



Euro 5 Effect Study Update

Alessandro A. Zardini, et al.

**DG-JRC-Ispra
Institute for Energy and Transport
Sustainable Transport Unit (VELA laboratories)**

10th EPPR IWG meeting, Brussels March 18, 2015

EU Regulation No 168/2013

Article 23 (4)

*By 1 January 2016, the Commission shall carry out a **comprehensive environmental effects study**. The study shall evaluate the air quality and the share of pollutants contributed by L-category vehicles and shall cover the requirements of test types I, III, IV, V, VII and VIII*

Article 23 (5)

*Based on the findings referred to paragraph 4, the Commission shall by 31 December 2016 present to the **European Parliament** and the Council a report*

Euro 5 Effect Study



Pre-Study (JRC)

Experimental Test Programme (Sep14-Mar15)

Phase 1: Stocktaking and data mining, stakeholder consultation, literature survey, planning for phases 2 and 3.

Study (Contractor + JRC supervision)

Phase 2: Experimental Test Programme, cost/benefit analysis, impact assessment

Phase 3: Validation Programme, Report

Pre-Study - Structure



**Theoretical identification of a commonly applicable
engine load variable**

Experimental test programme

**Miniature emission test equipment - PEMS
(Literature + Companies + Tests)**

Stakeholder Consultation (Survey)

Call for Tender: Technical specifications

Pre-Study - Experimental



Tested Vehicles: > 120 roller bench tests

Vehicle	Cat	Stroke	Displacement [cm ³]	Technology	Power [kW]	Mileage [km]	Year	Euro
1	L1e-B	4	50	Carburetor 2-way-cat	3.4	2500	2010	2
2	L1e-B (25 km/h)	4	50	Carburetor 2-way-cat	3.2	2000	2012	2
3	L3e-A2	4	400	I.E. 2-way-cat	24	27000	2013	3
4	L3e-A3	4	909	I.E. 2-way-cat	100	15000	2006	2
5	L7e-A1	4	496	I.E. 2-way-cat	14.4	500	2014	2

Pre-Study - Experimental



Vehicle	Cat	Stroke	Displacement [cm ³]	Technology	Power [kW]	Mileage [km]	Year	Euro
6	L1e-B	2	50	Carburetor 2-way-cat	2.6	2500	2010	2
7	L3e-A1	4	125	E.I. 2-way-cat	7.9	>2000	2010	3
8	L3e-A2	4	278	E.I. 2-way-cat	16.4	3000	2012	3
9	L1e-B	2	50	Carburetor 2-way-cat Manual trans.	3	5000	2008	2
10	L7e-A1							
11	L3e-A1			Manual trans.				

Pre-Study - Timeline



	Dec 2014	Mar 2015	Apr-May 2015	July 2015
Pre-study	On-going	Finish tests	End	X
Data mining	Collecting	Assessment	End	X
Consultation	On-going	Launch	End	X
Literature	On-going	Draft	End	X
Call for Tender	Start	Launch	End	Signed

Study - Phase II

Contractor to be appointed



- **Experimental assessment and verification programme of measures within the Euro 5 Environmental Step (different Test types + cost/benefit)**

July 2015 – June 2016

- **Research and assessment of further elements (e.g. off-cycle emission testing, in-service verification, expand PN limits)**

January 2016 – September 2016

Study - Phase III

Contractor to be appointed



Validation Programme and Final Report

- **Completion of Final Report**
September 2016
- **Commission to report to Parliament**
December 2016

Euro 5 Effect Study

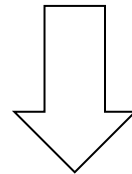


Effect Study

should confirm the measures in the Euro 5 package:

Requirements in:
[Regulation EU No. 168/2013](#)

Supplemented by:
[Regulation EU No. 134/2014](#)



Environmental and Propulsion unit Performance Requirements
for type approval of Euro 5 vehicles

and should also assess:

Feasibility of further elements (post-Euro 5):
**off-cycle emission testing, in-service verification,
particle number**

Background

- i) Asymmetric pollution by L-cat vehicles: small fleet, large contribution (urban THC, CO, PM).
- ii) In off-cycle mode (hence in real-driving), tailpipe emissions and/or fuel consumption may significantly differ from type-approval.
- iii) Vehicle speed profile poorly correlates with engine load.

