations not sold in Europe, as well as vehicles that are not sold in Europe at all. This may result in a situation where vehicles are sold in Australia that have not been subjected to the regulatory requirements of RDE testing. Introduction of a CO₂ policy may result in consumers paying more for advanced technology in their vehicles, and it is considered important to ensure that any additional costs incurred by consumers provides benefit via real CO₂ emissions reductions. The figure below provides an illustration of the factors taken into account when determining real driving emissions.

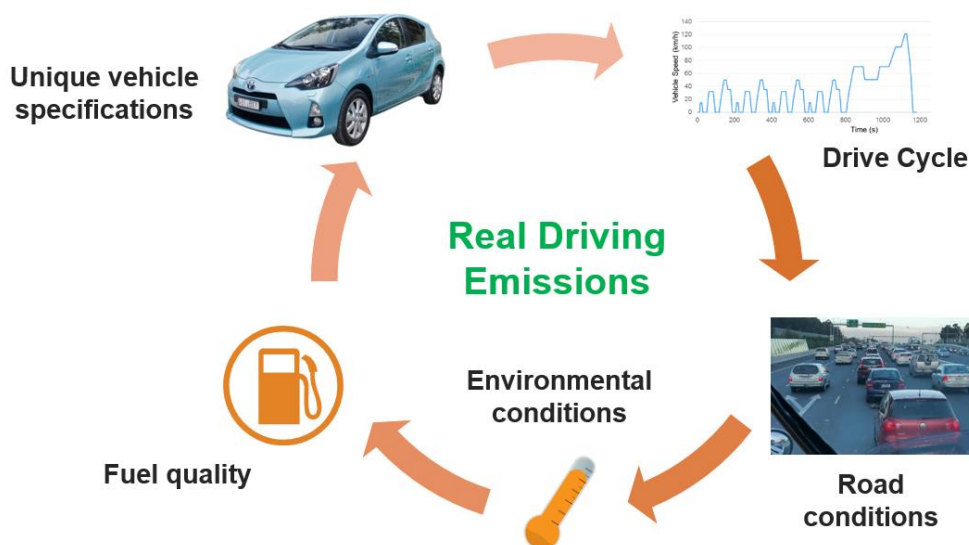


Figure 1 – Real Driving Emissions Overview

The objective of the AAA program of real world emissions and fuel consumption measurement is to compare the actual on-road vehicle performance of a range of cars to the regulated laboratory emissions limits and fuel consumption results in order to understand how Australian vehicles perform in Australian real world conditions. In total, 30 vehicles will be tested.

TEST VEHICLES:

Vehicles were selected to represent Australia's new vehicle fleet. The first ten test vehicles have been tested. One vehicle was tested in two configurations (petrol and LPG), meaning 11 test sequences have been conducted.

The 30 vehicles have been selected to:

- Maximise the representation of Australia's new vehicle fleet
- Cover a representative range of:
 - Manufacturers
 - Vehicle segments
 - Fuel types
- Include vehicles of interest by:
 - Technology
 - Fuel type
- Low volume, new market entries and models not sold into Europe or the USA

All vehicles tested were chosen based on the following criteria:

- The current model is available in Australia
- The vehicle tested has driven at least 2,000 km but no more than 50,000 km
- The actual test vehicle is a 2014 year model or newer

Vehicles tested were taken from the general service fleet.

MEASUREMENTS:



Emissions

Emissions were measured with a Portable Emissions Measurement System (PEMS), providing repeatability of 1% or better and complying with EC 2016_427 and European RDE draft regulations.

- **Particulate Matter (PM):** Collected on gravimetric filter with real time photo acoustic sensor for second by second data.
- **Gaseous:** Total Hydrocarbons, Carbon Monoxide (CO), Carbon Dioxide (CO₂), Nitric Oxide (NO) and Nitrogen Dioxide (NO₂).

The exhaust gas sample was taken from probes in the exhaust extension and transferred via heated sample lines to the gaseous analysers and gravimetric filter.



Fuel Consumption

Fuel consumption was derived using the carbon balance method by utilising an exhaust flow meter as specified in EC 2016/427 Appendix 2 Paragraph 7. Fuel properties were determined as per ASTM 4052 (density) and ASTM D240 (gross calorific value) to correct emissions and fuel consumption to standard fuel data.



Vehicle Information

An OBD data logger was used to record engine parameters via CAN-Bus (SAE J1979) according to EC 2016/427 Appendix 1 Paragraph 3.4.5.



