

Second Report by the "Volkswagen" Commission of Inquiry

Investigations into CO₂ emission levels of the vehicles from the field trial
of the Federal Motor Transport Authority

Completed version



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A. Introduction

In April 2016, in the First Report of the "Volkswagen" Commission of Inquiry that was established by the Federal Ministry of Transport and Digital Infrastructure (BMVI), inter alia, the results of the field trial conducted by the Federal Motor Transport Authority (KBA) with regard to unlawful defeat devices used in diesel vehicles were published. The report can be found on the website of the Federal Motor Transport Authority:

https://www.kba.de/DE/Marktueberwachung/Abgasthematik/first_report_vw_c_of_i_nox_pdf.pdf?blob=publicationFile.

The primary goal of the field trial was to measure and assess the NO_x emission levels in the context of the use of unlawful defeat devices. To this end, the Federal Motor Transport Authority had 56 measurements performed and assessed on 53 models of diesel vehicles of the emission classes "Euro 5" and "Euro 6" with regard to the objectives of the investigation. The CO₂ emission or fuel consumption levels that were determined at the same time during the measurements exhibited anomalies; however, due to the general conditions of the measurements, no assessment of the CO₂ emission levels of the examined vehicle models with regard to type approval was possible. For this reason, the Federal Ministry of Transport and Digital Infrastructure's Commission of Inquiry tasked the Federal Motor Transport Authority with investigating and assessing the CO₂ emission levels of vehicles exhibiting significant anomalies. The relevant European type approval legislation does not yet provide for procedures for monitoring in-service vehicles with regard to their CO₂ emissions or criteria for their assessment. However, according to the judgements issued by the Federal Court of Justice, major deficiencies can be assumed for vehicles that exceed the stated fuel consumption levels by more than 10 %. Such an exceedance should therefore be considered an indication to investigate, where appropriate, the vehicles assessed in the NO_x field trial report in greater detail.

Those diesel vehicles which, in the field trials, showed a CO₂ value which deviated from the approved (catalogue) value by more than 10 % have been measured and tested again specifically with regard to their CO₂ values since April 2016.

This report presents the results of the investigations performed on vehicles for which the Federal Motor Transport Authority (KBA) is the type approval authority with regard to emission levels, vehicles of German manufacturers for which the KBA is not the competent type approval authority with regard to emission levels as well as the investigations of vehicles of foreign manufacturers for which the KBA is not the competent type approval authority with regard to emission levels. This is the completed version of the second report of the "Volkswagen" Commission of Inquiry.

Overall, 29 of 53 vehicle models were exhibited anomalies within the framework of the field trial. In the field trials, the following CO₂ values were found for the vehicle models exhibiting anomalies: Alfa Romeo Giulietta 2.0l – (124 g/km), Audi A3 2.0l - (126 g/km), Audi A6 2.0l - (157 g/km), Audi A6 3.0l - (180 g/km), Audi A6 3.0l (EU 5) - (154 g/km), BMW 216d GT 1.6l - (130 g/km), Fiat Ducato 3,0l – (278 g/km), Jaguar XE 2,0l – (136 g/km), Jeep Cherokee 2.0l – (169 g/km), Land Rover Evoque 2.0l – (158 g/km), Mercedes C220 CDI - (144 g/km), Mercedes V250 CDI - (173 g/km), Mitsubishi ASX 2.3l TDI - (176 g/km), Opel Zafira 1.6l (alte Version) - (132 g/km), Peugeot 308SW 1.6l – (97 g/km), Porsche Macan 3.0l TDI - (187 g/km), Renault Kadjar 1.5l – (114 g/km), Renault Kadjar 1.6l – (147 g/km), Smart Fortwo 0.8l Diesel - (102 g/km), Suzuki Vitara 1.6l –

(128 g/km), VW Golf 1.6l BMT (EA 288) - (100 g/km), VW Golf Plus 1.6l TDI (EA 189) - (148 g/km), VW Passat 2.0l TDI (EA 189) - (141 g/km), VW Passat 2.0l (EA 288) - (137 g/km), VW Polo 1.2l TDI (EA 189) - (122 g/km), VW Sportsvan 2.0l TDI (EA 288) - (131 g/km), VW Touareg 3.0l - (202 g/km), VW Touran 2.0l TDI (EA 288) - (149 g/km), Volvo V60 2.0l – (126 g/km).

This report starts by explaining the fundamentals with regard to CO₂ emission levels of vehicles in the context of type approval legislation and other statutory provisions. A focus will be on the presentation of the most important measurement variables and, as a result, the determined CO₂ emission values.

For the specific investigations performed, the respective procedure for verifying the conformity of production (CoP) as well as the CO₂ retesting of vehicle models for which the Federal Motor Transport Authority is the competent approval authority are described.

The retests performed by the Federal Motor Transport Authority of vehicle models of German manufacturers for which another European authority is the competent type approval authority as well as of vehicles of foreign manufacturers for which the Federal Motor Transport Authority is not the competent type-approval authority with regard to emission levels are covered in Chapter D (CO₂ retests of vehicles for which the Federal Motor Transport Authority is not the competent type approval authority with regard to emission levels – market surveillance).

On the basis of the clarification of the facts and the submitted findings from the further investigations of the Federal Motor Transport Authority on CO₂ emission levels, the Federal Ministry of Transport and Digital Infrastructure's Commission of Inquiry has drawn conclusions and made proposals that are presented in Chapter E ("Conclusions ") of this report.

B. Fundamentals

I. Carbon dioxide (CO₂) as part of the exhaust gas emission levels of motor vehicles

1. Production of CO₂ as a result of the combustion process

Internal combustion engines are thermal engines; they convert the heat that is released during the combustion of fuels into mechanical work. In the internal combustion process, fuel is burned with the addition of air. In chemical terms, diesel fuel (like petrol, liquefied petroleum gas or natural gas) is a hydrocarbon compound. In addition to the comparatively low percentage of the total pollutant emissions mass, such as uncombusted hydrocarbons (HC), particulate matter, carbon monoxide (CO) and nitrogen oxides (NO_x), the exhaust emissions from diesel engines mainly contain water (H₂O) in its gaseous state (steam) and carbon dioxide (CO₂).

When trying to reduce NO_x and CO₂ emissions from motor vehicles, fundamental technical conflicts of objectives are encountered. In the case of combustion in the engine at high temperature levels, the efficiency is high and results in low CO₂ emission and lower fuel consumption levels. At the same time, high combustion temperatures automatically lead to increased NO_x formation in the exhaust emissions. The use of certain exhaust gas aftertreatment systems can cause higher CO₂ emission and fuel consumption levels, e.g. when required regeneration processes are executed.

2. Different assessments of CO₂ emission and pollutant emission levels

The pollutants emitted by combustion engines are detrimental to human health in different ways, depending on their concentration in ambient air. On the other hand, CO₂ emissions are not directly harmful, but contribute significantly to the greenhouse effect and thus to climate change. Because CO₂ is so relevant in terms of climate, efforts have been made for a long time to reduce emission levels, including in the automotive sector.

However, in the type-approval procedure, CO₂ emissions are not subject to thresholds, which makes them not comparable to pollutant thresholds such as "Euro 6". However, the type approval procedure requires determining the CO₂ emissions levels as well as the directly related fuel consumption of a vehicle type using a predefined measurement method. The determined CO₂ emission and fuel consumption levels form the basis for further CO₂-related measures and legislation:

- Regulations on the Marking of Motor Vehicles to provide information to consumers.
- CO₂-based motor vehicle tax
- CO₂ monitoring to determine annual fleet emission levels regulated and limited by Regulation (EC) No 443/2009

There are further differences with regard to the treatment of CO₂ and pollutant emission levels in the type-approval procedure for motor vehicles. Although the legislation for the measurement procedure is largely similar, compliance with the thresholds must be demonstrated for pollutants emissions, while vehicle manufacturers provide type-specific CO₂ emission and

fuel consumption levels that are later verified. For verifying the conformity of production, different procedures are defined by the legislation. In-service conformity (ISC) can only be verified in terms of pollutant emission levels and is currently not applicable with regard to CO₂ emission levels. In the following chapter, the legislation for the determination of CO₂ emission levels in the framework of the type approval procedure are described in greater detail.

II. Determination of CO₂ emission levels during the type approval procedure

1. Statutory requirements

For the licensing of a vehicle in road transport in a Member State of the European Union, it is a basic prerequisite that the vehicle conforms to an official type approval. The approval of the category M1 and N1 vehicles considered here is governed by European Directive 2007/46/EC, which has been transposed into German law by means of the EC Vehicle Approval Regulations. Accordingly, the approval process requires compliance with additional individual technical provisions. One example is Regulation (EC) No 715/2007 on type approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6). The Implementing Regulation is Regulation (EC) No 692/2008. In order to comply with this legislation, it is also necessary to measure CO₂ emission levels, among other things.

