Test report

Measurement results and short comments

Real Drive Emissions (RDE)

Emission measurement on four (4) passenger cars of M1, Euro 6

- Mercedes A 180 (gasoline)
- Mazda 6 (diesel)
- VW Passat – 2 types (diesel)

A report for the Swedish Transport Administration

2015-12-15
Report no. 157082

Ecotraffic

Content

1. Abstract

Ecotraffic have on behalf of Trafikverket carried out emission tests on 4 Euro 6 vehicles with respect to Real Drive Emissions (RDE). The cars represent 4 different Euro 6 technologies.

1. **VW Passat – Euro 6 – diesel**
   This car use a technology named DeNOX or (LNT). NO_X is trapped in the catalyst and reduced to nitrogen gas by use hydrocarbons (diesel fuel) as reducing agent. This car is also equipped with diesel particle filter.

2. **VW Passat – Euro 6 – diesel**
   This car use a technology named SCR (Selective Catalytic Reduction) there NO_X is reduced to nitrogen gas by using urea (trade name adblue) as reducing agent. This car is also equipped with diesel particle filter.

3. **Mazda 6 – Euro 6 – diesel**
   This car do not use a trap or catalytic reduction. The main technology used for decreasing the concentration of NO_X in the exhaust gases is EGR (Exhaust gas reduction). This car is also equipped with diesel particle filter.

4. **Mercedes A 180 – Euro 6 – gasoline**
   This car use a three way catalytic converter in combination with a lambda sond to control the exhaust gases. The engine is of the type direct injection (DI)

Read more about the different technologies in chapter Conclusions

The cars have been tested according to the test cycles below:

- NEDC at + 22°C
- WLTP at + 22°C
- WLTP at – 7°C
- WLTP at – 15°C

All tests were carried out during the second half of 2015 at TÜV NORD's emission laboratory in Essen, Germany. By comparing emissions measured from the tests we can draw these conclusions:

Generally conclusions are that NO_X is a problem for diesel powered passenger cars and emission of small particles (high number) is a problem for gasoline cars.

- Tests outside the NEDC cycle (certification condition) show much higher NO_X emissions compared to the Euro 6 limit.
- Higher HC emissions for the DeNOX system (especially at WLTP test cycle) compared with SCR

- Increased fuel consumption with decreased ambient temperatures for all cars tested
- High NO_X emissions at low ambient temperatures (especially at WLTP test cycle) for all tested diesel cars
- The SCR system seems to have lower NO_X emissions than the DeNOX system
- Almost all emitted NO_X consists of NO – most significant for the gasoline car
- Relatively low particle emissions (both mass and number) for all tested diesel cars
- Relatively high numbers of particles from the gasoline cars but the car met the Euro 6 limit
- These measurement clearly show that filters are very efficient in reducing the number of particles emitted

Project information (in Swedish)

Beställare	Trafikverket	**Beställningsnummer**	TRV2011/48682 A
Beställningsdatum		**Slutdatum enligt beställning**	
Ansvarig hos beställare	Magnus Lindgren	**Projektnummer**	7082
Ansvarig hos Ecotraffic	Lars Eriksson	**Rapportering**	Testrapport (engelska)
Avvikelser	Se kap 3	**Provningsplats**	TUV NORD - Essen
Rapport språkgranskad	Nej	**Rapport godkänd av**	
Rapportnummer	157082	**Rapporteringsdatum**	2015-12-15
Författare	Lars Eriksson		

Abbreviations, acronyms and glossary

CVS	Constant Volume Sampler/Sampling, a dilution device used for dilution of engine/vehicle exhaust for emission measurements.
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
EGR	Exhaust Gas Recirculation
FC	Fuel Consumption
NEDC	New European Driving Cycle
NO_X	Nitrogen oxides (NO + NO_2)
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
PM	Particulate Matter
PN	Particle number
MK1	Swedish Environmental Class 1 Gasoline
MK2	Swedish Environmental Class 2 Gasoline
SCR	Selective Catalytic Reduction
TWC	Three Way Catalyst
WLTP	The worldwide harmonized light vehicles test procedure

2. The assigment

Scope of work

Ecotraffic shall on behalf of Trafikverket carry out emission tests on 4 cars by using these test cycles:

- NEDC at + 22°C
- WLTP at + 22°C
- WLTP at – 7°C
- WLTP at – 15°C

The study shall be reported as a technical test report with short comments.

Test sites

All tests have been carried out at TÜV NORD in Essen and all tests were performed during the second half of 2015.

	Test Cell
Climatisation	-20°C - +35°C WEISS
Chassis Dynamometer	MAHA ECDM 48L 4x4
Control Unit	MAHA
CVS-Unit	MAHA-CVS
Analytical System for gaseous emissions (CO, CO_2, THC, NMHC, NO, NO_x)	MAHA-AMA D1
Particle Collector	MAHA-PTS
Particle Balance for particle mass	SARTORIUS SE2-F
Particle Counter	MAHA

Vehicles

	Car 1 (DeNOx)	Car 2 (SCR)
Manufacture	Volkswagen	Volkswagen
Model	Passat TDI BMT Limousine	Passat TDI SCR BMT Limousine
Chassi no	WVWZZZ3CZFE433951	WVWZZZ3CZFE448256
Wheel/Tires	215/60R16	215/155R17
Fuel	Diesel	Diesel
Engine displacement	1968 cc	1968 cc
Power	110 kW	150 kW
Odometer	15 129 km	3 004 km
Emission class	Euro 6	Euro 6
Year model	2015	2015
Exhaust system	DeNOx (NOX-trap) Particle filter	SCR Particle filter

	Car 3	Car 4
Manufacture	Mercedes	Mazda
Model	A 180 (Direct Injection)	6
Chassi no	WDD1760421J236763	JMZGJ692621187955
Wheel/Tires	225/40R18	225/45R19
Fuel	Gasoline	Gasoline
Engine displacement	1595 cc	2191 cc
Power	90 kW	129 kW
Odometer	21 296	18 835
Emission class	Euro 6	Euro 6
Year model	2015	2015
Exhaust system	TWC	EGR + Particle filter

Dynomometer settings

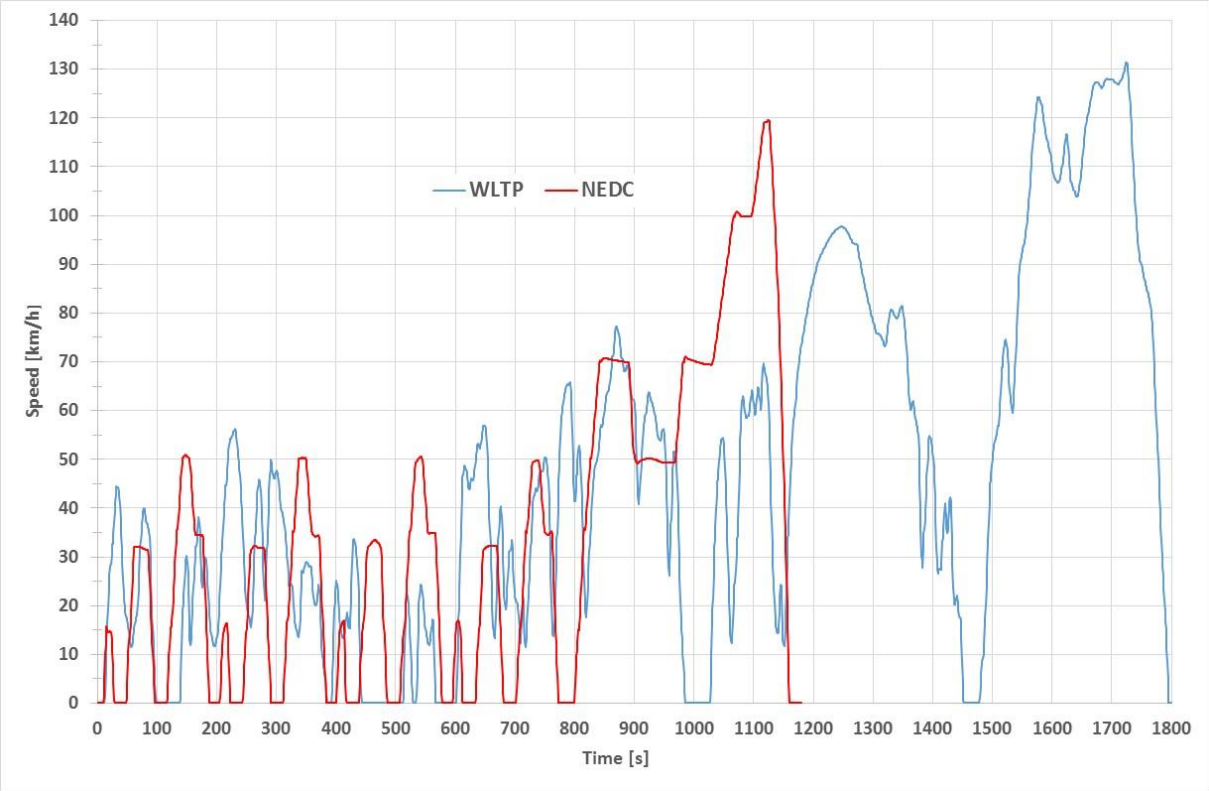
		Car 1 VW Passat (DeNOx)		Car 2 VW Passat (SCR)	
		Roller	**Street**	**Roller**	**Street**
F0	N	97,41	167	90,04	166
F1	[N/(km/h)]	0,1834	0,58	-0,4583	0,58
F2	[N/(km/h)^2]	0,03029	0,0302	0,03444	0,0302
Inertia	kg	1830		1935	

		Car 3 MB A 180		Car 4 Mazda 6	
		Roller	**Street**	**Roller**	**Street**
F0	N	-2,83	89	-4,79	73,53
F1	[N/(km/h)]	0,0573	0,76	-0,2043	0,6631
F2	[N/(km/h)^2]	0,02905	0,0277	0,03446	0,0314
Inertia	kg	1360		1470	

Driving Cycles and emission limits

Two type of driving cycles have been used in this study, NEDC and WLTP test cycles and the tests have been carried out under three different ambient temperatures:

- NEDC at + 22°C
- WLTP at + 22°C
- WLTP at – 7°C
- WLTP at – 15°C



Emission limit values during NEDC test cycle.