Ambient Conditions

Ambient conditions, humidity, pressure & temperature were recorded according to EC 2016/427 Appendix 2 Paragraph 8.



Location & Vehicle Speed

Vehicle speed and vehicle location was recorded via GPS, according to EC 2016/427 Appendix 1 Paragraph 4.7.

OUTPUT:

For each test the following was measured and has been reported:

- Grams (g) of emissions per kilometre travelled (km)
- Litres of fuel per 100 kilometres travelled (100 km)

The emissions data processing and calculations were performed in accordance with prescribed methodologies conforming to EC2016_427 Annex IIIA Appendix 4, for the analysis of RDE measurement data.

The allowable emissions on the RDE test under Euro 6c are determined by using a Conformity Factor (CF). The CF is a multiplier, which is applied to the laboratory limits. Presently, there is only a CF specified for NOx (at 1.9), with a CF for Particulate Number currently under consideration. There is no regulated CF available for pre-Euro 6c vehicles. The purpose of this study, is to measure the pollutants that are regulated under laboratory conditions in the real world and compare these results to the laboratory limits.

EMISSIONS TEST PROCEDURE:

The test route is based on the current draft Real Driving Emissions test procedure developed by the JRC, and meets requirements specified by the draft RDE procedure and EC No 2016_427 Annex IIIA Part 6, modified to Australian roads and conditions and conducted in and around Melbourne, Victoria. The urban segment was completed in Melbourne’s south eastern suburbs, with the rural and freeway driving segments being completed on the Monash freeway between Melbourne and Dandenong.

In line with the European RDE procedure, the drive route consists of approximately one third urban, one third rural and one third freeway, with no less than 16 km distance travelled in each of the three segments, lasting between 90 and 120 minutes in duration. The actual trip distance was 83 km and duration of approximately 105 min. The test is conducted twice, bringing total measurement time to approximately 210 minutes, which is the equivalent of more than 10 laboratory tests using the New European Drive Cycle. An overview of the drive route is shown below in Figure 2.

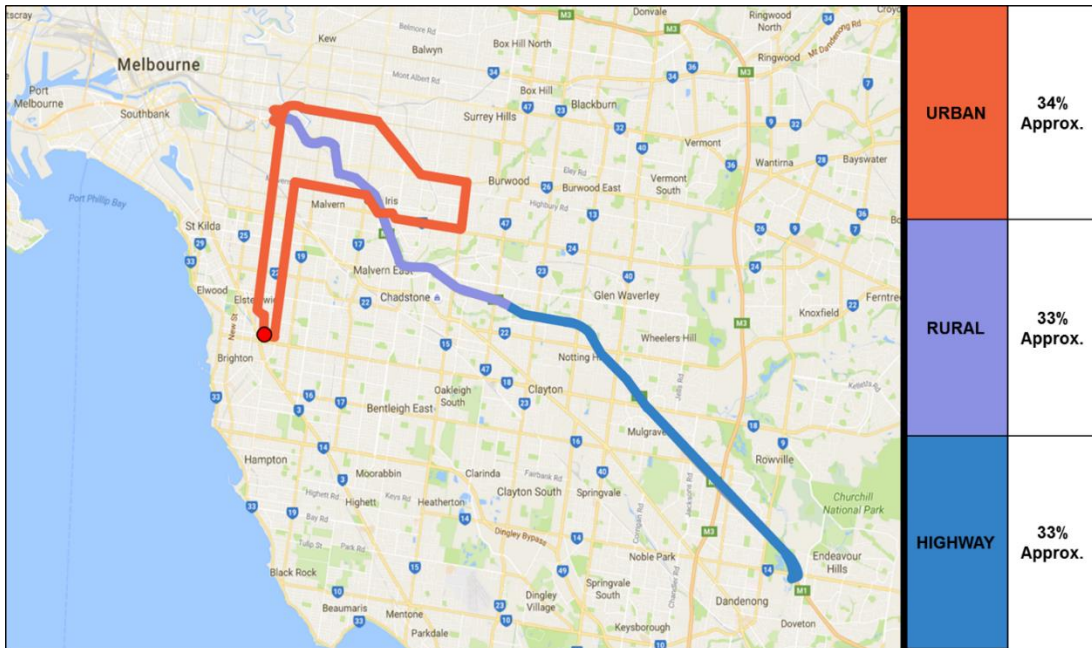






Figure 2 – Test Route Overview

KEY OUTCOMES OF REAL WORLD DRIVING EMISSIONS TESTING:

-  An evidence based approach to policy development.
-  Real world fuel economy over the designated route incorporating urban, rural and freeway driving conditions, and comparison to the official fuel economy.
-  Evaluation of vehicle emissions in real world driving conditions compared to their certified laboratory limits.
-  Evaluation of the emissions performance and fuel consumption across a range of fuel types and technologies available in the Australian market.