The requirements for measuring CO₂ emission and fuel consumption levels are set out in Annex XII to Regulation (EC) No 692/2008. This annex refers to UN Regulation No 101. The Regulation lays down uniform conditions for the approval of passenger cars of categories M₁ and N₁ operating only a combustion engine with regard to the measurement of CO₂ emission and fuel consumption levels. For the technical implementation, the Regulation refers to the procedure under which the type I test is carried out, as described in Annex 4a to UN Regulation No 83. For the determination of CO₂ emission levels, the New European Driving Cycle (NEDC) will be run on the chassis dynamometer under the same conditions as in the determination of pollutants. A detailed description of the NEDC and the corresponding process during the type 1 test can be found in the report of the "Volkswagen" Commission of Inquiry.¹

The manufacturer states the CO₂ emission value (catalogue value), which is not related to a statutory threshold. This value is then considered the type approval value and included in the EC Certificate of Conformity, provided that the subsequent measurement by the technical service does not exceed this value by more than 4 %. Should the measured value exceed this tolerance, additional measurements are performed and a mean value is calculated. If the 4 % tolerance range is still exceeded, the measurement value of the technical service is determined to be the type approval value.

¹ Cf. Report of the "Volkswagen" Commission of Inquiry (April 2016), Chapter B ("Basis") Part II Point 2 (pp. 9-10).

During the type approval procedure, the CO₂ emission and fuel consumption levels are determined based on the energy requirements of the vehicles' powertrains. The energy requirements of auxiliary systems that can be switched on and off, for example air conditioning systems, lighting or seat heating, are not taken into account during the measurement.

2. Measurements and results variables

The measurement methods for the determination of CO₂ emission levels that are regulated by European law contain a wide range of tolerances that can be exhausted when carrying out the measurements. This is another reason why there are discrepancies between the officially determined fuel consumption levels and those found in real world driving. However, a particular result is also that the repeatability of additional tests (retests) is limited.

In 2010, the Federal Highway Institute (BAST) had commissioned a study to investigate significant influences with regard to CO₂ emission and fuel consumption levels as determined by the currently valid NEDC-based type-approval rule book in Europe.² The investigation included influences from the fields of driving cycle, measurement procedures and administrative provisions. The aim was, on the one hand, to quantify the influences and verify their relevance with regard to the CO₂ and fuel consumption levels of type approval and, on the other hand, determine how realistic the levels obtained on the basis of this testing requirement were.

The purpose of the study was to include the results and findings in the development of the Worldwide Harmonised Light Vehicles Test Procedure (WLTP) in a way that would make the determination of the relevant CO₂ emission and fuel consumption levels of passenger cars and light commercial vehicles as realistic and reproducible as possible.

In the following, some significant variables with regard to measurements in accordance with UN Regulation No 83, Annex 4a are considered in greater detail. As a result of this study, the variables were identified as being of high relevance for good repeatability and reproducibility of the measurement results.

a. Ambient conditions

The allowed temperature of the test cell in which the measurements take place ranges between 20 °C and 30 °C. After pre-conditioning the test vehicle on the chassis dynamometer exactly as specified, the vehicle is placed in a room whose relatively constant temperature must be in the range between 20 °C and 30 °C. The vehicle must remain in this temperature range for at least 6 hours. The engine oil temperature and that of the coolant (if any) should be equal to the room temperature with a tolerance of ± 2 °C. This level of the engine oil temperature achieved is then also available at the start of the emission test.

Higher room temperatures tend to lead to lower CO₂ emission levels, as friction losses in the engine or powertrain are reduced.

² H. Schmidt, R. Johannsen, "Pilotprojekt zur Relevanzanalyse von Einflussfaktoren bei der Ermittlung der CO₂-Emissionen und des Kraftstoffverbrauchs im Rahmen der Typgenehmigung von Pkw", final report of the study commissioned by the Federal Highway Research Institute (German only), FE 84.0501/2010, Bergisch Gladbach 2010

b. Driver

Another variable of CO₂ measurements on the chassis dynamometer is the driver. Under the regulation, drivers must not deviate from the defined driving trace by more than ± 2 km/h and ± 1 second. This results in a tolerance range. Therefore, drivers can drive exactly along the line of the driving cycle and not make use of the tolerance range or drive in a particularly energy-efficient manner within this range and achieve a better CO₂ emission value.

c. Adjustment of the chassis dynamometer – road load and inertia

When measuring the exhaust gas emission levels on the chassis dynamometer, the road load is simulated. In order to correctly adjust the dynamometer for the vehicle to be tested, it is imperative to determine its specific road load.

This usually happens on a test track. The vehicle is accelerated to a certain speed and, after reaching this speed, the gearbox is placed in neutral. The times the vehicle requires to coast down are measured at defined intervals. A wide range of general conditions have to be met, for example surface and slope of the road, different wind speeds, air density and certain technical parameters of the vehicle. An overview of the conditions can be found in the regulation together with admissible tolerances during the measurement.

The inertia set on the dynamometer simulates the mass of the vehicle. This influences the road load especially with accelerated movements from low speeds. The dynamometer is adjusted in accordance with the defined inertia classes and must be adapted to the mass of the vehicle or vehicle family.

The setting of the chassis dynamometer in turn influences the measurement of CO₂ emission levels.

3. Examples of the variance of valid measurements as a result of empirical influences

The following measurement results are to serve as examples of the variance of CO₂ measurements. All measurements were performed within the framework of investigations by the Federal Motor Transport Authority in compliance with statutorily specified boundary conditions.

Measurements of two similar Mercedes-Benz V-Class 2.1 l Diesel Euro 6 vehicles under different conditions on different certified test benches with different drivers and minor differences in ambient temperature resulted in significantly different CO₂ emission levels, which are listed in the table below.

Ambient temperature [°C]	Total CO ₂ [g/km]
22.7	169.2
24.5	160.8

CO₂ emission levels in the NEDC with different variables – measurements of two similar vehicles

Another example is the Audi A6 3.0 l Diesel Euro 6 estate car. The same vehicle was measured twice on the same dynamometer with slightly different ambient temperatures and differ-

ent drivers. One driver followed the prescribed speed trace as precisely as possible, the other followed the speed trace in a way that was optimised with regard to fuel consumption making use of the permissible tolerances. Both measurements must be recognised as valid in accordance with the regulation.

Ambient temperature [°C]	Total CO ₂ [g/km]
26.3	151.8
23.9	161.2

CO₂ emission levels in the NEDC with different variables – two measurements of the same vehicle

The data collected shows that even small differences in the boundary conditions result in substantial variances of the CO₂ measurement results.

4. Conformity of production (CoP)

Regulation (EC) No 692/2008 defines the requirements for the conformity of production with regard to CO₂ emission levels. Inspections must be carried out exclusively on new vehicles.

The legislation currently in force provides that the manufacturer – in order to take into account the reduction of friction losses and thus CO₂ emission levels of the run-in vehicle at 15,000 km – can determine an evolution coefficient or use the fixed value of 0.92 from the regulation and multiply the CO₂ values measured on new vehicles by this value.

The test procedure involves selecting at least three vehicles of the current series at random and measuring their CO₂ emission levels as stated by the manufacturer.

The investigation is based on "statistical procedures" which, to some extent, allow for production-related variances around the type approval (catalogue) value or the CoC value and assume a logarithmic normal distribution of production variances. They are described in detail in Appendices 1 and 2 to UN Regulation No 83, to which the above-mentioned Regulation (EC) No 692/2008 refers. Which of the two procedures is to be used specifically depends on whether the manufacturer's proof of the production standard deviation meets a certain quality criterion. By using a mathematical formula including a test statistic comparison for the evaluation, the statistical procedures subsequently determine whether the measurement results of the three vehicles taken from production comply with the approval criterion for the batch under consideration straightaway, whether no decision can yet be made and further vehicles have to be tested or whether the approval cannot take place. If the measured CO₂ levels show a distribution above the type approval value and no approval can take place straightaway, the number of vehicles in the sample must be increased gradually until either the type approval value is confirmed within the framework of the statistical procedure or the production batch has failed. This procedure allows for a sample size of up to 32 vehicles.

C. CO₂ investigations of the vehicles for which the Federal Motor Transport Authority is the type approval authority with regard to emission levels

I. Approach

1. Basic information for carrying out the retests

The CO₂ retesting was generally carried out on the test benches of the technical services designated by the Federal Motor Transport Authority. If, in justified exceptional cases, deviations from this rule were required, direct supervision by the Federal Motor Transport Authority was ensured.

The road load values and inertia classes determined during the type approval procedure under the supervision of the technical services were used.

The specified CO₂ catalogue values refer to the vehicles tested within the framework of this CO₂ emission analysis. These values may differ from the values of the vehicles tested within the framework of the Federal Motor Transport Authority's field trials on the unlawful defeat devices (see Chapter A (Introduction)) since the retests were partly performed with different versions of the same models.

Further differences between the CO₂ values determined within the framework of this investigation and the values from the field trial of the Federal Motor Transport Authority result from the fact that the retest of CO₂ values constitutes a verification of manufacturers' specifications from the type approval process. This involves a test conducted within the framework of the applicable tolerances of the measurement procedure. Manufacturers can determine the CO₂ emission value within this tolerance range in line with the provisions. For example, this concerns speed traces optimised for fuel consumption or measurements at higher engine oil temperatures. The measurements took place within the temperature range of 20 °C to 30 °C degrees specified in the regulation. It should be noted that higher ambient temperatures lead to higher engine oil temperatures, which usually result in lower CO₂ emission results.