Stage	Date	CO	HC	HC+NOx	NOx	PM	PN
		mg/km					#/km
Compression Ignition (Diesel)							
Euro 6	2014.09	500	-	170	80	5[c]	6.0×10^{11}
Positive Ignition (Gasoline)							
Euro 6	2014.09	1000	100[a]	-	60	5[b,c]	6.0×10^{11} [b,d]

a. and NMHC = 680 mg/km
b. applicable only to vehicles using DI engines
c. 0.0045 g/km using the PMP measurement procedure
d. 6.0×10^{12} 1/km within first three years from Euro 6 effective dates

3. Results

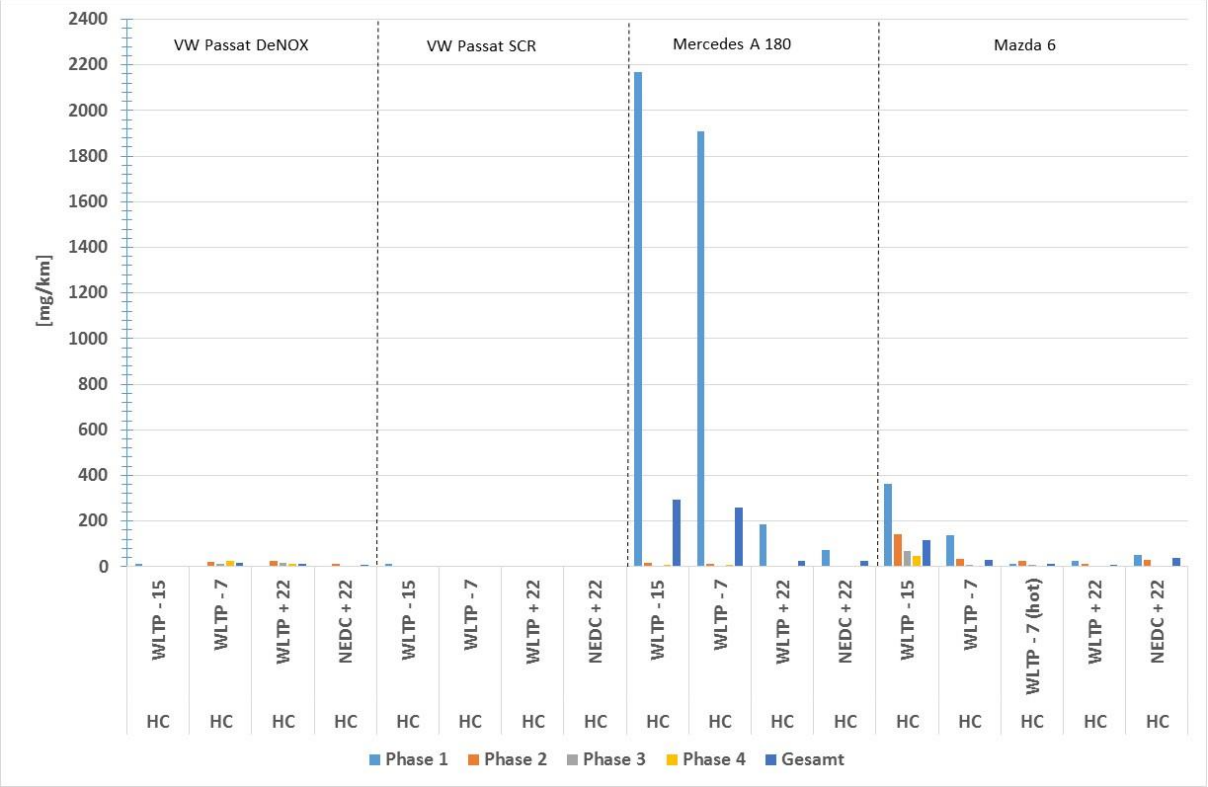
The table below show a matrix over tests performed in this study

	VW Passat DeNO$_X$	VW Passat SCR	MB A 180	Mazda 6
NEDC + 22°C	X	X	X	X
WLTP + 22°C	X	X	X	X[1]
WLTP – 7°C (hot)			---[2]	X
WLTP – 7°C	X	X	X	X
WLTP – 15°C	X	X	X	X

1. Test with another test individe (exact same specification)
2. This was planned to be tested but not possible to do.

On the following pages the main results from the tests are showed and briefly discussed.

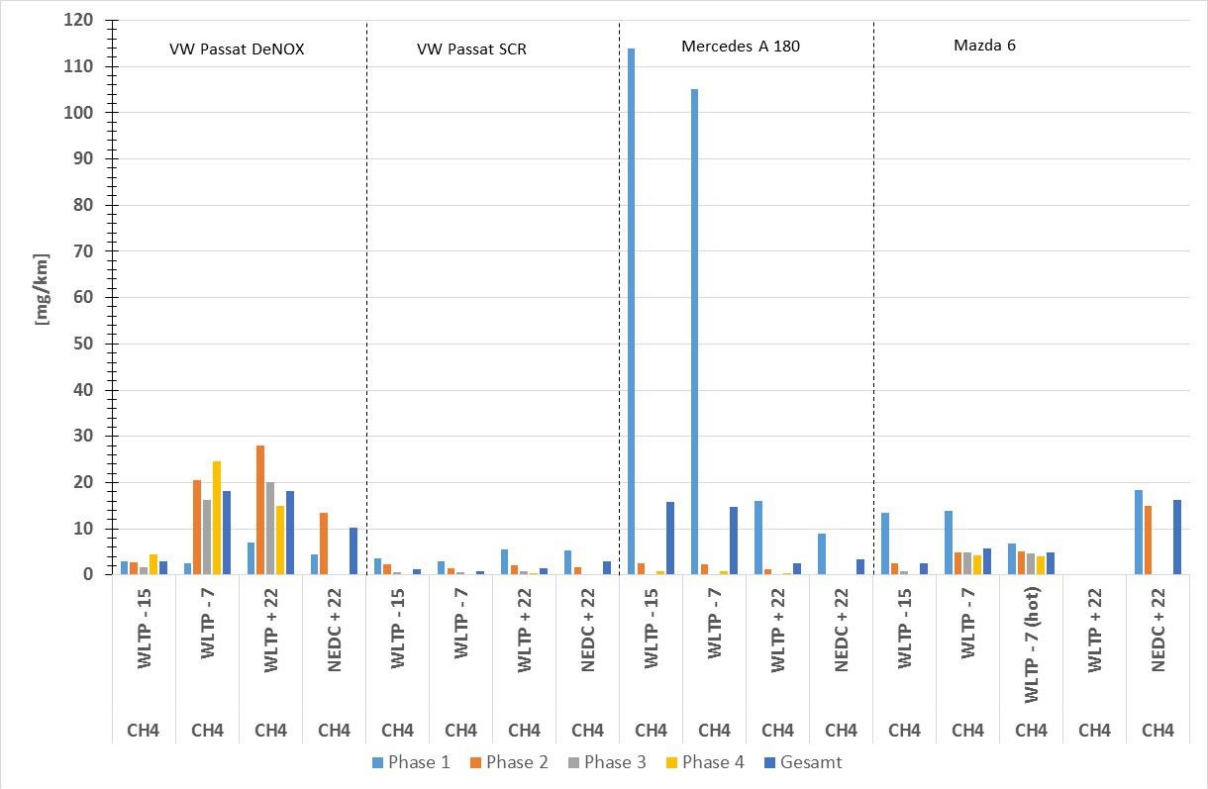
THC (Total Hydro Carbon)



The emission of hydrocarbon is relatively low for all cars at tests at 22 C. The emission is highest for the gasoline car but the emission of HC only occur at the first part of the cycles and after catalyst converter reach the light-off temperature the emissions of HC is close to zero. For the three diesel powered cars the levels of HC emissions are low. For Mazda 6 the emissions seams to increase with decreased ambient temperatures.

There is no limit value for Euro 6 diesel but for gasoline it is 100 mg/km for NEDC. The gasoline car (Mercedes A 180) is well under the HC-limit in the NEDC test performed at certification condition but exceed the limit for WLTP at low ambient temperatures.

