Swedish In-Service Conformity Test Programme on Emissions from Passenger Cars and Light-Duty Trucks

Annual Report 2016

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by

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Content

1. List of Abbreviations 3
2. Summary 4
3. Introduction 6
4. Project Implementation 10
Investigation Programme 10
Vehicle Selection 11
Implementation of Tests 13
5. Main results in the 2016 years program 15
Type I test (Exhaust emissions) 15
Type II test (Idle emissions) 19
Type III (Crankcase emissions) 19
Type IV (Evaporative emissions) 19
Type VI (Low temperatures emissions) 22
CO_2 and Fuel consumption 23
OBD (On-Board Diagnosis) 25
NEDC vs WLTP and ERMES 26
6. Appendix 1 – Additional test program (PEMS) 31
Background information 31
Vehicle Selection 32
Main results 34
7. Appendix 2 – Driving Cycles 38
New European Driving Cycle (NEDC) 38
Worldwide Light Vehicle Test Cycle (WLTC) 38
European Research group on Mobile Emission Sources (ERMES) 42
8. References 43

1. List of Abbreviations

A4 / A5 / A6	4-speed / 5-speed / 6-speed automatic gearbox
CADC	Common Artemis Driving Cycle
CO	Carbon monoxide
CO_2	Carbon dioxide
COP	Conformity of production
CPC	Condensation Particle Counter
CVS	Constant Volume Sampler; exhaust emission sampling system
EC	European Community
ERMES	European Research group on Mobile Emission Sources
EUDC	Extra Urban Driving Cycle; Part 2 of the New European Driving Cycle
Euro 1	Type approval test in accordance with Directive 91/441/EEC
Euro 2	Type approval test in accordance with Directive 94/12/EEC
Euro 3	Type approval test in accordance with Directive 98/69/EC
Euro 4	Type approval test in accordance with Directive 98/69/EC, stricter requirements (incl. lower limit values in driving cycle, -7°C test)
Euro 5, Euro 6	Type approval test in accordance with EU Regulation 715/2007/EC
FC	Fuel consumption
FTP 75	Federal Test Procedure 75 = US American driving cycle, defined in 1975
HC	Hydro carbons; see THC
KBA	Kraftfahrtbundesamt – German Federal Motor Transport Authority
M1	Vehicles for passenger transportation with a capacity of max. 8 seats excluding the driver and a maximum total vehicle mass of 3,500kg
M5 / M6	5-speed / 6-speed manual gearbox
MK	Miljöklass; Swedish Environmental Class
N1	Vehicles for transportation of goods and a total vehicle mass of up to 3,500kg
NEDC	New European Driving Cycle according to EU Regulation 715/2007/EC
NO_X	Nitrogen oxides
OBD	On-Board Diagnosis
PEMS	Portable Emission Measurement System
PM	Particle Mass
PMP	Particle Measurement Programme
PN	Particle Number
RPA	Relative Positive Acceleration
SHED	Sealed Housing for Evaporative Emissions Determination
STA	Swedish Transport Agency
THC	Total Mass of hydro carbons emitted by a vehicle, given in C_1 equivalent
TSN	Type code number
UDC	Urban Driving Cycle; Part 1 of the New European Driving Cycle
UNECE	United Nations Economic Commission for Europe
WLTP	Worldwide harmonized Light vehicles Test Procedures

2. Summary

In this In-Service Conformity test programme a total of 45 vehicles, spread over 4 vehicle types with positive ignition engine and 5 vehicle types with compression ignition engine were tested with respect to the exhaust emissions limited by law. PEMS (drive emissions in real traffic) tests were carried out in an additional program of total 18 vehicles, 4 vehicle types with positive ignition and 2 vehicle types with compression ignition engine. The additional program is presented in **appendix 1.**

The measurements were carried out in the respective type approval cycle, the "New European Driving Cycle"(NEDC) in accordance with EU Regulation 715/2007/EC (Type I test). In addition to this, measurements according to the upcoming Worldwide Harmonized Light Vehicle Test Procedure (WLTP) were conducted according to the latest version of the existing Procedure Draft. During the measurements on the chassis dynamometer, the exhaust emissions were measured and the fuel consumption was calculated from the emissions of the carbon-containing exhaust components. Exhaust emissions at idle speed (Type II test) and crankcase emissions (Type III test) were measured of all vehicles with positive ignition engine. At two vehicles per type with positive ignition engine the evaporative emissions (Type IV test) were determined. In addition on two vehicles per type with positive ignition engine, the exhaust emissions at low ambient temperatures (Type VI test) were measured. With the Directive 98/69/EC an on-board diagnosis (OBD) system for passenger cars was introduced. With EU Regulation 715/2007/EC the Diagnose of Compression ignition engines becomes more important. During this programme the OBD-data were registered. Additional, some emission relevant failures were simulated to control the function of the OBD system of one vehicle per type. Below, some of the main findings during the 2016 programme.

During Type I tests, nearly all vehicle model tested complied with the limits given by the directive. Below cases of none comply are given

- 1 vehicle with compression ignition engine exceed the particle limit
- 1 vehicle with compression ignition engine exceed the NO_X limit
- 1 vehicle with positive ignition engine exceed the NO_X limit

Measuring exhaust emissions at idle speed during the Type II test no emission related problems were detected.

On all vehicle types with positive ignition engine no crankcase emissions (Type III) were emitted into the atmosphere during the tests.

During the exhaust emission test at low ambient temperatures (Type VI test), all vehicles complied with the limits according to EU Regulation 715/2007/EC.

During this project the OBD-data were registered. In addition some emission relevant defects were simulated to control the function of the OBD system at one of the vehicles per type. All simulated failures were detected by the OBD systems.

During the Type I test on 9 vehicle types the measured fuel consumption (and CO_2) were higher than the values declared by the manufacturer for all vehicle types.

- The average value for all 9 vehicle types was 7,9 percent higher
- The average value for vehicles with positive ignition engines was 7,2 percent higher
- The average value for vehicles with compression ignition engines was 8,3 percent higher
- On two vehicle types the average values was more than 10 percent higher

All tested vehicles in the additional PEMS-program complied with the limits given by the directive during Type I test. Types II to type VI were not included in the additional program. Also in the additional program measured fuel consumption and CO_2–emissions were higher for all tested vehicles compared with values given by manufactures. Beside that the main results from these test are:

- Real drive (RDE) results in higher CO emission for vehicles with positive ignition engines
- RDE results in higher NO_X emission for vehicles with compression ignition engines
- RDE results in higher CO_2 emissions and fuel consumptions for both types of vehicle.

To test the vehicles on different test cycles showed the influence of driving behaviour and driving conditions on the exhaust emissions. Dynamic driving, high speed, high engine load and cold start conditions cause an increase of carbon monoxide and hydrocarbon emissions, especially on vehicles with positive ignition engine. The major environmental exposure caused by compression ignition vehicles is nitric oxide and particulate emissions. NO_x was emitted by compression ignition vehicles especially during the WLTP and ERMES cycle. This is due to the high temperature inside the combustion chamber at high engine load, combined with a surplus of oxygen within the cylinder. It became obvious that dynamic driving with strong accelerations on urban conditions gives the worst fuel consumption. Positive ignition engines suffer from cold start the most. Smoothly running traffic with moderate speed and acceleration gives the lowest fuel consumption.

3. Introduction

Well-functioning transportation is vital for undertakings and citizens. Road transport dominates as it carries about 46 percent of freight and 83 percent of passenger traffic in Europe. The rise of the population causes a rise of the number of passenger cars. **Figure 1** shows the trend for the last 100 years.

In the end of 2016 Sweden's population was 9,995,153 people (see, **Figure 1**). There is an increase of 144 153 people compared with the previous year. Population growth is the biggest ever recorded between two individual years. The number of passenger cars in traffic was in the end of 2016, 4 776 744. The number of vehicles per persons increases over time and was in the end of 2016 just below ½ vehicle per person.

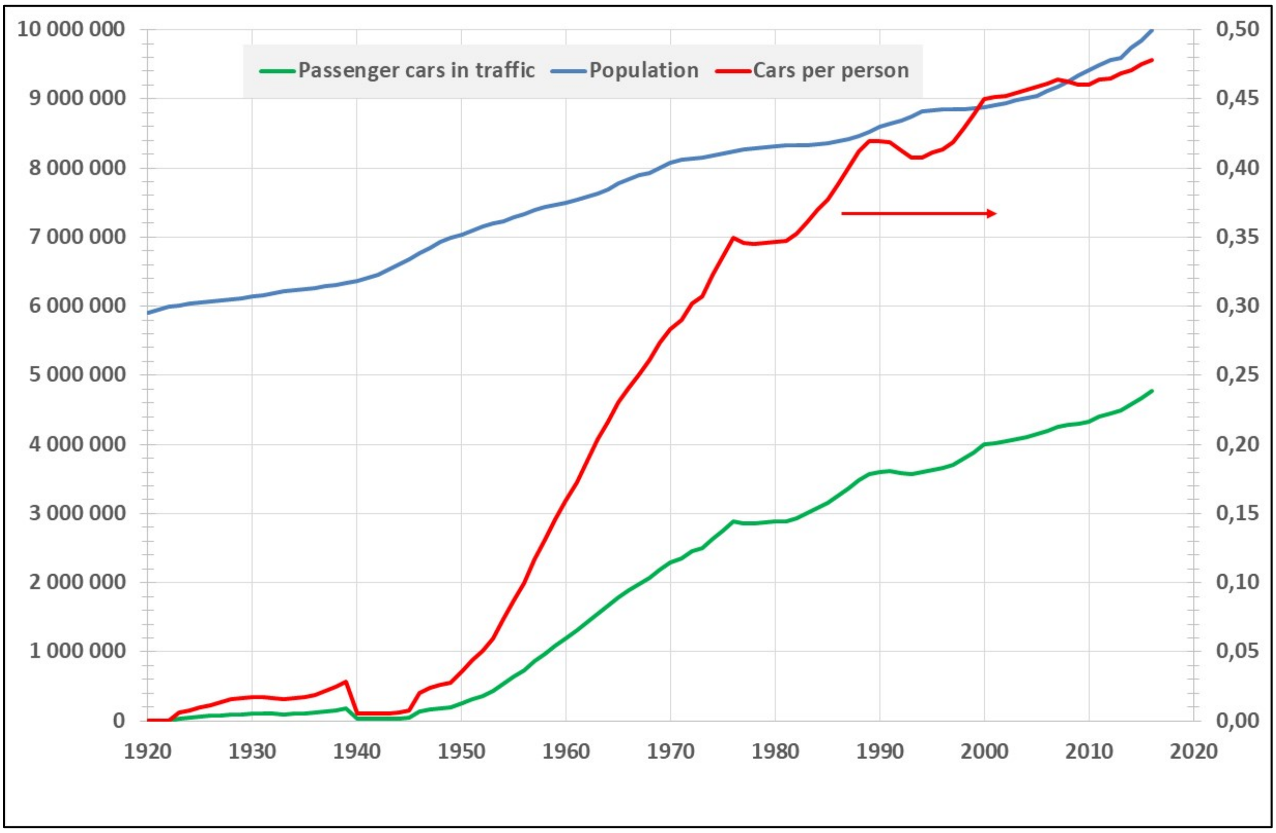

Figure 1. *Population and passenger cars in traffic in Sweden the last 100 years,*

Within this rising number of passenger cars and population the pollution to the air by the emissions gets more and more important. Main changes 2016 compared with 2015 and some comments on the Swedish vehicle fleet.

Number of sold passenger cars	+ 12 % (388 014 sold cars)
Percent sold compression ignition vehicles of total	52 % (58 % year 2015)
E85 cars	856 (- 31 %)
Gas cars	3810 (- 25 %)
Electrical cars	2993 (same as 2015)
Hybride cars	23 926 (+ 74 %)

Table 1*. Sold passenger cars 2016*

- In addition the use of Ethanol (E85) decreased from the highest use of 20 percent in 2008 down to about close to zero percent in 2016.
- The number of compression ignition vehicles sold is still on a high level but it may be a trend shift (the share of diesel seams to decrease)
- The number of hybrid- and or electrical vehicles increase but the total number is still on a low level
- The total number of vehicles in traffic increases steadily from year to year and correlates to the increasing population.

Transport policies aim at ensuring clean, safe and efficient carriage of passengers and goods. Increasing the efficiency and reducing negative effects of road traffic on the environment is a major challenge. Road traffic is still the main source of air pollution from carbon monoxide, hydrocarbons and nitrogen oxides in Europe. In order to counter environmental pollution from motor vehicle emissions, exhaust legislation has been stepwise tightened over the past few decades. There is now an extensive package of measures available to reduce air pollution due to road traffic. This includes both control of new vehicles and test of vehicles in-use. The control of new vehicles comprises type approval, durability test and conformity of production (COP). The control of vehicles in-service includes an on-board diagnosis (OBD) system in the vehicles, the periodic inspection of all vehicles on the road, vehicle manufacturers' In-Service Conformity test, plus enhanced requirements regarding fuel quality shows various statutory measures taken to reduce exhaust emissions from motor vehicles.

The In-Service Conformity test of vehicles in operation on the roads was introduced in October 1998 with Directive 98/69/EC, the provisions is now included in EU regulation 715/2007/EC. Here privately owned vehicles that have been registered compliant with Directive 98/69/EC or EU Regulation 715/2007/EC are examined after a statistical selection process in a complete test procedure according to the type approval cycle. It is the vehicle manufacturer who is responsible for this test. In addition to the manufacturer's own In-Service Conformity test, some countries in the EU have parallel national programs for In-Service Conformity. On a regular basis, this started in Sweden in 1991, first based on the national emission regulation and later on the EU legislation.

In numerous programmes it has been shown that In-Service Conformity test can reveal type-specific and design-related faults or inadequate maintenance regulations which, after an extended operating period of the vehicle, lead to an inadmissible increase in exhaust emissions.

Swedish Transport Agency (STA) is responsible for type-approval together with other obligations, for motor vehicle emission controls. With that follows the obligation to carry out evaluations of the product performance in-service. The STA has commissioned TÜV Nord (Germany) in collaboration with Ecotraffic (Sweden) to carry out the test programme on light duty vehicles.

The objective of the Swedish test programme is to conduct screening tests on a number of vehicle models, picked out on a spot-check basis, to verify durability in the emission control concept. This is done in close collaboration with the vehicle manufacturers. This enables the manufacturers concerned to rectify any type-specific faults relevant to emissions of the vehicles on the road and serial production and to incorporate knowledge gained from the field monitoring in future developments. By proceeding in this way, this research programme contributes directly to lowering the environmental pollution from emissions caused by road traffic.

Besides In-Service Conformity test it is also a minor objective of the programme to get information of emissions from vehicles during real world driving. These data will be used to update the European emission model HBEFA. HBEFA is used in Sweden for national emission inventories and as input to local air pollution calculations.

To get more information about real world driving the expert group of the European commission for Real Driving Emission on Light Duty Vehicles (RDE-LDV) declared the use of a Portable Emission Measurement System (PEMS) for type approval starting 2017. Up to now the RDE-LDV Group discusses how to precede such measurements the right way. To update the database and to support the ongoing process different types of vehicles in this program where tested with PEMS. The collected data were given to the Joint Research (JRC) Centre of the European Commission.

	New Vehicles			Vehicles on the Road		
	Type Approval Test	**Durability Test**	**Conformity of Production**	**In-Service Conformity test**	**Periodic Exhaust Inspection**	**On-Board Diagnosis**
Aim:	Verification of compliance with statutory specifications by the vehicle type	Verification of compliance with statutory specifications by the vehicle type	Statistical back-up for serial production	Detection of type-specific design-related defects or inadequate maintenance instructions	Detection of high-emission vehicles, servicing condition	Malfunction detection and indications for immediate repair
Area of Responsibility	Vehicle Manufacturer	Vehicle Manufacturer	Vehicle Manufacturer	Vehicle Manufacturer	Vehicle Owner	Vehicle Owner
Vehicle Selection	Prototypes	Prototypes or serial vehicles	Random sample from serial production	Random sample of vehicle fleet in the field	All vehicles on the road	All vehicles on the road
Test Interval	One-off	One-off	Sporadic	Regular	Regular	Permanent
Type of Test	Type test	Continuous run (AMA) or fixed deterioration factor	Type test	Type test	Idle test	Actual conditions according to manufacturer's application
Influence on Emission Reduction	Technology used	Durability under laboratory conditions	Technology used and implementation in production	Technology used and implementation in the field	Servicing condition	Durability and servicing condition in actual traffic
Statutory Basis	European Directives governing measures to prevent air pollution from motor vehicle emissions 98/69/EC ; 715/2007/EC			98/69/EC; 715/2007/EC	96/96/EC	98/69/EC; 715/2007/EC

Table 2. *Approaches to the reduction of exhaust emissions from motor vehicles*

4. Project Implementation

Investigation Programme

Within the framework of this programme a total of 4 vehicle types with positive ignition engine and 5 vehicle types with compression ignition engine were tested with respect to the exhaust emissions limited by EU emission legislation.

The measurements were carried out in the respective type approval cycle, i.e. the "New European Driving Cycle"(NEDC) in accordance with EU Regulation 715/2007/EC. In addition to this, measurements according to the upcoming Worldwide Harmonized Light Vehicle Test Procedure (WLTP) and European Research group on Mobile Emission Sources (ERMES) were conducted according to the latest version of the existing Procedure Drafts. Results were given to the European working group that is responsible for the Correlation exercise between NEDC and WLTP (and ERMES). The different driving cycles are shown in **appendix 2**

During the measurements on the chassis dynamometer, the emissions of carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_X) and carbon dioxide (CO_2) were collected in bags in accordance with the regulations and the integral values were determined. For all vehicles particle mass was determined according to the current regulation. Parallel to this the exhaust emissions were recorded continuously every second (modal measurement). The results of the modal measurements serve as the basis for determining the emission control strategies with which the exhaust emission behaviour can be shown in all relevant traffic situations.

In addition to exhaust emissions, fuel consumption was determined in the respective type approval cycle in accordance with EU Regulation 715/2007/EC. The fuel consumption was calculated from the emissions of the carbon-containing exhaust components (CO_2, CO and HC).

Exhaust emissions at idle speed (Type II test) and crankcase emissions (Type III test) were measured on all vehicles with positive ignition engine.

On two vehicles per type with positive ignition engine the evaporative emissions (Type IV test) were determined. Exhaust emissions at low ambient temperatures (Type VI test) of two vehicles per type with positive ignition engine were measured.

With Directive 98/69/EC an on-board diagnosis (OBD) system for passenger cars and light-duty vehicles was introduced. The provisions for the OBD system is developed further in EU Regulation 715/2007/EC. During this programme the OBD-data were registered. In addition some emission relevant failures were simulated to check the function of the OBD system at one vehicle per vehicle type.

The test date was agreed upon with the vehicle manufacturer or importer concerned to enable him to be present during the tests. Representatives of the respective vehicle manufacturer were present, having been invited to witness the implementation of the tests.