There are no procedural rules for testing vehicles which are no longer in production. Anomalies were found in several second-hand vehicles procured on the market. After invalid measurements, these vehicles had to be put into a technically perfect condition or in some cases even replaced. In turn, measurement costs increased.

2. The Federal Motor Transport Authority as the competent type approval authority with regard to emission levels

a. CO₂ retesting of vehicles still in production (verification of CoP or type approval)

Vehicles for which the Federal Motor Transport Authority is the competent type approval authority with regard to emission permits and which are still in production were directly taken from the manufacturer's production by the Federal Motor Transport Authority or a representative in a sample size of initially three vehicles and were tested by a technical service designated by the Federal Motor Transport Authority. If the measurements, after multiplication by

the evolution coefficient of 0.92, represent the manufacturer's type approval value in their logarithmic normal distribution, the CoP test is considered passed.

In two cases, retesting was performed on vehicles on the basis of the legislation governing the re-issuance of a type-approval.

b. CO₂ retesting of vehicles no longer in production

Vehicles that are no longer in production had to be procured as used vehicles on the open market and tested. As a result, no checks of the conformity of production regulated by law could be performed; however, all other technical conditions of the legislation were complied with to the extent possible.

Since the mileage of the vehicles, with the exception of a model of the Opel Zafira 1.6 I, was greater than 15,000 km and, as a result, these vehicles had been run-in, no evolution coefficient was used for the evaluation of the results.

If the statistical procedure or the evolution coefficient were not used, the retest conducted within the scope of this investigation was considered to be not exhibiting anomalies if the test result did not exceed the type approval value by more than 4 %. This criterion correlates with the statutory level of acceptance to which the specification of the manufacturer must correspond during type approval according to the regulation.

II. Measurement results of the vehicles for which the Federal Motor Transport Authority is the competent type approval authority with regard to emission levels

1. CO₂ retesting of vehicles still in production (verification of CoP or type approval)

The following vehicle models have not exceeded the type-approval value during the retests performed by the Federal Motor Transport Authority on vehicles still in production. Three vehicles of each model were tested. For the verification of the Mercedes V Class, a fourth vehicle was tested according to the statistical procedure.

The test results listed below represent the respective mean value of the retests; the oil temperature is also shown as a mean value.

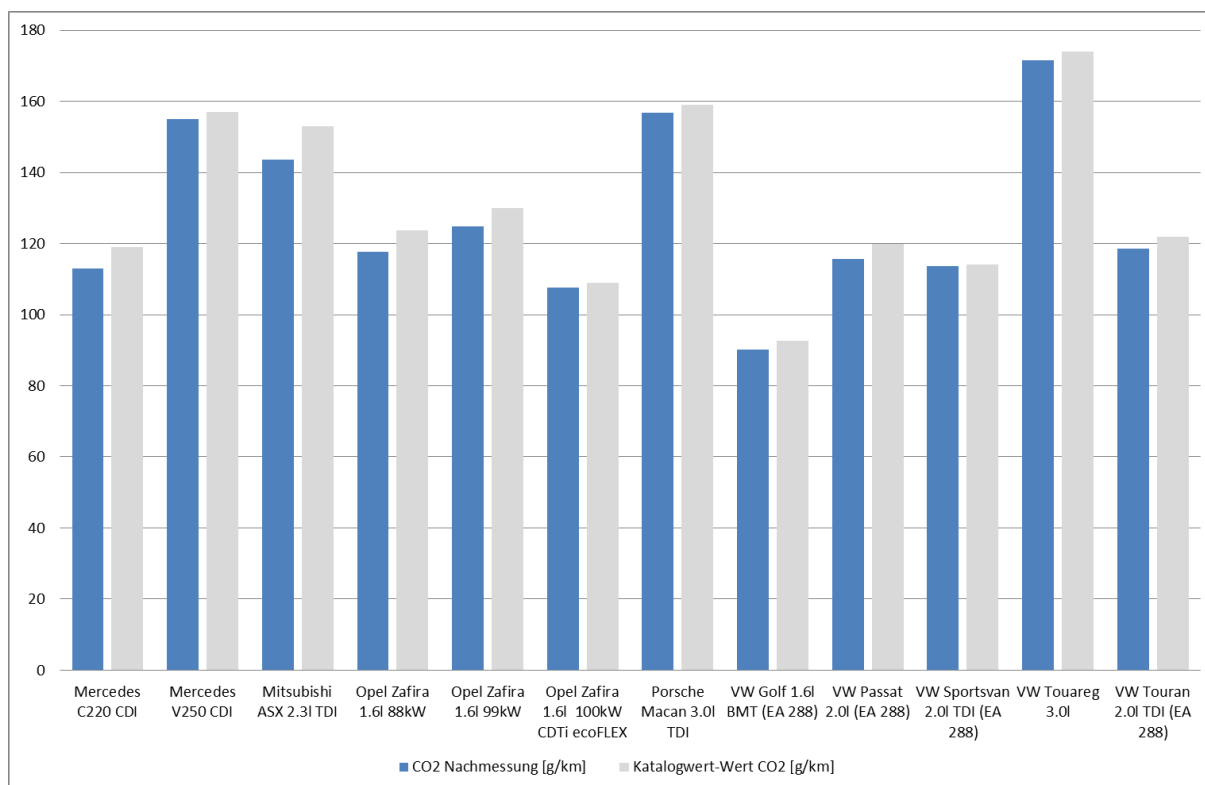
The test results are listed in the following in table form and graphically.

Vehicle model	CO ₂ Retest [g/km] ³	CO ₂ catalogue value [g/km]	Deviation [%]	Oil temperature [°C] ⁴
Mercedes C220 CDI	113.0	119.0	-5.0	27.9
Mercedes V250 CDI	155.1	157.0	-1.2	23.9
Mitsubishi ASX 2.3l TDI	143.6	153.0	-6.1	24.8
Opel Zafira 1.6l 88kW	117.6	123.8 ⁵	-5.0	27.0
Opel Zafira 1.6 l 99 kW	124.9	130.0 ⁵	-3.9	27.0
Opel Zafira 1.6 l 100 kW CDTi ecoFLEX	107.6	109	-1.3	27.4
Porsche Macan 3.0 l TDI	156.8	159.0	-1.4	23.3
VW Golf 1.6 l BMT (EA 288)	90.2	92.6 ⁵	-2.6	29.4
VW Passat 2.0 l (EA 288)	115.6	120.0	-3.7	28.6
VW Sportsvan 2.0 l TDI (EA 288)	113.6	114.0	-0.4	23.3
VW Touareg 3.0 l	171.6	174.0	-1.4	28.2
VW Touran 2.0 l TDI (EA 288)	118.6	122.0	-2.8	24.3

³ Presentation including ki factor (correction factor of the CO₂ value due to periodic regeneration of the exhaust gas aftertreatment system) and evolution coefficients.

⁴ Motor oil temperature level at the start of the emission test.

⁵ Since the retests of the two Opel Zafira vehicles and the VW Golf 1.6 l BMT (EA 288) do not constitute a verification of the conformity of production test, but rather tests under type approval conditions, the catalogue value is given including the tolerance of 4 %.



2. CO₂ retesting of vehicles no longer in production

a. Vehicles not exhibiting anomalies

For the following vehicle models, the Federal Motor Transport Authority confirmed the type approval values as part of the retests of vehicles that are no longer in production.

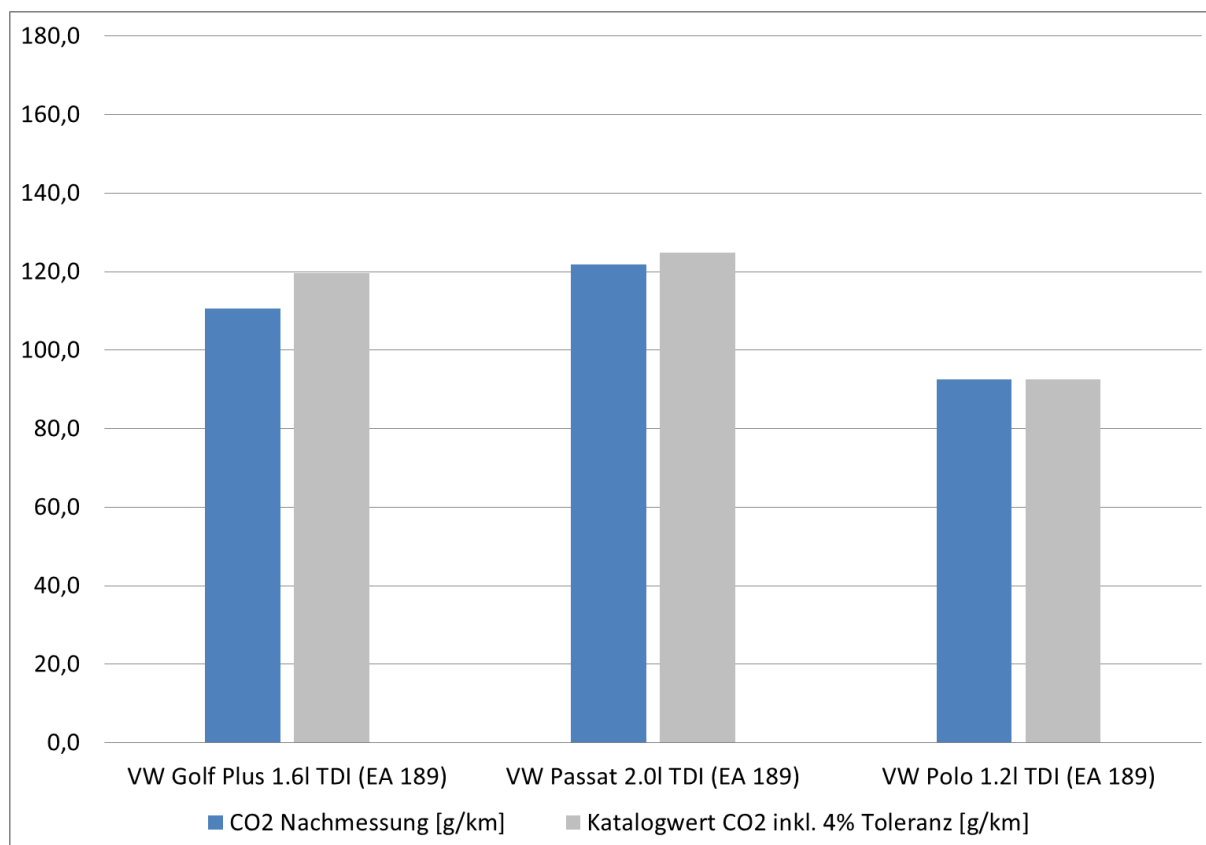
The test results are listed in the following in table form and graphically. For the VW Polo, two retests were carried out with the same vehicle. The mean values of the retests and the oil temperature are shown.