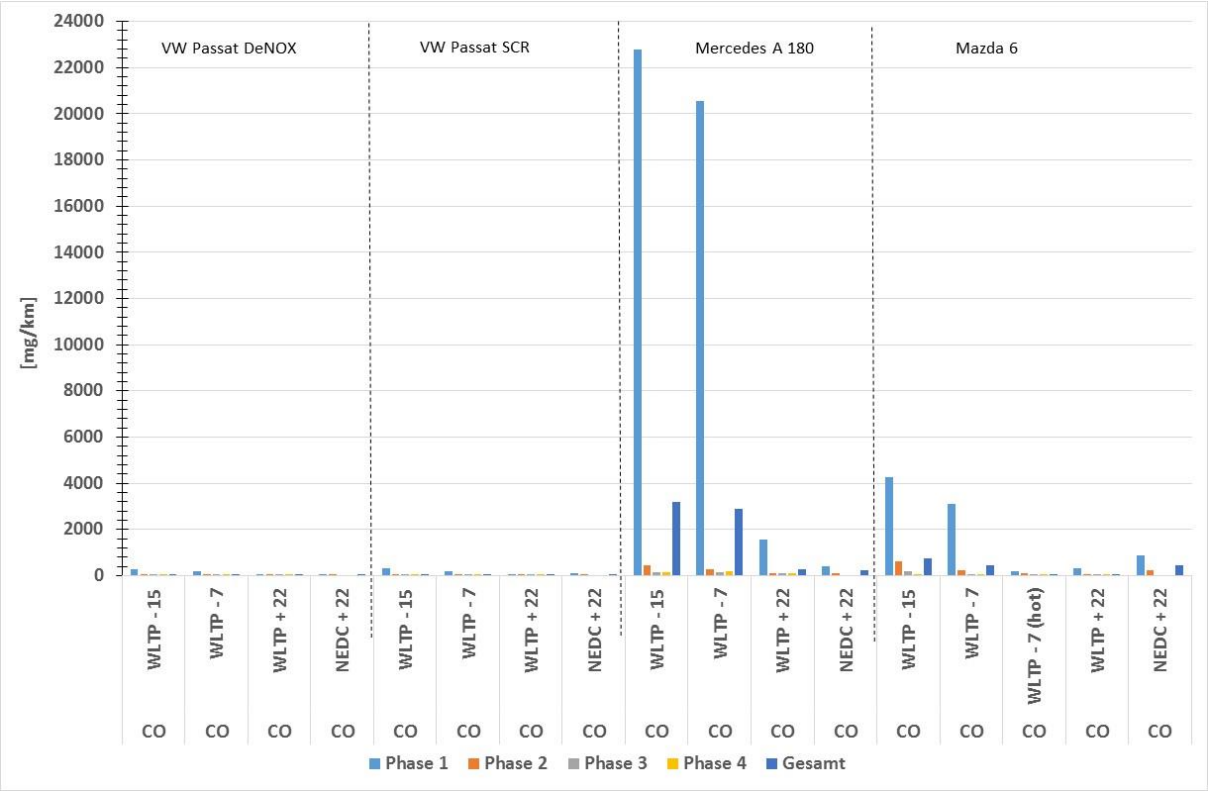
CH_4 (methane)



There is no limit value for methane in Euro 6.The emissions of methane is relative low during all tests except beginning of test cycle for the gasoline But after catalyst converters reach the light-off temperature the emissions of methane is close to zero

There emission of methane (and also THC) is higher for the VW Passat equipped with a NOX-trap system (DeNOX) compared with the Passat with SCR-system. The reason may be that the former one use hydrocarbons as reducing agent.

CO (Carbon Monoxide)



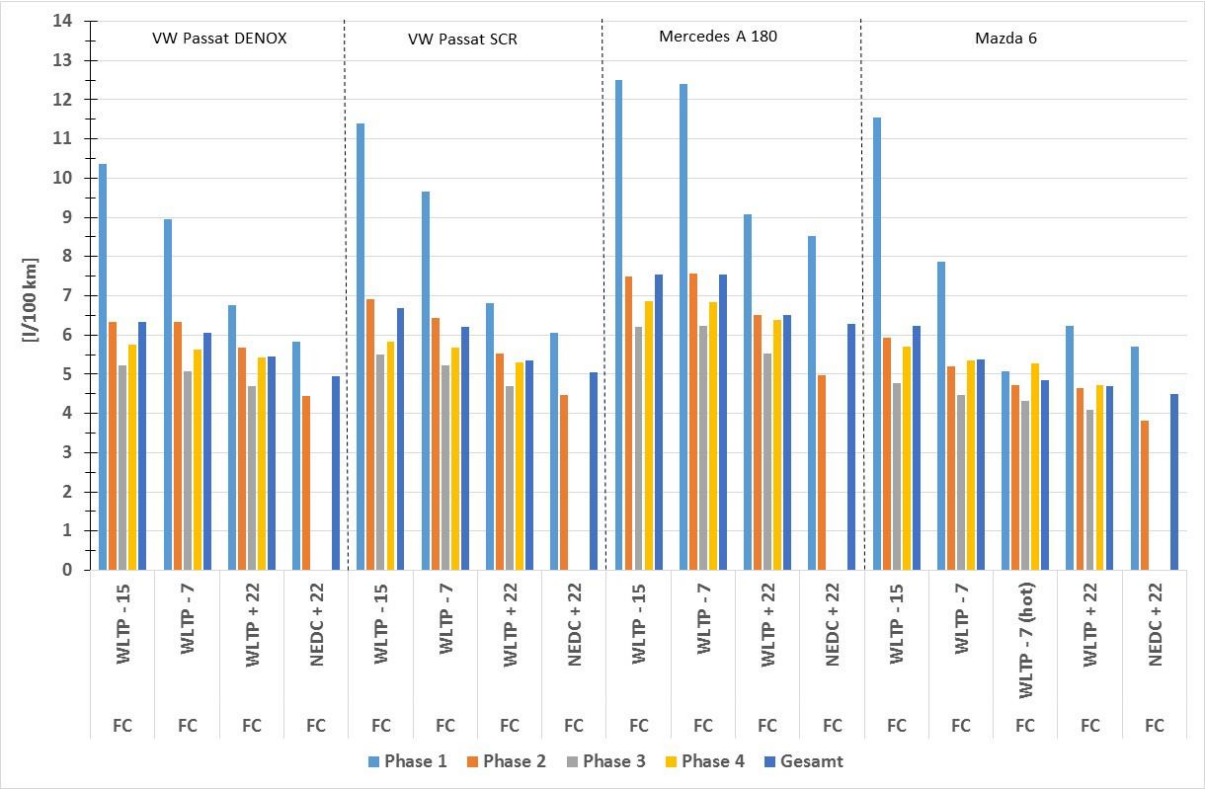
The emission of carbon monoxide is relatively low for all cars at tests at 22 C. The emission is highest for the gasoline car but the emission of HC only occur at the first part of the cycles and after catalyst converter reach the light-off temperature the emissions of CO is thereafter close to zero. For the three diesel powered cars the levels of CO emissions are low. For Mazda 6 the emissions seams to increase with decreased ambient temperatures.

The limit value for Euro 6, NEDC are for:

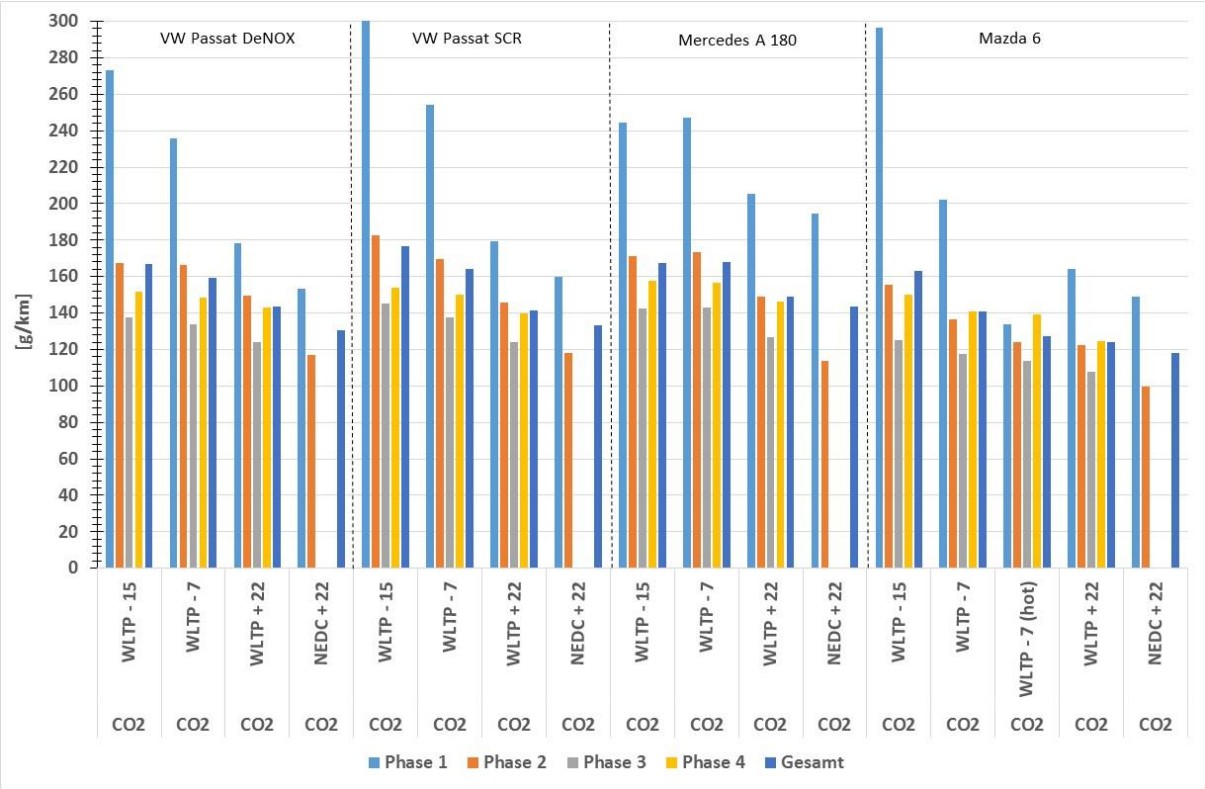
- Diesel 500 mg/km
- Gasoline 1000 mg/km

The gasoline car (Mercedes A 180) is well under the CO-limit in the NEDC test performed at certification condition but exceed the limit for WLTP at low ambient temperatures.