Scope

The vehicle should be clean and efficient at each feasible operation point under the max Torque curve.

Emission abatement technology which is neutral wrt to vehicles and test types (ratio part-load area vs feasible operation range).

Method

Engine load variable (e.g., engine torque, CO₂ mass emissions, etc.)

→ quality, quantity and dynamics of emission sampling used to compare part-load sampling conditions among various test types and vehicle types.

Effect Study: Test Type I



Task 1.1.: Test Type I - Tailpipe emissions test after cold start

Sub-task 1.1.1: Assessment of the applicability of the **WMTC** to all the L-category vehicle types

Sub-task 1.1.2: Assessment of the appropriateness of the Euro 5 tailpipe emission **limits**

Sub-task 1.1.3: Assessment of the separate **NMHC** limit

Sub-task 1.1.4: Assessment of the impact of **ethanol** in the reference fuel on the test type I results

Task 1.2: Assessment Type II – Tailpipe emissions at (increased) idle and free acceleration

The extension of the WMTC to the other L-category vehicles is based on the view that in congested urban areas the vehicle speed profile depends to a large extent on traffic conditions and road characteristics (vehicle speed limits, traffic lights, crossings,...).

The WMTC is expected to cover a more representative portion of the engine speed/engine torque area defined by the wide open throttle (WOT) torque curve.

The WMTC is expected to exhibit a higher dynamics of emission sampling implied by frequent stop and go in traffic (current legislative cycles simulate low dynamics, developed from traffic situation in the '60s and '70s).

Effect Study: Test Type I



Sufficient and comprehensive assessment of tailpipe emissions in the part-load area

Quality

Distribution of emission sampling within the specified part-load area of testing (engine load Vs engine speed). Indicators:

Covered part-load area: engine speed and load compared to maximum torque area.

Drive-ability: driver violations (actual vs desired vehicle speed) .

Quantity

Intensity of part-load area sampling.

Dynamics

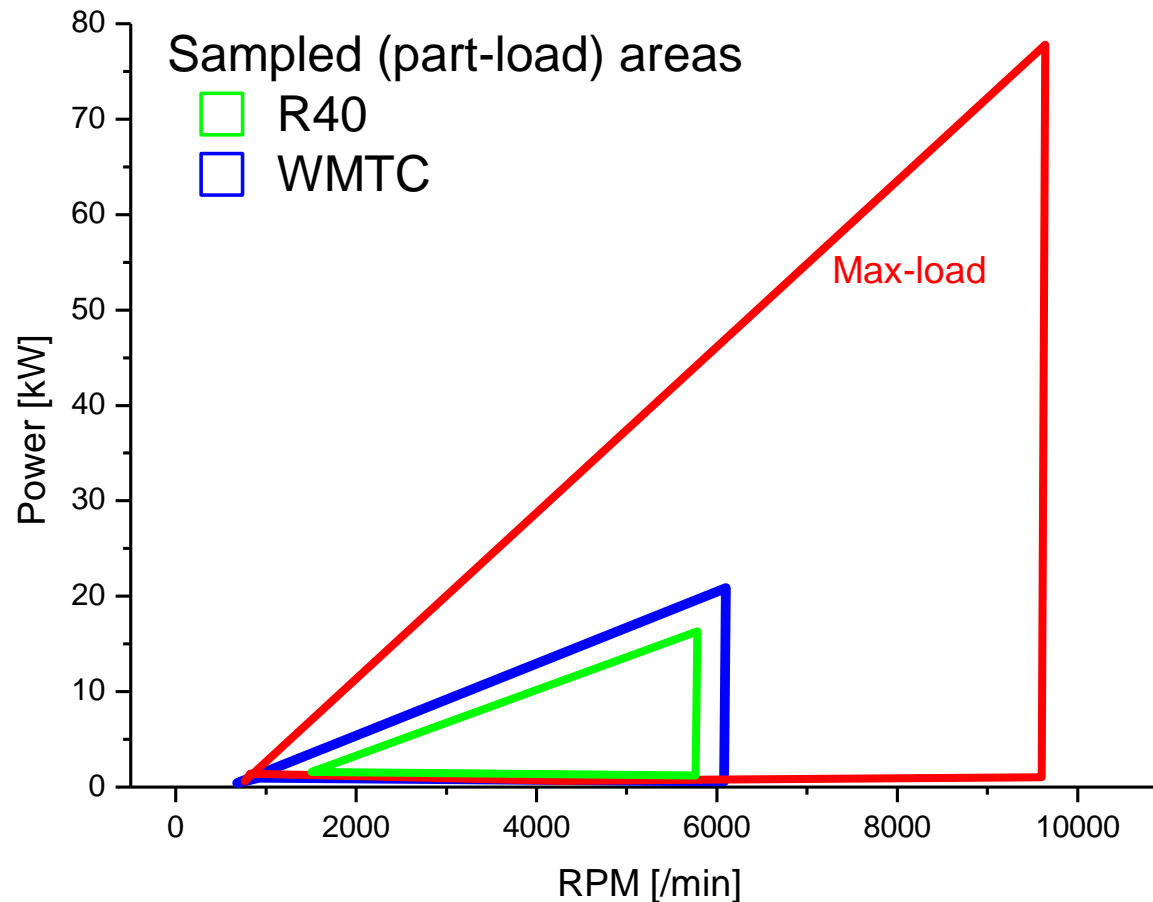
Statistics on the slope of “jumps” between the various engine speed and engine load matrix points.