Vehicle model	CO ₂ Retest [g/km] ⁶⁷	CO ₂ catalogue value incl. 4 % tolerance [g/km]	Deviation [%]	Oil temperature [°C]
VW Golf Plus 1.6 l TDI (EA 189)	110.5	119.6	-7.6	27.8
VW Passat 2.0 l TDI (EA 189)	121.8	124.8	-2.4	27.9
VW Polo 1.2 l TDI (EA 189)	92.6	92.6	0.0	28.3

⁶ These vehicles have already received new software as part of the recalls by Volkswagen. The retesting was carried out with the new software.

⁷ Presentation including ki factor.

The results of the retests of the VW Golf Plus 1.6 I TDI (EA 189), the VW Passat 2.0 I TDI (EA 189) and the VW Polo 1.2 I TDI (EA189) with the new modified software were compared with the type approval value. These vehicles achieved the original type approval value within the tolerance of 4 % using the new software.



b. Vehicles exhibiting anomalies

For the vehicle model Opel Zafira 1.6 I Diesel, an anomaly was found in the CO₂ retests performed within the framework of the investigations of this report. Therefore, to back up the measurement results, additional Opel Zafira 1.6 I Diesel vehicles were included in the measurements of the Federal Motor Transport Authority. It was possible to confirm the CO₂ catalogue value with the new software version within the permissible tolerance of 4 % for two test vehicles. For a third vehicle, it has not yet been possible to confirm the CO₂ catalogue value with the permissible tolerance of 4 %.

The affected Opel Zafira 1.6 I is a vehicle that is no longer in production and was classified in Group II during the investigations carried out by the Federal Ministry of Transport and Digital Infrastructure's Commission of Inquiry into NO_x emission levels. As part of the reduction of NO_x emission levels, the manufacturer has agreed to make an update aimed at improving the effectiveness of the combined EGR and SCR system across a broad temperature range up to the physical limits. Due to the above-mentioned deviations in the CO₂ retests, the Federal Motor Transport Authority asked the manufacturer to again revise the action plan in order to comply with the specific requirements of NO_x and the specified CO₂ catalogue value. The software update for the Opel Zafira 1.6 I was then approved.

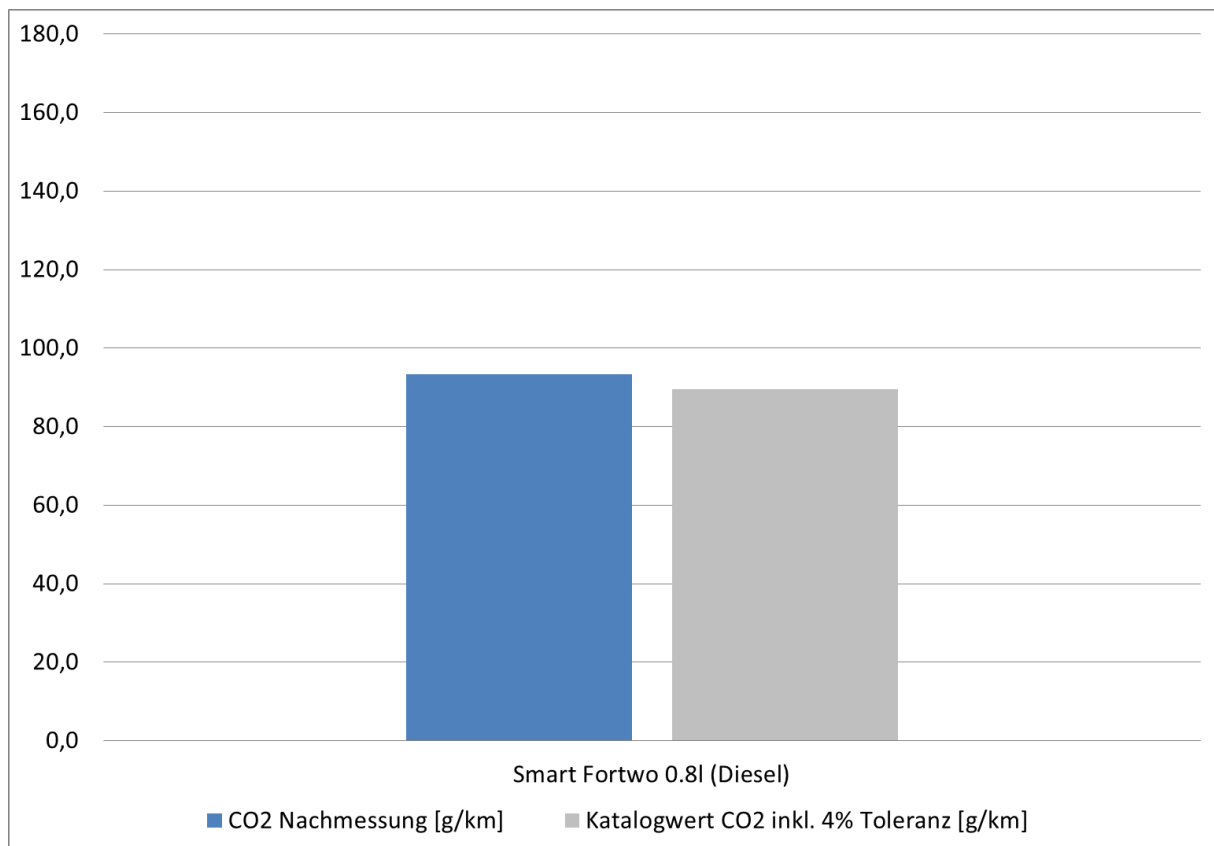
For the new versions of the Opel Zafira 1.6 l, the existing type approval was extended. The CO₂ emission values indicated therein were confirmed during type approval by targeted re-testing performed in the presence of the Federal Motor Transport Authority and a technical service. The Federal Motor Transport Authority has requested the manufacturer's CoP documentation for the ongoing production of this model. No anomalies were found.

The affected Smart Fortwo 0.8 l Diesel is a vehicle that is no longer in production and was classified in Group I during the investigations carried out by the Federal Ministry of Transport and Digital Infrastructure's Commission of Inquiry into NO_x emission levels. This means that no anomalies in terms of NO_x emission levels were found on this vehicle model. The CO₂ value is verified because, in the field trials, the CO₂ value was shown to have deviated by more than 10 % from the catalogue value.

To date, one vehicle from the field has been checked. This vehicle had a mileage of more than 15,000 km. Therefore, the retest was carried out taking into account the catalogue value including the tolerance of 4 %. Two retests were performed with the same vehicle. The measurement result shown in the following table as well as the engine oil temperature represent mean values.

Vehicle model	CO₂ Retest [g/km]⁸	CO₂ catalogue value incl. 4 % tolerance [g/km]	Deviation [%]	Oil temperature [°C]
Smart Fortwo 0.8 l (Diesel)	93.3	89.4	4.4	28.1

⁸ Presentation including ki factor.



Even though the value was slightly higher and extensive investigations were performed, it was not possible to demonstrate that the manufacturer had failed to comply with the provisions.

D. CO₂ retesting of the vehicles for which the Federal Motor Transport Authority is not the competent type approval authority with regard to emission levels – market surveillance

I. Introduction

The principles set out in Chapter C (CO₂ investigations) Part I, Point 1, apply equally to the retesting of vehicles for which the Federal Motor Transport Authority is not the competent type-approval authority with regard to emission levels.

Such vehicles can only be tested by the Federal Motor Transport Authority within the framework of market surveillance measures, as it is the responsibility of the competent approval authority to monitor the verification of the conformity of production as required by law.

During the retests, three vehicles at a time were taken from the production of 4 models and tested in accordance with the CoP legislation. It was not possible to take this approach for the Audi A6 3.0 I TDI (EU 5), because this model was no longer in production. This model was tested based on the conditions during type approval.