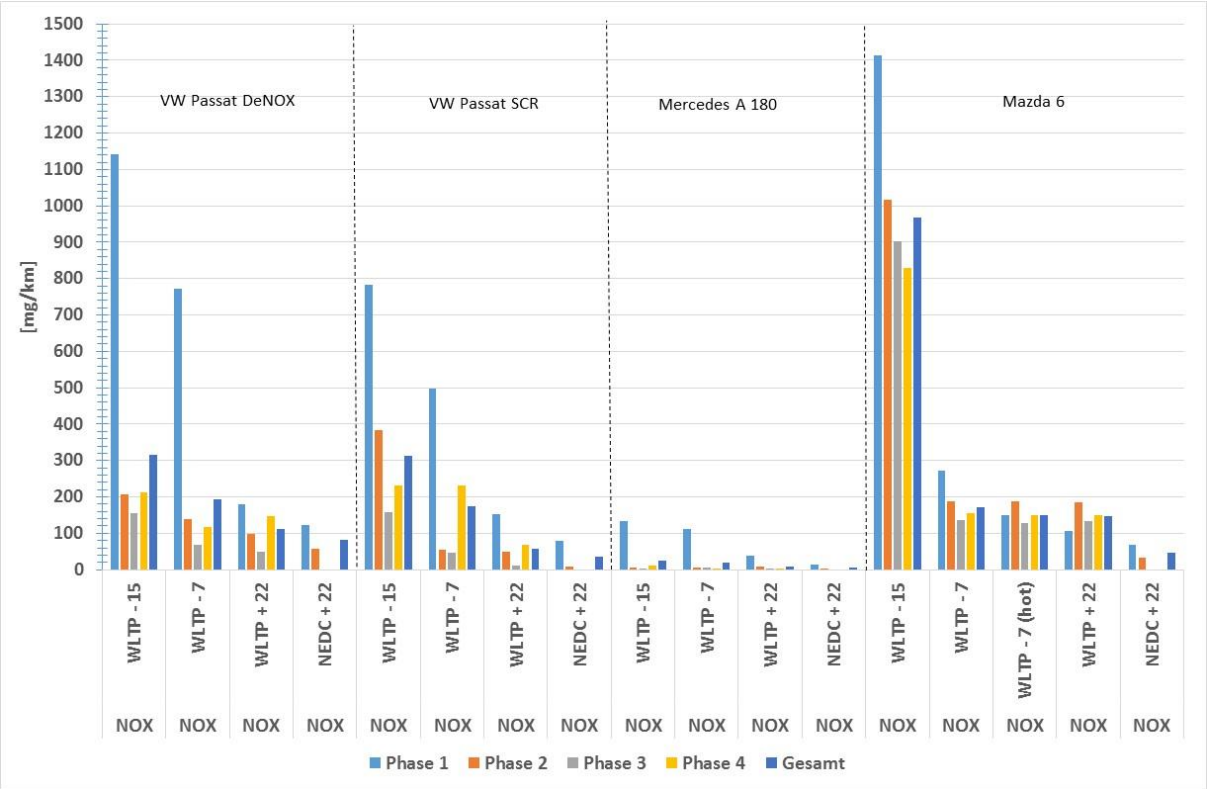
CO_2 and fuel consumption



CO_2 and fuel consumption seems to be higher for WLTP compared with the NEDC test cycle and also increase with decreased ambient test cell temperatures.



NOX



There is relatively high NO_X emissions for all tested diesel cars during test outside the NEDC (with certification conditions) test cycle. Especially at low ambient temperature the emissions are significantly higher than the Euro 6 limit.

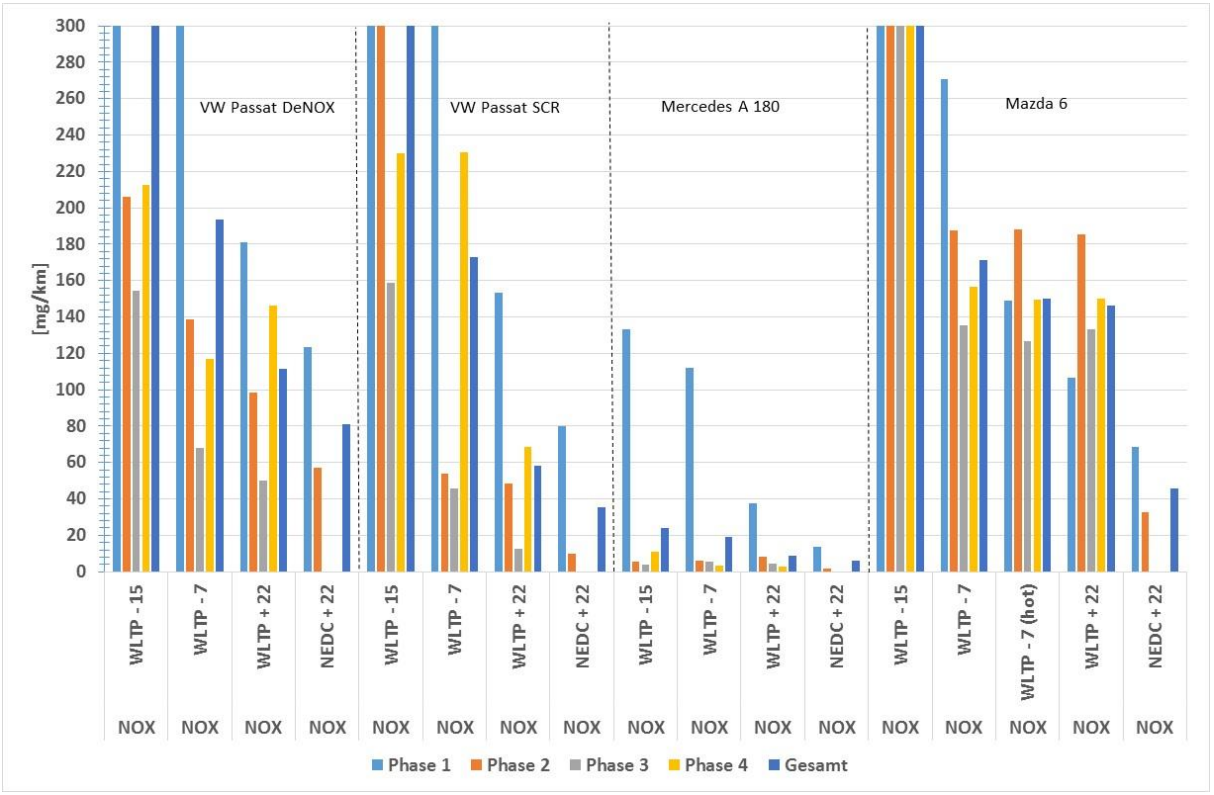
For the gasoline cars emissions of NO_X are low for all tests except the first phase of WLTP at low ambient test cell temperatures.

The NO_X limit value for Euro 6, NEDC are for:

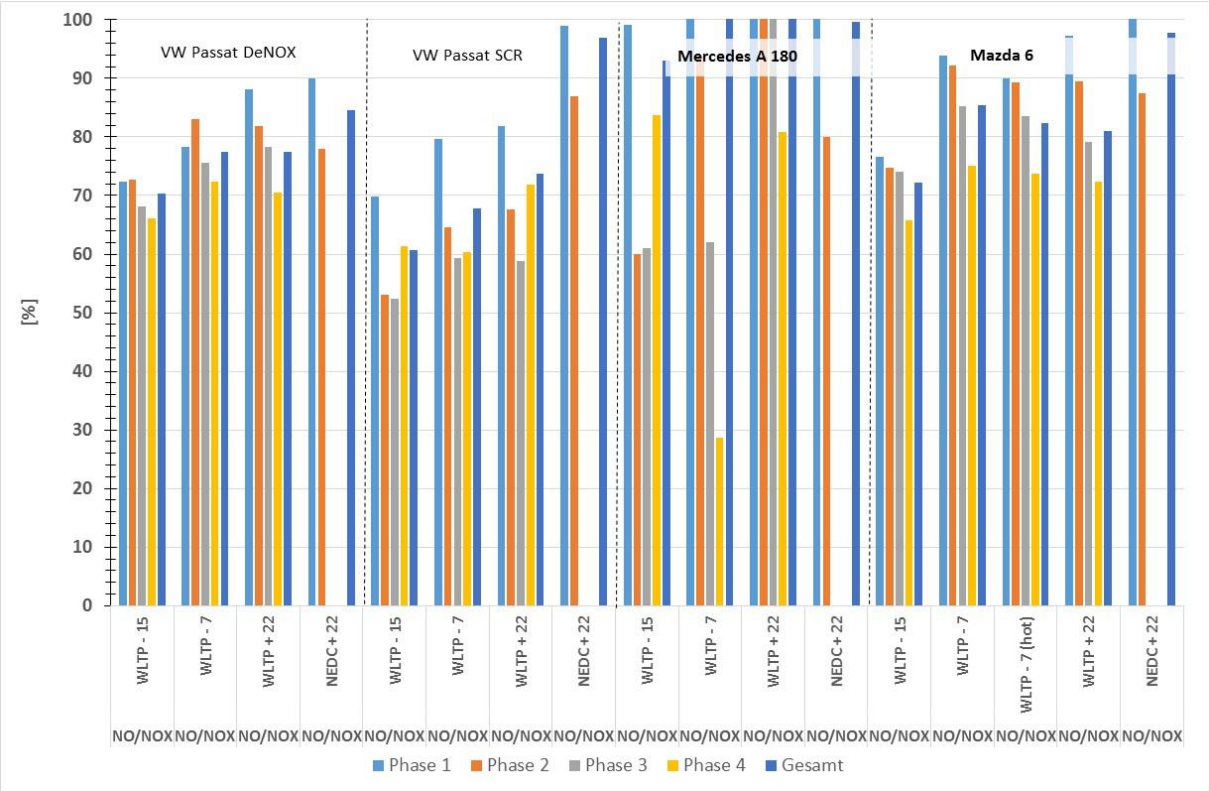
- Diesel 80 mg/km
- Gasoline 60 mg/km

All diesel cars are met the limit value during NEDC test performed at certification conditions but not with big marginal. It may be interesting to retest these cars after that they reach high odometer readings. It is obvious that the emission of NO_X for all tested diesel cars increase with decreasing ambient test cell temperatures. This is most significant for Mazda tested at – 15 C in accordance to the WLTP test cycle. One explanation may be that these diesel cars not use (or at least decrease the flow) EGR at low ambient temperatures.