Vehicle Selection

It was intended that the selected vehicles should cover as wide a spectrum of manufacturers as possible, while maintaining a representative cross-section of the vehicle types licensed in Sweden. Vehicle types from 8 different manufacturers were investigated in the programme (and 4 in the additional program). All selected vehicles were type approved according to EU Regulation 715/2007/EC.
Table 3 shows the exhaust emission limits valid for the type approval test of passenger cars and light duty vehicles. For passenger cars (M1) with a maximum mass higher than 2,500 kg and light duty trucks (N1) separate limits can be applied according to the reference weight of the vehicle. The "New European Driving Cycle" is described **appendix 2.**

Engine	Limit	Vehicle Class *)	Reference Mass (RM) [kg]	CO [mg/km]	HC [mg/km]	NMHC [mg/km]	NO_x [mg/km]	$HC+NO_x$ [mg/km]	PM [mg/km]	PN [#/km]
positive ignition	Euro5	M1 ≤ 2500kg	All	1000	100	-	80	-	-	-
		N1 class I	RM ≤ 1305	1000	100	-	80	-	-	-
		N1 class II	1305< RM ≤1760	1810	130	-	100	-	-	-
		N1 class III	1760 < RM	2270	160	-	110	-	-	-
	Euro6	M1 ≤ 2500kg	All	1000	100	68	60	-	-	-
		N1 class I	RM ≤ 1305	1000	100	68	60	-	-	-
		N1 class II	1305< RM ≤1760	1810	130	90	75	-	-	-
		N1 class III	1760 < RM	2270	160	108	82	-	-	-
compression ignition	Euro5	M1 ≤ 2500kg	All	640	-	-	500	560	50	-
		N1 class I	RM ≤ 1305	640	-	-	500	560	50	-
		N1 class II	1305< RM ≤1760	800	-	-	650	720	70	-
		N1 class III	1760 < RM	950	-	-	780	860	100	-
	Euro6	M1 ≤ 2500kg	All	500	-	-	180	230	4,5	$6,0*10^{11}$
		N1 class I	RM ≤ 1305	500	-	-	180	230	4,5	$6,0*10^{11}$
		N1 class II	1305< RM ≤1760	630	-	-	235	295	4,5	$6,0*10^{11}$
		N1 class III	1760 < RM	740	-	-	280	350	4,5	$6,0*10^{11}$
* N1 limits are also valid for class M vehicles with a maximum mass > 2500kg										

Table 3. *Emission limits for passenger cars and light-duty vehicles, valid for the Type I test (NEDC)*

The vehicle selection was done in cooperation with local dealers to guarantee a good maintenance condition of the vehicles. Further criteria such as kilometre reading and date of first registration were taken into consideration. When the vehicles were taken over for the programme, additional data regarding repairs carried out on the vehicles as well as deviations from the series production condition was noted. The components which are relevant for exhaust emissions were checked for directly recognisable damage. OBD information was read to ensure that no emission relevant fault code was stored.

The following criteria were used as a basis when selecting individual vehicles:

- same type approval for vehicles of one type
- Kilometre reading between 15,000 km (alternatively at least 6 months in traffic) and 100,000 km,
- regular servicing according to manufacturer’s advice
- vehicle is unmodified series production model
- no mechanical damage to components

ID	Manufacturer	Type	Trade name	Engine type	Engine capacity cm³	Power kW	Emission approval	Engine speed rpm	EC-Approval no
Vehicles with Compression Ignition engine									
20	BMW	1K4	118d	N47D20C	1 995	105	Euro 5	4 000	e1*2007/46*0283*
30	Volvo	M	V40	D4162T	1 560	84	Euro 5	3 600	e4*2001/116*0076
40	Citroen	S	C3	8H01	1 398	50	Euro 5	4 000	e2*2007/46*0003*
80	Kia	JD	Ceed	D4FC	1 582	94	Euro 5	4 000	e11*2007/46*0195
100	Skoda	3T	Superb	CFGB	1 968	125	Euro 5	4 000	e11*2001/116*032
Vehicles with Positive Ignition engine									
50	Toyota	X13	Yaris	1NR-FE	1 329	73	Euro 5	6 000	e11*2007/46*0152
60	VW	6R	Polo	CJZ	1 197	66	Euro 6	4 400	e2*2007/46*0510
70	Peugeot	C	208	HM01	1 199	60	Euro 5	5 750	e2*2007/46*0070*
90	Kia	UB	Rio	G4LA	1 248	62	Euro 5	6 000	e11*2007/46*0195

ID	Manufacturer	Milage min km	Milage min km	Registration date
Vehicles with Compression Ignition engine in the PEMS-program				
20	BMW	32 582	74 860	04/2012 – 06/2013
30	Volvo	34 264	69 719	07/2013 – 12/2013
40	Citroen	22 491	45 578	06/2012 – 08/2014
80	Kia	31 227	74 226	03/2013 – 07/2014
100	Skoda	20 752	62 989	09/2013 – 02/2016
Vehicles with Positive Ignition engine in the PEMS-program				
50	Toyota	31 106	61 546	02/2013 – 07/2013
60	VW	12 717	33 561	06/2014 – 10/2014
70	Peugeot	19 555	53 143	09/2013 – 03/2016
90	Kia	33 054	60 665	03/2013 – 07/2014

***Table 4**. Vehicles included in the test program (PEMS-vehicles are described in **appendix 1**)*

Implementation of Tests

In **Table 5** the application of tests for type approval of passenger cars and light duty vehicles is illustrated.

Test	Description	Positive Ignition Vehicles	Compression Ignition Vehicles
Type I	tailpipe emissions after cold start	yes	yes
Type II	carbon monoxide emissions at idling speed	yes	-
Type III	emission of crankcase gases	yes	-
Type IV	evaporative emissions	yes	-
Type V	durability of anti-pollution control devices	yes	yes
Type VI	low ambient temperature tailpipe emissions after a cold start	yes	-
OBD	On Board Diagnosis	yes	yes

Table 5. *Application of tests for type approval*

Within the framework of the programme 9 vehicle types were tested (see **Table 4**). (6 vehicle models were also tested in an additional program, Real-Drive-Emissions, see **Table 10**. Results from these tests are presented in **Appendix 1***).* The investigations were implemented with reference to EU Regulation 715/2007/EC. In order to obtain a reliable assessment if type-specific defects are present on a vehicle type, initially five vehicles per type were measured with respect to exhaust emissions. After the vehicles had been received at the laboratory, a check was made as to whether the specified maintenance intervals had been observed and that the vehicles were in a proper condition. Proof was provided by means of the service record manual. Before commencement of the measurements on the chassis dynamometer, the vehicles were checked with respect to the tightness of the exhaust system.

For dynamometer setting the same inertia weight and coast down values were chosen as for the type approval test. A deterioration factor was not used for evaluating the Type I test results. The vehicle types were assessed in accordance with EU Regulation 715/2007/EC.

The vehicles were tested in a measuring programme which not only includes the tests applied for type approval, but also covers other test cycles like WLTP[1] and ERMES[2] to determine exhaust emission factors. **Table 6** and **Figure 2** gives a simplified illustration of the programme. It does not show the different tests in the order conducted during the programme.

The WLTP was driven according the version of the WLTP GTR in the beginning of the test programme to implement an additional conditioning of the vehicles before starting the tests according to the directive. On the afternoon of the day before running the Type I tests, all vehicles were conditioned (NEDC for vehicles with positive ignition, 3 Extra Urban Driving Cycles (EUDC) for vehicles with compression ignition).

Type II and III tests on vehicles with positive ignition engine were carried out immediately after the Type I test. The OBD check was done at the end of the test procedure to make sure that the simulation of emission relevant failures could not affect the results of the other tests. **Table 6** displays the procedure of the different tests during the programme. Driving cycles are described in **Appendix 2**

[1] **W**orldwide harmonized **L**ight vehicles **T**est **P**rocedure
[2] **E**uropean **R**esearch group on **M**obile **E**mission **S**ources

ID	Manuf.	Model	Euro	Engine	PEMS	WLTP	ERMES	Conditioning	Type I	Type II	Type III	Type IV	Type VI	OBD cehck
20	BMW	118	5	CI		3 of 5	3 of 5	5 of 5	5 of 5					1 of 5
30	Volvo	V40	5	CI		3 of 5	3 of 5	5 of 5	5 of 5					1 of 5
40	Citroen	C3	5	CI		3 of 5	3 of 5	5 of 5	5 of 5					1 of 5
50	Toyota	Yaris	5	PI		3 of 5	3 of 5	5 of 5	5 of 5	5 of 5	5 of 5	2 of 5	2 of 5	1 of 5
60	VW	Polo	6	PI		3 of 5	3 of 5	5 of 5	5 of 5	5 of 5	5 of 5	2 of 5	2 of 5	1 of 5
70	Peugeot	208	5	PI		3 of 5	3 of 5	5 of 5	5 of 5	5 of 5	5 of 5	2 of 5	2 of 5	1 of 5
80	Kia	Ceed	5	CI		3 of 5	3 of 5	5 of 5	5 of 5					1 of 5
90	Kia	Rio	5	PI		3 of 5	3 of 5	5 of 5	5 of 5	5 of 5	5 of 5	2 of 5	2 of 5	1 of 5
100	Skoda	Superb	5	CI		3 of 5	3 of 5	5 of 5	5 of 5					1 of 5
110	Seat	Leone	6	PI	3 of 3	3 of 3	3 of 3		3 of 3					
120	Opel	Combo	5	CI	3 of 3	3 of 3	3 of 3		3 of 3					
130	Peugeot	208	6	PI	3 of 3	3 of 3	3 of 3		3 of 3					
140	Opel	Corsa	6	PI	3 of 3	3 of 3	3 of 3		3 of 3					
160	Mini	Cooper	6	PI	3 of 3	3 of 3	3 of 3		3 of 3					
170	Mercedes	200 A	6	CI	3 of 3	3 of 3	3 of 3		3 of 3					

Table 6*.* Overview of the test programme (vehicle ID 110-170, tested in the additional program, are described in appendix 1)

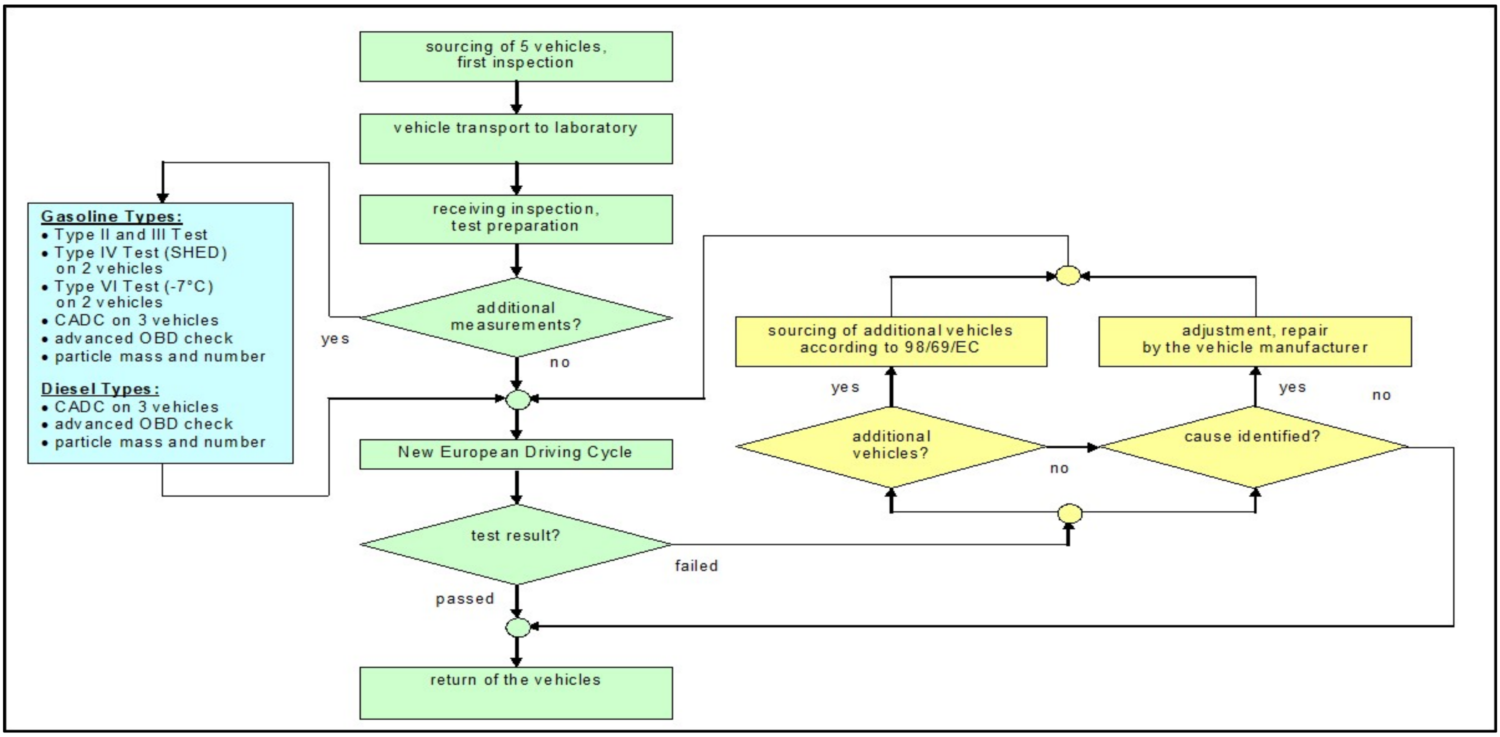

Figure 2*. Simplified illustration of the In-Service Conformity test programme*

5. Main results in the 2016 years program

Type I test (Exhaust emissions)

In the following sections the values for exhaust emissions and fuel consumption of the various vehicles in the respective approval cycle are examined. **Figure 3** to **Figure 5** give examples for the carbon monoxide emissions (CO), the total hydro carbon emissions (THC) and nitric oxide (NO_X) emissions of a typical Euro 5 vehicle with positive ignition engine during Type I test.

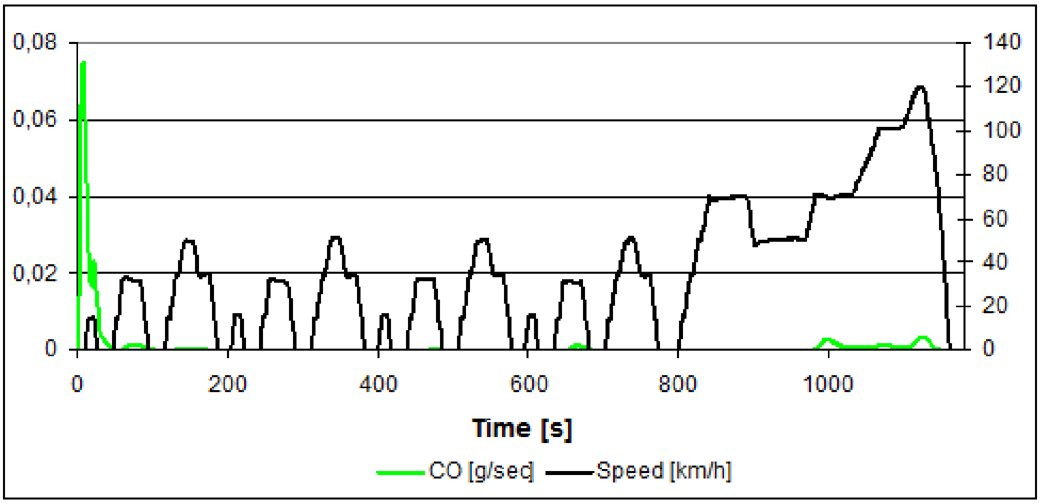

Figure 3. *CO emitted by a positive ignition vehicle during NEDC<*

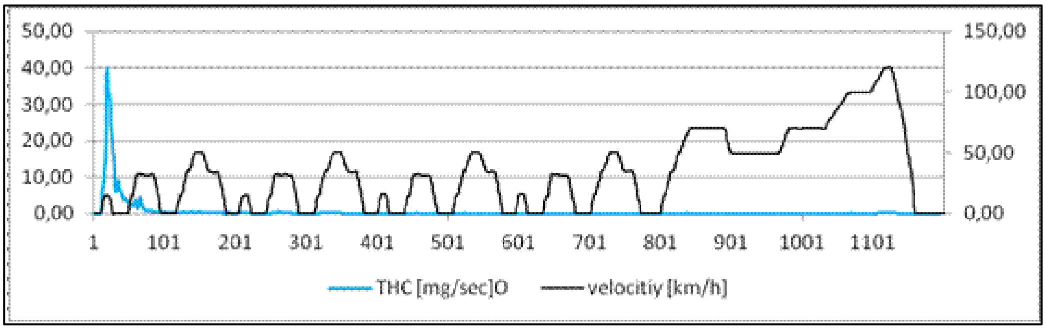

Figure 4. *THC emitted by a positive ignition vehicle during NEDC*

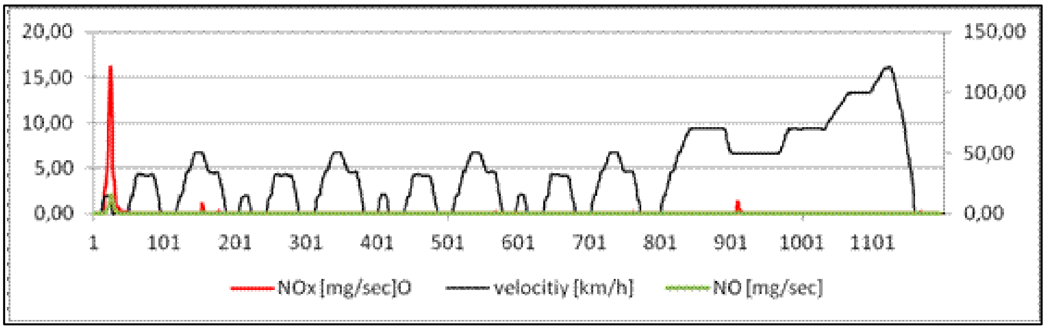

Figure 5. *NOx and NO emitted by a positive ignition vehicle during NEDC*

The major fraction of the CO, the THC and NOx emissions occurs at cold start conditions in the beginning of the driving cycle. As soon as the catalyst has reached its light off temperature of about 250°C carbon monoxide, hydrocarbons and nitric oxides are converted to carbon dioxide, water vapour and nitrogen.

Figure 6 to **Figure 8** show the carbon monoxide emissions (CO), the total hydro carbon emissions (THC) and nitric oxide (NO_X) emissions of a Euro 5 vehicle with compression ignition engine during Type I test.