Effect Study: Test Type I



Quality

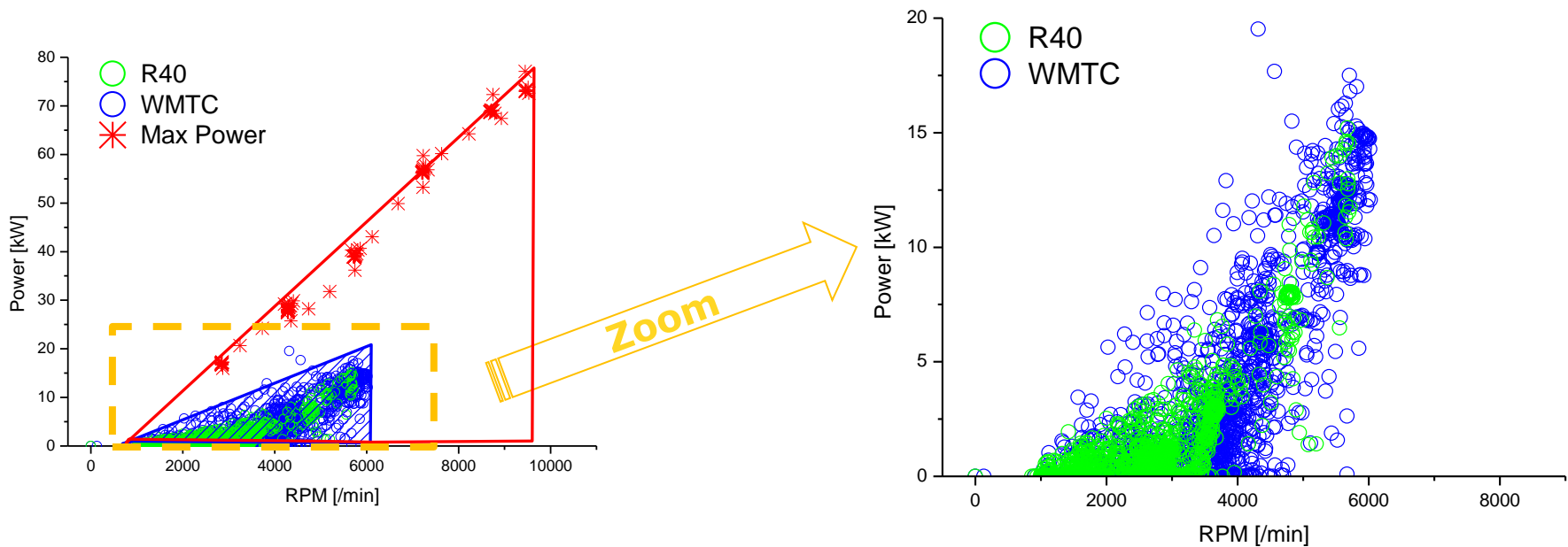
Covered part-load area: engine speed and load under the max power curve (L3e-A3)