II. Results of the uniform retesting of vehicles of German manufacturers for which the Federal Motor Transport Authority is not the competent type approval authority with regard to emission levels

Three vehicles were taken from production and checked on the manufacturer's test benches in accordance with the CoP legislation under the supervision of the Federal Motor Transport Authority and the competent technical service of the relevant European type-approval authority. The vehicles were selected in such a way that the tests were carried out in the highest inertia class for emission type approval.

The results presented below represent the mean values of the results of the individual retests performed. The underlying values of the individual measurements were all below the respective catalogue value. The oil temperature is the mean value of the three retests performed.

Audi A3 2.0 I

Vehicle model	CO₂ Retest [g/km]⁹	Catalogue value CO₂ [g/km]	Deviation [%]	Oil temperature [°C]
Audi A3 2.0 I	131.8	135.0	-2.4	24.2

The result of all three vehicles was lower than indicated in the catalogue; therefore, the retest is not considered to exhibit anomalies.

Audi A6 2.0 I

⁹ Presentation including ki factor and evolution coefficient.

Vehicle model	CO ₂ Retest [g/km] ¹⁰	Catalogue value CO ₂ [g/km]	Deviation [%]	Oil temperature [°C]
Audi A6 2.0 I	119.0	126.0	-5.6	24.6

The result of all three vehicles was lower than indicated in the catalogue; therefore, the retest is not considered to exhibit anomalies.

Audi A6 3.0 I

Vehicle model	CO ₂ Retest [g/km] ¹¹	Catalogue value [g/km]	Deviation [%]	Oil temperature [°C]
Audi A6 3.0 I	168.6	172.0	-2.0	26.4

The result of all three vehicles was lower than indicated in the catalogue; therefore, the retest is not considered to exhibit anomalies.

BMW 216d GT

Vehicle model	CO ₂ Retest [g/km] ¹²	Catalogue value CO ₂ [g/km]	Deviation [%]	Oil temperature [°C]
BMW 216d GT	106.8	111.0	-3.8	28.6

The result of all three vehicles was lower than indicated in the catalogue; therefore, the retest is not considered to exhibit anomalies.

Audi A6 3.0 I TDI (EU5)

Production of the Audi A6 3.0 I TDI (EU5) has already stopped. The KBA is currently testing adapted new software to improve nitrogen oxide emissions.¹³ Since these tests are carried out on used vehicles, a tolerance of 4 % against the catalogue value was included in the measurements. In the measurements, one vehicle was not able to reach this value.

Vehicle model	CO ₂ Retest [g/km] ¹⁴	CO ₂ catalogue value incl. 4 % tolerance [g/km]	Deviation [%]	Oil temperature [°C]
Audi A6 3.0I EU5	145.5 ¹⁵	144.6	0.6	28.6
Audi A6 3.0I EU5	144.1 ¹⁶	144.6	-0.3	27.0

¹⁰ Presentation including ki factor and evolution coefficient.

¹¹ Presentation including ki factor, evolution coefficient and four-wheel factor.

¹² Presentation including ki factor and evolution coefficient.

¹³ Cf. Report of the "Volkswagen" Commission of Inquiry (April 2016), Chapter C ("Investigations") Part II Point 3 (p. 72).

¹⁴ Presentation including ki factor.

¹⁵ Mean value from two measurements.

¹⁶ The value was determined using new software. A comparative test of the two software statuses showed the same level of CO₂ values.

Audi A6 3.0l EU5	142.9	144.6	-1.2	29.5
Audi A6 3.0l EU5	139.4	144.6	-3.6	28.2

Based on the statistical procedure for vehicles in the field, a sampling test is considered to have been passed if three out of four vehicles reach the necessary value. Therefore, the vehicle is not considered to exhibit anomalies.

Three vehicles showed technical problems. After successful repairs, two vehicles were measured again and showed the above-mentioned results.

III. Retesting of vehicles of foreign manufacturers for which the Federal Motor Transport Authority is not the competent type approval authority with regard to emission levels

As part of the retests performed, the vehicles still in production were procured on the second-hand market with the lowest possible mileage (< 15,000 km). One vehicle each was measured. Depending on the actual mileage of the vehicles, the linear average of the evolution coefficient, which is multiplied by the measured CO₂ value, was determined and the result was rounded up.

A retest is not considered to exhibit anomalies if its result is lower than or equal to the type-approval value, taking into account the evolution coefficient adapted to the respective mileage.

In the event that the production had already stopped, the same approach was taken.

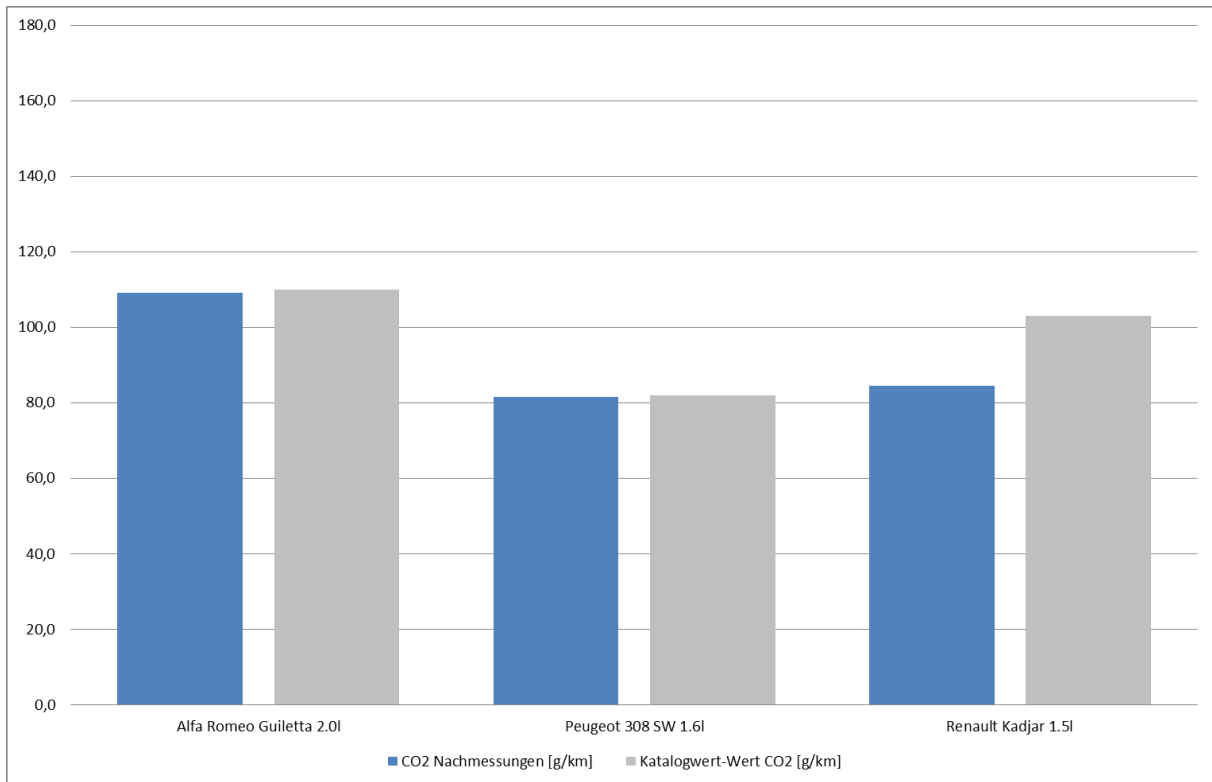
In terms of mileage, only one tested vehicle (Fiat Ducato 3.0 l Diesel) was unable to satisfy the mileage requirement of <15,000 km. Therefore, no evolution coefficient was applied when evaluating the results.

1. Vehicles not exhibiting anomalies

The following overview shows the vehicles in which the type-approval values of the CO₂ emission levels were achieved within the framework of the retests performed by the Federal Motor Transport Authority. As described, one used vehicle each with as little mileage as possible from the field was tested in the framework of a retest. For the Renault Kadjar 1.5 l, two retests were carried out with the same vehicle.

Vehicle model	CO ₂ retest [g/km] ¹⁷	CO ₂ catalogue value [g/km]	Deviation [%]	Oil temperature[°C]
Alfa Romeo Giulietta 2.0l	109.0	110.0	-0.9	24.3
Peugeot 308 SW 1.6l	81.6	82.0	-0.5	25.7
Renault Kadjar 1.5l	84.4	103.0	-18.1	23.1

¹⁷ Presentation including ki factor and evolution coefficient.