For more detailed information over NO_X-emissions see also the figure below.

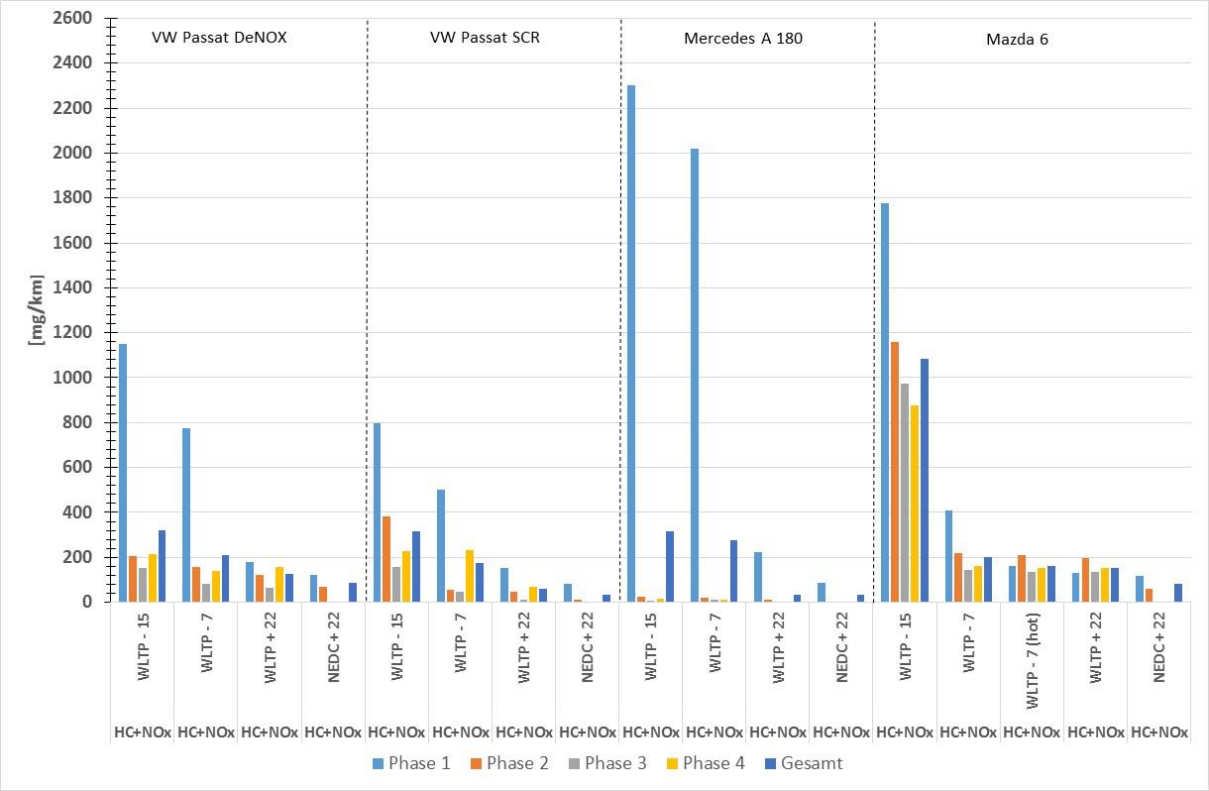

[mg/km]
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
VW Passat DeNOX
VW Passat SCR
Mercedes A 180
Mazda 6
WLTP - 15
WLTP - 7
WLTP + 22
NEDC + 22
WLTP - 15
WLTP - 7
WLTP + 22
NEDC + 22
WLTP - 15
WLTP - 7
WLTP + 22
NEDC + 22
WLTP - 15
WLTP - 7
WLTP - 7 (hot)
WLTP + 22
NEDC + 22
NOX
Phase 1
Phase 2
Phase 3
Phase 4
Gesamt

NO / NO_X



Interesting to note is that almost all NO_X emitted consists of NO. For the gasoline car the NO_X is more or less 100 % NO.

NO_X + HC



There is relatively high NO_X + HC emissions for all tested diesel cars during test outside the NEDC (with certification conditions) test cycle. Especially at low ambient temperature the emissions are significantly higher than the Euro 6 limit.

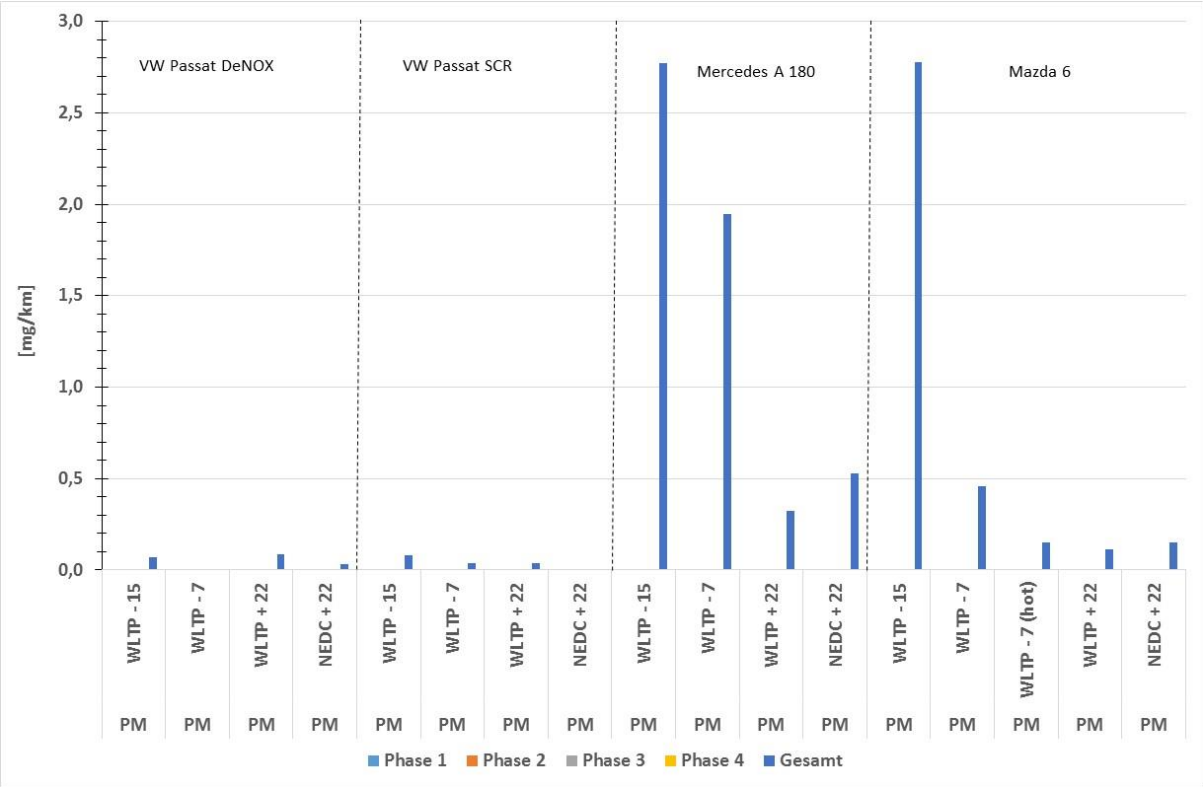
For the gasoline cars emissions of NO_X + HC are low for all tests except the first phase of WLTP at low ambient test cell temperatures.