Effect Study: Test Type I

Quality

Covered part-load area: R40 and WMTC part-load areas



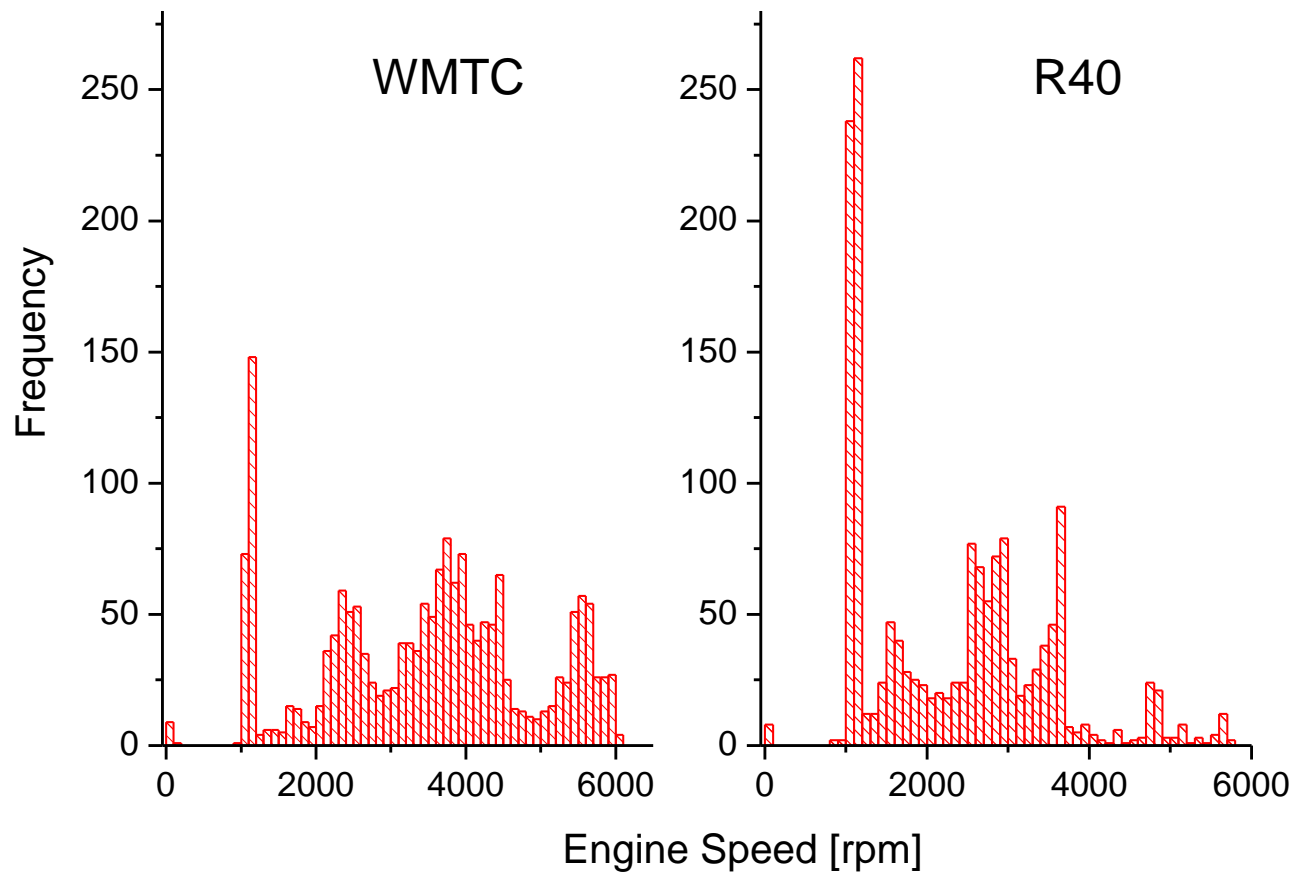
Larger area covered by WMTC → maximized sampling in the part-load area