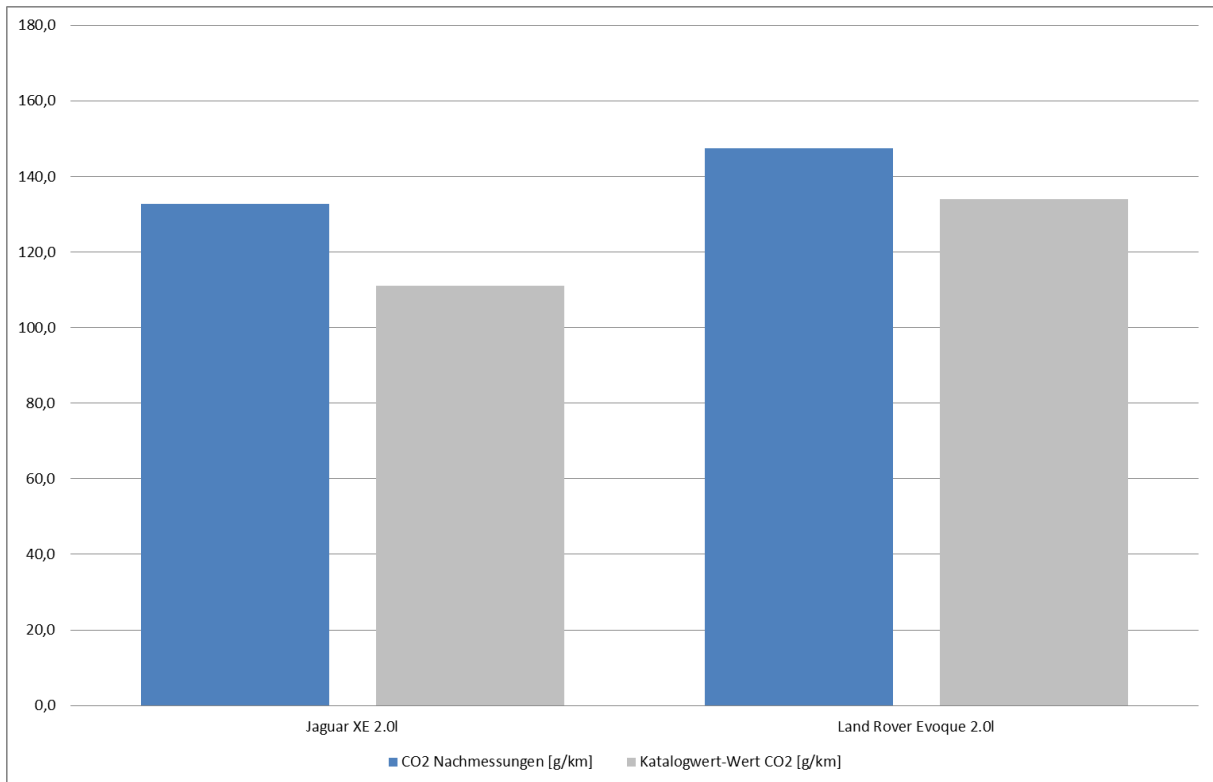
2. Vehicles exhibiting anomalies

The following overview shows the vehicles for which the CO₂ emission levels from type approval were not achieved by the Federal Motor Transport Authority during the retest performed. As described, one used vehicle of each type from the field with as little mileage as possible was retested. For the Jaguar XE 2.0 I, two retests were carried with the same vehicle.

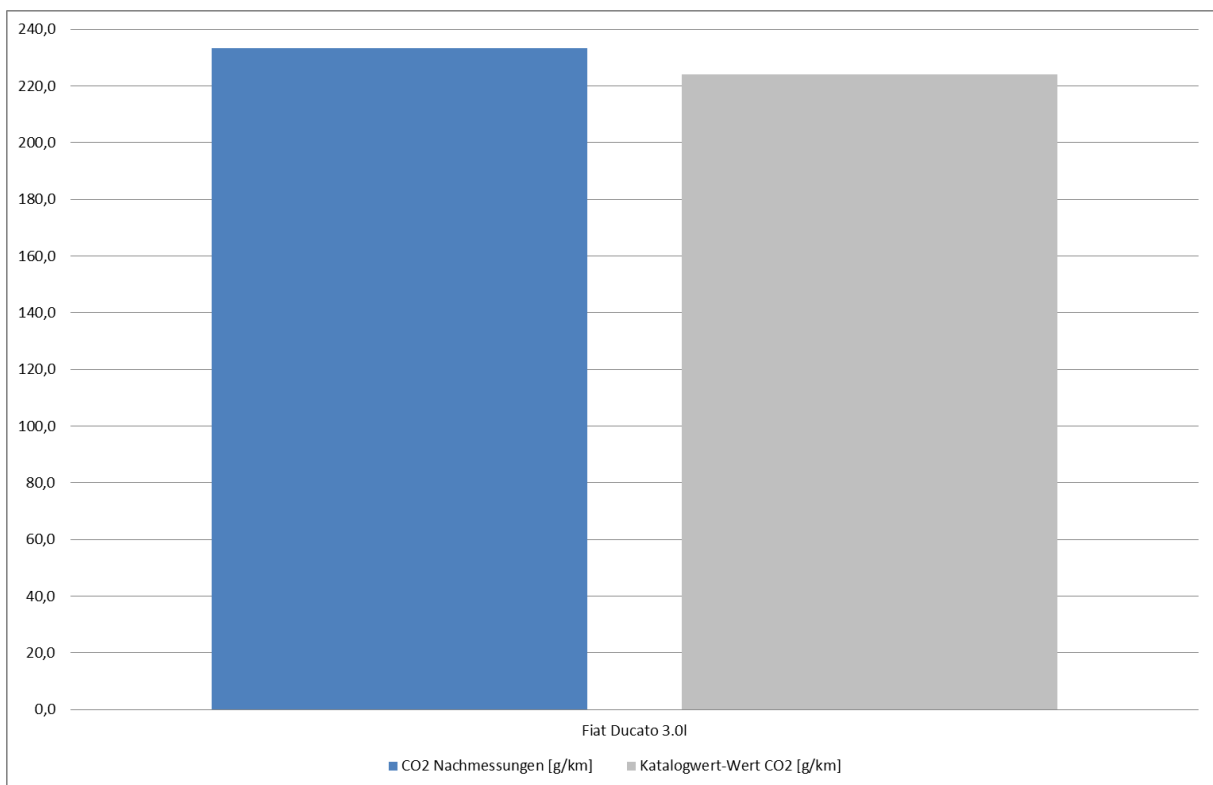
Vehicle model	CO ₂ retest [g/km] ¹⁸	CO ₂ catalogue value [g/km]	Deviation [%]	Oil temperature [°C]
Fiat Ducato 3.0 I	233.3	224.0	4.2	24.8
Jaguar XE 2.0 I	132.7	111.0	19.6	25.2
Jeep Cherokee 2.0 I	163.5	154.0	6.1	24.1
Land Rover Evoque 2.0 I	147.5	134.0	10.0	25.0
Renault Kadjar 1.6 I	142.8	129.0	10.7	23.1
Suzuki Vitara 1.6 I	117.7	111.0	6.0	24.1
Volvo V60 2.0 I	112.3	105.0	6.9	26.1

With regard to these results, too, it has to be taken into account that the temperatures were not measured in the optimal allowed range. If the temperature was increased, CO₂ emission levels could be reduced and, for this reason, deviate from the catalogue value.

¹⁸ Presentation including ki factor and evolution coefficient.

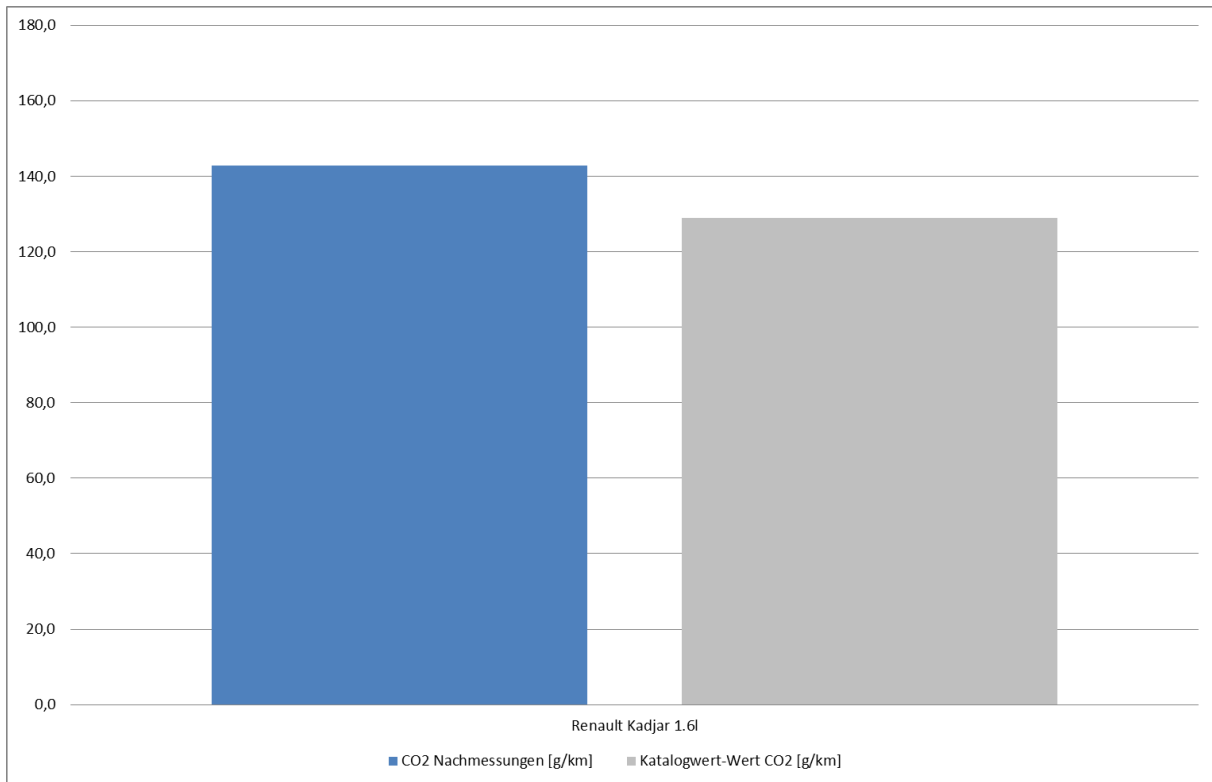


On the basis of the test results, the Federal Motor Transport Authority wrote to the Vehicle Certification Agency (VCA) in the United Kingdom requesting that the results be verified. The VCA then took part in conformity tests on vehicles of the same type. According to the VCA, the results of the tests remained within the scope of statutory tolerances, so that it was not possible to demonstrate any illegality.