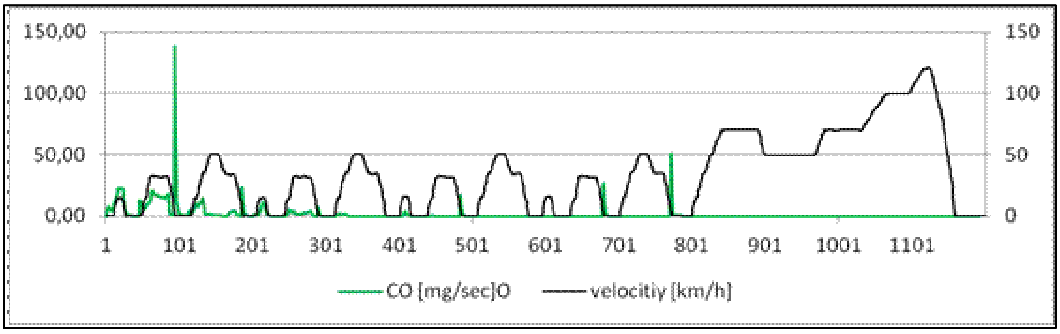

***Figure 6.** CO emitted by a compression ignition vehicle during NEDC*

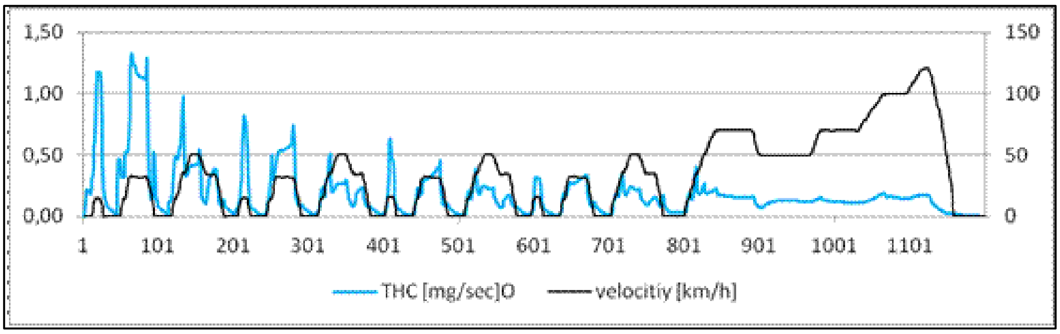

***Figure 7.** THC emitted by a compression ignition vehicle during NEDC*

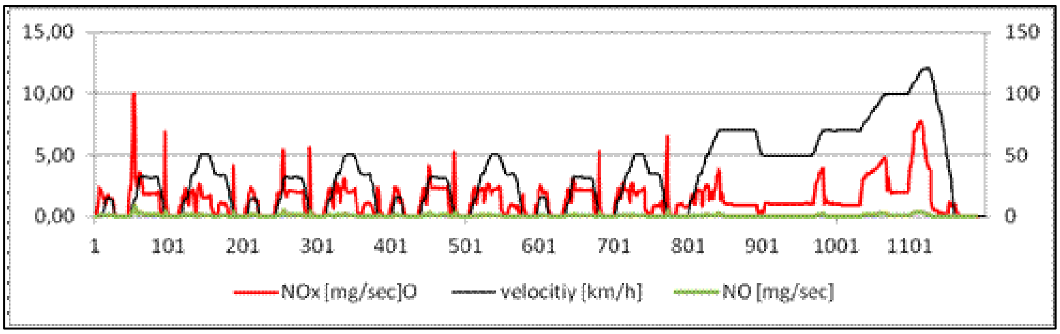

***Figure 8.** NOx and NO emitted by a compression ignition vehicle during NEDC*

Carbon monoxide and total hydro carbon emissions of compression ignition vehicles show a graph similar to positive ignition vehicles on a lower level. Due to cold start the major fraction of CO and THC are emitted during the first minutes of the test. As soon as the catalyst has reached its light off temperature, carbon monoxide and hydro carbons are oxidised. Because of the different combustion process, compression ignition engines generate higher nitric oxide emissions than positive ignition engines. High temperatures and a surplus of oxygen in the combustion chamber cause nitric oxide emissions. These conditions are found especially during accelerations. Due to an oxygen surplus within the exhaust gas these nitric oxides cannot be converted by a three-way catalytic converter on compression ignition cars.

In **Table 7** average of the measured exhaust emissions for the different vehicle categories are compared to the type approval limits. The average emissions of all types tested complied with the limits given by the regulation, but

- 1 vehicle with compression ignition engine exceed the particle limit (8,26 mg)
- 1 vehicle with compression ignition engine exceed the NO_X limit (210 mg)
- 1 vehicle with positive ignition engine exceed the NO_X limit (88,6 mg)

Category	**Emission class**	**Cycle**	**Average Exhaust Emissions**					
			CO [mg/km]	**HC [mg/km]**	**NO_x [mg/km]**	**HC+NO_x [mg/km]**	**PM [mg/km]**	**PN [#/km]**
Positive ignition	Euro 5	UDC	*506*	*76*	*43*	*119*	*0,3*	*5,07E+11*
	Euro 5	EUDC	*93*	*2*	*22*	*23*		*2,55E+11*
	Euro 5	NEDC	230	28	31	59	0,3	3,69E+11
Limit	**Euro 5 and 6**	**NEDC**	**1000**	**100**	**60**	**n.a**	**4,5**	**n.a**
Compression ignition	Euro 5	UDC	*230*	*22*	*166*	*188*	*0,6*	*9,18E+11*
	Euro 5	EUDC	*6*	*2*	*119*	*121*	*0,0*	*2,39E+11*
	Euro 5	NEDC	92	10	143	154	1,3	2,43E+11
Limit	**Euro 5**	**NEDC**	**1000**	**n.a**	**180**	**230**	**4,5**	**6,00E+11**

Table 7. *Average values from the vehicles included in the test program. Based on in total 25 vehicles with compression ignition engine and 20 with positive ignition engine. All vehicles types are of Euro 5 except (1 of 4) Euro 6 type with positive ignition engine*

Figure 9 presents the Particle mass and NO_X emissions from vehicle types with positive ignition and compression ignition during Type I test.

All tested vehicle types types with positive ignition and all vehicle types with compression ignition engines complied with the Euro 5 (and also the Euro 6 vehicle with positive ignition engine) limits during Type I test and fulfilled the requirements for In-Service test according to the statistical procedure defined with EU Regulation 715/2007/EC.

All tested vehicles with compression ignition were equipped with a periodically regenerating particulate trap. During type approval a factor (Ki) is used to consider the emissions during filter regeneration. The values given in this report do not consider the Ki factor. But also considering the emission during filter regeneration and the Ki factor all compression ignition vehicle types with particle filter complied with the limit for particulate mass given in EU Regulation 715/2007/EC.

Particle mass emissions and nitric oxide emissions from vehicle types with positive and compression ignition during Type I test are shown in **Figure 9.** None of the vehicle types tested exceeded the Euro limits for particle and nitric oxide.

Figure 10 presents the carbon monoxide emissions and the hydrocarbon emissions from vehicle types with positive and compression ignition during Type I test. None of the vehicle types tested exceeded the Euro limits for carbon monoxide and hydro carbons during Type I test (or NO_X+HC for vehicles with compression ignition engine).

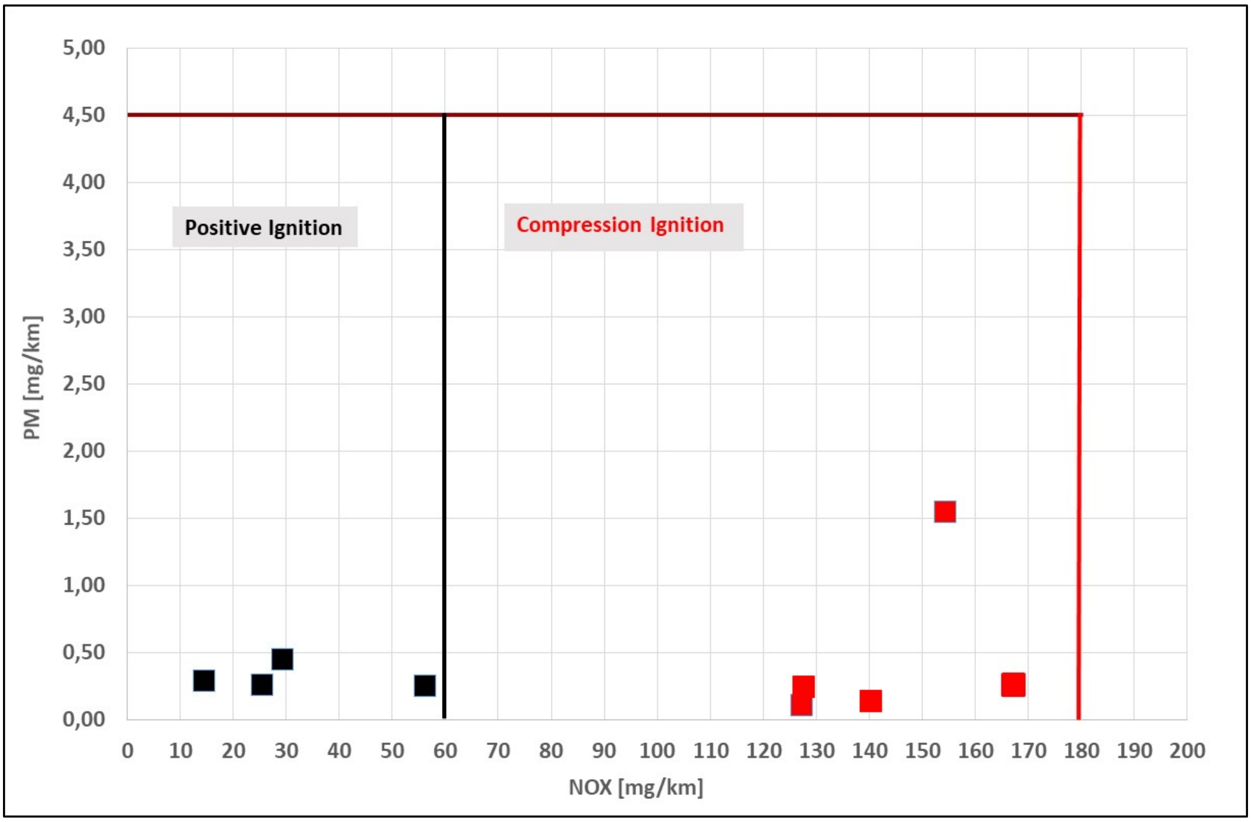

Figure 9. *Average PM and NO_X emissions from vehicle types with compression (red) and positive ignition engines (black)*

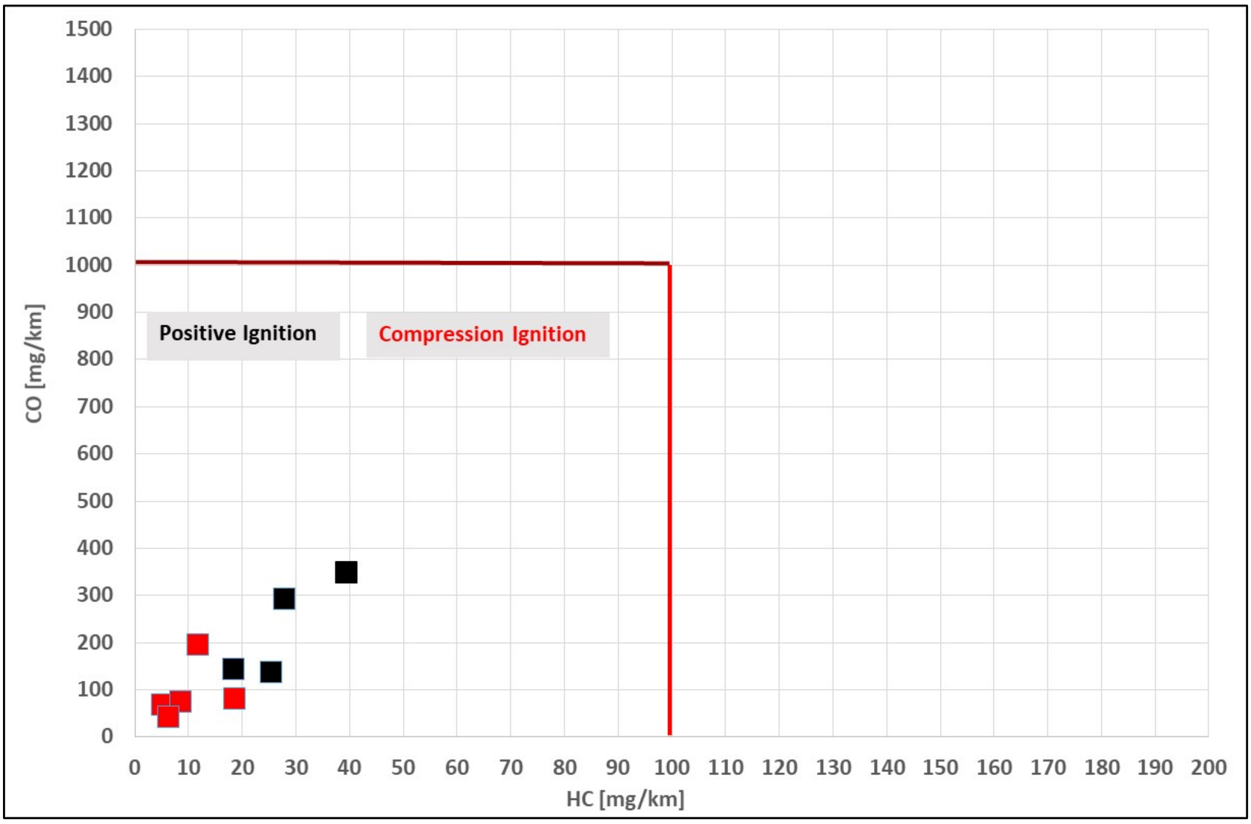

Figure 10. *Average CO and HC emissions from vehicle types with compression (red) and positive ignition engines (black). There is no HC limit for compression ignition vehicles but a limit for NO_X+HC None of the vehicle types tested exceeded that limit.*

Type II test (Idle emissions)

CO emissions at idle speed (Type II Test) were measured on all tested vehicles with positive ignition engines. During these tests no emission related problems were detected on the vehicles.

The average engine speed and CO-emissions were:

- *710 rpm and CO concentration 0,013 vol-%*

The CO-vol concentration is well under the limit value of 3,5 vol-%

The Type II test is not relevant for vehicles with compression ignition engine

Type III (Crankcase emissions)

Exhaust gases passing by the piston rings could cause environmental pollution. Therefore vehicle types with positive ignition engine are equipped with a crankcase ventilation system. The crankcase gases are routed to the intake manifold and are combusted in the engine. The crankcase ventilation system is tested by measuring the pressure within the system at idle speed and at 50 km/h on the dynamometer with two different load settings. The pressure measured in the crankcase may not exceed the atmospheric pressure at different load conditions.

Crankcase emissions (Type III Test) were measured at all tested vehicles with positive ignition engines. During these tests no emission related problems were detected on the vehicles and no crankcase gases were emitted into the atmosphere during the tests.

The Type III test is not relevant for vehicles with compression ignition engine

Type IV (Evaporative emissions)

For type approval test, in addition to exhaust emissions in the type I test, the amount of evaporative hydrocarbon emissions escaping mainly from the vehicle fuel system is measured. For this Type IV test a Sealed Housing for Evaporative Emissions Determination (SHED) is used. The Type IV test is designed to determine hydrocarbon evaporative emissions caused by hot soaks during parking and by diurnal temperatures variation. The measurement of evaporative emissions according to EU Regulation 715/2007/EC includes three phases:

- test preparation including a driving cycle
- hot soak loss determination
- diurnal loss determination

For measuring the hot soak emissions, the test vehicle is placed in a SHED for one hour directly after having finished a driving cycle. During the diurnal test the vehicle is placed in the SHED for 24 hours to determine the fuel-system and tank ventilation losses. The vehicle is exposed to an ambient temperature cycle which simulates the temperature profile for a summer day while the hydrocarbons released are measured. In this way, hydrocarbon emissions due to permeation and micro-leaks in the whole fuel system are considered. The results of the hot soak test and of the diurnal test are summated to a total result. The statutory limit value for the total evaporative emissions is 2 g hydrocarbons per test.

Figure 11 gives a detailed outline of the Type IV test procedure according EU Regulation 715/2007/EC. During this programme the vehicles were refilled with reference fuel and driven the

Worldwide Harmonized Light Vehicles Test Cycle (WLTC) before starting the SHED-procedure. On all tested vehicles the washer fluid canister was drained, purged and refilled with clear water.

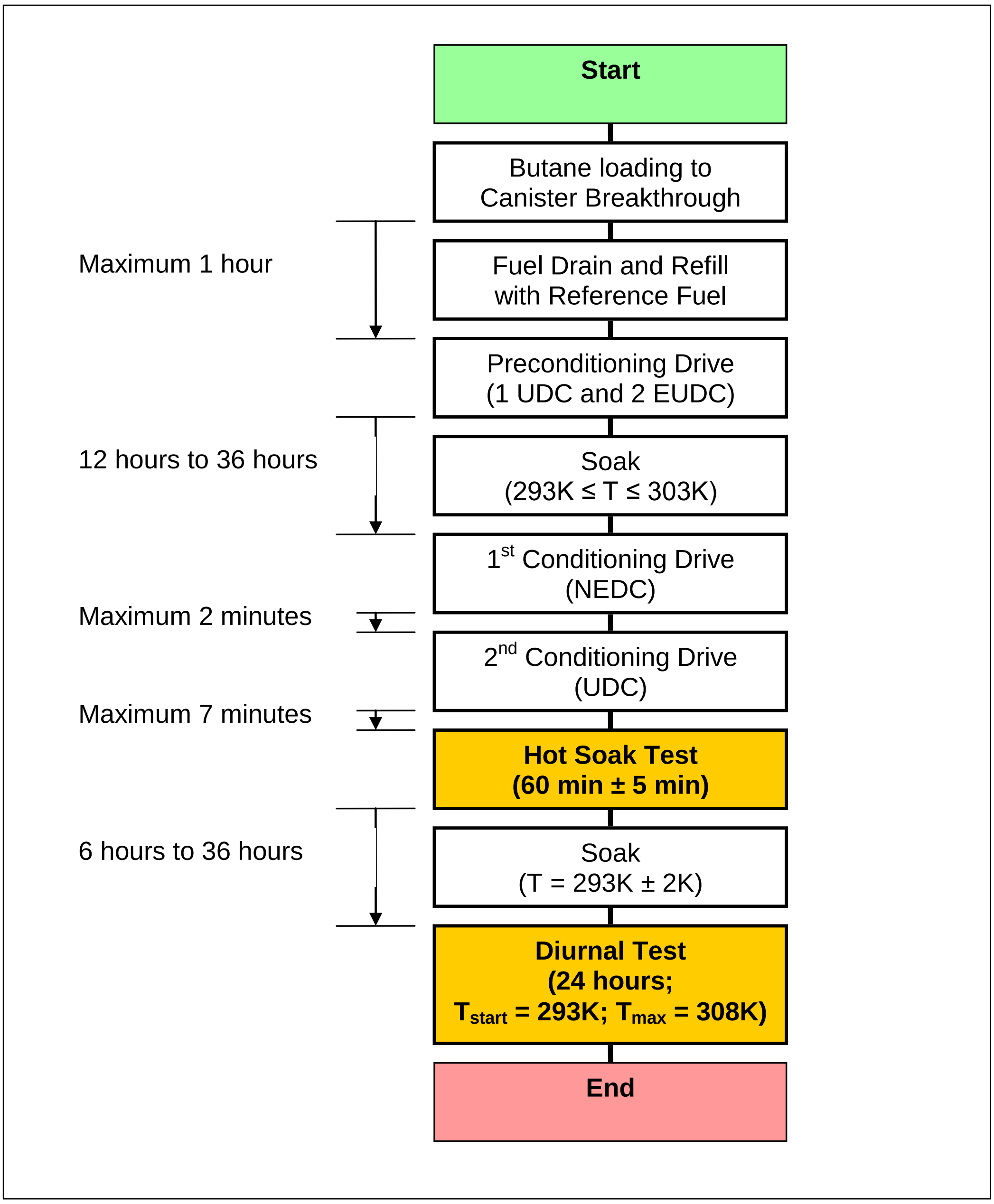

Figure 11. Type IV test procedure

During this In-Service Conformity test programme, measurement of the evaporative emissions was performed on two vehicles per type with positive ignition engine in addition to the exhaust emission measurement. The results of these measurements are summarised in **Table 8**

Vehicle No.	**Evaporative emissions [g HC]**		
	Hot Soak	Diurnal	Total
1	0,08	1,22	1,33
2	0,07	1,05	1,12
3	0,12	1,04	1,16
4	0,08	1,11	1,19
5	0,07	1,05	1,12
6	0,08	1,33	1,41
7	0,03	0,44	0,47
8	0,02	0,31	0,33
Average			
	0,07	0,94	1,02
Limit			
	-	**-**	**2.00**

Table 8. Type IV results

During the Type IV test all tested vehicles complied with the limit for evaporative emissions.