Effect Study: Test Type I



Quantity

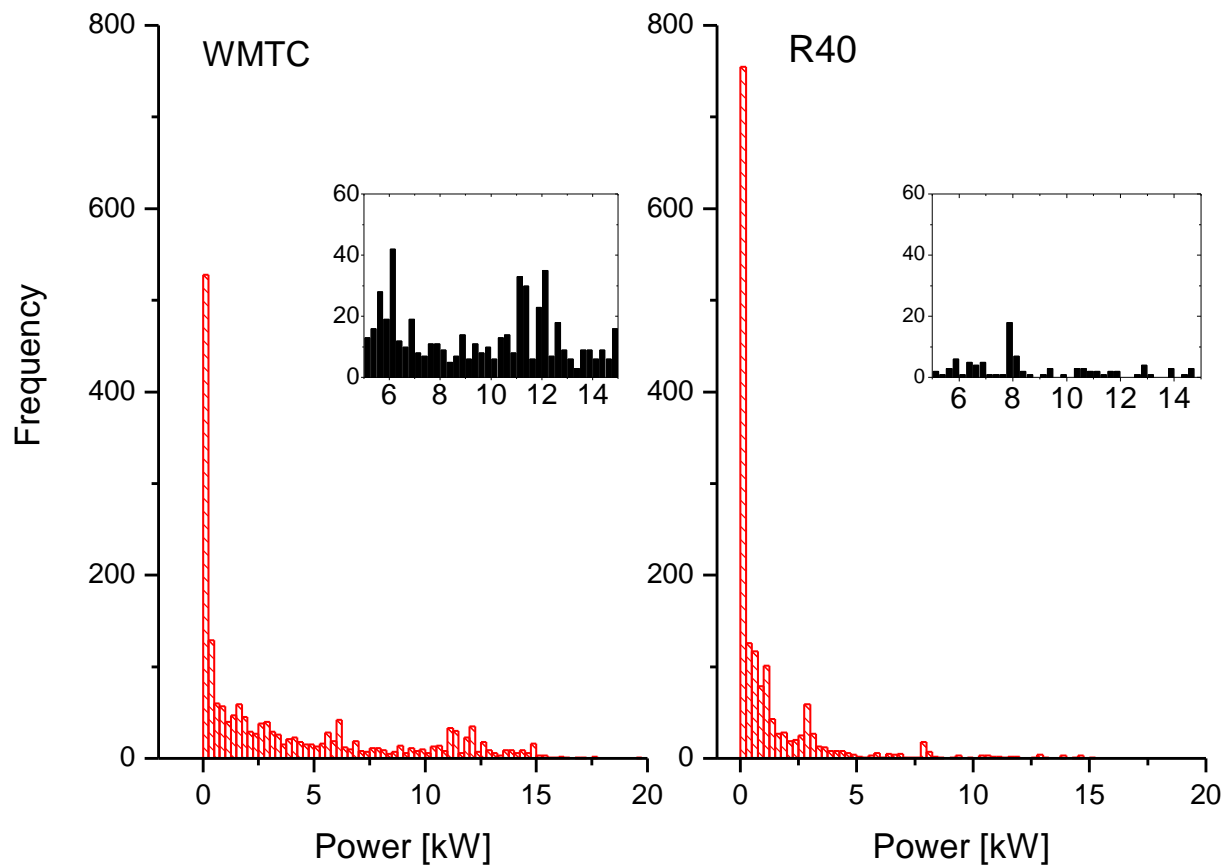
Intensity of part-load area sampling



Effect Study: Test Type I

Quantity

Intensity of part-load area sampling.



Effect Study: Test Type III



Task 1.3: Test Type III – Emissions of crankcase gases

Test method:

The pressure measured in the crankcase does not exceed the atmospheric pressure.

Two alternative test procedures (Annex IV, Reg. 134/2014):

Alternative 1:

Bag connected to the dipstick hole.

Empty before each measurement → No visible inflation of the bag occurs.

Alternative 2:

Leak check with compressed air inducing an overpressure in the crankcase ventilation system.

Effect Study: Test Type IV



Task 1.4: Test Type IV – **Evaporative** emissions test

Sub-task 1.4.1: Permeation and SHED test procedures

Sub-task 1.4.2: Investigation of the cost effectiveness of a 25% lower Euro 5 evaporative emission limit compared to the Euro 4 limit for vehicles subject to the SHED test

Sub-task 1.4.3: Investigation of the impact of fuel quality on the evolution of fuel **permeation rate** over time as well as the **ageing effects** of the carbon canister.