RESULTS:

On average, the real world fuel consumption of all vehicles tested was 20% higher than the official fuel results. The vertical lines on all charts denote the minimum and maximum values recorded across all vehicles tested.

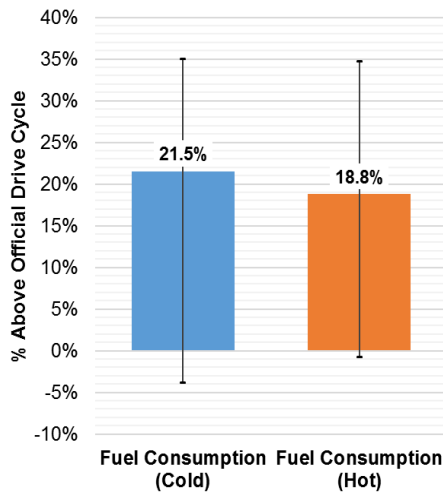


Chart 1 – Fuel Consumption Compared to Official Numbers

Generally, the average result for pollutants was low in comparison to the laboratory limits, however there were outliers recorded for NOx and CO that were in exceedance of the legislated limit, and one vehicle was only just below the legislated limit for PM.

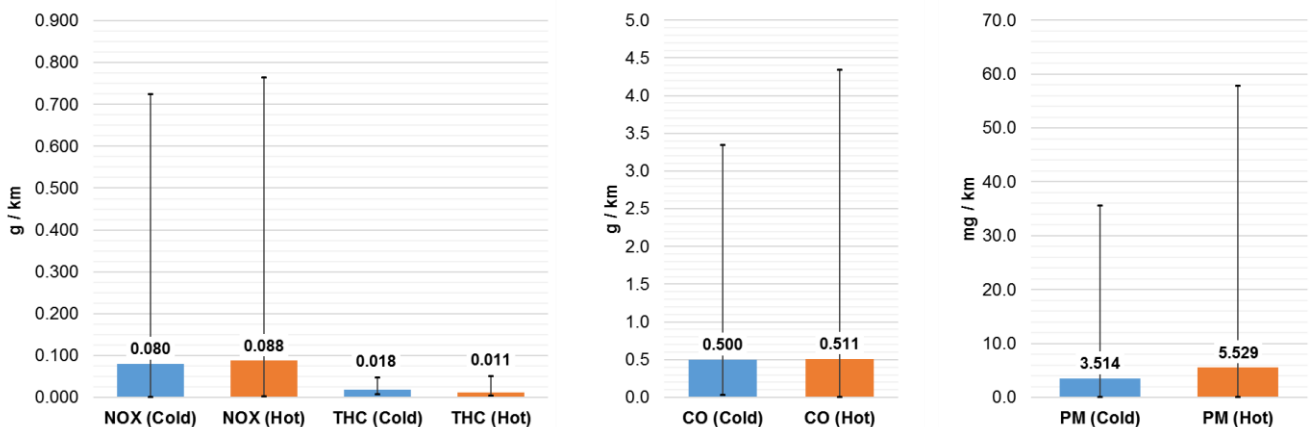
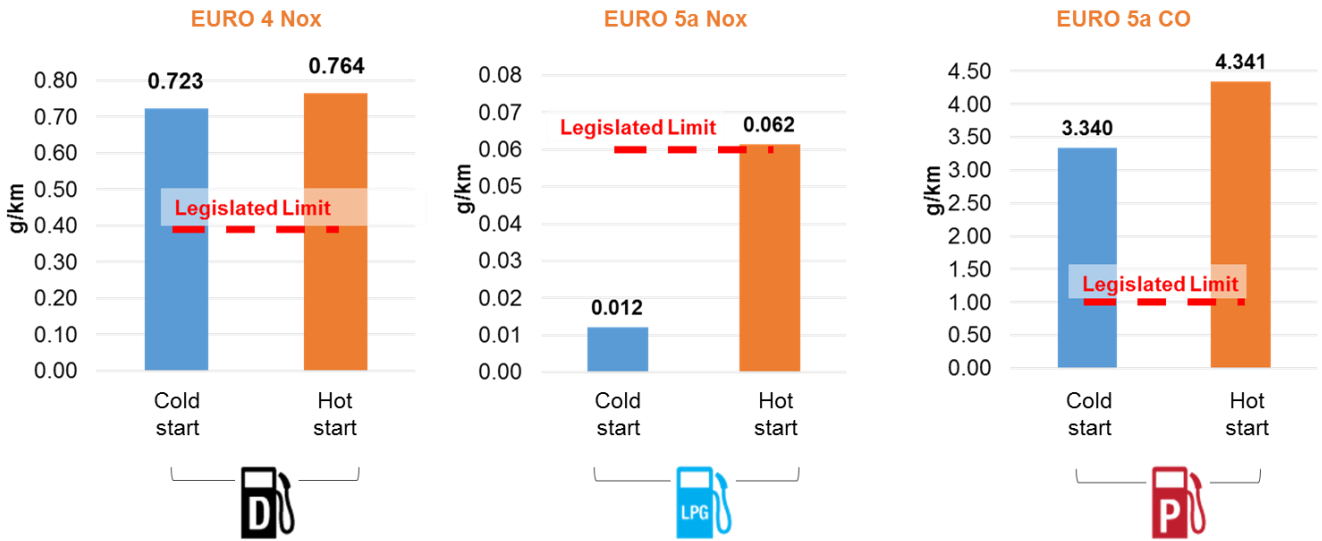