The Type IV test is not relevant for vehicles with compression ignition engine

Type VI (Low temperatures emissions)

Directive 98/69/EC introduced an exhaust emission test at low ambient temperatures for vehicles with positive ignition engine. Also in EU Regulation 715/2007/EC the test at low temperature is mandatory. The test includes a cold start at -7°C and the urban part of the NEDC. The purpose of this Type VI test is the adaptation of type approval test to realistic driving conditions. Carbon monoxide and hydrocarbon emissions are limited by the Regulation.

During this In-Service Conformity test programme, two vehicles per vehicle type with positive ignition engine were tested with the type VI test at low ambient temperatures.

Table 9 and **Figure 12** show the Type VI test results compared to the Type I test results of the positive ignition vehicles tested at low ambient temperatures.

	UDC Type I		**UDC Type VI** - 7 °C	
	CO mg/km	**THC** mg/km	**CO** mg/km	**THC** mg/km
Average	506	76	4 255	814
Limit	n.a	n.a	15 000	1 800

Table 9. *Average UDC type I and type VI CO and THC emissions from vehicles with positive ignition engines*

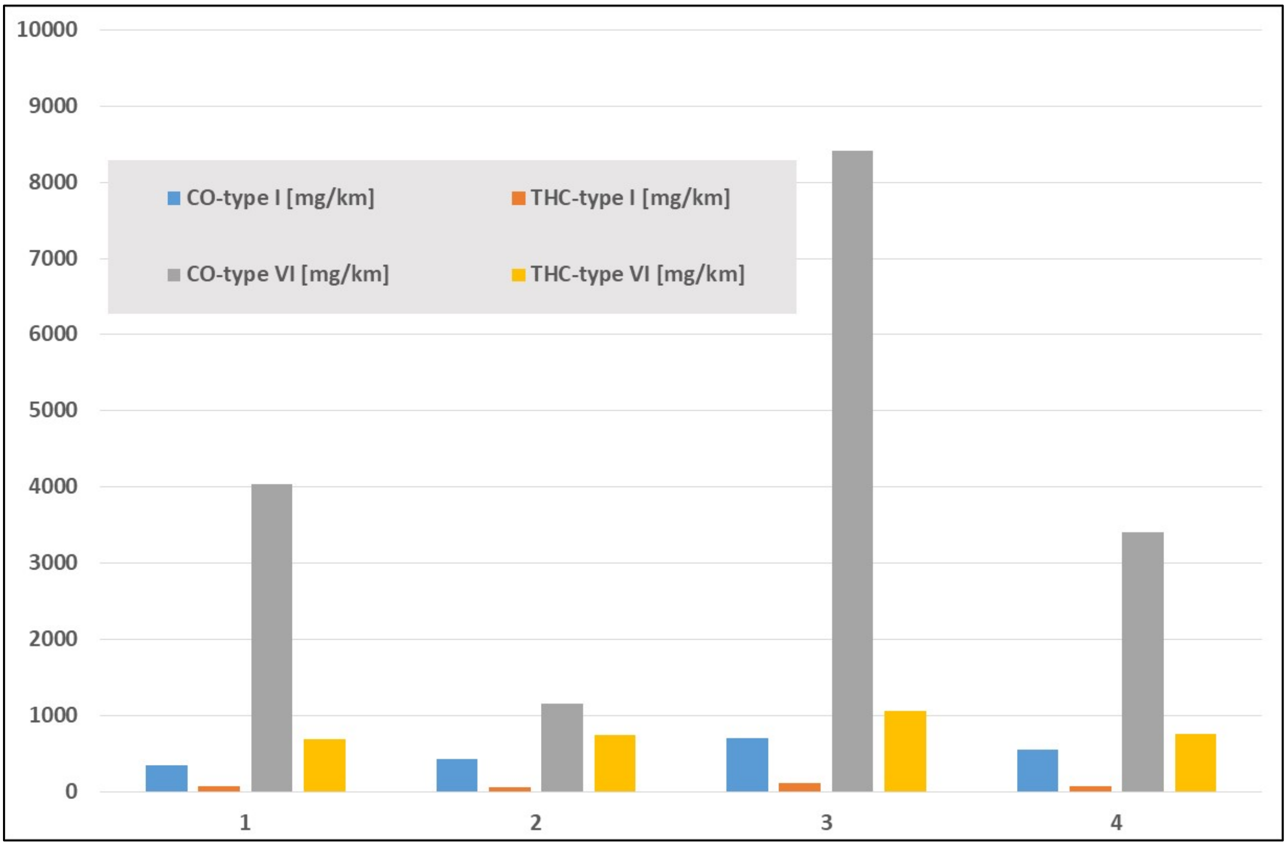

Figure 12. Type I and type VI CO and THC emissions from four (4) vehicles with positive ignition engines

During the exhaust emission test at low ambient temperatures, all tested vehicles complied with the limits according to EU Regulation 715/2007/EC.

The Type VI test is not relevant for vehicles with compression ignition engine

CO_2 and Fuel consumption

Carbon dioxide is an important greenhouse gas because it transmits sunlight and strongly absorbs the infrared radiation reflected by earth. Combustion of fossil fuels increases the concentration of carbon dioxide in the atmosphere. Road traffic is a major source for man-made carbon dioxide emissions. Traffic of passenger cars contributes to about 12 percent of man-made CO_2 in Europe, according to 2004, EU-25 figures from the European Commission.

There is a requirement on the manufacturer on average CO_2 emissions from all vehicles sold during a year. From the year 2015 the average CO_2 emissions shall not exceed the limit value of 130 g/km. If there is an exceedance the manufacturer have to pay a fine for every gram exceeding the limit. From 2020 the limit value is 95 g/km.

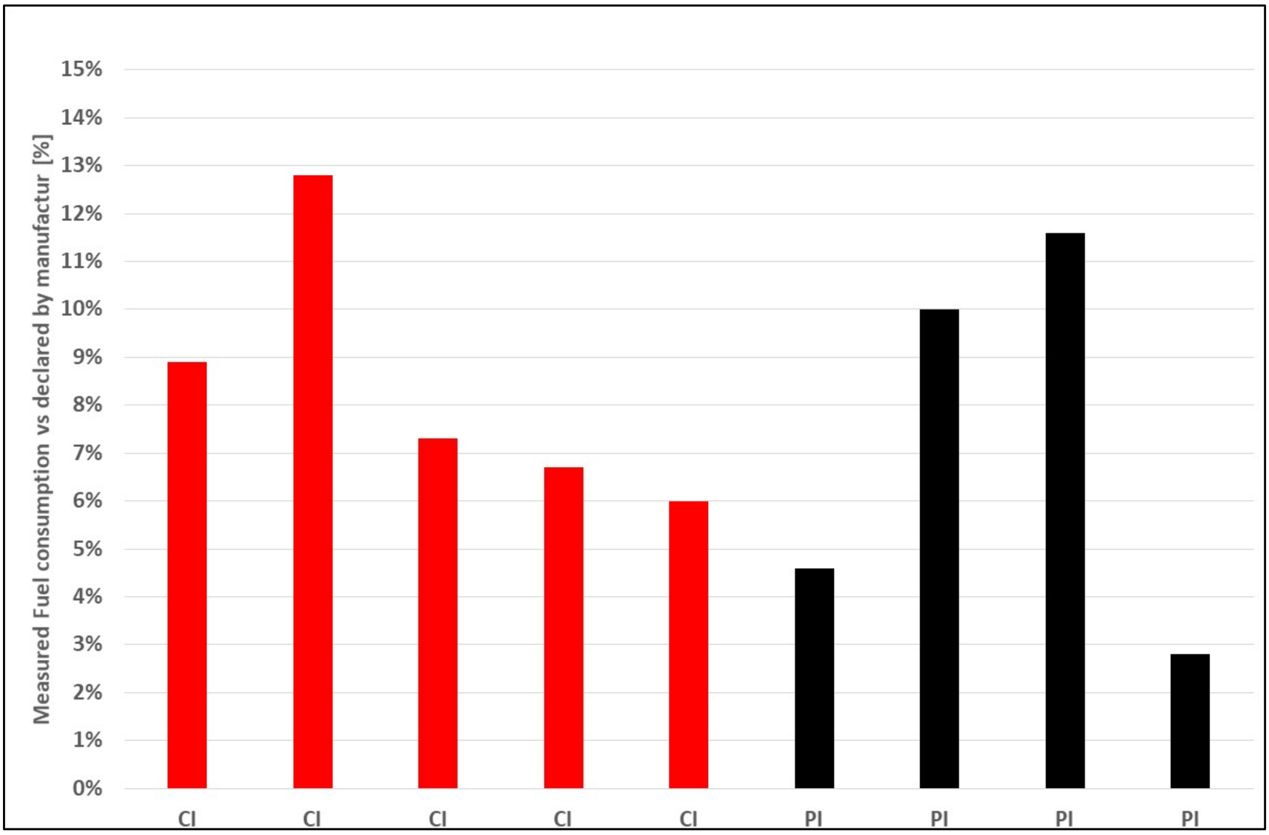

Figure 13. *Difference in measured and by manufacturer declared fuel consumption during the Type I test.*

The CO_2 emissions are measured in the "New European Driving Cycle". The fuel consumption is calculated using the measured CO_2 emissions and the other carbon-containing emissions (CO and HC). The test vehicle must be presented in good mechanical condition. For type approval it must be run-in and it must have been driven for at least 3,000 km, but for less than 15,000 km.

Figure 13 show the average difference in measured and by manufacturer declared fuel consumption during the Type I test for the tested vehicle types.

During the Type I test on 9 vehicle types the measured average fuel consumption was higher than the fuel consumption declared by the manufacturer for all vehicle types.

- The average value for all 9 vehicle types was 7,9 percent higher
- The average value for vehicle types with positive ignition engines was 7,2 percent higher
- The average value for vehicle types with compression ignition was 8,3 percent higher
- For two vehicle types the average value was more than 10 percent higher

The average measured fuel consumption for vehicle types with:

- compression ignition engines was 4,9 litre/100 km
- positive ignition engines 5,2 litre/100 km

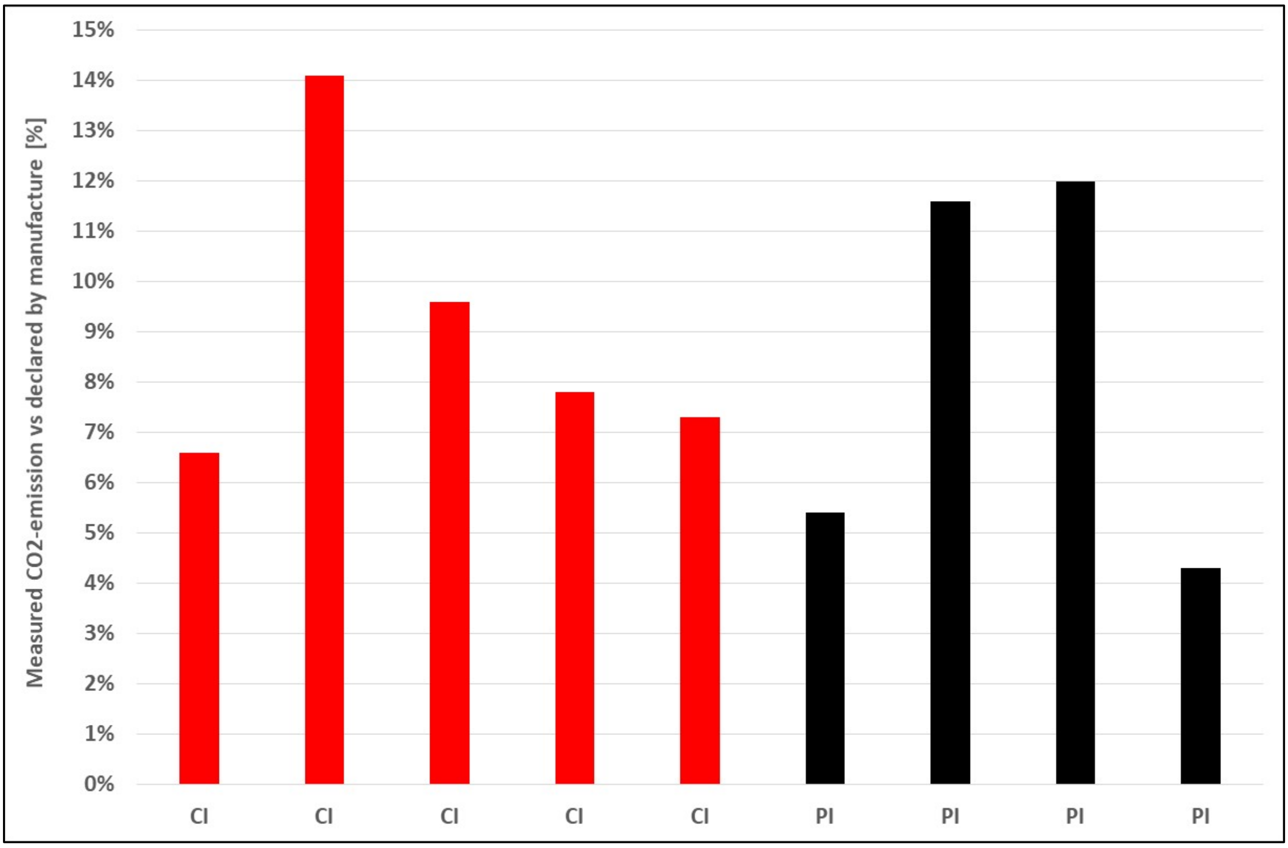

Figure 14. Difference in measured and by manufacturer declared CO_2-emissions during the Type I test

Figure 14 show the difference in measured and by manufacturer declared CO_2-emissions during the Type I test for the tested vehicle types.

During the Type I test on 9 vehicle types the measured average CO_2 emissions was higher than the CO_2 emissions declared by the manufacturer for all vehicle types.

- The average value for all 9 vehicle types was 8,7 percent higher
- The average value for vehicles with positive ignition engines was 8,3 percent higher
- The average value for vehicles with compression ignition engines was 9,1 percent higher
- 8 of 9 vehicle models exceeded the declared value with more than 5 percent

The average measured CO_2-emission for vehicles with:

- compression ignition engines was 123 g/km
- positive ignition engines 121 g/km

OBD (On-Board Diagnosis)

With Directive 98/69/EC an on-board diagnosis (OBD) system for passenger cars and light-duty vehicles was introduced. The provisions for the OBD system is developed further in EU Regulation 715/2007/EC. The aim of introducing the OBD system was to achieve a significant upgrade in emission performance over the useful lifetime of vehicles in service. The OBD is an electronic system designed to detect failures of anti-pollution devices immediately, monitor critical functions of the engine and emission control systems, store additional information about deviations and assist during maintenance with fault diagnosis and fault rectification. OBD is required for vehicles with positive ignition engine registered since the 1. January 2001 and for vehicles with compression ignition engine registered since the 1. January 2004.

During this project the OBD-data were registered. In addition, some emission relevant defects were simulated to check the function of the OBD system at one of the vehicles per vehicle type. Different failures like electrical disconnection of intake air pressure sensor, disconnection of throttle position sensor, misfire, electrical disconnection of injector, disconnection of oxygen sensor (before and after catalyst) were implemented depending on the power train of the vehicles tested.

All simulated failures were detected by the OBD system.

NEDC vs WLTP and ERMES

In this section (**Figure 15** to **Figure 21**) the results from tests from using of three different driving cycles are shown, NEDC, WLTP and ERMES. The driving cycles are described in **appendix 2**.

Values presented are average values for five vehicle types with compression and four with positive ignition engines. Some of the main conclusions from these tests are:

The figures demonstrate that the major fraction of CO and HC within the New European Driving Cycle is emitted during the Urban Driving Cycle including cold start. High load and high speed during the WLTP and ERMES cause increasing CO emissions on positive ignition engine vehicles.

Both CO and HC emissions are products of incomplete combustion. Therefore CO and HC are emitted at the same driving conditions. Especially at cold start conditions before the catalyst has reached its light-off-temperature and at high load with a rich air fuel ratio CO and HC are emitted because they cannot be converted. Due to a surplus of oxygen in the air fuel mixture, CO and HC emissions of vehicles with compression ignition engine are lower than of vehicles with positive ignition during all different test cycles.

The major environmental exposure caused by compression ignition vehicles is NO_x and particulate emissions. NO_x is emitted by compression ignition vehicles especially during the WLTP phase extra high and ERMES P4 cycle. This is due to the high temperature inside the combustion chamber at high engine load combined with a surplus of oxygen within the cylinder.

During this programme particle emissions were measured both on compression ignition and on positive ignition vehicles. It has to be considered that due to the measurement technique especially on positive ignition vehicles beside particles, condensed volatile HC might have been collected on the filter pads which could have affected the test results.

The particle mass (PM) were very low, close to detection limit, for both vehicles with compression ignition engines and vehicles with positive ignition engines. The particle number was higher during NEDC for vehicles with positive ignition engines compared with vehicles with compression ignition engines. For test in accordance with WLTP and ERMES driving cycles the emission of particles were higher for vehicles with compression ignition engines compared with vehicles with positive ignition engines. The number of particles were for both type of engines much higher during WLTP and ERMES compared with NEDC.