The NO_X limit value for Euro 6, NEDC are for (no limit value for gasoline)

- Diesel 170 mg/km

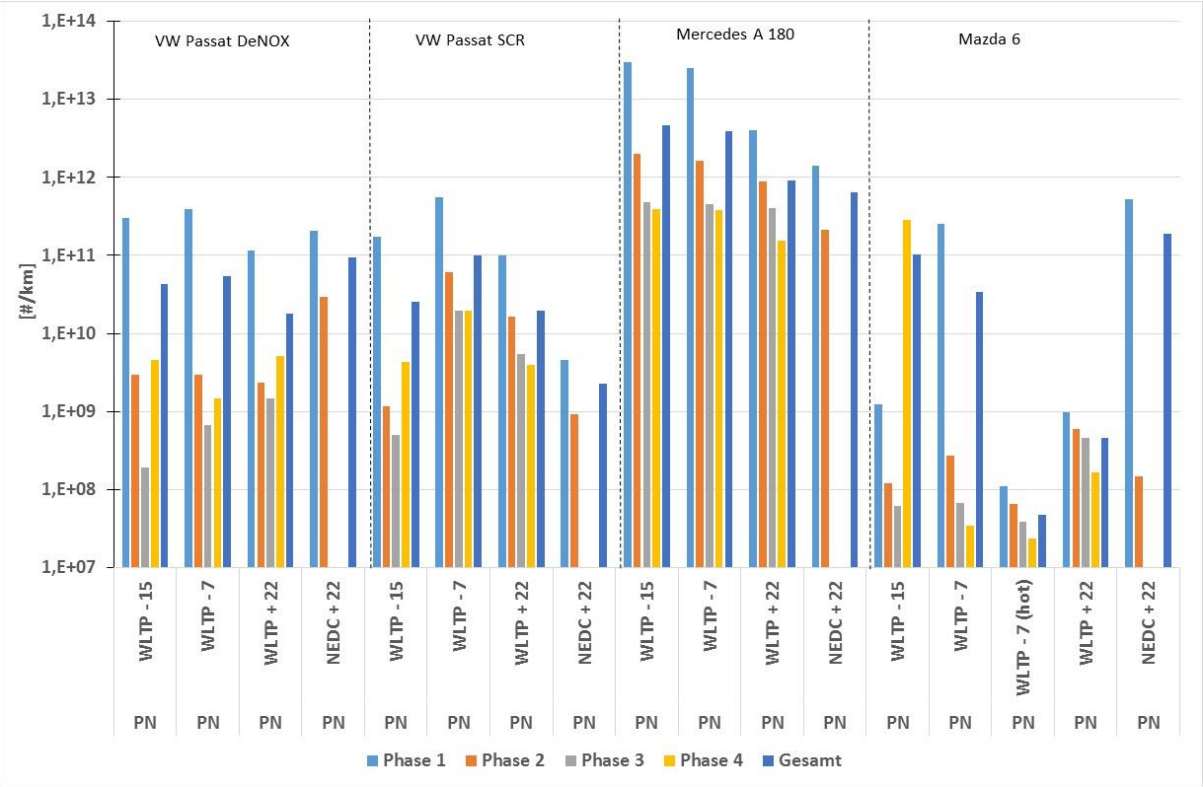
All diesel cars met the limit value during NEDC test performed at certification conditions but not with big marginal. It may be interesting to retest these cars after they reach high odometer readings. It is obvious that the emission of NO_X for all tested diesel cars increase with decreasing ambient test cell temperatures. This is most significant for Mazda tested at – 15 C in accordance to the WLTP test cycle. One explanation may be that these diesel cars not use (or at least decrease the flow) EGR at low ambient temperatures.

Particle mass (PM)



PM was measured by collecting particles on filter paper. These are very low weights (in absolute terms). This allows the measurement uncertainty is relatively large, so large that it is difficult to draw relevant conclusions from filter weight (e.g. for modern cars it is so low emission of particle mass that it is difficult to measure on filter). A general conclusion is that there are very low PM emissions. The Euro 6 limit is 5 mg/km and all car tested are well under the limit.

Particle number (PN)



There are no significant differences in emissions of number of particles between the three tested diesel cars. The number of particles are higher with start at low ambient temperature but the behaviors are almost the same for all diesel cars tested.

The Euro 6 limit is

- Diesel # $6*10^{11}$/km.
- Gasoline # $6*10^{12}$/km (until September 2017, thereafter $6*10^{11}$)

The number of particles from the gasoline car is much higher than from the diesel cars. This may due to the lack of particle filter on the gasoline car. These measurement clearly show that filters are very efficient in reducing the number of particles emitted.

(The relatively strange values for Mazda, WLTP -15, is not clearly understood. It may be some error in this test – or it may be a regeneration during phase 4)

4. Conclusions

For diesel passenger cars – there are three main NOx control technologies currently on the market; exhaust gas recirculation (EGR), lean-burn NOx traps (DeNOX) and selective catalytic reduction (SCR). (Definitions below from Green Car Congress, 2 December 2015)

- 6 % of the Euro 6 diesel passenger cars in EU use only - EGR systems recirculate a portion of exhaust gas to the combustion chamber, lowering the combustion temperature and the production of engine-out NOx. EGR use has been widespread from Euro 4 to Euro 6 since the 1990s and can be used alone or in combination with LNT and SCR. One of the limitations of relying solely on EGR is the difficulty of controlling NOx emissions during high-load operation, the researchers noted.
- 54 % of the Euro 6 diesel passenger cars in EU use - DeNOX (LNT systems) adsorb NOx to a catalyst during lean engine operation. The stored NOx is periodically reduced during short periods of fuel-rich operation (LNT regeneration events). Because LNT systems do not require a separate tank of reductant, as do SCR systems, they are lighter and more compact than SCR systems. LNT systems have a high incremental cost per liter of engine displacement associated with increased used of platinum-group metals (PGMs). Small LNTs are generally more economical than SCR systems for passenger vehicles with displacements below 2 liters.
- 40 % of the Euro 6 diesel passenger cars in EU use - SCR systems use a catalyst and an aqueous urea solution commercially known as diesel exhaust fluid (DEF) or AdBlue to reduce NOx to gaseous nitrogen and water. The (current) third commercial generation of SCR systems can approach 95% NOx reduction efficiency. SCR technology can also improve fuel economy by allowing engine operation to be tuned to higher efficiency and higher engine-out NOx emissions (which are dealt with by the aftertreatment system), but it is limited by poor catalyst activity at low exhaust temperatures, especially during cold engine start events.

By comparing the emission measurements following conclusion may be drawn:

Generally conclusions are that NO_X is a problem for diesel powered passenger cars and emission of small particles (high number) is a problem for gasoline cars.

- Tests outside the NEDC cycle (certification condition) show much higher NO_X emissions compared to the Euro 6 limit.

- Higher HC emissions for the DeNOX system (especially at WLTP test cycle) compared with SCR
- Increased fuel consumption with decreased ambient temperatures for all cars tested
- High NO_X emissions at low ambient temperatures (especially at WLTP test cycle) for all tested diesel cars
- The SCR system seems to have lower NO_X emissions than the DeNOX system
- Almost all emitted NO_X consists of NO – most significant for the gasoline car
- Relatively low particle emissions (both mass and number) for all tested diesel cars
- Relatively high numbers of particles from the gasoline cars but the car met the Euro 6 limit
- These measurement clearly show that filters are very efficient in reducing the number of particles emitted

5. Appendix (measurement values)

VW Passat - DeNOX

				Phase 1	Phase 2	Phase 3	Phase 4	Gesamt
Car 1 WLTP - 15	[mg/km]	HC	**WLTP - 15**	10,402	0,000	0,000	2,866	2,399
	[mg/km]	CH4	**WLTP - 15**	2,959	2,643	1,762	4,385	3,030
	[mg/km]	NMHC	**WLTP - 15**	7,8235	0,0000	0,0000	0,0000	1,0408
	[mg/km]	NOX	**WLTP - 15**	1141,4000	205,8488	154,1603	212,8074	316,8376
	[mg/km]	NO	**WLTP - 15**	826,0359	149,7418	104,9123	140,6759	222,6772
	[%]	NO/NOX	**WLTP - 15**	72,3704	72,7436	68,0540	66,1048	70,2812
	[mg/km]	HC+NOx	**WLTP - 15**	1151,8020	205,8488	154,1603	215,6738	319,2370
	[mg/km]	CO	**WLTP - 15**	260,8080	1,1807	0,7709	0,6977	35,4228
	[g/km]	CO2	**WLTP - 15**	273,07	167,26	137,85	151,93	166,84
	[mg/km]	PM	**WLTP - 15**					0,072
	[1/km]	PN	**WLTP - 15**	3,04E+11	2,99E+09	1,93E+08	4,57E+09	4,28E+10
	[l/100km]	FC	**WLTP - 15**	10,373	6,344	5,228	5,762	6,330
Car 1 WLTP - 7	[mg/km]	HC	**WLTP - 7**	1,772	19,032	12,050	23,309	16,102
	[mg/km]	CH4	**WLTP - 7**	2,465	20,522	16,256	24,519	18,223
	[mg/km]	NMHC	**WLTP - 7**	0,0000	1,1543	0,0000	1,9488	0,9268
	[mg/km]	NOX	**WLTP - 7**	771,6892	138,8240	68,0659	117,0191	193,4596
	[mg/km]	NO	**WLTP - 7**	604,3612	115,2823	51,4124	84,6168	149,7767
	[%]	NO/NOX	**WLTP - 7**	78,3167	83,0421	75,5332	72,3102	77,4201
	[mg/km]	HC+NOx	**WLTP - 7**	773,4614	157,8562	80,1161	140,3278	209,5615
	[mg/km]	CO	**WLTP - 7**	177,0887	27,4390	3,9887	28,3500	40,4394
	[g/km]	CO2	**WLTP - 7**	235,67	166,57	133,83	148,53	159,28
	[mg/km]	PM	**WLTP - 7**					0,005
	[1/km]	PN	**WLTP - 7**	3,95E+11	2,99E+09	6,74E+08	1,45E+09	5,39E+10
	[l/100km]	FC	**WLTP - 7**	8,949	6,321	5,077	5,637	6,045
Car 1 WLTP + 22	[mg/km]	HC	**WLTP + 22**	0,000	23,625	15,059	11,873	13,678
	[mg/km]	CH4	**WLTP + 22**	7,087	27,940	20,191	14,947	18,173
	[mg/km]	NMHC	**WLTP + 22**	0,0000	0,0000	0,0000	0,0000	0,0000
	[mg/km]	NOX	**WLTP + 22**	180,8994	98,3558	50,1556	146,4891	111,5461
	[mg/km]	NO	**WLTP + 22**	159,5011	80,4814	39,2787	103,2079	86,3465
	[%]	NO/NOX	**WLTP + 22**	88,1712	81,8268	78,3136	70,4543	77,4088
	[mg/km]	HC+NOx	**WLTP + 22**	180,8994	121,9807	65,2146	158,3616	125,2246
	[mg/km]	CO	**WLTP + 22**	7,8825	12,2852	16,8312	10,4399	12,4463
	[g/km]	CO2	**WLTP + 22**	178,54	149,59	124,04	143,28	143,33
	[mg/km]	PM	**WLTP + 22**					0,084
	[1/km]	PN	**WLTP + 22**	1,16E+11	2,33E+09	1,46E+09	5,14E+09	1,81E+10
	[l/100km]	FC	**WLTP + 22**	6,772	5,677	4,707	5,436	5,438
Car 1 NEDC + 22	[mg/km]	HC	**NEDC + 22**	0,000	10,574			6,729
	[mg/km]	CH4	**NEDC + 22**	4,449	13,509			10,214
	[mg/km]	NMHC	**NEDC + 22**	0,0000	0,0000			0,0000
	[mg/km]	NOX	**NEDC + 22**	123,2371	57,1904			81,2074
	[mg/km]	NO	**NEDC + 22**	110,9443	44,5659			68,7035
	[%]	NO/NOX	**NEDC + 22**	90,0251	77,9255			84,6025
	[mg/km]	HC+NOx	**NEDC + 22**	123,2371	67,7643			87,9362
	[mg/km]	CO	**NEDC + 22**	13,7662	4,9756			8,1722
	[g/km]	CO2	**NEDC + 22**	153,56	117,02			130,31
	[mg/km]	PM	**NEDC + 22**					0,034
	[1/km]	PN	**NEDC + 22**	2,06E+11	2,96E+10			9,38E+10
	[l/100km]	FC	**NEDC + 22**	5,825	4,440			4,943