Chart 2 – Variation of Emissions Results between 11 Tests

POLLUTANT LIMIT EXCEEDANCE:

The charts below represent individual tests conducted on vehicles. Pollutant limits that exceeded legislated limits were: NOx by two different vehicles, CO by one vehicle, and PM was close to the limit on one vehicle.



Vehicle A: Both hot and cold RDE tests exceeded the NOx limit, with the hot test exceeding the legislated limit of 0.39 g/km by 96%.

Vehicle B: Only the hot test exhibited high NOx emissions. The magnitude of the difference in cold start and hot start results appears unusual. It is not clear if this was due to the LPG technology or another vehicle system. The hot test exceeded the legislated limit of 0.06 g/km by 3%.

Vehicle C: Both hot and cold RDE tests exceeded the CO limit, with the hot test exceeding the legislated limit of 1 g/km by more than four times.

Chart 3 – High Gaseous Emission Results

POLLUTANTS CLOSE TO LIMIT:

Vehicle A exhibited PM emissions that were only 4% below the legislated limit of 60mg/km.

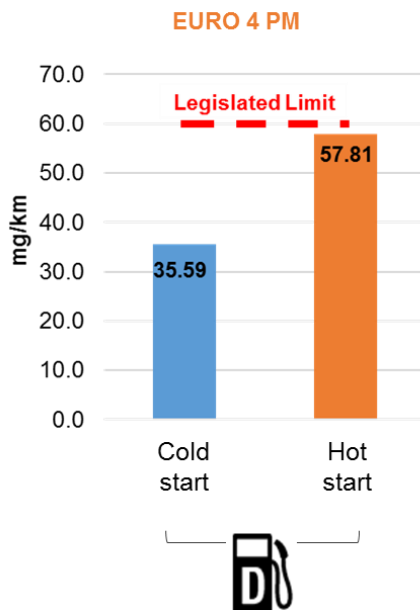


Chart 4 – High PM Results

CONCLUSION:

To date, this program has determined that:

- It may not be possible to rely on tests conducted in overseas jurisdictions to ensure the compliance of Australia's light duty fleet, as many vehicles (or vehicle configurations) sold in Australia are not available in Europe.
- It is not possible to meet all the requirements of the European Real Driving Emissions test schedule on Australian roads due to differing traffic and speed conditions, and the Australian climate, however, adaptation made to the test route specifications were made in consultation with the JRC.
- The real-world fuel consumption of vehicles tested was on average 20% higher than the NEDC results, with the highest measured being 35% greater.
- When compared to the laboratory limits, vehicle pollutant emissions were exceeded for the following:
 - CO by 4 times the legislated laboratory limit by one vehicle
 - NOx by nearly twice the limit on one vehicle and 3% on another
- Vehicle pollutant emissions were close to the limit for the following:
 - PM for one vehicle



REAL WORLD DRIVING

Fuel Efficiency & Emissions Testing

ABMARC

ADDRESS
ABMARC
7/51 Kalman Dr
Boronia, Vic 3155

GENERAL ENQUIRIES
P + 61 3 9729 5129
E info@abmarc.com.au
www.abmarc.com.au