All vehicles with compression ignition engines were equipped with particulate filter - and none of the vehicles with positive ignition engines had a particle filter.

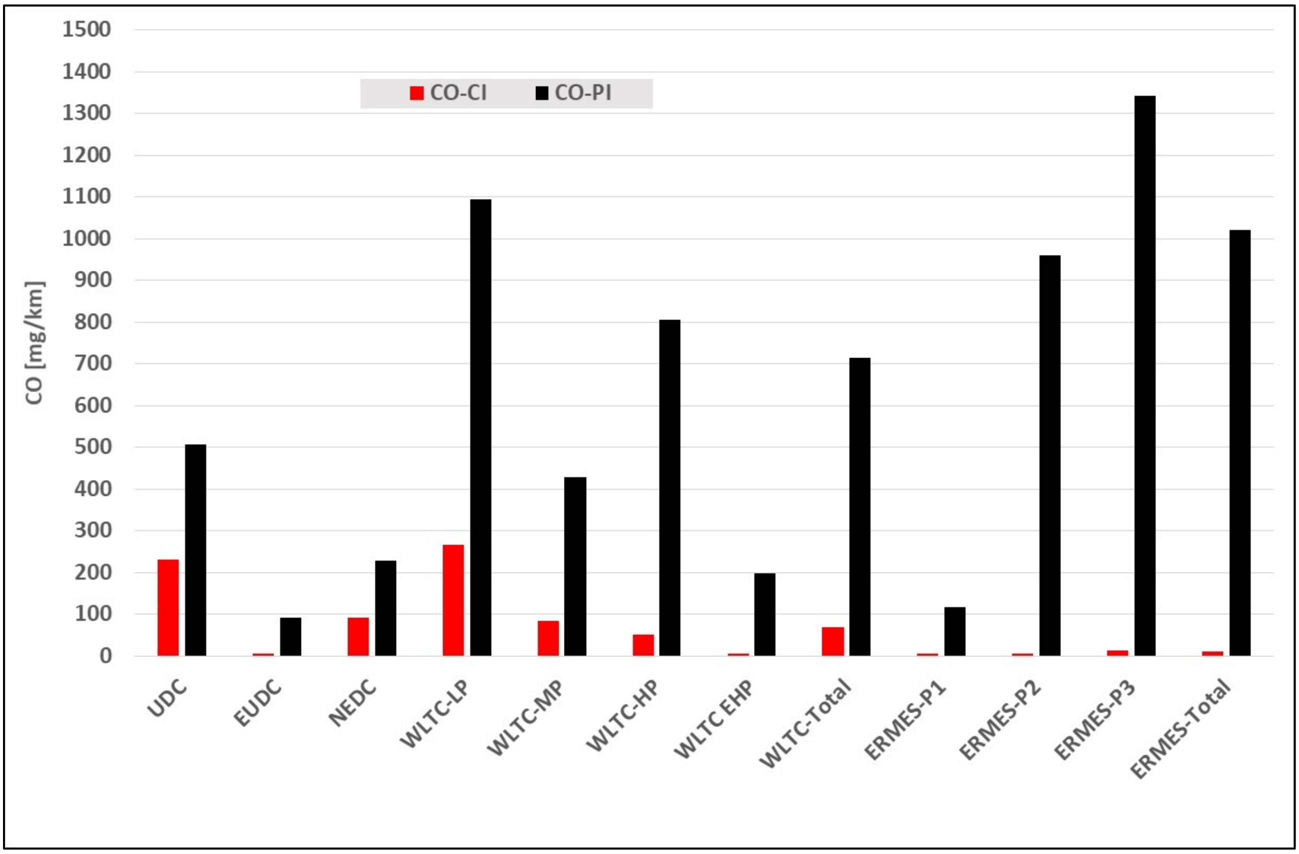

Figure 15. *CO-emissions during the NEDC, WLTP and ERMES driving cycles*

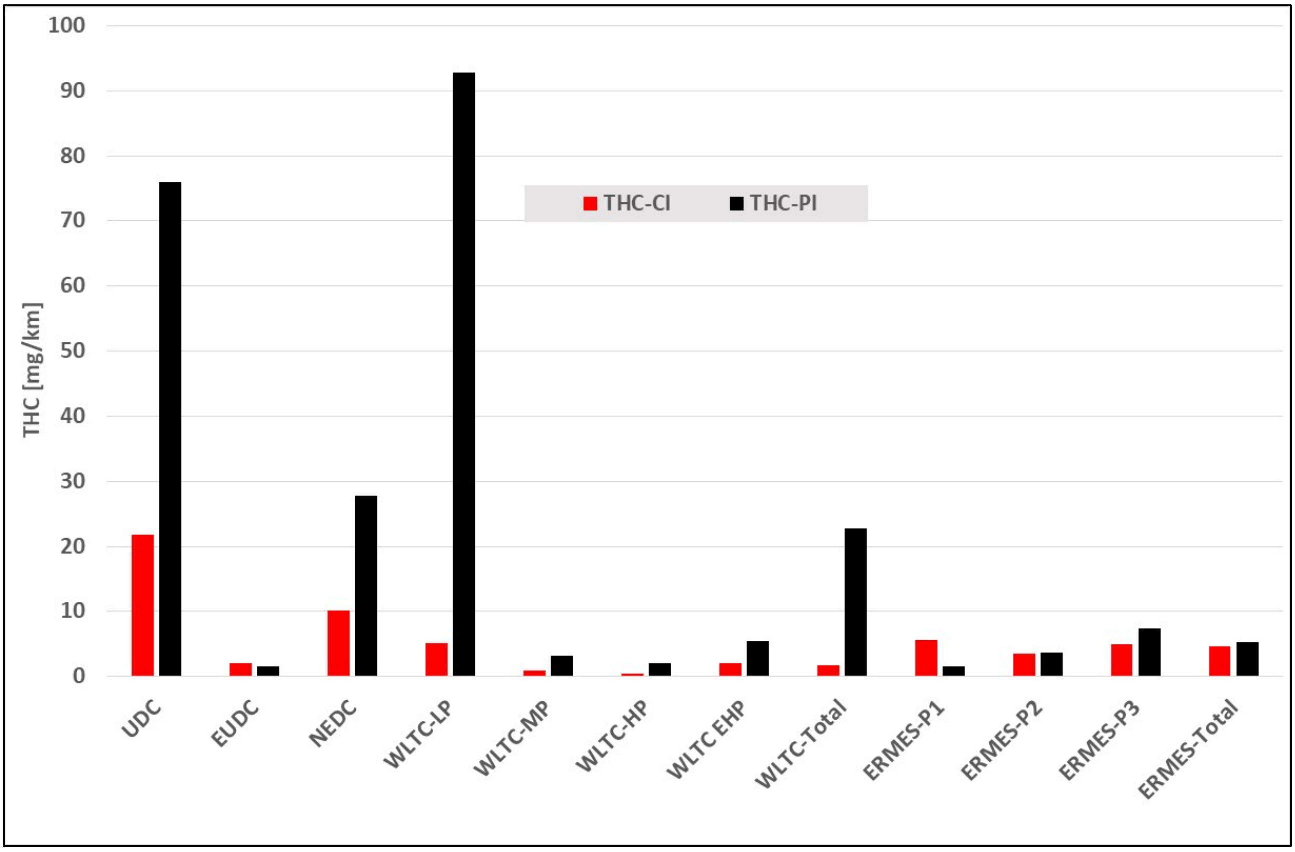

Figure 16. *HC-emissions during the NEDC, WLTP and ERMES driving cycles*

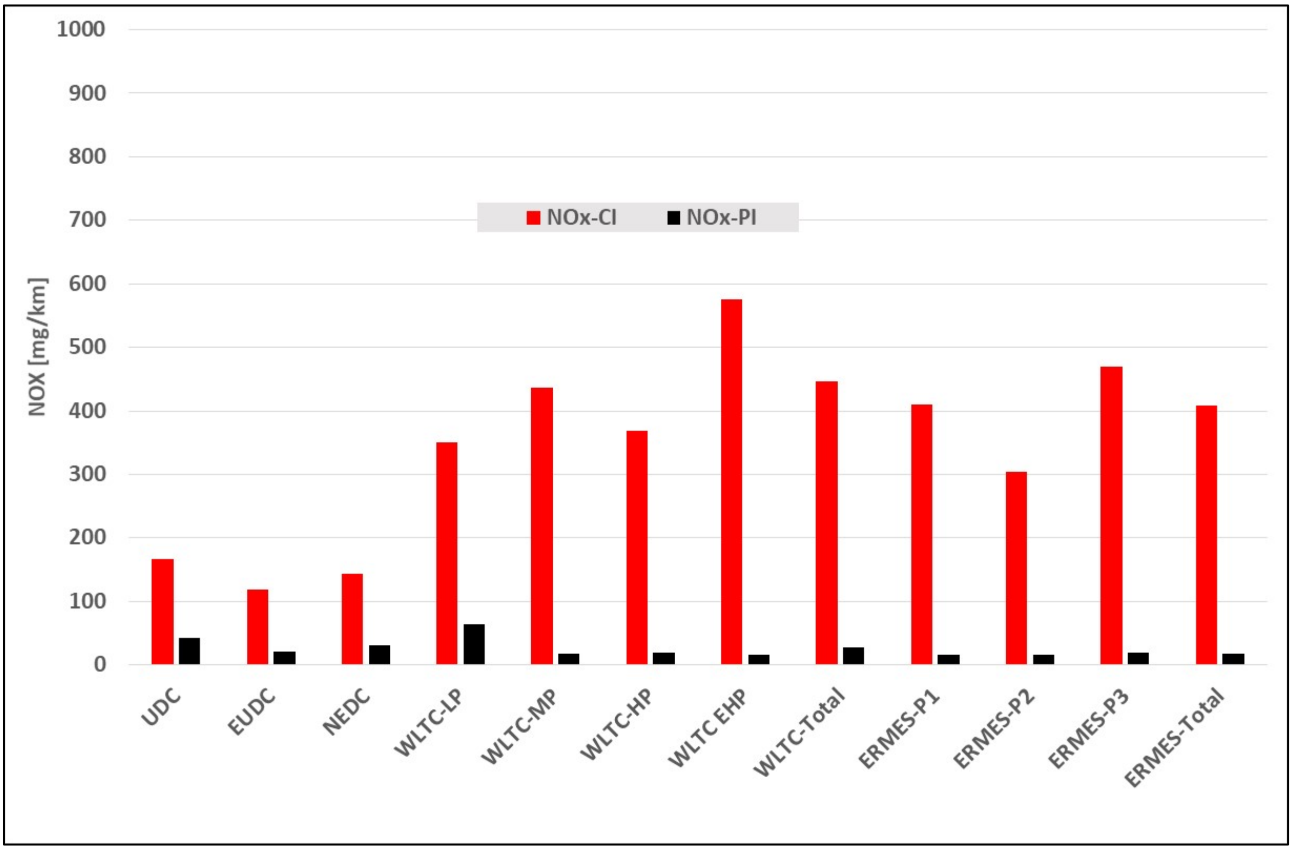

***Figure 17**. NO_x emissions during the NEDC, WLTP and ERMES driving cycles*

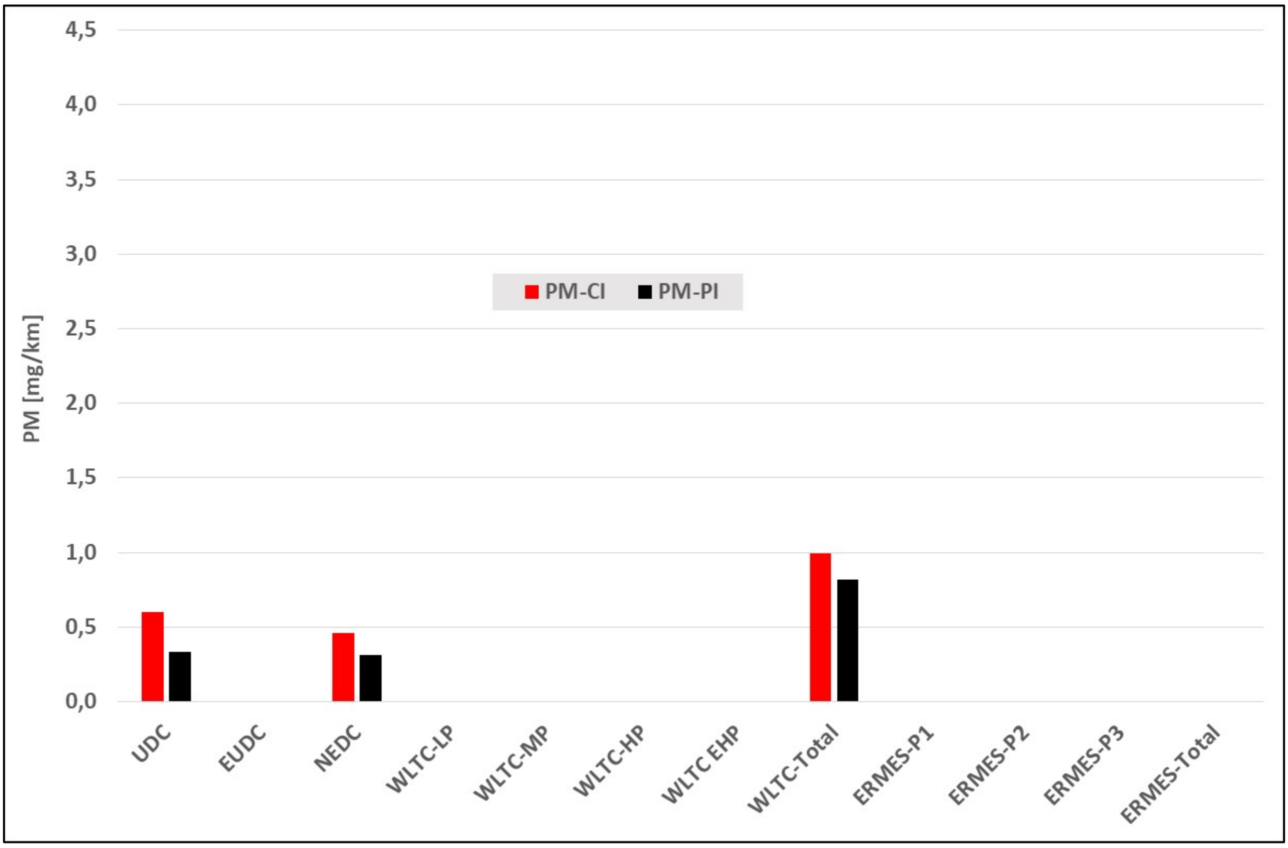

***Figure 18.** PM (particle mass)-emissions during the NEDC, WLTP driving cycles.*

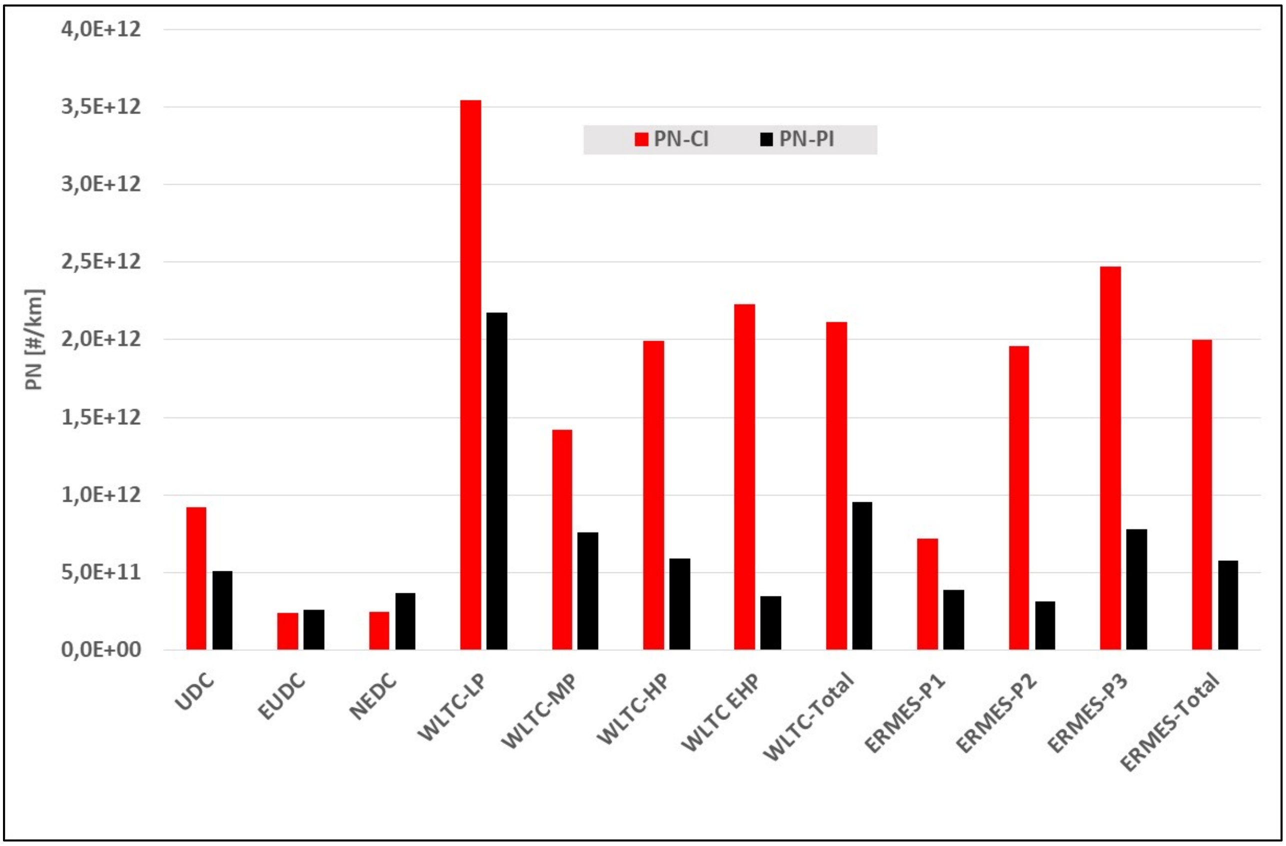

Figure 19. *PN (particle number)-emissions during the NEDC, WLTP and ERMES driving cycles.*