VW Passat SCR

				Phase 1	Phase 2	Phase 3	Phase 4	Gesamt
Car 2 WLTP - 15	[mg/km]	HC	**WLTP - 15**	12,640	0,187	0,000	0,000	1,719
	[mg/km]	CH4	**WLTP - 15**	3,501	2,259	0,620	0,037	1,130
	[mg/km]	NMHC	**WLTP - 15**	9,5896	0,0000	0,0000	0,0000	1,2752
	[mg/km]	NOX	**WLTP - 15**	782,7665	383,7512	158,8220	229,9547	312,8534
	[mg/km]	NO	**WLTP - 15**	546,0714	203,7019	83,1681	141,2384	189,8806
	[%]	NO/NOX	**WLTP - 15**	69,7617	53,0818	52,3656	61,4201	60,6932
	[mg/km]	HC+NOx	**WLTP - 15**	795,4064	383,9378	158,8220	229,9547	314,5722
	[mg/km]	CO	**WLTP - 15**	332,9198	1,4823	1,0024	1,4856	45,4074
	[g/km]	CO2	**WLTP - 15**	300,04	182,56	145,15	153,70	176,40
	[mg/km]	PM	**WLTP - 15**					0,079
	[1/km]	PN	**WLTP - 15**	1,75E+11	1,18E+09	4,97E+08	4,27E+09	2,51E+10
	[l/100km]	FC	**WLTP - 15**	11,400	6,924	5,505	5,829	6,693
Car 2 WLTP - 7	[mg/km]	HC	**WLTP - 7**	1,269	0,000	0,000	0,000	0,168
	[mg/km]	CH4	**WLTP - 7**	2,948	1,481	0,548	0,022	0,869
	[mg/km]	NMHC	**WLTP - 7**	0,0000	0,0000	0,0000	0,0000	0,0000
	[mg/km]	NOX	**WLTP - 7**	498,8148	53,9812	45,9446	230,6577	173,0839
	[mg/km]	NO	**WLTP - 7**	396,9152	34,8406	27,2865	139,0696	117,4192
	[%]	NO/NOX	**WLTP - 7**	79,5717	64,5421	59,3900	60,2926	67,8395
	[mg/km]	HC+NOx	**WLTP - 7**	500,0840	53,9812	45,9446	230,6577	173,2518
	[mg/km]	CO	**WLTP - 7**	177,1781	1,6792	0,9998	1,1759	24,5089
	[g/km]	CO2	**WLTP - 7**	254,35	169,80	137,47	149,87	163,93
	[mg/km]	PM	**WLTP - 7**					0,035
	[1/km]	PN	**WLTP - 7**	5,60E+11	6,06E+10	1,94E+10	1,98E+10	9,95E+10
	[l/100km]	FC	**WLTP - 7**	9,657	6,440	5,214	5,684	6,219
Car 2 WLTP + 22	[mg/km]	HC	**WLTP + 22**	0,000	0,000	0,000	0,000	0,000
	[mg/km]	CH4	**WLTP + 22**	5,495	1,994	0,792	0,356	1,507
	[mg/km]	NMHC	**WLTP + 22**	0,0000	0,0000	0,0000	0,0000	0,0000
	[mg/km]	NOX	**WLTP + 22**	153,5693	48,2679	12,3629	68,4784	58,3068
	[mg/km]	NO	**WLTP + 22**	125,7644	32,6318	7,2655	49,1659	43,0085
	[%]	NO/NOX	**WLTP + 22**	81,8942	67,6055	58,7688	71,7978	73,7624
	[mg/km]	HC+NOx	**WLTP + 22**	153,5693	48,2679	12,3629	68,4784	58,3068
	[mg/km]	CO	**WLTP + 22**	35,9576	5,0563	0,8285	1,0234	6,4200
	[g/km]	CO2	**WLTP + 22**	179,32	145,67	123,78	140,02	141,37
	[mg/km]	PM	**WLTP + 22**					0,038
	[1/km]	PN	**WLTP + 22**	9,89E+10	1,66E+10	5,45E+09	4,00E+09	1,96E+10
	[l/100km]	FC	**WLTP + 22**	6,803	5,525	4,694	5,310	5,362
Car 2 NEDC + 22	[mg/km]	HC	**NEDC + 22**	1,533	0,000			0,558
	[mg/km]	CH4	**NEDC + 22**	5,300	1,574			2,930
	[mg/km]	NMHC	**NEDC + 22**	0,0000	0,0000			0,0000
	[mg/km]	NOX	**NEDC + 22**	79,7158	9,7778			35,2321
	[mg/km]	NO	**NEDC + 22**	78,9140	8,5079			34,1325
	[%]	NO/NOX	**NEDC + 22**	98,9941	87,0120			96,8790
	[mg/km]	HC+NOx	**NEDC + 22**	81,2493	9,7778			35,7902
	[mg/km]	CO	**NEDC + 22**	81,2943	0,6025			29,9706
	[g/km]	CO2	**NEDC + 22**	159,66	117,92			133,11
	[mg/km]	PM	**NEDC + 22**					0,000
	[1/km]	PN	**NEDC + 22**	4,58E+09	9,16E+08			2,25E+09
	[l/100km]	FC	**NEDC + 22**	6,060	4,472			5,050