The **Euro 4** step (2016) introduces SHED evaporative emission testing for (sub-)categories L3e, L4e, L5e-A and L7e-A vehicles similar as already is the case for the USA State of California since 1976.

The **Euro 5** step extends the fuel evaporation control requirements from the categories above to all L-category vehicles, but leaves the choice on test procedure.

Determine **which test procedure, permeation test or SHED, is cost beneficial** and appropriate for the vehicle types that are not yet subject to evaporative emission testing in the Euro 4 step.

TEST PROCEDURES

Fuel storage and delivery system permeation: based on weighing the fuel storage tank and fuel tubing before and after a temperature-controlled soak.

SHED: Sealed Housing for Evaporation Determination test procedure. (a) conditioning phase: driving cycle; vehicle soak; (b) test phase: diurnal (breathing loss) test; driving cycle; hot soak loss test.

Each subcategory will only be made subject to a **single test procedure** and that in the anticipation of this study and subsequent decision Annex VI(C2) of Reg. 168/2013 contains limits for both test procedure types

Effect Study: Test Type V



Task 1.5: Test Type V – Durability test of pollution control devices

Sub-task 1.5.1: Validation of distance accumulation cycle (**SRC-LeCV**)

Sub-task 1.5.2: Validation of assigned Deterioration Factors and useful life values

Three possible methods to ensure that type approval durability requirements are met

(Article 23, Paragraph 3 of Regulation 168/2013):

- (a) actual durability testing with full mileage accumulation;
- (b) actual durability testing with partial mileage accumulation;
- (c) mathematical durability procedure.

Two durability distance accumulation test cycle alternatives available for method (a) and (b): the AMA and the SRCLeCV cycles.

The mathematical procedure (c) only considers the multiplication of deterioration factors by the environmental test results, and compare the values to the environmental limits Regulation 168/2013, Annex VI (A) and (Annex VII (B)).

Effect Study: Test Type V



Considerations on AMA and SRC cycles can be found in:

“Durability of pollution control measures for L-category vehicles”

PUBLISHED PROJECT REPORT PPR627, 2012

Transport Research Laboratories

Prepared for: EC, DG ENTR (now DG-GROW)

Uploaded on Circabc (motorcycle Working Group)

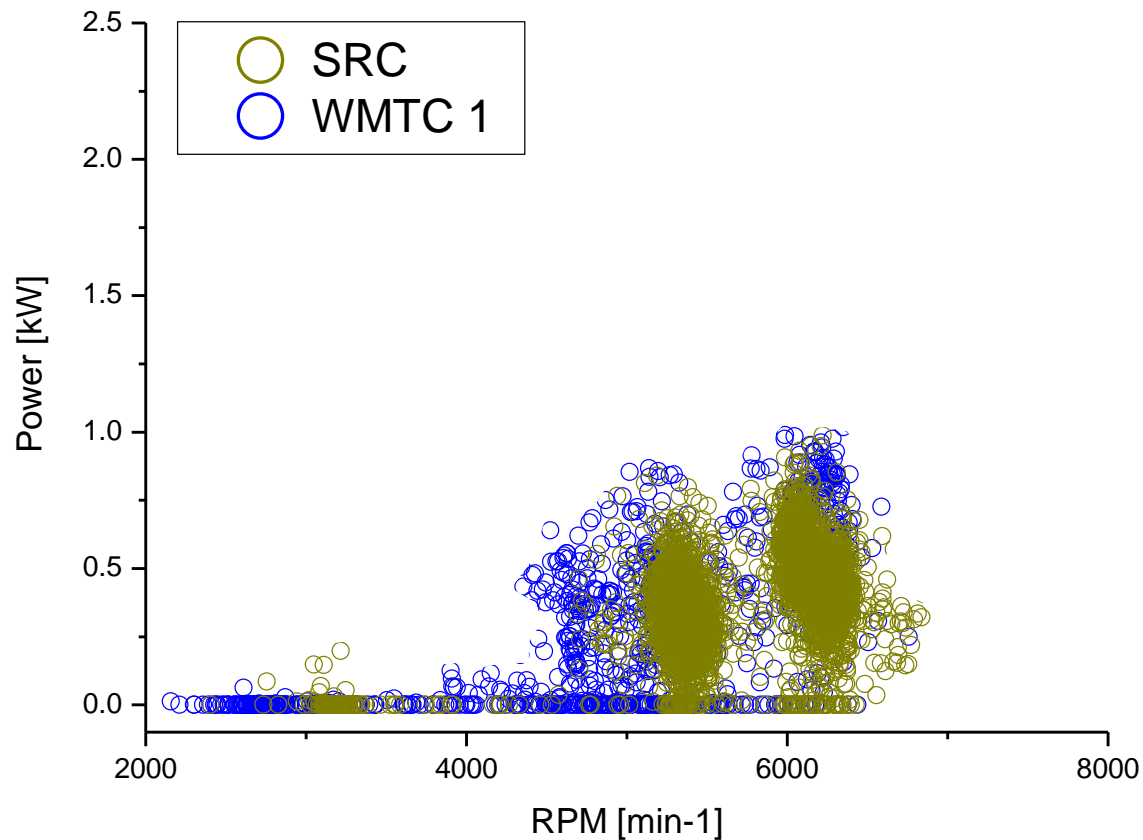
https://circabc.europa.eu/d/a/workspace/SpacesStore/cd01c5b2-b304-457e-b933-f55255a98ac2/report-trl-ppr627_en.pdf