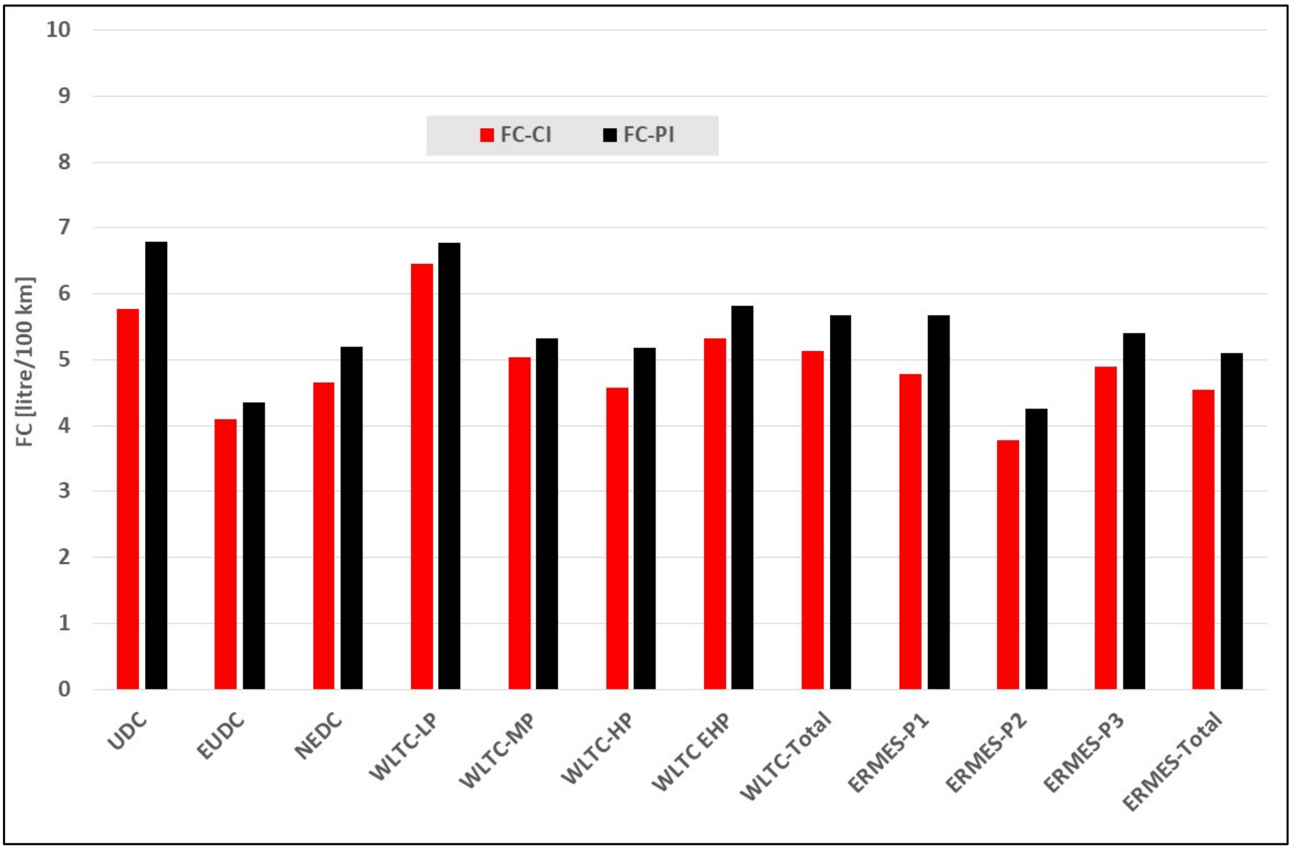

Figure 20*. FC (fuel consumption) during the NEDC, WLTP and ERMES driving cycles.*

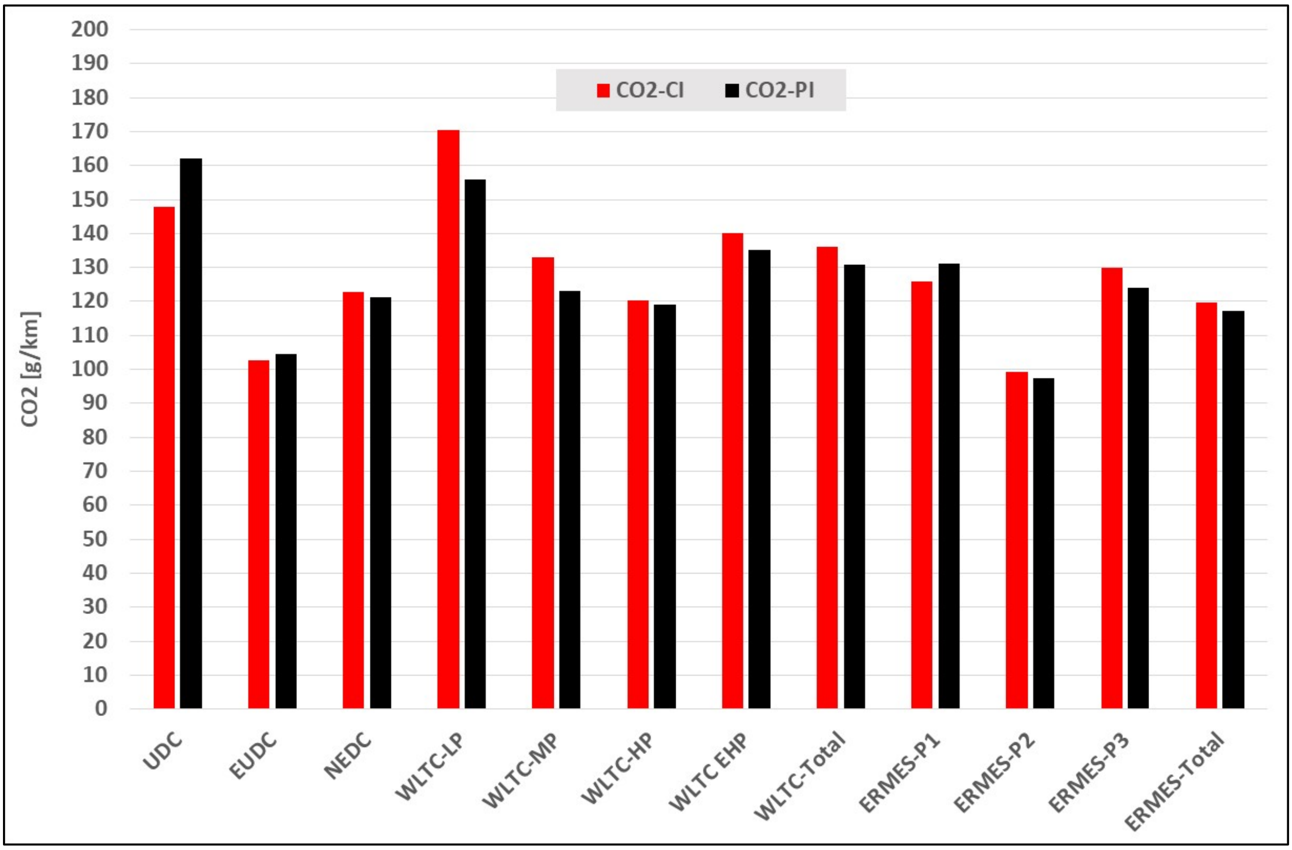

Figure 21. *CO_2-emissions during the NEDC, WLTP and ERMES driving cycles.*

6. Appendix 1 – Additional test program (PEMS)

This section summarize the additional RDE-test carried out in 2016. In these tests total 18 vehicles, 4 vehicle types with positive ignition- and 2 vehicle types with compression ignition engine were investigated. In the In the PEMS-program, three vehicles per model are used. In the main-program, 5 vehicles per model are used. Only Type I test are performed (e.g. not type II to type VI in the additional program)

All vehicles were investigated in accordance with:

- WLTC tests were carried out according the latest version of the GRT.15
- ERMES test was performed for updating the Emission factor handbook.
- PEMS measurements were carried out according directive (EU) 2016-427 and (EU) 2016-646.

Background information

In January 2011 European commission established a working group dealing with real driving emission on light duty vehicles (RDE-LDV). The aim of this working group was finding a correct way for the regulation of the emission emitted by passenger cars and light duty trucks in real traffic.

Based on the existing regulation for heavy duty vehicles EC 49 a definition for measuring emissions in real traffic was made. The measurements that are shown in this report were also used to develop the now nearly fixed procedure. The main part of this regulation, which will be added to the existing Implementing Regulation 692/2008 as Annex IIIa, is the use of a Portable measurement system (PEMS). The system is equipped to the vehicle and able to measure emission components CO, CO2, THC and NOx**. Figure 22** shows a vehicle equipped with the measurement system

Figure 22. *Example of an PEMS equipped vehicle*

All vehicles were validated driving a WLTP on the chassis dyno, afterwards one hot PEMS round and two cold started PEMS rounds were driven. Carbon monoxide (CO), carbon dioxide (CO_2), total hydrocarbons (THC), nitrogen oxides (NO_X) and the particle number (PN) were recorded in modal form. A summary of these data is given in appendix D. **Table 11** describes the measuring system used for the PEMS-tests and **Figure 23** show the route used

Vehicle Selection

ID	**Manufacturer**	**Type**	**Trade name**	**Engine type**	**Engine capacity** cm³	**Power** kW	**Emission approval**	**Engine speed** rpm	**EC-Approval no**
Vehicles with Compression Ignition engine in the PEMS-program									
120	Opel	D-VAN	Combo	263A200	1248	66	Euro 5	4000	e3*2007/46*0076*_
170	MB	245G	A200D	651930	2143	100	Euro 6	4000	e1*2001/116*0470
Vehicles with Positive Ignition engine in the PEMS-program									
110	Seat	5F	Leon	CYV	1197	81	Euro 6	4600	e9*2007/46*0094*_
130	Peugeot	C	208	HM01	1199	60	Euro 6	5750	e2*2007/46*0070*_
140	Opel	S-D	Corsa	B14XER	1398	66	Euro 6	6000	e1*2001/116*0379_
160	BMW	UKL-L	Mini	B38A15A	1499	100	Euro 6	4400	e1*2007/46*0371*_

Table 10. *Vehicles included in the Real-drive-emission tests*

SEMTECH ECOSTAR	
Ecostar PDM	
Ecostar FID	0 – 30 000 ppm
Ecostar NOx	NO 0 – 3 000 ppm; NO2 0 – 1 000 ppm
Ecostar FEM	CO 0 – 80 000 ppm; CO2 0 – 20 %
EFM	20 – 800 kg/h
SEMTECH DS	
PDM	
FID	0 – 40 000 ppm
NOx	NO 0 – 2 500 ppm; NO2 0 – 500 ppm
FEM	CO 0 – 80 000 ppm; CO2 0 – 20 %
EFM	

***Table 11** Equipment used for PEMS-measurements*

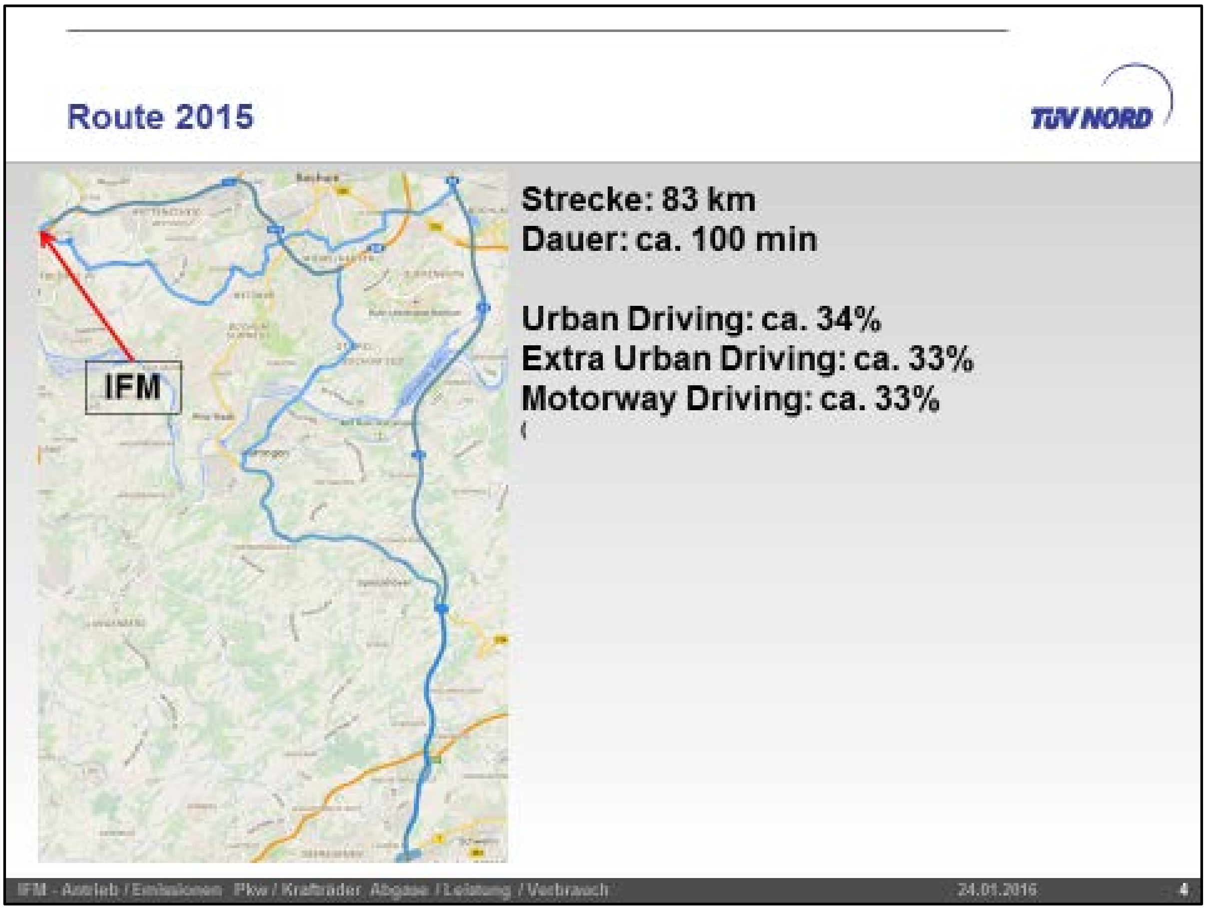

***Figure 23.** PEMS route developed 2015 (and used under the 2016 years tests)*

Main results

During type 1 test all 18 tested vehicles complied with the actual Euro limit. The emission of CO_2 and fuel consumption exceeded manufacture declared values for all vehicle tested, see **Figure 24** below.

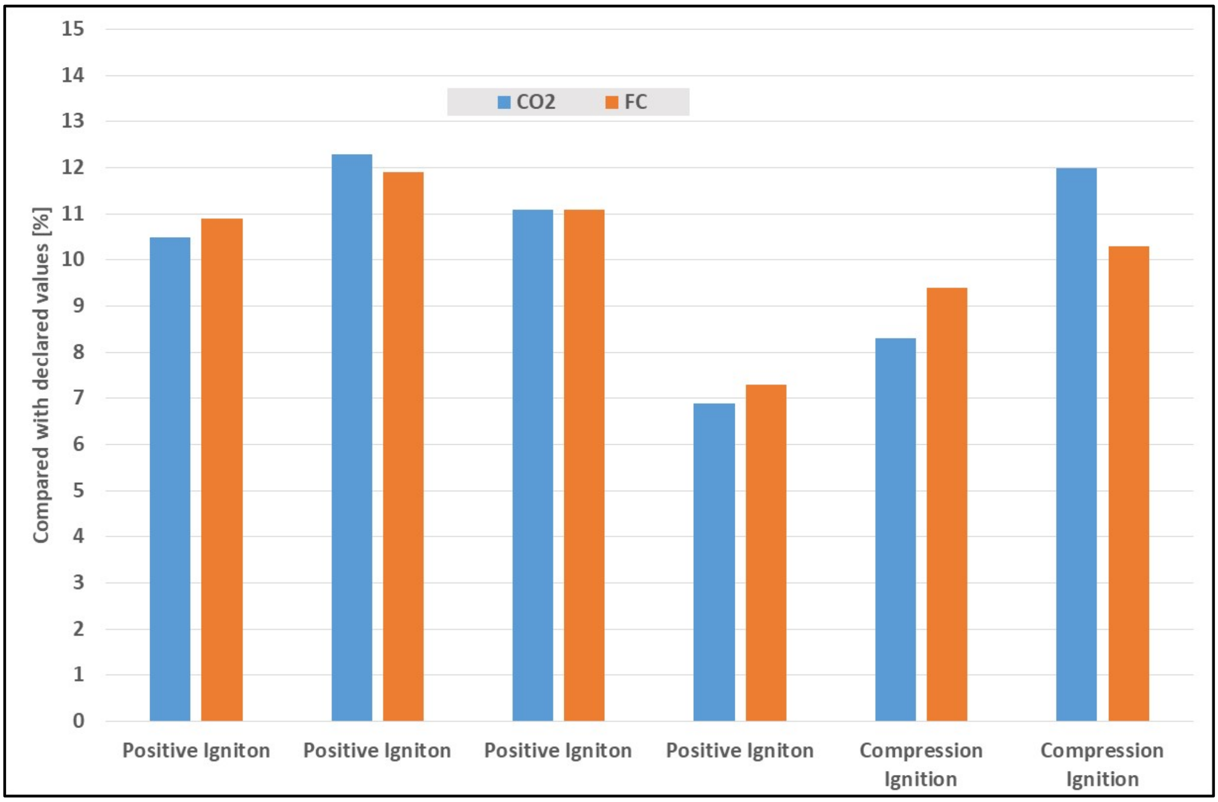

***Figure 24**. Measured CO_2 and fuel consumption compared with by manufacture's declared values during Type I test, NEDC*

In the following section below the results of the PEMS measurements are presented. The results are showed as average values in **Figure 25** to **Figure 29**. In the figures the RDE emissions are compared with the three driving cycles NEDC, WLTP and ERMES

Main conclusions compared with chassis dynamometer tests

- RDE results in higher CO emission for vehicles with positive ignition engines
- RDE results in higher NO_X emission for vehicles with compression ignition engines
- RDE results in higher CO_2 emissions and fuel consumptions for both engine types