				Phase 1	Phase 2	Phase 3	Phase 4	Gesamt
Car 3 WLTP - 15	[mg/km]	HC	**WLTP - 15**	2168,642	17,506	5,373	6,244	294,344
MB A 180	[mg/km]	CH4	**WLTP - 15**	113,920	2,557	0,170	0,701	15,894
	[mg/km]	NMHC	**WLTP - 15**	2067,9650	15,2463	5,2225	5,6244	280,2969
	[mg/km]	NOX	**WLTP - 15**	133,4925	5,3062	3,8172	10,9666	23,8134
	[mg/km]	NO	**WLTP - 15**	132,3605	3,1866	2,3294	9,1896	22,1409
	[%]	NO/NOX	**WLTP - 15**	99,1520	60,0532	61,0235	83,7965	92,9768
	[mg/km]	HC+NOx	**WLTP - 15**	2302,1340	22,8125	9,1899	17,2108	318,1570
	[mg/km]	CO	**WLTP - 15**	22791,4800	442,6418	157,8902	147,8640	3206,7490
	[g/km]	CO2	**WLTP - 15**	244,45	171,39	142,57	157,43	167,21
	[mg/km]	PM	**WLTP - 15**					2,771
	[1/km]	PN	**WLTP - 15**	2,98E+13	2,02E+12	4,74E+11	3,93E+11	4,65E+12
	[l/100km]	FC	**WLTP - 15**	12,494	7,494	6,218	6,864	7,538
Car 3 WLTP - 7	[mg/km]	HC	**WLTP - 7**	1907,580	13,574	5,038	6,795	258,505
MB A 180	[mg/km]	CH4	**WLTP - 7**	105,149	2,261	0,187	0,861	14,703
	[mg/km]	NMHC	**WLTP - 7**	1814,6540	11,5763	4,8724	6,0342	245,5111
	[mg/km]	NOX	**WLTP - 7**	111,7976	6,2641	5,4816	3,3254	18,9069
	[mg/km]	NO	**WLTP - 7**	130,9591	5,8736	3,4036	0,9529	19,8719
	[%]	NO/NOX	**WLTP - 7**	117,1395	93,7655	62,0923	28,6536	105,1042
	[mg/km]	HC+NOx	**WLTP - 7**	2019,3780	19,8384	10,5194	10,1205	277,4118
	[mg/km]	CO	**WLTP - 7**	20552,5700	259,7703	152,8877	176,2818	2875,3960
	[g/km]	CO2	**WLTP - 7**	246,89	173,57	142,83	156,65	167,75
	[mg/km]	PM	**WLTP - 7**					1,948
	[1/km]	PN	**WLTP - 7**	2,50E+13	1,63E+12	4,60E+11	3,79E+11	3,90E+12
	[l/100km]	FC	**WLTP - 7**	12,412	7,576	6,229	6,832	7,534
Car 3 WLTP + 22	[mg/km]	HC	**WLTP + 22**	183,792	2,161	0,784	2,170	25,841
MB A 180	[mg/km]	CH4	**WLTP + 22**	16,011	1,314	0,208	0,470	2,624
	[mg/km]	NMHC	**WLTP + 22**	169,6421	0,9997	0,6005	1,7543	23,5219
	[mg/km]	NOX	**WLTP + 22**	37,5102	8,0948	4,2855	2,7826	8,9398
	[mg/km]	NO	**WLTP + 22**	40,0588	8,1874	4,4621	2,2480	9,1616
	[%]	NO/NOX	**WLTP + 22**	106,7945	101,1446	104,1210	80,7867	102,4810
	[mg/km]	HC+NOx	**WLTP + 22**	221,3024	10,2553	5,0697	4,9525	34,7807
	[mg/km]	CO	**WLTP + 22**	1552,5920	81,4084	106,7849	102,2166	291,8203
	[g/km]	CO2	**WLTP + 22**	205,41	149,21	126,75	146,35	148,73
	[mg/km]	PM	**WLTP + 22**					0,321
	[1/km]	PN	**WLTP + 22**	4,06E+12	8,78E+11	4,08E+11	1,56E+11	8,99E+11
	[l/100km]	FC	**WLTP + 22**	9,073	6,501	5,525	6,378	6,498
Car 3 NEDC + 22	[mg/km]	HC	**NEDC + 22**	73,093	0,322			27,205
MB A 180	[mg/km]	CH4	**NEDC + 22**	8,886	0,213			3,417
	[mg/km]	NMHC	**NEDC + 22**	65,2397	0,1341			24,1857
	[mg/km]	NOX	**NEDC + 22**	13,5285	1,4858			5,9347
	[mg/km]	NO	**NEDC + 22**	13,9740	1,1879			5,9114
	[%]	NO/NOX	**NEDC + 22**	103,2930	79,9526			99,6084
	[mg/km]	HC+NOx	**NEDC + 22**	86,6214	1,8077			33,1400
	[mg/km]	CO	**NEDC + 22**	400,4197	101,8441			212,1454
	[g/km]	CO2	**NEDC + 22**	194,78	113,80			143,71
	[mg/km]	PM	**NEDC + 22**					0,530
	[1/km]	PN	**NEDC + 22**	1,40E+12	2,11E+11			6,50E+11
	[l/100km]	FC	**NEDC + 22**	8,516	4,961			6,274

				Phase 1	Phase 2	Phase 3	Phase 4	Gesamt
Car 4 WLTP - 15	[mg/km]	HC	**WLTP - 15**	363,533	141,766	69,921	45,568	115,155
Mazda 6	[mg/km]	CH4	**WLTP - 15**	13,546	2,543	0,742	0,176	2,618
	[mg/km]	NMHC	**WLTP - 15**	351,7323	139,5505	69,2750	45,4145	112,8740
	[mg/km]	NOX	**WLTP - 15**	1414,8390	1017,5000	903,0685	830,2396	968,9330
	[mg/km]	NO	**WLTP - 15**	1084,0910	760,9370	668,4890	546,5651	699,6123
	[%]	NO/NOX	**WLTP - 15**	76,6229	74,7850	74,0242	65,8322	72,2044
	[mg/km]	HC+NOx	**WLTP - 15**	1778,3720	1159,2650	972,9900	875,8073	1084,0880
	[mg/km]	CO	**WLTP - 15**	4253,2300	611,7872	172,2455	31,4193	756,9373
	[g/km]	CO2	**WLTP - 15**	296,28	155,25	125,13	150,00	162,95
	[mg/km]	PM	**WLTP - 15**					2,774
	[mg/km]	PM	**WLTP - 15**	1,538	2,028	1,636	4,657	2,774
	[1/km]	PN	**WLTP - 15**	1,22E+09	1,21E+08	6,12E+07	2,88E+11	1,02E+11
	[l/100km]	FC	**WLTP - 15**	11,534	5,941	4,764	5,696	6,239
Car 4 WLTP - 7	[mg/km]	HC	**WLTP - 7**	139,616	32,277	8,071	5,657	29,560
Mazda 6	[mg/km]	CH4	**WLTP - 7**	13,898	4,786	4,866	4,147	5,790
	[mg/km]	NMHC	**WLTP - 7**	127,5083	28,1080	3,8317	2,0439	24,5165
	[mg/km]	NOX	**WLTP - 7**	270,9069	187,7262	135,2845	156,4605	171,4489
	[mg/km]	NO	**WLTP - 7**	254,5309	173,1324	115,2176	117,5992	146,3193
	[%]	NO/NOX	**WLTP - 7**	93,9551	92,2260	85,1669	75,1622	85,3428
	[mg/km]	HC+NOx	**WLTP - 7**	410,5227	220,0034	143,3554	162,1171	201,0089
	[mg/km]	CO	**WLTP - 7**	3100,2680	228,3814	13,9908	3,6053	462,3860
	[g/km]	CO2	**WLTP - 7**	202,38	136,56	117,75	141,00	141,04
	[mg/km]	PM	**WLTP - 7**					0,457
	[mg/km]	PM	**WLTP - 7**	0,395	0,443	0,658	0,314	0,457
	[1/km]	PN	**WLTP - 7**	2,56E+11	2,73E+08	6,75E+07	3,48E+07	3,39E+10
	[l/100km]	FC	**WLTP - 7**	7,877	5,197	4,468	5,348	5,380
Car 4 WLTP - 7 (hot)	[mg/km]	HC	**WLTP - 7 (hot)**	11,207	23,797	8,029	4,708	10,489
Mazda 6	[mg/km]	CH4	**WLTP - 7 (hot)**	6,773	5,098	4,601	4,075	4,804
	[mg/km]	NMHC	**WLTP - 7 (hot)**	5,3068	19,3551	4,0207	1,1581	6,3039
	[mg/km]	NOX	**WLTP - 7 (hot)**	148,8855	187,8723	126,7261	149,2870	150,1475
	[mg/km]	NO	**WLTP - 7 (hot)**	133,8833	167,8980	105,8383	110,0270	123,7098
	[%]	NO/NOX	**WLTP - 7 (hot)**	89,9237	89,3682	83,5174	73,7017	82,3922
	[mg/km]	HC+NOx	**WLTP - 7 (hot)**	160,0924	211,6688	134,7548	153,9950	160,6367
	[mg/km]	CO	**WLTP - 7 (hot)**	168,9297	102,7946	10,5610	2,6819	47,6211
	[g/km]	CO2	**WLTP - 7 (hot)**	133,76	124,23	113,51	139,01	127,43
	[mg/km]	PM	**WLTP - 7 (hot)**					0,148
	[mg/km]	PM	**WLTP - 7 (hot)**	0,131	0,204	0,105	0,160	0,148
	[1/km]	PN	**WLTP - 7 (hot)**	1,09E+08	6,49E+07	3,91E+07	2,35E+07	4,81E+07
	[l/100km]	FC	**WLTP - 7 (hot)**	5,084	4,721	4,306	5,273	4,837
Car 4 WLTP + 22	[mg/km]	HC	**WLTP + 22**	23,745	10,057	1,281	2,564	6,517
Mazda 6	[mg/km]	CH4	**WLTP + 22**					
	[mg/km]	NMHC	**WLTP + 22**					
	[mg/km]	NOX	**WLTP + 22**	106,8219	185,2387	133,3695	150,0098	146,3154
	[mg/km]	NO	**WLTP + 22**	103,8387	165,7256	105,4481	108,5124	118,6101
	[%]	NO/NOX	**WLTP + 22**	97,2073	89,4660	79,0646	72,3369	81,0647
	[mg/km]	HC+NOx	**WLTP + 22**	130,5671	195,2952	134,6503	152,5742	152,8326
	[mg/km]	CO	**WLTP + 22**	325,8257	10,9194	0,0572	0,9788	45,9820
	[g/km]	CO2	**WLTP + 22**	164,00	122,57	107,73	124,48	124,19
	[mg/km]	PM	**WLTP + 22**					0,115
	[1/km]	PN	**WLTP + 22**	9,94E+08	6,05E+08	4,62E+08	1,67E+08	4,57E+08
	[l/100km]	FC	**WLTP + 22**	6,233	4,644	4,080	4,714	4,707
Car 4 NEDC + 22	[mg/km]	HC	**NEDC + 22**	50,867	29,306			37,212
Mazda 6	[mg/km]	CH4	**NEDC + 22**	18,370	14,972			16,218
	[mg/km]	NMHC	**NEDC + 22**	34,8643	16,2631			23,0838
	[mg/km]	NOX	**NEDC + 22**	68,4595	32,4416			45,6487
	[mg/km]	NO	**NEDC + 22**	72,8122	28,3545			44,6563
	[%]	NO/NOX	**NEDC + 22**	106,3580	87,4016			97,8260
	[mg/km]	HC+NOx	**NEDC + 22**	119,3265	61,7472			82,8605
	[mg/km]	CO	**NEDC + 22**	871,6035	225,4763			462,3994
	[g/km]	CO2	**NEDC + 22**	149,02	99,82			117,86
	[mg/km]	PM	**NEDC + 22**					0,152
	[1/km]	PN	**NEDC + 22**	5,19E+11	1,49E+08			1,91E+11
	[l/100km]	FC	**NEDC + 22**	5,710	3,803			4,502