Effect Study: Test Type V



Quality

Covered part-load area: WMTC and SRC-LeCV part-load areas (L1e-B)



Effect Study: Test Type VII



Task 1.6: Assessment Type VII – Energy efficiency tests

(CO2 emissions, fuel/energy consumption and electric range measurements)

Article 24 (1) of Regulation 168/2013 states that carbon dioxide emissions shall be determined in the applicable laboratory emission test cycle by the manufacturer and reported by the manufacturer to the approval authority and to the consumer at point of sale.

Fuel consumption and/or electric energy consumption and electric range shall be either calculated based on the type approval emission laboratory test results or measured, witnessed by the technical service and reported to the approval authority.

At the moment **there are no limit values**, and the European Union is not considering to introduce them in the Euro 5 step.

Effect Study: Test Type VIII



Task 1.7: Functional on-board diagnostics requirements and Type VIII – **OBD** environmental tests

Sub-task 1.7.1 - On-board diagnostic requirements – expansion functionality OBD stage I to OBD stage II
– relevance for effective and efficient vehicle repair

Sub-task 1.7.2: Type VIII test - assessment of OBD emission thresholds (OTLs)

Regulation 168/2013 introduces OBD for L3e-L7e vehicles in order to monitor the proper functioning of any electric circuit and electronic failure of emission control systems.

Euro 5 step: vehicles L3e, L5e-A, L6e-A and L7e-A shall be equipped with an OBD stage II system to **monitor and report emission control system failures and degradation.**

According to Article 23 of the Regulation 168/2013, the environmental study shall confirm the introduction of the OBD stage II for the above mentioned vehicle categories on the basis of scientific research findings and cost efficiency.

The main objective of on-board diagnostics (OBD) is to ensure **effective and efficient vehicle repair.**

A key objective of the Euro 5 regulation is to ensure the full and **non-discriminatory access** to vehicle onboard data as well the diagnostic information → increase competition and lower costs.

Many of the OBD features have beneficial secondary effects on **environmental protection** and vehicle functional safety.

Effect Study: Beyond Euro 5



TASK 2 - RESEARCH AND ASSESSMENT OF THE ELEMENTS LISTED IN RECITAL 12 OF REGULATION (EU) NO 168/2013 (**BEYOND THE EURO 5 STEP**)

Task 2.1: **Off-cycle** emissions testing

Sub-task 2.1.1. Experimental test programme on technical feasibility off-cycle emission requirements

Sub-task 2.2.2. Benefit / cost and cost effectiveness analysis off-cycle emission requirements