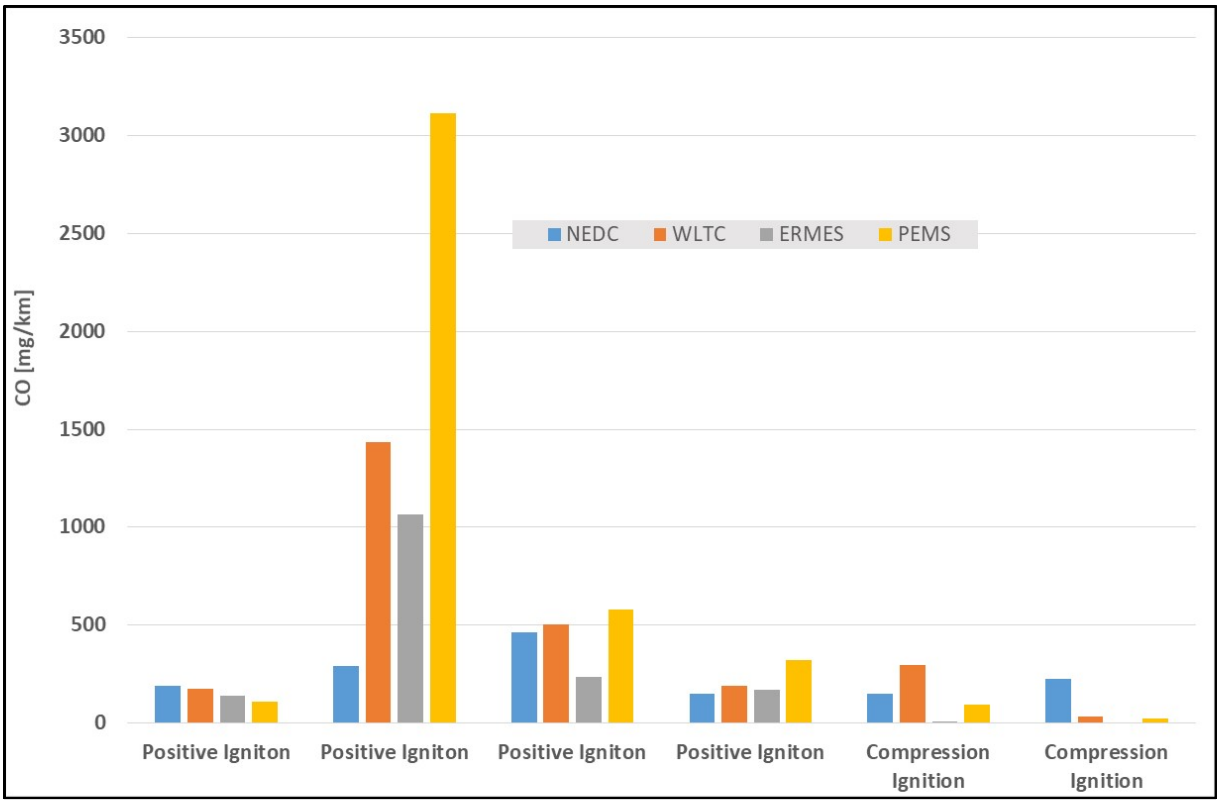

Figure 25. *CO emissions*

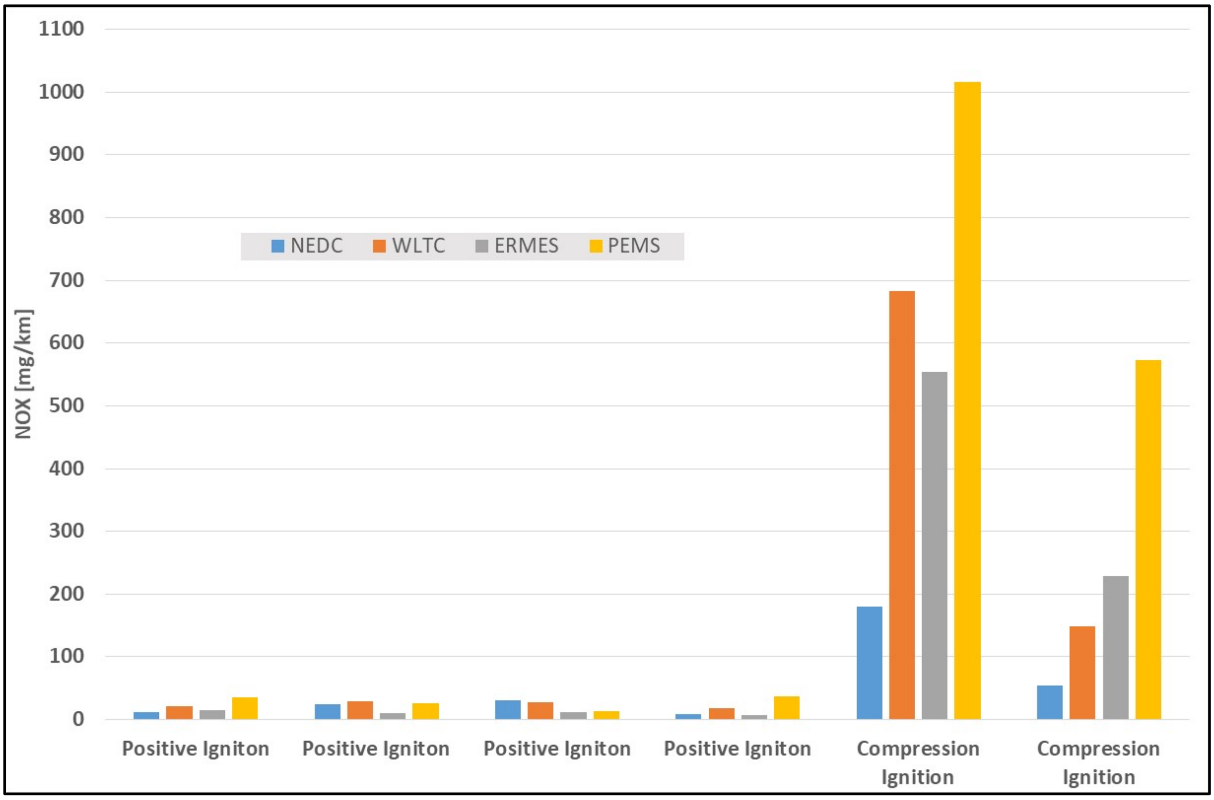

Figure 26*. NO_X emissions*

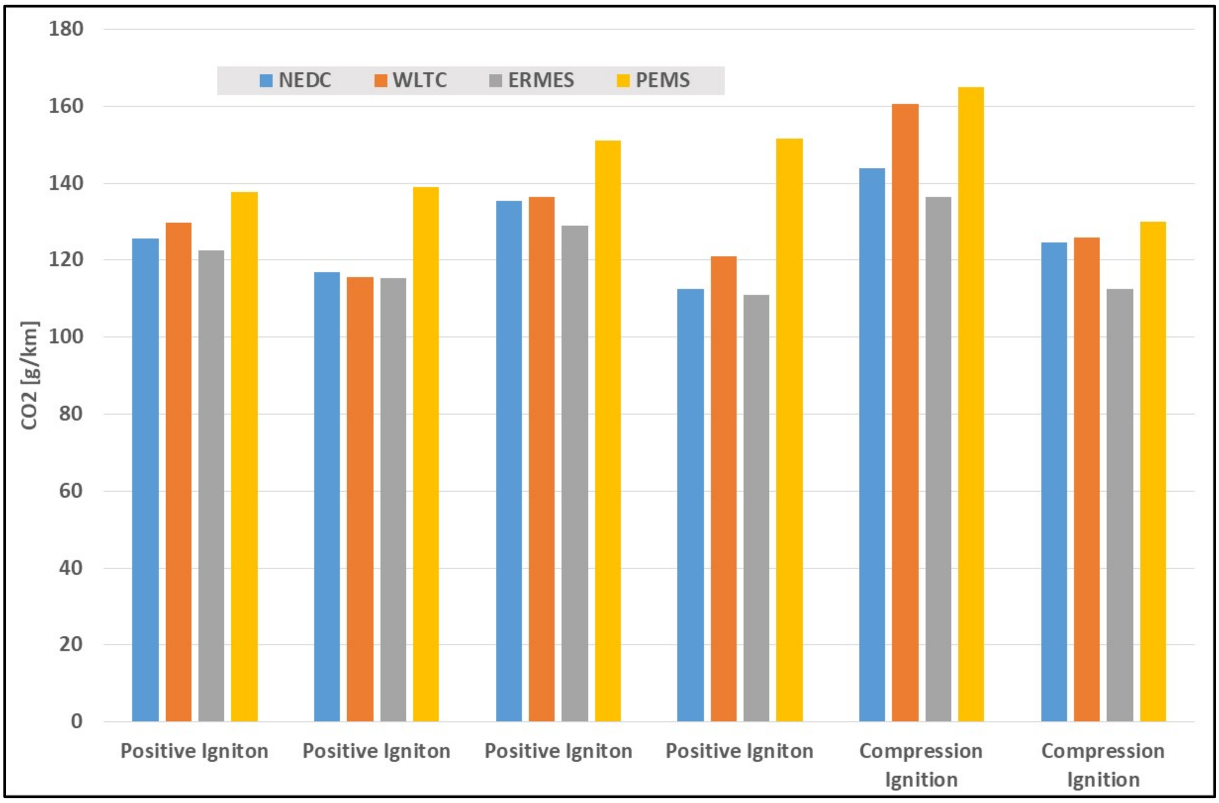

Figure 27. *CO_2 emissions*

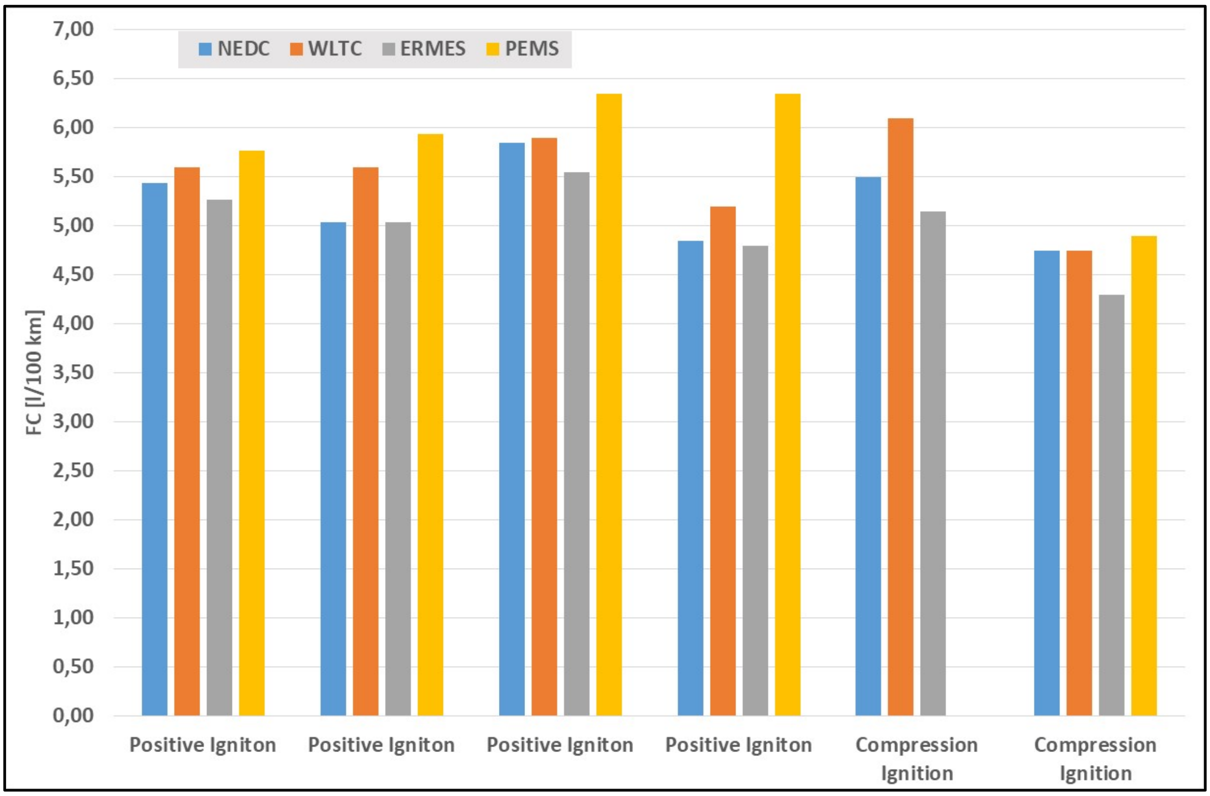

Figure 28*. Fuel consumption (FC)*

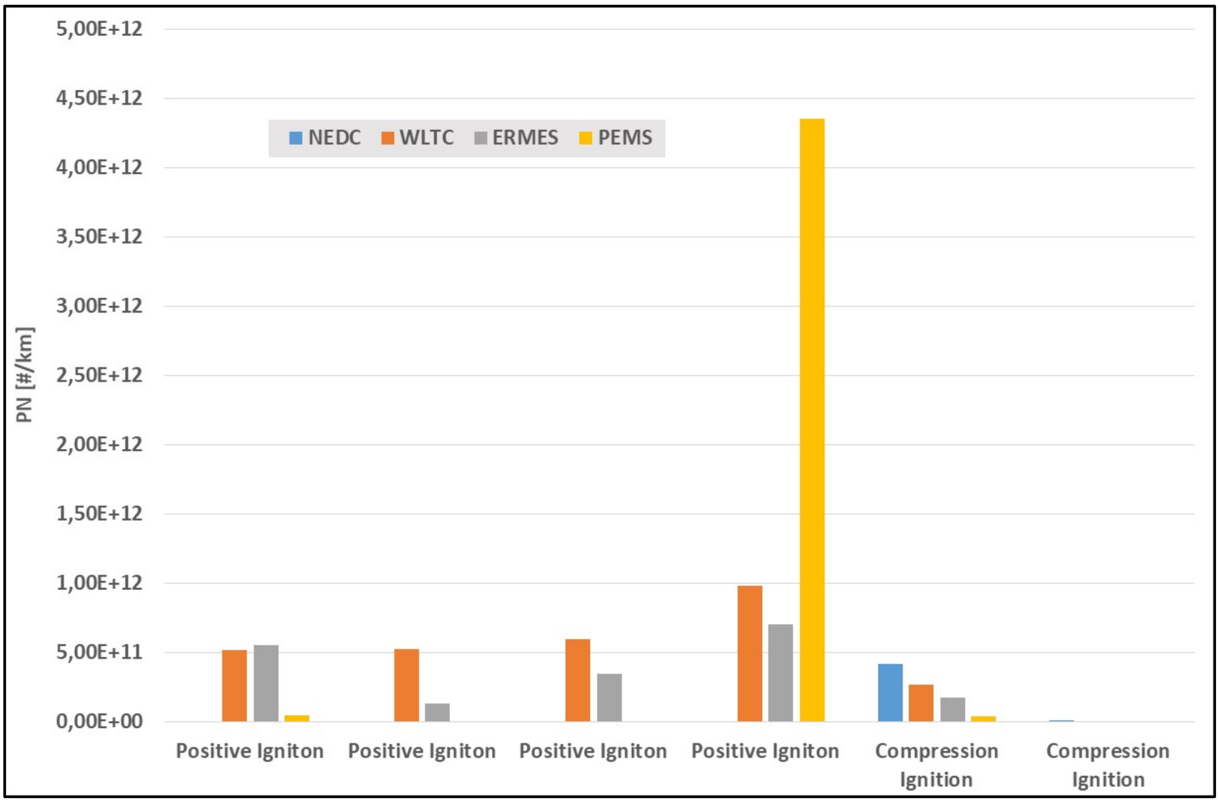

Figure 29*. Particle number (PN)*

7. Appendix 2 – Driving Cycles

New European Driving Cycle (NEDC)

After conditioning the vehicle for at least 6 hours at an ambient temperature of 20 °C up to 30 °C the New European Driving Cycle (NEDC) begins with a cold start. The Urban Driving Cycle (UDC) has duration of 780 seconds, a driving distance of 4.1 km, an average speed of 19 km/h and a maximum velocity of 50 km/h. It is followed by an Extra Urban Driving Cycle (EUDC) with a duration of 400 seconds, a driving distance of 6.9 km, an average speed of 62.6 km/h and a maximum velocity of 120 km/h. Exhaust emissions of both UDC and EUDC are combined to get a total test result.

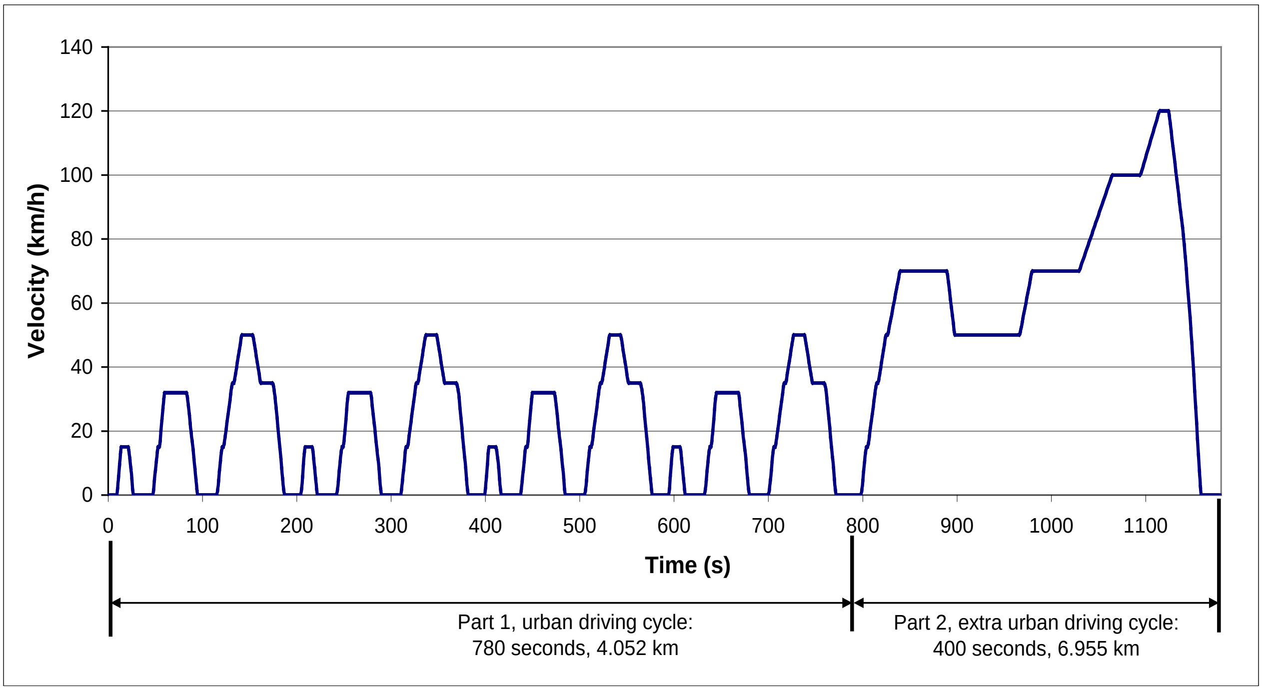

Figure 30. New European Driving Cycle (NEDC)

Worldwide Light Vehicle Test Cycle (WLTC)

The test cycle part of WLTP is the WLTC and consists of four phases. The predominant WLTC cycle in EU is the class 3.

- Phase Low, duration 589 seconds
- Phase Medium, duration 433 seconds
- Phase High, duration 455 seconds
- Phase Extra High, duration 323 seconds

In **Figure 31** to **Figure 34** the different phases are shown.