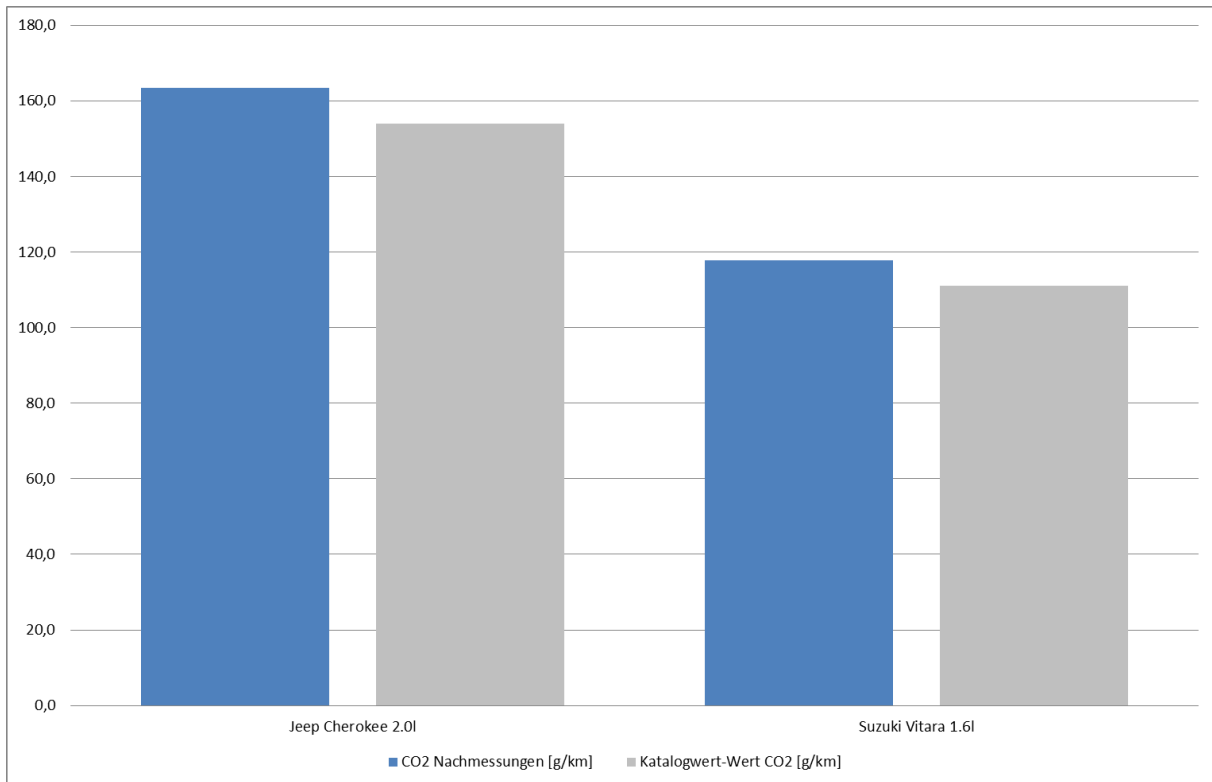


On the basis of the test result, the Federal Motor Transport Authority wrote to the Italian ap-

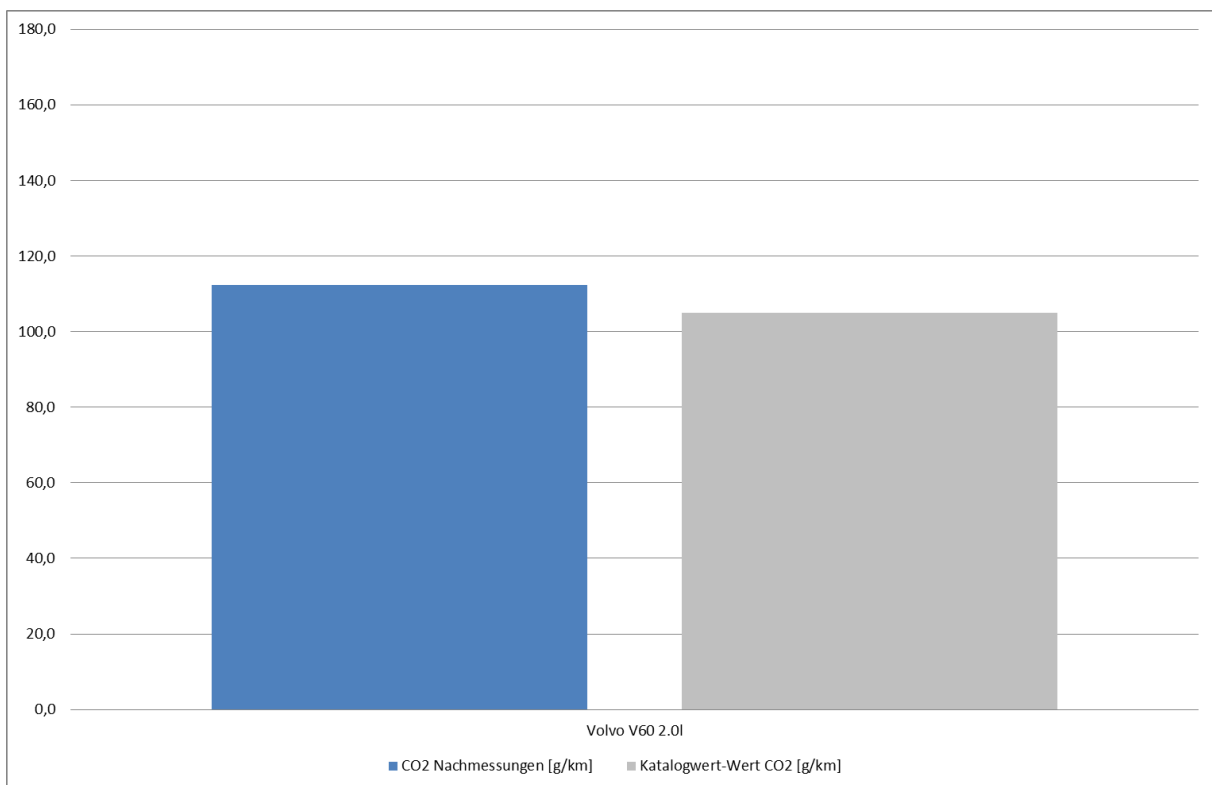
proval authority requesting that it verify the Federal Motor Transport Authority's test result. The Italian approval authority subsequently commissioned tests of conformity from its technical service. According to the Italian approval authority, the test results remained within the scope of statutory tolerances, so that it was not possible to demonstrate any illegality.



On the basis of the test result, the Federal Motor Transport Authority wrote to the French approval authority requesting that it verify the result. The French approval authority subsequently requested submission of the results of the manufacturer's conformity tests. According to the French approval authority, the results remained within the scope of statutory tolerances, so that it was not possible to demonstrate any illegality.



On the basis of the test result, the Federal Motor Transport Authority wrote to the Dutch approval authority requesting that it verify the result. The Dutch authority replied to the Federal Motor Transport Authority that the vehicles should be included in the plans for conformity assessments. The results were not submitted to the Federal Motor Transport Authority. However, the Federal Motor Transport Authority has no legal capacity to obtain these results.



On the basis of the test result, the KBA wrote to the Spanish approval authority requesting

that it verify. The Spanish authority replied to the Federal Motor Transport Authority that the vehicles should be included in the plans for conformity assessments and that the verifications of the conformity carried out by the manufacturer are satisfactory. The results of the verification by the approval authority were not communicated to the Federal Motor Transport Authority. However, the Federal Motor Transport Authority has no legal capacity to obtain these results.

IV. Conclusion on tests of vehicles for which the Federal Motor Transport Authority is not the competent type-approval authority with regard to emission levels

Five models from German manufacturers were classified as not exhibiting anomalies after the tests. The same applies to three vehicle models from foreign manufacturers.

As a result, seven conspicuous vehicle models from foreign manufacturers remain, which have been examined more closely by the competent European authorities. However, at first glance these anomalies do neither justify suspicion of illegal manipulation nor do they prove that the CO₂ value of the model concerned must be corrected.

In the case of the models exhibiting anomalies, it should also be borne in mind that the results of the measurements at higher oil temperatures would have led to lower CO₂ values and thus to lower deviations. Manufacturers, technical services and type approval authorities must be allowed to use such options for optimization.