Task 2.2: In-service conformity verification testing

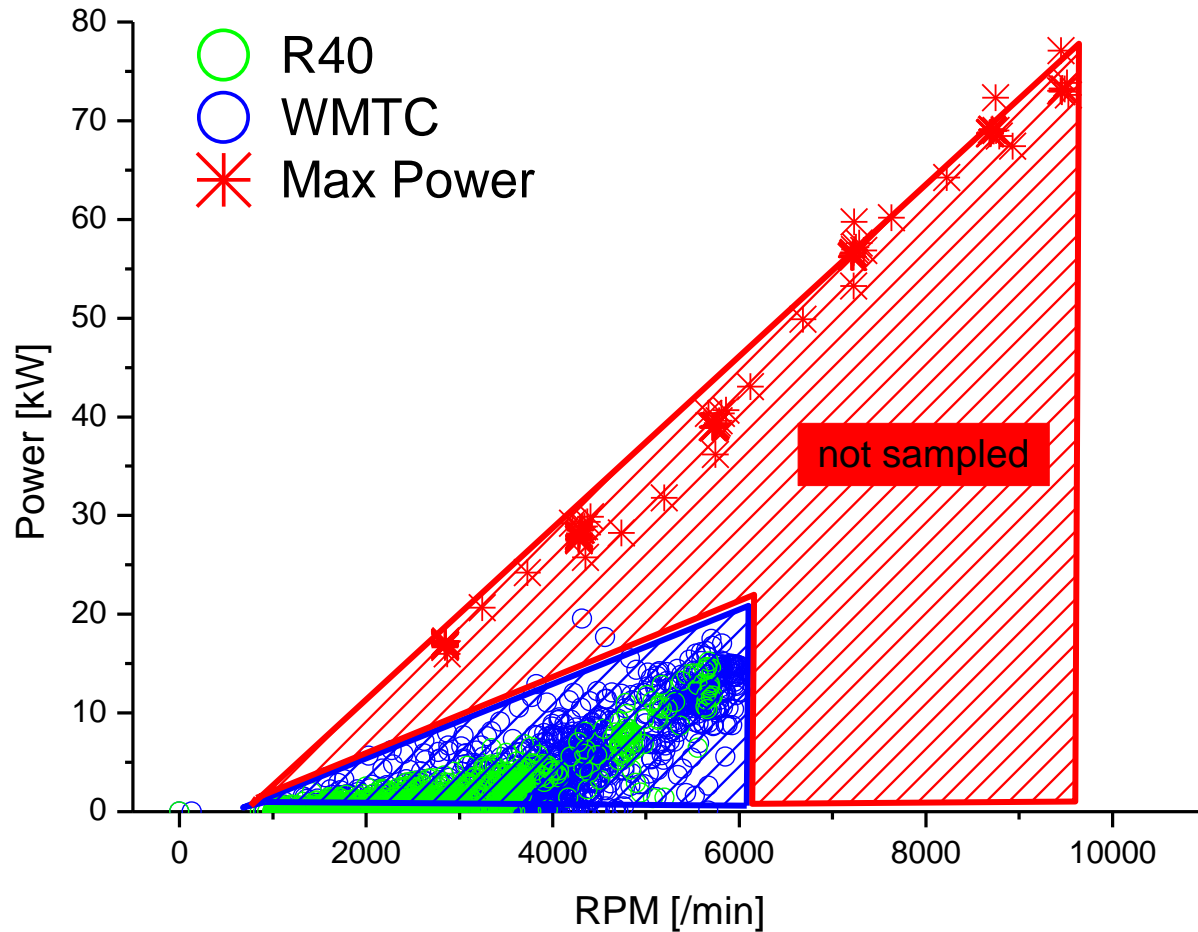
Regulation (EU) No 168/2013 requires an environmental study that should, inter alia, assess technical feasibility and cost-effectiveness of potential measures to keep under control **off-cycle emissions, in-service conformity, and Particle Number** extension.

The claimed fuel consumption (calculated from CO₂ measurements) communicated to consumers as single value at point of sale is not realistic.

Off-cycle emission testing is deemed to complement tailpipe emissions after cold start in the Type I emission laboratory test cycle in the future, in order to help improving the overall environmental performance assessment at type-approval.

Portable emission measurement systems, on the roller bench and on-road during urban, rural and highway driving.

Effect Study: Beyond Euro 5



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