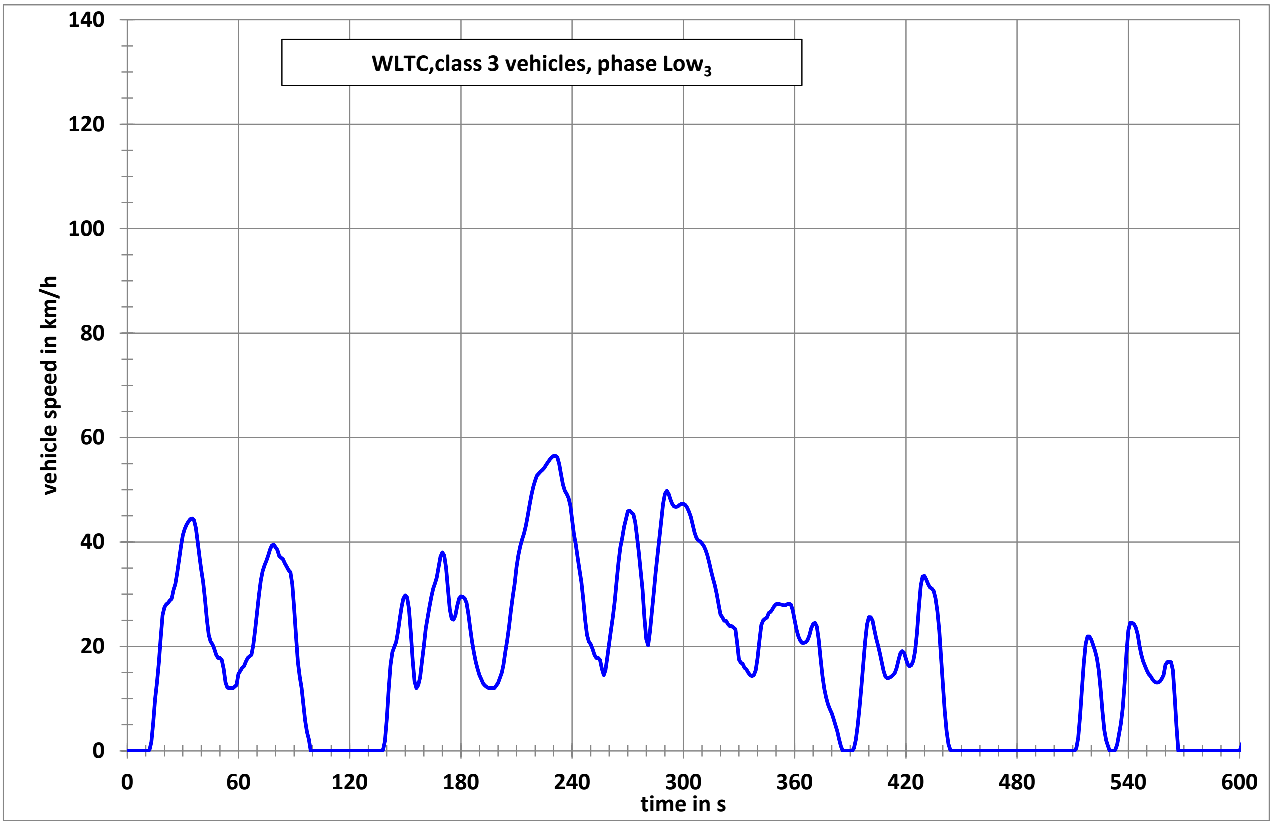

Figure 31. *Phase Low*

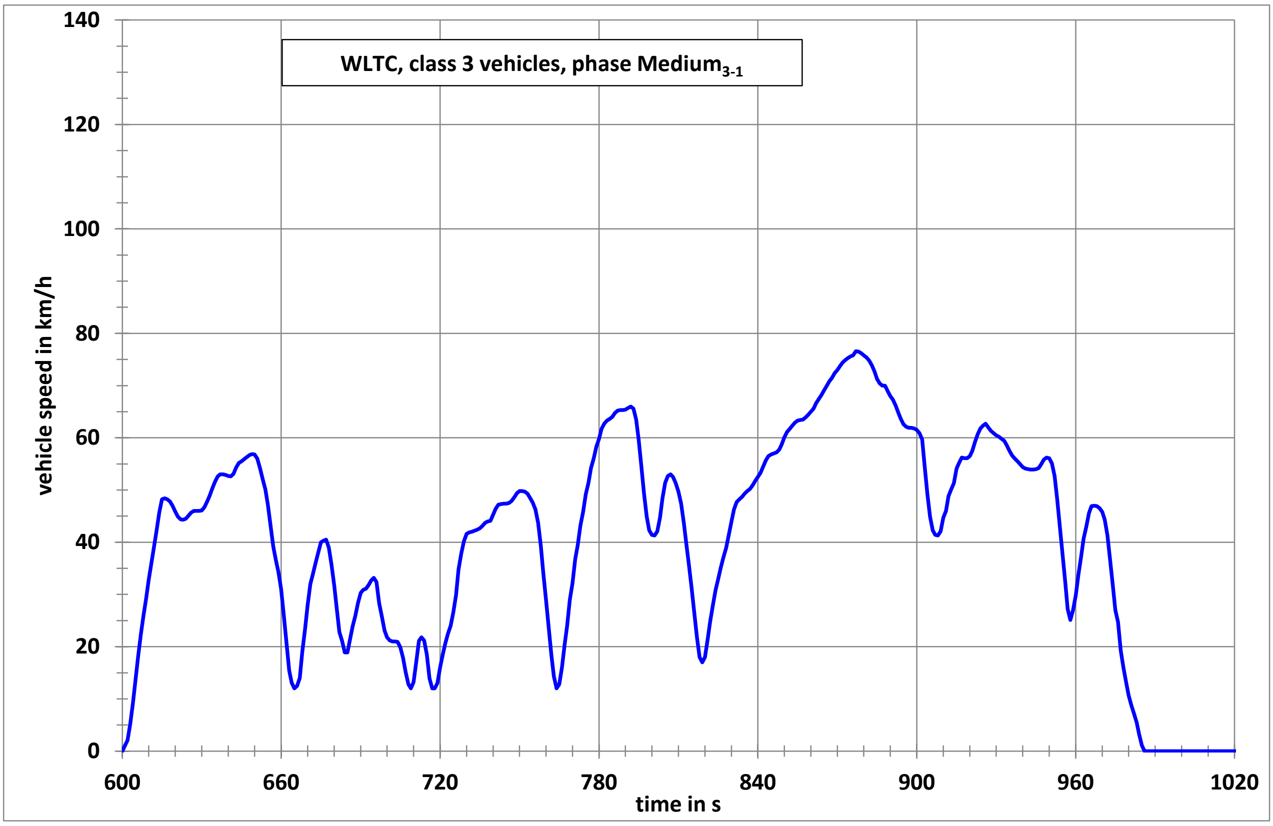

Figure 32. *Phase Medium*

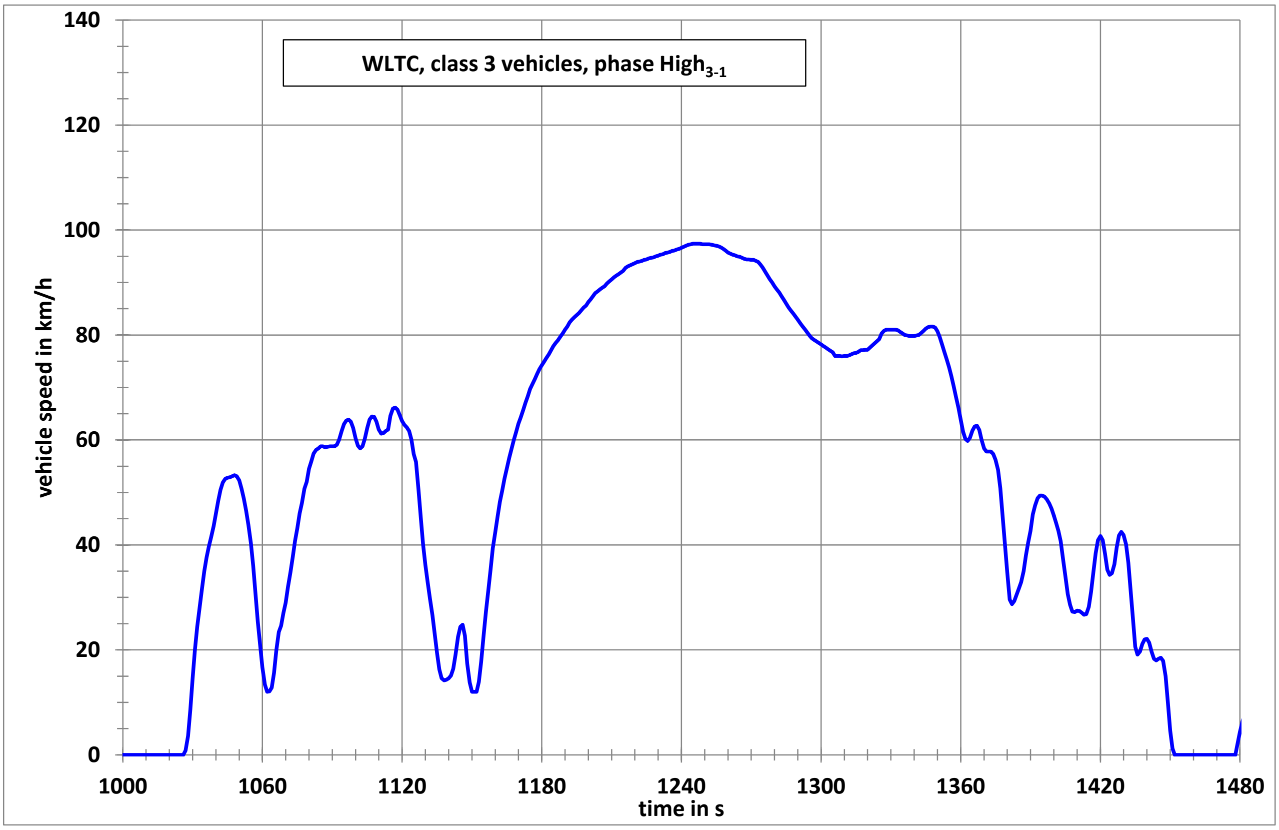

Figure 33. *Phase High*

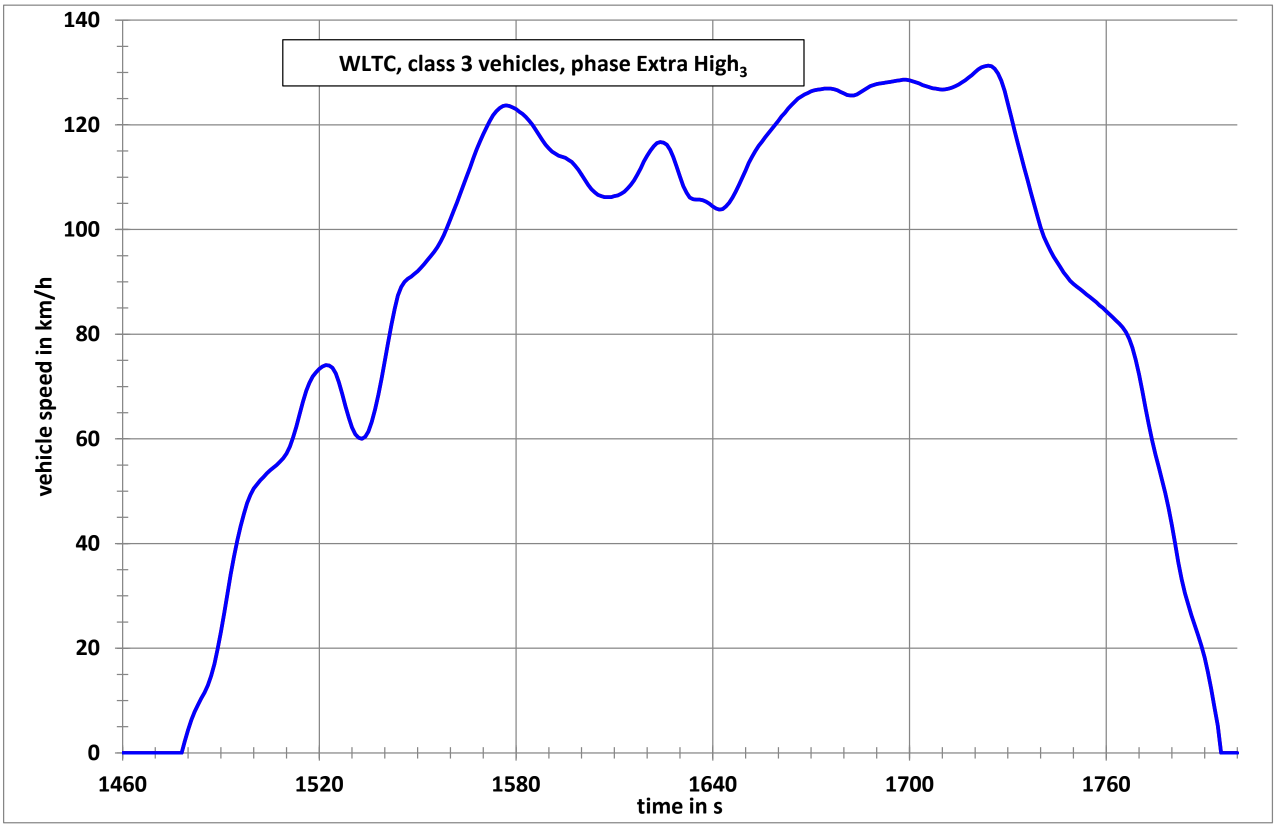

Figure 34. *Phase* Extra High

A comparison of the sub-cycles of NEDC and WLTC is given in **Table 12**. The average speed of UDC is comparable to WLTC LOW. The same is valid for EUDC and WLTC HIGH. However the WLTC cycles are much more dynamic as can be seen from the Relative Positive Acceleration (RPA). The gear shifting points are determined in accordance with the vehicle's weight, engine power and engine revolutions.

Driving cycle	**NEDC**		**WLTC – class 3**			
	UDC	**EUDC**	**LOW**	**MEDIUM**	**HIGH**	**EXT-HIGH**
Distance [km]	4.1	7.0	3,1	4,8	7,2	8,3
Average Speed [km/h]	19	63	19	40	57	92
RPA [m/s^2]	0.13	0.09	1,5	1,6	1,6	1,6

Table 12. *Comparison of driving cycles NEDC and WLTP*

Gaseous emissions in all driving cycles were measured integrally and in parallel continuously every second (modal measurement). The results of the modal measurements may serve as the basis for determining the exhaust emission behaviour in all relevant traffic situations.

European Research group on Mobile Emission Sources (ERMES)

Text and **Figure 35** are from ERMES-webpage (http://www.ermes-group.eu/web/about_ermes)

"The European Research for Mobile Emission Sources (ERMES) is a group of research institutions, competent authorities, industry associations, whose mission includes the support of cooperative research in the field of transport emission modelling. The ERMES group emerged from the collaboration since early 2000 of two groups engaged in developing the models HBEFA (DACHNL group headed by INFRAS and TUG) and COPERT (EEA/JRC/LAT/Emisia). Both groups have been active in emission measurements and modelling since the 90s. The group, chaired by JRC since 2009, strives to bring together the knowledge produced in Europe, to facilitate the exchange of information and to promote the cooperation among the actors involved in the measurement and modelling of emission from road vehicles."

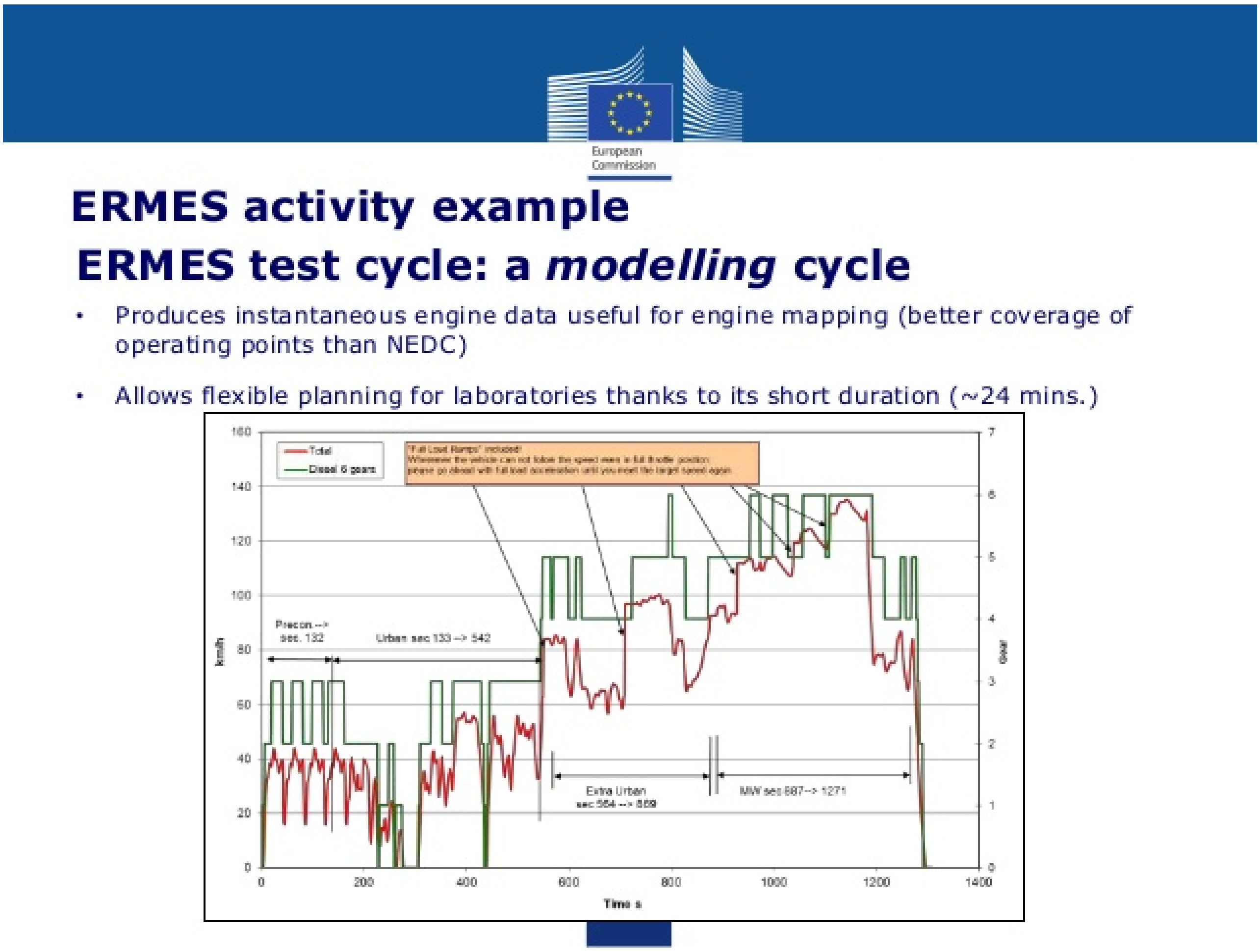

Figure 35. *ERMES-driving cycle*

8. References

- REGULATION (EC) No 715/2007 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
  on type approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair information, amending Directives; Working Party on Environment (Euro-5); European Commission

- COMMISSION REGULATION (EC) No 692/2008 implementing and amending Regulation (EC) No 715/2007 of the European Parliament and of the Council on type approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair information, amending Directives; Working Party on Environment (Euro-5); European Commission

- European Commission: 'The European Climate Change Programme, EU Action against Climate Change'

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