The results of all measurements were transmitted to the competent European type-approval authorities, which carried out appropriate investigations and, where appropriate, implemented measures under their own responsibility.

E. Conclusions

I. Legal assessment

CO₂ values are determined as part of the type approval procedure based on standardized European parameters. If they change, e.g. due to production tolerances, manufacturers must either modify production in such a way that the vehicle is again in conformity with the CO₂ value originally determined or request that the CO₂ value be changed in type approval and subsequently in the vehicle documents. European type approval legislation does not provide for an assessment of the individual vehicle; rather deviations are assessed by means of statistical procedures. However, such procedures are currently only applied with regard to the conformity of production, and not for vehicles already in service.

Changes have an impact only on new registrations from the date on which the CO₂ value has been redefined with a supplement to type approval and is indicated in the certificate of conformity (CoC) of the vehicle produced. This procedure for supplements has an impact on tax procedures only in so far as new registrations take place. For these new registrations, the new CO₂ value is already indicated in the type database and is therefore taken into account in the basic decision by the approval authorities.

A retroactive change to CO₂ values without the manufacturer's willingness to cooperate can be considered if it can be demonstrated to the manufacturer that the CO₂ value determined at the time of type approval had been deliberately erroneous from the start.

The measurements performed by the Federal Motor Transport Authority in this report also included used vehicles. Current European type approval legislation does not provide for a verification of CO₂ values of vehicles already in service.

Legislative amendments already adopted

In 2007, the European Commission was asked by the Council and the European Parliament to adapt the current NEDC by 2014 and make it as realistic as possible in terms of CO₂ or prepare a new cycle by then. Since 2009, several working parties/groups, some chaired by Germany, at the United Nations Economic Commission for Europe (UNECE) and the European Union have been working on the development of a Global Technical Regulation (GTR) entitled "WLTP – Worldwide Harmonised Light Vehicles Test Procedure".

The development of the new driving cycle and the adaptation of the boundary conditions for the measurement of pollutant and CO₂ emissions as well as fuel consumption or consumption of electrical energy were undertaken with a view to making them as realistic as possible in terms of global traffic and driving behaviour. In addition, by reformulating the measurement procedure by defining considerably tighter tolerances and realistic boundary conditions, maximum reproducibility was ensured.

The main parts of the GTR, such as the new cycle and test procedure, were adopted at UNECE in March 2014 as GTR No 15. They were transposed into European type approval legislation for passenger cars and light commercial vehicles by the European Commission. The amending regulation was adopted by the Technical Committee for Motor Vehicles in

June 2016. Publication in the European Official Journal will take place shortly. Germany successfully campaigned to find a majority for the introduction scenario proposed by the European Commission, i.e. 1 September 2017 for new type-approvals and 1 September 2018 for all new vehicle registrations.

III. Further development of the legislation

1. Extending the measurement of CO₂ emission levels to checks of in-service vehicles

As regards the in-service conformity (ISC) of vehicles, European type-approval legislation currently only provides for a verification of pollutant emissions thresholds with regard to gases and particulate matter. In the European negotiations on the introduction of the WLTP, the German government advocated that, in the future, CO₂ emission and fuel/energy consumption levels should also be verified for in-service vehicles. A corresponding proposal has already been included in the forthcoming adaptation of Regulation (EC) No 715/2007.

2. Verification of CO₂ emission and fuel consumption levels under real driving conditions

The WLTP was developed with the aim of identifying values in the context of type-approval that are as representative as possible for real world driving and, at the same time, reproducible, so that they can be used for purposes such as CO₂ monitoring, the labelling of energy consumption or levying motor vehicle tax. The European Commission intends to establish a test procedure for the validation of CO₂ emission levels from vehicles in service. Regulation (EU) 2018/1832 lays down the requirements for devices for monitoring the consumption of fuel and electric energy with regard to type approval. Information obtained on the average consumption in real-world driving can be used in the future, for example, to verify whether the current test procedures in the approval process adequately reflect the average real-driving CO₂ emission levels.

3. Determination of CO₂ emission levels caused by the energy requirements of auxiliary systems

As described in Chapter B ("Basics"), only CO₂ emission levels based on the energy requirements of the vehicle drivetrain are currently determined in the type approval procedure. In the future, it will be necessary to additionally determine separately the energy requirements and the resulting CO₂ emission levels of other relevant auxiliary systems of motor vehicles. This will contribute to improved consumer information.

As a first step, a reproducible test method was developed on the initiative of the European Commission to assess the efficiency of vehicle air conditioning systems, which can be used to determine the fuel consumption and CO₂ emission levels from the use of air conditioning systems in passenger cars. The preparation of the test procedure is largely completed.

4. Retesting of CO₂ emission levels and market surveillance in the future

The future retests by the Federal Motor Transport Authority presented in the first report of the "Volkswagen" Commission of Inquiry in April 2016 include not only pollutant emission levels but also CO₂ emission and fuel consumption levels.¹⁹ European type approval legislation is to apply.

The Federal Motor Transport Authority will no longer leave the retests to the sole responsibility of a technical service, but will also perform independent retesting at its own testing facilities. Since the beginning of 2017, the Federal Motor Transport Authority has been regularly taking vehicles from the market to check them for compliance. Moreover, the authority also performs random follow-up checks on vehicles for which other authorities have granted type-approval.

¹⁹ Cf. Report of the "Volkswagen" Commission of Inquiry (April 2016), Chapter D ("Conclusions") Part III Point 3 (p. 125).

F. Conclusion on the Second Report by the "Volkswagen" Commission of Inquiry

In the field trial on NO_x described in the first report of the "Volkswagen" Commission of Inquiry (April 2016), the CO₂ values that were measured at the same time exhibited anomalies. For this reason, the Federal Ministry of Transport and Digital Infrastructure's Commission of Inquiry commissioned the Federal Motor Transport Authority to carry out CO₂ retests for 29 vehicle models exhibiting anomalies. This first part of the Commission of Inquiry's second report presents the results of the investigations for 19 of these vehicle models. This concerns the vehicles for which the Federal Motor Transport Authority is the type approval authority with regard to emission levels, as well as the vehicles of German manufacturers for which it is not the competent type approval authority with regard to emission levels. With regard to these CO₂ investigations, the Federal Ministry of Transport and Digital Infrastructure's Commission of Inquiry has reached the following conclusions:

For all vehicle models currently produced where the Federal Motor Transport Authority is the competent type approval authority, the type approval values were confirmed to be in compliance with the statutory boundary conditions.

In the Smart Fortwo Diesel model, which is no longer produced, the type approval value was exceeded by 4.4 %. The investigations carried out have not produced any evidence of increased CO₂ emission levels for the newly produced vehicles.

For the Opel Zafira 1.6 I Diesel, which is also no longer produced, exceedances of more than 4 % were found in the retests performed to verify the CO₂ catalogue value. It is a model in which, during the field trials carried out by the Federal Ministry of Transport and Digital Infrastructure's Commission of Inquiry, there were doubts as to the legality of the defeat device used. The manufacturer had therefore pledged to improve the effectiveness of its exhaust gas cleaning system to reduce NO_x emission levels. In the meantime, the manufacturer has succeeded in providing proof of compliance for the vehicles with software update and the update has been rolled out nationwide, so that the vehicles in the field comply with the requirements.

The five models of German manufacturers for which the Federal Motor Transport Authority is not the competent type approval authority with regard to emission levels were classified as not exhibiting anomalies after the tests.

Of the ten models of foreign manufacturers, three were classified as not exhibiting anomalies. The other models showed mostly slight exceedances during the measurements by the Federal Motor Transport Authority. These have been notified to the competent type approval authorities, which have acted on their own responsibility.

The measurements have shown that the existing statutory regulations with regard to the boundary conditions of measurements grant manufacturers a range of tolerance that is too wide, especially with regard to temperatures, the influence of the driver when following the test cycle as well as the chassis dynamometer settings. This means that reproducibility is only guaranteed if all boundary conditions are almost identical in the measurements. If CO₂ measurements are performed with different boundary conditions, this can lead to significant

differences in the CO₂ measurement results, although they are within the statutory framework.

In addition to the partly unrealistic test conditions of the currently applicable legislation for determining the CO₂ and fuel consumption levels in the NEDC, it is in particular also the exploitation of permissible tolerance ranges by manufacturers that contributes to the discrepancy between catalogue values and actual fuel consumption. With the transposition of the GTR No. 15 (WLTP) into European type approval legislation and the simultaneous revision of the administrative provisions, an important step has been taken to improve the reality and reproducibility of CO₂ values and fuel consumption levels in the future.

In addition, from the point of view of the Federal Ministry of Transport and Digital Infrastructure's Commission of Inquiry, it is necessary to make further improvements and upgrades to the motor vehicle regulations. The German government has been campaigning for a long time to include CO₂ emission levels in the legislation governing the verification of vehicles in operation. In addition, the European Commission will make proposals to check CO₂ emission and fuel consumption levels under real driving conditions. Similarly, procedures that allow for a separate determination of CO₂ emission levels resulting from the energy requirements of ancillary consumers are to be developed and introduced.

With the aim of ensuring autonomous and independent monitoring in the future, the Federal Motor Transport Authority already began to regularly take vehicles from the market at the beginning of 2017 and carry out measurements in its own testing facilities.